

## Original Research

## Bacteriological Profile and Antimicrobial Resistance Patterns in Pediatric Urinary Tract Infections: A Cross-Sectional Study at Dhaka Shishu Hospital

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### Abstract

**Background:** Urinary tract infections (UTIs) are a prevalent concern in pediatric healthcare, causing distress to children, raising parental concerns, and potentially leading to lasting kidney damage. The highest incidence of first-time symptomatic UTIs occurs in infants during the first year of life, with a subsequent marked decrease. Febrile infants under 2 months, presenting with unexplained fever, constitute a critical subset requiring particular attention. Knowledge of the bacteriological profile and antimicrobial resistance patterns in specific regions is crucial for guiding effective treatment strategies. **Methods:** A cross-sectional study was conducted at 250 Bedded General Hospital, Jamalpur, Bangladesh from Feb 2016 to Aug 2016 to assess the bacteriological profile and antibiotic resistance patterns in pediatric UTIs. A total of 147 culture-positive UTI patients were included. Bacterial isolates were identified, and colony counts for samples with  $\geq 10^5$  CFU/mL bacteria were considered positive. Antimicrobial susceptibility testing was performed using twelve agents, and resistance patterns were analyzed. **Results:** Among the 147 culture-positive UTI patients, *Escherichia coli* (E-coli) was the predominant isolate (70%), followed by *Klebsiella* spp. (13.6%), *Pseudomonas* (5.44%), *Enterobacter* spp (3.40%), *Staphylococcus Aureus* (3.40%), *Proteus* (2.72%), and *Enterococcus* (1.36%). Antimicrobial resistance analysis revealed varying patterns, with Cefradine (79.59%), Co-trimoxazole (SXT) (69.39%), Nalidixic acid (NA) (66.67%), and Ceftazidime (CTM) (48.98%) showing higher resistance rates. No drug exhibited 100% resistance against urinary pathogens, indicating a dynamic resistance landscape. **Conclusion:** This study highlights the importance of understanding local prevalence and resistance patterns in guiding empirical antibiotic selection for pediatric UTIs. The observed decrease in antimicrobial resistance underscores the need for continuous surveillance and tailored antibiotic strategies. Clinicians should base their treatment decisions on the specific epidemiological context rather than relying solely on universal or national guidelines.

## INTRODUCTION

Urinary tract infection (UTI) stands as one of the most prevalent pediatric infections, exerting distress on the affected child, causing concern among parents, and potentially leading to enduring kidney damage. The incidence of first-time symptomatic UTIs peaks during the inaugural year of life, diminishing significantly thereafter. Notably, febrile infants below 2 months of age, presenting

with unexplained fever, represent a critical subset warranting heightened attention, as UTIs are a common cause of fever in this demographic.

UTIs, both in community and hospital settings, pose a significant threat to pediatric health, ranking as the most prevalent serious bacterial infection among infants and children. The repercussions of

UTIs extend beyond immediate discomfort, contributing to morbidity and mortality, making it imperative to address this clinical concern promptly<sup>1-3</sup>. UTIs can affect the lower urinary tract, upper urinary tract, or both,<sup>4</sup> with a shifting susceptibility between boys and girls across different age groups<sup>5-6</sup>. Rapid diagnosis and timely antimicrobial intervention become paramount to mitigate potential complications, including urosepsis, urolithiasis, renal abscess, and the prevention of renal scarring or permanent parenchymal damage. The need for empirical antibiotic prescription, often preceding culture results, underscores the urgency in managing UTIs, particularly in the face of increasing global trends in antibiotic resistance, especially towards commonly used antimicrobials<sup>7-9</sup>.

Understanding the etiology of UTIs and their antimicrobial resistance patterns in specific geographical locations is pivotal for clinicians when selecting appropriate antimicrobial therapies. With empirical antibiotic decisions often made before culture results are available, knowledge of local resistance trends becomes a crucial factor in ensuring effective treatment strategies<sup>10-11</sup>. Antimicrobial susceptibility testing, while traditionally taking 48 hours, influences empirical treatment choices based on available data reflecting antibiotic resistance.

This study, conducted at Dhaka Shishu Hospital, a teaching and referral hospital in Bangladesh, aims to address the local context. By determining the frequency of isolation and the antimicrobial resistance patterns of uro-pathogens among children subjected to urine culture, we seek to contribute valuable insights to the empirical management of pediatric UTIs in this specific geographical setting<sup>12</sup>. The importance of such studies resonates not only in the context of immediate patient care but also in the broader realm of antimicrobial resistance surveillance at local, national, and international levels, thereby enhancing the efficacy of therapeutic interventions and safeguarding the well-being of pediatric populations.

## Objectives

**General Objective:** To evaluate the antibiotic resistance pattern among children diagnosed with Urinary Tract Infection (UTI) in Bangladesh.

**Specific Objectives:** To determine the bacteriological profile of uro-pathogens causing UTI in children in Bangladesh.

