ORIGINAL ARTICLE

Antimicrobial resistance patterns and associated risk factors among patients with urinary tract infections at Sally Mugabe Central Hospital, Zimbabwe

Shelancina Kudzayi Muhomba[1], Emmanuel Ifeanyi Obeagu[1, 2]*

[1]Department of Biomedical and Laboratory Science, Africa University, Mutare, Zimbabwe

[2]Department of Molecular Medicine and Haematology, Faculty of Health Sciences, University of Witwatersrand, Johannesburg, South Africa

Abstract

Background: Urinary Tract Infections (UTIs) rank as one of the most prevalent bacterial infections globally and pose a major public health issue due to the rising incidence of Antimicrobial Resistance (AMR) in uropathogens. Ongoing monitoring of local resistance trends is crucial for directing empirical therapy, enhancing treatment results, and bolstering antimicrobial stewardship efforts. *Aim and Objectives:* To evaluate AMR trends in uropathogens obtained from UTI patients at Sally Mugabe Central Hospital (SMCH), Zimbabwe, and to determine factors linked to AMR from January to August 2024. *Material and Methods:* A retrospective cross-sectional analysis was performed utilizing medical and laboratory records of patients diagnosed with culture-confirmed UTIs at SMCH. A total of 323 patient records meeting eligibility criteria were chosen using systematic sampling. Bacterial identification and antimicrobial susceptibility testing were conducted following the Clinical and Laboratory Standards Institute (CLSI) guidelines (2024). Data regarding demographic traits, microbiological results, antibiotic resistance profiles, and possible risk factors were gathered and analysed. Descriptive statistics outlined pathogen distribution and resistance patterns, whereas chi-square tests and multivariable logistic regression identified factors linked to AMR, defined as resistance to one or more tested antimicrobial agents. *Results:* Out of the 323 UTI cases with positive cultures, the primary uropathogens were Escherichia coli (n = 107, 33.1%) and Klebsiella pneumoniae (n = 94, 29.1%). The greatest resistance rates were recorded for nitrofurantoin (34.9%) and ciprofloxacin (31.4%). Relatively lower resistance rates were noted for gentamicin, ceftriaxone, and amoxicillin-clavulanate. Prior use of antibiotics (adjusted OR = 2.50, 95% CI: 1.40–4.46; $p < 0.05$) and past hospitalization (adjusted OR = 1.75, 95% CI: 1.05–2.92; $p < 0.05$) were independently linked to AMR, while diabetes mellitus showed no significant association with resistance ($p = 0.06$). *Conclusion:* A significant level of AMR was noted in uropathogens responsible for UTIs at SMCH, especially in isolates of E. coli and K. pneumoniae. Prior antibiotic use and hospitalization were key indicators of resistance. These results underscore the significance of antimicrobial stewardship initiatives, regular culture and susceptibility assessments, judicious antibiotic prescribing, and continuous AMR monitoring to guide evidence-based treatment protocols and enhance patient outcomes.

Keywords: Urinary tract infection, Antimicrobial resistance, Uropathogens, Enterobacterales, Antimicrobial susceptibility testing, Multidrug resistance, Antimicrobial stewardship, Zimbabwe

Introduction

Urinary Tract Infections (UTIs) rank among the most prevalent infectious diseases worldwide, impacting people of all ages and significantly contributing to both outpatient and inpatient illness. The significant occurrence, reoccurring nature, and possible complications of UTIs present a major public health issue. In resource-constrained environments, the situation is worsened by inequalities in access to diagnostic tools,

restricted antimicrobial choices, and deficiencies in surveillance systems. These intricacies highlight the importance of ongoing studies centered on pathogen dissemination and resistance patterns [1-2]. Clinically, UTIs present in various forms, spanning from simple cystitis to serious pyelonephritis and urosepsis. Successful management depends significantly on the timely start of suitable antimicrobial treatment. Traditionally, first-line medications like trimethoprim-sulfamethoxazole, fluoroquinolones, and beta-lactams have offered dependable protection against typical uropathogens. The worldwide increase in Antimicrobial Resistance (AMR) has significantly altered treatment dynamics, making some previously effective medications less dependable and jeopardizing patient outcomes [3].

