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Detection of Uropathogens and Their Antimicrobial Susceptibility Pattern in Children Attending at a Tertiary Care Hospital in Bangladesh

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Abstract

Background: Urinary tract infections (UTIs) are a leading cause of morbidity in children, with rising concern over antimicrobial resistance (AMR) among uropathogens, particularly in resource-limited settings like Bangladesh. **Objective:** This study investigates the distribution of uropathogens and their antimicrobial susceptibility patterns in pediatric patients attending a tertiary care hospital in Dhaka. **Methodology:** This cross-sectional study was conducted from November 2023 to August 2024 in the Department of Microbiology at Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh. Urine samples from 3,455 pediatric patients suspected of having UTIs were collected and cultured. Pathogen identification and antimicrobial susceptibility testing (AST) were performed using standard microbiological techniques and the Kirby-Bauer disc diffusion method, following CLSI guidelines. **Results:** Out of 3,455 urine samples, 643(18.6%) showed positive growth, including 494(76.8%) bacterial and 149 (23.2%) fungal isolates. Gram-negative bacteria dominated (72.9%), with *Escherichia coli* (38.46%) and *Klebsiella pneumoniae* (10.12%) being the most prevalent. Among Gram-positive isolates, Enterococcus species (26.9%) were predominant. AST revealed widespread multidrug resistance. *Escherichia coli* showed high resistance to cefixime (100.0%), ampicillin (96.3%), and ciprofloxacin (90.0%), with moderate susceptibility to carbapenems (64.0%). *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* also demonstrated significant resistance to third-generation cephalosporins and fluoroquinolones. *Enterococcus* spp. exhibited 100% resistance to penicillin but remained largely susceptible to vancomycin. **Conclusion:** This study underscores an alarming prevalence of multidrug-resistant uropathogens among children with UTIs in Bangladesh. The resistance patterns challenge empirical treatment strategies, highlighting the urgent need for routine AMR surveillance, judicious antibiotic use, and updated local treatment guidelines to ensure effective management of pediatric UTIs.

Keywords: Urinary tract infection; antimicrobial resistance; pediatric population

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Introduction

Urinary tract infections (UTIs) are among the most common bacterial infections in children and represent a significant cause of morbidity worldwide. In pediatric populations, UTIs may present with non-specific symptoms, especially in younger children, making early diagnosis and appropriate treatment critical to prevent complications such as renal scarring, hypertension, and chronic kidney disease[1]. The spectrum of uropathogens and their antimicrobial susceptibility patterns varies across geographic regions and healthcare settings, influenced by local antibiotic prescribing practices and resistance trends. Escherichia coli is the most frequently isolated

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organism in childhood UTIs, accounting for over 70% of community-acquired infections, followed by other gram-negative organisms such as *Klebsiella, Proteus,* and *Pseudomonas* species[2,3].

In Bangladesh, UTIs in children are a growing concern, particularly due to the rise in multidrug-resistant (MDR) uropathogens. Several studies conducted in tertiary care hospitals in the country have reported increasing resistance to commonly used antibiotics such as ampicillin, co-trimoxazole, and third-generation cephalosporins, complicating empirical treatment options[4,5]. This trend underscores the importance of continuous surveillance of antimicrobial resistance patterns to guide rational antibiotic use and effective clinical management.

The current study aims to identify the predominant uropathogens in pediatric patients presenting with UTIs and assess their antimicrobial susceptibility profiles in a tertiary care hospital setting in Bangladesh. The findings will provide valuable insights for clinicians to make evidence-based decisions in the management of UTIs among children.

Methodology

Study Settings and Population: This cross-sectional study was conducted in the Department of Microbiology at Bangladesh Shishu Hospital and Institute, Dhaka, Bangladesh between November 2023 to August 2024. All patients admitted to Bangladesh Shishu Hospital and Institute with suspected UTI were included in this study. Data regarding the identity of the patient, referring departments, and susceptibility reports were collected from the laboratory. This study utilized laboratory data with prior approval from the hospital administration and the study was conducted in accordance with institutional ethical guidelines.

