

Antibiotic Resistance Patterns of Uropathogens Isolated from Patients with Urinary Tract Infections at Kathmandu Medical College, a Tertiary Care Hospital in Nepal



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Abstract

Urinary tract infection (UTI) is one of the most common bacterial infections globally, with increasing prevalence and rising antimicrobial resistance posing major challenges in clinical settings. Nepal continues to report a significant burden of UTIs, particularly among females and individuals of reproductive age. The purpose of the present research was to ascertain the urinary pathogenic bacterial profiles, antimicrobial susceptibility patterns, prevalence, and demographic distribution of patients suspected of having UTIs at Kathmandu Medical College Public Limited. A total of 151 urine samples were collected from patients with UTI symptoms. Samples were sent to the Microbiology Laboratory at Himalayan White House International College, where they were cultured, identified, and tested for antibiotic susceptibility using conventional microbiological techniques.

Significant bacterial growth was found in 51 (33.77%) of the 151 samples examined. Males showed a lower prevalence (21.57%) than females (40%). The age group of 21 to 30 years old had the largest number of UTI cases. The most common pathogen was *Escherichia coli* (33.33%), followed by *Pseudomonas aeruginosa* (17.64%) and *Klebsiella pneumoniae* (13.70%). The isolates showed high resistance to ceftazidime and cefaclor, while the highest susceptibility was observed to amikacin and piperacillin-tazobactam. Notably, multidrug resistance was identified in 66.7% of uropathogenic isolates, including *E. coli*, *Klebsiella* spp., and *Pseudomonas* spp. showing the highest prevalence. The study shows that UTIs are common, especially among young adult women. The predominance of *E. coli* and high-level resistance to widely used antibiotics underscore the importance of routine culture and sensitivity testing for successful treatment. These results highlight the critical need in Nepali healthcare settings for improved antimicrobial stewardship, regular monitoring of resistance trends, and ongoing updates to empiric therapy recommendations. Controlling the rising incidence of UTIs and preventing the development of resistant uropathogens also depend on incorporating routine culture-based diagnosis, encouraging doctors to use antibiotics sensibly, and raising public awareness of the dangers of self-medication. For doctors, microbiologists, and public health policymakers, this study offers up-to-date, hospital-based data on UTI prevalence and resistance rates in Kathmandu.

Keywords- AMR, Antimicrobial resistance, *E. coli*, Multidrug resistance, Nepal, Urinary tract infection, Uropathogens, and UTI

1. Introduction

Urine is generally sterile or contains only a small number of microorganisms unlikely to cause infection in a healthy person (Mancuso et al., 2023). UTIs, or urinary tract infections, are common in both community settings and medical facilities. They are among the most prevalent bacterial infections (Swamy et al., 2020). A significant proportion of adult women, estimated between 40% and 50%, experience at least one urinary tract infection during their lifetime, making UTIs a major health concern in this population. The likelihood of developing a UTI increases steadily with age, with prevalence rising by about 5% every decade. Furthermore, pregnancy further elevates susceptibility, contributing to roughly a 7% increase in UTI risk due to physiological and hormonal changes that favor bacterial colonization and infection (Shaifali et al., 2012). Gram-negative bacterial pathogens are mostly responsible for urinary tract infections, with *Escherichia coli* (*E. coli*) being the most common culprit. Because of its strong adhesion mechanisms and ability to colonize the urinary tract, this organism alone is thought to account for 65–90% of UTIs. *Proteus mirabilis*, *Staphylococcus saprophyticus*, *Staphylococcus epidermidis*, and *Klebsiella pneumoniae* are additional prominent uropathogens that account for a smaller but noteworthy percentage of infections. Furthermore, *Pseudomonas* species are frequently associated with infections in patients undergoing long-term catheterization or with impaired urinary drainage, whereas they are less common in typical UTIs (Sedhain et al., 2019; Shaifali et al., 2012).

Confirming the diagnosis of a urinary tract infection requires routine urine analysis, microscopic examination, urine culture, and pertinent biochemical assays (Sedhain et al., 2019). Urinary tract infections have been observed to affect between 23% and 37% of patients in general hospitals in Nepal (Shakya et al., 2021). Antibiotic-resistant uropathogens have spread more quickly due to the abuse of broad-spectrum antibiotics, whether through self-medication or improper empirical treatment given in clinics and emergency rooms (Calzada et al., 2022). AMR, or antimicrobial resistance, is a fast-expanding global issue, especially in low- and middle-income nations. Among the microbial groupings exhibiting some of the highest levels of resistance are uropathogens in particular (Raj KC et al., 2023; Shakya et al., 2021). These rising resistance patterns highlight the urgent need for continuous surveillance and updated antimicrobial guidelines to ensure effective management of UTIs (Lee et al., 2018).

