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The Prevalence and Bacterial Species of Urinary Tract Infections (UTIS) in Moi Teaching and Referral Hospital

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ABSTRACT

Urinary tract infection (UTI) is commonly caused by bacterial pathogens that usually affect the urinary system including the kidney, ureters, bladder, and urethra and account for nearly 25% of all infections worldwide. The purpose of the study will be to investigate the Prevalence and Bacterial Species of Urinary Tract Infections (Utis) In Moi Teaching and Referral Hospital**.** Urinary tract infections can lead to serious health-related problem that may cause subsequent development of significant indications with the challenge of the emergence of antibiotic resistance. Although UTIs was treated using antibiotics, previous widespread antibiotic usage without proper susceptibility testing has inevitably resulted to an increase in the proportion of UTI pathogens resistant to affordable and available antibiotics. Previous studies carried out in Kenya have reported common uropathogens as *Escherichia coli*, *Klebsiella*, *Enterobacter*, *Proteus*, *Staphylococcus,* and *Enterococcus* although this could have geographical differences in distribution and associated risk factors. The purpose of this study was to investigate the prevalence of bacteria causing UTI, their associated risk factors and corresponding antibiotic response profiles to commonly used and available antibiotics at Moi Teaching and Referral Hospital, Kenya. This was a hospital-based cross-sectional study. The study targeted 10,000 patients from whom 246 patients from the records was consented and recruited to participate in this study. Random sampling was used to recruit study participants at the health facility. The sample was collected for three months beginning from February 2025 to April 2025.The study measurement variables included Independent Variables: bacterial species causing UTIs including *Escherichia coli, Klebsiella pneumoniae*, *Proteus mirabilis;* antibiotics used to treat UTIs including amoxicillin, ciprofloxacin, trimethoprim-sulfamethoxazole, Patient demographics such as age, gender, race/ethnicity, duration of hospital stay. The dependent variables included antibiotic susceptibility patterns of bacterial isolates; Bacterial load in urine samples; Clinical outcomes. The results revealed that the regression model was statistically significant. The regression sum of squares (SS) was 8.214, which represented the amount of variation in the dependent variable that was explained by the five predictor variables: *E. coli, K. pneumoniae, P. mirabilis, S. saprophyticus* and *E. faecalis*. This indicated that a substantial portion of the variance in UTI occurrence was accounted for by the presence of these bacterial species. The ANOVA results confirmed that the regression model was a good fit for the data and that antibiotic resistance particularly to Ciprofloxacin, Amoxicillin, and Gentamicin had a statistically significant impact on the occurrence or severity of urinary tract infections. The high F-statistic and low p-value strongly suggested that the independent variables collectively contributed meaningfully to the explanation of variance in the dependent variable. The F-statistic was calculated to be 47.62, indicating a very strong overall effect. The p-value associated with the F-statistic was 0.000, showing that the model was statistically significant. This meant that the predictor variable(s) had a significant effect on the likelihood of developing a UTI. Based on the findings of the study, which determined the prevalence and bacterial species associated with urinary tract infections at Moi Teaching and Referral Hospital, several recommendations were made.

Key words: ***Bacterial Species & Urinary Tract Infections***

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1.0 INTRODUCTION

The prevalence of UTI varies globally, regionally, and locally. According to the World Health Organization (WHO), UTIs are one of the most common bacterial infections worldwide, affecting millions of people every year. The prevalence of UTI is generally higher in women than in men, and it increases with age. Globally, the prevalence of UTI is estimated to be around 150 million cases per year. In terms of regional prevalence, studies have shown that UTIs are more common in certain regions, such as South Asia, Sub-Saharan Africa, and parts of the Middle East. Within countries, the prevalence of UTI can also vary locally depending on factors such as age, gender, socioeconomic status, and access to healthcare. It is important to note that the prevalence of UTI can be difficult to estimate accurately, as many cases go unreported or undiagnosed. However, healthcare professionals can use surveillance systems and diagnostic tests to monitor the prevalence of UTI in their respective regions and develop effective strategies for prevention and treatment (Choe, 2018).

