

ORIGINAL ARTICLE

Organism Detected and Resistant Pattern in Children with UTI

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ABSTRACT

Introduction: Urinary tract infections (UTIs) in children are common but increasingly complicated by antimicrobial resistance. Understanding pathogen profiles, resistance patterns, and clinical outcomes is essential to optimize management. **Methods & materials:** This cross-sectional study included 53 children diagnosed with culture-confirmed UTIs at the Dhaka National Medical College. Demographic, clinical, laboratory, and treatment data were collected prospectively. Isolates were identified using standard microbiological methods, and antibiotic susceptibility was determined via the Kirby–Bauer disk diffusion method, following CLSI guidelines. Statistical analysis explored associations between clinical variables and multidrug resistance (MDR). **Results:** *Escherichia coli* (66.0%) and *Klebsiella spp.* (18.9%) were the predominant pathogens. MDR was detected in 34.0% of cases, with highest resistance to cefixime (71.7%), ceftriaxone (66.0%), and ciprofloxacin (62.3%). Amikacin (90.6%) and carbapenems ($\geq 94\%$) remained highly effective. Female sex (OR: 3.25, $p=0.028$), previous UTI (OR: 2.95, $p=0.041$), and CRP >50 mg/L (OR: 3.80, $p=0.014$) were significant predictors of MDR. Despite empiric therapy with ceftriaxone and amikacin, 11.3% experienced treatment failure and 75.5% required hospitalization. Median defervescence time exceeded 3 days in 81.1% of cases. **Conclusion:** There is a high prevalence of multidrug-resistant uropathogens in pediatric UTIs, particularly against commonly used oral antibiotics. Predictive markers like CRP and prior UTI history may guide early intervention. Empiric regimens should consider local resistance trends, and routine susceptibility testing should be prioritized to improve treatment outcomes.

Keywords: Pediatric UTI, Antibiotic resistance, Multidrug resistance, *E. coli*, Risk factors

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INTRODUCTION

Urinary tract infections (UTIs) are among the most common bacterial infections in the pediatric population, accounting for a substantial proportion of febrile illnesses in children worldwide. It is estimated that UTIs constitute 5–7% of febrile episodes in childhood, ranking as the second most frequent bacterial infection after respiratory tract infections [1]. The burden is not limited to acute morbidity; recurrent or inadequately treated UTIs can lead to renal parenchymal damage and subsequent scarring, which in turn increases the risk of long-term complications such as hypertension and chronic kidney disease (CKD). Systematic reviews and meta-analyses have shown that up to 23% of children with febrile UTIs develop renal scars, underscoring the need for timely diagnosis and effective treatment [2]. More recent evidence highlights that even a single febrile UTI episode in young children may predispose to renal scarring, and recurrence further amplifies this risk [3,4]. These findings emphasize the

broader public health importance of pediatric UTIs, which extend beyond acute infections to include long-term renal outcomes.

The etiology of pediatric UTIs is relatively well established, with *Escherichia coli* consistently identified as the most prevalent causative organism, responsible for 70–80% of community-acquired cases [5,6]. Other organisms such as *Klebsiella spp.*, *Proteus spp.*, *Enterococcus spp.*, and *Pseudomonas aeruginosa* are less common but clinically important, especially in complicated or hospital-acquired infections [7,8]. For instance, *Proteus* and *Enterococcus* have been reported more frequently in cases of pyelonephritis, while *Pseudomonas* is often associated with nosocomial infections or children with structural urinary tract abnormalities [9]. The spectrum of causative pathogens is not entirely uniform across regions or clinical contexts; studies demonstrate that pathogen distribution may differ between community-acquired and nosocomial settings, and variations

have also been observed by gender, age, and the presence of underlying congenital anomalies [7,10]. These patterns suggest the importance of region-specific and population-specific data when assessing the microbial epidemiology of UTIs in children.

A major clinical concern linked to pediatric UTIs is the rising trend of antimicrobial resistance (AMR). Globally, resistance rates among uropathogens have increased substantially, particularly against commonly used antibiotics such as ampicillin, cotrimoxazole, and third-generation cephalosporins [11]. The emergence of extended-spectrum β -lactamase (ESBL)-producing organisms and multidrug-resistant (MDR) strains of *E. coli* and *Klebsiella spp.* further complicates empirical therapy [12,13]. Evidence from multiple regions indicates that more than 80% of pediatric *E. coli* isolates may be resistant to ampicillin, while resistance to cotrimoxazole often exceeds 30% [12,14]. ESBL-producing strains are frequently resistant to third-generation cephalosporins, rendering standard empirical regimens increasingly unreliable [15]. In Nepal, more than half of pediatric *E. coli* isolates were multidrug-resistant, highlighting how MDR organisms are no longer confined to tertiary-care hospitals but are also appearing in community-acquired infections [13]. Collectively, these findings underscore the urgency of local surveillance and rational prescribing to mitigate resistance trends and safeguard therapeutic options. In the South Asian context, and particularly in Bangladesh, the challenge of pediatric UTI management is exacerbated by healthcare system constraints and antibiotic misuse. Recent studies from tertiary-care centers in Dhaka reveal alarmingly high resistance rates among pediatric uropathogens, with ESBL-producing *E. coli* and *Klebsiella spp.* frequently encountered [16]. Data from semi-urban Bangladeshi communities also indicate widespread multidrug resistance in pediatric UTIs, driven in part by unregulated over-the-counter antibiotic access and the common practice of empirical therapy without culture confirmation [17]. Overuse and inappropriate prescribing of antimicrobials are further compounded by limited diagnostic capacity, delayed laboratory confirmation, and poor infection control measures [18,19]. A population-level study of antibiotic use in Bangladesh has also demonstrated significant parental reliance on self-medication for their children, with limited awareness of the consequences of antibiotic resistance [20]. These factors together contribute to the escalating AMR crisis and highlight the relative paucity of robust, updated surveillance data specific to pediatric UTI pathogens in the country.