The purpose of this study was to thoroughly evaluate the prevalence, demographic trends, microbiological diversity, and antibiotic resistance profiles of uropathogenic bacteria isolated from patients at Kathmandu Medical College Public Limited in Kathmandu with urinary tract infection symptoms.

2. Review of Literature

Urinary tract infection (UTI) is a frequently encountered clinical condition in both general and gynecological medical practices. It ranks among the most prevalent infections observed in outpatient clinics and among hospitalized patients (Shaifali et al., 2012). UTIs can result from several underlying causes. These causes are generally grouped into three categories: behavioral factors (like poor hygiene or sexual activity), urologic factors (such as urinary tract obstructions or catheter use), and biological/genetic factors (including inherited traits or anatomical differences that increase susceptibility). Each category influences the likelihood of infection in different ways (Sedhain et al., 2019). Urinary tract infections (UTIs) are most commonly caused by bacterial pathogens, the most common of which is *Escherichia coli* (*E. coli*). Between 70 and 90 percent of simple UTIs are caused by *E. coli* because of its ability to stick to uroepithelial cells via specific virulence factors, including hemolysins and fimbriae (P and type 1 fimbriae) (Sedhain et al., 2019). Other Gram-negative bacteria, in addition to *E. coli*, are important, especially in nosocomial or complicated UTIs. These include *Enterobacter* species, *Citrobacter* species, *Pseudomonas aeruginosa*, *Proteus mirabilis*, and *Klebsiella pneumoniae*. These infections often have mechanisms of antibiotic resistance and are associated with underlying comorbidities or catheter use (Usman Anjum et al., 2016). Gram-positive bacteria can also be involved, albeit less frequently. Notable examples are *Enterococcus faecalis* and *Staphylococcus saprophyticus*, which are commonly isolated in community-acquired infections, particularly in sexually active females (Kaur & Kaur, 2021; Raj KC et al., 2023).

The classification of urinary tract infections (UTIs) can be based on several criteria, including anatomical location, clinical symptoms, complications, and recurrence. Uncomplicated urinary tract infections (UTIs) generally occur in otherwise healthy individuals without structural or neurological abnormalities of the urinary tract. These infections are categorized into lower UTIs (such as cystitis) and upper UTIs (such as pyelonephritis). Some factors can increase the risk of developing cystitis, including being female, having a history of UTIs, engaging in sexual activity, the presence of vaginal infections, diabetes, and obesity (Flores-Mireles et al., 2015). Complicated urinary tract infections (UTIs) are characterized by conditions that impair the urinary tract or the body's natural defenses. These include urinary obstruction, retention due to neurological disorders, immunosuppression, kidney failure, renal transplants, pregnancy, and foreign objects such as urinary stones, indwelling catheters, or other drainage devices (Mareş et al., 2024).

Numerous host, behavioral, and clinical factors might impact urinary tract infections (UTIs). While anatomical or functional problems such as vesicoureteral reflux, nephrolithiasis, urinary obstruction, and neurogenic bladder predispose to urinary stasis and bacterial colonization, female sex, shorter urethral length, pregnancy, and postmenopausal hormonal changes also increase susceptibility to urinary stasis and bacterial colonization. The risk is further increased by behavioral factors such as frequent sexual activity, extended urine retention, poor perineal hygiene, and inadequate hydration. Host defenses are further weakened by comorbid conditions such as diabetes mellitus, immunosuppression, and chronic renal disease. Indwelling urinary catheters, frequent urinary instrumentation, recent urological procedures, and prior antibiotic exposure all play major roles in the development and recurrence of UTIs in hospital settings, especially when multidrug-resistant uropathogens are involved (Swamy et al., 2020).

3. Methodology

a. Ethical Approval

The Institutional Review Committee (IRC) of Kathmandu Medical College in Kathmandu, Nepal, granted ethical permission for this investigation. The Declaration of Helsinki was followed in conducting the study. Before collecting a urine sample, each subject gave their informed consent. All information was anonymized prior to analysis, and patient anonymity was scrupulously upheld.

b. Study Design

A cross-sectional, laboratory-based study was conducted among patients attending Kathmandu Medical College Public Limited in Sinamangal, Kathmandu, Nepal. Patients clinically suspected of urinary tract infection (UTI) by attending clinicians were referred to the microbiology laboratory for confirmation. All eligible urine samples received from January 2025 to February 2025 were consecutively included. A total of 151 midstream urine samples were processed. Demographic information, clinical characteristics, and relevant patient history were recorded using a structured form.

c. Study Environment

The tertiary care facility at Kathmandu Medical College Public Limited is situated in Kathmandu, Bagmati Province. Patients from both urban and rural locations can receive a wide range of outpatient, inpatient, surgical, and diagnostic services from the hospital. Urine samples were collected from Kathmandu Medical College Public Limited and sent to the Microbiology Laboratory at Himalayan White House International College for culture, biochemical identification, and antibiotic susceptibility testing.