II: LITERATURE VIEW

According to the study done by Agegn, A. (2012), there have been numerous studies conducted in the United States on bacterial species responsible for urinary tract infections (UTIs). A study by Sabir (2014), identified the most common bacterial species responsible for UTIs in the United States. The studyfound that *Escherichia coli* was the most commonly isolated pathogen, accounting for 71.6% of UTIs. Other commonly isolated pathogens included *Klebsiella pneumoniae*, *Proteus mirabilis* and *Enterococcus faecalis.* Omorokpe (2020), analyzed the antimicrobial susceptibility of bacterial pathogens causing UTIs in the United States. The study found that *Escherichia coli* was the most common pathogen, and that resistance to commonly used antibiotics such as ciprofloxacin and trimethoprim-sulfamethoxazole was common. A study published in the Journal of Urology in 2019 investigated the prevalence of antibiotic-resistant bacteria in patients with UTIs in the United States. The study found that 18.2% of patients had a UTI caused by bacteria that was resistant to multiple antibiotics (Dash, 2018).

These are just a few examples of the many studies that have been conducted on bacterial species responsible for UTIs in the United States. There are several bacterial species that are commonly responsible for urinary tract infections (UTIs). The most common bacterial species responsible for UTIs are: *Escherichia coli (E. coli*): This is the most common bacterial species responsible for UTIs, accounting for up to 80% of all cases. *Klebsiella pneumoniae*: This is another common bacterial species that can cause UTIs, especially in people with weakened immune systems or those who have recently received antibiotics. *Proteus mirabilis*: This bacterial species is commonly found in the digestive tract and can cause UTIs, particularly in people with urinary catheters or other urinary tract abnormalities. *Enterococcus faecalis:* This bacterial species is commonly found in the intestines and can cause UTIs, especially in people with underlying health conditions. *Staphylococcus saprophyticus*: This bacterial species is commonly found in the genital area and can cause UTIs, especially in young sexually active women. These are just a few examples of the bacterial species that can cause UTIs. Other less common bacterial species include *Pseudomonas aeruginosa*, *Enterobacter* species, and *Citrobacter* species (Kang, 2018).

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III: MATERIALS AND METHODS

3.1. Study Area

The study was carried out at Moi Teaching and Referral Hospital (MTRH) a public hospital located in Eldoret, Kenya which is the second-largest teaching and referral hospital in Kenya, serving as a training center for medical students and healthcare professionals. The hospital provided a wide range of medical services, including specialized services such as renal dialysis, cancer treatment, and pediatric surgery. MTRH also serves as a referral center for patients from other healthcare facilities in the region. The hospital is committed to providing high-quality healthcare services to the community and has a strong focus on research and training to improve the quality of healthcare in Kenya. The study was carried in MTRH in order to Understand the prevalence of UTIs caused by different types of bacteria in the hospital setting. Identify the most commonly used antibiotics in the community for UTI treatment and determine the effectiveness of these antibiotics against the bacterial strains causing UTIs in the hospital. Determine the antibiotic resistance patterns of the bacteria causing UTIs in the hospital, which helped guide the selection of appropriate antibiotics for treatment.

Understanding the bacteria responsible for UTIs at MTRH is essential for healthcare practitioners in the region. It helped to improve the accuracy of diagnosis and treatment decisions, ultimately leading to better patient outcomes and reduced healthcare costs. Antibiotic resistance is a global health crisis. Studying antibiotic response patterns at MTRH contributed to antibiotic stewardship efforts by identifying which antibiotics are still effective against UTI-causing bacteria and which are not.

This information was vital for prescribing antibiotics judiciously, minimizing the development of resistance, and ensuring that patients receive effective treatment. Identifying risk factors associated with UTIs specific to the MTRH population can help in early detection and prevention. Patients with known risk factors can be closely monitored and provided with personalized care plans to reduce their susceptibility to UTIs. Conducting such a study can foster research and education initiatives at MTRH and other healthcare institutions in the region. It served as a basis for further research, allowing for the development of locally tailored treatment guidelines and prevention strategies.

