



Original Article

Prevalence and Antibiotic Susceptibility Pattern of Uropathogens Isolated from Urine Samples in a Tertiary Care Hospital January–June 2025

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ABSTRACT

Background: Urinary tract infections (UTIs) are among the most common bacterial infections worldwide and are increasingly associated with antimicrobial resistance. The rising prevalence of antimicrobial-resistant uropathogens, including multidrug-resistant organisms (MDROs) and carbapenem-resistant Enterobacteriaceae (CRE), has become a significant clinical challenge. Continuous monitoring of bacterial isolates and their antibiotic susceptibility patterns is essential to guide appropriate empirical therapy.

Aim: To determine the prevalence of uropathogens and evaluate their antimicrobial susceptibility patterns among urine samples received in the microbiology laboratory of a tertiary care hospital.

Materials and Methods: A retrospective study was conducted on 900 urine samples received in the microbiology laboratory between January and June 2025. Among these, 244 culture-positive urine samples were analysed. Organisms were identified using standard microbiological procedures, and antimicrobial susceptibility testing was performed using the automated VITEK 2 system. Results were interpreted according to the Clinical and Laboratory Standards Institute (CLSI) M100 guidelines, 2025 edition. Data obtained from laboratory records were compiled and analysed using descriptive statistical methods to determine the distribution of uropathogens and their antimicrobial susceptibility patterns.

Results: Among the 244 culture-positive samples, 223 (91.4%) were bacterial isolates and 21 (8.6%) were fungal isolates identified as *Candida* species. Of the bacterial isolates, 206 were pathogenic and 17 were commensals. Gram-negative organisms predominated, with *Escherichia coli* being the most common pathogen (130; 53.3%), followed by *Klebsiella pneumoniae* (34; 13.9%). Among Gram-positive bacteria, *Enterococcus* species accounted for 16 isolates, while *Staphylococcus* species were isolated in 2 cases. Multidrug resistance was observed, including 15 CRE *E. coli* isolates and 12 MDRO *Klebsiella pneumoniae*. Fosfomycin and tigecycline showed 100% sensitivity among *E. coli* isolates, while carbapenems and aminoglycosides demonstrated higher effectiveness compared to fluoroquinolones and third-generation cephalosporins. Linezolid, teicoplanin, and vancomycin showed high susceptibility against *Enterococcus* species.

Conclusion: *Escherichia coli* remains the predominant uropathogens in UTIs. High resistance to fluoroquinolones and cephalosporins highlights the need for continuous antibiogram surveillance to guide effective therapy and limit the spread of multidrug-resistant organisms.

Keywords: Urinary tract infection, antibiogram, antimicrobial resistance, *Escherichia coli*, *Klebsiella pneumoniae*, multidrug-resistant organisms, carbapenem-resistant Enterobacteriaceae.

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INTRODUCTION

Urinary tract infections (UTIs) are among the most common bacterial infections encountered in clinical practice and account for a significant proportion of healthcare visits worldwide. It is estimated that nearly 150 million people are affected by UTIs each year, leading to considerable morbidity and healthcare costs (1). UTIs may involve the lower urinary tract (cystitis) or the upper urinary tract (pyelonephritis) and occur in both community and hospital settings.

The majority of UTIs are caused by Gram-negative bacteria, with *Escherichia coli* being the most frequently isolated pathogen, followed by *Klebsiella pneumoniae*, *Proteus* species, and *Pseudomonas aeruginosa*. Gram-positive organisms such as *Enterococcus* species and *Staphylococcus saprophyticus* also contribute to a smaller proportion of cases (2). The increasing prevalence of antimicrobial resistance among these uropathogens has become a major public health concern.

In recent years, the emergence of multidrug-resistant organisms (MDROs), extended-spectrum beta-lactamase (ESBL) producers, and carbapenem-resistant Enterobacteriaceae (CRE) has complicated the management of UTIs (3). Inappropriate or excessive use of antibiotics has accelerated the development of resistance, thereby limiting therapeutic options. Continuous surveillance of antimicrobial susceptibility patterns is therefore essential for guiding empirical therapy and improving patient outcomes (4).

Local antibiogram data are particularly important because resistance patterns vary across geographical regions and healthcare institutions. Periodic monitoring of uropathogens and their susceptibility profiles helps clinicians select appropriate antimicrobial agents and implement effective infection control strategies (5).

