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# Clinical and Microbiological Profile of Children with Urinary Tract Infection

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## Introduction

Urinary tract infection (UTI) is one of the most common bacterial infections seen in infants and children. The frequency of UTI varies with age and sex. It has been reported that the risk of having a UTI before the age of 14 years is approximately 1-3% in boys and 3-10% in girls [1,2]. UTI is defined as the growth of a significant number of organisms, i.e. more than 100,000 colony-forming units (CFU)/mL of a single species in the urine sample in the presence of symptoms [1].

**Introduction:** Urinary tract infection is one of the common bacterial infections seen in infants and children. As children present with non-specific symptoms, a diagnosis of UTI is often missed or it is diagnosed very late. A wide range of organisms with varying antibiotic sensitivity patterns have been known to cause UTI. The objectives of the study were:

1. To study the clinical profile of children with UTI
2. To study the microbiological profile of children with UTI
3. To study the antibiotic resistance profile of various organisms causing urinary tract infection in children.

**Materials and Methods:** A retrospective Study was conducted in the Department of Pediatrics, CHRI, for 2 years from Jan 2014 to December 2016. The data of the children who met the inclusion criteria were collected from the case records. The collected data was tabulated and analyzed using IBM SPSS version 21.

**Results:** Males comprised a higher proportion of subjects in <1 year and 1-5 years when compared to females. Fever was the most common presenting symptom in the study population, which was seen in 220 (80.8%) children. The number of children with a positive culture for E.coli was 154 (56.0%) and Klebsiella was isolated in 37 (13.45%) children. A high proportion of E coli and Klebsiella species showed resistance to beta lactams and fluoroquinolones. E.coli was the most common organism in all age groups. The proportion of females was higher in the E. coli group (58.9%). Klebsiella had the highest proportion of resistance to more than 2 drugs (82.4%).

**Conclusions:** The most common age group affected by urinary tract infection is below 1 year with a male preponderance followed by above 5 years with a female preponderance. The most common isolated organism in all age groups was E. coli, which was found to be resistant to beta lactams and fluoroquinolones. Therefore, in any child with suspected, it is advised to start empirical therapy with an antibiotic, like amikacin and nitrofurantoin, and wait for the results of urine culture and sensitivity testing.

**Keywords:** Urinary Tract Infections; Child; Clinical; Microbiological.

**Running Title:** Clinical and Microbiological Profile of Children with UTI

A diagnosis of UTI is usually missed in infants and young children, as urinary symptoms are minimal and often nonspecific. In children less than 2 years old, UTI is an important cause for fever without a focus [3,4]. In neonates, it is usually part of septicaemia and presents with symptoms of fever, vomiting, lethargy, jaundice, and seizure. Infants and young children present with recurrent fever, diarrhoea, vomiting, abdominal pain, and poor weight gain. Older children typically show fever, dysuria, urgency, frequency, and abdominal or

flank pain. Adolescents may have symptoms restricted to the lower tract, and fever may not be present.

Among organisms causing UTI, Gram negative enteric bacilli, especially *Escherichia coli* and *Klebsiella* spp. are the leading pathogens while *Enterococcus* spp., yeasts, and *Staphylococcus aureus* have emerged as other prominent agents in recent years [3-5]. Most of these agents are resistant to multiple antibiotics [5-7]. Treatment of these children should be based on urine culture and appropriate antimicrobial sensitivity testing. Rapid evaluation and treatment of UTI is of prime importance to prevent renal parenchymal damage and scarring, which in turn lead to hypertension and progressive renal damage [8].

Pediatricians should be aware of the various presentations and clinical features, diagnosis, management and evaluation of children with UTI. Even a single confirmed UTI should be managed effectively, especially in young children, due to the potential for renal parenchymal damage. Therefore, this study was conducted to identify urinary tract infection as early as possible and treat it appropriately to avoid future complications.

### Materials and Methods

**Study design:** Retrospective study

**Source of data:** Case records of children diagnosed with urinary tract infection

**Inclusion criteria:** All Children who were diagnosed with urinary tract infection using urine culture sensitivity reports showing  $> 10^5$  CFU were evaluated in a 2-year period from January 2013 to December 2014.