Study Procedure: The method of urine collection in pediatric patients depends on the child's age, toilet training status, and clinical context. Clean-Catch Midstream Urine (CCMS) was collected for toilet-trained children; Urine Collection Bag was used for non-toilet-trained infants and young children and in cases requiring sterile collection Suprapubic Aspiration (SPA) was considered the gold standard for infants, especially when contamination must be minimized[6].

Laboratory Procedure: With all aseptic precautions, urine sample was collected in a sterile container & transported to the laboratory within 2 hours of collection. Refrigerate the sample at 4°C for up to 24 hours if delayed[7]. Urine microscopy was performed before culture. A wet mount was examined under high-power field (HPF) to assess the presence of Pus cell. Samples with ≥5 pus cells/HPF were considered suggestive of infection and included for culture. The urine sample was mixed gently to ensure homogenization. A calibrated loop usually (1 µL or 10 µL) was dipped vertically into the urine sample to obtain a fixed volume. The surface of the MacConkey agar, and the blood agar plates was streaked using a semi-quantitative method. The initial streak was made in a straight line down the center of the plate, followed by crosswise direction without flaming the loop. The plate was incubated at 35 to 37^{o}C for 18 to 24 hours in ambient air[8]. After incubation, culture plates were examined for observe bacterial growth, heamolysis, colony morphology. Then Gram staining and different biochemical tests like catalase, coagulase, oxidase test, reaction in TSI agar, MIU, Simmon's citrate agar and bile esculin agar media were done. A bacterial count ≥ 10^5 CFU/mL from clean catch urine was considered as true infection[9,10]. Antimicrobial Susceptibility Testing (AST) was done by Kirby-Bauer Disc Diffusion method11. Following antimicrobial discs were used amikacin(30µg), ampicillin (10µg), chloramphenicol (5 µg), Sulamethroxazole/trimethoprim (25 µg), azithromycin(15 µg) , meropenem (10 µg) piperacillin-tazobactum(100/10 µg), imepenem(10 µg), ciprofloxacin(30 µg), ceftriaxone (30 µg), ceftazidime(30 µg), cefepime(30 µg), gentamycin (10 µg), levofloxacin (5 µg),linezolid (30 µg), penicillin(10 µg), moxifloxacin(5 µg), netilmicin (30 µg), erythromycin (15 µg), vancomycin (30 µg), amoxiclav (amoxicillin 20 µg &clavulanic acid 10 µg), fosfomycin (200 µg), nalidixic acid (30 µg), nitrofurantoin (300 µg), and tetracyclin (30 µg). Interpretations were done as 'Sensitive', 'Intermediate', 'Resistant' on the basis of zone diameter that inhibit bacterial growth recommended by the disc manufacturer. Zone of inhibition was measured according to CLSI guideline M100, 20249,[11].

Statistical Analysis: Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS). Descriptive statistics were used to summarize demographic characteristics, culture positivity rates, distribution of uropathogens, and antimicrobial resistance patterns. Categorical variables were expressed as frequencies and percentages. The prevalence of urinary tract infection (UTI) was calculated as the proportion of culture-positive cases among the total number of urine samples processed.

Ethical Consideration: All procedures of the present study were carried out in accordance with the principles for human investigations (i.e., Helsinki Declaration 2013) and also with the ethical guidelines of the Institutional research ethics. Formal ethics approval was granted by the local ethics committee. Participants in the study were informed about the procedure and purpose of the study and confidentiality of information provided. All participants consented willingly to be a part of the study during the data collection periods. All data were collected anonymously and were analyzed using the coding system.