- To assess the efficacy of commonly prescribed antibiotics in the treatment of pediatric UTIs in Bangladesh.
- To identify and analyze the resistance patterns exhibited by uro-pathogens against antibiotics commonly used for the management of UTIs in the pediatric population in Bangladesh.
- To provide a comprehensive understanding of the prevailing antibiotic resistance landscape in children with UTIs, facilitating informed decision-making in empirical antibiotic prescription.
- To contribute valuable insights for the development of targeted and effective strategies for the management of UTIs in pediatric patients in the Bangladeshi context.

## Methods

**Study Design:** This cross-sectional study was conducted at 250 Bedded General Hospital, Jamalpur, encompassing both inpatients and outpatients, over the period from February 2016 to August 2016.

**Sample Collection and Processing:** Well-mixed urine samples were obtained from pediatric patients exhibiting urinary symptoms, such as fever ( $\geq 38^{\circ}\text{C}$ ), chills, frequency, urgency, dysuria, suprapubic and/or flank tenderness, and pyuria (defined as  $\geq 10$  leukocytes/hpf). Neonates displaying clinical evidence of sepsis were also included. A calibrated loop method was employed to culture urine samples on MacConkey agar plates and blood agar plates. Pipetting an auto-adjustable, calibrated loopful (0.01 mL) of each urine sample facilitated the culture process. The cultured plates were then incubated aerobically at  $37^{\circ}\text{C}$  for 24 hours.

**UTI Diagnosis Criteria:** A diagnosis of UTI was established by the presence of a pure bacterial growth exceeding  $10^3$  CFU/mL (colony forming units/mL) in children with the aforementioned urinary symptoms. Suspected colonies were identified through colony morphology, Gram stains, and biochemical testing.

**Patient Data Collection:** Relevant demographic information, including age and sex, was systematically collected from each patient included in the study.

**Inclusion and Exclusion Criteria:** Inclusion Criteria: Urine samples yielding bacterial growth of  $10^5$  CFU/mL or more were considered significant.

Exclusion Criteria: Urine cultures were regarded as negative when bacterial growth was lower than  $10^3$  CFU/mL. Additionally, the presence of polymorphic bacterial growth (two or more bacterial species) was considered an exclusion criterion.

**Antimicrobial Susceptibility Testing (AST):** For cases meeting the inclusion criteria, antimicrobial susceptibility testing (AST) was performed using the modified Kirby Bauer disc diffusion method on Mueller Hinton plates. This step aimed to assess the resistance patterns of the isolated uropathogens against a panel of antimicrobial agents.

By adhering to these standardized methods, the study aimed to comprehensively investigate the bacteriological profile and antimicrobial resistance patterns in pediatric UTIs at Dhaka Shishu Hospital during the specified timeframe.

## Result

In this cross-sectional study conducted at Dhaka Shishu Hospital, a total of 147 confirmed pediatric urinary tract infection (UTI) cases were analyzed from both inpatient and outpatient departments over the period of February 2016 to August 2016. Among these cases, 64.6% were outpatient cases, while 35.4% were inpatients. The study population comprised 61.22% girls and 38.77% boys, with average ages of 4.5 years and 4.2 years, respectively.

**Table I:** Distribution of patients by sex and age.(n=147)

Age	Male N(%)	Female N(%)	Total
1-5 yrs.	37 (38)	60 (62)	97
6-10 yrs.	20 (40)	30 (60)	50
Total	57 (39)	90 (61)	147

Pyuria was observed in 79% of cases during urinalysis, prompting further investigation. The bacteriological profile revealed *E. coli* as the predominant pathogen, isolated in 70% of cases, followed by *Klebsiella* spp. (13.6%), *Pseudomonas aeruginosa* (5.44%), and others. Antimicrobial susceptibility testing identified 12 drugs, with Cefradine, Co-trimoxazole, Nalidixic acid, and Ceftazidime exhibiting the highest resistance rates at 79.59%, 69.39%, 66.67%, and 48.98%, respectively. Importantly, none of the tested drugs showed 100% resistance, indicating a dynamic resistance landscape. The age and gender distribution demonstrated a higher prevalence of UTIs in females across both age groups, with females comprising 61.85% and 60% in the 1-5 years and 6-10 years age groups, respectively. This comprehensive analysis provides crucial insights into the epidemiology and antimicrobial resistance patterns of pediatric UTIs in the specific setting of Dhaka, Bangladesh. The observed resistance profiles underscore the importance of judicious antibiotic use and the need for continuous surveillance to inform evidence-based therapeutic strategies.