d. Study Population and Sampling Technique

Patients who were clinically recommended to have a urine culture and who presented with symptoms suggestive of a UTI were included. Urine samples from midstream clean catches that satisfied the quality standards were enrolled one after the other. Samples that were not properly labeled or collected, as well as those that lacked demographic information, were not included.

e. Collection of Specimens

In sterile, wide-mouthed, leak-proof receptacles already filled with boric acid, participants were instructed

to collect 10-20 mL of clean-catch midstream urine (CC-MSU). Samples were quickly sent to the microbiology lab after being labeled with the patient's details, date, and time.

f. Macroscopic, Chemical, and Microscopic Examination

The color, clarity, and appearance of urine samples were assessed. Standard methods were used to conduct chemical analyses for protein, glucose, and pH. Ten milliliters of urine were centrifuged at 3000 rpm for 10 minutes to evaluate the sediment for WBCs, RBCs, and epithelial cells at 40X magnification.

g. Culture and Bacterial Isolation

Using a semi-quantitative streaking method, a loopful of urine was inoculated onto MacConkey and blood agar plates. For 24-48 hours, plates were aerobically incubated at 37°C. Significant growths of $\geq 10^5$ colony-forming units (CFU)/mL underwent further processing.

h. Identification of Isolates

Bacterial isolates were identified based on colony morphology, Gram staining, and biochemical tests. Pure cultures were prepared on nutrient agar before performing catalase, oxidase, IMViC tests, motility, gas production, and hydrogen sulfide tests.

i. Antibiotic Susceptibility Testing

The Kirby-Bauer disk diffusion method was used to test antibiotic susceptibility on Mueller-Hinton agar in accordance with CLSI standards (2023). The McFarland turbidity of bacterial suspensions was set at 0.5. Inhibition zones were determined and classified as sensitive, intermediate, or resistant after plates were incubated at 37°C for 18 to 24 hours.

j. Multidrug Resistance Analysis

Multidrug resistance (MDR) analysis was performed using antibiotic susceptibility data from 51 uropathogenic isolates. Isolates were classified as multidrug-resistant if resistance to at least one antimicrobial agent in three or more antibiotic classes was observed. Resistance patterns across various antimicrobial classes were analyzed to determine the distribution of MDR among Gram-negative and Gram-positive bacteria.

k. Quality Control

Laboratory equipment, including incubators, refrigerators, and autoclaves, was routinely monitored. Media sterility was checked using control plates. Reagents and antibiotic discs were inspected for expiry and proper storage.

l. Data Analysis

Data were analyzed using Microsoft Excel 2019 and GraphPad Prism 10.0. Statistical significance was determined using the chi-square test and Fisher's exact test, with $p < 0.05$ considered significant.

4. Results

a. Urine culture outcomes

During the study period, 151 urine samples were analyzed. 51 (33.77%) of the samples revealed considerable bacterial growth, confirming a urinary tract infection, while 100 (66.23%) showed no growth. While 40 out of 100 female participants (40%) were culture positive, 11 out of 51 male participants (21.57%) tested positive, suggesting a higher prevalence of UTIs among females.

b. Distribution of Significant Bacteriuria by Gender

Of the 51 samples that tested positive on culture, 11 (21.57%) were from male patients and 40 (78.43%) from female patients. Within their respective gender categories, 21.57% of males and 40% of females had significant bacteriuria of $\geq 10^5$ colony-forming units (CFU)/mL. Gender and UTI prevalence were significantly correlated with the higher incidence of UTIs among females ($\chi^2 = 4.34$, $P = 0.037 < 0.05$). This demonstrates that women are more prone to urinary tract infections due to physiological and anatomical variables (Table 1).

Table 1: Distribution of Significant Bacteriuria by Gender

Gender	Significant Bacteriuria (Count)	No Growth (Count)	Total (Count)	% Within Gender (Significant Bacteriuria)	% Within Gender (No Growth)	% Within Gender (Total)
Male	11	40	51	21.57%	78.43%	100.0%
Female	40	60	100	40.00%	60.00%	100.0%
Total	51	100	151	33.77%	66.23%	100.0%

c. Bacterial Growth Cross-Age Group

The 21–30 age group had the greatest number of infections (12 cases, 23.53%) among the culture-positive cases (n = 51), followed by the 31–40 age group (9 cases, 17.65%). The age groups of 11–20 and 41–50 showed very little development (2 cases each, 3.92%). Patients aged 0–10 and 71–80 did not exhibit any bacterial growth. In every age group, most cases were female, except in the 61–70 age group, where males had a slightly higher incidence (Table 2).