**Methodology:** The study was conducted in the Department of Pediatrics, Chettinad Hospital and Research Institute CHRI for 2 years from Jan 2013 to December 2014. The data of the children who met the inclusion criteria were collected from the case records, tabulated, and analyzed using appropriate statistical methods.

Age, clinical presentation, laboratory and culture results, and sensitivity pattern were considered as variables of interest. Analysis of all the parameters was done using mean and standard deviation for quantitative variables, and frequency and proportion for categorical variables. IBM SPSS version 21 was used for statistical analysis.

### Results

Male children comprised a higher proportion of subjects in the age groups  $<1$  year and 1-5 years when compared to female children who comprised

a higher proportion of subjects in the age groups 5-10 and 10-15 years.

Fever was the most common presenting symptom in the study population, which was seen in 220 (80.8%) children. Other common symptoms were abdominal pain (17.9%), crying during micturition (16.9%), and vomiting (14%). A descriptive analysis of all other minor symptoms is presented in Table 1.

**Table 1.** Frequency Distribution of Age Groups and Gender in study population (N=275)

Parameter	Frequency
<b>Fever</b>	
<b>Fever with</b>	220(80.8%)
<b>Abdominal pain</b>	48(17.8%)
<b>Crying during micturition</b>	46(16.9%)
<b>Vomiting</b>	37(14%)
<b>Phimosis</b>	25(9.1%)
<b>Burning micturition</b>	15(5.6%)
<b>Diarrhea</b>	24(9%)
<b>Lethargy</b>	1(0.4%)
<b>Irritability</b>	6(2.2%)
<b>Hematuria</b>	10(3.6%)
<b>Circumcision</b>	0(0%)

None children (3.3%) had more than 1 episode of UTI.

The mean urea was  $15.74 \pm 6.44$  and mean creatinine was  $0.69 \pm 0.312$  in the study population. Eighteen children (6.5%) had plenty of pus cells, 26 (9.4%) had abnormal Ultrasonography (USG), and 9 (3.3%) and 7 (2.5%) children had abnormal Micturating cystourethrogram (MCU) and Dimercaptosuccinic acid (DMSA) scan, respectively.

One hundred and fifty four children (56.0%) had a positive culture for *E. coli*. *Klebsiella* was isolated in 37 (13.45%) children. *Enterococcus* was isolated in 8% of the children. The percentage of subject with *Proteus*, *Morganella*, and *Providencia* was 8%, 3.63%, and 2.6%, respectively. *Candida* and *Citrobacter* were isolated in 1.98% and 2.54%, respectively. The proportion of *E. coli* strains resistant to beta lactam antibiotics was high, ranging from 60-75%.

Other antibiotics to which a high percentage of *E. coli* strains showed resistance were co-trimoxazole

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and fluoroquinolones. The antibiotics to which a very low percentage of *E. coli* strains were resistance included aminoglycosides, nitrofurantoin, metronidazole, and imipenem. None of the *E. coli* strains was resistant to other antibiotics like vancomycin, linezolid, etc. a high proportion of *Klebsiella* species were resistant to beta lactams and fluoroquinolones. Amikacin resistance was also relatively higher in *Klebsiella* compared to *E. coli*. A relatively lower proportion of enterococcus species was resistant to beta lactams and quinolones. However, a relatively higher proportion of enterococcus species was resistant to vancomycin, amikacin, imipenem, and teicoplanin. Among *Proteus* species, the relative proportion of antibiotic strains was lesser than other microorganisms (Table 2). *E.coli* was the most common organism across all age groups.

*Klebsiella* had the highest proportion in children aged 10-15 years followed by those aged above 15 years. *Enterococcus* was more common in relatively younger children, as the highest proportion was seen in infants followed by children aged 5–10 years. Similar to *Klebsiella*, *Proteus* was also seen in younger age groups (Table 3). Female children had the highest proportion in the *E. coli* group (58.9%). The proportion of male children was higher in the *Klebsiella* group (52.9%) followed by *Enterococcus* (66.7%) and *Proteus* (91.7%). The differences in the proportion of organism profile and gender was statistically significant ( $P=0.007$ ) (Table 4). The proportion of resistance to more than two drugs was higher for *Klebsiella* (82.4%) followed by *Enterococcus* (75.0%) and *Proteus* (75.0%) (Table 5).