The rise of AMR has been fuelled by various factors, such as improper empiric prescribing, unfinished treatment courses, rampant selfmedication, and insufficient regulation of antimicrobial distribution. As resistance grows and extends, healthcare providers encounter fewer treatment choices, escalating costs, and rising hospitalization and death rates. The issue is especially severe for Enterobacterales that produce Extended-Spectrum Beta-Lactamase (ESBL) and other multidrug-resistant pathogens, which greatly limit the antibiotic options available [4-5]. In Zimbabwe, new information from tertiary hospitals and national reports shows a troubling increase in resistance among prevalent Gram-negative and Grampositive bacteria. In spite of these signals, local AMR monitoring continues to be sporadic, resulting in clinicians lacking regularly updated advice for empirical treatment. Considering that antimicrobial susceptibility patterns differ greatly between institutions and change over time, ongoing and localized research is critical to inform evidence -based clinical decision-making [6-7]. Sally Mugabe Central Hospital, a major referral center in Zimbabwe, handles a large number of patients who show signs of suspected UTIs. The hospital caters to various communities inside and outside Harare, establishing it as an essential location for tracking AMR trends. However, recent extensive data regarding uropathogen profiles and their resistance patterns from this center is scarce. Lacking current information, the selection of empirical antibiotics becomes more difficult, possibly leading to treatment failures and increased resistance development [8].

Grasping resistance trends in this hospital's catchment population is crucial for enhancing clinical results and developing antimicrobial stewardship programs. Surveillance of local resistance influences formulary choices, facilitates targeted educational initiatives, and directs strategies for infection prevention and control. It additionally backs national public health initiatives focused on fighting AMR in line with global action strategies.

The main aim of this research was to evaluate the AMR patterns of uropathogens obtained from individuals with urinary tract infections at Sally Mugabe Central Hospital in Zimbabwe and to identify the risk factors linked to the emergence of multidrug-resistant infections in the study group.

Research design

This research utilized a retrospective cross-sectional approach carried out at Sally Mugabe Central Hospital in Zimbabwe. The research encompassed a thorough examination of medical records and microbiology lab data of individuals with culture-verified UTI during the study timeframe from January to August 2024. All qualifying cases that fulfilled the inclusion criteria were included consecutively, and pertinent demographic, clinical,

and laboratory information was gathered for analysis to identify AMR trends and related risk factors for multidrug-resistant infections.

Study setting and rationale for selection

The research took place at Sally Mugabe Central Hospital (SMCH), a tertiary referral care facility situated in Harare, Zimbabwe. The hospital functions as a key regional referral hub and handles a large number of patients with UTI, making it a suitable environment for monitoring AMR. SMCH features a specialized urology department and an operational microbiology lab that regularly conducts urine cultures and antimicrobial susceptibility tests, thus offering dependable diagnostic assistance for clinical decision-making. The hospital was chosen for its pivotal role in handling both simple and complex UTI, along with its reach to a varied patient demographic from urban and peri-urban regions. The presence of thorough medical records, microbiology lab information, and qualified staff enhanced the systematic collection and examination of data. Patients with culture-verified UTI were identified through the urology and microbiology departments and included based on established inclusion criteria until the necessary sample size was reached. This context offered a suitable and well-equipped atmosphere for producing strong data on local AMR trends and related risk factors.

Study population

The research population included all patients of any age and gender who arrived at Sally Mugabe Central Hospital with clinically suspected UTI and whose urine samples were collected for culture and antimicrobial susceptibility testing during the study timeframe (January to August 2024). Only patients with UTI confirmed by culture, characterized by substantial bacterial growth that met laboratory diagnostic criteria, were included in the final analysis. Patients with insufficient medical records or tainted urine samples were excluded. The population encompassed both inpatient and outpatient cases treated within the urology department and other related clinical units, guaranteeing a diverse representation of the UTI cases encountered at the institution.

Exclusion criteria

To ensure accuracy and reliability of the study findings, the following patients were excluded from the study so as to avoid confounding factors that might have affected the results: Patients with chronic kidney disease; patients on long term antibiotic treatment; patients with incomplete medical records; patients without a confirmed UTI diagnosis; patients with incomplete antibiotic treatment; patients with known allergy to an antibiotic; patients with known history of urinary tract surgery or anomalies; patients with immune-compromised status; patients with missing or unclear treatment details.

Inclusion criteria

Patients had to meet the following criteria for them to be included in the study, allowing for accurate and reliable analysis of AMR patterns. Patients with have a confirmed UTI diagnosis; complete medical records; have treatment details for UTI during the specified period; have been admitted to SMCH during the specified time frame; have UTI as primary diagnosis ; and have available laboratory results.

Sample size

The participants for the study were selected based on the inclusion and exclusion criteria set for the

study. The sample size was determined to provide sufficient power to detect significant differences in AMR patterns among different patient groups. The sample size was calculated using Cochran's formula below:

$N = Z^2 \times P(1-P)/E^2$

Where:

n is the required sample size,

Z is the Z-value corresponding to the desired confidence level (1.96 for 95% confidence),

P is the estimated prevalence of AMR,

E is the margin of error (0.05).

