

*Research article***Bacterial pathogens causing urinary tract infections in children and their antimicrobial susceptibility patterns in a tertiary care hospital in Sri Lanka**

KLW Hathagoda<sup>1</sup>, SS Gunathilaka<sup>2</sup>, B Dissanayake<sup>2</sup>,  
I Tharaka<sup>2</sup>, K Gunathilaka<sup>2</sup>, R Jayawardane<sup>2</sup>, R Gunapala<sup>1</sup>

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**Abstract**

**Introduction and Objectives:** Urinary tract infection (UTI) is one of the most common infections in childhood. The objective of our study was to ascertain the commonest organisms causing UTI in children and their ABST patterns. The study was carried out in a Teaching Hospital in Sri Lanka.

**Methods:** Data was collected from children who were confirmed to have UTI by positive urine culture ( $>10^5$  bacteria/ml urine) between July-December 2015. The clinical presentation, presence of predisposing factors and reports of urine culture and the antibiotic susceptibility patterns were analysed.

**Results:** Coliforms were found to be the commonest organism followed by *Enterococcus spp.* Nitrofurantoin showed the highest sensitivity of the tested antibiotics against both coliforms and the enterococcus groups. However the sensitivity to most of the antibiotics showed a reduction from previously recorded values in studies done in Sri Lanka.

**Conclusions:** The authors emphasize the need for regular revision of the list of organisms causing UTI and the antibiotic sensitivity to improve the treatment of childhood UTI with the ideal antibiotic.

*Keywords: Urinary tract infection, UTI, Children, Pathogens*

**Introduction**

UTI is one of the most common infections in the paediatric population.<sup>1</sup> It is a heterogeneous disease which can be categorized into lower and upper UTI, or complicated and uncomplicated UTI, depending on the clinical features and laboratory findings.<sup>2</sup> It causes significant morbidity and mortality, especially if complicated with structural or congenital defects of the urinary

<sup>1</sup>Lady Ridgeway Hospital for Children, Colombo 8, Sri Lanka

<sup>2</sup>Faculty of Medicine and Allied Sciences, Rajarata University of Sri Lanka, Sri Lanka

Address for correspondence: Dr Shobha Sanjeevani Gunathilaka, Faculty of Medicine and Allied Sciences  
Rajarata University of Sri Lanka, Sri Lanka Telephone: +94773153361/94711997323

Email: [mgrssgunathilaka@gmail.com](mailto:mgrssgunathilaka@gmail.com)  <https://orcid.org/0000-0002-03>

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tract. In children presenting with UTI, 30-40% have underlying vesico-ureteric reflux (VUR), while other congenital anomalies like posterior urethral valves, pelvi-ureteric junction obstruction, ureteroceles and duplex systems are encountered less frequently.<sup>3</sup>

Fever, increased frequency, straining on micturition, diarrhoea and offensive urine are the common presentations of childhood UTI.<sup>3,4</sup> Features are often non-specific and it is therefore recommended to perform a semiquantitative urine culture to confirm the diagnosis in children with suspected UTI.<sup>5</sup> Management of UTI is with either oral or parenteral antibiotics depending on the clinical need.<sup>6</sup> The initial choice of antibiotics is decided on available clinical guidelines, with availability, cost and personal preferences playing a secondary role.<sup>7</sup> Clinical guidelines are available in both Sri Lanka and international contexts and provide guidance for initial antibiotic choice.<sup>8,9,10</sup> As the treatment of the acute episode is of utmost importance, the correct choice of initial antibiotic should be based on local and timely information of the responsible organisms and their ABST pattern. Renal scarring may result from improper treatment, especially in infants and very young children.<sup>11</sup> Non-response to initial treatment requires a change of antibiotic guided by the ABS results and/or further investigation.

The ABS pattern of a particular organism is known to change with time and vary from place to place, resulting in very specific ABS patterns for causative bacteria in different locations.<sup>3,11</sup> Probable reasons for varying antibiotic susceptibility include continued exposure of causative bacteria to antibiotics in both clinical and non-clinical settings, including inappropriate and improper use (wrong dose, wrong duration). A positive correlation between antibiotic usage and development of resistance has been observed in many studies.<sup>12</sup>

Information on local ABS pattern is therefore important to treat UTI effectively, while avoiding unnecessary use of a wide range of antibiotics which can contribute to antibiotic resistance. In many countries, updated local information is made available to clinicians for this purpose. However, although the availability of such data in Sri Lanka is increasing, information on causative bacteria and their ABS patterns in children is still limited.<sup>13,14</sup>

Island wide availability of systematic updated information on causative agents/ABS of UTI in the paediatric population is a national need. This study aims to contribute to this need by studying the causative bacteria and their ABS in a paediatric population with confirmed UTI in the North Colombo Teaching Hospital, Sri Lanka.

## **Methods**

A prospective study was done in the paediatric wards of North Colombo Teaching Hospital during a five-month period from 1<sup>st</sup> July to 1<sup>st</sup> December 2015.

