

Spectrum and Prevalence of Urinary Pathogens in a Tertiary Care Hospital

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ABSTRACT

Background: Urinary tract infections (UTIs) are among the most frequently encountered bacterial infections in clinical practice. They contribute substantially to outpatient visits, hospital admissions, and antimicrobial use worldwide. Tertiary care hospitals, in particular, manage patients with complicated UTIs who often have underlying comorbidities, prolonged hospital stays, or prior antibiotic exposure, which can influence the spectrum of uropathogens. Continuous surveillance of local uropathogen profiles is therefore essential to guide appropriate empirical therapy and strengthen antimicrobial stewardship programs. The present study was undertaken to determine the spectrum and prevalence of bacterial pathogens isolated from urine specimens in a tertiary care hospital and to analyze their distribution with respect to inpatient and outpatient status as well as gender. **Material and Methods:** This was a descriptive cross-sectional study conducted in the Department of Microbiology at a tertiary care teaching hospital over a period of three months. A total of 110 urine samples were collected from patients clinically suspected of having UTIs, attending both inpatient (IPD) and outpatient (OPD) services, irrespective of age and gender. Midstream urine samples were collected aseptically in sterile containers, while catheterized samples were obtained from the catheter sampling port. Samples were processed within two hours of collection. Microscopic examination of uncentrifuged urine was performed, followed by culture on CLED agar, MacConkey agar, blood agar, and nutrient agar using a calibrated loop. Significant bacteriuria was defined as a colony count of

$\geq 10^5$ CFU/mL. Isolates were identified based on colony morphology, Gram staining, and standard biochemical tests. Data were analyzed using descriptive statistics and expressed as frequencies and percentages. **Results:** Out of 110 urine specimens, all yielded significant bacterial growth. *Escherichia coli* was the most predominant uropathogen, accounting for 45 isolates (41%). This was followed by coagulase-negative staphylococci (CONS) with 23 isolates (21%) and *Klebsiella* spp. with 19 isolates (17%). Other organisms isolated included *Enterococcus* spp. (9%), *Pseudomonas* spp. (6%), *Acinetobacter* spp. (3%), *Staphylococcus* spp. (2%), and *Proteus vulgaris* (1%). Overall, both IPD and OPD settings, Gram-negative organisms were more frequently isolated than Gram-positive cocci, with a higher isolation rate observed among inpatients. **Conclusion:** The study demonstrates that UTIs in a tertiary care hospital are predominantly caused by Gram-negative bacteria, with *Escherichia coli* remaining the leading uropathogen. The higher prevalence of infections among inpatients highlights the influence of hospitalization-related risk factors. Regular monitoring of local uropathogen distribution is essential to support effective empirical treatment and improve patient outcomes.

KEYWORDS: Urinary tract infection, Urinary pathogens, *Escherichia coli*, Bacterial profile

INTRODUCTION

Urinary tract infections (UTIs) are among the most common bacterial infections affecting humans worldwide and constitute a major cause of morbidity in both

community and hospital settings. They account for a significant proportion of outpatient visits and hospital admissions, resulting in considerable healthcare expenditure and antibiotic consumption^[1]. UTIs may affect individuals of all age groups and are particularly common in females, elderly patients, and those with underlying medical conditions^[2].

Clinically, UTIs range from uncomplicated infections involving the lower urinary tract to complicated infections affecting the upper urinary tract, often associated with structural abnormalities, catheterization, immunosuppression, or prolonged hospitalization^[3]. The burden of complicated UTIs is especially high in tertiary care hospitals, where patients frequently present with multiple comorbidities and prior exposure to broad-spectrum antimicrobials^[4].

Bacterial pathogens are the predominant etiological agents of UTIs. *Escherichia coli* remains the most frequently isolated uropathogen in both community-acquired and hospital-acquired infections^[5]. Other commonly reported organisms include *Klebsiella* species, *Pseudomonas aeruginosa*, *Enterococcus* species, *Proteus* species, and *Staphylococcus* species. The relative prevalence of these pathogens varies according to geographic location, patient population, and healthcare setting^[6].

Gram-negative bacilli account for the majority of UTI pathogens; however, Gram-positive cocci also play a significant role, particularly in hospitalized patients and those with indwelling urinary catheters^[7]. The emergence of antimicrobial resistance among uropathogens has further complicated the management of UTIs, emphasizing the need for continuous monitoring of local pathogen distribution and resistance trends^[8].

Tertiary care hospitals cater to a diverse patient population and often report a different microbial spectrum and higher resistance rates compared to primary and secondary care centers^[9]. Knowledge of the local prevalence and spectrum of urinary pathogens is therefore essential for guiding empirical therapy, optimizing antimicrobial stewardship programs, and improving patient outcomes^[10].

