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Original Research Article

Bacteriological study and antibiogram of urinary tract infection in children from a tertiary care hospital

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ABSTRACT

Background: The purpose of this observational study was to evaluate the aetiology and antimicrobial resistance pattern in urinary tract infection among children under 18 years of age.
Methods: It was a retrospective observational study carried out in Sanjay Gandhi memorial hospital, Rewa over a period of 18 months from March 2023 to August 2024. The study included 362 children below 18 years of age whose urine cultures were positive for the growth of an organism. Their demographic characteristics, aetiological agents and antimicrobial resistance were evaluated.
Results: Among the 362 patients UTI was more common among females (54.15%). In age group of 0-1 years of age UTI was more in males as compared to females. Most common isolated organism was *E. coli* (n=105, 29.05%). In our study gram negative uropathogens showed highest sensitivity to imipenem followed by gentamycin whereas gram positive uropathogens showed highest sensitivity to tetracycline followed by chloramphenicol.
Conclusions: Our study found that *Escherichia coli* continues to be a predominant cause of urinary tract infections in children. However, there has been a notable shift in antibiotic susceptibility, with many frequently prescribed medications now exhibiting significant resistance. Therefore, it is important to have institute based antibiogram for prompt treatment of UTI and limiting of further antibiotic resistance.

Keywords: Urinary tract infection, Antibiogram, Antimicrobial resistance

INTRODUCTION

Urinary tract infections (UTIs) are a prevalent health issue in pediatric populations, representing one of the most common bacterial infections encountered in children.[1] The incidence of UTIs in children varies widely based on age, sex and other demographic factors. In infancy, boys are more susceptible to UTI due to factors such as circumcision status, while after one year of age, the prevalence shifts to favor girls, largely due to the shorter urethra and proximity of the urethral opening to the anal region.[2] The prevalence of UTI is 2%-8% among children.[3] Several risk factors can predispose children to UTIs, including anatomical anomalies such as renal calculi, vesicoureteral reflux, urinary obstruction and neurogenic bladder.[4] The majority of pediatric UTIs are caused by a limited number of pathogenic agents, with *Escherichia coli* being the most prevalent, responsible for approximately 80-90% of cases. Other significant pathogens include *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Proteus mirabilis* and *Enterococcus* species.[5] The virulence of these bacteria often correlates with their ability to adhere to the uroepithelial cells, evade the immune response and produce toxins, which can lead to tissue damage and inflammation.[6] The UTI in children needs to be diagnosed early as it can have lasting effects on renal function and overall health. Acute complications include pyelonephritis, which can result in fever, vomiting and flank pain, necessitating hospitalization and intravenous antibiotics. If untreated or inadequately treated, pyelonephritis can progress to renal scarring and chronic

kidney disease. Chronic complications may arise from recurrent UTIs, leading to long-term sequelae such as hypertension and impaired renal function.[7]

Resistance of uropathogens to antibiotics is increasing due to frequent use of antibiotics.[8] Thus this study is aimed at isolating microorganisms from the urine and also assessing susceptibility of specific organisms to the antibiotics. This will help to formulate antibiotic prescription policies for a region.

METHODS

This study was a retrospective observational study carried out in Sanjay Gandhi memorial hospital, Rewa over a period of 18 months from March 2023 to August 2024.

Inclusion criteria

Newborns, infants and children from 1 year to 18 years of age suspected of having UTI were included in the study.

Exclusion criteria

Urine cultures showing no growth were excluded.

The age, gender, growth of organism grown on culture, their sensitivity and resistance patterns were noted. Urine samples were collected following standard perineal hygiene either by catheterization in patients below 2 years and from above 2 years patients midstream urine samples were obtained. Urine samples were sent to the laboratory where they were inoculated and incubated at 37°C for 24 hours. A UTI was defined as ≥100,000 colony-forming units (CFU)/ml of midstream urine, ≥10,000 CFU/ml of urine obtained by transurethral catheterization.

The age, gender, growth of organism grown on culture, their sensitivity and resistance patterns were noted.

