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ANTIMICROBIAL RESISTANCE PATTERNS OF URINARY TRACT INFECTION PATHOGENS AT VICTORIA CHITEPO PROVINCIAL HOSPITAL LABORATORY FROM JANUARY TO DECEMBER 2023

BY

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200321

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF MEDICAL LABORATORY SCIENCES (HONOURS) IN THE COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

2024

Abstract

This study was carried out to identify the antimicrobial susceptibility patterns of urinary tract bacteria isolated at Victoria Chitepo Provincial Hospital Laboratory from January 2023 to December 2023. The study was a retrospective study that was and the study population were all the patients attending Victoria Chitepo Provincial Hospital who had tested positive for urinary tract bacterial infection. The sample size for this study was 385 participants and random sampling method was used to select the participants. This study showed that more females (56.4%) were affected with urinary tract infections than males (43.6%). Two age groups were most affected and that was the 0 to 9 years age group and the 20 to 29 age group which was were both 16.6% of the total participants. The isolated uropathogens were *E. coli, K. pneumoniae, Enterobacter spp, Staphylococcus spp, Pseudomonas spp, Streptococcus spp, N. Gonorrhoeae* and *Proteus spp*. The most frequently isolated were *E. coli* (27.2%), *K Pneumoniae* (18.4%), *Staphylococcus spp* (17.4%) and *Enterobacter spp* (12.2%). Antimicrobial susceptibility patterns were different according to the pathogens. E. coli was most susceptible to Chloramphenicol with 90% susceptibility and most resistant to Doxycycline. K. pneumoniae was most susceptible to Ceftriaxone (71%). Staphylococcus spp and Enterobacter spp were most susceptible to Ampicillin (100%) and Chloramphenicol (67%) respectively. One limitation of the study was that the antimicrobial susceptibility testing was limited to the drugs that were available at the institution and hence, there could not be a wider picture that includes the wide range of antibiotics that is used in medical settings currently. The conclusion according to the findings was that antimicrobial resistance is high and one recommendation was for the need to put measures in place that prohibit prescribing of antibiotics without laboratory tests confirming a bacterial infection as well as the antimicrobial susceptibility testing being done.

Key words: UTI, Prevalence, Zimbabwe, AMR

Acknowledgements

I would like to acknowledge Dr. M. Salissou my supervisor who helped me with the skills used this research, teaching me the fundamentals of how research is done and guiding me step by step. I would also like to thank my family for their love and support, both financially and emotionally. Lastly and most importantly, I would like to thank the Lord Almighty for enabling me to do this research and for His guidance throughout this degree program from first year until final year.

Declaration

I, Mufaro Manyawu, hereby declare that this is my original work and has not been presented in any academic institution for any award. The other authors' work used in this proposal has been acknowledged accordingly.

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Dedication

This research is dedicated to all patients who have had complications due to antimicrobial resistance.

Acronyms and Abbreviations

VCPH:	Victoria Chitepo Provincial Hospital
VCPHL:	Victoria Chitepo Provincial Hospital Laboratory
UTI:	Urinary tract infection
WHO:	World Health Organization
ESBL:	Extended Spectrum Beta-Lactamase
MDR:	Multidrug resistant
AUREC:	Africa University Research Committee
AMR:	Antimicrobial Resistance
AMS:	Antimicrobial Susceptibility
AST:	Antimicrobial Susceptibility Testing
spp:	Species
NOR:	Norfloxacin
DOX:	Doxycycline
GM:	Gentamicin
NA:	Nalidixic Acid
CIP:	Ciprofloxacin
ATH:	Azithromycin
CRO:	Ceftriaxone
C:	Chloramphenicol
CD:	Clindamycin
PG:	Penicillin
AMP:	Ampicillin
AUG:	Augmentin

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Background on Urinary tract infections is given in this chapter. It looks at the demographic group that is most affected by these urinary tract infections. It also looks at information on the bacteria that cause urinary tract infections, the antimicrobials that are used to treat them and resistance of the bacteria to the antibiotics used to treat them. This chapter also introduces the topic of antimicrobial resistance (AMR). It also discusses the need to evaluate susceptibility patterns of these bacteria. The purpose of this study and its significance to public health are also be emphasized in this chapter.

1.2 Background of the study

Urinary system includes the kidneys, ureters, urethra and the bladder and an infection occurs when any of the organs of the system is infected. The bladder and the urethra, which are at the lower part of the urinary system are the ones mostly affected. Infection on the lower part of the urinary system is painful and annoying. Serious health problems occur when the kidney gets infected. Infections occur when bacteria enter the urethra and begin to spread in the bladder (Urinary Tract Infection (UTI) - Symptoms and Causes, 2022). Most common UTIs occur in women and affect the bladder and urethra, because the urethra is close to the anus and urethral opening close to the bladder. The most common pathogen causing UTIs is Escherichia coli (E. coli) and this is because it resides in the gastrointestinal tract (Urinary Tract Infection (UTI) - Symptoms and Causes, 2022). UTIs affect anyone at any age including infants. Urinary tract infections are caused by a range of bacterial pathogens, but most commonly by *E. coli, Klebsiella pneumonia (K. pneumoniae),*

Proteus mirabilis (P. mirabilis), Enterococcus faecalis (E. faecalis) and Staphylococcus saprophyticus (S. saprophyticus) (Flores-Mireles et al., 2015). UTIs are some of the most common bacterial infections, affecting 150 million people each year worldwide and a lot of money goes into the treatment of these UTIs (Zhillin Zeng et al.,2022). Examples of common antimicrobials used to treat UTIs include trimethoprim, β-lactams, fluoroquinolones, nitrofurantoin, and fosfomycin tromethamine, cefdinir, cephalexin, ampicillin, cotrimoxazole, nicene, nalidixic acid and cotrimoxazole (Michael Bono et al., 2023). Most of these antimicrobials are no longer effective due to the resistance by the bacterial pathogens. Due to misuse and overuse of antibiotics some bacteria have become resistant and less effective in treatment of UTIs. Antimicrobial is a naturally occurring process in bacteria as a way of protecting themselves from antimicrobials but humans increase the occurrence of this process. Resistance comes about through use of antibiotics therefore it is vital that a person takes antibiotics for treatment of bacterial infections and not any other infection other than that which is the opposite of what people are actually doing. The more antibiotics are used the more chances bacteria get of gaining resistance against them. Resistance is brought about through clinicians over-prescribing antibiotics and patients not taking antibiotics as directed. Resistance is also caused by poor hygiene and lack of infection prevention for example proper washing of hands and travelers also spread resistant bacteria (Resistance, 2022). A number of resistant strains were discovered which included methicillin resistant S.aureus (MRSA) (Wagenlehner and Naber, 2004), multidrug resistant P. aeruginosa (Linuma, 2007) and extended spectrum beta lactamase (ESBL) resistant enterococci (Bhattacharya, 2006) just to mention a few. A study in Bulawayo, Zimbabwe reported that there was high resistance to ampicillin (84.5%) and cotrimoxazole (68.5%) among the Gram negative bacilli. Gram positive cocci showed resistance to Nalidixic acid (81%) and cotrimoxazole (69%). *E. coli* was susceptible to most of the drugs but 84% of the strains were resistant to ampicillin, and 68% to cotrimoxazole. All isolates were

sensitive to Nicene, (Mbanga et al., 2011). If no immediate action is not taken it will force the use of more sophisticated antibiotics for all treatments, which will greatly increase the burden on last-line therapies.