METHODOLOGY

This study was a descriptive cross-sectional study focusing on the laboratory identification of bacterial agents causing urinary tract infections. The work was undertaken in the Department of Microbiology, American International Institute of Medical Science College and Hospital, Udaipur. The study was conducted over a period of three months.

Study Subjects

Urine samples obtained from a total of 110 patients attending both outpatient and inpatient services, irrespective of age or gender, and clinically suspected to have urinary tract infection were included in the study.

Inclusion criteria

- Patients with clinical symptoms suggestive of UTI such as dysuria, increased frequency of micturition, urgency, suprapubic pain, fever, or flank pain.
- Patients who had not received antibiotics.

Exclusion criteria

- Samples that were inadequately collected or improperly labeled
- Specimens received after prolonged delay without refrigeration

Collection and Handling of Samples

Midstream urine samples were collected in sterile, leak-proof containers. In catheterized patients, urine was aspirated aseptically from the catheter sampling port. All specimens were transported immediately to the laboratory and processed within two hours. Samples were stored at 4°C if processing was delayed.

Microscopic Examination

Uncentrifuged urine samples were examined under the microscope using wet mount preparations to identify pus cells, red blood cells, epithelial cells, and bacteria. These findings were later correlated with culture results.

Bacteriological Culture

After gentle mixing, urine specimens were inoculated using a calibrated inoculating loop delivering 0.001 mL onto the Cysteine Lactose Electrolyte Deficient (CLED) agar, MacConkey agar, blood agar and nutrient agar. The inoculated plates were incubated aerobically at 37°C and examined after 18–24 hours. Blood agar plates were specifically observed for haemolytic reactions. Culture plates showing no growth were incubated for an additional 24 hours before being reported as negative.

Assessment of Significant Bacteriuria

The number of colonies obtained was multiplied by the loop factor to calculate bacterial count per millilitre. A colony count of $\geq 10^5$ CFU/mL was considered indicative of significant bacteriuria, as described by Kass, while lower counts were evaluated in relation to clinical symptoms and microscopy findings.

Identification of Isolates

Bacterial growth was identified through observation of colony characteristics on different culture media. Gram staining was done to determine cellular morphology and Gram reaction. Standard biochemical tests including catalase, oxidase, indole, citrate utilization, urease, triple sugar iron (TSI) agar reactions, and motility testing were performed. Identification was finalized using conventional microbiological criteria.

Quality Assurance

All culture media and reagents were prepared and tested according to standard protocols. Quality control strains were used to verify the performance of media and biochemical tests. Strict aseptic techniques were maintained throughout the study.

Data Recording and Analysis

Laboratory findings were entered into a structured proforma and later transferred to a spreadsheet for analysis. Data were summarized using descriptive statistics and presented as percentages.

Ethical Approval

Prior approval for the study was obtained from the Institutional Ethics Committee. Confidentiality of patient information was maintained, and samples were processed exclusively for research and diagnostic purposes.

RESULTS

A total of 110 bacterial isolates were recovered from urine specimens [Table. 1]. *Escherichia coli* was the most predominant uropathogen, accounting for 45 isolates (41%), followed by coagulase-negative staphylococci (CONS) with 23 isolates (21%). *Klebsiella* spp. constituted 19 isolates (17%), while *Enterococcus* spp. accounted for 10 isolates (9%). *Pseudomonas* spp. was isolated in 7 cases (6%). Less frequently isolated organisms included *Acinetobacter* spp. (3 isolates; 3%), *Staphylococcus* spp. (2 isolates; 2%), and *Proteus vulgaris* (1 isolate; 1%). Overall, Gram-negative bacteria predominated among the isolates, highlighting *E. coli* as the leading cause of urinary tract infections in the study population.

The gender-wise distribution of bacterial isolates from urine specimens among inpatient (IPD) and outpatient (OPD) populations is shown in [Table. 2]. Among IPD samples, a higher number of isolates were obtained from male patients (55 isolates) compared to female patients (26 isolates). In the OPD group, isolates were also more frequent in males (16 isolates) than females (13 isolates). *Escherichia coli* was the most commonly isolated organism in both IPD and OPD samples, with a predominance in males (IPD: 22 males vs. 11 females; OPD: 8 males vs. 4 females).

Microorganism Isolate	Number of Isolates	Percentage (%)
<i>E. coli</i>	45	41%
<i>Klebsiella</i> spp.	19	17%
<i>Pseudomonas</i> spp.	7	6%
<i>Proteus vulgaris</i>	1	1%
<i>Enterococcus</i> spp.	9	9%
<i>Acinetobacter</i> spp.	3	3%
CONS	23	21%
<i>Staphylococcus</i> spp.	2	2%
Total	110	100%

Table 1: Distribution of Bacterial Isolates from Urine Specimens

Klebsiella spp. were the second most frequent isolates, mainly recovered from male IPD patients (13 isolates), with fewer isolates from females and OPD patients. *Pseudomonas* spp. was predominantly isolated from male IPD patients (5 isolates), with minimal representation in OPD samples. Overall, the results indicate a higher prevalence of urinary tract infections among male patients, particularly in the inpatient setting, with *E. coli* remaining the predominant uropathogen across both genders and clinical settings.