Results

A total 3455 urine sample was collected. Among them 643 cases of UTI. Among these 494 (76.82%) were bacterial infections, 149 (23.17%) were fungal infections. Among Gram-negative bacterial isolates, the following were identified like *Escherichia coli* (190 isolates; 38.46%), *Klebsiella pneumoniae* (50

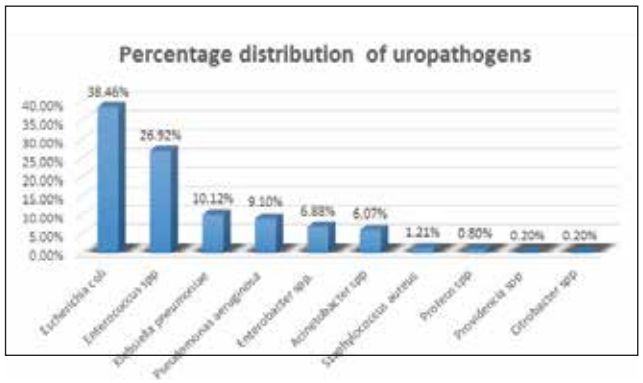

Figure I: Percentage Distribution Of Uropathogens Isolated From Urine Samples

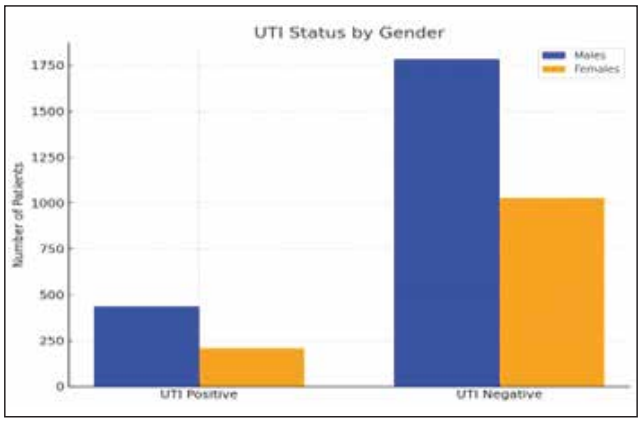

Figure II: Distribution of UTI-Positive and UTI-Negative Cases Among Male And Female Patients

Table 1: Antimicrobial Resistance Pattern of Gram-Positive Bacteria Isolated from Urine Culture of Paediatric Patients

Antibiotic	*Enterococcus* spp (133)	*Staphylococcus aureus* (6)
Penicillin	133(100.0%)	0(0.0%)
Ampicillin	74(55.6%)	-
Oxacillin	**	5(83.3%)
Ciprofloxacin	128(96.2%)	5(83.3%)
Levofloxacin	67(50.4%)	4(66.7%)
Cotrimoxazole	-	0(0.0%)
Gentamicin	-	0(0.0%)
Vancomycin	12(9.0%)	-
Nitrofurantoin	35(26.3%)	4(66.7%)
Tetracycline	5(3.7%)	-
Fosfomycin	0(0.0%)	-

TTable 2: Antimicrobial Resistance Pattern of Gram-Negative Bacteria Isolated from Urine Culture of Paediatric Patients

Antibiotic	*Escherichia Coli* (190)	*Klebsiella pneumonia* (50)	*Pseudomonas spp* (45)	*Enterobacter spp* (34)	*Acinetobacter spp* (30)
Amikacin	132(69.5%)	50(100.0%)	37(82.2%)	20(58.8%)	21(70.0%)
Ampicillin	183(96.3%)	50(100.0%)	-	30(88.2%)	-
Ceftriaxone	181(95.3%)	50(100.0%)	-	25(73.5%)	10(33.3%
Cefixime	190(100.0%)	50(100.0%)	-	30(88.2%)	-
Ceftazidime	177(93.2%)	40(80.0%)	36(80.0%)	17(50.0%)	7(23.3%)
Cefepime	175(92.2%)	42(84.0%)	34(75.5%)	17(50.0%)	4(13.3%)
Ciprofloxacin	171(90.0%)	50(100.0%)	40(88.9%)	34(100.0%)	10(33.3%)
Levofloxacin	160(84.2%)	48(96.0%)	38(88.2%)	30(88.2%)	9(30.0%)
Imipenem	121(63.7%)	40(80.0%)	34(75.5%)	0(0.0%)	5(16.7%)
Meropenem	122(64.2%)	40(80.0%)	32(71.1%)	0(0.0%)	5(16.7%)
Nitrofurantoin	45(23.7%)	49(98.0%)	-	4(11.8%)	-
Fosfomycin	18(9.5%)	-	-	-	-
Amoxicillin-clavulanic acid	55(28.9%)	35(70.0%)	-	15(44.1%)	11(36.7%)
Piperacillin-tazobactam	55(28.9%)	36(72.0%)	37(82.2%)	0(0.0%)	11(36.7%)
Cotrimoxazole	150(78.9%)	43(86.0%)	-	17(50.0%)	-
Gentamicin	120(63.1%)	45(90.0%)	-	0(0.0%)	21(70.0%)