Collection of urine for culture was done by mid-stream clean catch sampling. The correct procedure was routinely taught to mothers by one of the medical officers in each ward before collection of urine. Positive urine culture is defined as the presence of significant bacteriuria, (> 10<sup>5</sup> CFU of a single organism/ml of urine). All the children who were confirmed to have UTI by means of positive urine culture and whose parents consented were included in the study.

An interviewer administered questionnaire was used to obtain the clinical history from the patient's mother or guardian. Thorough clinical examination was performed on the patient by

the investigators to elicit the signs. Relevant data on the organism and the ABS was extracted from the urine culture reports. The data were entered to a beta version of SPSS statistical software. The frequencies and the cross relationships were analysed where relevant.

## Results

A total of 97 subjects were recruited, 47 (48.5%) males and 50 (51.5%) females. The ages varied from two months to twelve years. The mean age was 3.69 years (SD 3.3) (Table 1).

**Table 1**  
**Demographic data of the children with culture positive UTI**

	category	Frequency	Percentage%
Age	<1 year	25	25.8
	1 - 5 years	44	45.4
	5 - 10 years	18	18.6
	> 10 years	10	10.3
Gender	Male	47	48.5
	Female	50	51.5

Fever is the commonest presenting feature of UTI in children of all age groups. In 81.4% of the children with UTI, fever was the main complaint at presentation. Straining, increased frequency of micturition, diarrhoea and offensive urine were the other common complaints (Table 2)

**Table 2**  
**Clinical presentations of children with culture positive UTI according to age in the study population**

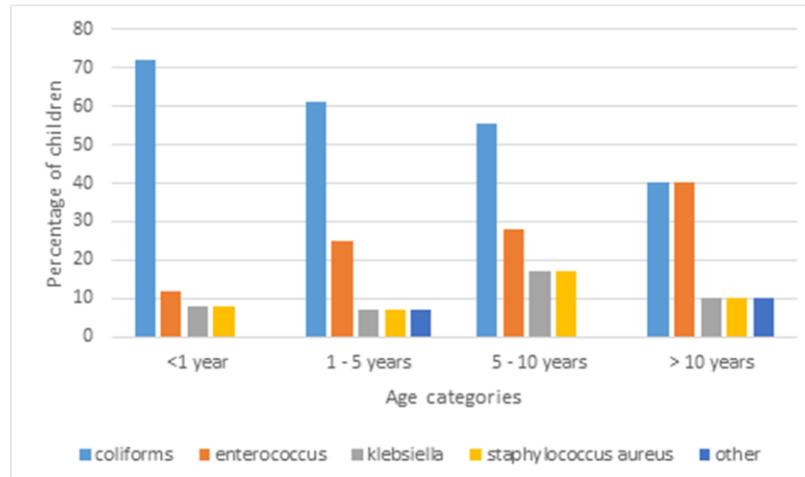
	<1 yr	1 - 5 yrs	5 - 10 yrs	> 10 yrs	Significance
<b>Fever</b>	84%	88.6%	77%	50%	0.04
<b>Straining</b>	56%	45.4%	11%	10%	0.004
<b>Frequency</b>	28%	61.3%	55%	60%	0.054
<b>Dysuria</b>	44%	59.0%	88%	100%	0.001
<b>Offensive urine</b>	25%	15.9%	5.5%	20%	0.308
<b>Diarrhoea</b>	20%	9.1%	5.5%	10%	0.44
<b>Irritability</b>	32%	13.6%	0%	0%	0.12
<b>Abdominal pain</b>	4%	11.4%	66%	90%	0.000

The known predisposing factors for UTI were present in 15 of 97 (15.5 %) patients of which constipation and previously diagnosed abnormality of the urinary tract were the most common.

The commonest organisms isolated from urine cultures in children of all age groups were coliforms, accounting for 60.8% (59/97) of which *Klebsiella* spp. was found in 9 (9.3%) patients (Figure 1). In 23 patients (23.7%), enterococci and *Staphylococcus spp* in 2 (2.1%) patients respectively. There was no gender based difference in the causative organisms (Table 3).

**Table 3: Organisms causing UTI in male and female children of the study population**

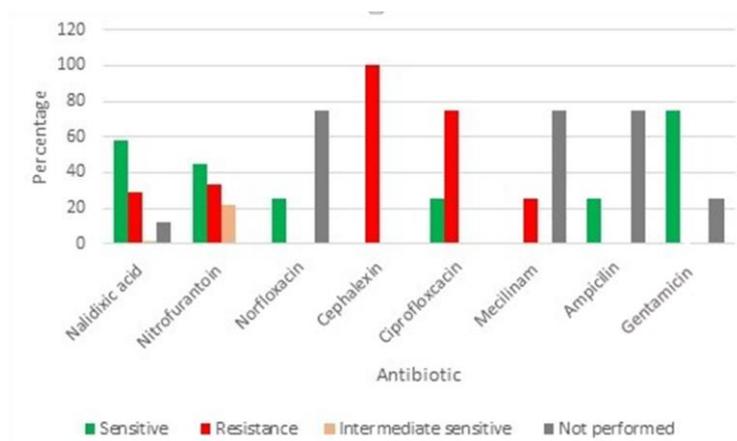
	Coliforms	Enterococcus spp.	Klebsiella	<i>Staphylococcus aureus</i>
Male	53.3%	25.6%	10.7%	4.3%
Female	68%	22%	8%	0%



