



Original Article

Bacteriological Profile and Antibiotic Sensitivity Pattern of Urinary Tract Infections Among Pediatric and Adult Patients In A Tertiary Care Centre

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ABSTRACT

Background: Urinary tract infection (UTI) is one of the most common bacterial infections affecting both pediatric and adult populations. Increasing antimicrobial resistance among uropathogens has become a major challenge in clinical management.

Aim; To study the bacteriological profile and antibiotic sensitivity pattern of urinary tract infections among pediatric and adult patients attending Barpeta Medical College and Hospital.

Materials and Methods; This prospective observational study was conducted over a period of one year in the Department of Microbiology at Barpeta Medical College and Hospital. A total of 250 patients with clinically suspected UTI were included in the study. Midstream urine samples were collected and processed using standard microbiological techniques. Conventional biochemical methods identified isolated organisms, and antibiotic susceptibility testing was performed using the Kirby–Bauer disc diffusion method according to CLSI guidelines.

Results; Out of 250 urine samples, 162 (64.8%) showed significant bacterial growth. Females (64.2%) were more commonly affected than males (35.8%). The highest prevalence was observed in the 21–40 years age group. *Escherichia coli* (56.8%) was the predominant isolate followed by *Klebsiella pneumoniae* (17.3%). Gram-negative isolates showed the highest sensitivity to Imipenem, Meropenem, Piperacillin-Tazobactam, and Nitrofurantoin, while high resistance was observed against Ceftriaxone and Cotrimoxazole.

Conclusion; The study demonstrated that *Escherichia coli* is the major uropathogen causing UTI. Increasing antimicrobial resistance among urinary isolates highlights the importance of routine urine culture, antibiotic susceptibility testing, and rational antibiotic use for effective management of urinary tract infections.

Keywords: Urinary tract infection, Uropathogens, Antibiotic sensitivity, Antimicrobial resistance, *Escherichia coli*, Urine culture.

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections affecting individuals of all age groups worldwide. It is a major public health problem associated with significant morbidity, increased healthcare expenditure, and reduced quality of life, particularly among pediatric patients, women, elderly individuals, and hospitalized patients (1). UTI occurs when pathogenic microorganisms invade any part of the urinary tract including the urethra, bladder, ureters, or kidneys. The disease spectrum ranges from asymptomatic bacteriuria to severe pyelonephritis and urosepsis (2).

Globally, approximately 150 million people are diagnosed with UTIs annually, making it one of the leading causes of hospital visits and antibiotic prescriptions (3). Females are more frequently affected due to anatomical and physiological factors such as shorter urethra, proximity of the urethral opening to the anal region, and hormonal influences (4). In

pediatric populations, congenital anomalies of the urinary tract, poor hygiene, and vesicoureteral reflux are important predisposing factors (5).

The etiological agents responsible for UTI vary according to geographical location, patient age, hospitalization status, catheterization, and antibiotic usage patterns. Among the bacterial pathogens, *Escherichia coli* remains the most predominant uropathogen followed by *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus* species, *Enterococcus* species, and *Staphylococcus aureus* (6). The emergence of multidrug-resistant organisms due to irrational and excessive use of antibiotics has become a serious global concern (7).

Antimicrobial resistance among uropathogens has significantly increased over the past decade, limiting treatment options and resulting in treatment failure, prolonged hospitalization, and increased mortality (8). The resistance pattern varies across regions and healthcare settings; therefore, periodic surveillance of bacteriological profile and antibiotic susceptibility is essential for empirical therapy and infection control strategies (9).

In developing countries like India, indiscriminate antibiotic usage, self-medication, poor sanitation, and lack of antimicrobial stewardship contribute substantially to increasing resistance among urinary pathogens (10). Therefore, continuous monitoring of local bacteriological trends and antimicrobial susceptibility patterns is necessary for effective patient management and formulation of hospital antibiotic policies.

The present study was undertaken to determine the bacteriological profile and antibiotic sensitivity pattern of urinary tract infections among pediatric and adult patients attending Barpeta Medical College and Hospital, a tertiary care centre in Assam.

MATERIALS AND METHODS

Study Design and Study Setting; This hospital-based prospective observational study was conducted in the Department of Microbiology at Barpeta Medical College and Hospital over a period of one year. The study aimed to determine the bacteriological profile and antibiotic sensitivity pattern of urinary tract infections (UTIs) among pediatric and adult patients attending the tertiary care centre.

Study Population

The study population included both pediatric and adult patients clinically suspected of urinary tract infection and attending the outpatient departments (OPD), inpatient wards, emergency units, and intensive care units of the hospital during the study period.

Inclusion Criteria

1. Patients of all age groups and both sexes with clinical suspicion of urinary tract infection.
2. Patients presenting with symptoms such as fever, dysuria, increased frequency of micturition, urgency, suprapubic pain, flank pain, burning micturition, or cloudy urine.
3. Patients willing to provide informed consent (or assent/guardian consent in case of children).