1.3 Problem Statement

Urinary Tract Infections (UTIs) are one of the leading causes of morbidity and growing health care expenditure worldwide. They also account for the most common bacterial infection seen in tertiary hospitals, with higher morbidity and mortality among developing countries (Shakya et at., 2021). Burden of Urinary Tract Infections has led to the increase in antibiotic use in a bid to rid the discomfort caused by UTIs. This use has been by both self-administered and inappropriate prescribing. Due to this, the bacteria is genetically mutating, becoming resistant to these overused antibiotics. Antimicrobial resistance (AMR) is a rapidly emerging problem especially in low income and middle-income countries and urinary pathogens are among the most frequently resistant (Shakya et al., 2021). Some of the problems and challenges of Antimicrobial resistance in Zimbabwe are the issue of limited appropriate antibiotics and poor regulation of antibiotic use. Because of the poor regulation of the antibiotic use, there is then inappropriate use of the antibiotics as mentioned by (Chitungo et al.,2022). There is also increased mortality as the treatment options are less for these infections. At Victoria Chitepo Provincial Hospital Laboratory, isolated uropathogens/bacteria are more resistant than susceptible to the antibiotics used in Antimicrobial Susceptibility Testing (AST), and this is anecdotal data. Antibiotics such as Norfloxacin and Doxycycline face resistance from bacteria but not all bacteria as they have other bacteria that are susceptible to them. Hence, it is vital for clinicians to know the right empirical treatment. Because of this, it is vital that studies be done concerning the type of bacteria responsible for UTIs and their resistance patterns. There is a normally used choice of drugs to treat different infections as in the

case of UTIs. Some of the common drugs have been mentioned above with the resistance patterns of E. coli in previous studies. Updating treatment guidelines is a reason why this study should be done as the pathogens are getting more resistant. The data provided by microbiology laboratories helps to choose the empirical choice of antimicrobials to treat urinary tract infections.

1.4 Study Justification

This study allows for the assessment of the frequency of UTIs in patients and the reason behind the infections. Knowing the cause of the infections helps the clinicians know how to treat a person in the proper way. The study also helps to see which antimicrobials are useful in treating the infection and which ones are not. Studying the trend of the resistance enlightens the healthcare workers about how critical the situation is. Bacteria can evolve resistance mechanisms against drugs through selection and mutation. For instance, certain bacteria have evolved to create biochemical "pumps" that can eliminate antibiotics before they even reach their target, while other bacteria have evolved to create enzymes that render antibiotics inactive. It helps them discover the rate at which they have to find suitable solutions like producing antibiotics and organizing awareness campaigns. The patients also get to learn about the resistance and why it is important for them to take their prescriptions seriously and follow instructions. It also discourages them from self-treatment but visiting the clinician as soon as possible.

1.5 Research Objectives

1.5.1 Broad Objective

This research aims to establish the prevalence of Urinary Tract Infections and to assess the antimicrobial susceptibility patterns of uropathogens causing the Urinary Tract Infections at Victoria Chitepo Provincial Hospital for the year 2023

1.5.2 Specific Objectives

1. To identify the demographic group mostly affected by urinary tract infections at VCPH in 2023
2. To identify the pathogens causing the urinary tract infections at VCPH in 2023
3. To establish the antimicrobial susceptibility patterns of the most prevalent uropathogens identified

1.6 Research Questions

1. Which demographic group was mostly associated with affected with urinary tract infections at VCPH in 2023
2. Which pathogens caused the urinary tract infections at VCPH in 2023
3. What are the antimicrobial susceptibility patterns of the most prevalent uropathogens?

1.7 Study limitations

- Some of the people are not be able to afford the tests and hence it is not be a scope of every patient who visited VCPH
- The study was limited to antibiotics that were available at the hospital in 2023 and that did not cover all the antibiotics that the uropathogens could be resistant to

1.8 Study delimitations

- The study only looked at patients who visited VCPH
- The study was limited to UTI cases that occurred in 2023 only
- The study included both genders and all age groups that were affected by UTIs

1.9 Summary

This chapter was to introduce the research of the antimicrobial susceptibility patterns of bacteria that cause urinary tract infection. The chapter opened up with an introduction and then a background to the stuff of the problem. It then went on to discuss the problem statement and the justification of the study. The chapter also looked at research objectives and questions, and finally looked at limitations and delimitations of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter aims to provide information on studies that have already been done in relation to this area of interest and hence what different publishers have said about Urinary tract infections, particularly about commonly affected demographic groups, most common causal uropathogens and the antimicrobial susceptibility patterns of these pathogens. This chapter is to review and acknowledge literature by the other authors concerning this topic.

2.2 Conceptual Framework

This is the diagrammatic representation of the relationship between the research objectives, questions and theories binding these together. In the objectives, three variables were studied, which are the uropathogens, most affected demographic groups and AMS patterns. Of these, the independent variables are the risk factors and the causal uropathogens. There are just there and their outcome do not depend on any of the other objectives. The dependent variables are the AMS patterns and the most demographically affected groups. The AMS patterns are dependent on the uropathogens that will be found and the antibiotics present. The most commonly affected demographic group is also dependent on the risk factors of UTIs.

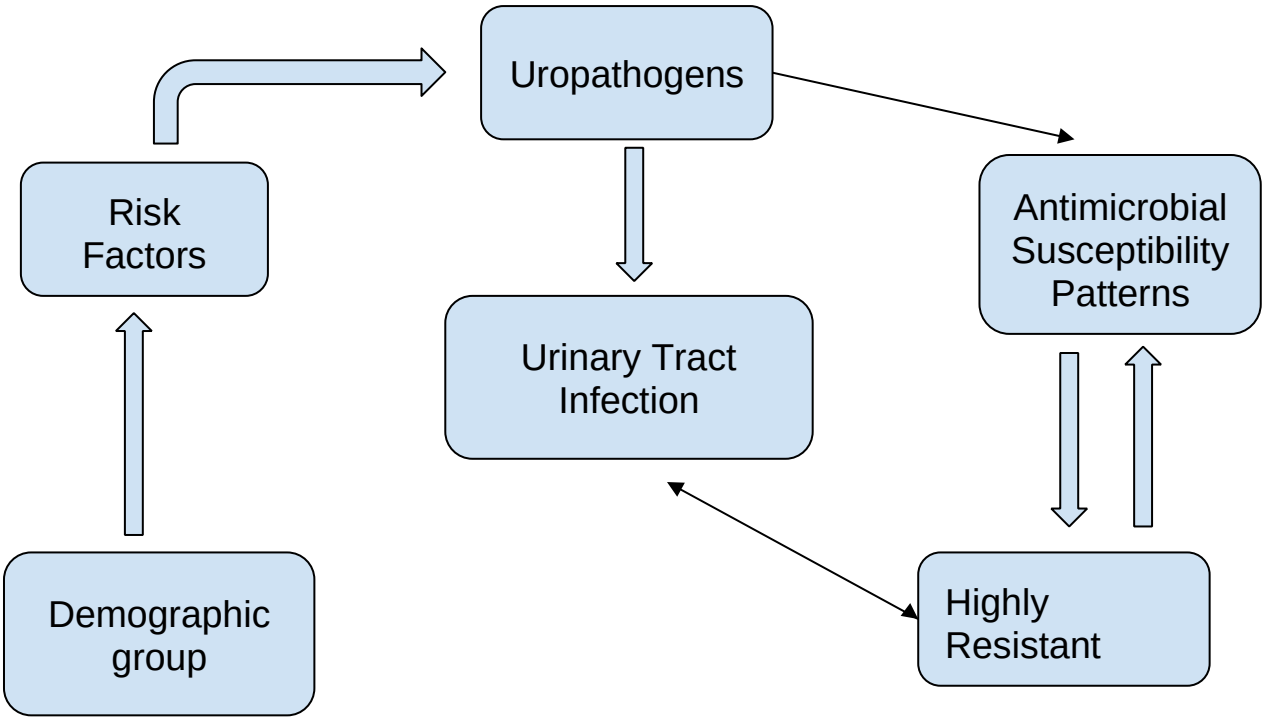

Figure 1 shows the conceptual framework

2.3 Literature review in relation to most affected demographic groups

Urinary tract infections (UTIs) can affect individuals of any age and gender, but certain demographics are more commonly affected. In general, women are more likely to experience UTIs than men, and the risk increases with age. This is confirmed in a study done by Yang & Chen et al., (2022) where he mentions that in the study, women have more incidence of urinary tract infections than the men. Among women, those who are sexually active and postmenopausal are particularly susceptible as seen in the study by Medina & Castillo-Pino et al., (2019). In terms of age, older adults are at higher risk due to factors such as weakened immune systems and other health conditions as seen in the cross sectional study according to Mlugu, Mohamedi & Mwambete et al., (2023) on a study done in Tanzania that looked at prevalence as well as the socio demographic factors associated with urinary tract infections at an outpatient clinic.

