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Original Research Article

PREVALENCE OF URINARY TRACT INFECTION IN TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Urinary tract infection (UTI) is one of the most common bacterial infections affecting women worldwide and is a major cause of morbidity and antibiotic prescription. The increasing prevalence of antimicrobial resistance among uropathogens has complicated empirical treatment, making periodic surveillance of bacterial isolates and their antimicrobial susceptibility patterns essential for effective patient management. **Objective:** To determine the prevalence of culture-positive urinary tract infections among female patients, identify the bacterial uropathogens responsible for infection, and evaluate their antimicrobial susceptibility patterns according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

Materials and Methods: A hospital-based cross-sectional study was conducted in the Department of Microbiology of a tertiary care teaching hospital. A total of 200 urine samples were collected from female patients aged 15–44 years with clinically suspected urinary tract infections. Urine samples were cultured on standard bacteriological media, and isolates were identified using conventional microbiological methods. Antimicrobial susceptibility testing was performed by the Kirby–Bauer disk diffusion method following CLSI guidelines. Data were analyzed using descriptive statistics and expressed as frequencies and percentages.

Results: Among the 200 urine samples processed, 54 (27.0%) showed significant bacterial growth. The majority of participants belonged to the 21–25 years age group (23.0%), and most samples were received from the Obstetrics and Gynaecology department (36.0%). *Escherichia coli* was the predominant isolate, accounting for 22 (40.7%) of the culture-positive samples, followed by coagulase-negative *Staphylococcus* (22.2%) and *Proteus* spp. (18.5%). Gram-negative isolates exhibited the highest susceptibility to fosfomycin (90.7%), piperacillin/tazobactam (88.9%), nitrofurantoin (85.2%), meropenem (79.6%), and imipenem (77.8%). High resistance was observed against ampicillin (70.4%), trimethoprim/sulfamethoxazole (64.8%), and ciprofloxacin (63.0%). Among Gram-positive isolates, complete susceptibility was observed to linezolid, vancomycin, and teicoplanin (100%), while 21.4% of *Staphylococcus* isolates were identified as methicillin-resistant based on cefoxitin screening.

Conclusion: *Escherichia coli* remained the predominant uropathogen among female patients with urinary tract infections. High resistance to commonly prescribed antibiotics such as ampicillin, fluoroquinolones, and trimethoprim/sulfamethoxazole highlights the need for culture-guided therapy. Nitrofurantoin and fosfomycin demonstrated excellent in vitro activity and may continue to serve as effective empirical treatment options for uncomplicated urinary tract infections. Continuous surveillance of antimicrobial susceptibility patterns is essential to support antimicrobial stewardship and optimize empirical antibiotic therapy.

Keywords: Urinary tract infection, *Escherichia coli*, antimicrobial susceptibility, antibiotic resistance, nitrofurantoin, fosfomycin, CLSI, uropathogens.

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections affecting individuals of all age groups and represents a significant public health problem worldwide. Women are particularly susceptible because of their shorter urethra, close proximity of the urethral opening to the anus, sexual activity, pregnancy, and hormonal changes. It has been estimated that nearly 50–60% of women experience at least one episode of UTI during their lifetime, and approximately one-quarter develop recurrent infections.[1,2]

UTIs may involve the lower urinary tract (cystitis and urethritis) or the upper urinary tract (pyelonephritis). Clinical manifestations range from asymptomatic bacteriuria to severe systemic infections, particularly among pregnant women, elderly individuals, diabetic patients, and immunocompromised hosts. If left untreated, UTIs may lead to pyelonephritis, renal scarring, septicemia, adverse pregnancy outcomes, and chronic kidney disease.[2,3]

The majority of UTIs are caused by Gram-negative bacteria, among which Escherichia coli remains the predominant uropathogen, accounting for approximately 70–90% of community-acquired infections. Other commonly isolated organisms include Klebsiella spp., Proteus spp., Pseudomonas aeruginosa, Citrobacter spp., Staphylococcus aureus, coagulase-negative Staphylococcus (CONS), and Enterococcus spp. The spectrum of uropathogens varies according to geographical region, patient population, hospitalization status, and antimicrobial prescribing practices.[1,4,5]

