Original Article

Childhood Urinary Tract Infection: Clinical and Laboratory Profiles and Antimicrobial Sensitivity Patterns

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Abstract

Background: *In infants and children, urinary tract infection (UTI) is a serious bacterial infection. Early detection and treatment can reduce the risk of substantial morbidity.* ***Objective:*** *The objective of the study was to evaluate the clinical profile, laboratory findings and antimicrobial sensitivity pattern of uropathogens causing urinary tract infection in children.* ***Materials and method:*** *This cross sectional study was conducted in the Department of Paediatrics Jalalabad Ragib-Rabeya Medical College Hospital, Sylhet, Bangladesh, from 1st January 2019 to 31st December 2019. A total of 150 cases aged 2 months to 12 years were enrolled in the study by consecutive sampling method.* ***Results:*** *Among 150 cases, 60% were female with a male-female ratio of 1:1.5. Overall, the highest number of cases were within the age group of 1 to <5 years (52.7%). Fever (74%) was the most common presenting feature, followed by abdominal pain (45.3%), dysuria (43.3%), increased frequency of micturition (33.3%), and nausea and vomiting (30.3%). Significant pyuria was present in 61.3% of cases, and microscopic haematuria was in 24% of cases. Urine culture was positive in 60% of cases. Escherichia coli (57.9%) were the most common isolated organism, followed by Klebsiella (33.3%). The most of the organisms were highly sensitive to imipenem (87.8%), nitrofurantoin (74.4%), amikacin (61.1%) and levofloxacin (48.9%).* ***Conclusion:*** *Children under five and those who were female had higher rates of UTI. Judicial use of antibiotics is necessary to treat these children.*

Keywords: *Urinary tract infection; Clinical profile; Laboratory profile; Antimicrobial sensitivity.*

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Introduction

The pathological invasion of the urinary tract by bacteria is known as urinary tract infection (UTI).[1] The most common serious bacterial illness in febrile infants and young children is

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urinary tract infection (UTI). Many cases of pediatric UTI go undiagnosed due to the lack of particular clinical presentations, especially in newborns and young children. Renal scarring, hypertension, reduced renal function, and end-stage renal disease (ESRD) can all result from a delay in diagnosis and treatment.[2,3] The prevalence of urinary tract infections varies by age, ethnicity, and gender. Approximately 1% of boys and 3% of girls acquire UTI within their first ten years of life. In the first year of life, it affects male children more than female children, and after that, it predominantly affects female children.[4]

Fever is the most prevalent symptom in newborns, infants, and young children, whereas older children have specific urinary symptoms like dysuria, frequency and urgency. In younger children, dysuria might be the primary symptom of a UTI, but it usually implies cystitis. Enuresis and foul-smelling turbid urine may be accompanied with dysuria. Nonspecific symptoms such as jaundice, poor feeding, irritability, and weight loss may appear in some neonates and infants.[4]

The gold standard for diagnosing a UTI is urine culture and sensitivity.[5] A colony count of more than 10^5 colony forming units (CFU)/mL organisms of a single species in the midstream urine of girls and $>10^4$ CFU/mL organisms in the midstream urine of males is considered confirmatory of UTI on culture. Significant bacteriuria is considered as a pure growth of 10^2 CFU/mL from a catheterized urine sample or a growth of any number of uropathogens from urine collected by suprapubic aspiration.[6] In female children, Escherichia coli (E. coli) is the most common cause of UTI, followed by Klebsiella and Proteus, whereas in boys older than one year, as a bacterial cause of UTI, Proteus is just as common as E. coli.[7]

A significant cause of paediatric outpatient visits is urinary tract infection (UTI).[8] Because of the high prevalence of UTI in children and the associated morbidity, it is critical to diagnose and treat UTI as soon as possible. Before the results of urine cultures are available, the most reliable and fastest way to diagnose a UTI is to demonstrate bacteria microscopically. In resource-limited settings, the diagnosis of UTI is primarily based on the patient's clinical presentation; urinalysis is frequently used to corroborate the diagnosis, although urine culture and sensitivity are rarely used. It is more applicable in outdoor settings.[8] So knowledge about clinical presentation of childhood UTI and antibiotic sensitivity pattern of commonest organism are necessary for early diagnosis and to treat them empirically.