2.4 Literature review in relation to bacteria commonly causing urinary tract infections

According to a number of studies UTIs are one of the most common infections seen in clinical practice especially in developing countries with a high rate of morbidity and financial costs. According to Tansarli et al., (2013) a study was done in Africa to evaluate the susceptibility of Enterobacteriaceae causing UTIs. Twenty-eight studies were conducted which accounted for 381 899 urine isolates from 14 African countries that had met the criteria of the study. The common pathogens were *E. coli*, *Klebsiella spp*., and *Proteus spp*. Following a cross sectional study done in Harare, Zimbabwe ten bacterial species were isolated which are *Coagulase Negative Staphylococcus* (29.4%), *E. coli* (23.5%). The other isolated bacteria were *S. aureus, Salmonella, Klebsiella, Providencia, S. viridans and Shigella* species (Rukweza et al., 2018).

According to a study done at Anambra State Teaching Hospital, Amaku, and Anambra State, Nigeria by Ekwealor et al., (2016) the most common pathogenic organisms of UTI are *E. coli, S. saprophyticus, S. aureus, Proteus sp., K. pneumoniae, P. aeruginosa*, and *Enterococci*. According to Mazzariol et al., (2017) UTIs are primarily caused by Gram-negative bacteria, the main pathogen being *Escherichia coli* followed by other species of *Enterobacteriaceae*, such as *Proteus mirabilis* and mostly *Klebsiella pneumoniae*, and by Gram-positive pathogens, such as *Enterococcus faecalis* and *Staphylococcus saprophyticus.*

According to Fenta et al., (2020) a study done in Ethiopia indicated that both Gram positive and Gram-negative isolates were recovered with a rate of 88% and 12% respectively. For the Gramnegative organisms, the predominant was E. coli (63.6%) followed by Klebsiella spp (15, 9%) and then Citrobacter spp (13, 6%). According to (Olaru et al., 2020) in a study done in Zimbabwe the most common cause of UTIs in the community setting is E. coli followed by K. pneumoniae.

According to Carrasco et el.,(2022) there is a study that was done at Saint Joseph Kitgum Hospital Uganda in which 100 organisms were isolated. The most common uropathogens in this study were Enterococcus spp (57%) and E. coli (28%). From a prospective cohort study done at a teaching hospital in Zimbabwe it was established that the commonest causative organism is *E. coli* (27.6%), Klebsiella species (21.1%), E. faecalis and (19.7%) (Mukapa et al., 2022). According to that same study it was also discovered that 29% of the gram negative bacteria cultured were ESBL producers.

2.5 Literature review in relation to antimicrobial resistance of common uropathogens

Among Gram negative bacterial isolates highest resistance was observed to meropenem followed by ciprofloxacin, cefoxitin, ceftazidime and chloramphenicol according to a study done in Ethiopia (Fenta et al., 2020). There was 100% resistance observed to ampicillin, 88, 6% to augmentin and 81, 8% to tetracycline. Above 75% of E. coli were susceptible to cefoxitin, cefotaxime, ceftazidime, ciprofloxacin, meropenem, chloramphenicol and nitrofurantoin. K. pneumoniae also showed high level of susceptibility to meropenem followed by ceftazidime and the least being nitrofurantoin. Overall MDR was 66% and higher rate was observed in Gram negative bacteria compared to Gram positive. The highest MDR was observed in Klebsiella spp followed by Citrobacter spp and then E. coli. Following a cross sectional study done in Harare, Zimbabwe CoNS was highly sensitive to gentamycin, ciprofloxacin and norfloxacin but was least sensitive to ceftriaxone and nitrofurantoin. E coli was highly sensitive to ceftriaxone and gentamycin but least sensitive to norfloxacin and nitrofurantoin. S. aureus was sensitive to all but one, nitrofurantoin, among the commonly tested antimicrobials. K. pneumonia was sensitive to ceftriaxone, ciprofloxacin and gentamycin (Rukweza et al., 2018).

According to Reza Mortazavi-Tabatabaei et al., (2019) in a study done in Iran most resistance among E. coli was observed in the following antibiotics, ampicillin, amoxicillin, tetracycline, trimethoprim-sulfamethoxazole, cephalexin and cefalothin. For E. coli there was less resistance observed in imipenem, nitrofurantoin, amikacin and chloramphenicol. Resistance of E. coli isolates as compared to other used antibiotics was as follows: gentamicin 32%, ceftriaxone 35%, cefazolin 48%, cefixime 45%, nalidixic acid 43%, cefotaxime 42%, and ceftazidime 40%. Lowest level of resistance was observed in imipenem, ciprofloxacin and amikacin for Klebsiella spp. The resistance rate of Klebsiella isolates to other antibiotics was cefalothin 55%, trimethoprimsulfamethoxazole 54%, tetracycline 53%, cefixime 53%, chloramphenicol 47%, nitrofurantoin

42%, ceftazidime 40%, ceftriaxone 40%, gentamicin 38%, cefotaxime 38%, and nalidixic acid 33%. For the Staphylococcus isolates highest rate of resistance was observed to ampicillin, cephalexin, and ceftriaxone antibiotics and the lowest rate of resistance to ciprofloxacin antibiotics, a resistance rate had also been seen in antibiotics of sulfamethoxazole 58%, nalidixic acid 51%, gentamicin 49%, cephalothin 43%, nitrofurantoin 42%, and amikacin 41%. According to (Odoki et al., 2019) prevalence of UTIs in Algeria amongst patients admitted was 4.5%, In

Senegal 0.7% and Uganda 13.3% and drug resistance was reported to be 20-60%. A study done in Bushenyi District, Uganda reported 22.33% prevalence of UTIs with E.coli being the most prevalent with (61.19%) followed by S.aureus (14.93%), K.pnuemoniae (5.9%), E. faecalis (5.6%), and P. aeruginosa (1.49%), (Odoki et al., 2019). According to Carrasco et al., (2022) nitrofurantoin was the most effective drug with 81, 7% susceptibility in Gram positive bacteria and 87, 3% in Gram negative bacteria. It was followed by imipenem with 94, 2% susceptibility in Gram positive bacteria and 74, 5% in Gram negative. Highest resistance was observed for amoxicillin (66, 2%) and ciprofloxacin (44, 6%).

2.6 Summary of Chapter 2

This chapter was to give an insight on other work that had been done that is in line with this research. First, it looked at the Conceptual Framework which is a diagrammatic representation of the objectives of the research and looks at the variables and non-variables of the study. The chapter also then looked at the literature review according to the three objectives which are the demographic group mostly affected with urinary tract infection, the etiological agents most responsible and the antimicrobial resistance patterns of those urinary tract bacteria.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The aim of this chapter is to indicate the type of research design which was used to conduct the research study, the tool and method which was used for data collection. It also highlights the study population, the sampling type that was done and the inclusion and exclusion criteria. It also explains how the data was analyzed and presented as well as the ethical considerations and lastly the summary of the chapter.

3.2 Research design

This research design was retrospective which was non-interventional. Data previously collected was analyzed and used to make conclusions. This study type was a retrospective cross-sectional design, where the chosen groups differ in terms of exposure degree and also were free of outcome of interest.