Microorganism	IPD Male	IPD Female	OPD Male	OPD Female
<i>E. coli</i>	22	11	8	4
<i>Klebsiella</i> spp.	13	4	1	1
<i>Pseudomonas</i> spp.	5	0	1	1
<i>Proteus vulgaris</i>	1	0	0	0
<i>Acinetobacter</i> spp.	0	2	1	0
<i>Enterococcus</i> spp.	4	2	1	3
CONS	10	6	4	3
<i>Staphylococcus</i> spp.	0	1	0	1
Total	55	26	16	13

Table 2: Gender-wise Distribution of bacterial isolates from the Urine Specimens

The IPD–OPD wise distribution of urinary isolates is shown in [Table. 3]. Among IPD isolates, Gram-negative bacilli (GNB) predominated, accounting for 58 isolates, while Gram-positive cocci (GPC) constituted 23 isolates. Similarly, in OPD samples, GNB were more frequently isolated (17 isolates) compared to GPC (12 isolates). Overall, Gram-negative bacilli were the predominant pathogens in both IPD and OPD urine specimens, with a higher overall isolation rate observed in the inpatient setting compared to the outpatient setting.

Type of Specimen	Type of Microorganism	IPD (81)	OPD (29)
Urine	GNB	58	17
Urine	GPC	23	12

Table 3: IPD-OPD wise Distribution of Gram - negative bacilli and Gram - positive cocci

DISCUSSION

This study investigated the spectrum and prevalence of urinary pathogens isolated from urine specimens at a tertiary care hospital, demonstrating several important epidemiological patterns when compared with similar studies both internationally and within India.

In our findings, *Escherichia coli* was the most predominant uropathogen, accounting for 41% of isolates, followed by coagulase-negative staphylococci (21%) and *Klebsiella* spp. (17%). This pattern parallels epidemiological data from large tertiary care settings, where *E. coli* consistently emerges as the most frequent pathogen in UTI cases due to its virulence factors and adaptability within the urinary tract^[1]. A retrospective tertiary care study from North West India also reported *E. coli* as the leading isolate (45.7%), followed by coagulase-negative staphylococci and *Klebsiella* spp., underscoring the consistency of *E. coli* predominance in Indian hospital settings^[11].

The high rate of Gram-negative bacilli in our study is consistent with broader global and regional observations. Another multicentric Indian epidemiological analysis reported that *E. coli* and *Klebsiella pneumoniae* collectively accounted for a large majority of community UTI cases, reflecting the prominence of Enterobacteriaceae in urinary infections^[12]. This supports the conclusion that Gram-negative organisms dominate the uropathogen profile in both community and hospital environments.

Compared to some international data where Gram-positive and non-fermenters occasionally contribute more substantially to the uropathogen load, the Indian data maintains a higher relative proportion of *E. coli* and *Klebsiella* spp., which may relate to differences in patient demographics, antibiotic exposure, and healthcare practices^[12, 13].

Gender-wise distribution in our study showed a higher number of male inpatient isolates, this finding may be attributed to increased catheterization, prolonged hospitalization, and underlying comorbidities among male patients. Whereas many Indian community studies report higher UTI prevalence in females, particularly in outpatient community settings.¹⁴ This discrepancy likely reflects the tertiary care population, where males with comorbid conditions or catheterization may be over-represented. In contrast, community-based studies often

find a female predominance because of anatomical predisposition and hygiene practices leading to higher UTI susceptibility^[15].

The isolation of *Pseudomonas* spp., although less frequent in our study, is clinically important given its association with nosocomial and complicated UTIs. Similar low but significant rates of *Pseudomonas* have been documented in other Indian tertiary studies, emphasizing the need for careful surveillance due to its intrinsic and acquired resistance mechanisms^[16].

Our findings reinforce the need for periodic local surveillance of uropathogen prevalence and antimicrobial sensitivity because of evolving patterns of resistance and pathogen distribution. This is especially relevant in tertiary hospitals, where empirical therapy must be guided by updated local data to enhance clinical outcomes and reduce the emergence of resistant strains.

CONCLUSION

This study demonstrates that urinary tract infections in a tertiary care hospital are predominantly caused by Gram-negative bacteria, with *Escherichia coli* being the most common uropathogen. A higher number of isolates were obtained from inpatients, reflecting the impact of hospitalization and associated risk factors. The presence of both Gram-negative and Gram-positive organisms highlights the diverse etiological profile of UTIs in tertiary care settings. Regular surveillance of local uropathogen patterns is essential to support appropriate empirical therapy and strengthen antimicrobial stewardship efforts.

DISCLOSURE

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