The aim of this study, therefore, was to evaluate the clinical profile and laboratory findings of UTI, and antimicrobial sensitivity of uropathogens in children who attended the paediatric outpatient department and inpatient department at Jalalabad Ragib-Rabeya Medical College Hospital, Sylhet, Bangladesh.

Materials and method

This was a cross-sectional study conducted among infants and children, aged 2 months to 12 years, who attended the paediatric outpatient and inpatient department of Jalalabad Ragib-Rabeya Medical College Hospital, a tertiary care medical college hospital situated in Sylhet city, Bangladesh, between the periods of 1st January to 31st December 2019. A total of 150 cases were enrolled for the study by consecutive sampling method. Consent was taken from the parents before enrolling them in the study. Ethical permission was taken from the institutional review board. Patients presenting with signs and symptoms of UTI or other nonspecific symptoms like fever, vomiting and abdominal pain, were included in the study. After enrolment, data regarding socio-demographic characteristics and clinical profile were collected by using a pre-designed questionnaire, and urine samples were collected. The young children were instructed to gather urine samples using sterile plastic bags or wide-mouthed containers provided by the lab. For hospital patients in critical

condition, catheterization was indicated. Older kids and teenagers were requested to gather clean, midstream urine samples. The collected urine samples were then sent to the hospital's laboratory for microscopic examination, bacteriological culture, and testing of antibiotic sensitivity. Culture positive UTI was considered if a single organism was grown in culture media at a concentration of more than 10^5 colony-forming units per ml of urine. Other tests, such as a complete blood count (CBC), an ultrasonography (USG) of the abdomen and micturating cystourethrogram (MCUG) were performed in selected cases. The data were analysed using SPSS version 21. The data was presented in the form of frequency, percentage, and bar chart. A chi-square test was used to determine the relationship between the patient's age and gender who presented with UTI.

Results

A total of 150 cases were enrolled in the study. Among them, 40% were male and 60% were females. The male-to-female ratio was 1:1.5. The mean age of the patients was 48.06±41.28 months. The age range of one to less than five years had the largest number of UTI cases (52.7%) and female children in this group made 30% of the overall number of cases. Compared to the age group under 5 years, the incidence of UTI was considerably greater in female children aged 5 or more, which was statistically significant (p=0.02). (Table I)

The most common presenting symptom was fever (74%), followed by abdominal pain (45.3%), dysuria (43.3%), increased frequency of micturition (33.3%), nausea and vomiting (30.3%), and dribbling of urine (17.3%). (Table II)

Table I: Age and gender distribution of the respondents, N=150

Age	Gender of the respondents		Total	p-value
	Male	Female	N (%)	
	n (%)	n (%)		
2 month- <1 year	14 (9.3)	10 (6.7)	24 (16)	
1-<5 year	34 (22.7)	45 (30)	79 (52.7)	0.02
5-14 year	12 (8)	35 (23.3)	47 (31.3)	
Total	60 (40)	90 (60)	150 (100)	

Table II: Clinical presentations of children with UTI, N=150

Characteristics	Frequency	Percentage
Fever	111	74
Abdominal pain	68	45.3
Dysuria	65	43.3
Increased frequency of micturition	50	33.3
Nausea and vomiting	46	30.7
Dribbling of urine	26	17.3
Anorexia	25	16.7
Headache	13	8.7
Back pain	7	4.7
Others**	15	10

* One respondent considered more than one reason.

**Other symptoms include foul smelling urine, reddish urine, itching around genitalia, straining during micturition, leg oedema.

In all suspected cases of UTI, urine analysis was performed. Urine microscopic examination revealed pus cells more than 10/ high power field (HPF) in 42% cases, 6-10/HPF in 19.3% cases, while 38.7% had 5 or less pus cells per HPF. RBCs were found in 24% of urine samples, while epithelial cells were found in 49.3% of urine samples. A positive urine culture was found in 60% of the individuals. (Table III)

Table III: Results of urine routine examination and urine culture, N=150

Urine RME and culture	Frequency (%)
Urine pus cell	
<5/HPF	58 (38.7)
6-10/HPF	29 (19.3)
>10/HPF	63 (42)
Urine RBC	
Present	36 (24)
Absent	114 (76)
Urine epithelial cell	
Present	74 (49.3)
Absent	76 (50.7)
Urine culture	
Positive	90 (60)
Negative	60 (40)