Given the global and local significance of pediatric UTIs, coupled with the growing threat of antimicrobial resistance, region-specific studies are essential to inform evidence-based clinical practice and policy. Understanding the distribution of causative organisms and their resistance profiles in Bangladeshi children is particularly critical for guiding empirical antibiotic therapy, reducing treatment failures, and preventing long-term renal sequelae. The present study therefore aims to identify the predominant organisms associated with UTIs in children in Bangladesh and analyze their antimicrobial resistance patterns, with the ultimate goal

of informing rational antibiotic prescribing and contributing to the national and global response to antimicrobial resistance.

METHODS & MATERIALS

This cross-sectional study was conducted at the Dhaka National Medical College, Dhaka, Bangladesh, from January, 2023 to December, 2023. A total of 53 children clinically diagnosed with urinary tract infection (UTI) and confirmed by positive urine culture and sensitivity testing were purposively enrolled. Data were collected prospectively using a structured case record form that captured sociodemographic characteristics, relevant clinical features, and laboratory findings. Midstream or catheterized urine samples were collected under aseptic precautions and processed immediately in the microbiology laboratory. Bacterial isolates were identified using standard culture and biochemical methods, including colony morphology, Gram staining, and conventional biochemical reactions, in accordance with established microbiological protocols [21]. Antimicrobial susceptibility testing (AST) was performed by the Kirby-Bauer disk diffusion method, and interpretation of results was carried out according to the latest Clinical and Laboratory Standards Institute (CLSI) guidelines [22,23]. Quality control of media and antibiotic discs was ensured using standard control strains (*Escherichia coli* ATCC 25922, *Klebsiella pneumoniae* ATCC 700603). The primary outcome measures included the distribution of isolated uropathogens, their resistance profiles to commonly prescribed antibiotics, prevalence of multidrug-resistant (MDR) organisms, and treatment response. Informed written consent was obtained from the guardians of all participating children prior to data collection, and ethical approval for the study was secured from the Institutional Ethics Committee of the study hospital. Data entry and analysis were conducted using IBM SPSS Statistics version 26 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized as frequencies and percentages, whereas continuous variables were expressed as means with standard deviations (SD). Associations between categorical variables (e.g., organism type and resistance status) were assessed using the Chi-square test or Fisher's exact test when cell counts were small. Binary logistic regression analysis was applied to identify independent predictors of multidrug resistance, and the results were presented as odds ratios (OR) with 95% confidence intervals (CI). To complement the statistical analyses, visual representations including heatmaps, radar charts, stacked bar charts, bubble plots, and forest plots were prepared to highlight resistance trends and predictors of MDR. A two-tailed p-value <0.05 was considered statistically significant.

RESULTS

Among the 53 pediatric UTI patients, the majority were aged 2–4 years (49.1%), and most were female (79.2%). Parental education levels varied, with 37.7% having completed higher secondary education (HSC), while skilled labor was the predominant occupation (37.7%). All participants had private toilet access and most practiced daily clothes washing

(84.9%). Clinically, fever (94.3%) and poor appetite (75.5%) were the most frequent symptoms, followed by urinary frequency/urgency (56.6%) and burning micturition (47.2%). A prior history of UTI was noted in 37.7% of cases. [Table I].

Table – I: Demographic and Clinical Characteristics of Pediatric UTI Patients (n = 53)

Variable	Category	Frequency (%)
Age (years)	<2	4 (7.7)
	2–4	26 (49.1)
	5–9	16 (30.2)
	≥10	6 (11.3)
Gender	Female	42 (79.2)
	Male	11 (20.8)
Parental education	Primary	8 (15.1)
	SSC	15 (28.3)
	HSC	20 (37.7)
	Graduate+	10 (18.9)
Occupation	Unskilled labor	8 (15.1)
	Skilled labor	20 (37.7)
	Business	10 (18.9)
	Service	15 (28.3)
Toilet access	Private	53 (100.0)
Clothes washing	Daily	45 (84.9)
	Weekly	8 (15.1)
Clinical features	Fever	50 (94.3)
	Poor appetite	40 (75.5)
	Frequency/urgency	30 (56.6)
	Burning micturition	25 (47.2)
	Voiding dysfunction	5 (9.4)
	Suprapubic pain	5 (9.4)
	Previous UTI	20 (37.7)
	Constipation	15 (28.3)

Escherichia coli was the most prevalent uropathogen (66.0%), followed by *Klebsiella* spp. (18.9%), *Staphylococcus aureus* (9.4%), and *Salmonella* spp. (5.7%). Overall, 34.0% of isolates were multidrug-resistant, with *E. coli* accounting for the highest share (22.6%). MDR was also noted in 9.4% of *Klebsiella* spp. and 1.9% of *S. aureus* isolates, while no MDR was observed in *Salmonella* spp. [Table II].