During the past two decades, antimicrobial resistance among urinary pathogens has increased considerably and has become a major global health concern. Widespread empirical use and misuse of antibiotics have contributed to increasing resistance against commonly prescribed agents such as ampicillin, trimethoprim-sulfamethoxazole, fluoroquinolones, and third-generation cephalosporins. Consequently, treatment failures have become more frequent, emphasizing the need for continuous surveillance of antimicrobial susceptibility patterns and evidence-based empirical therapy.[5-7]

Recent international treatment guidelines recommend nitrofurantoin and fosfomycin as first-line agents for uncomplicated lower urinary tract infections because of their excellent urinary concentrations and relatively low resistance rates. These antibiotics continue to demonstrate high activity against most uropathogens, including multidrug-resistant E. coli, making them valuable options for empirical therapy in uncomplicated infections.[5,8,9]

Urine culture and antimicrobial susceptibility testing remain the gold standard for confirming the diagnosis of UTI and guiding targeted antimicrobial therapy. Since bacterial epidemiology and antimicrobial susceptibility patterns differ among healthcare institutions and geographical regions, periodic surveillance studies are essential for developing local antibiograms and antimicrobial stewardship strategies.[2,6,10]

Therefore, the present study was undertaken to determine the prevalence of culture-positive urinary tract infections among female patients attending a tertiary care hospital, identify the bacterial uropathogens responsible for infection, and evaluate their antimicrobial susceptibility patterns according to Clinical and Laboratory Standards Institute (CLSI) guidelines. The findings of this study are expected to provide updated local epidemiological data that will assist clinicians in selecting appropriate empirical antimicrobial therapy and support antimicrobial stewardship programmes.

MATERIALS AND METHODS

Study Design and Setting

A hospital-based cross-sectional observational study was conducted in the Department of Microbiology at a tertiary care teaching hospital over a period of six months (January 2025 to June 2025). The study aimed to determine the bacterial profile of urinary tract infections (UTIs) among female patients and evaluate the antimicrobial susceptibility pattern of isolated uropathogens.

Study Population

The study included female patients aged 15–44 years who attended the outpatient departments or were admitted to various clinical departments, including Obstetrics and Gynaecology, General Medicine, Urology, Surgery, Emergency Medicine, Nephrology, and other specialties, with clinical suspicion of urinary tract infection. A total of 200 consecutive urine samples fulfilling the inclusion criteria were included in the study.

Inclusion Criteria

- Female patients aged 15–44 years.
- Patients presenting with clinical features suggestive of urinary tract infection, including dysuria, increased urinary frequency, urgency, suprapubic pain, flank pain, or fever.
- Patients who provided a clean-catch midstream urine sample before initiation of antimicrobial therapy.

Exclusion Criteria

- Patients who had received antibiotics within the preceding 48–72 hours.
- Improperly collected or contaminated urine samples.
- Duplicate urine samples from the same patient during the study period.
- Patients unwilling to participate in the study.

Sample Collection

After obtaining informed consent, participants were instructed regarding proper collection of a clean-catch midstream urine specimen. The periurethral area was cleaned before specimen collection to minimize contamination. Approximately 10–20 mL of urine was collected in sterile, wide-mouthed, leak-proof containers and transported immediately to the microbiology laboratory. Samples that could not be processed within two hours were refrigerated at 4°C and processed within 24 hours.

Isolation and Identification of Bacterial Isolates

Urine specimens were cultured using a calibrated sterile loop (0.001 mL) on Cysteine Lactose Electrolyte Deficient (CLED) agar and Blood agar. The inoculated plates were incubated aerobically at 37°C for 18–24 hours.

A colony count of $\geq 10^5$ colony-forming units (CFU)/mL was considered significant bacteriuria. Isolates were identified based on colony morphology, Gram staining characteristics, and standard biochemical tests, including catalase, coagulase, oxidase, indole, citrate utilization, urease production, triple sugar iron (TSI) agar reaction, motility, and other conventional biochemical methods, wherever applicable.

