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Prevalence of uropathogenic species in pregnant women at Pathology Laboratory in Harare, Zimbabwe 2023

BY

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Abstract

Urinary tract infections are a prevalent health issue among pregnant women, affecting approximately 2% to 10% of this population globally. The physiological changes during pregnancy, such as increased urinary stasis and altered immune responses, contribute to the heightened risk of UTIs. At Pathology laboratory in January 2023, 2 in 10 pregnant women were isolated of different uropathogenic species by December 2023 the number had increased to 6 in 10 pregnant women. This study was a census which allowed the assessment of prevalent uropathogenic species, particularly uropathogenic Escherichia coli (UPEC), among pregnant women at Pathology Laboratory in 2023. Data was collected from electronic medical records, focusing on positive urine culture results and antibiotic susceptibility profiles. The study included pregnant women aged 18 and older with confirmed urinary tract infections (UTIs) during the period January 2023 to December 2023. Data revealed a concerning rise in antimicrobial resistance to a commonly prescribed antibiotic Ampicillin. Descriptive statistics were used to assess prevalence and resistance trends, highlighting that E. coli remained the dominant pathogen accounting 65.3% of isolates obtained. Yeasts accounted for 45% of isolates being the second highest isolate obtained. Cotrimoxazole, Nitrofurantoin and Ciprofloxacin were effective against gram negative uropathogens throughout the year of 2023. This showed that E. coli and yeast infections are highly susceptible in pregnant women and should be managed and treated immediately to reduce risk of serious maternal and foetal complications, such as pyelonephritis and preterm labour. Antibiotics such as Ampicillin showed that there are no longer effective for treatment and administering them should be halted. Ethical approval was obtained, and informed consent procedures were followed to ensure compliance with research standards.

Key words: Uropathogenic Escherichia coli; Urinary Tract Infection; Pregnant women

Declaration

I, Vanessa Denhere, student number 210764 do hereby declare that this dissertation is my original work except where sources have been cited and acknowledged. The work has never been submitted, nor will it ever be submitted to another university for the award of a Bachelor of Science degree.

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Acronyms and Abbreviations

UPEC Uropathogenic E. coli

UTI Urinary Tract Infection

HIPAA Health Insurance Portability and Accountability Act

AUREC Africa University Research Ethics Committee

Definition of key terms

Uropathogens – pathogens of the urinary tract

Prevalence – the fact or condition of being common

Pregnant women – a female who is developing one or more springs in their uterus

UPEC – Uropathogenic Ecoli

Urinary Tract Infection – infection in any part of the urinary system

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Urinary tract infection (UTI) refers to the presence and multiplication of bacterial pathogens in the organs of the urinary tract (Degu, Dadi, & Shiferaw, 2020). According to (Degu, Dadi, & Shiferaw, 2020) UTI is characterized by a broad spectrum of symptoms ranging from mild irritative voiding to bacteraemia, sepsis, or even death. About 50 to 60% of women experience at least one episode of UTIs during their lifetime because of the short length of the urethra along with proximity to the absence of bactericidal prostatic secretion and moist anal canal region (Czaja & Hooton, 2006)

Pregnant women are more likely infected with UTIs with uropathogenic bacteria than nonpregnant women and can be associated with adverse outcomes for both the mother and foetus (Degu, Dadi, & Shiferaw, 2020) In pregnant women, the enlarged uterus affects all the tissues of the urinary tract at various degrees, while in the nonpregnant state, the uterus lies just behind and partly over the bladder. When the uterus grows, its weight increases and blocks the drainage of urine from the bladder, thus causing urinary stasis, which leads to infection of the urinary tract (Degu, Dadi, & Shiferaw, 2020). Sexual intercourse also facilitates the ascent of bacteria into the bladder. According to (cheesbrough, 2006) UTIs are mainly caused by Gram-negative bacteria such as Escherichia coli, Proteus species, Klebsiella spp., and Pseudomonas aeruginosa and less extent by Gram-negative bacteria which include Staphylococcus aureus, Enterococcus spp., and Streptococcus spp.

These organisms vary in their prevalence and patterns of antibiotic resistance, which can impact the selection of appropriate empirical antibiotic therapy. These infections can lead to serious complications for both the mother and the developing foetus if left

untreated, including pyelonephritis, preterm labour, low birth weight, and increased risk of neonatal mortality. This retrospective study aimed to investigate the prevalence of these key uropathogenic organisms isolated from urine samples of pregnant women attended at Pathology Laboratory in 2023. Additionally, the antimicrobial susceptibility profiles of the isolated organisms was analysed to determine the most effective empirical treatment options. Understanding the local epidemiology and antimicrobial resistance trends of uropathogenic organisms was crucial to guide clinical decision-making and prevent adverse outcomes in this vulnerable patient population. The findings of this study contributed to the development of evidence-based guidelines for the management of UTIs in pregnant women within the local healthcare setting.

1.2 Background

Urinary tract infections (UTIs) are a common complication during pregnancy, with an estimated incidence ranging from 2-10% (Matuszikiewciz-Rowinska, Malyszko, & Wieliczko, 2015). Pregnant women are at an increased risk of developing UTIs due to physiological and anatomical changes that occur during gestation, including ureteral dilation, vesicoureteral reflux, and compression of the urinary tract by the enlarging uterus. Untreated UTIs in pregnancy can lead to serious maternal and foetal complications, such as pyelonephritis, preterm labour, low birth weight, and increased risk of neonatal mortality (Habak , Carlson, & Griggs Jnr, 2024). Therefore, prompt diagnosis and appropriate antimicrobial therapy are crucial to prevent these adverse outcomes.

Globally, the most prevalent uropathogenic organisms responsible for UTIs include Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis, and Staphylococcus saprophyticus (Flore-Mireles, Walker, Caparon , & Hultgren, 2015).

A systematic review highlighted that E. coli accounts for approximately 70-90% of UTI cases in pregnant women (Gupta, et al., 2011).In Europe, a study found that about 8% of pregnant women experienced UTIs, with significant variations across countries. For instance, the prevalence in Scandinavian countries is reported to be lower, around 3%, while Southern European countries show rates as high as 12% (Schnarr & Smaill, 2008).

The prevalence of UTI among pregnant women varies among study populations. In Africa, it ranges from 11.6% to as high as 75%. In Ghana, the prevalence of UTI among pregnant women is represented by fragmented and small-size pocketed studies with a reported prevalence range of 42.8 to 56.5% (Vicar, et al., 2023).

The COVID-19 pandemic has further complicated the landscape of UTI management, affecting healthcare access and antibiotic prescribing practices (Gupta, et al., 2011). There is an urgent need for updated data on the prevalence and antimicrobial resistance patterns of uropathogenic organisms in pregnant women, particularly in the context of changing healthcare dynamics.