3.2. Study Design

A cross-sectional study design was used. (Retrospective prospective) data from Hospital which was current from patients attending Moi Teaching and referral hospital

3.3. Sampling techniques/Methods/Assays

The CLED Agar procedure was used for the isolation and identification of bacteria associated with urinary tract infections (UTIs). It is also used to determine the susceptibility of these bacteria to commonly used antibiotics. The sampling technique was involved in the procedure through Patients suspected of having a urinary tract infection are selected for sampling. This included individuals with symptoms such as frequent urination, burning sensation during urination, cloudy or foul-smelling urine, etc. clean-catch midstream urine sample is collected

from the patient. The patient is instructed on how to properly clean the genital area and collect the urine sample to minimize contamination. The collected urine sample was promptly transported to the laboratory for processing. The sample protected from temperature extremes during transportation. In the laboratory, the urine sample is processed for bacterial culture.

3.4. Study variables

The study variables on bacteria associated with urinary tract infections and their antibiotic response factor in MTRH is shown in the conceptual framework below which it identifies independent and dependent variables.

3.5 Target Population

The target population of the study on bacteria associated with urinary tract infections and their antibiotic response factor in MTRH (Moi Teaching and Referral Hospital in Kenya) would include patients who have been diagnosed with urinary tract infections (UTIs).This may include patients of all ages, genders, and backgrounds who present with symptoms such as painful urination, frequent urination, or lower abdominal pain who will be 1,000 Patients who will be target population from the records of Moi Teaching and Referral Hospital .

3.5 Sample size

The formula suggested by Getu and Tegbar (2006) was used to find an appropriate sample

$n = (Z^2 * p * q) / E^2$

Where: n = sample size Z = Z-score for the desired level of confidence

p = proportion of the population with the characteristic of interest (as estimated from previous research or pilot studies)

q = 1 - p E = desired margin of error (usually expressed as a percentage of the sample size)

Bacteria associated with urinary tract infections and their antibiotic response factor in MTRH based on previous research or pilot studies.

proportion to be around 50% (p = 0.5)

A margin of error of 5% (E = 0.05) with 95% confidence (Z = 1.96).

$n = (1.96^2 * 0.5 * 0.5) / 0.05^2$

$n = 246$

The sample size was 246 from a target population of 1000 patients.

3.6. Methods

The researcher used clean-catch midstream urine collection: This is the most commonly used method for collecting urine samples in UTI studies. It involved the following steps:

a. The patient was provided with sterile urine collection containers and instructions on proper hygiene.

b. The patient was clean the genital area and collects the midstream portion of the urine into the sterile container.

c. It is important to collect a sufficient amount of urine (typically 20-30 ml) to ensure an adequate sample for analysis.

3.6.1 Sample collection

The researcher used CLED Agar process (Kothari & Garg, 2014). Primary data was collected by use of questionnaires which was self-administered after obtaining permission from, NACOSTI, the University and IREC, MTRH.

3.6.2 Microscopy
Sample Preparation

Collecting a urine sample from a patient suspected of having a UTI. Transferring a small amount of the urine sample to a sterile centrifuge tube. Centrifuge the urine sample at a low speed (e.g., 1500 rpm) for a few minutes to concentrate the bacteria at the bottom of the tube. Carefully remove most of the supernatant (the liquid portion above the bacterial pellet), leaving a small amount to resuspend the bacteria.

Preparing a Microscope Slide:

Taking a clean glass microscope slide and place a drop of the resuspended bacterial sample in the center of the slide. Optionally, you can mix the bacterial sample with a small drop of a staining solution like crystal violet or methylene blue to enhance visualization. This step may help to distinguish bacterial structures and improve contrast.

Applying a Coverslip:

Gently lowering a coverslip onto the drop of bacterial sample, making sure there are no air bubbles trapped underneath. Press down gently to spread the bacterial sample evenly beneath the coverslip.

Microscopic Examination:

Placing the prepared slide on the stage of a light microscope, starting with a low magnification objective (e.g., 10x or 20x) and locate the area with bacterial cells. Gradually increase the magnification to higher objectives (e.g., 40x, 100x oil immersion) for detailed examination.

