

## Organisms causing urinary tract infections in children and their sensitivity pattern in a level 2 pediatric hospital at a district place in South India

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**Background:** Urinary Tract Infection is second the common bacterial infection affecting children. Resistance to routine antibiotics for treating CA-UTI is on the rise. It is necessary to determine the antibiotic sensitivity patterns of uropathogens in a particular region to prevent complications of UTI and to determine empirical antibiotic. **Aims:** To evaluate the bacteriological profile and antibiotic sensitivity patterns in children with urinary tract infections **Setting and Design:** Retrospective observational study conducted over a period of 2 years in a level 2 pediatric hospital at a district place in South India **Materials and methods:** Children between the ages of one day and 13 years who had UTI over a period of 2 years from 01 Jan 2018 to 31 Dec 2019 were included in the study. Urine specimens with the growth of single organism of  $>10^5$ /ml were studied for various uropathogens and their sensitivity patterns. **Statistical analysis:** All the data obtained were presented in percentages and frequencies using Microsoft excel. **Results:** Out of 446 urine samples, 139 children were positive for pathogenic organisms. Escherichia coli constituted for 118 (84%) organisms followed by Proteus Mb 12 (8.6%) and Klebsiella sp 9 (6.4%). The organisms were found to be most sensitive to Amikacin (98%), Gentamicin (66%), and Ofloxacin (55%). **Conclusion:** E.coli is the leading pathogen causing UTI in children. It is highly sensitive to amikacin and is resistant to most of the commonly used antibiotics. This knowledge is necessary to treat UTI empirically in the local population.

**Keywords:** UTI, Children, Uropathogens, Antibiotics, Sensitivity

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## Introduction

Urinary Tract Infection (UTI) is a bacterial infection routinely encountered by clinicians in developing countries [1] and is one of the most common bacterial infections in infants and young children [2]. UTI accounts for 2.1-7.5% of febrile children attending to hospital based on age and sex [3]. It is often missed because of its non specific presentations especially in infants [4,5]. Prompt and appropriate antimicrobial therapy should lead to rapid recovery and the avoidance of complications. Delayed or incorrect antibiotic treatment may result in recurrence, particularly in children with renal abnormalities who are at risk of developing progressive renal damage with renal scar, hypertension and chronic renal failure [6,7].

Various studies carried out in infants and children to determine the type of organisms causing UTI have shown that (*E.coli*) is the most commonly cultured organism followed by other organisms including *Klebsiella* spp, *Pseudomonas*, *Staphylococci*, *Proteus* Mb and *Enterobacter* etc [8-10]. Increasing levels of infection with extended-spectrum  $\beta$ -lactamase (ESBL)-producing *E. coli* strains have been described in many countries [11,12] requiring monitoring of antimicrobial susceptibility.

In children with suspected UTI, antibiotic treatment is usually started empirically especially in rural and suburban areas. Empirical antibiotic selection should be based on knowledge of the local prevalence of bacterial organisms and antibiotic sensitivities, because resistance patterns may vary in different regions and over a period of time [8, 13-15]

## Aim

The objective of this study is to know the uropathogens causing UTI in children and their susceptibility pattern to commonly used antimicrobials for deriving options to empirical antibiotic therapy in children with community acquired UTI.

## Materials and Methods

**Design:** A retrospective observational study of all positive urine cultures in children

**Setting:** A 25 bedded level-2 exclusive pediatric hospital catering mainly rural and low socioeconomic status population at a district place in southern India.

**Materials:** Retrospective information of all the urine culture positive cases done between the age group of 0-13 years who attended OPD as well as IPD over a period of 2 years from 01 Jan 2018 to 31 Dec 2019 was collected from laboratory and medical records stored in computers.

**Methods:** In all cases, urine was collected before starting antibiotics on the first day itself through the midstream clean-catch urine method (CCU). Even in most of the infants, urine was collected through the CCU method by specially training the mothers [5]. Children requiring intensive care management with the immediate necessity of antibiotic therapy and hospital-acquired infections were excluded from the study group. According to US Centers for Disease Control and Prevention (CDC) guidelines, any infection 48 hours after admission and before discharge should be categorized as hospital-acquired and those taken before or within 48 hours of admission should be categorized as community-acquired.

In routine urine analysis, urine microscopy was done using un-centrifuged urine. Observation of more than 5 pus cells/HPF was taken as a positive diagnosis of UTI [16]. Then the urine specimen was inoculated in culture media using standard loop technique usually within 30 min. UTI was diagnosed only when a single uropathogen with CFU  $\geq 10^5$ /mL, designated as significant growth was present [17]. Growth of uncommon organisms, such as *staphylococcus*, *pseudomonas*, *Citrobacter* etc and the growth of multiple organisms was considered as a sign of contamination [18]. The culture positive cases were tested for sensitivity by using combined gram negative microbial sensitivity discs consisting of 12 antibiotics i.e amikacin, gentamicin, ofloxacin, ciprofloxacin, norfloxacin, nitrofurantoin, ceftriaxone, netilmycin, cefotaxime, cefixime, ceftazidime and nalidixic acid.