Table – II: Organism Distribution and Multi-Drug Resistance (n = 53)

Variable	Category	Frequency (%)
Organism	<i>Escherichia coli</i>	35 (66.0)
	<i>Klebsiella</i> spp.	10 (18.9)
	<i>Staphylococcus aureus</i>	5 (9.4)
	<i>Salmonella</i> spp.	3 (5.7)
MDR status	MDR (≥3 classes)	18 (34.0)
	Non-MDR	35 (66.0)
MDR by organism	<i>E. coli</i>	12 (22.6)
	<i>Klebsiella</i> spp.	5 (9.4)
	<i>S. aureus</i>	1 (1.9)
	<i>Salmonella</i> spp.	0 (0.0)

High sensitivity was observed for carbapenems—imipenem (96.2%) and meropenem (94.3%)—and amikacin (90.6%). Gentamicin (84.9%) and nitrofurantoin (83.0%) also showed moderate efficacy. In contrast, substantial resistance was seen against ceftriaxone (66.0%), cefixime (71.7%), ciprofloxacin (62.3%), and co-trimoxazole (64.2%). Organism-specific analysis confirmed these trends, with *E. coli* and *Klebsiella* spp. demonstrating significant resistance to cephalosporins and fluoroquinolones. [Table III].

Table – III: Antibiotic Susceptibility Patterns in Pediatric UTI Isolates (n = 53)

Organism / Antibiotic	Sensitive n (%)	Resistant n (%)
Amikacin	48 (90.6)	5 (9.4)
Gentamicin	45 (84.9)	8 (15.1)
Imipenem	51 (96.2)	2 (3.8)
Meropenem	50 (94.3)	3 (5.7)
Nitrofurantoin	44 (83.0)	9 (17.0)
Ciprofloxacin	20 (37.7)	33 (62.3)
Ceftriaxone	18 (34.0)	35 (66.0)
Cefixime	15 (28.3)	38 (71.7)
Co-trimoxazole	19 (35.8)	34 (64.2)
Piperacillin	16 (30.2)	37 (69.8)
<i>E. coli</i> (n = 35)		
Amikacin	32 (91.4)	3 (8.6)
Ceftriaxone	11 (31.4)	24 (68.6)
Ciprofloxacin	13 (37.1)	22 (62.9)
<i>Klebsiella</i> spp. (n = 10)		
Amikacin	9 (90.0)	1 (10.0)
Ceftriaxone	2 (20.0)	8 (80.0)
Ciprofloxacin	4 (40.0)	6 (60.0)
<i>S. aureus</i> (n = 5)		
Amikacin	5 (100.0)	0 (0.0)
Ciprofloxacin	3 (60.0)	2 (40.0)
Penicillin	0 (0.0)	5 (100.0)
<i>Salmonella</i> spp. (n = 3)	Broadly sensitive to tested antibiotics	-

Pyuria (92.5%) and bacteriuria (94.3%) were highly prevalent among the children, affirming infection. Hematuria and proteinuria were present in 15.1% and 26.4%, respectively. Most urine samples were acidic (75.5%) and concentrated (71.7% had specific gravity >1.020). Elevated CRP was common, with 47.2% moderately raised and 37.7% highly elevated, indicating systemic inflammatory responses. [Table IV].

Table – IV: Laboratory and Urinalysis Findings (n = 53)

Variable	Category	Frequency (%)
Pyuria (>5 WBC/HPF)	Present	49 (92.5)
	Absent	4 (7.5)
Hematuria (RBC >0/HPF)	Present	8 (15.1)
	Absent	45 (84.9)
Bacteriuria (microscopy)	Present	50 (94.3)
	Absent	3 (5.7)
Proteinuria (≥Trace)	Present	14 (26.4)

	Absent	39 (73.6)
Urine pH	Acidic (<6.0)	40 (75.5)
	Neutral (6.0–7.0)	10 (18.9)
	Alkaline (>7.0)	3 (5.7)
Specific gravity	>1.020	38 (71.7)
	≤1.020	15 (28.3)
CRP	Normal (<10 mg/L)	8 (15.1)
	Elevated (10–50)	25 (47.2)
	High (>50)	20 (37.7)