3.3 Study population

The study population of this research was patients infected with Urinary Tract Infections who visited Victoria Chitepo Provincial Hospital from 1 January to 31 December 2023.

3.4 Study Site

The study site for this research was Victoria Chitepo Provincial Hospital.

3.5 Exclusion criteria

Patients who do not possess the inclusion criteria for this study.

3.6 Inclusion Criteria

All patients who had Urinary Tract Infections and attended Victoria Chitepo Provincial Hospital between 1 January and 31 December 2023.

3.7 Sample size

The sample size was taken from the target population. After a sample size had been determined, random sampling was used to select the participants. Single size population formula was used where it had a 95% confidence level. The sample size was 50% of the total study population which gave a more accurate frame of the results. The confidence interval was the percentage of uncertainty which was 5% and expressed as decimal, it became 0.05.

$SS=Z^2 \times p \times (1-p)/C^2$

Where SS= Sample size

Z = Z-value which is 1.96 for a 95% confidence level

p = percentage of population which is 0.5

C = confidence interval expressed as a decimal which is 0.05

Sample size = $1.96^2 \times 0.5(1-0.5)/0.05^2$

= 384.16 which rounded off

Sample size = 385 participants.

3.8 Sampling method

Random sampling method was going employed since the data that was used accommodated all the available data on patients who presented at Victoria Chitepo Provincial Hospital with UTIs.

3.9 Data Analysis

The data was then analyzed in descriptive method and data analysis was quantitative. The data was visualized in the forms of tables, charts, line and bar graphs which illustrated the statistics. The culture results showed the most etiologic bacteria of UTIs and the AST showed the antimicrobial susceptibility patterns of the bacteria. The age and sex of the participants gave a picture of the most affected demographical group.

3.10 Ethical Considerations

The proposal was sent to AUREC and AUREC provided an ethical approval letter which gave the go ahead to continue with the project. A letter was also sent to Victoria Chitepo Provincial Hospital requesting for permission to conduct a study there as well as collecting data from that site. The study site granted the requested approval. The data collected was kept private and confidential and it was used only for this project.

3.11 Summary of chapter 3

This chapter focuses on the type of research design that was used in this research. It was a cohort study that did not have intervention from the researcher. Data that was previously collected is what was used for analysis and drawing up suitable conclusions. The study was conducted at Victoria Chitepo Provincial Hospital and focused on the patients who were diagnosed with Urinary Tract Infections at this particular hospital between January and December 2023. The research had inclusion and exclusion criteria and the sample size that was chosen was calculated and data collected was analyzed and presented quantitatively in the form of tables, charts and graphs. This research was presented to the university research ethics committee which provided a letter that approved the research going forward.

CHAPTER 4: DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This chapter focuses on the analysis and presentation of the data findings of the research. This is done in relation to the objectives of the research. The data will be presented in the form of tables, pie charts and graphs. The values will be presented either as absolute values or percentages and an explanation will company the presented data where necessary.

4.2 Most demographic group affected by UTIs at VCPH in 2023

The demographic groups were assessed based on the gender of the participants as well as the age.

4.2.1 Most demographic group affected by UTIs at Victoria Chitepo Provincial Hospital in relation to gender.

According to the sample size that was chosen, there was a total of 385 patients chosen whom were affected by urinary tract infection. Of these, 217 were female while 168 of the participants were male. The females were a higher percentage of 56.4% while males were 43.6% of the total participants chosen using random sampling method. According to the data, more females were affected by UTIs than males.

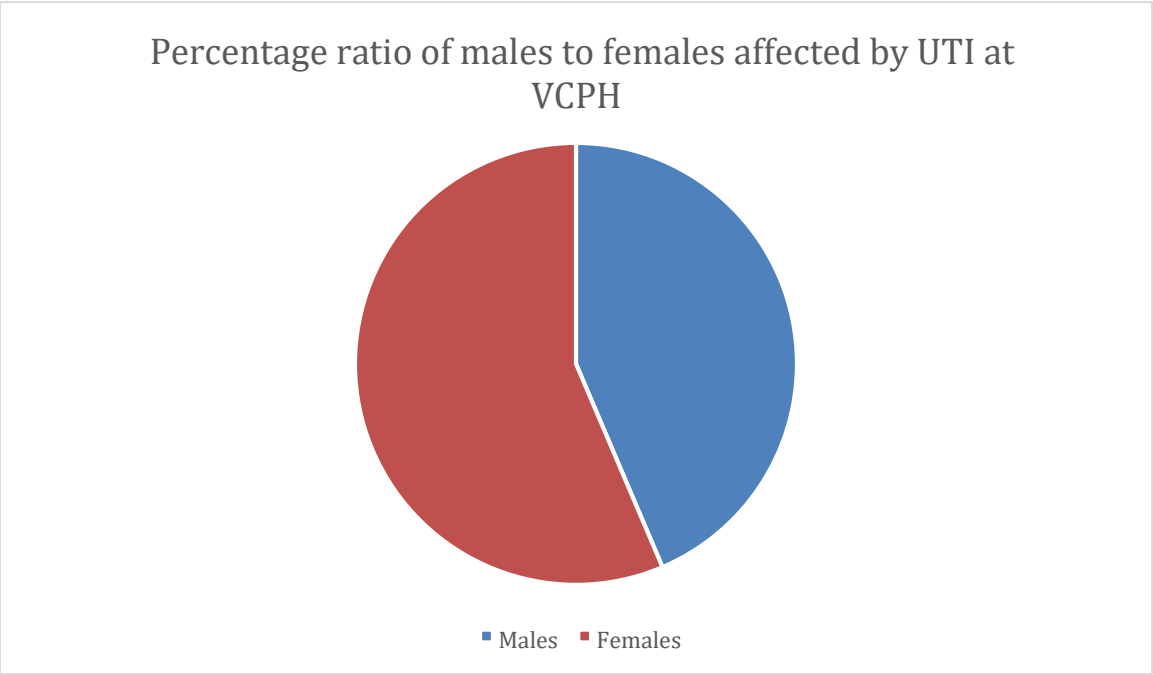

Figure 2 shows percentage ratio of females to males affected by urinary tract infections at Victoria Chitepo Provincial Hospital in 2023.

4.2.2 Most demographic group affected by UTIs at Victoria Chitepo Provincial Hospital in relation to most affected age group

The age groups of the participants were split into groups of ten years and calculated according to those age groups. In the 0 to 9 group, a total of 64 participants were recorded to have had a UTI which was 16.6% of the sample size. The 10 to 19 group had 37 positive cultures which was 9.6%. The 20 to 29 age group had 64 positive cultures which was 16.6%. The 30 to 39 age group had 61 UTI cases, which was 15.8%. The 40 to 49 age group had 37 cases which was 9.6%. Group 50 to 59 years had 43 cases which was 11.2%. The 60 to 69 age group had 27cases which 7% and the last group was the 70+ age group which had 52 cases which made up for 13.5% of the total cases.