Therefore, the present study was undertaken to determine the prevalence of uropathogens isolated from urine samples and to evaluate their antimicrobial susceptibility patterns in a tertiary care hospital.

MATERIALS AND METHODS

Study Design and Setting

A retrospective observational study was conducted in the Department of Microbiology at a tertiary care hospital. The study included urine samples received in the microbiology laboratory between January and June 2025.

Sample Size

During the study period, a total of 900 urine samples were processed in the microbiology laboratory. Among these, 244 samples that showed significant culture positivity were included in the study for further analysis.

Inclusion Criteria

- Urine samples received in the microbiology laboratory during the study period (January–June 2025).
- Samples showing significant culture positivity on microbiological examination.
- Samples from both inpatients and outpatients.

Exclusion Criteria

- Urine samples showing no bacterial growth.
- Contaminated samples or mixed growth with more than two organisms.
- Duplicate samples from the same patient collected within a short time period.

Sample Collection and Processing

Urine samples were collected using the standard clean-catch midstream urine collection method and transported to the microbiology laboratory under aseptic conditions. The samples were cultured on appropriate culture media, including Cysteine Lactose Electrolyte Deficient (CLED) agar and MacConkey agar, using the standard calibrated loop technique (0.001 mL loop).

The inoculated plates were incubated aerobically at 37°C for 18–24 hours. Significant bacteriuria was determined based on colony count criteria of $\geq 10^5$ colony-forming units (CFU)/mL, along with clinical correlation (6).

Identification of Isolates

Bacterial isolates were identified using standard microbiological procedures including colony morphology, Gram staining, and biochemical tests. Final identification of organisms was confirmed using the automated VITEK 2 system.

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility testing was performed using the VITEK 2 automated system. The results were interpreted according to the Clinical and Laboratory Standards Institute (CLSI) M100 guidelines, 2025 edition (7).

Data Analysis

Data obtained from laboratory records were compiled and analyzed using descriptive statistical methods. The prevalence of various uropathogens and their antimicrobial susceptibility patterns were expressed in terms of numbers and percentages.

RESULTS

A total of 900 urine samples were processed in the microbiology laboratory during the study period from January to June 2025. Among these, 244 samples (27.1%) showed significant culture positivity and were included for further analysis.

Among the 244 culture-positive samples, 223 (91.4%) were bacterial isolates, while 21 (8.6%) were fungal isolates identified as *Candida* species. Out of the 223 bacterial isolates, 206 (92.4%) were bacterial pathogenic organisms, whereas 17 (7.6%) were identified as commensals.

Among the bacterial pathogens, Gram-negative organisms predominated. *Escherichia coli* was the most frequently isolated pathogen with 130 isolates (53.3%), followed by *Klebsiella pneumoniae* with 34 isolates (13.9%). Among Gram-positive bacteria, *Enterococcus* species accounted for 16 isolates, while *Staphylococcus* species were isolated in 2 cases.

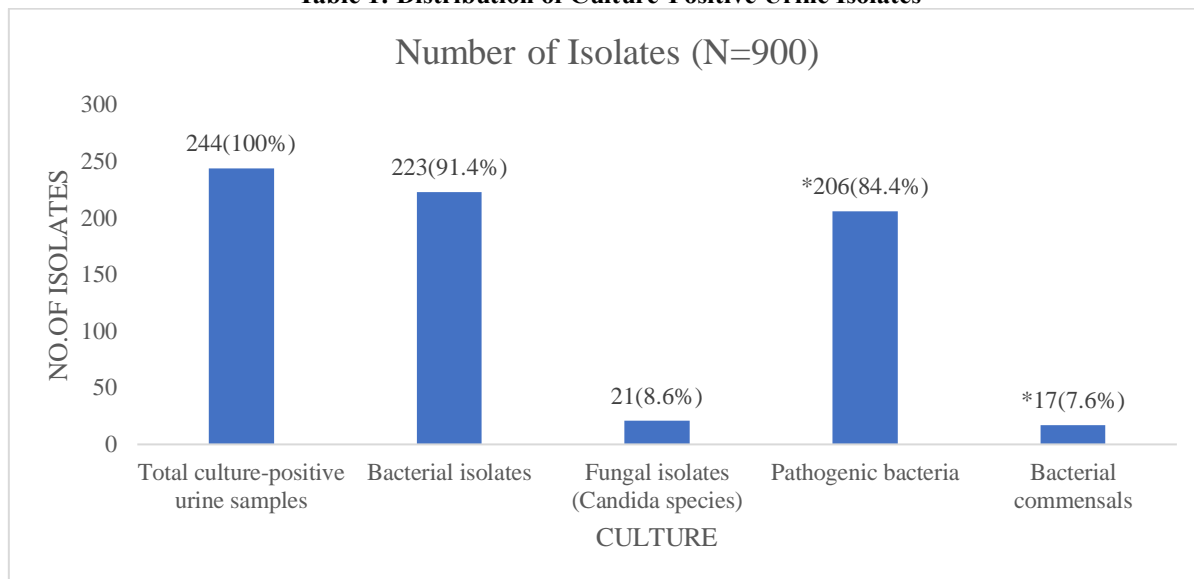
Analysis of antimicrobial susceptibility patterns showed a high level of multidrug resistance among Gram-negative uropathogens. A total of 15 carbapenem-resistant *E. coli* (CRE) isolates and 12 multidrug-resistant *Klebsiella pneumoniae* (MDRO) isolates were identified.

