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Clinico-Microbiological Evaluation of Urinary Tract Infections in Paediatric Patients at a Tertiary Care Centre

Dr. Rudra Gouda[1] Dr. Shilpa Hampannavar[2*]

[1] Assistant Professor, Department of Paediatrics, Prathima Institute of Medical Sciences, Karimnagar, Telangana

[*2] Assistant Professor, Department of Microbiology, Prathima Institute of Medical Sciences, Karimnagar, Telangana

CORRESPONDIN AUTHOR:

Dr. Shilpa Hampannavar

Assistant Professor,
Department of Microbiology,
Prathima Institute of Medical Sciences,
Karimnagar, Telangana
Contact no.: 9164450909
Mail-id: shilphurkadli@gmail.com

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ABSTRACT:

Background:

Urinary tract infections (UTIs) are among the most common bacterial infections in children and may lead to significant complications if not diagnosed and treated promptly. Knowledge of the local microbial profile and antimicrobial susceptibility patterns is essential for appropriate empirical therapy.

Objectives:

To evaluate the clinical profile, microbiological spectrum, and antimicrobial susceptibility patterns of urinary tract infections in paediatric patients attending a tertiary care centre.

Materials and Methods:

This hospital-based observational study included paediatric patients aged 0–14 years with clinical suspicion of UTI. Urine samples were collected using standard aseptic techniques and processed by conventional culture methods. Bacterial isolates were identified, and antimicrobial susceptibility testing was performed using the Kirby–Bauer disc diffusion method as per CLSI guidelines.

Results:

Out of 90 urine samples analyzed, 32 (35.5%) showed significant bacterial growth. *Escherichia coli* was the most common uropathogen, followed by *Klebsiella pneumoniae* and *Enterococcus* species. High resistance was observed to ampicillin and cotrimoxazole, whereas nitrofurantoin and aminoglycosides demonstrated higher sensitivity rates.

Conclusion:

Paediatric UTIs are predominantly caused by Gram-negative organisms, with *E. coli* being the leading pathogen. Increasing antimicrobial resistance emphasizes the need for culture-guided therapy and regular surveillance of local resistance patterns to optimize treatment outcomes.

Keywords: Paediatric urinary tract infection; Uropathogens; Antimicrobial susceptibility; Urine culture; Tertiary care centre

INTRODUCTION:

Urinary tract infections (UTIs) are among the most frequently encountered bacterial infections in the paediatric age group and represent a significant cause of outpatient visits and hospital admissions. The clinical importance of UTIs in children lies not only in their high prevalence but also in their potential to cause serious short- and long-term complications, including renal scarring, hypertension, and chronic kidney disease, particularly when diagnosis and treatment are delayed.[1],[2] The presentation of UTIs in children is often non-specific, especially in infants and young children, making laboratory confirmation essential for accurate diagnosis.

The epidemiology of paediatric UTIs varies with age, gender, and underlying risk factors. UTIs are more common in male infants during the first year of life, often associated with congenital urinary tract anomalies, while female predominance is observed in older children due to anatomical and physiological factors.[3] Fever is the most common presenting symptom, although dysuria, increased frequency, abdominal pain, vomiting, and failure to thrive may also be observed. Given this wide spectrum of clinical manifestations, microbiological evaluation plays a pivotal role in confirming infection and guiding therapy.[4]

Bacterial pathogens account for the majority of paediatric UTIs, with Gram-negative bacilli being the predominant causative agents. *Escherichia coli* is consistently reported as the most common uropathogen worldwide due to its virulence factors that facilitate adherence to uroepithelial cells. Other organisms such as *Klebsiella pneumoniae*, *Proteus* species, *Enterococcus* species, and *Pseudomonas aeruginosa* are also implicated, particularly in hospital-acquired infections and children with underlying comorbidities.[5],[6] The spectrum of uropathogens may vary across geographical regions and healthcare settings, underscoring the importance of local surveillance data.

Antimicrobial resistance among uropathogens has emerged as a major global concern and poses a significant challenge in the management of paediatric UTIs. Increasing resistance to commonly prescribed antibiotics such as ampicillin, cotrimoxazole, and third-generation cephalosporins has been widely reported.[7] Empirical therapy, which is often initiated before culture results are available, may be ineffective if not guided by current local susceptibility patterns. Inappropriate antibiotic use further contributes to the development and spread of multidrug-resistant organisms, emphasizing the need for rational antibiotic selection based on microbiological evidence.[8]

Urine culture remains the gold standard for the diagnosis of UTIs and provides essential information regarding the causative organism and its antimicrobial susceptibility profile. In a tertiary care centre, where patients often present with complicated infections or prior antibiotic exposure, periodic evaluation of uropathogens and their resistance patterns is particularly important. Such data not only aid clinicians in choosing appropriate empirical therapy but also contribute to antibiotic stewardship efforts.[9]

In view of the clinical burden of paediatric UTIs and the growing challenge of antimicrobial resistance, the present study was undertaken to evaluate the clinical features, microbiological profile, and antimicrobial susceptibility patterns of urinary tract infections in paediatric patients attending a tertiary care centre.