**Figure 1: Bacterial pathogens causing UTI in children of different age groups**

The organisms causing UTI in different age groups of children is shown in Figure 1. In all age groups coliforms (including *Klebsiella spp.*) was the commonest isolate. Antibiotics had been started empirically prior to the availability of ABST report in all patients. Co-amoxiclav had been prescribed in 66 of the 97 patients (68%) followed by cefotaxime in 15 patients (15.5%).

Sensitivity to nitrofurantoin was seen in 40 of the 59 (67.8%) coliforms (excluding *Klebsiella spp.*) isolated in the study. Sensitivity to nalidixic acid was seen in 34 coliform isolates (57.6%). Co amoxiclav sensitivity was lower at 52.5% (31/59 isolates). None of the isolated organisms were found to be ESBL producers.



**Figure 2 Sensitivity (%) of coliforms against tested antibiotics**

The percentage sensitivity of antibiotics against enterococci were 87% (20/23), 43.5% (10/23) and 34.8% (5/23) for nitrofurantoin, nalidixic acid and co-amoxycylav respectively. Ampicillin and ciprofloxacin were the least sensitive of tested antibiotics which denotes 14.4% and 18.6% respectively for any type of organisms. Figure 2 shows the cumulative percentages of sensitivities of each tested antibiotic against any type of organism.

## Discussion

UTI is a common childhood bacterial infection and accounts for a considerable number of admissions to paediatric wards. The symptoms of UTI vary with age. As previously described by Gunasekara 2010<sup>7</sup>, fever was the most commonly encountered symptom and found to be more evident in younger children ( $p = 0.04$ ) in this study. Dysuria and abdominal pain were seen in older children ( $p = 0.001$ ). These findings could be used in developing clinical criteria for the diagnosis of UTI in children of different age groups.<sup>7</sup>

Coliforms were the most commonly isolated organisms in the current study. However, the isolation rate of 60.8% in the current study is less than the previously described.<sup>5</sup> *Enterococcus spp.* was the second most common organism in contrast to previous studies where *Klebsiella spp.* were identified as the second common infecting organism.<sup>5,11</sup> It must be noted that although *Klebsiella spp.* are also 'coliforms', they are often reported independently and are therefore considered in a separate category in the current study.

The enterococci are considered intrinsically resistant to many commonly used antimicrobial agents.<sup>16</sup> The enterococci have emerged as an important health care associated infectious agent in recent times. Although the children in the study sample did not have a history of prolonged hospital stay or other risk factors for colonization with enterococci, 23.7% of UTIs in the present study were due to enterococci. The authors believe this may be a negative outcome of the over usage of antibiotics in the community, producing more enterococci with intrinsic and acquired antibiotic resistance. This may need further evaluation in order to prevent more complicated infections with resistant organisms in the future.

Although co-amoxycylav is the most commonly prescribed antibiotic for empirical treatment of UTI in children, only 52.5 % of coliforms and 34.8% of enterococci in the study sample were sensitive to this drug. Sensitivity to co-amoxycylav had shown a dramatic reduction from 86.6% reported by Abeygunawardane e al.<sup>12</sup> to 52.5% in the current study. The two studies were done in different locations, Peradeniya and Ragama respectively. No similar studies done in the same study site on a paediatric population was available for comparison. Studies done in adult populations with UTI has detected similar reduction of the susceptibility to antibiotics in Sri Lanka.<sup>14</sup>

A reduction of antibiotic sensitivity is observed all over the world. Overuse, misuse of antibiotics and growing genetic diversity of the organisms are the possible causes for this.<sup>17</sup> Misuse of antibiotics has been identified as a global crisis since it has given rise to various issues such as increase in antibiotic resistance and spread of *Clostridium difficile* infections. Discovery of new antibiotics that can combat emerging resistance has been very slow and ineffective.<sup>17</sup>

Collection of the data on antibiotic sensitivity at national and international levels is important to make stakeholders aware of the extent of the problem of antibiotic resistance. Strengthening research on newer drugs is suggested to overcome the crisis of antibiotic resistance.<sup>18</sup> Some countries have reported a reduction in the misuse of antibiotics following interventions including establishment of guidelines for antibiotic use.<sup>19</sup>

## Conclusions

The results of this study emphasize the need for regular surveillance of organisms causing UTI and their antibiotic sensitivity. This information, both local and national, is essential to provide appropriate guidelines for empirical treatment of childhood UTI.

**Conflict of interest:** The authors declare that there are no competing interests.

**Ethics statement:** Approval for this study was obtained from the Ethics Review Committee of the College of Paediatricians, Sri Lanka.

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