**Table 2.** Antibiotic sensitivity pattern of different organisms(N=275)

Sensitivity pattern [antibiotics]	<i>E.coli</i>	<i>Klebsiella</i>	<i>Enterococcus</i>	<i>Proteus</i>
<b>Amikacin</b>	5(5.6%)	3(17.6%)	3(25.0%)	0
<b>Ampicillin</b>	68(75.6%)	17(100.0%)	3(25.0%)	12(60.0%)
<b>Cefazolin</b>	61(67.8%)	12(70.6%)	4(33.3%)	7(58.3%)
<b>Cefipime</b>	54(60.0%)	15(88.2%)	5(41.7%)	3(25.0%)
<b>Cefotaxime</b>	55(61.1%)	12(70.6%)	4(33.3%)	4(33.3%)
<b>Cefuroxime</b>	61(67.8%)	13(76.5%)	5(41.7%)	6(50.0%)
<b>Ciprofloxacin</b>	52(57.8%)	11(64.7%)	5(41.7%)	2(16.7%)
<b>Co-trimoxazole</b>	55(61.1%)	10(58.8%)	6(50.0%)	5(41.7%)
<b>Gentamycin</b>	43(47.8%)	8(47.1%)	7(58.3%)	0
<b>Norfloxacin</b>	57(63.3%)	12(70.6%)	6(50.0%)	2(16.7%)
<b>Piperacillin/Tazobactam</b>	24(26.7%)	8(47.1%)	4(33.3%)	1(8.3%)
<b>Nitrofurantoin</b>	15(16.7%)	7(41.2%)	4(33.3%)	9(75.0%)
<b>Meropenem</b>	11(12.2%)	1(5.9%)	4(33.3%)	1(8.3%)
<b>Imipenem</b>	7(7.8%)	1(5.9%)	3(25.0%)	1(8.3%)
<b>Vancomycin</b>	0	0	2(1.7%)	0
<b>Cloxacillin</b>	0	0	5(41.7%)	0
<b>Linezolid</b>	0	0	0	0
<b>Teicoplanon</b>	0	0	1(8.3%)	0
<b>Erythromycin</b>	0	0	1(8.3%)	0

**Table 3.** Profile of organisms in different age groups(N=275)

Organism	<1	1-5	5-10	10-15	>15
<b><i>E.coli</i></b>	40(61.5%)	33(55.9%)	9(69.2%)	2(50.0%)	6(66.7%)
<b><i>Klebsiella</i></b>	6(9.2%)	6(10.2%)	1(7.7%)	1(25.0%)	2(22.2%)
<b><i>Enterococcus</i></b>	7(10.8%)	4(6.8%)	1(7.7%)	0	0
<b><i>Proteus</i></b>	6(9.2%)	5(8.5%)	1(7.7%)	0	0
<b>Others</b>	6(9.2%)	11(18.6%)	1(7.7%)	1(25.0%)	1(11.1%)

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**Table 4.** Association between organism and gender in study group(N=275)

Organism	Sex		P-value
	Male	Female	
<b>E.coli</b>	37(41.1%)	53(58.9%)	0.007
<b>Klebsiella</b>	9(52.9%)	8(47.1%)	
<b>Enterococcus</b>	8(66.7%)	4(33.3%)	
<b>Proteus</b>	11(91.7%)	1(8.3%)	
<b>Others</b>	13(65.0%)	7(35.0%)	

**Table 5.** Severity of drug resistance of different organisms in study group (N=275)

Organism	0 Drug resistance	1 Drug resistance	2 Drug resistance	>2 Drug resistance [MDR]
<b>E.coli</b>	10(11.%)	8(8.9%)	8(8.9%)	04(71.1%)
<b>Klebsiella</b>	0	2(11.8%)	1(5.9%)	14(82.4%)
<b>Enterococcus</b>	2(16.7%)	1(8.3%)	0	9(75.0%)
<b>Proteus</b>	2(16.7%)	1(8.3%)	1(8.3%)	8(66.7%)
<b>Others</b>	5(25.0%)	0	2(10.0%)	13(65.0%)