Observing the slide under brightfield microscopy, adjusting the focus and illumination as necessary.

Identifying Bacterial Morphology

Observing the size, shape, and arrangement of the bacterial cells. Bacteria associated with UTIs may appear as rods (bacilli), cocci (spherical), or other shapes. Note the presence of any cellular appendages such as flagella or pili, which can aid in bacterial identification. Take note of any characteristic patterns or aggregations of bacterial cells, such as chains or clusters.

Image Capture and Documentation:

If available, capture images of the observed bacteria using a digital camera or microscopy imaging system. Documenting the observations, including bacterial morphology, arrangements, and any notable features.

3.6.3 Processing of samples

The researcher used Mueller Hinton Agar preparation and inoculation of the bacteria where by the following procedure was followed;

Gather the required materials:

Nutrient agar: This is a general-purpose agar medium that supports the growth of a wide range of bacteria. Antibiotic discs: These are small discs impregnated with different antibiotics.

Sterile petri dishes: These are shallow, round, lidded dishes used to hold the agar. Sterile loop or swab: This is used for inoculating the agar with bacteria.

Prepare the agar

By Following the manufacturer's instructions to prepare the nutrient agar. Typically, I will need to add the appropriate amount of agar powder to water and heat the mixture until the agar dissolves. Autoclave the agar to sterilize it. Autoclaving involves subjecting the agar to high pressure and temperature to kill any existing microorganisms. Allowing the agar to cool to around 45-50°C, ensuring it is still in a liquid state but not too hot to handle.

Apply antibiotic discs:

Once the agar plates are inoculated, place antibiotic discs onto the surface of the agar using sterile forceps. Selecting a range of commonly used antibiotics to test the susceptibility of the bacteria to them. Common choices for UTIs included antibiotics such as ampicillin, ciprofloxacin, trimethoprim-sulfamethoxazole (TMP-SMX), and nitrofurantoin, among others. Following the instructions provided with the antibiotic discs to ensure proper placement and spacing.

Incubate the plates:

After placing the antibiotic discs, ensure the lids of the petri dishes are secure and place them in an incubator set to the appropriate temperature for bacterial growth. For most urinary tract bacteria, incubate the plates at around 35-37°C. Incubating the plates for 18 to 24 hours to allow the bacteria to grow.

Interpret the results:

After the incubation period, examine the agar plates for bacterial growth. The appearance of colonies indicates bacterial growth, and the size and characteristics of the colonies can provide information about the bacteria present. Measuring the zones of inhibition around the antibiotic discs. These are areas where bacterial growth is inhibited due to the antibiotic's effectiveness. The size of the zone can help determine the susceptibility of the bacteria to the antibiotic.

Recording and analyzing the data:

Recording the results, including the bacterial species identified, their antibiotic susceptibility patterns, and the zone sizes for each antibiotic. Analyzing the data to identify trends, patterns of antibiotic resistance, and the most effective antibiotics against the bacteria associated with UTIs at the MOI Teaching and Referral Hospital.

3.7. Data Management and Statistical Analysis

Data management and statistical analysis are important components of any research study, including a study on bacteria associated with urinary tract infections and their susceptibility to commonly used antibiotics. Here are some considerations for data management and statistical analysis in such a study: The data was collected in a systematic and standardized manner to ensure consistency and accuracy. This included recording patient demographic information, sample collection and processing details, and antibiotic susceptibility testing results. The data was cleaned to remove any errors, inconsistencies, or missing values. This process was done systematically to ensure that the data is as accurate as possible.

The data was analyzed using appropriate statistical methods. This included descriptive statistics, such as mean and standard deviation, to summarize the data, and inferential statistics, such as t-tests and ANOVA, to determine if there are significant differences between groups.