Table 2 : Bacterial Growth Cross-Age Group

Age Group	Male (Count)	Female (Count)	Total (Count)	Percent of (Male)	Percent of (Female)	Percent of Total (Overall)
0–10	0	0	0	0.00%	0.00%	0.00%
11–20	0	1	1	0.00%	2.50%	2.00%
21–30	2	10	12	3.92%	25.00%	23.53%
31–40	2	7	9	3.92%	17.50%	17.65%
41–50	2	5	7	3.92%	12.50%	13.73%
51–60	1	5	6	1.96%	12.50%	11.76%
61–70	2	1	3	3.92%	2.50%	5.88%
71–80	0	0	0	0.00%	0.00%	0.00%
Total	11	40	51	21.57%	78.43%	100.00%

d. Prevalence of Bacterial Isolates

Escherichia coli emerged as the predominant uropathogen, responsible for 33.33% of infections. This was followed by *Pseudomonas aeruginosa* (17.64%), *Klebsiella pneumoniae*, and *Shigella spp.* (both 13.70%). Other isolates included *Enterobacter spp.* (7.80%), *Proteus spp.* (7.80%), and *Enterococcus spp.* (5.88%). This distribution reflects a diverse range of uropathogens with varying pathogenic potential (Table 3).

Table 3 : Prevalence of Bacterial Isolates

Bacteria	Total Isolates	Prevalence (%)
<i>Escherichia coli</i>	17	33.33%
<i>Pseudomonas aeruginosa</i>	9	17.64%
<i>Klebsiella pneumoniae</i>	7	13.70%
<i>Shigella spp.</i>	7	13.70%
<i>Enterobacter spp.</i>	4	7.80%
<i>Proteus spp.</i>	4	7.80%
<i>Enterococcus spp.</i>	3	5.88%
Total	51	100%

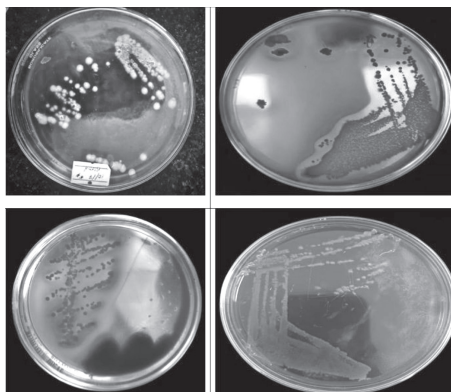


Figure 1: illustrates the distribution of uropathogenic bacteria isolated from culture-positive urine samples. *Escherichia coli* was the dominant pathogen, accounting for 33.33% of total isolates. This was followed by *Pseudomonas aeruginosa* (17.64%) and *Klebsiella pneumoniae* (13.70%). Other organisms such as *Shigella spp.*, *Enterobacter spp.*, *Proteus spp.*, and *Enterococcus spp.* were isolated in smaller proportions, indicating a diverse etiological profile of UTIs

e. Antibiotic Susceptibility Pattern

The antibiotic susceptibility profile of the uropathogenic isolates revealed varied resistance patterns across the tested agents. Notably, Amikacin (A) and Piperacillin-Tazobactam (D) exhibited the highest efficacy, with susceptibility rates of 70.0% in *E. coli*, 75.0% in *Pseudomonas spp.*, and 66.7% across *Klebsiella spp.*, *Enterobacter spp.*, *Shigella spp.*, and *Proteus spp.* Conversely, Ceftazidime (B) and Cefaclor (H) demonstrated the lowest effectiveness, with *Enterobacter spp.*, *Proteus spp.*, and *Enterococcus spp.* showing 100% resistance to Ceftazidime, and *Enterococcus spp.* and showing complete resistance to Cefaclor as well.

Shigella spp. and *Enterococcus spp.* were among the most resistant pathogens, with *Enterococcus* showing 0% sensitivity to Ceftazidime (B), Nalidixic Acid (C), and Cefaclor. Chloramphenicol (E) and Neomycin (F) exhibited moderate effectiveness across most isolates, while Streptomycin (G) maintained a consistent susceptibility rate of 60-70% in the majority of Gram-negative isolates (Table 4)

Table 4: Antibiotic susceptibility profiles of *E. coli*, *Klebsiella*, *Pseudomonas*, *Enterobacter*, *Shigella*, *Proteus*, and *Enterococcus* isolates from urinary tract infections