Exclusion Criteria

1. Patients who had received antibiotic therapy within the previous 48–72 hours.
2. Patients with contaminated urine samples.
3. Patients unwilling to participate in the study.
4. Patients with incomplete clinical or laboratory data.

Sample Size Calculation

The sample size was calculated using the formula for prevalence studies:

$$n = \frac{Z^2 pq}{d^2}$$

Where:

- n = required sample size
- Z = standard normal variate at 95% confidence interval (1.96)
- p = expected prevalence = 20% (0.20)
- $q = 1 - p = 0.80$
- d = allowable error = 5% (0.05)

Substituting the values:

$$n = \frac{(1.96)^2 \times 0.20 \times 0.80}{(0.05)^2}$$

Calculated sample size:

$$n \approx 246$$

Considering possible non-response and inadequate samples, the final sample size was rounded to 250 participants.

Sampling Technique

The consecutive sampling technique was used. All eligible patients fulfilling the inclusion criteria during the study period were enrolled until the desired sample size was achieved.

Data Collection

Detailed demographic and clinical information including age, sex, presenting symptoms, history of previous UTI, catheterization, hospitalization, and associated comorbidities were collected using a predesigned proforma.

Specimen Collection; Clean-catch midstream urine samples were collected from adult patients in sterile wide-mouthed containers after proper instructions regarding genital hygiene. In pediatric patients, urine samples were collected using sterile urine collection bags or catheterization under aseptic precautions wherever necessary.

Samples were transported immediately to the microbiology laboratory and processed within one hour of collection. If delay was anticipated, samples were refrigerated at 4°C.

Laboratory Processing

Urine samples were subjected to the following investigations:

Macroscopic Examination

Urine samples were examined for color, turbidity, and appearance.

Microscopic Examination

A wet mount preparation of centrifuged urine sediment was examined microscopically for the presence of pus cells, red blood cells, epithelial cells, bacteria, casts, and crystals.

Culture and Identification

Urine culture was performed using a calibrated loop method on Cysteine Lactose Electrolyte Deficient (CLED) agar, Blood agar, and MacConkey agar plates. The inoculated plates were incubated aerobically at 37°C for 18–24 hours.

Significant bacteriuria was defined as growth of $\geq 10^5$ colony-forming units (CFU)/mL of urine. Isolated organisms were identified based on colony morphology, Gram staining characteristics, and standard biochemical tests.

Antibiotic Susceptibility Testing

Antibiotic susceptibility testing of bacterial isolates was performed by the Kirby–Bauer disc diffusion method on Mueller–Hinton agar according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

The commonly tested antibiotics included:

- Amoxicillin-clavulanic acid
- Ampicillin
- Ceftriaxone
- Cefotaxime
- Ciprofloxacin
- Nitrofurantoin
- Gentamicin
- Amikacin
- Piperacillin-tazobactam
- Imipenem
- Meropenem
- Cotrimoxazole

Zones of inhibition were measured and interpreted as sensitive, intermediate, or resistant according to CLSI recommendations.

Quality Control

Standard operating procedures were strictly followed throughout the study. Quality control strains of *Escherichia coli* ATCC 25922 and *Staphylococcus aureus* ATCC 25923 were used for culture and antibiotic susceptibility testing.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 25.0. Categorical variables were expressed as frequency and percentage. Continuous variables were expressed as

mean \pm standard deviation. Chi-square test was used to assess association between categorical variables. A p-value of <0.05 was considered statistically significant.

Ethical Consideration

Ethical clearance for the study was obtained from the Institutional Ethics Committee of Barpeta Medical College and Hospital prior to commencement of the study. Written informed consent was obtained from all participants or from parents/guardians in case of pediatric patients. Confidentiality of patient information was maintained throughout the study.

RESULTS AND OBSERVATIONS

A total of 250 urine samples were collected from clinically suspected urinary tract infection (UTI) cases among pediatric and adult patients attending Barpeta Medical College and Hospital during the study period of one year. Out of these, 162 (64.8%) samples showed significant bacterial growth, while 88 (35.2%) samples showed no significant growth.

Table 1: Distribution of Study Participants According to Culture Findings

Culture Findings	Number of Cases (n=250)	Percentage (%)
Culture Positive	162	64.8
Culture Negative	88	35.2
Total	250	100

The overall prevalence of culture-positive urinary tract infection was 64.8%.

Table 2: Age-wise Distribution of Culture Positive Cases

Age Group (Years)	Number of Cases	Percentage (%)
<10	24	14.8
11–20	18	11.1
21–40	58	35.8
41–60	42	25.9
>60	20	12.4
Total	162	100

Maximum culture-positive cases were observed in the 21–40 years age group (35.8%), followed by 41–60 years age group (25.9%).