RESULTS

Out of the 672 clinical specimens which were tested, 362 (53.86%) were culture positive, 110 showed insignificant growth of organisms, i.e., due to contamination of urine samples and 200 were culture negative. Among the 362 patients UTI was more common among females (54.15%). In age group of 0-1 years of age UTI was more in males as compared to females. Overall infection rate was higher in age group of >1-5 years (Table 1). The organisms that were isolated from the urine culture of patients in decreasing order were Escherichia coli (n=105, 29.05%), Staphylococcus aureus (n=89, 24.59%), *klebsiella* spp (n=61, 16.85%), *Candida* (n=36, 9.94%), coagulase-negative *Staphylococcus* (CONS) (n=31, 8.56%), *Pseudomonas aeruginosa* (n=20, 5.52%) and Mixed flora (n=20, 5.52%) as shown in Table 2.

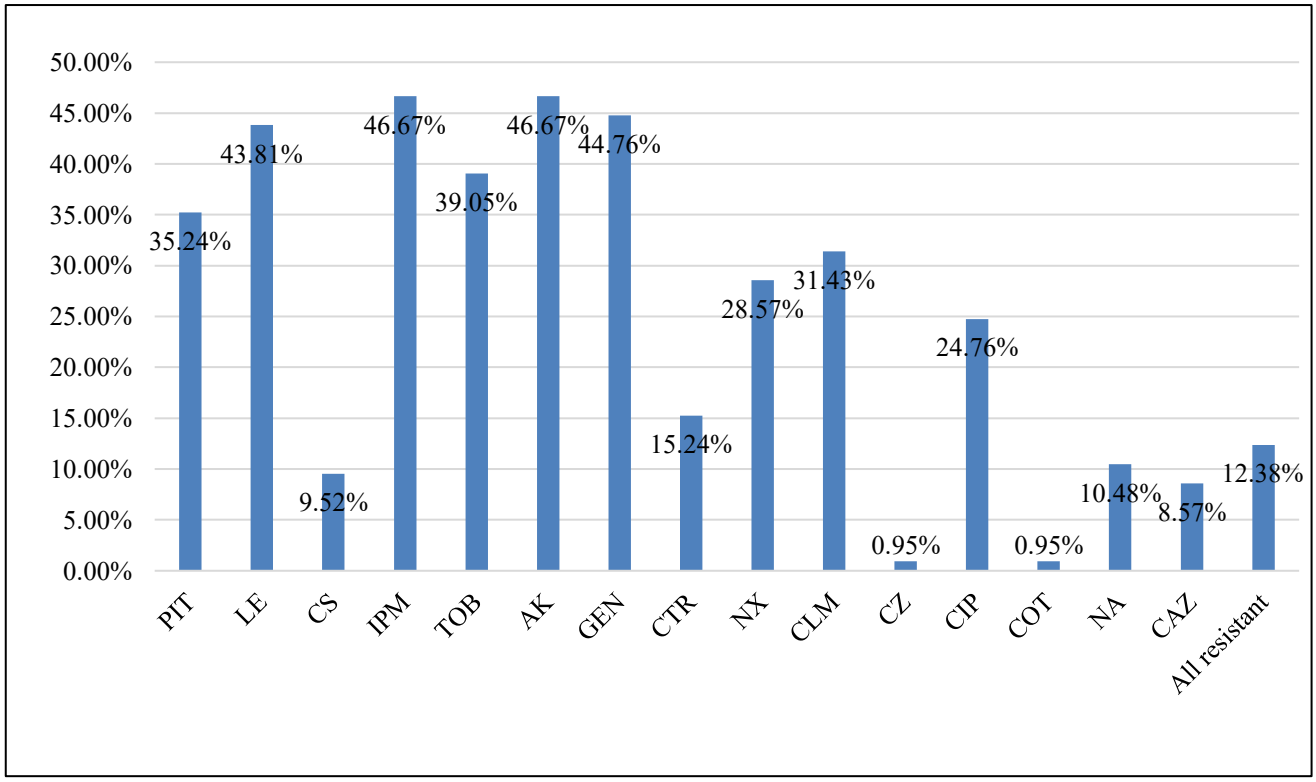

Figure 1: Sensitivity pattern of antibiotics to *E. coli.*

PIT: Piperacillin+tazobactum, LE: Levofloxacin, CS: Cefoprazone+sulbactam, IPM: Imipenem, TOB: Tobramycin, AK: Amikacin, GEN: Gentamycin, CTR: Ceftriaxone, NX: Norfoxacin, CLM: Clarithromycin, CZ: Cefazolin, CIP: Ciprofloxacin COT: Cotrimoxazole, NA: Nalidixic acid, CAZ: Ceftazidime.

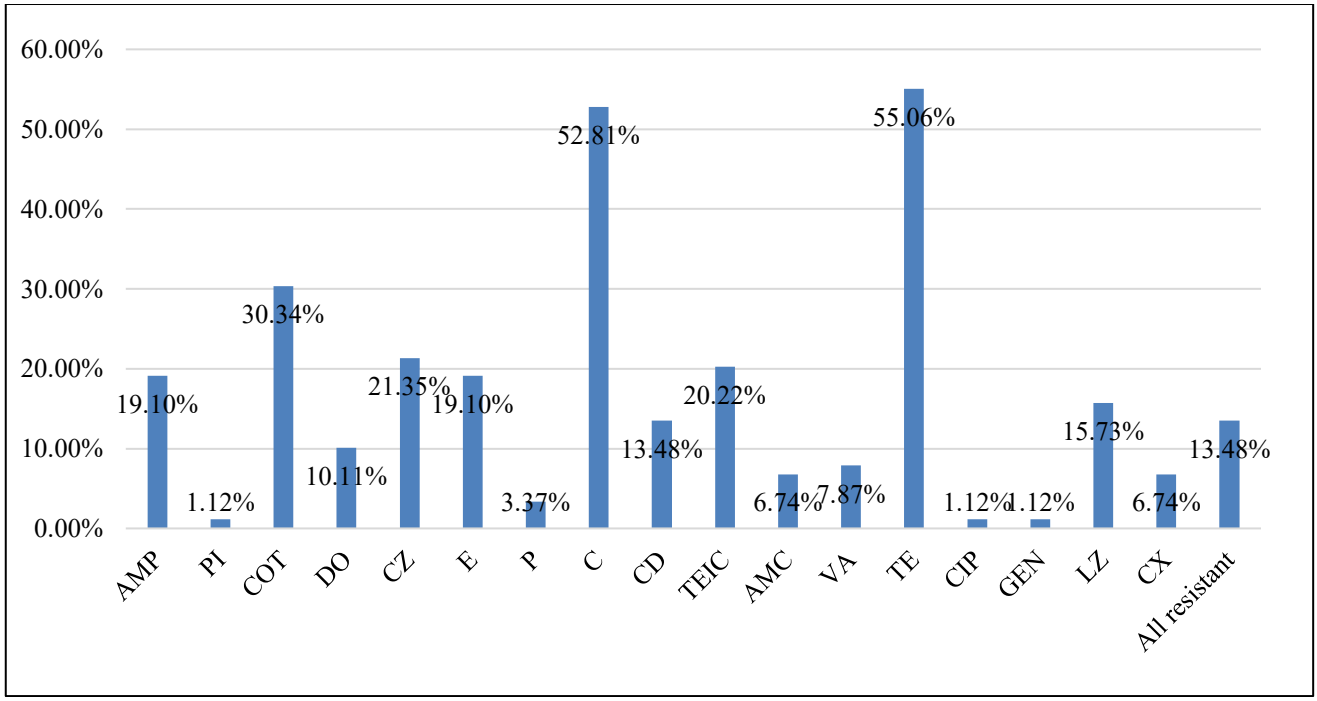

Figure 2: Sensitivity pattern of antibiotics to *Staphylococcus aureus*.