This study aimed to investigate the prevalence of uropathogenic organisms in pregnant women with positive urine cultures attended at Pathology Laboratory in 2023. The findings provided essential insights into local epidemiology, guide empirical treatment strategies, and contribute to the development of effective antimicrobial stewardship programs.

1.3 Statement of the problem

In January 2023, 2 in 10 pregnant women attended at Pathology Laboratory were isolated of different uropathogenic species whereas by end of December 2023 uropathogenic species isolated from pregnant women had increased to 6 in 10 pregnant

women. According to (Habak , Carlson, & Griggs Jnr, 2024) pregnant women are at risk of complications such as preterm birth and maternal sepsis if uropathogenic species causing UTIs are left untreated.

1.4 Research objectives

1.4.1 Broad objective

Determine the prevalence and antimicrobial susceptibility patterns of key uropathogenic organisms isolated from urine samples of pregnant women with positive urine cultures attended at a Pathology Laboratory in 2023.

1.4.2 Specific objectives

1. Determined the prevalence of common uropathogenic organisms (such as Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis, and Staphylococcus saprophyticus) isolated from urine samples of pregnant women attended at the Pathology Laboratory in 2023.

2. Assessed the antimicrobial susceptibility profiles of the isolated uropathogenic organisms to commonly used antibiotics at Pathology Laboratory in 2023

3. Identified any trends or changes in the antimicrobial resistance patterns of the uropathogenic organisms at Pathology Laboratory in 2023.

4. Provided recommendations for the empirical antibiotic treatment of urinary tract infections in pregnant women based on the local epidemiology and antimicrobial susceptibility data at Pathology Laboratory from January in 2023.

1.5 Research questions

1. What is the prevalence of common uropathogenic organisms (such as Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis, and

Staphylococcus saprophyticus) isolated from urine samples of pregnant women attended at the Pathology Laboratory in 2023?

2. What are the antimicrobial susceptibility patterns of the isolated uropathogenic organisms to commonly used antibiotics at Pathology Laboratory in 2023?

3. How have the antimicrobial resistance patterns of the uropathogenic organisms changed at Pathology Laboratory in 2023?

4. What are the most effective empirical antibiotic treatment options for urinary tract infections in pregnant women based on the local epidemiology and antimicrobial susceptibility data at Pathology Laboratory in 2023?

1.6 Justification of the study

The proposed research topic on the prevalence of uropathogenic species in pregnant women attended at Pathology Laboratory in 2023 was justified based on the fact that most of the existing literature on the epidemiology of uropathogenic organisms in pregnant women is from studies conducted before 2020 and the COVID-19 pandemic and other factors may have influenced the prevalence and antimicrobial resistance patterns of these organisms leading to a need for updated data to reflect the current situation at Pathology Laboratory. The findings of this study helped clinicians select the most appropriate empirical antibiotic therapy for UTIs in pregnant women. The prevalence and antimicrobial resistance patterns of these organisms can vary across different geographic regions and healthcare settings.

1.7 Delimitation of the study

The study focused on pregnant women with positive urine cultures attended at the specified Pathology Laboratory during the given timeframe which was a year and excluded non-pregnant individuals and pregnant women who did not attend Pathology

Laboratory in 2023. The study was conducted at a single Pathology Laboratory, which serves a specific geographic region or catchment area. The findings were generalizable to other regions or healthcare settings. The study was a retrospective analysis of the Pathology Laboratory's records in 2023.

1.8 Summary

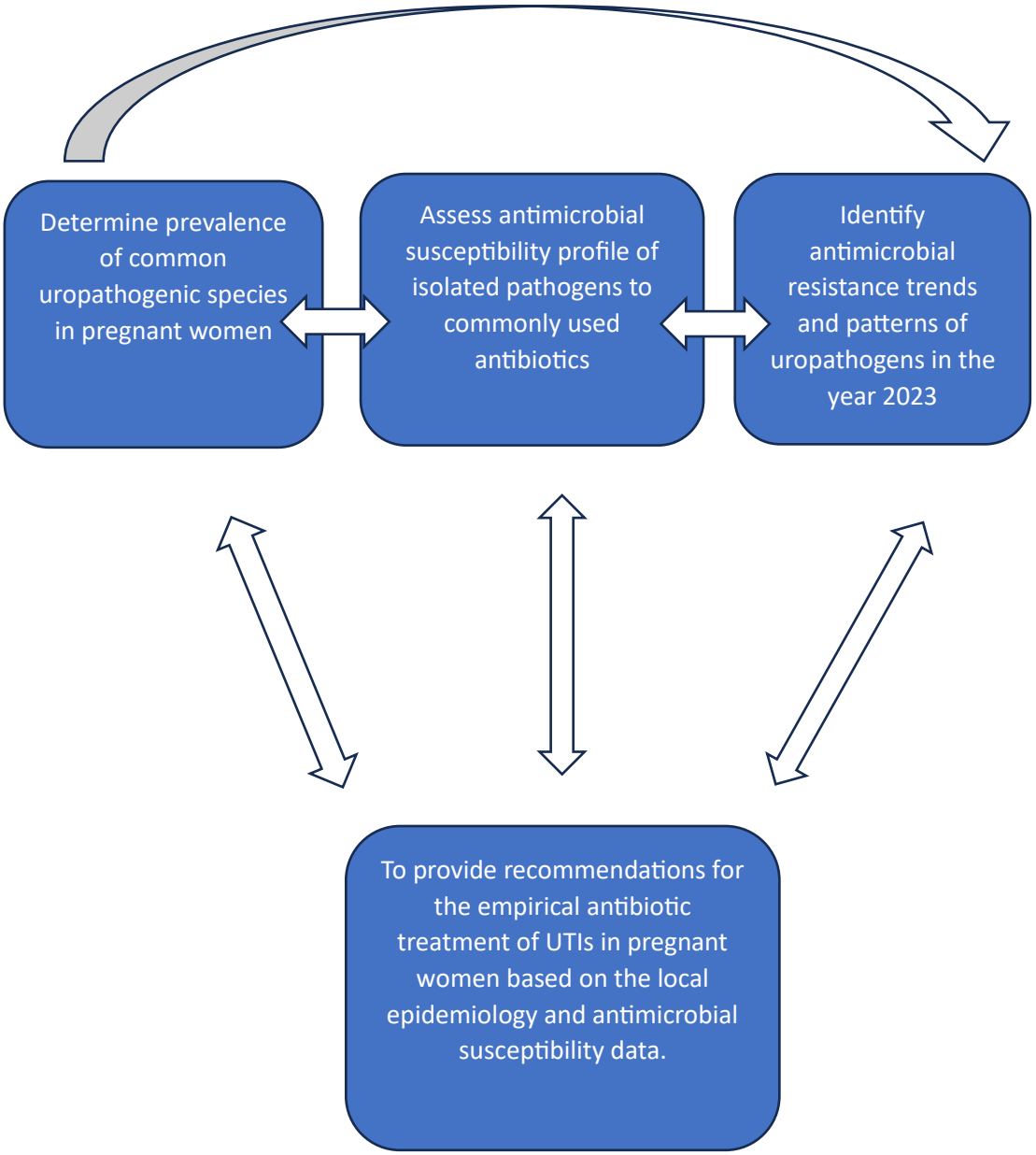
Chapter 1 provided an introduction to the research topic proposal and this chapter established the context, significance, and objectives of the study. This study investigated the prevalence of uropathogenic species among pregnant women who attended Pathology Laboratory in Harare, Zimbabwe, 2023.The study aimed to bridge the knowledge gap on the local epidemiology of urinary tract infections (UTIs) in pregnancy, providing insights for effective diagnosis, treatment, and prevention. The findings informed local treatment guidelines, infection control strategies, and antimicrobial stewardship programs, ultimately contributing to improved maternal and foetal health outcomes.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter looked at the literature review of this study and aimed to explore the existing body of literature by examining various scholarly articles and findings related to the research question. We can identify the strengths and weaknesses of different approaches and methodologies used by other researchers. This allows us to build upon existing knowledge and contribute new insights to the field.