Complete blood count (CBC), USG of the abdomen, and micturating cystourethrogram were among the other laboratory tests required for our participants (MCUG). In 66.7% of patients, a CBC was performed. Neutrophilic leucocytosis and high ESR were found in 21.3% cases. In 40% of the instances, an abdominal USG was performed, and abnormalities such as cystitis, hydronephrosis, and nephrolithiasis were

discovered in 8% of the cases. In four cases, MCUG was done. There were aberrant findings in three of the instances, including vesico-ureteric reflux, ureteric calculi, and hydronephrosis. (Table IV)

Table IV: Investigation reports of CBC, USG and MCUG

Investigations	Normal n (%)	Abnormal n (%)	Not done n (%)	Total n (%)
CBC*	68 (45.4)	32 (21.3)	50 (33.3)	150 (100)
USG**	48 (32)	12 (8)	90 (60)	150 (100)
MCUG***	1 (0.7)	3 (2)	146 (97.3)	150 (100)

†CBC - Complete blood count, USG- Ultrasonography, MCUG- micturating cystourethrogram

*Abnormalities were leukocytosis, neutrophilia and high ESR
**Abnormalities were cystitis, hydronephrosis, nephrolithiasis
***Abnormalities were vesico-ureteric reflux, ureteric calculi and hydronephrosis

The most prevalent bacteria discovered in those who tested positive for bacteriuria was *Escherichia coli* (57.9%), followed by *Klebsiella* (33.3%). (Figure 1)

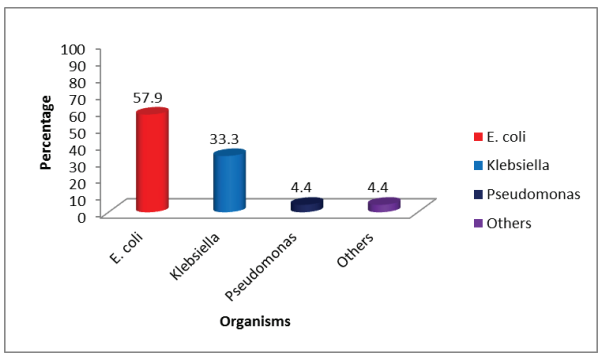

Fig. 1: Organisms isolated from patients with UTI, N=90

*Others - *Enterococcus,* Proteus and *Staphylococcus aureus*

Imipenam was the drug with the highest level of sensitivity (87.8%) for the isolated organisms, followed by nitrofurantoin (74.4%), amikacin (61.1%), and levofloxacin (48.9%). The drugs with the highest levels of resistance were first generation cephalosporin (Cephradine, cephalaxin >90%), second generation cephalosporin (Cefaclor 90%), amoxycillin (90%), azithromycin (76.7%), and third generation cephalosporin (Cefixime. ceftazidime, ceftriaxone >70%). (Figure 2)

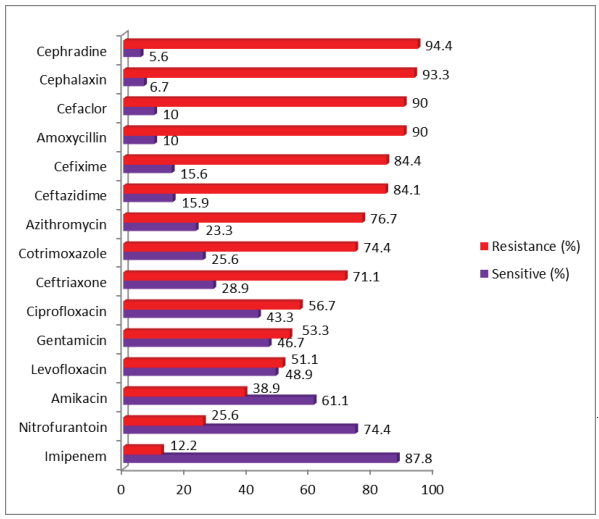

Fig. 2: Distribution of antibiotic susceptibility pattern, N=150

The most sensitive antibiotic against *E. coli* was found to be imipenem (84.6%), which was followed in decreasing order by nitrofurantoin (76.9%), amikacin (61.5%), gentamicin (48.1%), and levofloxacin (46.2%). Additionally, it was shown that imipenem had the highest sensitivity (96.7%) to *Klebsiella,* followed by nitrofurantoin (70%), amikacin (63.3%), levofloxacin (53.3%), and gentamicin (46.7%) (Table V).