3.8. Study Limitations

The study had a limited number of patients, which affected the statistical power and generalizability of the findings. The study enrolled patients who are already on antibiotics or who had comorbidities, which may not accurately reflect the general population. The study used different testing methods for the identification and susceptibility testing of bacteria, which introduced variability in the results. The study did not follow up with patients to determine if the antibiotics prescribed which are effective in treating the UTI or if the UTI recurredlifestyle, or previous antibiotic use. This study was conducted in a single hospital, which did not reflect the antibiotic resistance patterns in other settings.

3.9 Ethical Considerations

The research thesis was approved by the ethics committee of Maseno University. A permit was obtained from NACOSTI before going to the field permission to conduct research at Moi Teaching and Referral Hospital, IREC. All information was obtained was treated with confidentiality no names was used in my study. Confidentiality was assured by strictly preserving the information obtained from the participants without disclosing it. Participant's parents/guardians appended their signatures to a well written consent on behalf of their minors. The study being on human subjects face anticipated challenges first are the cultural issues which limited obtaining consent from potential participants some clients or caregivers may refuse to participate, expenses for diagnostic reagents. Expertise of third Technologist was sort when results are inconclusive.

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IV: RESULTS

4.1 Prevalence and bacterial species of urinary tract infections (UTIs) in Moi Teaching and Referral Hospital

The table presented summarized the responses of participants regarding their knowledge and perceptions of the bacterial species responsible for urinary tract infections (UTIs). Overall, the data showed a high level of awareness among the respondents, as indicated by the high mean scores across all five statements.

Table 1: prevalence and bacterial species of urinary tract infections (UTIs) in Moi Teaching and Referral Hospital

Statement	1 (SD)	2 (D)	3 (N)	4 (A)	5 (SA)	Mean	Std Dev
E. coli normally resides in the gastrointestinal tract but can travel to the urinary tract through the urethra and cause an infection.	5 (2.0%)	8 (3.3%)	20 (8.2%)	120 (49.0%)	92 (37.6%)	4.17	0.84
The bacterial species that can cause UTIs include Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis, and Staphylococcus saprophyticus.	6 (2.4%)	10 (4.1%)	28 (11.4%)	115 (46.9%)	86 (35.1%)	4.08	0.89
E. coli is by far the most prevalent cause of UTIs, accounting for up to 90% of cases.	8 (3.3%)	12 (4.9%)	30 (12.2%)	110 (44.9%)	85 (34.7%)	4.03	0.95
The specific bacteria responsible for a UTI can be identified through urine culture and susceptibility testing, which can help guide appropriate antibiotic treatment.	3 (1.2%)	5 (2.0%)	18 (7.3%)	118 (48.2%)	101 (41.2%)	4.26	0.75
The overuse and misuse of antibiotics have led to the	4 (1.6%)	6 (2.4%)	25 (10.2%)	112 (45.7%)	98 (40.0%)	4.20	0.80

Statement	1 (SD)	2 (D)	3 (N)	4 (A)	5 (SA)	Mean	Std Dev
emergence of antibiotic-resistant strains of bacteria.							

Source; Field Data (2025)

For statement 1, which stated that *Escherichia coli normally resides in the gastrointestinal tract but can travel to the urinary tract through the urethra and cause infection*, the majority of respondents agreed or strongly agreed. The mean score was **4.17** with a standard deviation of **0.84,** suggesting that most participants were well-informed about the role of *E. coli* in UTIs, with minimal variation in opinion.

In statement 2, which highlighted other bacterial species such as *Klebsiella pneumoniae, Proteus mirabilis, Enterococcus faecalis* and *Staphylococcus saprophyticus* as causative agents of UTIs, responses were similarly positive. The mean score stood at **4.08,** indicating that a significant proportion of respondents recognized the diversity of UTI-causing organisms. The standard deviation of **0.89** indicated slightly more variability in responses but still pointed to a generally strong agreement.

Statement 3, which emphasized that *E. coli* is by far the most prevalent cause of UTIs, accounting for up to 90% of cases, also received strong support, with a mean of **4.03** and a standard deviation of **0.95.** This confirmed that respondents were aware of *E. coli*'s dominant role in UTI infections, although the slightly higher standard deviation suggested that a few respondents were either uncertain or disagreed.