2.2 Conceptual framework



The prevalence of the uropathogenic species identified in pregnant women can be linked to the assessment of antimicrobial resistance profile of the common uropathogens as well as the trend patterns in the year 2023. This is brought upon by identifying specific pathogens causing UTIs in pregnant women attended at Pathology Laboratory in 2023. These specific species isolated are then assessed for their antimicrobial profile to common antibiotics and their trend patterns are identified in order to provide recommendations for empirical antibiotic therapy based on local epidemiology and antimicrobial susceptibility data.

2.3 Relevance of Framework

Urinary tract infections (UTIs) are a common complication during pregnancy, affecting up to 10% of pregnant women. Pregnant women are at an increased risk of UTIs due to physiological changes, such as the compression of the ureters, increased urinary stasis, and elevated levels of progesterone. Untreated UTIs can lead to serious maternal and foetal complications, including pyelonephritis, preterm labour, and low birth weight. Understanding the prevalence and antimicrobial susceptibility patterns of these uropathogenic organisms is crucial for the empirical management of UTIs in pregnant women. Monitoring the antimicrobial susceptibility patterns of uropathogenic organisms is essential for the development of evidence-based treatment guidelines and the implementation of effective antimicrobial stewardship strategies. These epidemiological trends can provide valuable insights into the changing dynamics of UTIs in pregnant women, which may be influenced by factors such as changes in healthcare practices, antibiotic use, and the emergence of new resistant strains.

2.3.1 Determine prevalence of common uropathogenic species in pregnant women

Urinary tract infections (UTIs) are a common complication during pregnancy, affecting up to 10% of all pregnant women (Schnarr & Smaill, 2008). Uropathogenic Escherichia coli (UPEC) is the primary causative agent, responsible for 70-95% of all UTIs in pregnant women (Foxman, 2010). However, other uropathogenic species such as Klebsiella pneumoniae, Proteus mirabilis, and Enterococcus faecalis have also been reported to cause UTIs in pregnant women (Tadesse, Teshome, Merid, Kibret, & Shimelis, 2014). Understanding the determinants of the prevalence of these common uropathogenic species is crucial for effective prevention and management of UTIs in pregnant women.

Prevalence of Uropathogenic Escherichia coli (UPEC) is the most common uropathogen isolated from pregnant women with UTIs. Several factors have been associated with the high prevalence of UPEC in this population. Physiological changes during pregnancy, such as increased urine production, decreased bladder capacity, and vesicoureteral reflux, can create a favourable environment for the proliferation of UPEC (Schnarr & Smaill, 2008). Additionally, the use of indwelling catheters and improper hygiene practices can also contribute to the increased risk of UPEC infections (Foxman, 2010)

While UPEC is the predominant uropathogen, other species such as K. pneumoniae, P. mirabilis, and E. faecalis have also been reported to cause UTIs in pregnant women. The prevalence of these species can be influenced by factors such as geographic location, antibiotic resistance patterns, and the presence of underlying medical conditions (Tadesse et al., 2018). For example, a study in Ethiopia found that K. pneumoniae was the second most common uropathogen after UPEC, accounting for 15% of UTI cases in pregnant women (Alemu, et al., 2012)

Several factors have been identified as determinants of the prevalence of uropathogenic species in pregnant women. The increase in antimicrobial resistance among uropathogens, particularly UPEC, can lead to the emergence of other species that are better equipped to survive antibiotic treatment (Foxman, 2010). Factors such as age, parity, and underlying medical conditions (e.g., diabetes, immunosuppression) can affect the susceptibility of pregnant women to specific uropathogens (Schnarr & Smaill, 2008). Poor hygiene practices, sexual activity, and the use of contraceptives can increase the risk of UTIs caused by various uropathogenic species (Foxman, 2010). Geographical location can affect access to healthcare, and socioeconomic status can also influence the distribution of uropathogenic species in pregnant women (Tadesse, Teshome, Merid, Kibret, & Shimelis, 2014)

The prevalence of common uropathogenic species in pregnant women is influenced by a complex interplay of factors, including physiological changes during pregnancy, antimicrobial resistance, host factors, behavioural factors, and environmental factors. Continued surveillance and research are necessary to better understand the determinants of uropathogenic prevalence and develop effective strategies for the prevention and management of UTIs in pregnant women.

2.3.2 Antimicrobial susceptibility profile of the isolated species to commonly used antibiotics

Urinary tract infections (UTIs) are a common complication during pregnancy, and the increasing prevalence of antimicrobial resistance among uropathogenic species is a significant public health concern (Schnarr & Smaill, 2008). Understanding the antimicrobial susceptibility profile of the isolated uropathogenic species is crucial for the effective management and treatment of UTIs in pregnant women.

Uropathogenic Escherichia coli (UPEC) is the primary causative agent of UTIs in pregnant women, accounting for 70-95% of all cases (Foxman, 2010). Studies have reported a concerning trend of increasing antimicrobial resistance among UPEC isolates from pregnant women. For example, a study in Ethiopia found that 71.4% of UPEC isolates were resistant to ampicillin, 50% were resistant to cotrimoxazole, and 35.7% were resistant to ciprofloxacin (Alemu, et al., 2012). Similar patterns of resistance have been reported in various other geographical regions (Matuszikiewciz-Rowinska, Malyszko, & Wieliczko, 2015)

While UPEC is the predominant uropathogen, other species such as Klebsiella pneumoniae, Proteus mirabilis, and Enterococcus faecalis have also been reported to cause UTIs in pregnant women (Tadesse, Teshome, Merid, Kibret, & Shimelis, 2014). These species can also exhibit varying patterns of antimicrobial resistance, which can complicate the treatment of UTIs.