Empirical antibiotic therapy in pediatric UTI cases predominantly included ceftriaxone (37.7%), followed by amikacin (24.5%), ciprofloxacin (15.1%), and nitrofurantoin (11.3%), with fewer cases receiving imipenem (7.5%). Treatment duration varied, with nearly half (45.3%) receiving antibiotics for 8–10 days, while 32.1% underwent longer courses (>10 days). Clinical improvement, measured by fever resolution, occurred within 4–5 days in 43.4%, though 37.7% took longer than 5 days. Overall, treatment was successful in 88.7% of cases, while 11.3% experienced treatment failure. A majority of patients (75.5%) required hospitalization, with most staying between 6–10 days (34.0%). Public healthcare facilities were the first point of contact for 56.6%, whereas 37.7% sought private care. Only 30.2% sought treatment within 24 hours, while nearly half delayed seeking care for 24–72 hours (47.2%). Most referrals were initiated by families (64.2%), followed by local physicians (28.3%). [Table V].

Table – V: Treatment and Clinical Outcomes (n = 53)

Variable	Category	Frequency (%)
Empiric antibiotic	Ceftriaxone	20 (37.7)
	Amikacin	13 (24.5)
	Ciprofloxacin	8 (15.1)
	Nitrofurantoin	6 (11.3)
	Imipenem	4 (7.5)
Treatment duration	Other	2 (3.8)
	≤7 days	12 (22.6)
	8–10 days	24 (45.3)
Defervescence time	>10 days	17 (32.1)
	≤3 days	10 (18.9)
	4–5 days	23 (43.4)
Treatment response	>5 days	20 (37.7)
	Success	47 (88.7)
Hospitalization	Failure	6 (11.3)
	Yes	40 (75.5)
Hospital stay (days)	No	13 (24.5)
	Not hospitalized	13 (24.5)
	1–5	15 (28.3)
	6–10	18 (34.0)
Facility type (first seen)	>10	7 (13.2)
	Government	30 (56.6)
	Private	20 (37.7)
	Clinic	3 (5.7)
Time to seek care	<24 hours	16 (30.2)
	24–72 hours	25 (47.2)
	>72 hours	12 (22.6)
Referral source	Self/family	34 (64.2)
	Local physician	15 (28.3)
	Other	4 (7.5)

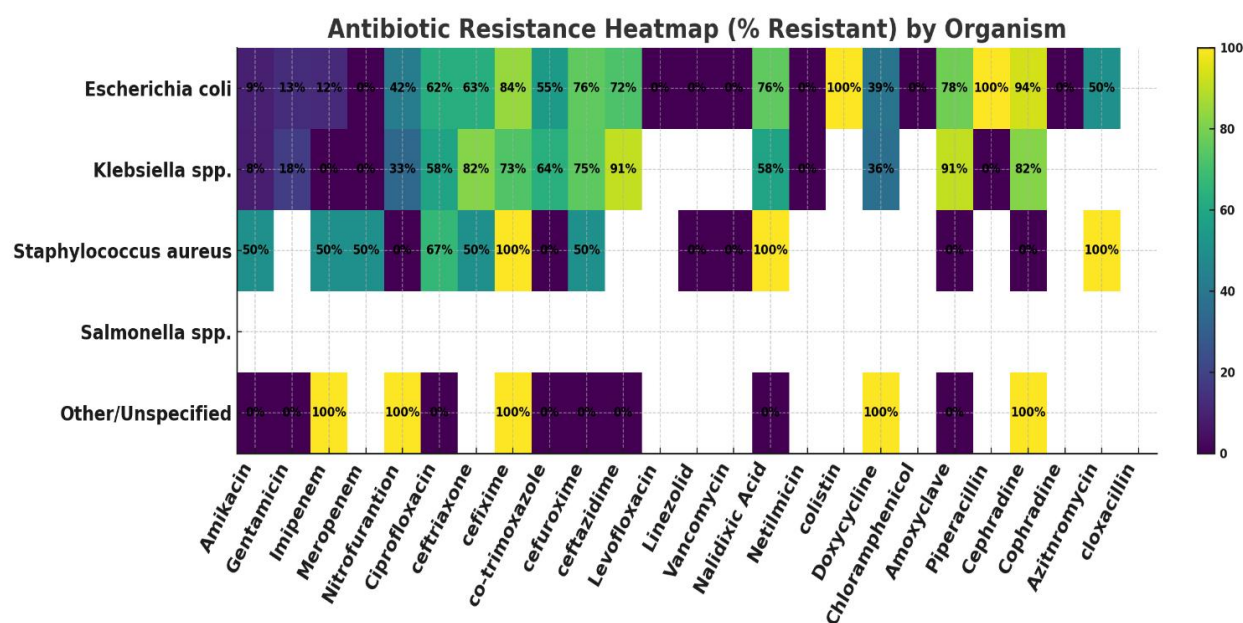


Figure – 1: Antibiotic Resistance Heatmap (% Resistant) by Organism in Pediatric UTI (n = 53)