Among the antibiotics tested, fosfomycin and tigecycline demonstrated 100% sensitivity against *E. coli* isolates. Carbapenems and aminoglycosides showed relatively higher effectiveness, whereas fluoroquinolones and third-generation cephalosporins exhibited considerable resistance.

Among Gram-positive organisms, linezolid, teicoplanin, and vancomycin showed high susceptibility against *Enterococcus* species, indicating their continued effectiveness for treating infections caused by resistant Gram-positive bacteria.

Tables for Results Section

Table 1: Distribution of Culture-Positive Urine Isolates



*Percentages calculated out of total bacterial isolates (n = 223)

Table 2- Distribution of Uropathogens:

ORGANISMS	NO. OF UROPATHOGENES	Percentages%
MRSA	2	0.90%
<i>P.aeruginosa</i>	5	2.40%
<i>Acinetobacter.baumannii</i>	3	1.40%
<i>other Enterobacterales</i>	8	3.88%
<i>E. coli</i>	130	63.10%
<i>Klebsiella species</i>	34	17%
<i>Citrobacter /Enterobacter species</i>	8	3.88%

<i>Enterococcus species</i>	16	8%
TOTAL NO OF URINE ISOLATES	206	100%

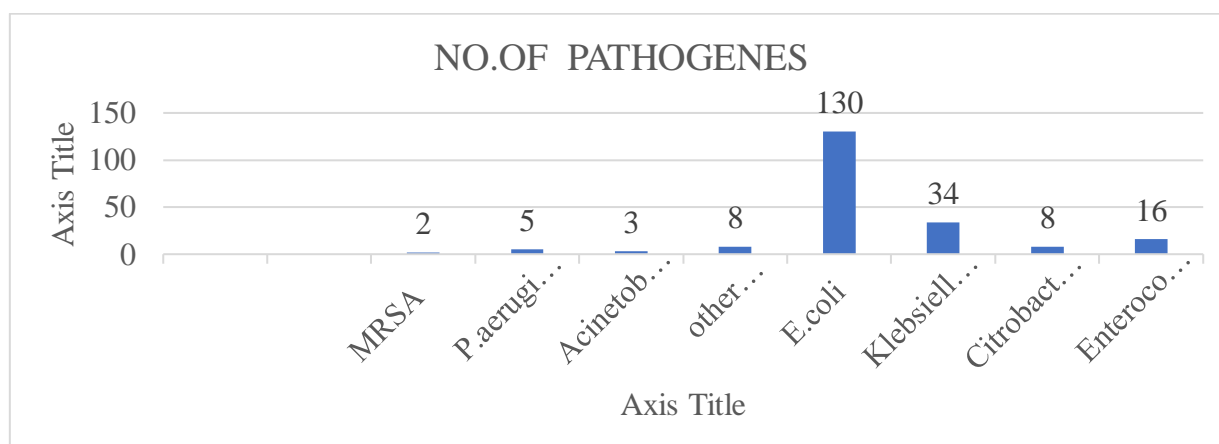


Table 3: Antimicrobial Susceptibility Pattern of *Escherichia coli* Isolates

S.No	Antibiotic	% Susceptible (S)	S (No.)	R (No.)	I (No.)
1	Amoxicillin/Clavulanic Acid	42%	55	18	57
2	Amikacin	76%	99	1	10
3	Aztreonam	15%	20	0	0
4	Ceftazidime	18%	24	0	0
5	Ciprofloxacin	5%	7	28	95
6	Ceftriaxone	12%	15	9	82
7	Colistin	0%	0	130	0
8	Cefuroxime	21%	27	4	99
9	Cefuroxime Axetil	21%	27	4	99
10	Ertapenem	75%	97	1	32
11	Cefepime	32%	42	11 (SDD)	77
12	Fosfomycin	100%	130	0	0
13	Gentamicin	66%	86	0	44
14	Imipenem	56%	73	2	15
15	Minocycline	31%	40	2	15
16	Levofloxacin	31%	40	0	0
17	Meropenem	87%	113	3	25
18	Cefoperazone/Sulbactam	48%	62	0	0
19	Trimethoprim/Sulfamethoxazole	49%	64	0	66
20	Tigecycline	100%	130	0	0
21	Piperacillin/Tazobactam	69%	90	2 (SDD)	38

DISCUSSION

Urinary tract infections remain a major cause of morbidity worldwide and are frequently encountered in both community and hospital settings. In the present study, a total of 244 culture-positive urine samples were analyzed to determine the distribution of uropathogens and their antimicrobial susceptibility patterns.

In this study, bacterial isolates accounted for the majority of culture-positive samples (91.4%), while fungal isolates due to *Candida* species constituted 8.6%. Similar findings have been reported in previous studies where bacterial pathogens were responsible for most UTIs (8).

Among bacterial pathogens, Gram-negative organisms predominated, with *Escherichia coli* being the most common isolate (53.3%), followed by *Klebsiella pneumoniae* (13.9%). This observation is consistent with several earlier studies that reported *E. coli* as the leading cause of UTIs due to its virulence factors, including adhesins and its ability to colonize the urinary tract (9).