isolates; 10.12%), *Pseudomonas aeruginosa* (45 isolates; 9.10%), *Enterobacter* species (34 isolates; 6.88%), *Acinetobacter* species (30 isolates; 6.07%), *Proteus* species (4 isolates; 0.80%), *Providencia* species (1 isolates; 0.20%), *Citrobacter* spp. (1 isolate; 0.20%). In contrast, the Gram-positive bacterial isolates included *Enterococcus* species. (133 isolates; 26.92%), *Staphylococcus aureus* (6 isolates; 1.21%). The majority of the bacterial pathogens were Gram negative with *Escherichia coli* being predominant followed by *Klebsiella pneumonia*. Among Gram positive bacterial isolates *Enterococcus* was predominant.

In this study, a total of 3455 patients suspected of having a UTI were analyzed, comprising 2217 males and 1233 females, resulting in a female-to-male ratio of 1:1.79. Among them, 435 males and 207 females tested positive for a UTI.

Discussion

In this study, 643/3455 (18.6%) of urine specimens yielded urinary tract infections (UTIs), with 494(76.8%) bacterial and 149(23.2%) fungal isolates. Among the bacterial infections, Gram-negative organisms were predominant 71.9%, whereas Gram-positive cocci 28.1% were less common. Our results align closely with global findings. Flores Mireles et al have reported that Gram-negative bacteria represent the majority of uropathogens, typically accounting for 70.0% to 85.0% of cases, with Escherichia coli being the foremost etiologic agent (≈ 40 to 90%) followed by *Klebsiella pneumoniae*, *Pseudomonas aeruginosa, Proteus* species, *Enterobacter* species and *Acinetobacter* species[12].

Specifically, *Escherichia coli* in our cohort comprised 38.5% of Gram-negative isolates. This figure is comparable to 40.8% reported by a Saudi Arabian cohort[13] and slightly lower than figures of around 51.0% to 60.0% reported in other regional studies. Similarly, our isolation rate of *Klebsiella pneumoniae* (10.1%) is consistent with documented ranges (10.0% to 15.0%)[14]. In this cohort of uropathogenic Enterococcus isolates, 100% demonstrated resistance to penicillin, and 55.6% were resistant to ampicillin, indicating a troubling resistance trend in commonly used β-lactam antibiotics. While traditionally considered effective against *Enterococcus faecalis*, penicillin resistance is not uncommon, especially in *Enterococcus faecium*. A global meta-analysis found penicillin resistance rates ranging from 1.4% in Europe to 97.5% in Southeast Asia15. Our study's 100.0% resistance is consistent with Southeast Asia's highest regional rates, suggesting significant local or regional antibiotic pressure.

Similarly, ampicillin resistance also exhibits dramatic regional variation. The same meta-analysis reported rates from 0.4% in the Americas to 77.3% in Southeast Asia. Our observed 55.6% resistance aligns with high-resistance zones like South-East Asia and India (ampicillin resistance ~74.1%)[16]. In hospital settings, *Enterococcus faecium* is often the culprit behind high-level β-lactam resistance due to modifications in penicillin-binding proteins, notably PBP5[17]. The high resistance recorded here likely reflects an increasing proportion of *Enterococcus faecium* or the emergence of resistant *Enterococcus faecalis* strains locally. In the present data, *Enterococcus* species exhibited high resistance to ciprofloxacin (96.24%) and moderate resistance to levofloxacin (50.4%), which aligns with previous findings indicating widespread fluoroquinolone resistance among enterococci due to mutations in the *gyrA* and *parC* genes and efflux mechanisms[18,19].