AMP: Ampicillin, PI: Piperacillin, COT: Cotrimoxazole, DO: Doxycycline, CZ: Cefazolin, E: Erythromycin, P: Penicillin, C: Chloramphenicol, CD: Cefdinir, TEIC: Teicoplanin, AMC: Amoxyclav, VA: Vancomycin, TE: Tetracycline, CIP: Ciprofloxacin, GEN: Gentamycin, LZ: Linezolid, CX: Cefoxitin.

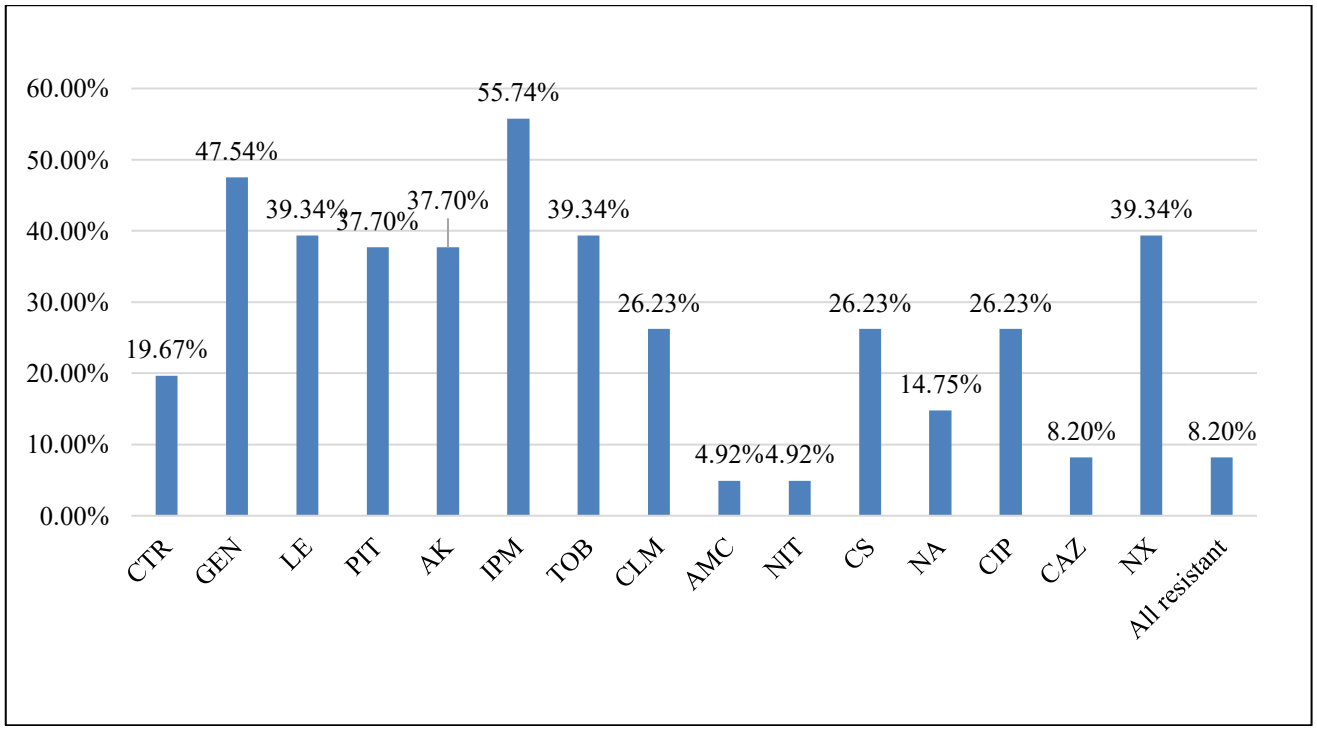

Figure 3: Sensitivity pattern of antibiotics to *Klebsiella*.

CTR: Ceftriaxone, GEN: Gentamycin, LE: Levofloxacin, PIT: Piperacillin+Tazobactam, AK: Amikacin, IPM: Imipenam, TOB: Tobramycin, CLM: Clarithromycin, AMC: Amocyclav, NIT: Nitrofurantoin, CS: Cefoperazone+Sulbactam, NA: Nalidixic acid, CIP: Ciprofloxacin, CAZ: Ceftazidime, NX: Norfloxacin.