Gram-positive organisms were less frequently isolated, with *Enterococcus* species accounting for a small proportion of cases. Similar patterns have been observed in previous reports where Gram-positive bacteria contributed to a minority of urinary infections (10).

The present study also highlights the growing problem of antimicrobial resistance among uropathogens. Multidrug resistance was observed in several isolates, including carbapenem-resistant *E. coli* and multidrug-resistant *Klebsiella pneumoniae*. The emergence of such resistant strains significantly limits therapeutic options and poses a challenge for clinicians (11).

Among the antibiotics tested, fosfomycin and tigecycline demonstrated high sensitivity against *E. coli* isolates. Carbapenems and aminoglycosides also showed relatively higher effectiveness compared to fluoroquinolones and third-generation cephalosporins, which exhibited considerable resistance. Similar resistance trends have been reported in recent surveillance studies on uropathogens (12).

Among Gram-positive isolates, linezolid, teicoplanin, and vancomycin showed high susceptibility against *Enterococcus* species, indicating their continued effectiveness for treating infections caused by resistant Gram-positive organisms.

Overall, the findings of this study emphasize the importance of periodic monitoring of local antibiogram patterns. Such surveillance helps guide empirical antibiotic therapy and supports antimicrobial stewardship programs aimed at reducing the spread of multidrug-resistant organisms.

CONCLUSION

Escherichia coli remains the predominant uropathogen in UTIs, with a high prevalence of multidrug-resistant strains. High resistance rates to fluoroquinolones and third-generation cephalosporins were observed, while fosfomycin, tigecycline, carbapenems, and aminoglycosides retained good activity against Gram-negative pathogens. Gram-positive uropathogens remained largely susceptible to linezolid, teicoplanin, and vancomycin.

Limitations of the Study

1. The study was retrospective and based on laboratory records; clinical correlation with patient outcomes was limited.
2. Molecular characterization of resistance genes (e.g., ESBL, carbapenemases) was not performed.

Despite these limitations, the study provides valuable local data on uropathogen prevalence and antimicrobial susceptibility, which is crucial for guiding empirical therapy in the hospital setting.

Conflict of interest

None declared

Funding

No external funding was received

Future Recommendations

Escherichia coli remains the predominant uropathogen in UTIs, with a high prevalence of multidrug-resistant strains. High resistance rates to fluoroquinolones and third-generation cephalosporins were observed, while fosfomycin, tigecycline, carbapenems, and aminoglycosides retained good activity against Gram-negative pathogens. Gram-positive uropathogens remained largely susceptible to linezolid, teicoplanin, and vancomycin.

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