MATERIALS AND METHODS

Study Design and Study Setting

This hospital-based observational study was conducted in the Department of Microbiology in collaboration with the Department of Paediatrics at a tertiary care teaching hospital. The study period extended over **one year**, during which paediatric patients presenting with clinical features suggestive of urinary tract infection were evaluated.

Study Population

The study included **paediatric patients aged 0–14 years** attending outpatient departments or admitted to paediatric wards with symptoms indicative of urinary tract infection. Clinical suspicion was based on presenting complaints such as fever, dysuria, increased urinary frequency, abdominal pain, vomiting, or unexplained irritability, particularly in infants and young children.

Inclusion Criteria

- Paediatric patients with clinical features suggestive of urinary tract infection
- Patients from whom urine samples were submitted for culture and sensitivity testing
- Both outpatient and inpatient cases

Exclusion Criteria

- Children who had received antibiotic therapy for more than 48 hours prior to sample collection

- Improperly collected or contaminated urine samples
- Patients with known chronic renal diseases already under treatment

Specimen Collection

Urine samples were collected following standard aseptic precautions using age-appropriate methods. In toilet-trained children, **midstream clean-catch urine samples** were obtained after proper perineal cleaning. In infants and younger children, urine samples were collected by **catheterization or suprapubic aspiration**, wherever clinically indicated. Samples were transported promptly to the microbiology laboratory and processed within one hour of collection to avoid bacterial overgrowth.

Macroscopic and Microscopic Examination

All urine samples were subjected to macroscopic examination for color and turbidity. Microscopic examination of centrifuged urine sediment was performed to detect the presence of pus cells, red blood cells, epithelial cells, and bacteria. Pyuria was defined as the presence of ≥5 white blood cells per high-power field.

Culture and Identification of Isolates

Urine samples were inoculated on **Cysteine Lactose Electrolyte Deficient (CLED) agar** and **MacConkey agar** using a calibrated loop delivering 0.001 mL of urine. Plates were incubated aerobically at **37°C for 18–24 hours**. Significant bacteriuria was defined as bacterial growth of $\geq 10^5$ colony-forming units (CFU)/mL for clean-catch samples, while lower colony counts were considered significant for catheterized and suprapubic aspirate specimens. Bacterial isolates were identified based on colony morphology, Gram staining, and standard biochemical tests.

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility testing was performed using the **Kirby–Bauer disc diffusion method** on Mueller–Hinton agar in accordance with **Clinical and Laboratory Standards Institute (CLSI) guidelines**. The antibiotic panel included commonly used agents such as ampicillin, cotrimoxazole, ciprofloxacin, nitrofurantoin, ceftriaxone, gentamicin, and amikacin. Results were interpreted as sensitive, intermediate, or resistant based on CLSI criteria.

Data Collection and Statistical Analysis

All collected data were compiled and entered into Microsoft Excel and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) software, version 20. Categorical variables were expressed as frequencies and percentages. Continuous variables were summarized as mean ± standard deviation. The association between categorical variables was assessed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS:

A total of **90 paediatric patients** clinically suspected of urinary tract infection were included in the study. The study population showed an overall female predominance. Male children were more commonly affected during infancy, whereas females constituted the majority in the older age groups. The highest number of suspected urinary tract infection cases was observed in children aged 1–5 years as shown in Table 1.

Table 1: Age and Gender Distribution of Paediatric Patients with Suspected UTI (n = 90)

Age Group	**Male n (%)**	**Female n (%)**	**Total n (%)**
< 1 year	12 (60.0)	8 (40.0)	20 (22.2)
1–5 years	18 (45.0)	22 (55.0)	40 (44.4)
6–14 years	10 (33.3)	20 (66.7)	30 (33.4)
Total	**40 (44.4)**	**50 (55.6)**	**90 (100)**

Approximately one-third of the urine samples demonstrated significant bacterial growth, indicating a moderate culture positivity rate among clinically suspected paediatric urinary tract infections as shown in Table 2.