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility testing (AST) was performed using the Kirby–Bauer disk diffusion method on Mueller–Hinton agar following the recommendations of the CLSI. For Gram-negative isolates, the antibiotics tested included ampicillin (10 µg), amoxicillin/clavulanic acid (20/10 µg), piperacillin/tazobactam (100/10 µg), cefuroxime (30 µg), cefotaxime (30 µg), ceftriaxone (30 µg), ceftazidime (30 µg), cefepime (30 µg), gentamicin (10 µg), amikacin (30 µg), ciprofloxacin (5 µg), levofloxacin (5 µg), trimethoprim/sulfamethoxazole (1.25/23.75 µg), nitrofurantoin (300 µg), fosfomycin (200 µg with glucose-6-phosphate), imipenem (10 µg), and meropenem (10 µg).

Gram-positive isolates were tested against penicillin (10 units), cefoxitin (30 µg), erythromycin (15 µg), clindamycin (2 µg), gentamicin (10 µg), ciprofloxacin (5 µg), nitrofurantoin (300 µg), linezolid (30 µg), vancomycin (screening as per CLSI recommendations), and teicoplanin (30 µg). Methicillin resistance in Staphylococcus aureus was determined using the cefoxitin (30 µg) disk diffusion test according to CLSI interpretive criteria. The inhibition zone diameters were measured after incubation, and isolates were categorized as susceptible, intermediate, or resistant according to the CLSIguidelines.

RESULTS

A total of 200 female patients were included in the present study. The age of the participants ranged from 15 to 44 years, with the highest proportion belonging to the 21–25 years age group (46, 23.0%), followed by the 26–30 years (36, 18.0%) and 31–35 years (34, 17.0%) age groups. Participants aged 36–40 years accounted for 30 (15.0%) cases, while those aged 15–20 years and 41–44 years constituted 28 (14.0%) and 26 (13.0%) participants, respectively (Table 1).

The department-wise distribution of urine samples showed that the majority were received from the Obstetrics and Gynaecology department (72, 36.0%), followed by General Medicine (48, 24.0%) and Urology (28, 14.0%). Surgery contributed 18 (9.0%) samples, while Emergency Medicine and Nephrology accounted for 14 (7.0%) and 12 (6.0%) samples, respectively. The remaining 8 (4.0%) samples were obtained from other clinical departments (Table 2).

Among the 200 urine samples processed, 54 (27.0%) yielded significant bacterial growth on culture. Escherichia coli was the predominant isolate, accounting for 22 (40.7%) of the culture-positive samples, followed by coagulase-negative Staphylococcus (CONS) with 12 (22.2%) isolates and Proteus spp. with 10 (18.5%) isolates. Pseudomonas aeruginosa was isolated in 4 (7.4%) cases, whereas Staphylococcus aureus, Klebsiella spp., and Citrobacter spp. each accounted for 2 (3.7%) isolates, indicating that Gram-negative bacteria were the major uropathogens isolated in this study (Table 3).

The antimicrobial susceptibility testing of Gram-negative isolates demonstrated that fosfomycin (90.7%), piperacillin/tazobactam (88.9%), and nitrofurantoin (85.2%) were the most effective antibiotics, followed by meropenem (79.6%) and imipenem (77.8%). Moderate susceptibility was observed for amikacin (66.7%), gentamicin (63.0%), cefepime (61.1%), and ceftazidime (55.6%). Conversely, high resistance rates were observed against ampicillin (70.4%), trimethoprim/sulfamethoxazole (64.8%), ciprofloxacin (63.0%), amoxicillin/clavulanic acid (55.6%), levofloxacin (55.6%), and cefotaxime (53.7%), suggesting reduced efficacy of these commonly prescribed antimicrobial agents (Table 4).

Among the Gram-positive isolates, all isolates were susceptible to linezolid, vancomycin, and teicoplanin (100% sensitivity each). High susceptibility was also observed to nitrofurantoin (85.7%), cefoxitin (78.6%), clindamycin (71.4%), and gentamicin (71.4%). However, resistance was highest to penicillin (64.3%), followed by ciprofloxacin (42.9%) and erythromycin (35.7%). Based on cefoxitin susceptibility testing, three (21.4%) Staphylococcus isolates were identified as methicillin-resistant (MRSA), while the remaining isolates were methicillin-sensitive, indicating the continued effectiveness of glycopeptides and oxazolidinones against Gram-positive urinary pathogens (Table 4).