Table V: Sensitivity of antibiotics against two common isolates (E. coli and Klebsiella), n=82

Antibiotics	*E. coli* (%)	*Klebsiella* (%)
Imipenem	84.6	96.7
Nitrofurantoin	76.9	70
Amikacin	61.5	63.3
Levofloxacin	46.2	53.3
Gentamicin	48.1	46.7
Ceftriaxone	38.5	20
Ciprofloxacin	36.5	53.3
Cotrimoxazole	26.9	23.3
Ceftazidime	21.6	10.3
Azythromycin	21.2	33.3
Cefixime	17.3	16.7
Cefaclor	11.5	10
Amoxycillin	9.6	6.7
Cephalaxine	7.7	6.7
Cephradine	5.8	6.7

Discussion

Urinary tract infection (UTI) is a common clinical problem in children. This study focused on the clinical and laboratory profiles and antibiotic sensitivity pattern of children presenting with symptoms of UTI. A total of 150 suspected cases of UTI were included in the study. Among them, 40% were males and females were 60%. The male-to-female ratio was 1:1.5. Several national and international studies also have found female predominance.[4,10-13] The fact that this disease is more common in female children is likely due to a small urethra in females, as well as other causes.

The mean age of the participants in the study was 48.06 ± 41.28 months. The age group of one to less than five years old had the most suspected UTI cases (52.7%). This category also included the majority of male and female patients, with 22.7% and 30%, respectively, belonging to this group. In a study conducted in Combined Military Hospital (CMH), Dhaka, Nazme et al. discovered that 62.5% of all UTI infections occurred in children aged <5, with females accounting for 38.3% of these cases, confirming our findings.[4] Another study from the Institute of Child Health and Shishu Shasthya Foundation Hospital in Mirpur, Dhaka, found that the most common age group was 1 to 3 years.[14]

Fever was the most prevalent presenting symptom (74%) in our study, followed by abdominal pain (45.3%), dysuria (43.3%), increased frequency of micturition (33.3%), nausea and vomiting (30.3%), dribbling urine (17.3%), and anorexia (16.7%). In a research, Nazme et al. discovered that fever was the most common clinical presentation (64.2%), followed by frequency of urination (53.3%), anorexia (49.2%), vomiting (44.2%), abdominal discomfort (38.3%), and dysuria (36.7%), which is substantially identical to our findings.[4] Sadia et al. also had comparable findings. However, they found vomiting in 80.5% of children with UTI, which is greater than our study.[10]

Urine analysis was performed in all suspected cases of UTI. Of these, 61.3% had pus cells that were greater than 5/HPF, and 24% had microscopic haematuria. The prevalence of pyuria was higher than in a previous study conducted in the Philippines (35.2%) and lower than two previous studies conducted at the CMH in Dhaka, Bangladesh (75%) and the Dhulikhel Hospital in Nepal (95.8%).[4,7] Nazme et al. observed haematuria in 26.7% of cases, which is similar to our findings.[4] A research in Nepal revealed a higher rate of haematuria (50.4%), however another study in the Philippines found only 6.4% instances.[7,8]

Sixty percent of the 150 participants in the study exhibited positive urine cultures. Yadav et al. observed a nearly similar outcome in a research where 55% of urine samples tested positive for bacteria.[15] However, the culture positivity rate is higher than that of two studies conducted in Bangladesh (48.3% and 44.6%, respectively).[4,14]

In our study, neutrophilic leucocytosis and high ESR were found in 21.3% of cases. A similar result was found in a study in CMH, Dhaka, where high ESR and neutrophilic leucocytosis were present in 25% cases.[4] Zamir et al. questioned the efficacy of routine renal ultrasonography (RUS) in the treatment of young children with their first uncomplicated UTI. The author concluded that RUS should only be conducted in children who have an unfavorable clinical course and are suspected of having a complication such as renal parenchyma disease or renal obstruction, or in children who have a VUR to search for renal structural abnormalities.[16] In the present study, USG was done in 40% of cases. Among them, abnormal findings were found in 8% cases, which included cystitis, hydronephrosis and nephrolithiasis. Micturating cystourethrogram (MCUG) was done in 4 cases, and abnormalities were found in 3 cases, which included vesico-ureteric reflux, ureteric calculi and hydronephrosis.