Assuming:

p = 0.30 (30% resistance) [9]

E = 0.05 (5% margin)

Plugging these values into the formula gives:

n = (1.96^2 *0.30* (1 - 0.30)) / 0.05^2

n ≈ (3.8416 *0.30* 0.70) / 0.0025

n ≈ (0.80688) / 0.0025

n ≈ 322.752

The sample size for this research included all qualified patients with culture-verified urinary tract infections found during the study timeframe from January to August 2024. A total of 323 cases satisfied the inclusion criteria and were incorporated into the analysis. As this constituted the entire collection of qualifying records during the specified study timeframe, no further sampling took place, and every accessible case was examined to guarantee thorough representation of the study group.

Sampling procedure

Every patient presenting with clinically suspected UTI and who had urine samples sent for culture and antimicrobial susceptibility testing at SMCH during the study period (January to August 2024) was assessed for eligibility. Only cases with culture-verified substantial bacterial growth, as determined by standard lab criteria, were included in the study. Records that met the eligibility criteria were reviewed, and all consecutive cases fitting the inclusion requirements were incorporated until a complete dataset of 323 cases was achieved. No further sampling methods like random or stratified selection were used, since the study employed a total enumeration of every qualified case during the specified timeframe. Clinical and laboratory data pertinent to the study were systematically gathered using a structured tool for data collection for later analysis.

Data collection instruments

The data collection instruments included a standardized data extraction form that was used to collect data from patient records and laboratory results. The form included sections for patient demographics, clinical information, laboratory results as well as risk factors.

Pilot study

Before starting comprehensive data collection, a pilot study was carried out with a limited selection of patient records from the same research environment to test the data extraction tool and evaluate the practicality of the study methods. The pilot study was conducted to confirm the clarity, completeness, and consistency of the data collection tool, and to pinpoint and rectify any ambiguities in defining variables and extraction methods. Results from the pilot phase were utilized to enhance the data collection tool and synchronize the data abstraction procedure. Data from the pilot study were excluded from the final analysis. The pilot exercise validated the study design's adequacy and ensured that enough relevant data was available to accomplish the study objectives.

Data collection procedure

Data were gathered via a systematic examination of microbiology lab logs and patient medical files at SMCH. A preconfigured data extraction instrument was utilized to gather pertinent information, including demographic factors (age and gender), clinical details (inpatient or outpatient status, recurrent UTI history, previous antibiotic use, and comorbid conditions), as well as microbiological results (isolated pathogens and AMR patterns).

Results of urine cultures and data on antimicrobial susceptibility were extracted from the microbiology laboratory records of the hospital, while clinical details and risk factor information were gathered from the relevant patient medical records. The final dataset included only records with confirmed UTI results that were complete and culture-verified. Data gathering was performed methodically to guarantee uniformity, precision, and thoroughness of the obtained variables. All gathered data were then encoded and input into a statistical software program for examination.

Data analysis and organization of data

The data were verified for completeness, coded, and inputted into Statistical Package for the Social Sciences (SPSS) version 30 for analysis. Before analysis, data cleaning was conducted to detect and rectify inconsistencies, missing values, and entry mistakes. Descriptive statistics summarized patient features, bacterial strains, and patterns of AMR. Categorical variables were shown as frequencies and percentages, whereas continuous variables were summarized using means and standard deviations where relevant.

The connection between possible risk factors and multidrug-resistant UTI was evaluated using the chi-square test. Variables exhibiting a p-value below 0.05 in bivariate analysis were incorporated into a multivariable logistic regression model to determine independent predictors of multidrug resistance. Adjusted Odds Ratios (AORs) along with 95% Confidence Intervals (CIs) were presented, and statistical significance was defined as $p < 0.05$. The dependent variable for regression analysis was identified as multidrug-resistant UTI following established criteria. Results were displayed in tables and figures to facilitate clear interpretation and alignment with the study's goals.

Ethical considerations

The research followed ethical principles and regulations concerning studies with human participants. All possible risks to participants were reduced, and the results were presented truthfully and impartially. The research received approval from the ethics committee of SMCH and its appropriate authorities (Ref: SMCHEC211825/ 18), and was later endorsed by the Africa University Research Ethics Committee (AUREC3613/25). Consent from the participants was not acquired since the information was gathered from the records. Information remained private and unidentifiable; medical records were only accessed by authorized individuals, and data was held in a safe environment. Privacy and security were guaranteed by employing secure methods for data storage and transmission.

The research leveraged secondary data obtained from laboratory and medical records; thus, the ethics committee waived informed consent owing to the study's retrospective design and the application of anonymized data. Patient information confidentiality and privacy were rigorously upheld during the study. Distinct identifiers replaced patient names and hospital numbers during data extraction, coding, and analysis to guarantee anonymity. All electronic

information was kept in password-secured files that could only be accessed by the lead researcher. The research was performed in line with the principles of the Declaration of Helsinki and complied with institutional standards for studies involving human data.