Several factors have been associated with the increasing antimicrobial resistance among uropathogenic species in pregnant women. According to (Foxman, 2010) the overuse and misuse of antibiotics, both in the community and healthcare settings, have contributed to the selection and spread of resistant strains. Factors such as diabetes, immunosuppression, and previous UTI episodes can increase the risk of acquiring resistant uropathogenic species (Schnarr & Smaill, 2008). The prevalence of antimicrobial resistance can vary significantly across different geographical regions, influenced by factors such as local antibiotic prescribing practices and healthcare access (Tadesse, Teshome, Merid, Kibret, & Shimelis, 2014)

The assessment of the antimicrobial resistance profile of the isolated uropathogenic species in pregnant women is crucial for the effective management of UTIs. The

increasing prevalence of antimicrobial resistance, particularly in UPEC and other common uropathogenic species, highlights the need for continued surveillance, rational antibiotic use, and the development of alternative treatment strategies to ensure the best possible outcomes for pregnant women with UTIs.

2.3.3 Antimicrobial resistance patterns and trends of uropathogens in pregnant women

Urinary tract infections (UTIs) are a common complication during pregnancy, with uropathogenic Escherichia coli (UPEC) being the predominant causative agent (Schnarr & Smaill, 2008). The rapid emergence of antimicrobial resistance among uropathogenic species is a growing concern, as it can significantly impact the management and treatment of UTIs in pregnant women. Understanding the antimicrobial resistance trends and patterns of the isolated uropathogenic species is crucial for developing effective infection control strategies.

Studies have consistently reported an increase in antimicrobial resistance among UPEC isolates from pregnant women. A meta-analysis by (Matuszikiewciz-Rowinska, Malyszko, & Wieliczko, 2015) found that the resistance rates for commonly used antibiotics, such as ampicillin, cotrimoxazole, and fluoroquinolones, ranged from 30% to 70% in various regions. Similar trends have been observed in other parts of the world, with resistance rates often exceeding 50% for certain antibiotics (Alemu, et al., 2012) (Tadesse, Teshome, Merid, Kibret, & Shimelis, 2014)

The emergence of extended-spectrum β-lactamase (ESBL)-producing UPEC strains is particularly concerning, as these bacteria are resistant to a broad range of β-lactam antibiotics (Foxman, 2010). While UPEC is the dominant uropathogen, other species such as Klebsiella pneumoniae, Proteus mirabilis, and Enterococcus faecalis have also been implicated in UTIs among pregnant women (Tadesse, Teshome, Merid, Kibret,

& Shimelis, 2014). These species can exhibit diverse antimicrobial resistance patterns, which can complicate the selection of appropriate antibiotic therapy. High resistance rates to commonly used antibiotics have been reported for other uropathogenic species, highlighting the need for comprehensive antimicrobial susceptibility testing (Alemu, et al., 2012)

Factors influencing antimicrobial resistance Trends can be linked to the overuse and misuse of antibiotics, both in the community and healthcare settings, have contributed to the selection and spread of resistant strains (Foxman, 2010). The prevalence of antimicrobial resistance can vary significantly across different geographical regions, influenced by factors such as local antibiotic prescribing practices and healthcare access (Tadesse, Teshome, Merid, Kibret, & Shimelis, 2014). Factors such as diabetes, immunosuppression, and previous UTI episodes can increase the risk of acquiring resistant uropathogenic species (Schnarr & Smaill, 2008)

The identification of antimicrobial resistance trends and patterns among the uropathogenic species isolated from pregnant women is crucial for guiding effective infection control and treatment strategies. The increasing prevalence of antimicrobial resistance, particularly in UPEC and other common uropathogenic species, highlights the need for continuous surveillance, rational antibiotic use, and the exploration of alternative treatment options to ensure the best possible outcomes for pregnant women with UTIs.

2.4 Summary

The literature on urinary tract infections (UTIs) in pregnant women highlights the significant prevalence and impact of uropathogenic organisms. Studies indicate that Escherichia coli accounts for the majority of UTI cases, ranging from 70% to 90%

globally. In Africa, including Zimbabwe, the prevalence of UTIs among pregnant women varies from 5% to 20%, with E. coli consistently identified as the predominant pathogen. Recent findings reveal alarming antibiotic resistance rates, with some studies reporting resistance levels exceeding 40% for commonly used antibiotics such as ampicillin and nitrofurantoin. The rise in antimicrobial resistance complicates treatment options and underscores the need for local surveillance data to guide empirical management. Furthermore, while numerous studies have investigated UTIs in pregnant women, there is a notable lack of recent longitudinal data specific to the prevalence of uropathogenic organisms in laboratory settings. This gap highlights the necessity for updated research on the prevalence and resistance patterns of uropathogenic species in pregnant women, particularly in the context of changing healthcare dynamics. This study aims to fill this gap by investigating the prevalence of uropathogenic organisms in pregnant women attended at a Pathology Laboratory in 2023.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This study investigated the prevalence of uropathogenic species among pregnant women with positive urine cultures, utilizing data from Pathology Laboratory in 2023. Uropathogenic E. coli is a leading cause of urinary tract infections (UTIs), particularly in pregnant populations due to physiological changes that increase susceptibility (Zhou, et al., 2023). Research indicated that UTIs occur in approximately 10-20% of pregnant women, with UPEC responsible for 80-90% of these cases (Hooton , 2015).

3.2 The research design

This study employed a retrospective cross-sectional design to assess the prevalence of uropathogenic species in pregnant women diagnosed with urinary tract infections (UTIs) who had positive urine cultures at Pathology Laboratory in 2023. This design was effective for evaluating the frequency and characteristics of specific pathogens within a defined population over a specified time period (Creswell, 2009).

3.3 Study site

The study was conducted at Pathology Laboratory, a reputable facility located in Harare, Zimbabwe. This laboratory served a diverse population, providing diagnostic services to multiple healthcare institutions, including hospitals and outpatient clinics. The laboratory was equipped with advanced microbiological testing capabilities, enabling accurate identification of uropathogenic species through urine cultures.

3.4 Study population

The study population consisted of all the pregnant women with positive urine culture who were attended at Pathology Laboratory for urine culture testing in 2023. This

population was critical for understanding the prevalence of uropathogenic species in a demographic that was at increased risk for urinary tract infections (UTIs).