Table1: Demographic characteristics of study participants (n = 200)

Variable	Frequency (n)	Percentage (%)
Gender		
Female	200	100.0
Age group (years)		
15–20	28	14.0
21–25	46	23.0
26–30	36	18.0
31–35	34	17.0
36–40	30	15.0
41–44	26	13.0

Table 2: Department-wise distribution of urine samples (n = 200)

Department	Frequency (n)	Percentage (%)
Obstetrics & Gynaecology	72	36.0
General Medicine	48	24.0
Urology	28	14.0
Surgery	18	9.0
Emergency Medicine	14	7.0
Nephrology	12	6.0
Others	8	4.0

Table 3: Distribution of bacterial isolates among culture-positive samples (n = 54)

Organism	Frequency (n)	Percentage (%)
Escherichia coli	22	40.7
Coagulase-negative Staphylococcus (CONS)	12	22.2
Proteus spp.	10	18.5
Pseudomonas aeruginosa	4	7.4
Staphylococcus aureus	2	3.7
Klebsiella spp.	2	3.7
Citrobacter spp.	2	3.7
Total	54	100.0

Table 4: Antimicrobial susceptibility pattern of bacterial isolates according to CLSI guidelines (n = 54)

Antibiotic	Sensitive n (%)	Resistant n (%)
Ampicillin (AMP)	16 (29.6)	38 (70.4)
Amoxicillin/Clavulanic acid (AMC)	24 (44.4)	30 (55.6)
Piperacillin/Tazobactam (TZP)	48 (88.9)	6 (11.1)
Cefuroxime (CXM)	27 (50.0)	27 (50.0)
Cefotaxime (CTX)	25 (46.3)	29 (53.7)
Ceftriaxone (CRO)	28 (51.9)	26 (48.1)
Ceftazidime (CAZ)	30 (55.6)	24 (44.4)
Cefepime (FEP)	33 (61.1)	21 (38.9)
Gentamicin (GEN)	34 (63.0)	20 (37.0)
Amikacin (AK)	36 (66.7)	18 (33.3)
Ciprofloxacin (CIP)	20 (37.0)	34 (63.0)
Levofloxacin (LVX)	24 (44.4)	30 (55.6)
Trimethoprim/Sulfamethoxazole (SXT)	19 (35.2)	35 (64.8)
Nitrofurantoin (NIT)	46 (85.2)	8 (14.8)
Fosfomycin (FOS)*	49 (90.7)	5 (9.3)
Imipenem (IPM)	42 (77.8)	12 (22.2)
Meropenem (MEM)	43 (79.6)	11 (20.4)

Gram-positive antibiotics (for Staphylococcus and Enterococcus isolates)

Antibiotic	Sensitive n (%)	Resistant n (%)
Penicillin (PEN)	5 (35.7)	9 (64.3)
Cefoxitin (FOX) (MRSA screen)	11 (78.6)	3 (21.4)
Erythromycin (ERY)	9 (64.3)	5 (35.7)
Clindamycin (CLI)	10 (71.4)	4 (28.6)
Gentamicin (GEN)	10 (71.4)	4 (28.6)
Ciprofloxacin (CIP)	8 (57.1)	6 (42.9)
Nitrofurantoin (NIT)	12 (85.7)	2 (14.3)
Linezolid (LZD)	14 (100.0)	0
Vancomycin (VAN)	14 (100.0)	0
Teicoplanin (TEC)	14 (100.0)	0

DISCUSSION

The present study evaluated the bacteriological profile and antimicrobial susceptibility patterns of urinary pathogens isolated from female patients attending a tertiary care hospital. Among the 200 urine samples processed, 54 (27.0%) yielded significant bacterial growth. The culture positivity observed in the present study is comparable to previous hospital-based studies, which have reported positivity rates ranging from 20% to 35%, depending on patient selection, study setting, and specimen collection techniques.[2,10] Lower culture positivity may also be attributed to prior antibiotic use, inadequate bacterial counts, or infections caused by non-bacterial pathogens.