Regarding 4, which stated that the specific bacteria responsible for a UTI can be identified through urine culture and susceptibility testing, there was a particularly high level of agreement. The mean score was **4.26,** the highest among the five statements, and the standard deviation was relatively low at **0.75**. This implied that most respondents understood the importance of laboratory testing in identifying the causative organisms and guiding treatment.

Lastly, statement 5 addressed the issue of antibiotic resistance due to the overuse and misuse of antibiotics. The responses again reflected a high level of agreement, with a mean of **4.20** and a standard deviation of **0.80.** This showed that the respondents were aware of the growing problem of antimicrobial resistance and its implications for UTI treatment. The data revealed that respondents generally demonstrated a good understanding of the bacteria associated with UTIs, the diagnostic processes involved, and the challenges posed by antibiotic resistance. The high mean scores across all statements suggested strong agreement, while the moderate standard deviations indicated some variability in knowledge, particularly around less common causative agents.

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V: SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Prevalence and bacterial species of urinary tract infections (UTIs) in Moi Teaching and Referral Hospital

The study findings revealed that the majority of respondents demonstrated strong knowledge and awareness of the bacterial species responsible for urinary tract infections (UTIs), particularly *Escherichia coli (E. coli*), and the role of antibiotic resistance. These findings are consistent with existing literature in the field.

Firstly, the high level of agreement with the statement that E. coli is the most prevalent cause of UTIs aligns with numerous studies. According to Foxman (2014), *E. coli* accounts for 75% to 90% of all uncomplicated UTIs, especially among women. Similar findings were reported by Flores-Mireles et al. (2015), who confirmed that uropathogenic *E. coli* (UPEC) is the leading cause of UTIs due to its ability to colonize the periurethral area and ascend the urinary tract.

Additionally, the respondents' recognition of other UTI-causing organisms such as Klebsiella pneumoniae, *Proteus mirabilis*, *Enterococcus faecalis*, and *Staphylococcus saprophyticus* reflects current microbiological understanding. Studies such as those by Medina and Castillo-Pino (2019) highlighted these bacteria as common secondary pathogens in complicated UTIs, particularly in catheterized patients or those with underlying health conditions.

The high mean score for the statement regarding the role of urine culture and susceptibility testing in identifying specific bacteria further reflected accurate knowledge. According to Gupta et al. (2011), urine culture is considered the gold standard in diagnosing UTIs, enabling clinicians to select appropriate antibiotics based on resistance patterns.

The awareness of the impact of antibiotic misuse and the emergence of resistant strains, as shown in the responses to statement A10, was also consistent with global trends. The World Health Organization (WHO, 2021) has warned that antimicrobial resistance (AMR) is one of the top 10 global public health threats, driven in part by the overuse and misuse of antibiotics. Research by Ventola (2015) further confirmed that the emergence of multidrug-resistant organisms (MDROs) in UTIs is becoming increasingly common, complicating treatment and increasing health care costs.

5.2 Conclusion

The study aimed to determine the prevalence and bacterial species associated with urinary tract infections (UTIs) at Moi Teaching and Referral Hospital. The findings revealed that UTIs were a common clinical concern among patients attending the facility, affecting individuals across various age groups and both sexes, with a higher prevalence observed among females. The most frequently isolated bacterial species was *Escherichia coli*, which accounted for the majority of infections. Other significant uropathogens included *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus saprophyticus*, and *Enterococcus faecalis*. The results underscored the predominance of Gram-negative bacteria, particularly *E. coli*, as the leading

cause of UTIs within the hospital. These findings confirmed the need for continued surveillance of bacterial profiles and reinforced the importance of routine culture and sensitivity testing to guide effective treatment and curb antibiotic resistance.

5.3 Recommendation

Based on the findings of the study, which determined the prevalence and bacterial species associated with urinary tract infections at Moi Teaching and Referral Hospital, several recommendations were made. First, it was recommended that routine urine culture and sensitivity testing be strengthened to ensure accurate identification of causative organisms and appropriate antibiotic selection. This would help reduce empirical treatment and improve patient outcomes.

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