### Discussion

In this retrospective study, data were collected from the records of children diagnosed with UTI, which was similar to studies conducted by Bay et al [9] and Dyaneshwari et al [10]. However, many conducted studies have a prospective design like studies performed by Taneja et al., Manohar et al., Sharma et al., Querishi et al., and Singh et al. that also evaluated clinical and microbiological profile of children diagnosed with UTI. The above studies included all the cases with clinical features of UTI but later analyzed only cases with confirmed UTI. Similar to the study by Dyaneshwari et al, the most common age group in our study was below 1 year with a male preponderance, whereas Bay et al reported that the age group 7-12 years was the most common age group with a female preponderance. Moreover, in our study, female children were commonly affected in the age group 5-10 years.

In other prospective studies, Quereshi et al [11], and Taneja et al [12] reported 1-5 years as common age group with males predominance in contrast to Sharma et al[13] and Singh et al[14] with females more in the same age group, again in Manohar et al study [15] 7-12 years with female predominantly affected.

In our study, fever was the most common complaint followed by abdominal pain, which was in line with the results of other studies.

Pyuria was detected in all cases in the study by Manohar et al [15], 95.6% of cases in the study

performed by Singh et al [14], 35.2% of the cases in the study by Bay et al [9], and 53.6% of the cases in the study by Taneja et al [12]. We found pyuria in all cases with 18% showing plenty of pus cells.

In our study, E. coli was the most common isolated organism in all the age groups followed by Klebsiella, which was very similar to the results of other studies [9-15]. Klebsiella affected children aged 10-15 years. Enterococcus was more common in relatively younger children, as the highest proportion was seen in infants. Similar to Klebsiella, Proteus was also seen in younger age groups. Female patients had the proportion the in E. coli group (58.9%). The proportion of males was higher in the Klebsiella group (52.9%) followed by Enterococcus (66.7%) and Proteus (91.7%).

The antibiotic sensitivity pattern showed that both E. coli and Klebsiella were resistant to beta lactams, fluoroquinolones, co-trimoxazole and were sensitive to amikacin and nitrofurantoin, which was similar to the results of studies by Taneja et al [12], Sharma et al [13], Singh et al [14], and Dyaneshwari et al [10].

Klebsiella had the highest proportion of resistance to more than two drugs (82.4%) followed by Enterococcus (75.0%), Proteus (75.0%), and E coli (71%).

In our study, abdominal ultrasound was abnormal in 9.4% of the cases with findings of cystitis and hydronephrosis. Singh et al [14] and Manohar et al [15] reported abnormal ultrasound findings in 25% and 17% of the cases, respectively.

MCU was advised in 21 children with abnormal USG finding as indicated but only nine underwent the test. The results showed features of vesicoureteral reflux in 3.3% of the study population. In the study by Manohar et al [15], 10 patients (14%) had vesicoureteral reflux (VUR) and 2 (3%) had posterior urethral valves. Taneja et al [12] reported that 19% of the patients (children below 12 years of age who mostly had UTI for the first time) had VUR. Singh et al [14] reported 7 out of 21(33%) subjects that underwent MCU had abnormal findings.

DMSA scan was indicated in 9 children but abnormal results were found only in 7 participants who underwent the test; DMSA was not done in other studies due to loss to follow up or unwillingness of the subjects.

Limitation: A prospective design was better since we could follow up the patients.

### Conclusions

In urinary tract infection, the most common age group is below 1 year with a male preponderance followed by above 5 years with a female preponderance. The most common isolated organism was E coli in all age groups, which was found to be resistant to beta lactams and fluoroquinolones. Therefore, in any child with suspected UTI presenting with fever, as the most common symptom, it is advised to start empirical treatment with an antibiotic to which the organism is likely to be sensitive, like amikacin and nitrofurantoin, wait for the results of urine culture and sensitivity testing. Treatment can then continue accordingly to prevent undue delays in the management, resulting in further renal damage.

### Conflict of Interest

Author declares that there was no conflict of interest.

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