Code	<i>E. coli</i> S/R (%)	<i>Klebsiella</i> spp. S/R (%)	<i>Pseudomonas</i> spp. S/R (%)	<i>Enterobacter</i> spp. S/R (%)	<i>Shigella</i> spp. S/R (%)	<i>Proteus</i> spp. S/R (%)	<i>Enterococcus</i> spp. S/R (%)
A	70.0/30.0	66.7 / 33.3	75.0 / 25.0	66.7 / 33.3	66.7 / 33.3	66.7 / 33.3	33.3 / 66.7
B	15.0/85.0	33.3 / 66.7	20.0 / 80.0	0.0 / 100.0	16.7 / 83.3	0.0 / 100.0	0.0 / 100.0
C	60.0/40.0	66.7 / 33.3	60.0 / 40.0	50.0 / 50.0	16.7 / 83.3	0.0 / 100.0	0.0 / 100.0
D	50.0/50.0	66.7 / 33.3	70.0 / 30.0	66.7 / 33.3	50.0 / 50.0	66.7 / 33.3	33.3 / 66.7
E	40.0/60.0	50.0 / 50.0	50.0 / 50.0	33.3 / 66.7	33.3 / 66.7	33.3 / 66.7	66.7 / 33.3
F	60.0/40.0	66.7 / 33.3	60.0 / 40.0	50.0 / 50.0	66.7 / 33.3	66.7 / 33.3	33.3 / 66.7
G	60.0/40.0	66.7 / 33.3	70.0 / 30.0	66.7 / 33.3	66.7 / 33.3	66.7 / 33.3	33.3 / 66.7
H	30.0/70.0	50.0 / 50.0	30.0 / 70.0	33.3 / 66.7	16.7 / 83.3	50.0 / 50.0	0.0 / 100.0

f. Multidrug resistance patterns of Uropathogens

A total of 51 uropathogenic isolates were evaluated for multidrug resistance (MDR), defined as resistance to at least one antibiotic in three or more different classes. Out of these, 34 isolates (66.7%) were classified as MDR, indicating a high prevalence of multidrug resistance among the urinary pathogens analyzed.

Among the Gram-negative isolates, MDR was most frequently observed in *Escherichia coli*, with 13 out of 17 isolates (76.5%) resistant to multiple antibiotic classes. *Klebsiella* spp. exhibited MDR in 5 out of 7 isolates (71.4%), while *Pseudomonas* spp. had 6 of 9 isolates (66.7%) showing multidrug resistance. *Shigella* spp. and *Enterobacter* spp. demonstrated moderate MDR prevalence, with 4/7 (57.1%) and 2/4 (50.0%) isolates classified as MDR, respectively. Among Gram-positive isolates, *Enterococcus* spp. showed a lower MDR rate, with only 1 out of 3 isolates (33.3%) exhibiting multidrug resistance.

The MDR patterns were predominantly associated with resistance to β -lactams, aminoglycosides, and fluoroquinolones, indicating that commonly used first-line antibiotics may be ineffective against a substantial portion of these uropathogens.

Table 5: MDR distribution by species

Bacterial species	No. of Isolates	No. of MDR isolates	MDR %
<i>E.coli</i>	17	13	76.5
<i>Pseudomonas</i> spp.	9	6	66.7
<i>Klebsiella</i> spp.	7	5	71.4
<i>Shigella</i> spp.	7	4	57.1
<i>Enterobacter</i> spp.	4	2	50.0
<i>Proteus</i> spp.	4	3	75.0
<i>Enterococcus</i> spp.	3	1	33.3
Total	51	34	66.7

g. Urine Microscopy and Pus Cell Distribution

There was a strong correlation between UTI positivity and higher pus cell counts. The 3-5 (35.29%) and 6-8 (25.49%) pus cells/HPF categories accounted for the bulk of culture-positive samples, whereas the 0-2, 9-

-11, and 12-14 groups showed fewer cases. This pattern highlights the significance of pyuria as a supportive signal for UTI, as it is typically associated with a higher likelihood of bacterial growth.

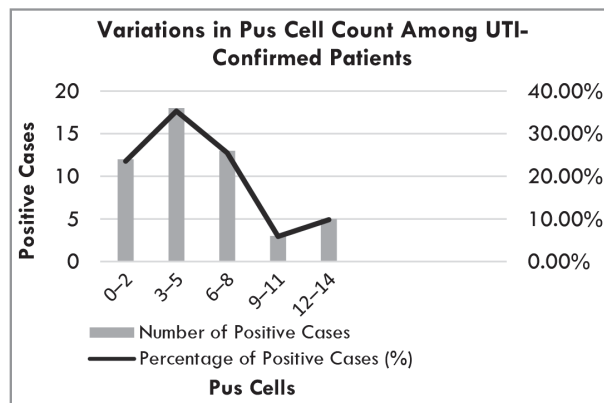


Figure 2 shows the distribution of pus cells per high-power field (HPF) in culture-positive urine samples. Most positive samples were associated with pus cell counts of 3–5/HPF (35.29%) and 6–8/HPF (25.49%). Fewer positive cultures were observed in samples with very low (0–2/HPF) or very high (>9/HPF) pus cell counts. This finding indicates that moderate pyuria is more commonly associated with significant bacteriuria, supporting the diagnostic value of urine microscopy.

h. Association between smoking status and urinary tract infection

A total of 151 participants were included in the study. The prevalence of urinary tract infection (UTI) was evaluated in relation to selected lifestyle factors. Smoking status was analyzed as a lifestyle factor to assess its association with UTI prevalence. Among 48 smokers, 37 (77.1%) were diagnosed with UTI, while 11 (22.9%) were UTI-negative. In contrast, among 103 non-smokers, 40 (38.8%) had a UTI and 63 (61.2%) did not.