Table 3: Gender-wise Distribution of Culture Positive Cases

Gender	Number of Cases	Percentage (%)
Male	58	35.8
Female	104	64.2
Total	162	100

Females constituted the majority of culture-positive UTI cases (64.2%) as compared to males (35.8%).

Table 4: Distribution of UTI among Pediatric and Adult Patients

Patient Group	Number of Cases	Percentage (%)
Pediatric Patients	38	23.5
Adult Patients	124	76.5
Total	162	100

UTI was more common among adult patients (76.5%) compared to pediatric patients (23.5%).

Table 5: Common Clinical Presentation among Culture Positive Cases

Clinical Symptoms	Number of Cases	Percentage (%)
Burning Micturition	118	72.8
Fever	84	51.9
Increased Frequency of Urination	96	59.3
Lower Abdominal Pain	62	38.3
Flank Pain	28	17.3
Hematuria	16	9.9

Burning micturition was the most common presenting symptom (72.8%) followed by increased frequency of urination (59.3%).

Table 6: Bacteriological Profile of Isolated Organisms

Organism Isolated	Number of Isolates	Percentage (%)
<i>Escherichia coli</i>	92	56.8
<i>Klebsiella pneumoniae</i>	28	17.3
<i>Pseudomonas aeruginosa</i>	14	8.6
<i>Staphylococcus aureus</i>	12	7.4
Enterococcus species	8	4.9
Proteus species	5	3.1
Citrobacter species	3	1.9
Total	162	100

Escherichia coli was the predominant uropathogen isolated (56.8%), followed by *Klebsiella pneumoniae* (17.3%).

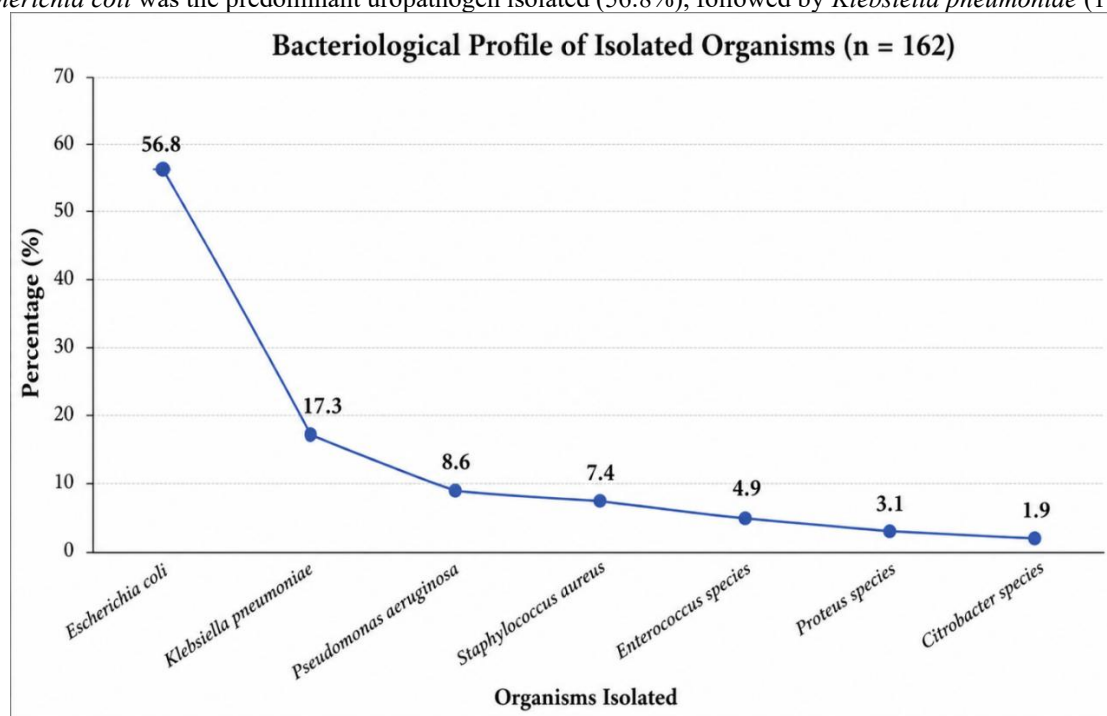


Table 7: Antibiotic Sensitivity Pattern of Gram Negative Isolates

Antibiotic	Sensitive Isolates n (%)
Nitrofurantoin	118 (81.9)
Amikacin	126 (87.5)
Gentamicin	102 (70.8)
Ciprofloxacin	76 (52.8)
Ceftriaxone	68 (47.2)
Cotrimoxazole	58 (40.3)
Piperacillin-Tazobactam	130 (90.3)
Imipenem	138 (95.8)
Meropenem	136 (94.4)

Gram-negative isolates showed highest sensitivity to Imipenem (95.8%), Meropenem (94.4%), and Piperacillin-Tazobactam (90.3%), while maximum resistance was observed against Cotrimoxazole and Ceftriaxone.