Vancomycin resistance was observed in 9.0% of isolates, a concerning trend given the critical role of vancomycin in treating multidrug-resistant Gram-positive infections. Hospitalized patients are more likely to receive broad-spectrum antibiotics, which create selective pressure for resistant strains. Invasive procedures, prolonged hospital stays, immunosuppression and cross-transmission via contaminated surfaces or healthcare workers increase the risk of VRE colonization and infection. The presence of vancomycin-resistant enterococci (VRE), particularly those harboring *vanA* and *vanB* genes, has been increasingly reported in pediatric populations and is associated with nosocomial transmission and limited therapeutic options[20,21]. Nitrofurantoin resistance (26.4%) was moderate, suggesting it remains a viable option for uncomplicated UTIs. However, resistance rates vary geographically and may be influenced by local prescribing practices[22]. Tetracycline resistance was low (3.8%), which may reflect reduced use in pediatric settings due to concerns over dental staining and bone growth inhibition[23].

Notably, fosfomycin showed no resistance, highlighting its potential as a first-line agent in pediatric UTIs caused by *Enterococcus* species Fosfomycin's unique mechanism of action and minimal cross-resistance with other antibiotics make it particularly valuable in the era of rising multidrug resistance[24]. Its efficacy against biofilm-forming

enterococci further supports its use in urinary infections[25]. The resistance profile of *Escherichia coli* isolates from paediatric urinary samples in this study reveals a disturbing trend of multidrug resistance. Beta-lactam antibiotics showed notably poor efficacy. Ampicillin resistance was alarmingly high at 96.3%, followed closely by ceftriaxone (95.3%), cefixime (100.0%), ceftazidime (93.1%), and cefepime (92.2%). These figures align with global trends that indicate rising resistance to third-generation cephalosporins in *Escherichia coli* due to extended-spectrum beta-lactamase (ESBL) production[26,27].

High levels of resistance were observed to ciprofloxacin (90.0%) and levofloxacin (84.2%), indicating diminished efficacy of fluoroquinolones, which are already limited in use in children due to potential musculoskeletal side effects[28]. These may reflect regional overuse or inappropriate prescribing of fluoroquinolones, leading to selective pressure and emergence of resistant *Escherichia coli* clones.

Carbapenems, typically reserved for resistant infections, also showed considerable resistance 63.7% for imipenem and 64.2% for meropenem. While imipenem resistance is comparable to 64.0% reported in Ardabil, Iran by Dostyar et al[29]. Meropenem resistance is significantly higher than in other studies. The elevated resistance may be due to the empirical overuse of carbapenems in pediatric settings, poor antibiotic stewardship, or the circulation of carbapenemase-producing clones. These findings raise concern about the possible presence of carbapenemase-producing strains, limiting last-line treatment options[30].

Among commonly used oral agents, nitrofurantoin and fosfomycin showed lower resistance rates (23.7% and 9.5%, respectively), suggesting some retained activity, although their use may be constrained by patient age and infection severity[31]. Conversely, resistance to amoxicillin-clavulanate and piperacillin-tazobactam was 28.9%, reflecting increased effectiveness of beta-lactam/beta-lactamase inhibitor combinations. In our study Cotrimoxazole exhibit 78.9% resistance, making it a poor choice for empirical therapy. This result is comparable to a study done in Tanzania which revealed that, more than 80.0% *Escherichia coli* were resistant to cotrimoxazole in urinary tract infections[32]. In this study gentamicin exhibit 63.1% resistance. Almost a similar finding was found by Neccodem et al[33] where gentamicin resistance was 57.5% cases. These results stress the importance of local antibiograms to guide targeted therapy in paediatric urinary tract infections and underscore the need for robust antimicrobial stewardship practices[34].