Fisher's exact test demonstrated no statistically significant association between smoking status and the occurrence of UTI ($p = 0.12$)

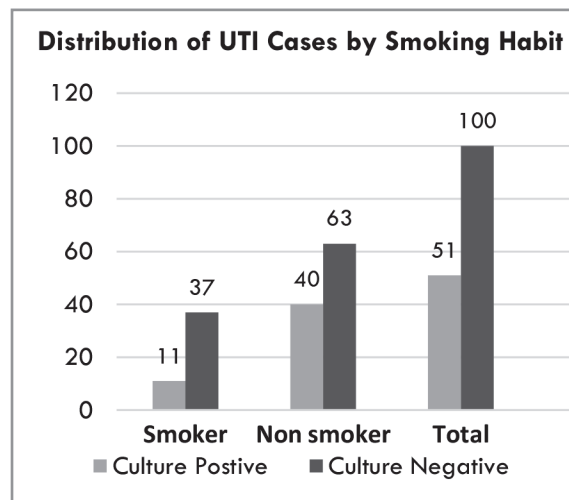


Figure 4 Presents the distribution of UTI cases based on smoking habits. Among smokers, 22.92% had significant bacteriuria, whereas 38.83% of non-smokers were culture-positive. Statistical analysis revealed no significant association between smoking and UTI occurrence ($P = 0.12$), indicating that smoking did not significantly influence UTI prevalence in the study population.

5. Discussion

The prevalence of urinary tract infections (UTIs) in the current study was 33.77%, which aligns with earlier reports from Nepal and other South Asian countries, where prevalence ranged from 23% to 37% (Kaur & Kaur, 2021). This indicates that UTIs remain a major public health concern in both hospital and community settings.

Demographic analysis revealed a significantly higher infection rate among females (40%) than among males (21.57%). This disparity is largely due to anatomical and hormonal factors that make females more susceptible to bacterial colonization, a trend well-documented worldwide (Chu & Lowder, 2018). Age-specific analysis showed that individuals aged 21-30 had the highest prevalence, reflecting patterns observed in South Asia and likely influenced by increased sexual activity, reproductive health factors, and lifestyle behaviors during this period (Foxman, 2014).

Microbiological examination demonstrated that *Escherichia coli* was the predominant pathogen, consistent with global observations, where *E. coli* remains the leading cause of UTIs due to virulence factors such as adhesins, fimbriae, and biofilm formation (Flores-Mireles et al., 2015). Less common pathogens, including *Pseudomonas aeruginosa* and *Shigella* spp., were also identified. Their presence may indicate hospital-acquired infections or environmental contamination, highlighting the need for stringent infection control practices (Ronald, 2002).

Antimicrobial susceptibility testing revealed that amikacin and piperacillin-tazobactam retained high efficacy, whereas older-generation antibiotics such as ceftazidime and nalidixic acid showed significant resistance. This

pattern reflects global trends of increasing antimicrobial resistance and underscores the necessity of judicious antibiotic use, frequent surveillance, and updating treatment guidelines based on regional resistance profiles (Yıldırım et al., 2025; Esposito et al., 2022; Mlugu et al., 2023; Raj KC et al., 2023). The rise of multidrug-resistant organisms presents a significant public health threat, emphasizing the importance of antimicrobial stewardship programs. The high prevalence of multidrug resistance observed in this study aligns with reports from other regions, where uropathogenic bacteria show widespread resistance to multiple antibiotic classes, significantly limiting effective treatment options and underscoring the urgent need for antimicrobial stewardship. Similar studies have documented MDR rates exceeding 65% among uropathogens and highlighted resistance to firstline agents such as β lactams and fluoroquinolones, necessitating reevaluation of empirical therapy protocols. These findings emphasize the importance of regular surveillance and optimized antibiotic policies to contain the spread of MDR organisms (Chowdhury et al., 2024).

Lifestyle factors such as smoking did not show a significant correlation with UTI incidence, consistent with previous studies suggesting that smoking may not directly influence UTI occurrence (Rabaeus et al., 2013). Other factors that can contribute to UTIs include poor hygiene, diabetes, urinary catheterization, pregnancy, and prior history of UTIs, all of which can increase susceptibility to infection.

Interestingly, although a substantial correlation was observed between pyuria (presence of pus cells in urine) and UTI, high pyuria levels did not always correspond to culture positivity. This discrepancy may be explained by sterile inflammation, prior antibiotic use suppressing bacterial growth, fastidious organisms not detected on routine culture, or contamination during sample collection (Chu & Lowder, 2018). Therefore, while pyuria is a useful early diagnostic marker, it should be interpreted alongside clinical findings and culture results to ensure an accurate diagnosis.