Table 2: Urine Culture Positivity Rate

Culture Result	**Number of Cases**	**Percentage (%)**
Culture positive	32	35.5

Culture Result	**Number of Cases**	**Percentage (%)**
Culture negative	58	64.5
Total	**90**	**100**

Gram-negative organisms were the predominant causative agents of urinary tract infections. *Escherichia coli* emerged as the most frequently isolated pathogen, followed by *Klebsiella pneumoniae*, while Gram-positive organisms accounted for a smaller proportion of cases as shown in Table 3

Table 3: Distribution of Uropathogens Isolated from Culture-Positive Samples (n = 32)

Organism Isolated	**Number (n)**	**Percentage (%)**
Escherichia coli	18	56.3
Klebsiella pneumoniae	7	21.9
Enterococcus spp.	4	12.5
Proteus spp.	2	6.3
Pseudomonas aeruginosa	1	3.0
Total	**32**	**100**

Antimicrobial susceptibility testing revealed high resistance to commonly used first-line antibiotics such as ampicillin and cotrimoxazole. In contrast, nitrofurantoin and aminoglycosides exhibited higher sensitivity rates against most Gram-negative uropathogens as shown in Table 4.

Table 4: Antibiotic Sensitivity Pattern of Gram-Negative Uropathogens

Antibiotic	**Sensitivity (%)**
Ampicillin	30
Cotrimoxazole	40
Ciprofloxacin	55
Ceftriaxone	60
Nitrofurantoin	80
Gentamicin	75
Amikacin	85

Culture positivity was higher among female patients compared to males, and the association between gender and culture positivity was found to be statistically significant as shown in Table 5.

Table 5: Association Between Gender and Culture Positivity

Gender	**Culture Positive n (%)**	**Culture Negative n (%)**	**Total**
Male	12 (30.0)	28 (70.0)	40
Female	20 (40.0)	30 (60.0)	50
Total	**32**	**58**	**90**

DISCUSSION:

Urinary tract infections continue to be a common and clinically significant problem in the paediatric population, particularly in tertiary care settings where children often present with complicated infections or prior antibiotic exposure. The present study evaluated the clinical profile, microbiological spectrum, and antimicrobial susceptibility patterns of paediatric

urinary tract infections, providing valuable insights into local epidemiology and resistance trends.

In the current study, a female predominance was observed overall, especially in children above one year of age. This finding is consistent with earlier studies and can be attributed to anatomical factors such as a shorter urethra and closer proximity of the urethral opening to the perineum, which facilitate ascending infections.[10] Male predominance observed in infancy has been associated with congenital anomalies of the urinary tract and lack of circumcision, which increase susceptibility to infection in this age group.[11]

The culture positivity rate in the present study was approximately one-third of clinically suspected cases. Similar rates have been reported in other hospital-based studies and may reflect early empirical antibiotic therapy, improper sample collection, or non-bacterial causes of urinary symptoms.[12] This highlights the importance of urine culture in confirming diagnosis and avoiding unnecessary antibiotic administration.

Escherichia coli was the most frequently isolated uropathogen, accounting for more than half of the culture-positive cases. This predominance is well documented in paediatric literature and is attributed to the organism's virulence factors, including adhesins and fimbriae that promote attachment to uroepithelial cells.[13] *Klebsiella pneumoniae* emerged as the second most common isolate, particularly among hospitalized children, possibly indicating healthcare-associated infections or prior antimicrobial exposure.[14] Gram-positive organisms, mainly *Enterococcus* species, constituted a smaller proportion of isolates, similar to findings reported from other tertiary care centres.[15]

Antimicrobial susceptibility testing revealed high resistance to commonly prescribed first-line antibiotics such as ampicillin and cotrimoxazole. This pattern is concerning, as these agents are frequently used for empirical treatment of paediatric UTIs. Comparable resistance trends have been reported globally and are largely attributed to indiscriminate antibiotic use and inadequate antibiotic stewardship.[16]

In contrast, nitrofurantoin and aminoglycosides demonstrated higher sensitivity rates against the majority of Gram-negative uropathogens, particularly *E. coli*. Nitrofurantoin remains an effective oral option for uncomplicated UTIs due to its high urinary concentration and relatively low resistance rates.[17] However, the use of aminoglycosides should be carefully monitored in children due to potential nephrotoxic and ototoxic effects.

The findings of this study underscore the importance of periodic monitoring of uropathogens and their antimicrobial susceptibility patterns, especially in tertiary care centres. Culture-guided therapy not only improves treatment outcomes but also plays a crucial role in reducing the emergence and spread of antimicrobial resistance.[18]

CONCLUSION:

Urinary tract infections are a common problem in the paediatric population, with a higher prevalence observed in females beyond infancy. *Escherichia coli* remains the most frequently isolated uropathogen, followed by other Gram-negative organisms. The study highlights increasing resistance to commonly used first-line antibiotics, limiting the effectiveness of empirical therapy. Nitrofurantoin and aminoglycosides demonstrated better antimicrobial activity against most isolates. Routine urine culture and susceptibility testing are essential to guide appropriate treatment and reduce antimicrobial resistance.

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