Results

Patient demographics

Table 1 presents the demographic characteristics of patients with AMR -associated UTI managed at SMCH between January and August 2024. 323 patients were included in the study. Females constituted the majority of the patients, accounting for 56.7% (n = 183), while males represented 43.3% (n = 140). Regarding age distribution, the highest proportion of patients was observed among those aged 60 years and above, comprising 22.9% (n = 74) of the study population while the lowest proportion was recorded among children aged 0–9 years, representing 7.1% (n = 23). Overall, the findings indicate a higher burden of AMR-associated UTI among females and older adults, particularly those aged 60 years and above.

Pathogen distribution

During the study period, 323 urine cultures produced bacterial isolates. Escherichia coli was the pathogen most commonly isolated, comprising 33.1% (n = 107) of cases, followed by Klebsiella pneumoniae at 29.1% (n = 94) and Staphylococcus aureus at 15.0% (n = 48). Together, these three organisms made up most of the UTI cases found at SMCH during the eight-month study duration. Table 2 illustrates the distribution of uropathogens. Moreover, Table 4 depicts the patterns of AMR in the three most common isolates (*E. coli*, *K. pneumoniae*, and *S. aureus*) throughout the study period.

Antimicrobial resistance patterns

The general AMR characteristics of all bacterial isolates showed significant resistance to frequently used antibiotics. Table 3 illustrates that the greatest resistance was noted for nitrofurantoin (34.9%, n = 113) and ciprofloxacin (31.4%, n = 101). Conversely, amikacin and carbapenems showed lower resistance rates, maintaining relatively higher susceptibility levels among the isolates. These results reveal differing resistance patterns among the evaluated antimicrobial agents, with activity preserved for a restricted number of drug classes.

Resistance patterns of *E. coli* and *K. pneumoniae*

Comprehensive evaluation of *Escherichia coli* isolates revealed consistently elevated resistance to

Table 1: Demographic characteristics of patients with antimicrobial resistance (AMR)-associated urinary tract infections (N = 323)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	140*	43.3
	Female	183*	56.7
	Total	**323**	**100.0**

Continued...

Age Group (Years)	0–9	23	7.1
	10–19	49	15.2
	20–29	43	13.3
	30–39	47	14.6
	40–49	42	13.0
	50–59	45	13.9
	≥60	74	22.9
	Total	**323**	**100.0**

Table 2: Prevalence and monthly distribution of uropathogens isolated from patients with urinary tract infections

Uropathogen	Jan	Feb	Mar	April	May	June	July	Aug	Total (n)	Prevalence (%)
E. coli	15	13	13	11	16	13	11	15	107	33.1
K. pneumoniae	10	7	12	9	13	12	14	17	94	29.1
P. mirabilis	5	5	7	6	8	4	7	7	49	15.2
E. faecalis	7	6	0	0	1	0	1	5	20	6.2
S. saprophyticus	3	1	6	4	7	5	4	8	38	11.8
S. aureus	0	0	7	3	4	1	0	0	15	4.6
Total	**40**	**32**	**45**	**33**	**49**	**35**	**37**	**52**	**323**	**100.0**

Table 2: Antimicrobial resistance proportions of selected antibiotics among uropathogens

Antibiotic	AMR Proportion (%)
Nitrofurantoin	34.88
Ceftazidime	22.67
Imipenem	3.49
Ciprofloxacin	31.40
Clindamycin	2.33
Vancomycin	19.19
Azithromycin	12.79

Continued...

Gentamycin	7.56
Augmentin	19.19
Cloxacillin	4.07
Nalidixic Acid	28.49
Cefoxitin	1.45

Table 4: Antimicrobial resistance patterns of the three most prevalent uropathogens against commonly used antibiotics

Antibiotic	*E. coli* (%)	*K. pneumoniae* (%)	*P. mirabilis* (%)
Nitrofurantoin	50.0	19.3	27.8
Ciprofloxacin	38.2	21.1	30.6
Nalidixic Acid	27.9	19.3	8.3
Ceftazidime	36.8	17.5	27.8
Augmentin	38.2	17.5	22.2

ampicillin and co-trimoxazole during the entire study duration. A slight rise in resistance to ciprofloxacin was noted during the eight-month period (Figures 1). In comparison, nitrofurantoin and amikacin exhibited relatively low resistance rates, demonstrating continued in vitro efficacy against *E. coli* isolates. Isolates of *Klebsiella pneumoniae* demonstrated increased resistance to third-generation cephalosporins, possibly indicating the production of Extended-Spectrum Beta-Lactamase (ESBL), though no confirmatory testing was conducted. Resistance to gentamicin showed moderate fluctuations over time. Carbapenems maintained strong efficacy against *K. pneumoniae* isolates, indicating maintained susceptibility to this antibiotic class (Figure 2). Three key resistance patterns were observed: ongoing resistance to beta-lactam agents, rising resistance to fluoroquinolones in E. coli, and consistent susceptibility to nitrofurantoin and amikacin, which could guide empirical treatment decisions within the study context.