6. Conclusion

This study provides insight into the prevalence, etiological agents, and patterns of antibiotic resistance in urinary tract infections among patients at Kathmandu Medical College Public Limited. The overall prevalence was found to be 33.77%, with females, especially those in the reproductive age groups, having much higher rates of UTIs. *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Shigella* species remained the most common uropathogens, indicating a wide range of bacterial agents that cause UTIs. Amikacin and Piperacillin-Tazobactam demonstrated the highest efficacy across key isolates, whereas the antibiotic susceptibility study revealed substantial resistance to frequently administered antibiotics, including Ceftazidime, Cefaclor, and Nalidixic Acid. These results underscore the need for evidence-based, pathogen-specific treatment approaches and highlight the growing problem of antibiotic resistance.

All things considered, this study emphasizes the importance of routine urine culture and sensitivity testing for accurate diagnosis and appropriate antibiotic selection. To reduce the prevalence of UTIs and stop the spread of antibiotic resistance in Nepal, ongoing surveillance, prudent antibiotic use, and public health education are crucial.

7. Limitation and Direction of Study

Due to its small sample size and concentration on a single tertiary care facility, this study may not accurately reflect Nepal's overall population. Advanced molecular approaches to identify resistance genes were not used; instead, laboratory tests were limited to culture and biochemical identification. The observed patterns of infection and resistance may have been influenced by insufficient evaluation of clinical data, including comorbidities, prior antibiotic exposure, and specific lifestyle factors. To increase generalizability, larger and more varied patient populations from various healthcare facilities should be included in future research. The mechanisms of antibiotic resistance could be better understood by incorporating molecular diagnostic techniques. Furthermore, assessing clinical, behavioral, and environmental risk variables may help identify predictors of UTI occurrence and guide more focused prevention and management strategies.

8. Acknowledgment

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9. Conflict Of Interest

The authors declare that they have no competing financial or personal interests that could have influenced the work presented in this manuscript. The research was supported through a shared funding arrangement, with 50% of the financial resources provided by Himalayan White House International College and 50% contributed by the authors. Himalayan White House International College also supplied the laboratory materials and facilities required for the study. The funding sources had no involvement in the study design, data acquisition, analysis, interpretation, or the writing of the manuscript.

References

- Calzada, F. C., Aguilera-Correa, J. J., González, J. C., Moreno, J. E., Biosca, D. R., & Pérez-Tanoira, R. (2022). Urinary Tract Infection and Antimicrobial Susceptibility of Bacterial Isolates in Saint Joseph Kitgum Hospital, Kitgum, Uganda. *Antibiotics*, *11*(4). <https://doi.org/10.3390/antibiotics11040504>
- Chowdhury, S. S., Tahsin, P., Xu, Y., Mosaddek, A. S. M., Muhamadali, H., & Goodacre, R. (2024). Trends in Antimicrobial Resistance of Uropathogens Isolated from Urinary Tract Infections in a Tertiary Care Hospital in Dhaka, Bangladesh. *Antibiotics*, *13*(10), 925. <https://doi.org/10.3390/antibiotics13100925>
- Chu, C. M., & Lowder, J. L. (2018). Diagnosis and treatment of urinary tract infections across age groups. *American Journal of Obstetrics and Gynecology*, *219*(1), 40–51.
- Esposito, S., Biasucci, G., Pasini, A., Predieri, B., Vergine, G., Crisafi, A., Malaventura, C., Casadio, L., Sella, M., Pierantoni, L., Gatti, C., Paglialonga, L., Sodini, C., La Scola, C., Bernardi, L., Autore, G., Canto, G. D., Argentiero, A., Cantatore, S., ... Iughetti, L. (2022). Antibiotic Resistance in Pediatric Febrile Urinary Tract Infections. In *Journal of Global Antimicrobial Resistance* (Vol. 29, pp. 499–506). Elsevier Ltd. <https://doi.org/10.1016/j.jgar.2021.11.003>
- Flores-Mireles, A. L., Walker, J. N., Caparon, M., & Hultgren, S. J. (2015). Urinary tract infections: Epidemiology, mechanisms of infection and treatment options. In *Nature Reviews Microbiology* (Vol. 13, Issue 5, pp. 269–284). Nature Publishing Group. <https://doi.org/10.1038/nrmicro3432>
- Foxman, B. (2014). Urinary tract infection syndromes: occurrence, recurrence, bacteriology, risk factors, and disease burden. *Infectious Disease Clinics*, *28*(1), 1–13.
- Ganesh, R., Shrestha, D., Bhattachan, B., & Rai, G. (2019). Epidemiology of urinary tract infection and antimicrobial resistance in a pediatric hospital in Nepal. *BMC Infectious Diseases*, *19*(1). <https://doi.org/10.1186/s12879-019-3997-0>
- Kaur, R., & Kaur, R. (2021). Symptoms, risk factors, diagnosis, and treatment of urinary tract infections. In *Postgraduate Medical Journal* (Vol. 97, Issue 1154, pp. 803–812). BMJ Publishing Group. <https://doi.org/10.1136/postgradmedj-2020-139090>
- Lee, D. S., Lee, S. J., Choe, H. S., & Giacobbe, D. R. (2018). Community-Acquired Urinary Tract Infection by Escherichia coli in the Era of Antibiotic Resistance. In *BioMed Research International* (Vol. 2018). Hindawi Limited. <https://doi.org/10.1155/2018/7656752>
- Mancuso, G., Midiri, A., Gerace, E., Marra, M., Zummo, S., & Biondo, C. (2023). Urinary Tract Infections: The Current Scenario and Future Prospects. In *Pathogens* (Vol. 12, Issue 4). MDPI. <https://doi.org/10.3390/pathogens12040623>