Escherichia coli (29.01%) was the commonest uropathogen which was isolated in all age groups (Table 2). Antibiotic sensitivity pattern of *E. coli is* shown in Figure 1. Maximum sensitivity was observed against

Imipenem and Amikacin (46.67%) followed by Gentamycin (44.67%).

Isolated *E. coli* was least sensitive to Cefazolin and Cotrimoxazole (0.95%). *Staphylococcus aureus* was the second most common uropathogen isolated from urine C/S of all the cases.

Tetracycline (55.06%) was found to be most sensitive against isolated strains of *Staphylococcus aureus* (Figure 2) followed by Chloramphenicol (52.81%). Piperacillin, Ciprofloxacin and Gentamycin was found to be least sensitive against *staphylococcus aureus*.

Antibiotic susceptibility pattern among *Kliebsella* was as shown in (Figure 3). Highest sensitivity among isolated strains of *klebsiella* was found for Imipenam followed by Gentamycin. Similarly, least sensitivity was found for Amoxyclav and Nitrofurantoin.

Table 3 and 4 shows Antibiogram i.e., sensitivity patterns of antibiotics against gram negative and gram-positive bacteria respectively. In the study gram negative uropathogens showed highest sensitivity to imipenem followed by gentamycin whereas gram positive uropathogens showed highest sensitivity to tetracycline followed by chloramphenicol.

Table 1: Age distribution in males and females with UTI.

Age group (in years)	Sex distribution				Total	
	Male		Female		No	%
0-1	34	9.36%	31	8.56%	65	17.92
>1-5	42	11.60%	58	16.02%	100	27.62
>5-12	64	17.68%	71	19.61%	135	37.29
>12-18	26	7.18%	36	9.94%	62	17.12
	166	45.85%	196	54.15%	362	100

Table 2: Organisms isolated on urine culture.

Organisms	Number	%
Escherichia coli	105	29.01
Staphylococcus aureus	89	24.59
Klebsiella spp	61	16.85
Candida	36	9.94
CONS	31	8.56
Pseudomonas aeruginosa	20	5.52
Mixed Flora	20	5.52

Table 3: Urinary isolate antibiogram, Gram negative isolates.

Organism	Isolates	%Total	IPM	GEN	LE	AK	TOB	PIT	CS	NX	CLM	CIP
E. coli	105	29.01 %	46.67 %	44.76 %	43.81 %	46.67 %	39.05 %	35.24 %	9.52 %	28.57 %	31.43 %	24.66 %
Klebsiella	61	24.59 %	55.74 %	47.54 %	39.34 %	37.70 %	39.34 %	37.70 %	26.23 %	39.34 %	26.23 %	26.23 %
Pseudomonas	20	5.52%	30%	20%	45%	20%	35%	15%	15%	15%	0%	15 %

Table 4: Urinary isolate antibiogram, Gram positive isolates.

Organism	Isolates	%Total	TE	C	COT	CZ	TEIC	AMP	LZ	CD
Staphylococcus aureus	89	24.59%	55.06%	52.81%	30.34%	21.35%	20.22%	19.01%	15.73%	13.48%
CONS	31	8.56%	41.93%	67.77%	35.48%	19.35%	16.12%	16.12%	16.12%	12.90%

DISCUSSION

Urinary tract infections in pediatric patients are a significant cause of morbidity and can lead to considerable mortality. It is widely accepted that children with UTIs require further investigation and treatment to reduce the risk of future complications. The goal of this study was to evaluate the distribution and antibiotic susceptibility pattern of microbial species isolated from pediatric patients with suspected UTI from a tertiary care center. The prevalence of UTI was significantly affected by the patient's gender and age. In our study, we observed a higher prevalence of UTIs in females beyond the age of one.