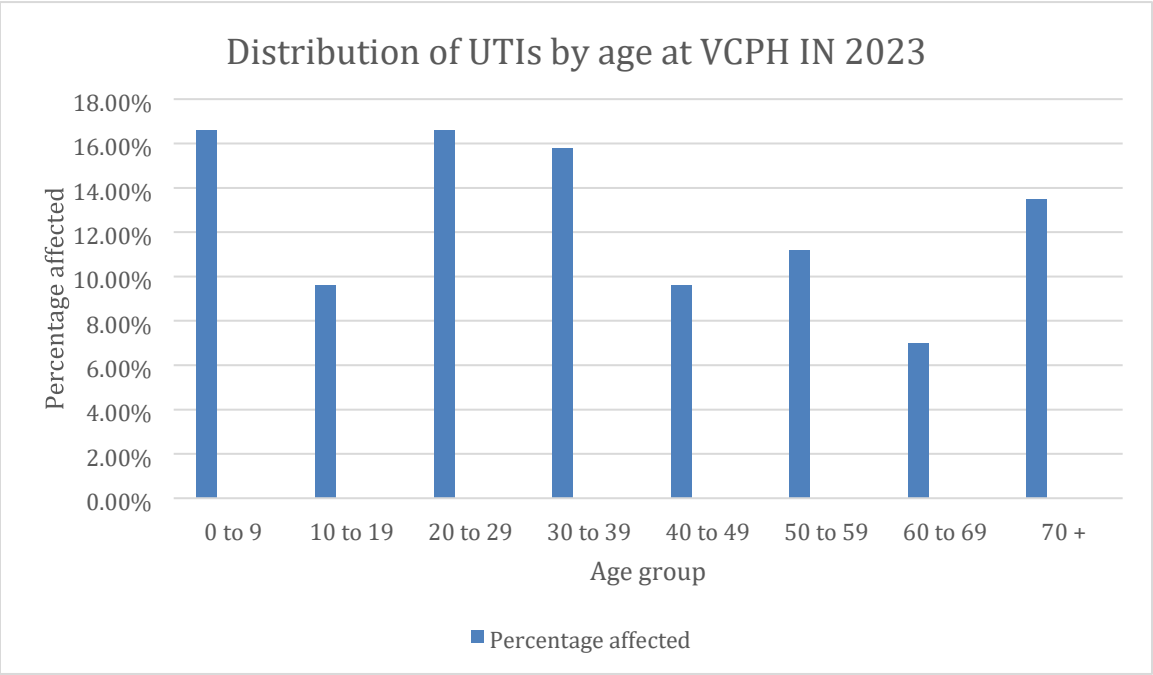

Figure 3 shows the distribution of urinary tract infection at VCPH by age in 2023

4.3 Pathogens causing Urinary Tract Infections at VCPH in 2023

The following pathogens were isolated; *E. coli* was the most prevalent bacteria, isolated on 105 cases and with a percentage of 27.2%. The next was *K. Pneumoniae* isolated on a total of 71 cases and a percentage of 18.4%. *Enterobacter spp* were also isolated with 47 cases and a prevalence of 12.2%. *Staphylococcus species* was isolated and speciated and coagulase negative staphylococcus, *S. Saprophyticus* the more prevalent species with *S. Saprophyticus* having 57 cases and *S. aureus* having 10 cases. In total, staphylococcus spp had 67 cases and a percentage of 17.4%. There were 30 cases of *Pseudomonas spp* which contributed to 7.7%, 33 cases of *Streptococcus spp* which was 8.6%, 23 cases of *Proteus spp* which was 6% and 9 cases of *N. gonorrhoeae* which amounted to 2.3%.

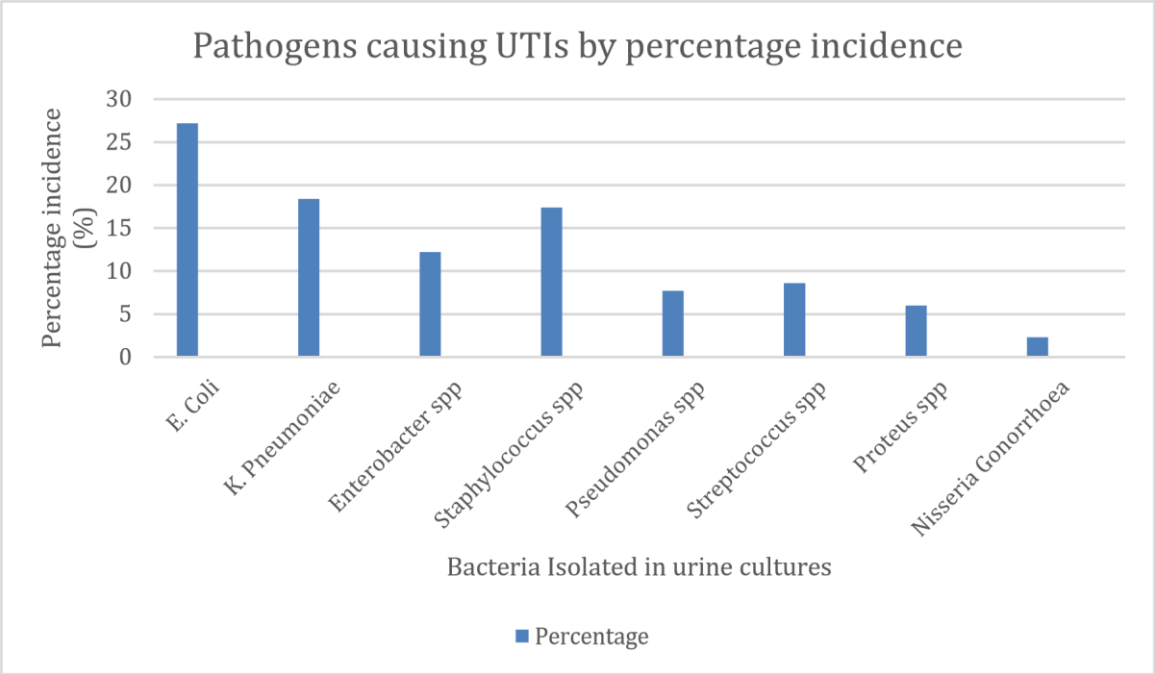

Figure 4 above shows the isolated pathogens by their percentage

4.4 Antimicrobial susceptibility patterns of most prevalent isolated pathogens

In the study, the most prevalent pathogens were E. coli (27.2%). K. Pneumoniae, (18.4%), Staphylococcus spp (17.4%) and Enterobacter spp (12.2%). Antimicrobial Susceptibility Testing for these was recorded to determine the resistance and susceptibility patterns of these patterns.

4.4.1 Antimicrobial susceptibility patterns of *E. coli*

The AST results for the 105 isolates found to be *E. coli* were as follows:

Table 1 shows AST results for E. coli

DRUG	**NOR**	**DOX**	**GM**	**NA**	**CIP**	**ATH**	**CRO**	**C**
Sensitivity	51	14	74	28	20	70	25	98
Resistance	54	91	31	77	85	35	80	7

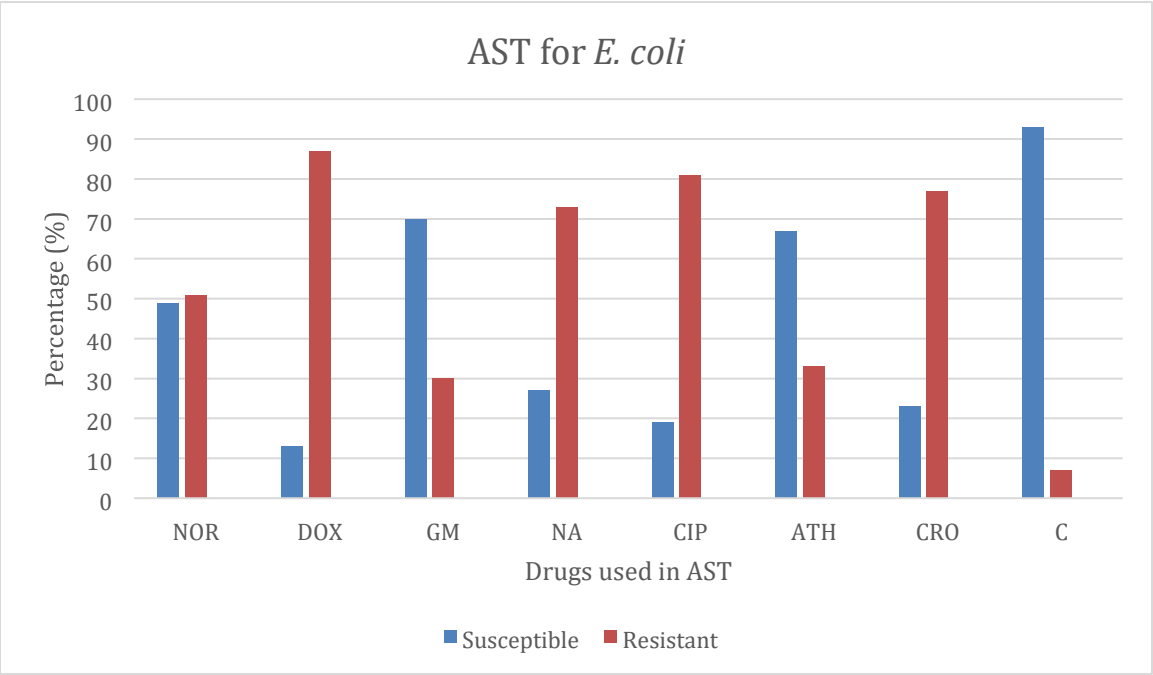

Figure 5 shows AST results of E. coli by percentage susceptibility and resistance