Klebsiella pneumoniae demonstrated 100.0% resistance to amikacin, ampicillin, ceftriaxone, and cefixime, with high resistance also noted to ceftazidime (80.0%) and cefepime (84.0%). *Enterobacter species* showed moderately high resistance: 58.8% to amikacin, 88.8% to ampicillin, 73.5% to ceftriaxone, 88.2% to cefixime, and 50.0% each to ceftazidime and cefepime. These findings are consistent with several published studies reporting increasing multidrug resistance in urinary *Klebsiella* and *Enterobacter* isolates. A study by Ranjan et al[35] in India reported 100.0% resistance of *Klebsiella pneumoniae* to ampicillin and third-generation cephalosporins such as cefotaxime and ceftriaxone in paediatric UTI cases. Similarly, Sharma et al[36] found *Klebsiella species* exhibiting over 90.0% resistance to ceftriaxone and cefixime, highlighting extensive beta-lactam resistance due to ESBL production.

In *Enterobacter* species, our results reflect the findings of a study by Al-Tawfiq et al[37], where cephalosporin resistance rates ranged from 60.0% to 80.0%, and resistance to aminoglycosides like amikacin was around 50.0% cases. These organisms are intrinsically resistant to ampicillin and often acquire plasmid-mediated resistance to multiple antibiotic classes, complicating empirical therapy[38]. *Klebsiella pneumoniae* displayed 100.0% resistance to ciprofloxacin, 96.0% to levofloxacin, and 80.0% to both imipenem and meropenem, indicating possible carbapenemase production and resistance to last-line antibiotics. Additionally, high resistance was observed to nitrofurantoin (98.0%), amoxicillin-clavulanic acid (70.0%), piperacillin-tazobactam (72.0%), cotrimoxazole (86.0%), and gentamicin (90.0%). These findings indicate that *Klebsiella pneumoniae* in paediatric UTIs is resistant to nearly all commonly used empirical antibiotics.

Similar resistance profiles have been reported in other studies. A study by Ranjan et al. found high resistance of *Klebsiella pneumoniae* to fluoroquinolones (>90%) and carbapenems (65.0% to 85.0%) in paediatric UTI cases in India, consistent with the current data[35]. In a separate multicentre study, Logan and Weinstein described the emergence of carbapenem-resistant Enterobacteriaceae (CRE), particularly *Klebsiella pneumoniae*, among children in the United States, noting widespread resistance across fluoroquinolones, aminoglycosides, and β-lactams[30]. In contrast, *Enterobacter spp.* showed a relatively more

favourable resistance profile. While ciprofloxacin resistance was also 100.0%, and levofloxacin resistance was 88.2%, the isolates were fully sensitive to imipenem, meropenem, piperacillin-tazobactam, and gentamicin (0% resistance). Resistance to nitrofurantoin was 11.8%, amoxicillin-clavulanic acid 44.1%, and cotrimoxazole 50.0% cases.

These findings reflect the intrinsic resistance mechanisms of *Enterobacter* species, which often include chromosomal AmpC β-lactamase production, while remaining susceptible to carbapenems and some β-lactam/β-lactamase inhibitor combinations unless further resistance mechanisms are acquired[39]. A study by Al-Tawfiq et al[37] similarly observed low carbapenem resistance and better sensitivity to gentamicin and piperacillin-tazobactam in *Enterobacter* species isolates from urinary infections. The resistance pattern of *Pseudomonas aeruginosa* was high across multiple antibiotic classes: amikacin (82.3%), ceftazidime (80.0%), cefepime (75.6%), ciprofloxacin (88.9%), levofloxacin (88.2%), imipenem (75.6%), meropenem (71.1%), and piperacillin-tazobactam (82.2%). These data suggest limited options for empirical therapy and the possible presence of extensively drug-resistant (XDR) strains.