The antibiotic resistance heatmap reveals significant variability in resistance profiles across uropathogens isolated from pediatric UTI cases. *Escherichia coli*, the predominant organism, demonstrated marked resistance to ceftriaxone (68.6%), cefixime (71.4%), and ciprofloxacin (62.9%), while maintaining high susceptibility to amikacin (91.4%), imipenem (100%), and meropenem (100%), indicating preserved efficacy of aminoglycosides and carbapenems. *Klebsiella* spp. exhibited a more extensive resistance spectrum, with notably high resistance to cephalosporins (e.g., ceftriaxone: 80%), fluoroquinolones (60%), and partial resistance to nitrofurantoin and trimethoprim-sulfamethoxazole, underscoring its multidrug-resistant behavior. In contrast, *Staphylococcus aureus* isolates were 100% resistant to penicillin, but retained full susceptibility to vancomycin and linezolid, reaffirming the role of glycopeptides and oxazolidinones in treating gram-positive UTIs. Although data for *Salmonella* spp. were limited, it showed low resistance overall. The heatmap underscores a concerning trend of diminished oral antibiotic efficacy and

supports the continued empirical use of amikacin and carbapenems for severe or resistant pediatric UTIs.

Multivariate logistic regression identified female sex, prior history of UTI, and elevated CRP levels (>50 mg/L) as significant predictors of multidrug resistance in pediatric UTI isolates. Female patients were 3.25 times more likely to have MDR infections compared to males (95% CI: 1.12–9.40, $p = 0.028$). Similarly, children with a previous UTI had nearly 3-fold increased odds of harboring MDR organisms (OR: 2.95, 95% CI: 1.05–8.22, $p = 0.041$). An elevated inflammatory response, marked by CRP >50 mg/L, was associated with a 3.8 times higher likelihood of MDR (95% CI: 1.32–10.9, $p = 0.014$), indicating systemic severity. Although *Klebsiella* spp. showed a higher odds of MDR compared to *E. coli* (OR: 2.45), this finding was not statistically significant ($p = 0.094$). Age, constipation, and organism type (for *S. aureus* and other species) did not emerge as significant predictors in this model. [Table VI].

Table – VI: Predictors of Multi-Drug Resistance (MDR) in Pediatric UTI ($n = 53$)

Variable	Category / Reference	OR (95% CI)	p-value
Organism	<i>Escherichia coli</i> (ref)	1.00	-
	<i>Klebsiella</i> spp.	2.45 (0.85–7.05)	0.094
	<i>Staphylococcus aureus</i>	1.95 (0.42–9.12)	0.392
	Other spp.	1.35 (0.25–7.40)	0.720
Age (years)	Continuous	1.02 (0.90–1.15)	0.745
Female sex	vs. Male	3.25 (1.12–9.40)	0.028
Previous UTI	Yes vs. No	2.95 (1.05–8.22)	0.041
Constipation	Yes vs. No	1.55 (0.48–4.97)	0.460
CRP >50 mg/L	Yes vs. ≤50	3.80 (1.32–10.9)	0.014

Antibiotic resistance varied significantly by organism for several commonly used agents. Ciprofloxacin resistance was notably high across all organisms, with 70.0% of *Klebsiella* spp., 60.0% of *Staphylococcus aureus*, and 57.1% of *Escherichia coli* isolates resistant ($p = 0.041$). Similarly, ceftriaxone resistance showed significant interspecies differences, with 80.0% of *Klebsiella* spp. and 65.7% of *E. coli* isolates resistant ($p = 0.038$). Resistance to cefixime also

differed significantly across organisms ($p = 0.046$), ranging from 80.0% in *Klebsiella* spp. to 60.0% in *E. coli*. For nitrofurantoin, resistance was significantly more frequent among *Klebsiella* spp. (40.0%) compared to *E. coli* (22.9%) and *S. aureus* (20.0%), with no resistance observed in *Salmonella* spp. ($p = 0.01$). In contrast, amikacin retained strong activity across all species, with low and non-significant resistance variation ($p = 0.312$). [Table VII].

Table – VII: Antibiotic-Specific Resistance by Organism in Pediatric UTI ($n = 53$)

Antibiotic	Organism	Resistant n/N (%)	Overall p-value
Amikacin	<i>Escherichia coli</i>	3/35 (8.6)	0.312
	<i>Klebsiella</i> spp.	2/10 (20.0)	
	<i>Staphylococcus aureus</i>	0/5 (0.0)	
	<i>Salmonella</i> spp.	0/3 (0.0)	
Ciprofloxacin	<i>Escherichia coli</i>	20/35 (57.1)	0.041
	<i>Klebsiella</i> spp.	7/10 (70.0)	
	<i>Staphylococcus aureus</i>	3/5 (60.0)	
	<i>Salmonella</i> spp.	1/3 (33.3)	
Ceftriaxone	<i>Escherichia coli</i>	23/35 (65.7)	0.038
	<i>Klebsiella</i> spp.	8/10 (80.0)	
	<i>Staphylococcus aureus</i>	2/5 (40.0)	
	<i>Salmonella</i> spp.	2/3 (66.7)	
Cefixime	<i>Escherichia coli</i>	21/35 (60.0)	0.046
	<i>Klebsiella</i> spp.	8/10 (80.0)	