E. coli and *Klebsiella* are the most common causes of paediatric UTI, according to several studies.[10,12,14,17] In our study, E. coli (57.9%) was the most common causative organism, followed by *Klebsiella spp.* (33.3%) and *Pseudomonas* (4.4%), which was similar to previous studies. In different studies, however, the pattern of isolated organisms differs substantially. *E. coli* was followed by *Enterococcus* (19.2%) in a study by Nazme et al.[4], E. coli was followed by *Enterobacter spp.* (16.7%) in a study by Bay et al.[8], and E. coli was followed by *Proteus* (20%) in a study by Shrestha et al.[18]

Imipenem, followed by nitrofurantoin and amikacin showed the highest sensitivity to the microorganisms isolated in our study. Levofloxacin, gentamicin, and cirpofloxacin all showed signs of moderate sensitivity. On the other hand, amoxicillin and first and second generation cephalosporins showed ≥90% resistance, while third generation cephalosporins and azithromycin showed >70% resistance in our study. In their investigation, Lehrasab et al.[19] discovered that ceftazidine (77.3%) demonstrated the highest sensitivity pattern, followed by levofloxacin (77.0%), imipenem (76.8%), and amikacin (75.4%), in that order. In a different study, Oluwafemi et al.[1] found that nitrofurantoin and ciprofloxacin had uropathogen sensitivity rates of 85.7% and 62.8%, respectively. The results of both researchers were notably different from ours.

Imipenem was found to be most sensitive (84.6%) against E. coli, followed by nitrofurantoin (76.9%), amikacin (61.5%), gentamicin (48.1%), and levofloxacin (46.2%%) in our study. A study done at CMH, Dhaka, showed that E. coli was most sensitive to ciprofloxacin (50%), followed by nitrofurantoin (47%), levofloxacin (41%) and amikacin (31%).[4] In another study, Sadia et al.[10] found that E. coli was 100% sensitive to amikacin and meropenem and >90% sensitivity to imipenem and nitrofurantoin. They also showed E. coli was >60% sensitive to cephalosporins, which was <40% in our study.

In this study, Klebsiella was found to be the most susceptible to imipenem (96.7%), followed by nitrofurantoin (70%), amikacin (63.3%), levofloxacin (53.3%), ciprofloxacin (53.3%), and gentamicin (46.7%). In a study conducted at Uttara Adhunik Medical College and Hospital, Dhaka, showed that Klebsiella was 100% sensitive to nitrofurantoin and amikacin, 87.5% sensitive to imipenem and >70% sensitive to third generation cephalosporin.[10] However, our study showed *Klebsiella* was <20% sensitive to third generation cephalosporin.

In our research, *E. coli* and *Klebsiella* isolates had a higher level of resistance to cotrimoxazole, amoxycillin, azythromycin, ciprofloxacin, and cephalosporins such as cephalaxine, ceftazidime, cefixime, and ceftriaxone than to imipenem, nitrofurantoin, and levofloxacin. The high incidence of resistance to routinely used antibiotics highlights the significance of establishing a monitoring system to track the scope of the problem in various institutions. After obtaining an appropriate urine specimen, empiric treatment with a "best guess" antibiotic should be started in all cases of suspected UTI. Inappropriate antibiotic use will delay successful treatment and raise the risk of renal scarring and chronic renal failure later in life.

Conclusion

Urinary tract infection (UTI) was shown to be more prevalent in children under the age of five and those who were female in this study. Fever was the most common presenting symptom, along with abdominal pain, dysuria, and increased frequency of micturition. Although the lack of pyuria does not rule out UTI, urine analysis is required for diagnosis. E. Coli, and Klebsiella were the commonest organism causing UTI in children. Isolated organisms were found to be sensitive to imipenem, nitrofurantoin, amikacin and levofloxacin and resistant to commonly used antibiotics like amoxycillin, cephalosporins, and ciprofloxacin. After sending urine culture and sensitivity, nitrofurantoin or levofloxacin can be used empirically in the outdoors, as most organisms are sensitive to these oral medications.