Similar high resistance rates have been documented in other studies. In a multicentre Indian study, Prakash et al[40] reported *Pseudomonas aeruginosa* isolates from paediatric UTIs showing resistance to ciprofloxacin (85.0%), ceftazidime (78.0%), and imipenem (72.0%), closely aligning with the current findings. Another study by Sharma et al[35] in North India found fluoroquinolone resistance exceeding 85.0%, and beta-lactam resistance, including ceftazidime and cefepime, ranging between 70.0% to 80.0% in paediatric *Pseudomonas aeruginosa* urinary isolates.

Globally, similar trends have been observed. A study from Egypt by Abd El-Baky et al[41] reported Pseudomonas aeruginosa resistance to ceftazidime at 76.2%, ciprofloxacin at 81.0%, and imipenem at 74.0%, highlighting the widespread resistance burden. The high levels of carbapenem resistance likely reflect the presence of metallo-beta-lactamases and efflux pump overexpression, which are known mechanisms of resistance in *Pseudomonas aeruginosa*[42]. Resistance was high to amikacin (70.0%) and gentamicin (70.0%), limiting the usefulness of aminoglycosides in treating Acinetobacter-related UTIs in children. The resistance pattern of *Acinetobacter* species to beta-lactam antibiotics varied: 33.3% to ceftriaxone, 23.3% to ceftazidime, and 13.3% to cefepime, suggesting that some third- and fourth-generation cephalosporins may still retain activity against these strains. Fluoroquinolone resistance was 33.3% to ciprofloxacin and 30% to levofloxacin, which aligns with cautious optimism about their use in selected cases, though safety concerns limit fluoroquinolone use in paediatrics.

Carbapenems showed the lowest resistance, with only 16.7% resistance to imipenem and meropenem, indicating these remain among the most effective options for serious *Acinetobacter* infections in this population. Resistance to amoxicillin-clavulanic acid was 36.7%, indicating limited but potential utility depending on local susceptibility patterns. Similar findings were reported in a study by Mathai et al[43] where paediatric *Acinetobacter* species isolates showed low carbapenem resistance (<20%), moderate resistance to fluoroquinolones, and high resistance to aminoglycosides, mirroring the current data. In another multicentre study in North India, Kaur et al[44] observed 60.0% to 75.0% resistance to amikacin and gentamicin, while carbapenems remained effective in more than 80.0% of isolates.

Globally, a study by Peleg et al45 noted that *Acinetobacter baumannii* strains are typically resistant to multiple drug classes, but carbapenems often retain some activity in non-ICU, community-acquired infections, which may reflect the lower resistance observed here. The high resistance rates to first-line and even second-line antibiotics limit treatment options for pediatric UTIs. While some isolates retained susceptibility to Fosfomycin and nitrofurantoin, especially in Gram-positives and *Escherichia coli*, their effectiveness was inconsistent across other Gram-negative pathogens. The preservation of vancomycin sensitivity in Gram-positive isolates offers some therapeutic hope, but reliance on these agents should be limited to avoid resistance development.

There are some limitations of study. The study lacked molecular typing for resistance mechanisms such as ESBL or carbapenemase genes. These limitations restrict deeper understanding of AMR patterns.

Conclusion

The results highlight a critical AMR burden among pediatric UTI pathogens, particularly Gram-negative bacteria such as Escherichia coli and Klebsiella pneumoniae. The high prevalence of multidrug-resistant organisms calls for stricter antimicrobial stewardship, regular surveillance, and

consideration of local antibiogram data when initiating empiric therapy.

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None

Conflict of Interest
The authors have no conflicts of interest to disclose.

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Authors' contributions
Nigha Zannat Dola. conceived and designed the study, analyzed the data, interpreted the results, and wrote up the draft imanuscript; Asma Rahman contributed to the formal analysis, methodology, investigation, resources; Nigha Zannat Dola contributed to the investigation and resources; Shadia Afroz involved in the manuscript review and editing; Md. Saiful Islam involved in the manuscript review and editing, administration; Md. Abdullah Yusuf contributed to the overall supervision, validation, funding acquisition, the manuscript review and editing; All authors read and approved the final manuscript.

Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate
Ethical approval for the study was obtained from the Institutional Review Board. As this was a prospective study the written informed consent was obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations.

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