3.4.1 Inclusion Criteria

The inclusion criteria involved pregnant women aged 18 years and older. Patients with a clinical diagnosis of urinary tract infection, confirmed by positive urine culture results and all trimesters of pregnancy were included to capture a comprehensive prevalence across different stages.

3.4.2 Exclusion criteria

Women who were not currently pregnant were not excluded. Patients with incomplete medical records or insufficient data regarding urine culture results were excluded to ensure data integrity.

3.5 Sampling

3.5.1 Sample size

All pregnant women with positive urine cultures attended at Pathology Laboratory in 2023 were used to conduct the census study.

3.5.2 Sampling procedure

This study employed a census to investigate the prevalence of uropathogenic species in pregnant women with positive urine cultures attended at Pathology Laboratory in 2023. The target population for this study included all pregnant women with positive urine cultures who were attended at Pathology Laboratory for urine culture testing in 2023. This population was critical for understanding the prevalence of uropathogenic species in pregnant women.

3.6 Data collection instruments

Effective data collection was pivotal in understanding the prevalence of uropathogenic species, among pregnant women. This study, focused on the period from January 2023 to December 2023 at Pathology Laboratory, employed various data collection instruments to ensure comprehensive and accurate results. The primary source of data was the laboratory's Electronic Medical Records. EMRs provided detailed information on patient demographics, including age, gestational age, and medical history. These records allowed for the identification of pregnant women who underwent urine culture testing. Urine culture reports were analysed as well to determine the presence of uropathogenic species. Each report included critical information about the identified pathogens and their antibiotic susceptibility profiles. UPEC is known to account for 80-90% of UTIs in pregnant women (Flore-Mireles, Walker, Caparon , & Hultgren, 2015), and these reports will help quantify its prevalence in the study population.

3.7 Pretest Study

The prevalence of uropathogenic species in pregnant women represented a critical area of research due to the unique physiological changes that occurs during pregnancy. These changes can predispose women to urinary tract infections (UTIs), which affect approximately 10-20% of this population (Hooton , 2015). Understanding the prevalence of these pathogens is essential for developing effective treatment and prevention strategies.

A pretest study was done at Pathology Laboratory in order to test the procedure and tools of the study before conducting the main study. The pretest study aimed to assess the feasibility of conducting a larger-scale research project focused on the prevalence of uropathogenic species in pregnant women at Pathology Laboratory in 2023. This

preliminary investigation helped identify potential challenges in data collection, patient recruitment, and analysis methods.

The pretest involved a small cohort of pregnant women with positive urine cultures who had undergone urine culture testing at the laboratory during the period January 2022 to July 2022. Data was collected on demographic factors such as age, gestational age, and medical history. Initial results focused on identifying the proportion of urine cultures that yielded uropathogenic species. The data which was used for the pretest study was not used to conduct the main study. The participates for the pretest study were not involved in the main study as well.

Initial findings from the pretest study were anticipated to provide insights into the prevalence rates of uropathogenic species. It is hypothesized that UPEC will account for a significant majority of positive cultures, consistent with findings from previous studies, which report UPEC as responsible for 80-90% of UTIs in pregnant women (Zhou, et al., 2023). The pretest also evaluated the antibiotic resistance patterns of isolated species, which have become increasingly concerning in clinical settings.

Preliminary data was analysed using descriptive statistics to summarize the demographic characteristics and prevalence rates. Statistical software was used to analyse the data. This phase helped refine the methodologies for the larger study, ensuring robust data collection and analysis strategies were in place.

3.8 Data collection procedure

Authorized personnel accessed the EMR system to identify eligible patients based on the inclusion criteria. Key variables, including age, gestational age, and specific uropathogenic species identified, were documented systematically in a data collection form. Each record also included the results of antibiotic susceptibility tests to assess

resistance patterns. To protect patient confidentiality, all data was anonymized, ensuring that personal identifiers were removed before analysis. To ensure data accuracy and reliability, a rigorous quality control process was implemented. Regular audits of the data collection process were conducted, and discrepancies were addressed promptly. Data was entered into statistical software where it was cleaned and validated before analysis.

3.9 Analysis and collection of data

Descriptive statistics summarized demographic characteristics and prevalence rates of uropathogenic species. The information gathered was displayed in line graphs and tables. This was accomplished by analysing the outcomes of the medical records. The data analysis verified if the information gathered is of high quality.

3.10 Ethical consideration

Conducting research on the prevalence of uropathogenic species in pregnant women involved several ethical considerations to ensure the integrity of the study and the protection of participants' rights. Although this study utilized retrospective data from electronic medical records and urine culture reports, it was essential to ensure that participants' rights were preserved. Informed consent was sought where applicable. The permission from the study site, Pathology Laboratories was sought as well before conducting the study.

Maintaining the confidentiality of patient information was of paramount importance. All data collected from electronic medical records were anonymized to eliminate any identifiable information. Access to the data was restricted to authorized research personnel only. Prior to commencing the study, ethical approval was obtained from the relevant institutional review board which is Africa University Research Ethics

Committee (AUREC). This process involved submitting the study protocol for review to ensure that the research design aligned with ethical guidelines and standards for conducting research involving human subjects.

The study was designed to minimize any potential harm to participants. Since the research utilized existing data, there are no direct interventions that could have caused physical or psychological harm. However, attention was paid to the interpretation and reporting of findings to avoid stigmatization of individuals diagnosed with UTIs or other related conditions. Careful consideration was given to how results were to be disseminated to ensure they contribute positively to public health knowledge and do not perpetuate negative stereotypes.

The principles of beneficence (maximizing benefits) and non-maleficence (minimizing harm) guided the research. The study aimed to contribute to knowledge about uropathogenic species prevalence, which led to improved clinical practices and health outcomes for pregnant women. By adhering to principles of informed consent, confidentiality, and ethical oversight, the research aimed to maintain high ethical standards while contributing to valuable insights in maternal health. Ensuring that the study was conducted ethically, enhanced its credibility and the applicability of its findings.

3.11 Summary

This study employed a retrospective cross-sectional design to investigate the prevalence of uropathogenic species, particularly uropathogenic Escherichia coli (UPEC), among pregnant women at Pathology Laboratory in 2023. Data was collected from electronic medical records, focusing on urine culture results, demographic information, and antibiotic susceptibility profiles. Inclusion criteria encompassed

pregnant women aged 18 and older with confirmed UTIs, while non-pregnant individuals and incomplete records were excluded. Data analysis involved descriptive statistics and inferential tests to identify prevalence rates and associations between demographic factors and UTI occurrences. Ethical approval was obtained to ensure compliance with research standards and patient confidentiality.