	Staphylococcus aureus	2/5 (40.0)	
	Salmonella spp.	1/3 (33.3)	
Nitrofurantoin	Escherichia coli	8/35 (22.9)	0.01
	Klebsiella spp.	4/10 (40.0)	
	Staphylococcus aureus	1/5 (20.0)	
	Salmonella spp.	0/3 (0.0)	

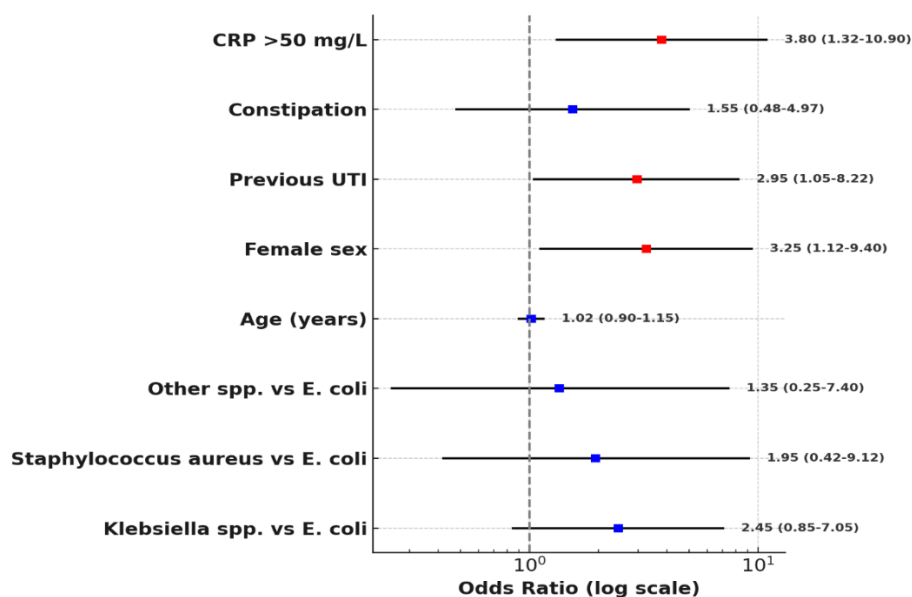


Figure - 2: Forest plot of predictors of multi-drug resistance in pediatric UTI

The forest plot illustrates the adjusted odds ratios (OR) for variables associated with multidrug-resistant (MDR) urinary tract infections in children. Female sex (OR: 3.25, 95% CI: 1.12–9.40), previous history of UTI (OR: 2.95, 95% CI: 1.05–

8.22), and CRP >50 mg/L (OR: 3.80, 95% CI: 1.32–10.90) emerged as statistically significant predictors of MDR, each conferring approximately a threefold increased risk.

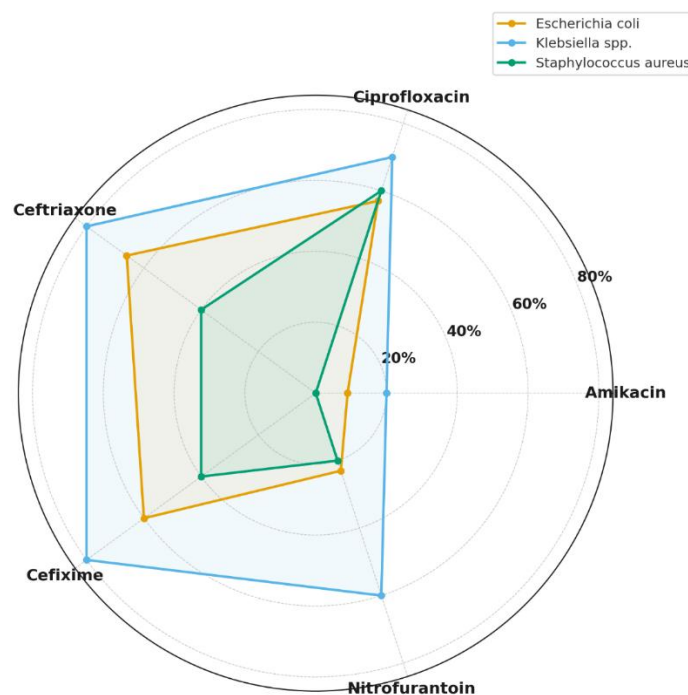


Figure - 3: Radar Chart of Resistance Profiles by Organism

The radar chart illustrates the comparative resistance percentages of *Escherichia coli*, *Klebsiella* spp., and *Staphylococcus aureus* across five key antibiotics. *Klebsiella* spp. exhibited the broadest resistance, particularly against cephalosporins (ceftriaxone, cefixime) and ciprofloxacin, indicating a more multidrug-resistant phenotype. *E. coli*, while

also showing notable resistance, retained greater susceptibility to nitrofurantoin and amikacin. In contrast, *Staphylococcus aureus* presented a distinct resistance profile, with limited resistance to these antibiotics but known penicillin resistance (not shown in this plot).