Risk factors associated with antimicrobial resistance

Binary logistic regression analysis was conducted to identify independent predictors of multidrug-resistant UTI among the study population (Table 5). Increasing age was associated with a statistically significant increase in the odds of multidrug-resistant infection (OR = 1.03 per year; 95% CI: 1.01–1.05; p = 0.02). Female gender was associated with lower odds of multidrug-resistant infection (OR = 0.45; 95% CI: 0.25–0.85; p = 0.01). A history of prior antibiotic use within the preceding months was the strongest independent predictor of multidrug-resistant infection (OR = 2.50; 95% CI: 1.35–4.63; p = 0.003), followed by previous hospitalization (OR = 1.75; 95% CI: 1.10–2.80; p = 0.02). Diabetes mellitus showed a borderline, non-

significant association with multidrug-resistant infection (OR = 1.80; 95% CI: 0.98–3.30; p = 0.06), suggesting a possible trend that did not reach statistical significance.

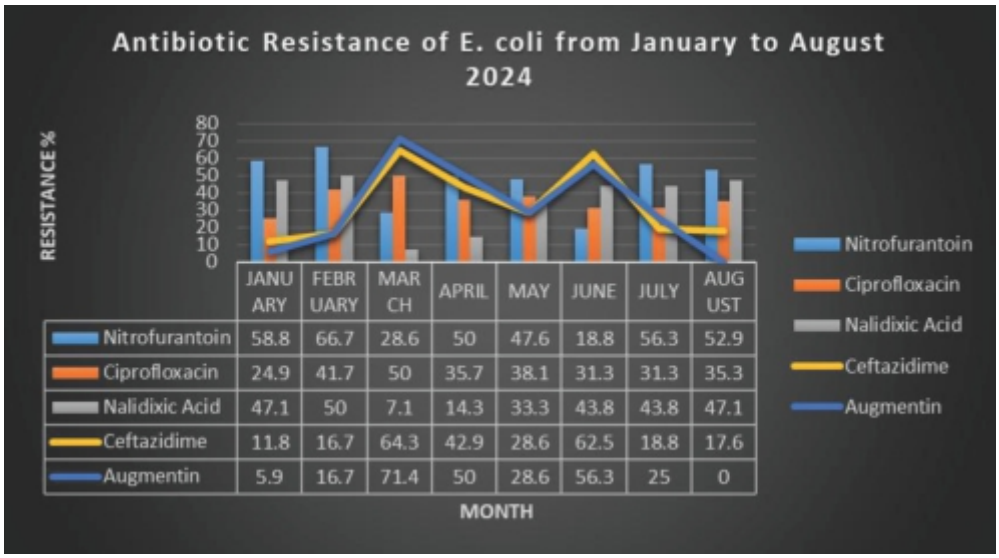

Figure 1: ***AMR patterns of*** **E. coli** ***from January to August 2024***

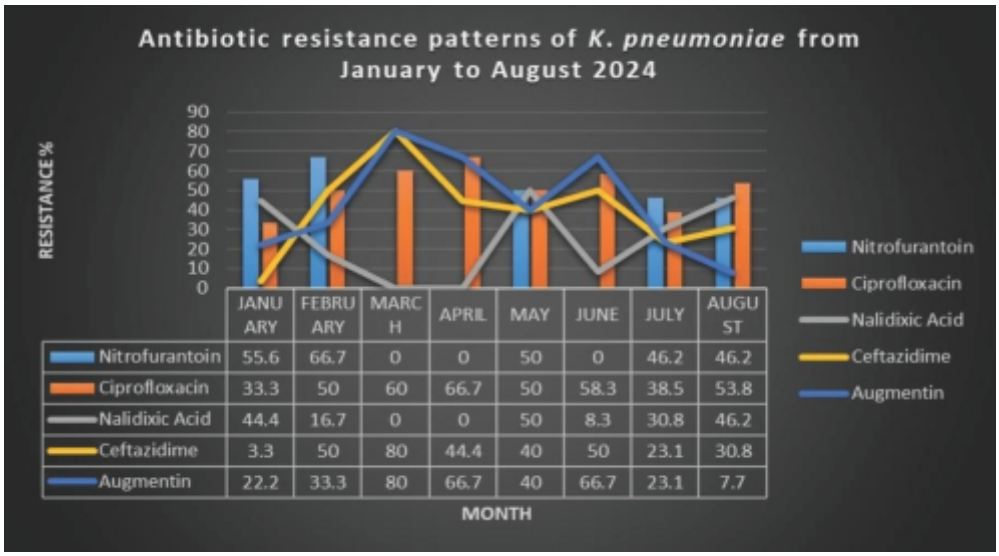

Figure 2: AMR patterns of *K. pneumoniae* from January to August 2024

Table 5:Logistic regression analysis

Variable	OR	95% CI	*P*
Age (per year increase)	1.03	(1.01, 1.05)	0.02
Female gender	0.45	(0.25, 0.85)	0.01
Previous antibiotic use	2.50	(1.35, 4.63)	0.003
Hospitalization history	1.75	(1.10, 2.80)	0.02
Diabetes mellitus	1.80	(0.98, 3.30)	0.06

Discussion

The present study provides a comprehensive assessment of UTI and AMR patterns among patients at SMCH over an eight-month period. The findings underscore critical epidemiological and clinical trends with implications for empirical treatment and antimicrobial stewardship.

Patient demographics

Examination of patient traits showed a majority of female patients, consistent with the recognized epidemiology of UTIs and highlighting anatomical and hormonal factors in women. The average age of 39 years and median age range of 30–39 years indicate that UTIs mainly impact young to middle-aged individuals in this context. The wide age range, reflected in a standard deviation of around 19 years, indicates that UTIs affect individuals of all ages, including children and seniors. These demographic trends align with worldwide findings, highlighting the importance of age- and sex-specific factors in assessing UTI risk and management approaches [2, 10].

Pathogen distribution

Escherichia coli became the most commonly identified uropathogen, followed by *Klebsiella pneumoniae* and *Staphylococcus aureus*. This distribution reflects global and regional patterns, where Enterobacterales are dominant in both community- and hospital-acquired UTIs. The widespread occurrence of *E. coli* emphasizes its key role in UTI development, whereas the detection of *K. pneumoniae* and *S. aureus* stresses the need to take into account nosocomial and potentially multidrug-resistant pathogens in clinical treatment. These results are essential for directing empirical treatment in this group, as pathogen-targeted therapy can greatly influence outcomes [11-12].