CHAPTER 4: DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter covered the presentation of the data of this study in forms of tables and 2x2 tables as well. The data collected comprised of common uropathogenic species found in pregnant, their susceptibility profiles and their changes in susceptibility rate throughout the year of 2023 to some of the common drugs used at Pathology Laboratories.

4.2 Data presentation and analysis

A census on all the medical reports for urine cultures from January 2023 to December 2023 was analysed. A total of 300 positive urine cultures were identified.

4.2.1 Prevalence of common uropathogenic species isolated from pregnant women

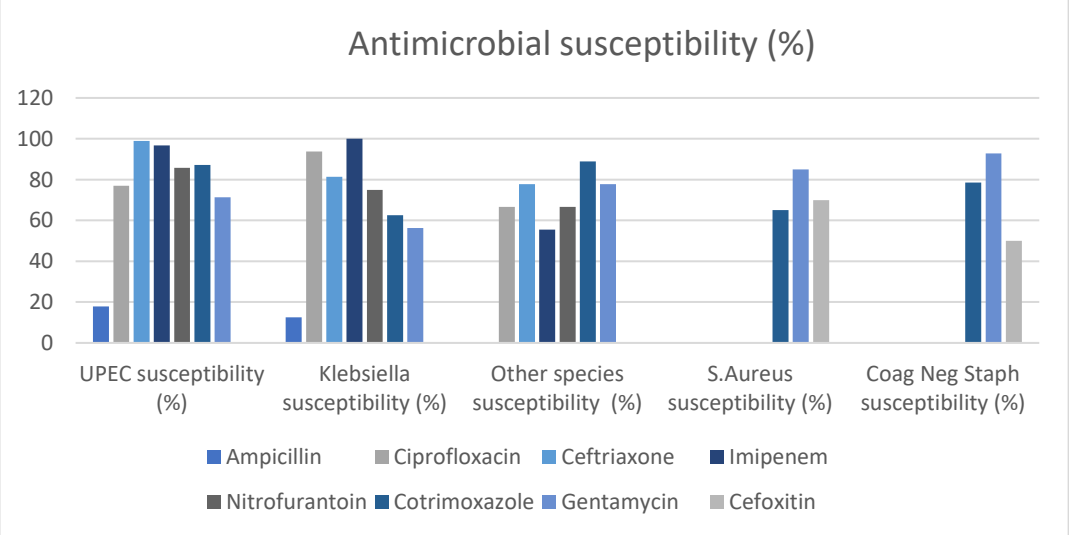
Table 1: The prevalence of the main uropathogenic species isolated from pregnant women urine culture

Uropathogenic Species	Frequency (n=300)	Percentage (%)
Uropathogenic E. coli (UPEC)	196	65.3
Klebsiella pneumoniae	16	5.3
Staphylococcus aureus	20	6.7
Coagulase Negative Staph (CNS)	14	4.7
Yeasts	45	15.0
Other species	9	3.0

A total of 300 positive cultures was obtained in the year 2023 at Pathology laboratory. The analysis indicated that Uropathogenic E. coli (UPEC) is the most prevalent pathogen, accounting for 65.3% of the total isolates. This distribution was consistent with existing literature, which identified UPEC as the leading cause of urinary tract infections (UTIs) in pregnant women (Hooton , 2015). This was followed by yeast species isolated from pregnant which is common in pregnancy with 15%. Klebsiella accounted for 5.3%, Staphylococcus had 6.7%. Coagulase Negative Staphylococcus had 4.7% which can be caused by contamination. Other species (Pseudomonas Aeruginosa, streptococcus species and Proteus Mirabilis) had 3%.

4.2.2 Susceptibility profile of the isolated uropathogenic species

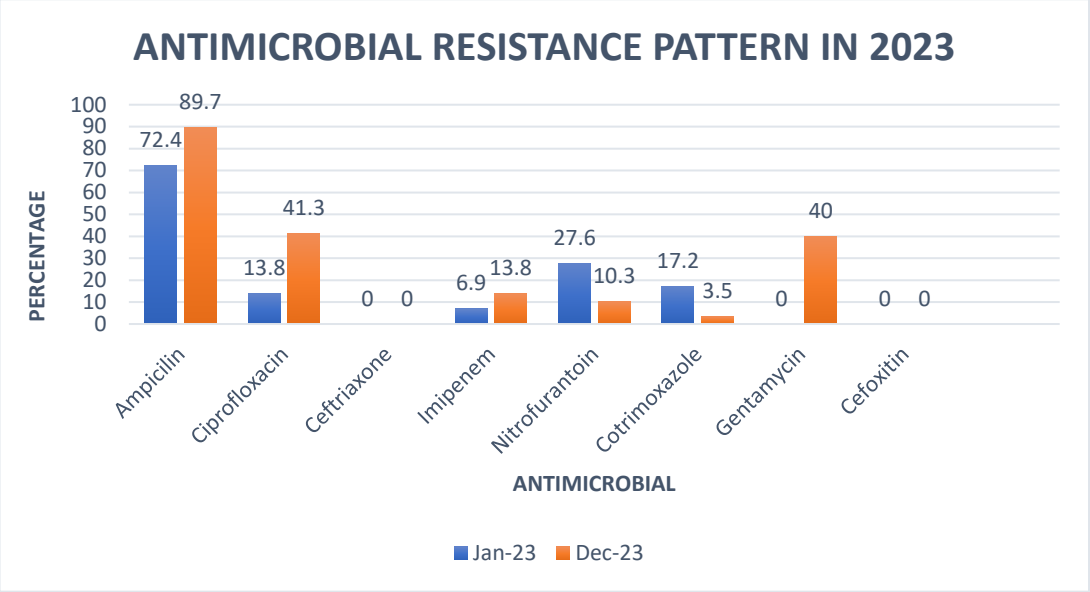
Figure 1: Susceptibility profile of the isolated species to the most common drugs used at Pathology Laboratory



Susceptibility data revealed that Ciprofloxacin, Ceftriaxone, Imipenem, Nitrofurantoin, Cotrimoxazole, Gentamycin and Cefoxitin remain viable options for treating the uropathogenic species in pregnant women. Ampicillin showed low susceptibility against uropathogens indicating challenges of using this antibiotic as a treatment option.

4.2.3 Trend in antimicrobial resistance

Figure 2: Changes in trends of antimicrobial resistance



The resistance of ampicillin to uropathogenic species increased from 72.4% in January 2023 to 89.7 % which indicated a growing challenge for first line treatment this may have been due to its overuse in the past years. Ciprofloxacin resistance increased from 13.8% to 41.3%. and Gentamycin showed an increased in resistance from 0% to 40% which may be due bacterial adaptations of these antibiotics. However, ceftriaxone for gram negative rods organisms and cefoxitin for gram positive cocci maintained a constant rate showing no resistance in the year 2023 indicating Ceftriaxone and Cefoxitin to be effective options for treatment. The resistance of Nitrofurantoin and Cotrimoxazole showed minor decrease in resistance this may be due to the strain of organisms affecting the pregnant women.