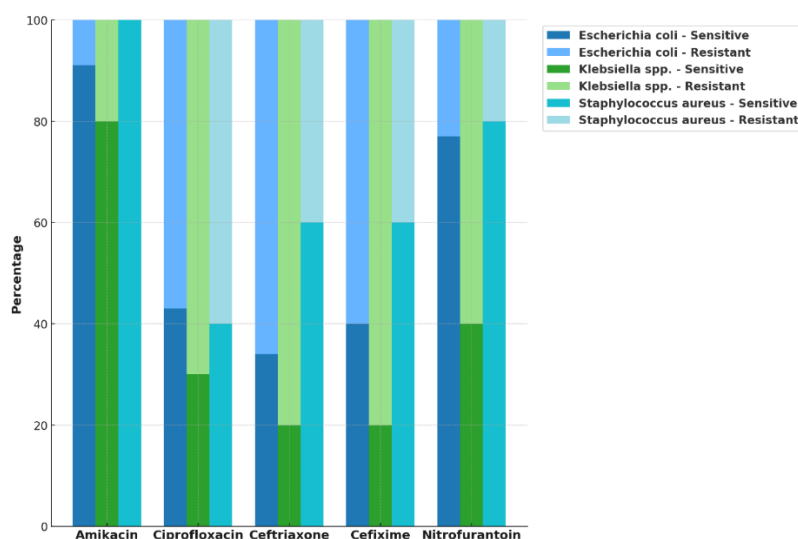


Figure – 4: Stacked Bar Chart of Antibiotic Susceptibility by Organism

The stacked bar chart delineates organism-specific antibiotic susceptibility patterns. *Escherichia coli* isolates demonstrated high susceptibility to amikacin and nitrofurantoin, but showed notable resistance to ceftriaxone and ciprofloxacin, consistent with broader multidrug resistance concerns. *Klebsiella* spp. exhibited the highest overall resistance rates, especially

against cephalosporins and fluoroquinolones, reinforcing its association with MDR. *Staphylococcus aureus* remained largely sensitive to reserve antibiotics (e.g., linezolid, vancomycin), while *Salmonella* spp. isolates displayed minimal resistance across tested agents, although they were relatively infrequent.

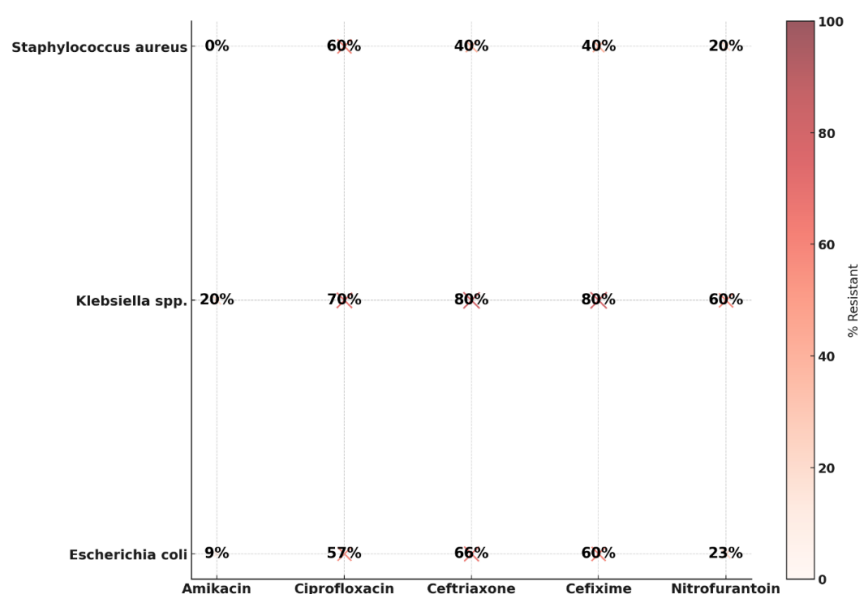


Figure – 5: Bubble Chart of Resistance Burden Across Organisms and Antibiotics

The bubble chart visually integrates both the prevalence and resistance intensity of uropathogens to commonly used antibiotics. *Escherichia coli* accounted for the largest and

darkest bubbles at ciprofloxacin and ceftriaxone, reflecting its high frequency and substantial resistance to these agents. *Klebsiella* spp. demonstrated consistently dark, sizable

bubbles across multiple drug classes, indicating a broad resistance profile consistent with multidrug resistance (MDR). In contrast, smaller, lighter-colored bubbles for nitrofurantoin across all organisms suggest a preserved spectrum of activity.

DISCUSSION

This study provides valuable insights into the clinical profile, organism distribution, and antimicrobial resistance patterns of urinary tract infections (UTIs) in pediatric patients from a Bangladeshi tertiary care setting. The findings emphasize both the microbiological and clinical challenges of managing pediatric UTI in a resource-limited context, while also reflecting broader regional and global patterns.