Badhan et al in their study also found preponderance of UTI in female patients.[9] Data from other international studies on pediatric patients also indicate that UTIs are more prevalent in females, aligning with findings.[10,11] In the current study *E. coli* was the most commonly isolated organism, detected in 95 (29.01%) of the positive cultures. This is consistent with studies reported by Ayelign et al (54.8%) in Ethopia, Alavudeen et al (31.82%) in Saudi arabia.[10,11] The current study observed *E. coli* isolates showed maximum sensitivity for Imipenem and Amikacin (46.67%) and showed high resistance to Cotrimoxazole (0.95%). Similarly, Ganie et al conducted a study to evaluate the antibiotic resistance in children with urinary tract infection in SKIMS Medical College Hospital, Srinagar and found that highest resistance of *E. coli* was found against amoxicillin/clavulunate (71.8%), followed by ampicillin-salbactam (68.6%) and cotrimoxazole (39.1%) and lowest resistance was found against imipenem (3.2%) and amikacin (5.1%).[12]

In this study after *E. coli*, *Staphylococcus aureus* (24.59%) and *Klebsiella* spp (16.85%) were next most commonly isolated uropathogens. The current study observed that tetracycline (55.06%) and chloramphenicol (52.81%) had highest sensitivity for isolated staphylococcus strains. A study conducted by Sonkar, et al, at Rohilkhand Medical College and hospital, Bareilly showed that staphylococcus aureus was the second most common isolated organism, but nitrofurantoin showed highest sensitivity against gram positive organisms. Another study by G. Chooramani, et al carried out at Vivekananda Polyclinic Institute of Medical Sciences in Lucknow, found that tetracycline had the greatest sensitivity against isolated Gram-positive uropathogens.[13,14]

In the current study isolated strains of klebsiella were found highly sensitive to Imipenam (55.74%) followed by Gentamycin (45.74%). Similarly, least sensitivity was found for Amoxyclav and Nitrofurantoin (4.92%). A study conducted by Akram et al found that klebsiella was highly resistant to nitrofurantoin and showed high sensitivity to imipenams.[15] Another study conducted by Hameed et al among pediatric patients admitted in the Department of Pediatrics, King Abdulaziz Medical City-Central Region (KAMC-CR), Ministry of National Guard e Health Affairs in Riyadh, Saudi Arabia demonstrated that the most frequently isolated uropathogen was *E. coli* (75.7%), followed by *K. pneumoniae* (9.4%).[16] The isolated *K. pneumoniae* strains had no resistance to imipenem/meropenem and showed high resistance to ampicillin and nitrofurantoin.

Due to antimicrobial resistance, treating common infections like UTIs is becoming increasingly challenging. Several risk factors in our environment may account for the elevated resistance of uropathogens to frequently prescribed antibiotics. Firstly, there is a notable over prescription of antibiotics in India, where they have historically been available over the counter in local pharmacies. Moreover, many broad-spectrum antibiotics, including third-generation cephalosporins, are often misused in our community for routine pediatric conditions like otitis media or pharyngitis.

In current practice, oral third generation cephalosporins (cefixime) are the commonly prescribed empiric antibiotics in UTI in children. This study shows that in our institute the organisms have lower sensitivity to cephalosporins.

Therefore, it may be prudent to best avoid it in the treatment of UTI in children and in its place. In our study *E. coli* was the most commonly isolated uropathogen with highest sensitivity to imipenem. So, imipenem alone or in combination with tetracycline (highly sensitive against gram positive bacteria) can be used as the empiric antibiotic option. Treatment may be tailored according to the susceptibility patterns.

In the study sensitivity of separate antibiotics were tested against gram positive and gram-negative organisms. It would be helpful if sensitivity of same antibiotics were tested against both gram positive and gram-negative organism so we can identify a common antibiotic that can be used as impirical therapy against both gram positive and gram-negative isolates.

CONCLUSION

Our study found that Escherichia coli continues to be a predominant cause of urinary tract infections in children. However, there has been a notable shift in antibiotic susceptibility, with many frequently prescribed medications now exhibiting significant resistance. This phenomenon may be linked to the selective pressure resulting from antibiotic use. To mitigate this challenge, it is crucial to conduct regular monitoring of antibiotic resistance patterns and to develop a corresponding antibiotic policy for individual institute to improve patient care.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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