4.3 Summary

A census was used to identify the common uropathogen species in pregnant women at pathology Laboratory in the year 2023. A total of 300 positive urine cultures was

identified with UPEC accounting for the highest percentage of pathogens that cause UTI in pregnancy. Most antibiotics such as Ceftriaxone and Cefoxitin showed to be effective options for treating UTIs in pregnancy whilst Ampicillin showed high rates of resistance. The change of resistance patterns for antibiotics such as ceftriaxone remain constant throughout the year with a resistance rate which are very low.

CHAPTER 5: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarized all of the research findings, identified any gaps in the information, and any unexpected information that was discovered. This was done in accordance to the research objectives and literature review described above.

5.2 Discussion

5.2.1 Discussion on the prevalence of common uropathogenic species in pregnant women

The predominant pathogen identified in this study was Uropathogenic Escherichia coli (UPEC), accounting for 65.3% of the isolates. This finding is consistent with global literature that consistently identifies E. coli as the leading cause of UTIs in pregnant women, often reported to be responsible for 70-90% of cases. (Ramos , et al., 2012). The next pathogen found in urine cultures of pregnant women was yeasts which according to (Peri, 2024) hormonal imbalance caused by pregnancy increases oestrogen levels significantly which alters the vaginal environment. This increase can disrupt the normal balance of yeast and bacteria, allowing yeast, particularly Candida albicans, to overgrow.

5.2.2 Discussion on the susceptibility of the isolated pathogens to most commonly used drugs at Pathology Laboratory

Amoxicillin showed low rate of susceptibility in uropathogens isolated from positive urine culture indicating its effectiveness against treating UTIs in pregnant women to be low. However, the third-generation cephalosporin, Ceftriaxone, remain the dominant antimicrobial against UTIs in pregnant women. Nitrofurantoin, Cotrimoxazole, Imipenem and Ciprofloxacin remain effective against gram negative uropathogens in urine at Pathology Laboratories.

5.2.3 Discussion on the change in the resistance trend of antibiotics used at Pathology Laboratory

The resistance trend of Ampicillin increased by the end of the year this may be due to pathogens increase to the antimicrobial resistance. Gentamycin resistance trend increased making it suspectable to become resistance to treating gram positive uropathogens in pregnant women in the coming years. Ceftriaxone, Imipenem and Nitrofurantoin susceptibility trend started in January 2023 above and by end of December it increased showing that these antimicrobials have less chances to be resistance to most uropathogens in pregnant women.

5.3 Limitations

This research was conducted at Pathology Laboratory, which limited the generalizability of the findings. Variations in susceptibility patterns and prevalence rates could exist in different geographic locations or healthcare settings. The study may have only included a limited number of antibiotics in susceptibility testing, potentially overlooking susceptibility patterns for other clinically relevant agents. The study may lack comprehensive demographic data on participants, such as age, socioeconomic status, and medical history, which could influence the prevalence and outcomes of UTIs.

5.4 Conclusion

In conclusion, this study highlighted the prevalence of uropathogenic species in pregnant women at Pathology Laboratory in 2023, revealing critical insights into the microbial landscape and antimicrobial susceptibility patterns. UPEC remained the predominant uropathogen, but rising resistance to commonly used antibiotics poses significant challenges. The findings underscore the need for ongoing surveillance of

uropathogenic species and their susceptibility patterns to inform clinical practice and improve health outcomes for pregnant women.

5.5 Recommendation

Routine surveillance programs to monitor the prevalence and resistance patterns of uropathogenic species in pregnant women may be implemented. This data may be necessary for updating treatment guidelines and ensuring effective management. Educating healthcare providers about local resistance patterns can help minimize the development of further resistance.

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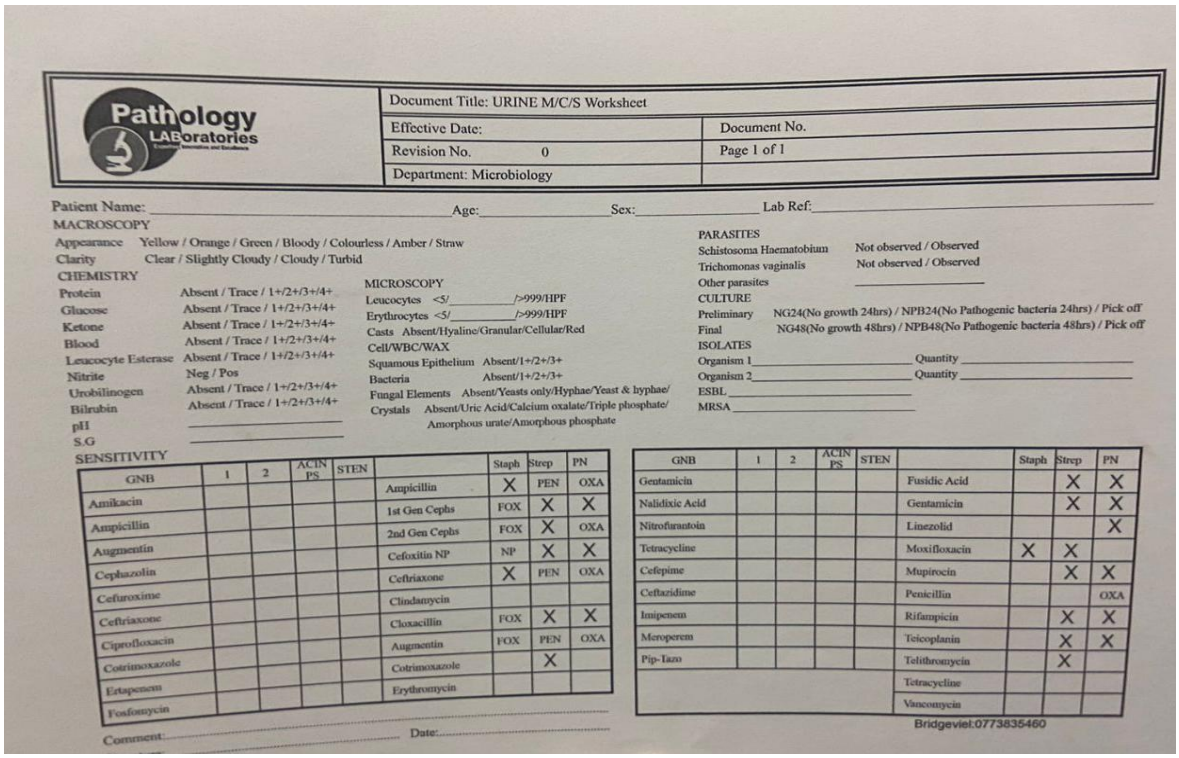
Appendices