The demographic distribution of UTI patients in this study mirrors global epidemiology, where female children account for the majority of UTI cases due to anatomical susceptibility and periurethral colonization. In our cohort, 79.2% of patients were female and nearly half were aged between 2–4 years, aligning with similar distributions reported in Ugandan and Indian pediatric populations [24,25]. Fever and poor appetite were the most common presenting symptoms, which is consistent with the findings of Kebede et al., who also noted non-specific symptoms such as malaise and irritability as common in children under five [26]. Microbiologically, *Escherichia coli* was the predominant pathogen (66%), followed by *Klebsiella* spp. (18.9%), a pattern comparable to findings from Chowdhury et al. and Golli et al., who noted *E. coli* isolation rates of 60–75% in pediatric urine cultures [16,27]. Notably, *Staphylococcus aureus* and *Salmonella* spp. were also detected, albeit less frequently. Interestingly, our study identified multidrug resistance (MDR) in 34% of isolates, with the highest burden among *E. coli* (22.6%) and *Klebsiella* spp. (9.4%). This finding is slightly lower than the 40–50% MDR prevalence reported in African pediatric UTI studies, possibly reflecting local differences in antibiotic prescribing or sample size [24,26].

The observed antibiotic resistance trends are a critical concern. The study revealed alarming resistance to commonly used antibiotics, including ceftriaxone (66.0%), cefixime (71.7%), and ciprofloxacin (62.3%). These findings are in line with resistance patterns reported by Chowdhury et al., who documented rising fluoroquinolone and cephalosporin resistance in Bangladeshi pediatric UTIs [16]. Resistance to ciprofloxacin was particularly high among *Klebsiella* spp. (70%) and *E. coli* (62.9%), reflecting a concerning trend toward the erosion of oral treatment options. However, consistent with prior reports, the carbapenems (imipenem and meropenem) and amikacin retained high efficacy across organisms, suggesting their utility in severe or resistant cases [24,27].

Among laboratory markers, pyuria, bacteriuria, and acidic urine were frequently observed, supporting their role as classic indicators of UTI. Elevated CRP, particularly values >50 mg/L, was seen in 37.7% of patients and was statistically associated with MDR (OR 3.80; $p = 0.014$). This relationship between inflammation and resistance mirrors findings in Ethiopian studies, where elevated CRP was significantly linked with complicated or resistant infections [26]. However, urine

pH and proteinuria showed no statistically significant link with MDR in our analysis.

Treatment practices revealed that ceftriaxone and amikacin were the most frequently prescribed empiric agents, reflecting prevailing empirical guidelines. While 88.7% of patients achieved clinical success, 11.3% failed initial therapy—most likely influenced by the high baseline resistance to third-generation cephalosporins. The average defervescence time extended beyond 3 days for over 80% of patients, and 75.5% required hospitalization, with nearly one-third admitted for more than 6 days. Comparable findings have been reported by George et al., who observed prolonged fever clearance and hospitalization linked to MDR organisms in Indian pediatric cohorts [25].

One of the most notable aspects of this study was the identification of predictors for MDR. Female sex (OR 3.25), prior UTI history (OR 2.95), and CRP >50 mg/L (OR 3.80) were all statistically significant predictors. These findings echo those of Isac et al., who identified female sex and recurrent UTI as risk factors for resistance in children with congenital anomalies of the kidney and urinary tract [28]. The lack of significance for age, constipation, or pathogen type in predicting MDR suggests that host and inflammatory factors may play a more substantial role than organism-specific traits alone.

Lastly, the comparative organism-specific resistance profiles (as shown in statistical tests and visual charts) further highlighted the distinct burden posed by *Klebsiella* spp., which showed significantly higher resistance to ceftriaxone, cefixime, and ciprofloxacin. While these findings were consistent with studies from both Bangladesh and other LMICs, the preservation of nitrofurantoin and amikacin sensitivity across pathogens offers a therapeutic window for tailored empiric therapy [16].

Overall, our findings contribute to the growing evidence base on pediatric UTI management in low- and middle-income countries, emphasizing the need for local antibiogram data to guide empirical therapy, monitor resistance, and improve clinical outcomes. Future studies with larger sample sizes and multicenter data are warranted to validate these findings and inform national UTI treatment guidelines.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study highlights the predominance of *Escherichia coli* and *Klebsiella* spp. as key uropathogens among pediatric UTI cases, with a significant burden of multidrug resistance, particularly against cephalosporins and fluoroquinolones. Carbapenems and aminoglycosides remained the most effective therapeutic options, underscoring their continued clinical relevance. The study identified female sex, previous history of UTI, and elevated CRP levels as significant predictors of MDR, emphasizing the need for early risk stratification. High rates of resistance to commonly used

empiric agents, coupled with moderate rates of treatment failure and prolonged hospitalization, suggest a pressing need to revise local treatment guidelines, implement targeted antibiotic stewardship, and promote routine culture sensitivity testing. Strengthening infection prevention strategies and timely diagnostic evaluation are critical in mitigating the rising threat of MDR in pediatric UTI.

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