4.4.2 Antimicrobial susceptibility patterns of *K. Pneumoniae*

The results of antimicrobial susceptibility testing on the 71 isolates of *K. pneumoniae* are as follows

Table 2 shows K. pneumoniae AST results

DRUG	NOR	DOX	GM	NA	CIP	ATH	CRO	C
SENSITIVITY	41	20	44	14	20	30	50	9
RESISTANCE	30	51	27	57	51	41	21	62

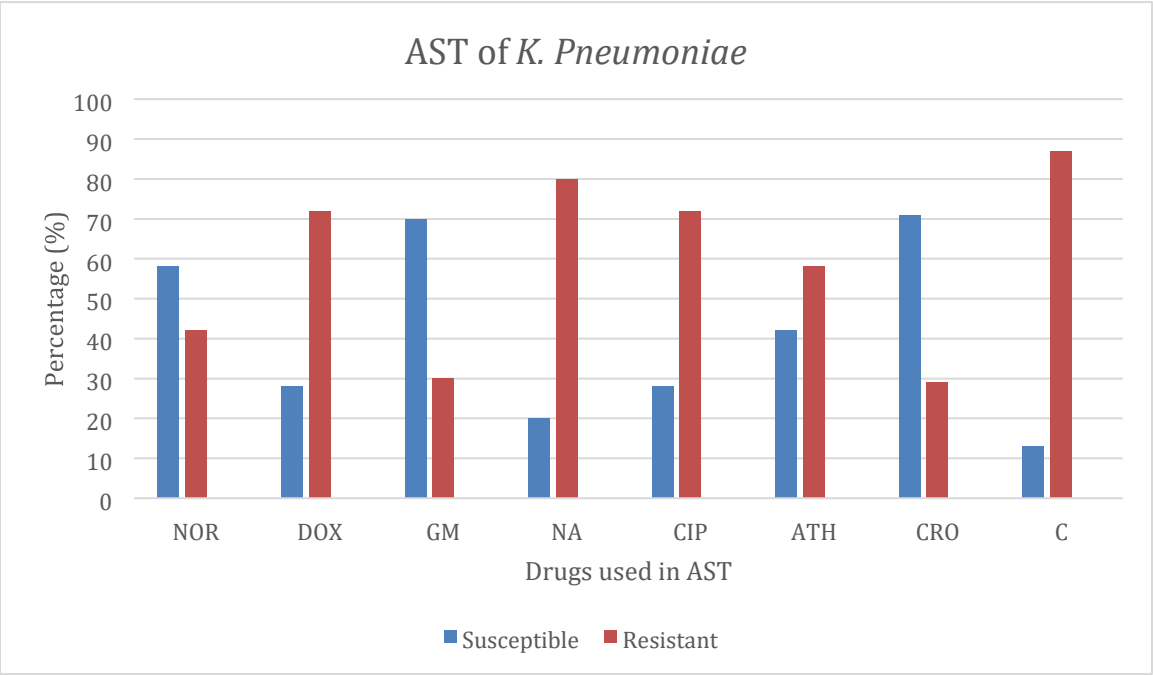

Figure 6 shows AST results of K. Pneumoniae by percentage of susceptibility and resistance

4.4.3 Antimicrobial susceptibility patterns of *Staphylococcus spp*

The *Staphylococcus spp* results for the AST in terms of number of sensed and resisted isolates of the total 67 are as follows:

Table 3 shows AST results for Staphylococcus spp

DRUG	NOR	DOX	GM	NA	CIP	CD	PG	AMP	AUG
SENSETIVITY	10	17	32	0	18	60	17	67	61
RESISTANCE	57	50	35	67	49	7	50	0	6

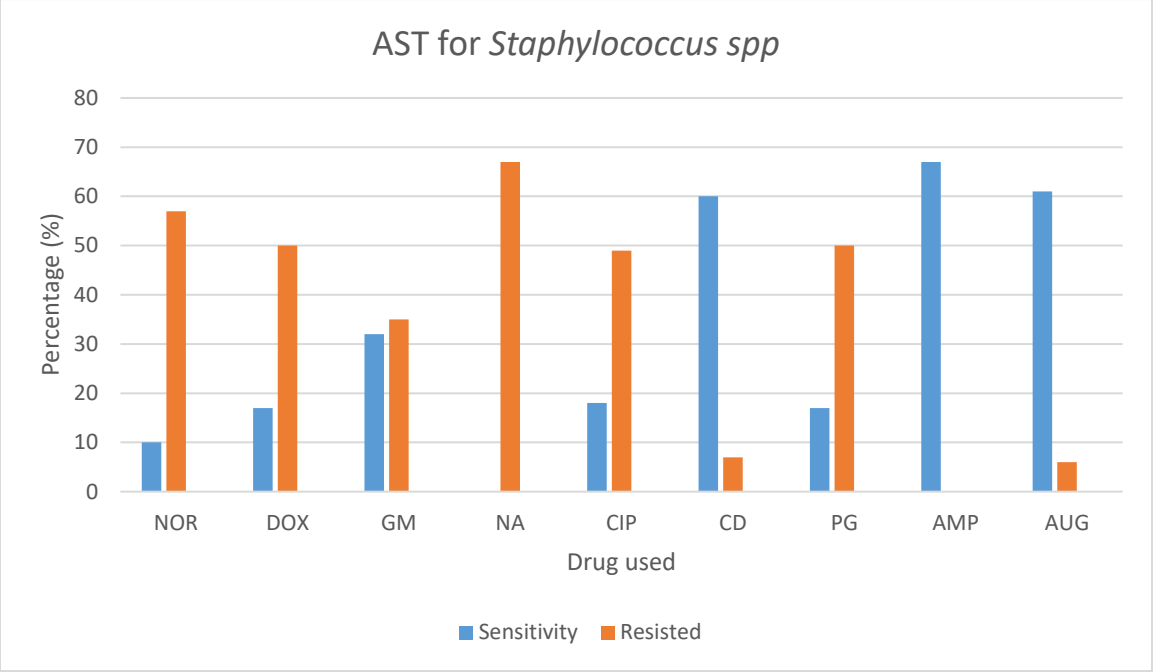

Figure 7 shows the AST results for Staphylococcus spp by percentage of susceptibility and resistance.