Appendix 1: Data collection tool



Pathology LABoratories

Document Title: URINE M/C/S Worksheet	
Effective Date:	Document No.
Revision No. 0	Page 1 of 1
Department: Microbiology	

Patient Name: _____ Age: _____ Sex: _____ Lab Ref: _____

MACROSCOPY

Appearance Yellow / Orange / Green / Bloody / Colourless / Amber / Straw

Clarity Clear / Slightly Cloudy / Cloudy / Turbid

CHEMISTRY

Protein Absent / Trace / 1+/2+/3+/4+

Glucose Absent / Trace / 1+/2+/3+/4+

Ketone Absent / Trace / 1+/2+/3+/4+

Blood Absent / Trace / 1+/2+/3+/4+

Leucocyte Esterase Absent / Trace / 1+/2+/3+/4+

Nitrite Neg / Pos

Urobilinogen Absent / Trace / 1+/2+/3+/4+

Bilirubin Absent / Trace / 1+/2+/3+/4+

pH _____

S.G _____

MICROSCOPY

Leucocytes <5/_____/>999/HPF

Erythrocytes <5/_____/>999/HPF

Casts Absent/Hyaline/Granular/Cellular/Red Cell/WBC/WAX

Squamous Epithelium Absent/1+/2+/3+

Bacteria Absent/1+/2+/3+

Fungal Elements Absent/Yeasts only/Hyphae/Yeast & hyphae/

Crystals Absent/Uric Acid/Calcium oxalate/Triple phosphate/ Amorphous urate/Amorphous phosphate

PARASITES

Schistosoma Haematobium Not observed / Observed

Trichomonas vaginalis Not observed / Observed

Other parasites _____

CULTURE

Preliminary NG24(No growth 24hrs) / NPB24(No Pathogenic bacteria 24hrs) / Pick off

Final NG48(No growth 48hrs) / NPB48(No Pathogenic bacteria 48hrs) / Pick off

ISOLATES

Organism 1 _____ Quantity _____

Organism 2 _____ Quantity _____

ESBL _____

MRSA _____

SENSITIVITY

GNB	1	2	ACIN PS	STEN
Amikacin				
Ampicillin				
Augmentin				
Cephazolin				
Cefuroxime				
Ceftriaxone				
Ciprofloxacin				
Cotrimoxazole				
Ertapenem				
Fosfomycin				

	Staph	Strep	PN
Ampicillin	X	PEN	OXA
1st Gen Cephs	FOX	X	X
2nd Gen Cephs	FOX	X	OXA
Cefoxitin NP	NP	X	X
Ceftriaxone	X	PEN	OXA
Clindamycin			
Cloxacillin	FOX	X	X
Augmentin	FOX	PEN	OXA
Cotrimoxazole		X	
Erythromycin			

GNB	1	2	ACIN PS	STEN
Gentamicin				
Nalidixic Acid				
Nitrofurantoin				
Tetracycline				
Cefepime				
Ceftazidime				
Imipenem				
Meroperem				
Pip-Tazo				

	Staph	Strep	PN
Fusidic Acid		X	X
Gentamicin		X	X
Linezolid			X
Moxifloxacin	X	X	
Mupirocin		X	X
Penicillin			OXA
Rifampicin		X	X
Teicoplanin		X	X
Telithromycin		X	
Tetracycline			
Vancomycin			

Comment: _____ Date: _____

Bridgeviet:0773835460

Appendix 2: Study site approval letter

PATHOLOGY LABORATORIES
Expertise. Innovation. Excellence

Pathology Laboratory
15 Baines Avenue
Harare

2 October 2024

To whom it may concern.

RE: RESEARCH APPROVAL LETTER

This letter serves as approval for Vanessa Denhere (210764) to carry out research on the prevalence of uropathogenic species in pregnant women at Pathology Laboratory in Harare Zimbabwe, 2023.

Yours sincerely

Marshia Chiriganyanga
Laboratory Manager

PATHOLOGY LABORATORIES
NO. 15 BAINES AVENUE
HARARE ZIMBABWE
0 2 OCT 2024
TEL: 0242 79633516
CELL: 0731 492 866 / 0783 285 175

DR T.V JAVANGWE
PATHOLOGIST

Appendix 3: AUREC approval letter

"Investing in Africa's future"

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

P.O. Box 1320 Mutare, Zimbabwe, Off Nyanga Road, Old Mutare-Tel (+263-20) 60075/60026/61611 Fax: (+263 20) 61785 Website: www.africau.edu

Ref: AU 3530/24 28 November 2024

VANESSA DENHERE
C/O Africa University
Box 1320
MUTARE

RE: ***PREVALENCE OF UROPATHOGENIC SPECIES IN PREGNANT WOMEN AT PATHOLOGY LABORATORY IN HARARE, ZIMBABWE 2023***

Thank you for the above-titled proposal you submitted to the Africa University Research Ethics Committee for review. Please be advised that AUREC has reviewed and approved your application to conduct the above research.

The approval is based on the following.

a) Research proposal

- **APPROVAL NUMBER** AUREC 3530/24
  This number should be used on all correspondences, consent forms, and appropriate document
- **AUREC MEETING DATE** NA
- **APPROVAL DATE** November 28, 2024
- **EXPIRATION DATE** November 28, 2025
- **TYPE OF MEETING**: Expedited
  After the expiration date, this research may only continue upon renewal. A progress report on a standard AUREC form should be submitted a month before the expiration date for renewal purposes.
- **SERIOUS ADVERSE EVENTS** All serious problems concerning subject safety must be reported to AUREC within 3 working days on the standard AUREC form.
- **MODIFICATIONS** Prior AUREC approval is required before implementing any changes in the proposal (including changes in the consent documents)
- **TERMINATION OF STUDY** Upon termination of the study a report has to be submitted to AUREC.

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC) APPROVED P.O. BOX 1320, MUTARE, ZIMBABWE

Yours Faithfully

MARY CHINZOU
ASSISTANT RESEARCH OFFICER: FOR CHAIRPERSON
AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE

Timeframe

Activity	November 2024	December 2024	January 2025	February 2025	March 2025
Proposal development					
Ethical considerations					
Data collection					
Data analysis					
Report compilation					
Presentation of findings					
Submission					

Budget

Transport	$100
Food	$50
Stationery	$20
WiFi	$50
Total	$220