**Statistical Analysis:** All the data were entered into MS-Excel and later exported to SPSS Version 23. Results were presented in terms of frequencies and percentages. The study was conducted as per the recommendations of the local ethical committee and in confirmation with the declaration of Helsinki.

## Results

Out of 446 CCU samples of urine collected from children with the clinical suspect of UTI, 139 (31%) samples yielded growth and were positive for pathogenic organisms.

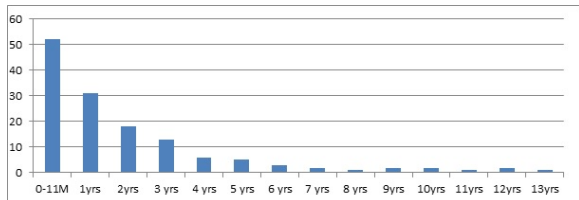
Most of the patients (72%) were below 3 years. The median age was 1.8 years. There were 82 (59%) males and 57(41%) females. Of the various pathogenic organisms isolated, Escherichia coli constituted for 118 (84%) organisms followed by Proteus Mb 12 (8.6%) and Klebsiella sp 9 (6.4%).

The organisms were found to be most sensitive to Amikacin (98.5%), Gentamicin (66.1%) and Ofloxacin (55.3%), moderately sensitive to Nitrofurantoin (40.2%) Ciprofloxacin (38%) and Norfloxacin (33.8%), least sensitive to drugs like Ceftriaxone (16.5%), Netilmycin (10.8%) Cefotaxime (6.5%), Cefadizime (5.7%), Cefixime (4.3%) and nalidixic acid (2.1%).

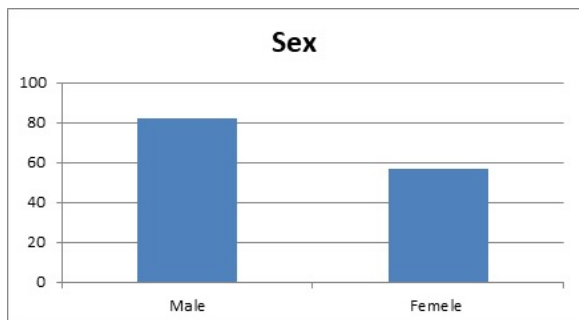
Amikacin was most sensitive to all the organisms followed by Gentamycin, Ofloxacin and Nitrofurantoin. Organisms were highly resistant to cephalosporins like Ceftriaxone, Cefadizime, Cefotaxime and Cefixime. Nalidixic acid showed high resistance to all isolates.

**Table-1: Total number samples v/s culture positive cases.**

	Total Number	Male	Female
Number of CCU samples	446	303	143
Number of Culture Positive	139	82	57



**Fig- 1 Age distribution of children with UTI**

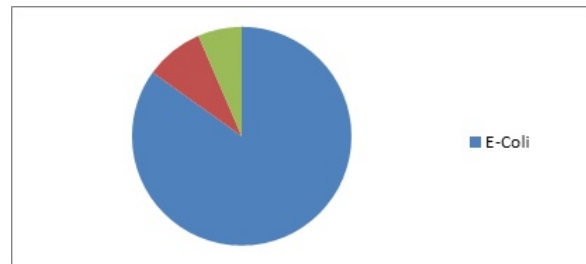


**Fig-2: Sex distribution of children with UTI**

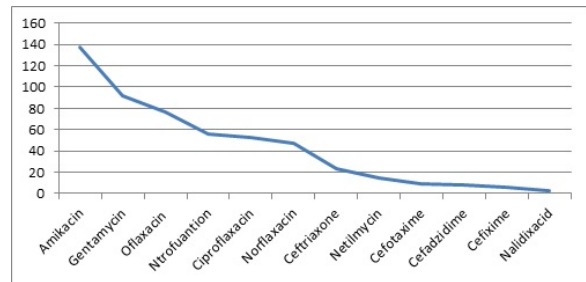
**Table-2: Antibiotic sensitivity of uropathogens**

Sensitive	Total	E-Coli	Proteus	Klebsiella
Amikacin	137(95.6%)	117(99.1%)	11(91.6%)	9(100%)
Gentamycin	92(66.2%)	80(67.8%)	8(66.7%)	4(44.5%)
Ofloxacin	77(55.4%)	63(53.4%)	7(58.3%)	7(77.8%)