Antimicrobial resistance patterns

The research indicated elevated resistance levels to widely utilized first-line antibiotics, such as ampicillin, co-trimoxazole, and ciprofloxacin. Resistance to these agents' carries significant clinical consequences, as they are frequently used empirically in both outpatient and hospital environments. The detected resistance patterns indicate selective pressure due to the frequent or improper use of antibiotics. Significantly, nitrofurantoin and amikacin maintained strong effectiveness against the majority of isolates, whereas carbapenems also showed sustained activity, though limited to severe or complicated situations. Resistance patterns observed during the eight-month timeframe showed a consistent presence of beta-lactam resistance and a slow rise in fluoroquinolone

resistance in E. coli, highlighting the necessity for continuous monitoring and timely revisions to treatment protocols [7, 13-14]. *E. coli* and *K. pneumoniae* displayed different resistance patterns, with K. pneumoniae revealing higher resistance to third-generation cephalosporins, indicative of extended-spectrum beta-lactamase (ESBL) production. These results align with reports of increasing ESBL prevalence in Sub-Saharan Africa, presenting a substantial challenge for empirical treatment and infection management. The recognition of three key resistance patterns —ongoing beta-lactam resistance, increasing fluoroquinolone resistance, and consistent susceptibility to nitrofurantoin and amikacin —offers practical information to shape local antibiotic stewardship strategies [15-16].

Risk factors for antimicrobial resistance

Binary logistic regression analysis revealed various patient-related factors linked to multidrug-resistant UTI. Previous antibiotic usage was the most significant independent indicator of multidrug-resistant infection (OR = 2.50; 95% CI: 1.35–4.63), highlighting the influence of earlier antimicrobial exposure in favoring resistant pathogens. A history of hospitalization was significantly linked to higher odds of multidrug-resistant infection (OR = 1.75; 95% CI: 1.10–2.80), indicating a role in the healthcare-associated acquisition of resistant organisms. Advancing age demonstrated a slight yet statistically significant correlation with multidrug-resistant infection (OR = 1.03 per year; 95% CI: 1.01–1.05), probably representing accumulated healthcare exposure and age-associated susceptibility. The female gender correlated with reduced odds of multidrug-resistant infection (OR = 0.45; 95% CI: 0.25–0.85), potentially indicating variations in exposure patterns and infection traits between the sexes. Diabetes mellitus exhibited a marginal, non-significant correlation with multidrug-resistant infection (OR = 1.80; 95% CI: 0.98–3.30; p = 0.06), suggesting a potential but not verified connection. These results underscore the complex factors underlying AMR, stress the necessity of antimicrobial stewardship, and focused prevention methods for high-risk patient populations [17–21].