**Table II:** Frequency and types of bacterial isolates.(n=147).

Bacterial Isolates	N(%)
<i>E. Coli</i>	103 (70)
<i>Klebsiella</i> spp.	20 (13.6)
<i>Pseudomonus aeruginosa</i>	8 (5.44)
<i>Enterobactor</i> Spp.	5 (3.40)
<i>Staph aureus</i>	5 (3.40)
<i>Protius</i> Spp.	4 (2.72)
<i>Enterococcu faecalis</i> Spp.	2 (1.36)
Total	147(100)

## DISCUSSION

This study represents the first comprehensive investigation in our country into the prevalence and

antibiotic resistance patterns of uropathogens in pediatric urinary tract infections (UTIs). The findings underscore the escalating rates of resistance among commonly used antimicrobial agents, emphasizing the dynamic and varying sensitivity patterns observed across hospitals.<sup>13-14</sup>

**Table III:** Antimicrobial Resistance (%) of Isolated Uropathogenic Bacteria (n=147)

Name of Antibiotics	Sensitivity in number	Resistant in number	Resistance (%)
Colistin (CL)	139	8	5.45
Cefradine	30	117	79.59
Co-trimoxazole (SXT)	45	102	69.39
Nalidixic acid (NA)	49	98	66.67
Ceftazidime(CTM)	75	72	48.98
Azithromycin(AZ),	75	72	48.97
Ciprofloxacin (CP)	93	54	36.74
Nitrofurantoin (FD)	101	46	31.29
Ceftriaxone (CRO)	119	28	19.05
Amikacin (AK)	135	12	8.16
Meropenem(MP)	138	9	6.12
Imepenum(IP)	143	4	2.72

Continuous surveillance of antimicrobial resistance remains critical for the empirical treatment of UTIs, adapting strategies to the evolving landscape of resistance. In this seven-month study at Dhaka Shishu Hospital, *E. coli* emerged as the predominant uropathogen (71.4%), consistent with global trends, with *Klebsiella* spp. as the second most common isolate (13.6%). However, notably high resistance rates were observed across all tested antibiotics except for amikacin, colistin, imipenem, and meropenem.<sup>15-16</sup> This heightened resistance may be attributed to the widespread and unregulated use of certain antimicrobial agents, particularly third-generation cephalosporins, over recent years in our country. This overuse extends beyond UTI treatment, contributing to the observed resistance patterns. While our study focused on Dhaka Shishu Hospital, future investigations extending to other regions could provide a more comprehensive understanding of uropathogens and their resistance patterns. Comparison with other studies, including those conducted in our country,

reveals consistent findings regarding the prevalence of *E. coli* and *Klebsiella* spp. In contrast to previous studies showing *E. coli* susceptibility to imipenem, our results suggest increased resistance, particularly to commonly prescribed antibiotics such as cefradine, co-trimoxazole, nalidixic acid, and ceftazidime. Strikingly, none of the urinary isolates demonstrated 100% resistance to any drug, indicating a complex and nuanced resistance landscape that necessitates ongoing surveillance and tailored treatment approaches.<sup>17</sup> The study underscores the urgency of implementing judicious antibiotic prescribing practices and the need for nationwide surveillance to guide effective therapeutic strategies.

### Limitation of this Study

This study has several limitations that warrant consideration. Firstly, it was conducted in a single center, Dhaka Shishu Hospital, which may not fully capture the diversity of uropathogens and their resistance patterns across the entire country. The restricted geographical scope may limit the generalizability of the findings to a broader population. Additionally, the study's sample size is relatively limited, potentially affecting the precision and generalizability of the results. The duration of the study, spanning only seven months, may not fully encompass seasonal variations or long-term trends in uropathogen prevalence and antibiotic resistance. Therefore, caution should be exercised in extrapolating these findings to a national context, and future research endeavors with larger sample sizes and extended durations are warranted to provide a more comprehensive understanding of the dynamics of pediatric urinary tract infections and antimicrobial resistance in Bangladesh.

### CONCLUSION

In conclusion, this study sheds light on the prevailing distribution of urinary pathogens and their antimicrobial resistance patterns among pediatric patients with urinary tract infections (UTIs) at Dhaka Shishu Hospital. The identified predominance of *E. coli* and notable resistance to

various commonly prescribed antibiotics emphasizes the dynamic nature of antimicrobial susceptibility in this population. The findings underscore the importance of local prevalence data in guiding empirical antibiotic selection. However, it is crucial to acknowledge the limitations of the study, particularly its single-center focus and limited sample size, which may restrict the generalizability of the results to the entire country. Despite these limitations, the study contributes valuable insights into the current landscape of pediatric UTIs in Bangladesh. Based on the study's findings, we recommend a more judicious approach to the empirical selection and use of antibiotics for the treatment of pediatric UTIs. Clinicians should prioritize local prevalence and resistance patterns when making therapeutic decisions, moving away from broad-spectrum antibiotics in favor of more targeted and effective choices. Furthermore, efforts should be directed towards continuous surveillance of antimicrobial resistance at both local and national levels to inform evidence-based treatment strategies. This approach is pivotal in mitigating the emergence and spread of antibiotic resistance, ensuring the efficacy of UTI treatments, and safeguarding the well-being of pediatric patients. The findings from this study call for ongoing research initiatives with larger sample sizes and extended durations to further refine our understanding of urinary pathogen dynamics and resistance patterns in the pediatric population across the country.

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