4.4.4 Antimicrobial susceptibility patterns of *Enterobacter spp*

AST was carried out on the 47 *Enterobacter spp* isolates and the results were as follows:

Table 4 shows the AST results of Enterobacter spp

DRUG	NOR	DOX	GM	NA	CIP	ATH	CRO	C
SENSETIVITY	30	10	31	10	14	31	23	31
RESISTANCE	17	37	16	37	33	16	24	16

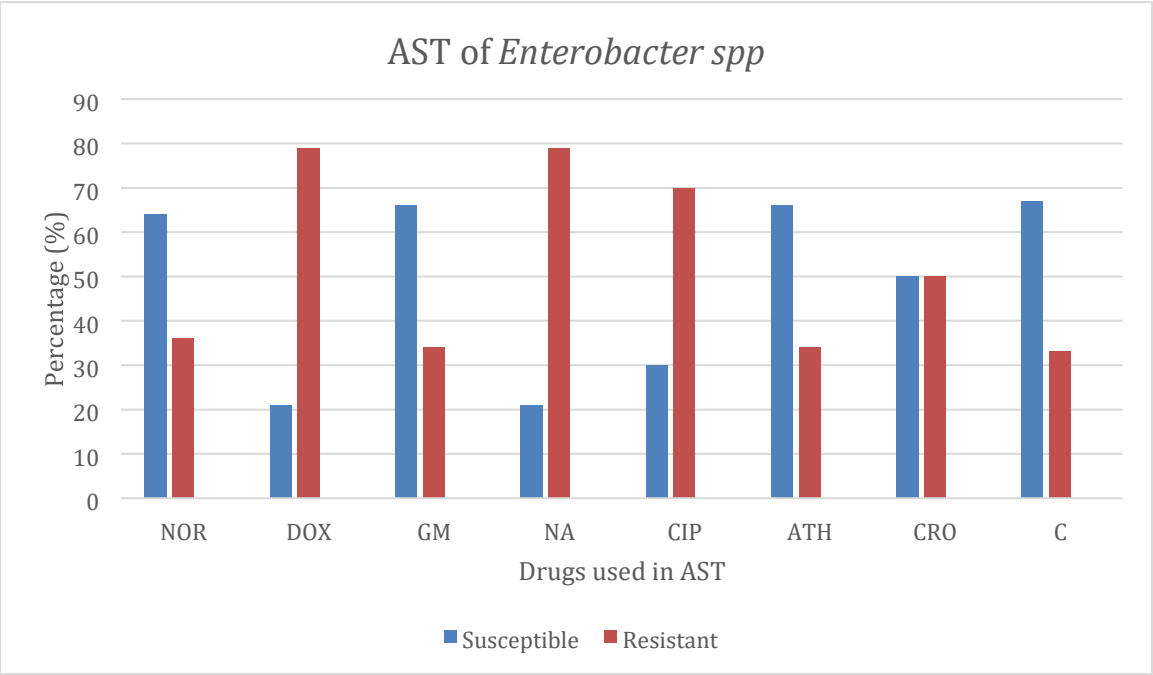

Figure 8 shows AST results for Enterobacter spp by percentage of susceptibility and resistance

CHAPTER 5: DISCUSSION, RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

This chapter presents discussions that have been drawn from the findings shown in the previous chapter. The discussion will also compare the findings of this research with findings from similar researches that have been conducted. This chapter also provides the general conclusion of this research and the recommendations that would be beneficial to the medical community

5.2 Most demographic group affected by UTIs

In this study, the most demographic group affected by UTIs in relation to gender were females where of the 385 participants, 217 were females, being 56.4% while there were 168 males giving 43.6%. As this is a descriptive study, inferences are not being made. However, this can be random or other possible reasons for this can be due to the different anatomical features between men and women. Females have a shorter urethra than men as well as having a shorter distance from the urethral opening to the rectal opening. Hormonal factors such as well such as estrogen affect the vaginal flora also makes women more prone to infections. A study by (Alghoraibi H. et al., 2023) has similar results with his study having 60.4% of UTI patients being female while 39.6% are male. He attributes the female anatomy as of the causes for the difference. Another study done in the Midwest by (Goedken A. et al., 2023) also confirms these results with a much higher difference. She brings to the floor the possible idea of prophylaxis to individuals who get recurrent UTIs.

As for the most demographic group affected by UTI infections, based on the finding of this research, it was noted that the pediatrics and young adults, age groups 0 to 9 and 20 to 29 had the

highest prevalence of UTIs with 16.6 percent each. This result in pediatrics can be attributed to febrile urinary tract infections which involves the kidneys are common in children, supported by (Hewitt I. A. et al., 2023). It can also be contributed to the younger children with developing immune systems. It can also be attributed to children as they are still learning some of the habits such as correct wiping after passing stool, holding in urine for long period of time. As for the 20 to 29 age group, as it is closely followed by the 30 to 39 age group which is 15.8% of the cases, there is high association with these two age groups being the most sexually active and hence they get more affected with UTIs. A study done by (Goedken A. et al., 2023) confirms this theory.

5.3 Pathogens causing Urinary Tract Infections at VCPH laboratory in 2023.

According to the data obtained in this study. Pathogens causing urinary tract infections at VCPH were and their frequency of isolation were *E. coli* (27.2%), *K pneumoniae* (18.4%), *Enterobacter spp* (12.2%), *Staphylococcus species*, (17.4%), *Pseudomonas spp* (7.7%), *Streptococcus spp* (8.6%), *Proteus spp* (6%) and *N. gonorrhoeae* (2.3%). *E. coli* being the frequent isolate can be attributed to it being a normal gut bacterium in adults. Due to this, it is highly likely that due to a shorter distance between the anus and urethral opening in females, this can be a cause of disease. Incorrect wiping after passing of stools another way by which *E. Coli* is spread into the urinary tract and this is a cause of infection. *K. Pneumoniae* is the second most frequently isolated pathogen. Studies done in 14 African countries by Tansarli et al., (2013) support this finding where these two are the most isolated pathogens in urinary tract infections. This is also confirmed in an Ethiopian study done by Fenta et al., (2020). *Staphylococcus spp* was isolated and mostly the coagulase negative, *S. saprophyticus* was more frequent that *S. aureus. S. aureus* is generally not commonly found as a urinary tract pathogen as compared to *S. saprophyticus* which is similar to the study done in Nigeria by Ekwealor et al., (2016). The rest of the other pathogens are common

to the urinary tract as seen in various studies such as in the studies by (Mukapa et al., 2022) and Mazzariol et al., (2017). Of interest, *N. gonorrhoeae* was isolated the least frequently possible because it is causes a sexually transmitted infection and it entering into the urinary tract to cause a UTI would be as the result of a complication of the otherwise localized and treatable sexually transmitted infection.

5.4 Antimicrobial Susceptibility Patterns of most prevalent pathogens isolated

Based on the data that has been presented, *E. coli* was the most prevalent pathogen that was isolated and it was most susceptible to Chloramphenicol (93%) and Gentamicin (70%). The most resistance was shown to ciprofloxacin and Doxycycline. There was also High resistance to Nalidixic acid. According to a study by Smith et al. (2019), *E. coli* isolates shows high levels of resistance to fluoroquinolones in certain regions. This is confirmed by the high resistance seen to ciprofloxacin. Norfloxacin being another floroquinolone shows high resistance to more than half of the *E.coli* isolates. Another study by Johnson et al. (2020) reports increasing resistance of *E. coli* to thirdgeneration cephalosporins. The only tried generation cephalosporin that was tested for was Ceftriaxone and the resistance shown by *E. coli* is high which confirms what other studies say. For *K. Pneumoniae*, there is high susceptibility to Gentamicin, Ceftriaxone and Nofloxacin. The high resistance is shown to Ciprofloxacin, chloramphenicol, nalidixic acid and Doxycycline. These resistance patterns are similar to a study done by Patel et al., (2020). A different study by Lee et al., 2018 shows increasing Carbapenem resistance of Klebsiella species but unfortunately, there were no carbapenem antibiotics classes among the AST drugs to relate to that theory.

With *Staphylococcus spp*, there was 100% susceptibility to Ampicilin and high susceptibility to Augmentin, Clindamycin and Gentamicin. High resistance was observed with Nalidixic acid, Norfloxacin, Doxycycline, Penicillin G and Ciprofloxacin. According to studies by Hsu et al.