Clinical and public health implications

The detected prevalence of multidrug-resistant uropathogens in patients with UTI at SMCH significantly affects choices for empirical treatment, infection control, and antimicrobial stewardship. The results endorse the ongoing utilization of nitrofurantoin and aminoglycosides as viable first-line treatments for suitable uncomplicated UTI, due to their relatively lower resistance rates observed in this study. On the other hand, the significant resistance noted in cephalosporins and fluoroquinolones highlights the necessity for careful and evidence-based application of these drugs, favoring culture-guided treatment when possible. The recognized risk factors for multidrug resistance, especially previous antibiotic use and recent hospital stays, can help clinicians in early risk assessment and inform choices about empirical antibiotic escalation or de-escalation. These findings underscore the importance of enhanced antimicrobial stewardship initiatives, regular local monitoring of resistance trends, and focused actions to decrease inappropriate antibiotic usage in hospital and community environments [22-23].

Conclusion

This research reveals a significant presence of AMR in uropathogens responsible for UTI at SMCH. The main isolates identified were Escherichia coli,

Klebsiella pneumoniae, and Staphylococcus aureus, exhibiting high resistance rates to frequently used first-line drugs, especially ampicillin, co-trimoxazole, and ciprofloxacin. In comparison, nitrofurantoin, amikacin, and carbapenems demonstrated relatively lower resistance and maintained valuable therapeutic effectiveness. Crucial patient-related elements such as past antibiotic use, prior hospitalizations, and advancing age were linked to multidrug-resistant infections, emphasizing the complex reasons behind AMR in this context. These results highlight the importance of enhanced antimicrobial stewardship, regular local monitoring of resistance patterns, and the creation of evidence-driven empirical treatment protocols. Integrating local resistance information and patient risk assessment into clinical decisions is crucial for enhancing treatment results and preventing the further dissemination of resistant uropathogens.

References

1. Mancuso G, Midiri A, Gerace E, Marra M, Zummo S, Biondo C. Urinary Tract Infections: The Current Scenario and Future Prospects. *Pathogens* 2023; 12(4):623.
2. Medina M, Castillo-Pino E. An introduction to the epidemiology and burden of urinary tract infections. *Ther Adv Urol* 2019; 11:1756287219832172.
3. Abbo LM, Hooton TM. Antimicrobial stewardship and urinary tract infections. *Antibiotics (Basel)* 2014; 3(2):174-192.
4. Salam MA, Al-Amin MY, Salam MT, Pawar JS, Akhter N, Rabaan AA, *et al*. Antimicrobial resistance: A growing serious threat for global public health. *Healthcare (Basel)* 2023; 11(13):1946.
5. Llor C, Bjerrum L. Antimicrobial resistance: risk associated with antibiotic overuse and initiatives to reduce the problem. *Ther Adv Drug Saf* 2014; 5(6):229-241.
6. Mhondoro M, Ndlovu N, Bangure D, Juru T, Gombe NT, Shambira G, *et al*. Trends in antimicrobial resistance of bacterial pathogens in Harare, Zimbabwe, 2012-2017: A secondary dataset analysis. *BMC Infect Dis* 2019; 19(1):746.
7. Bwanali AN, Lubanga AF, Kondowe S, Nzima E, Mwale A, Kamanga W, *et al*. Trends and patterns of antimicrobial resistance among common pathogens isolated from adult bloodstream and urinary tract infections in public health facilities in Malawi, 2020-2024. *BMC Infect Dis* 2025; 25(1):946.
8. Mickelsson M, Simbini T. Antimicrobials as cornerstones and quick fixes Zimbabwean in healthcare and society: Health practitioners´ critical reflections on two stories of antimicrobial use as part of antimicrobial resistance (AMR) education. *PLOS Glob Public Health* 2025; 5(7): e0004793.
9. Olaru ID, Yeung S, Ferrand RA, Stabler R, Chonzi P, Mabey D, *et al*. Antimicrobial resistance in Gram-negative bacteria from urinary specimens: A study of prevalence, risk factors and molecular mechanisms of resistance (ARGUS) in Zimbabwe - a study protocol. *Wellcome Open Res* 2020; 5:140.
10. Hanna-Wakim RH, Ghanem ST, El Helou MW, Khafaja SA, Shaker RA, Hassan SA, *et al*. Epidemiology and characteristics of urinary tract infections in children and adolescents. *Front Cell Infect Microbiol* 2015; 5:45.
11. Mouanga-Ndzime Y, Bisseye C, Longo-Pendy NM, Bignoumba M, Dikoumba AC, Onanga R. Trends in *Escherichia coli* and *Klebsiella pneumoniae* urinary tract infections and antibiotic resistance over a 5-year period in Southeastern Gabon. *Antibiotics (Basel)* 2024; 14(1):14.
12. Bazira J, Pauline PN, Nakato CN, Walekhwa AW, Nakazibwe B, Kawuma S. Trends in antibiotic resistance in uropathogens at mbarara regional referral hospital (2019-2024): A retrospective study. *Infect Drug Resist* 2025; 18:3875-3890.