Table 8: Antibiotic Sensitivity Pattern of Gram-Positive Isolates

Antibiotic	Sensitive Isolates n (%)
Vancomycin	18 (90.0)
Linezolid	19 (95.0)
Gentamicin	14 (70.0)
Ciprofloxacin	10 (50.0)
Penicillin	6 (30.0)

Gram-positive isolates demonstrated maximum sensitivity to Linezolid (95.0%) and Vancomycin (90.0%), while high resistance was noted against Penicillin.

Table 9: Distribution of Culture-Positive Cases According to Hospital Department

Department	Number of Cases	Percentage (%)
Outpatient Department (OPD)	86	53.1
Inpatient Department (IPD)	58	35.8
Intensive Care Unit (ICU)	18	11.1
Total	162	100

Most of the culture-positive cases were reported from the outpatient department (53.1%).

Table 10: Association of Catheterization with UTI

Catheterization Status	Culture Positive	Percentage (%)
Catheterized Patients	46	28.4
Non-catheterized Patients	116	71.6
Total	162	100

Catheter-associated urinary tract infection accounted for 28.4% of total culture-positive cases.

DISCUSSION

The present study evaluated the bacteriological profile and antibiotic sensitivity pattern of urinary tract infections among pediatric and adult patients in a tertiary care hospital setting. In the current study, the prevalence of culture-positive urinary tract infection was found to be 64.8%, which is comparable with studies conducted by Das et al. (11) and Gupta et al. (12), who reported culture positivity rates ranging between 55% and 70%. The high prevalence may be attributed to increased hospital attendance, poor hygiene practices, and indiscriminate antibiotic use.

In the present study, females (64.2%) were more commonly affected than males (35.8%). Similar findings were reported by Akram et al. (13) and Sharma et al. (14). The higher incidence among females can be explained by anatomical predisposition such as shorter urethra, hormonal changes, and greater susceptibility to ascending infections.

The highest number of UTI cases was observed in the 21–40 years age group (35.8%). This finding is in agreement with studies conducted by Foxman (15) and Kaur et al. (16), who reported that sexually active adults and middle-aged individuals are more prone to urinary tract infections.

Among the isolated organisms, *Escherichia coli* was the predominant pathogen accounting for 56.8% of isolates, followed by *Klebsiella pneumoniae* (17.3%). Similar observations have been documented by Flores-Mireles et al. (17) and Behzadi et al. (18). The predominance of *E. coli* may be due to its virulence factors such as adhesins, fimbriae, and ability to colonize the periurethral region.

The antibiotic susceptibility pattern in the present study revealed that gram-negative isolates showed maximum sensitivity to Imipenem, Meropenem, and Piperacillin-Tazobactam, whereas high resistance was observed against Ceftriaxone and Cotrimoxazole. Similar findings were reported by Niranjana and Malini (19), who observed increasing resistance to commonly used antibiotics among uropathogens. The higher sensitivity to carbapenems may be due to their restricted usage and broad-spectrum activity.

Nitrofurantoin also demonstrated good sensitivity against most gram-negative isolates in the present study. This finding correlates with studies by Hrbacek et al. (20), supporting the use of Nitrofurantoin as an effective empirical therapy for uncomplicated UTIs.

Gram-positive isolates in the present study showed highest sensitivity to Linezolid and Vancomycin, while resistance to Penicillin was significantly high. Similar findings were observed by Lee et al. (21). The increasing resistance among gram-positive organisms may be associated with irrational antibiotic use and hospital-acquired infections.

The present study also found that catheter-associated urinary tract infection constituted 28.4% of culture-positive cases. Catheterisation is a well-recognised risk factor for UTI due to biofilm formation and prolonged hospital stay. Similar observations were reported by Nicolle (22).

The findings of the present study highlight the need for routine urine culture and antimicrobial susceptibility testing before initiation of therapy. Periodic surveillance of resistance patterns and implementation of antibiotic stewardship programs are essential to reduce the burden of multidrug-resistant urinary pathogens.

CONCLUSION

Urinary tract infection is a common health problem among pediatric and adult patients, with females being more frequently affected. *Escherichia coli* was the predominant uropathogen isolated in the present study. Most isolates

showed high sensitivity to Imipenem, Meropenem, Piperacillin-Tazobactam, and Nitrofurantoin, while resistance to commonly used antibiotics such as Ceftriaxone and Cotrimoxazole was observed.

The study highlights the importance of routine urine culture and antibiotic susceptibility testing for the appropriate management of UTI. Continuous surveillance of antimicrobial resistance and rational use of antibiotics are essential to prevent the emergence of multidrug-resistant organisms.

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