(2019) and Tacconelli et al. (2018), Staphylococcus strains have exhibited resistance to commonly used antibiotics such as methicillin, penicillin, and erythromycin. Additionally, the emergence of methicillin-resistant *Staphylococcus aureus* (MRSA) strains has further complicated treatment options, as these strains are often resistant to multiple classes of antibiotics, including beta-lactams, macrolides, and fluoroquinolones (Tacconelli et al., 2018). Furthermore, *Coagulase-Negative Staphylococcus* species, although often considered less pathogenic, have also demonstrated increasing resistance to antibiotics commonly used in clinical practice. Studies by Miragaia et al. (2017) and Becker et al. (2018) have highlighted the emergence of multidrug-resistant coagulasenegative Staphylococcus strains, posing challenges in the management of infections, particularly in frequent infections such as UTI's which can be nosochom8al during to indwelling catheters.

As for the *Enterobacter spp*, it was most susceptible to Gentamicin. Azithromycin, Choramphenicol and Norfloxacin. The resistance was high to Doxycycline, Nalidixic acid and Ciprofloxacin. Other studies concerning *Enterobacter spp* have shown that according to research by Doi et al. (2017) and Jean et al. (2016), *Enterobacter spp* commonly exhibit resistance to multiple antibiotics, including beta-lactams, fluoroquinolones, and aminoglycosides. This is shown in this study in the case of high ciprofloxacin resistance. *Enterobacter spp* frequently demonstrate resistance to certain antibiotic classes, including third-generation cephalosporins, fluoroquinolones, and extended-spectrum beta-lactams. One study says that resistance can be mediated by various mechanisms, such as the production of extended-spectrum beta-lactamases (ESBLs), AmpC beta-lactamases, and carbapenemases (Jean et al., 2016).

In accordance with the susceptibility patterns, most authors talk about it referring to the resistance patterns of the pathogens. This is because back before AMR became a problem in the health set up, pathogens were susceptible to most, if not all antibiotics but as resistance goes up, patterns are

now being judged by which antibiotics are being resisted more rather than focus on which antibiotics do the pathogens still respond to.

5.5 Limitations of the study

The study carried out was a retrospective study. The data used was not specific to this study on antimicrobial resistance. The scope of antibiotics used in the AST was not all the drugs but just those that were available at VCPH at the time of this study and hence the resistance patterns could come out looking different had the study been conducted at another laboratory with a broader choice of AST antibiotics. The study also only focused on UTI caused by pathogenic bacteria and excluded parasitic infections of the urinary tract such as S. haematobium cases. Also, because the study was a retrospective one and not focusing on real time results, one could not fully differentiate at times whether they were lower urinary tract infections or upper urinary tract infections just based on the results.

5.6 Conclusion

The study was to identify prevalence or urinary tract infection as well as to find out the antimicrobial resistance patterns of isolated uropathogens. The antimicrobial resistance patterns were high with some uropathogens not recording a 100% susceptibility for any antibiotics that were used but the rate was low. The high antibiotic resistance is a cause of concern. There is high usage of antibiotics and this has brought about resistance. Most affected gender was the female gender and the most affected were the pediatrics and young adults and the middle aged.

5.7 Recommendations

1) Measures should be put in place by the government such that no antibiotics are issued out without laboratory testing.
2) There needs to be improvement in technology and machinery that can speed up process of bacterial isolation as the turnaround time for urine results is an upwards of three days and physicians might feel it is too long to wait and begin treatment post the laboratory results.

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APPENDIX

Appendix A: Timetable

Table 5 shows the activities done and the time they were done.

Activity	Jan	Feb	March	April	May
Identification and submission of research topic					
Research proposal writing					
Submission of research proposal					
Data Collection					
Data Entry and Analysis					
Report Writing					
Submission of dissertation					

Appendix B: Budget

Table 6 shows the budget

Item	*Cost (US$)*
Printing and Binding	20
Communication costs	10

Stationary	10
Transport	20
Total	60

Appendix C: Data collection table

Table 7 shows the outline that was used to collect data from VCPHL

Participants	*Sex*	*Age*	*Uropathogens*	*Antibiotics used for AMS testing*				
				1	*2*	*3*	*4*	*5…*
00								
01								

Appendix D: Approval letter from Supervisor

AFRICA UNIVERSITY
A United Methodist-Related Institution

Investing in Africa's Future

COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

P.O. BOX 1320, MUTARE, ZIMBABWE – Cell: (+263) 780079459 E
MAIL: salissoum@africau.edu,

12, March, 2024

To whom it my concern

Dear Sir

Re: Permission to submit to AUREC for MUFARO MANYAWU

Program: Bachelor of Medical Laboratory Sciences

This letter serves to confirm that I have supervised the above mentioned student and she has satisfied all the requirements of the college and she is ready in conducting research on

Antimicrobial Resistance Patterns of Urinary Tract Infection Pathogens at Victoria Chitepo Provincial Hospital Laboratory from January to December 2023

Your facilitation is greatly appreciated

Thank you

Research Supervisor:
Dr Maibouge T.M.Salissou PhD
Endowed Chair of Pathology CHANS Africa University
Phone 0780079459
Email: salissoum@africau.edu
Website: Maibouge T. M. Salissou – Africa University
Po Box 1320

Appendix E: Letter requesting study site approval

6 Rekai Tangwena
Morningside
Mutare

24 February 2024

The Medical Superintendent
Victoria Chitepo Provincial Hospital
P. O. Box 30
Mutare

Dear Madam

RE: REQUESTING PERMISSION TO CARRY OUT RESEARCH ON ANTIMICROBIAL SUSCEPTIBILITY PATTERNS OF UROPATHOGENS AT YOUR HOSPITAL

I am writing to you requesting permission to carry out research at your hospital.

My name is Mufaro Manyawu, a final year student at Africa University studying Medical Laboratory Sciences. The topic of the research is Antimicrobial Susceptibility Patterns of Urinary Tract bacteria isolated at Victoria Chitepo Provincial Hospital Laboratory from January to December 2023. This research project is to be submitted in partial fulfillment of the Bachelor of Medical Laboratory Sciences Honours Degree in the College of Health, Agriculture and Natural Sciences at Africa University. Your approval letter is crucial as it is required by the university ethics review board, AUREC. The data collected at your institution will be used for academic purposes.
Thank you in advance.

Yours sincerely

Mufaro Manyawu

Appendix F: Study site approval

Telephone: 263-020-64321
Fax: +263-020-67048
E-mail:mphosp@syscom.co.zw

ZIMBABWE

Reference:

Victoria Chitepo Provincial Hospital
P.O. Box 30
Mutare
MANICALAND
ZIMBABWE

11 March 2024

Att: Ms Manyau Mufaro
Victoria Chitepo Provincial Hospital
Po Box 30
Mutare

Re: PERMISSION TO CARRY OUT A RESEARCH STUDY ON ANTIMICROBIAL SUSCEPTIBILITY PATTERNS OF UROPATHOGENS AT VICTORIA CHITEPO PROVINCIAL HOSPITAL

In reference to the above subject matter:

I have no objection to your request.

You can go ahead with your research.

Hope you will find this institution helpful in your research.

DR H. Makiwa
ACTING MEDICAL SUPERINTENDENT

VICTORIA CHITEPO PROVINCIAL HOSPITAL
MEDICAL SUPERINTENDENT
14 MAR 2024
P.O. BOX 30, MUTARE
ZIMBABWE

Appendix G: 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: AU3202/24

20 March, 2024

MUFARO MANYAWU
C/O Africa University
Box 1320
MUTARE

RE: **ANTIMICROBIAL RESISTANCE PATTERNS OF URINARY TRACT INFECTION PATHOGENS AT VICTORIA CHITEPO PROVINCIAL HOSPITAL LABORATORY FROM JANUARY TO DECEMBER 2023**

Thank you for the above-titled proposal that 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** AUREC3202/24
  This number should be used on all correspondences, consent forms, and appropriate documents.
- **AUREC MEETING DATE** NA
- **APPROVAL DATE** March 20, 2024
- **EXPIRATION DATE** March 20, 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