13. El Aila NA, El Aish KIA. Six-year antimicrobial resistance patterns of *Escherichia coli* isolates from different hospitals in Gaza, Palestine. *BMC Microbiol* 2025; 25(1):559.
14. Massele A, Rogers AM, Gabriel D, Mayanda A, Magoma S, Cook A, *et al*. A narrative review of recent antibiotic prescribing practices in ambulatory care in Tanzania: Findings and implications. *Medicina (Kaunas)* 2023; 59(12):2195.
15. Olaitan MO, Orababa OQ, Shittu RB, Oyediran AA, Obunukwu GM, Arowolo MT, *et al*. Extended-spectrum beta-lactam-resistant Klebsiella pneumoniae in sub-Saharan Africa: a systematic review and meta-analysis from a One Health perspective. *BMC Infect Dis* 2025; 25(1):843.
16. Siriphap A, Kitti T, Khuekankaew A, Boonlao C, Thephinlap C, Thepmalee C, *et al*. High prevalence of extended-spectrum beta-lactamase-producing *Escherichia coli* and *Klebsiella pneumoniae* isolates: A 5-year retrospective study at a Tertiary Hospital in Northern Thailand. *Front Cell Infect Microbio*l 2022; 12:955774.
17. Chen Q, Li D, Beiersmann C, Neuhann F, Moazen B, Lu G, *et al*. Risk factors for antibiotic resistance development in healthcare settings in China: a systematic review. *Epidemiol Infect* 2021; 149: e141.
18. Trautner BW, Kaye KS, Gupta V, Mulgirigama A, Mitrani-Gold FS, Scangarella-Oman NE, *et al*. Risk factors associated with antimicrobial resistance and adverse short-term health outcomes among adult and adolescent female outpatients with uncomplicated urinary tract infection. *Open Forum Infect Dis* 2022; 9(12): ofac623.
19. Dasgupta C, Rafi MA, Salam MA. High prevalence of multidrug resistant uropathogens: A recent audit of antimicrobial susceptibility testing from a tertiary care hospital in Bangladesh. *Pak J Med Sci* 2020; 36(6):1297-1302.
20. Kalın G, Alp E, Chouaikhi A, Roger C. Antimicrobial multidrug resistance: Clinical implications for infection management in critically ill patients. *Microorganisms* 2023; 11(10):2575.
21. Alhomayani FK, Alazwari NM, Alshhrani MS, Alkhudaydi AS, Basaba AS, Alharthi TM, *et al*. The prevalence of multiple drug resistant urinary tract infections: A single-centered, observational retrospective study in King Abdulaziz Specialized Hospital, Taif, Saudi Arabia. *Saudi Med J* 2022; 43(8): 927-932.
22. Shenoy S, Shenoy S, Rao P, Baliga S. Antibiotic resistance pattern of multi-drug resistant *Klebsiella pneumonia* and detection of carbapenem-resistance genes. *J Krishna Inst Med Sci Univ* 2020; 9(4): 31-37
23. Uma BM, Naik N, Rama NK. Evaluation of resistance rates of Enterobacterales to beta-lactam drugs and interpretation of their minimum inhibitory concentrations relative to clinical breakpoints. *J Krishna Inst Med Sci Univ* 2024; 13(3): 60-70.

Author for Correspondence:
Emmanuel Ifeanyi Obeagu, Department of Biomedical and Laboratory Science, Africa University, Mutare, Zimbabwe, Email: emmanuelobeagu@yahoo.com

How to cite this article:
Muhomba SK, Obeagu EI. Antimicrobial resistance patterns and associated risk factors among patients with urinary tract infections at Sally Mugabe Central Hospital, Zimbabwe. *J Krishna Inst Med Sci Univ* 2026; 15(1): 156-168

Submitted: *13-Oct-2025* ***Accepted:*** *20-12-2025* ***Published:*** *01-Jan-2026*