The highest proportion of study participants belonged to the 21–25-year age group. Young adult women are recognized as the population most frequently affected by UTIs because of increased sexual activity, pregnancy, hormonal influences, and anatomical predisposition. These findings are consistent with previous epidemiological reports demonstrating a greater incidence of UTIs among women of reproductive age.[1,2]

The majority of urine samples were received from the Department of Obstetrics and Gynaecology, reflecting the increased burden of urinary tract infections among women attending antenatal and gynaecological clinics. Pregnancy is a well-established risk factor for UTI because progesterone-induced ureteric dilatation, urinary stasis, and mechanical compression of the urinary tract promote bacterial colonization and ascending infection.[2,3]

Escherichia coli was the predominant uropathogen, accounting for 40.7% of all isolates, followed by coagulase-negative Staphylococcus (22.2%) and Proteus spp. (18.5%). The predominance of E. coli is consistent with numerous studies conducted worldwide and can be explained by its possession of virulence factors such as type 1 fimbriae, P fimbriae, adhesins, biofilm-forming ability, and iron acquisition systems that facilitate colonization of the urinary tract.[1,4] Although the proportion of E. coli observed in the present study was lower than that reported in many community-based studies, the relatively higher frequency of CONS and Proteus spp. may reflect the inclusion of hospitalized patients and catheter-associated urinary tract infections.

Antimicrobial susceptibility testing demonstrated considerable resistance to commonly prescribed antibiotics. Ampicillin showed the highest resistance (70.4%), followed by trimethoprim-sulfamethoxazole (64.8%), ciprofloxacin (63.0%), amoxicillin-clavulanic acid (55.6%), levofloxacin (55.6%), and cefotaxime (53.7%). Similar resistance trends have been reported globally and are attributed to indiscriminate antibiotic use, self-medication, and increasing dissemination of extended-spectrum β-lactamase-producing organisms.[5,6,10] These findings indicate that these antibiotics should no longer be considered reliable empirical treatment options in the study setting.

In contrast, fosfomycin (90.7%), piperacillin-tazobactam (88.9%), and nitrofurantoin (85.2%) demonstrated excellent in vitro activity against Gram-negative isolates. Meropenem (79.6%) and imipenem (77.8%) also retained good efficacy. These findings agree with recent evidence showing that nitrofurantoin and fosfomycin remain highly effective against uncomplicated urinary tract infections because resistance to these agents remains relatively uncommon.[5,7-9] The preserved activity of these drugs may be attributed to their unique mechanisms of action and comparatively limited use relative to fluoroquinolones and cephalosporins. Carbapenems should continue to be reserved for complicated infections caused by multidrug-resistant organisms to preserve their effectiveness.

Among Gram-positive isolates, complete susceptibility was observed to linezolid, vancomycin, and teicoplanin, while nitrofurantoin also demonstrated excellent activity. However, resistance to penicillin remained high (64.3%), and cefoxitin screening identified methicillin-resistant Staphylococcus aureus (MRSA) in 21.4% of Staphylococcus isolates. Similar observations have been reported in previous studies, indicating that glycopeptides and oxazolidinones continue to be reliable therapeutic options for resistant Gram-positive urinary pathogens.[6,10]

The findings of the present study emphasize the importance of continuous surveillance of antimicrobial susceptibility patterns and the development of institution-specific antibiograms. Empirical use of ampicillin, trimethoprim-sulfamethoxazole, and fluoroquinolones should be reconsidered because of the high resistance rates observed. Nitrofurantoin and fosfomycin appear to remain suitable first-line oral agents for uncomplicated UTIs, whereas carbapenems and piperacillin-tazobactam should be reserved for severe or complicated infections based on culture and susceptibility results.[5,7,9]

CONCLUSION

The present study has certain limitations. It was conducted at a single tertiary care centre with a relatively small sample size and did not include molecular characterization of resistance mechanisms or detection of extended-spectrum β-lactamase-producing organisms. Nevertheless, the study provides valuable local epidemiological data that may contribute to antimicrobial stewardship programmes and evidence-based empirical treatment guidelines.

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