- Mareş, C., Petca, R. C., Popescu, R. I., Petca, A., Muşescu, R., Bulai, C. A., Ene, C. V., Geavlete, P. A., Geavlete, B. F., & Jinga, V. (2024). Update on Urinary Tract Infection Antibiotic Resistance—A Retrospective Study in Females in Conjunction with Clinical Data. *Life*, *14*(1). <https://doi.org/10.3390/life14010106>
- Mlugu, E. M., Mohamedi, J. A., Sangeda, R. Z., & Mwambete, K. D. (2023). Prevalence of urinary tract infection and antimicrobial resistance patterns of uropathogenic biofilm-forming capacity among outpatients in Morogoro, Tanzania: a cross-sectional study. *BMC Infectious Diseases*, *23*(1). <https://doi.org/10.1186/s12879-023-08641-x>
- Rabaeus, M., Salen, P., & de Lorgeril, M. (2013). Is it smoking or related lifestyle variables that increase metabolic syndrome risk? *BMC Medicine*, *11*(1), 196.
- Raj KC, S., Timilsina, B., Gupta, R., Prasad Upadhyay, H., Adhikari, A., & Dhakal, R. (2023). Urinary Tract Infection, Bacteriological Profile and its Antibiotic Susceptibility in a Tertiary Center. *Nepal Medical Journal*, *5*(2), 44–49. <https://doi.org/10.37080/nmj.146>
- Ronald, A. (2002). The etiology of urinary tract infection: traditional and emerging pathogens. *The American Journal of Medicine*, *113*(1), 14–19.
- Sedhain, A., Sapkota, A., & Shrestha, B. (2019). Antibiotic sensitivity pattern in urinary tract infection among adults in the central part of Nepal. *Journal of Chitwan Medical College*, *9*(4), 18–23. <https://doi.org/10.3126/jcmc.v9i4.26894>
- Shaifali, I., Gupta, U., Mahmood, S. E., & Ahmed, J. (2012). Antibiotic susceptibility patterns of urinary pathogens in female outpatients. *North American Journal of Medical Sciences*, *4*(4), 163–169. <https://doi.org/10.4103/1947-2714.94940>
- Shakya, S., Edwards, J., Gupte, H. A., Shrestha, S., Shakya, B. M., Parajuli, K., Kattel, H. P., Shrestha, P. S., Ghimire, R., & Thekkur, P. (2021). High multidrug resistance in urinary tract infections in a tertiary hospital, Kathmandu, Nepal. *Public Health Action*, *11*(1), 24–31. <https://doi.org/10.5588/pha.21.0035>
- Swamy, M. V., Faraz, M. A. A., Mendem, S., Shubham, P., & Vinyas, M. (2020). Urinary Tract Infections: A Comprehensive Review. *International Journal of Current Microbiology and Applied Sciences*, *9*(7), 773–786. <https://doi.org/10.20546/ijcmas.2020.907.089>
- Usman Anjum, Dr. M., Safdar Khan, Dr. M., Shahid, Dr. A. R., & Humayun Shah, Dr. S. (2016). URINARY TRACT INFECTIONS; ETIOLOGICAL PROFILE AND ANTIMICROBIAL SUSCEPTIBILITY PATTERNS OF UROPATHOGENS. *The Professional Medical Journal*, *23*(01), 10–14. <https://doi.org/10.17957/tpmj/16.3044>
- Yıldırım, Ç., Sarı, S., Parmaksızoğlu Aydın, A. M., Kiliç Toker, A., Turunç Özdemir, A., Erdem Kıvrak, E., Mermer, S., Kahraman, H., Soysal, O., & Yıldırım, H. Ç. (2025). Extended-Spectrum Beta-Lactamase Production and Carbapenem Resistance in Elderly Urinary Tract Infection Patients: A Multicenter Retrospective Study from Turkey. *Antibiotics*, *14*(7), 719.