References

1. Oluwafemi TT, Akinbodewa AA, Ogunleye A, Adejumo OA. Urinary tract infections and antibiotic sensitivity pattern of uropathogens in a tertiary hospital in South West, Nigeria. Sahel Med J. 2018;21(1):18-22.
2. Pouladfar G, Basiratnia M, Anvarinejad M, Abbasi P, Amirmoezi F, Zare S. The antibiotic susceptibility patterns of uropathogens among children with urinary tract infection in Shiraz. Medicine. 2017;96(37):e7834.
3. Shrestha LB, Baral R, Poudel P, Khanal B. Clinical, etiological and antimicrobial susceptibility profile of pediatric urinary tract infections in a tertiary care hospital of Nepal. BMC Pediatrics. 2019;19:36.
4. Nazme NI, Ahsan MR, Jalil F, Fatema NN. Childhood urinary tract infection: clinical & laboratory profile in a tertiary care hospital of Bangladesh. JAMMR. 2018;26(7):1-9.
5. Laila K, Roy E, Rahman MH, Roy RR. Urinary tract infection in children: An update. Bangladesh J Child Health. 2012;36(2):90-97.
6. Srivastava RN, Bagga A. Urinary tract infection. Pediatric Nephrology. 6th ed. New Delhi: Jaypee Brothers Medical Publishers Ltd.; 2016. p.273-300.
7. Singh SD, Madhup SK. Clinical profile and antibiotics sensitivity in childhood urinary tract infection at Dhulikhel Hospital. Kathmandu Univer Med J. 2013;44(4):319-24.
8. Bay AG, Anacleto F. Clinical and laboratory profile of urinary tract infection among children at the outpatient clinic of a tertiary hospital. PIDSP Journal. 2010;11(1):11-15.
9. Biggi A, Dardanelli L, Pomero G, Cussino P, Noello C, Sernia O. Acute renal cortical scintigraphy in children with a first urinary tract infection. Pediatr Nephrol. 2001;16(9):733-38.
10. Sadia N, Ferdaus MS, Maksud SI, Mahboob S. Demography, symptom and antibiotic sensitivity pattern of urinary tract infection in hospitalized children: A cross-sectional observation in Bangladesh. EC Paediatrics. 2017;3(5):457-64.
11. Acharya A, Gautam R, Subedee L. Uropathogens and their antimicrobial susceptibility pattern in Bharatpur, Nepal. Nepal Med Coll J. 2011;13(1):30-33.
12. Islam MA, Begum S, Parul SS, Bhuyian AKMT, Islam MT, Islam MK. Antibiotic resistance pattern in children with UTI: A study in a tertiary care hospital, Dhaka, Bangladesh. American J Pediatr. 2019;5(4):191-95.
13. Kayaş L, Yolbaş İ, Ece A, Kayaş Y, Balık H, Kocamaz H. Causative agents and antibiotic susceptibilities in children with urinary tract infection. J Microbiol Infecti Diseas. 2011;1(1):17-21.
14. Rizwan F, Monjur F, Asaduzzaman M, Nasrin N, Ghosh N, Samsuzzaman AKM, et al. Antibiotic susceptibility patterns of uropathogens isolated from pediatric patients in a selected hospital of Bangladesh. Int J Pharm Sci Rev Res. 2012;14(1):1-3.
15. Yadav NS, Pathak SS. Management of urinary tract infections in children: Antimicrobial sensitivity pattern, efficacy and pharmacoeconomics. Int J Basic Clin Pharmacol. 2019;8(6):1361-70.
16. Zamir G, Sakran W, Horowitz Y, Koren A, Miron D. Urinary tract infection: Is there a need for routine renal ultrasounography? Arch Dis Child. 2004;89:466-68.
17. Kavitha J, Aravind MA, Jayachandran G, Priya S. Risk factors for urinary tract infection in pediatric patients. Int J Contemp Pediatr. 2018;5(1):184-89.
18. Shrestha SP, Shrestha AK, Lamsal L, Joshi M. Bacteriological profile of urinary tract infection in children at GMC teaching hospital. J of Chitwan Med Coll. 2013;3(5):22-25.
19. Lehrasab W, Aziz T, Ahmed N, Ahmed I. Causative organisms of urinary tract infection and their sensitivity pattern in children. Ann Pak Inst Med Sci. 2016;12 (4):181-85.