Nitrofurantoin	56(40.3%)	47(39.8%)	6(50.0%)	3(33.3%)
Ciprofloxacin	53(38.1%)	46(39.0%)	3(25.0%)	4(44.5%)
Norfloxacin	47(33.8%)	42(35.6%)	2(16.7%)	3(33.3%)
Ceftriaxone	23(16.5%)	18(15.3%)	3(25.0%)	2(22.2%)
Netilmycin	15(10.8%)	8(6.8%)	4(33.3%)	3(33.3%)
Cefotaxime	9(6.5%)	8(6.8%)	1(8.3%)	0
Cefadizime	8(5.6%)	7(5.9%)	0	1(11.1%)
Cefixime	6(4.3%)	6(5.1%)	0	0
Nalidixic acid	3(2.2%)	3(2.5%)	0	0



**Fig-3: Uropathogens isolated**



**Fig-4: Antibiogram**

## Discussions

This study demonstrates the distribution and antibiotic susceptibility pattern of microbial species isolated from children with UTI from a level 2 hospital in a district place in south India catering mainly to rural and low socioeconomic children. To the best of our knowledge, this study is first of its kind in this region.

Out of 446 urine samples, 139 children had UTI. The majority of the organisms were isolated from male children. The male predominance in the present our study can be explained by the fact that half of the samples were less than 2 years of age and infection of the urinary tract before the age of one year occurs more frequently in boys than girls [19]. It is also true that 70% of the urine cultures samples were from male children.

Similarly, Taneja *et al* [20] in their study which included children up to 12 years of age, found that UTI is more common in males (77.8%).

However Kwan et al and Sharifian et al reported more female preponderance in their study [21, 22].

In the present study, *E.coli* was the commonest bacterial uropathogen causing UTI in children followed by *Proteus* and *Klebsiella*, other studies also isolated similar organisms [14,23-25]. *E Coli* was isolated in 89% of the cases and was consistent with studies conducted both inside and outside India [9,26-32]. Data from the above studies showed that *E. coli* is consistently found predominant uropathogen irrespective of country, community or hospital setting. However Muoneke Vet a isolated *Klebsiella* as the predominant organism [4].

Other organisms like *P.aeruginosa*, *Acinetobacter*, *Citrobacter* were not isolated in the present study. According to Akram et al. from North India, no such microorganisms were found in children from 0 to 19 years [26]. Gram-positive organisms like coagulase negative staphylococcus, *S aureus*, streptococci, and enterococci have been reported in small numbers by various authors [32-34].

The current study did not find any gram positive organisms. The reason could be that these organisms account for very small numbers in the above studies and the current study excluded the growth of staphylococci, pseudomonas and multiple organisms from the present study group.

After analyzing the antibiogram of the isolates, it was observed that Amikacin was the most active antibiotic against all the gram-negative isolates followed by gentamicin and ofloxacin [9,11,27,34,35]. All the organisms showed more than 50% sensitivity to these three drugs. The efficacy of third generation cephalosporins was reduced because of the high rate of production of ESBL resulting in drug resistance [9,26,35-37].

Nalidixic acid showed high resistance to all isolates similar to other studies from different parts of the world [26,38]. These results are mainly because of the irrational use of antibiotics even in rural areas and provide the physician with an idea of selecting appropriate antibiotics so that high antimicrobial resistance is not developed at the community level.

## Limitations of this study

Infants with very severe illnesses were excluded from the study as they required immediate intensive care treatment rather than wasting time in the collection of urine by midstream method.

Urine samples with the growth of uncommon organisms, such as staphylococcus, pseudomonas, *Citrobacter*, etc were excluded from the study. A perceived limitation of this study is that this study was performed retrospectively in only one center, necessitating the multicentric study to reflect the overall antibiotic susceptibility trends in this region.

## Conclusion

*E.coli* is the commonest isolate in pediatric patients with UTI followed by *Proteus Mb* and *Klebsiella* spp. The majority of the Gram-negative isolates are ESBL producing and resistant to most of the commonly used antibiotics. Organisms were highly sensitive to Amikacin. So Carbapenems should be spared and Amikacin is used empirically to treat UTI. Amikacin can be administered as a daily single dose and allows outpatient care due to its less nephrotoxicity and ototoxicity.

## What does the study add to the existing knowledge?

Prospective regional studies should be carried out periodically at different regions to determine the local prevalence of organisms and antimicrobial susceptibilities in order to guide the proper use of antibiotics empirically in managing children with UTI in the absence of facilities for urine culture especially in rural and suburban areas.

## Author's contributions

**Dr. Rajakumar Marol:** Concept, study design

**Mr. Rohit Kumar Marol:** Manuscript preparation

**Dr. Renuka Marol:** Manuscript preparation, statistical analysis

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