

A Study on Profile of Bacteria Causing Urinary Tract Infection in Under Five Children and their Antibiotic Sensitivity Pattern in Bankura Sammilani Medical College & Hospital

Arup Pal¹, Tanushree Ghosh²

¹MD, (Microbiology), Senior Resident, Department of Microbiology, Bankura Sammilani Medical College Kenduadihi, Bankura, West Bengal, India, Pin-722102

²Assistant Professor Department of Microbiology, MBBS, MD (Microbiology), Bankura Sammilani Medical College Kenduadihi, Bankura, West Bengal, India, Pin-722102

Received: 01-11-2025 / Revised: 15-12-2025 / Accepted: 02 -02-2026

Corresponding Author: Dr. Arup Pal

Conflict of interest: Nil

Abstract

Introduction: Urinary tract infection (UTI) is one of the most common bacterial infections of childhood. Among febrile infants, sick children and older children with urinary symptoms, 6%–8% will have a UTI. Prevalence varies with age, peaking in young infants, toddlers and older adolescents.

Aims: To identify causative bacteria causing UTI in under five children and their antibiotic susceptibility pattern.

Materials and methods: This descriptive cross-sectional study was conducted from April 2021 to October 2022 in the Department of Microbiology, Bankura Sammilani Medical College, Bankura. A total of 271 under-five children with urinary symptoms were included, representing all urine samples received from this age group during the study period.

Result: 99 (36.90%) patients were affected in *Escherichia coli.*, 35 (12.91%) patients were affected in *Klebsella pneumoniae*, 4 (1.40%) patients were affected in *Citrobacter koseri*, 42 (15.49%) patients were affected in *Klebsella oxytoca*, 11 (4.05%) patients were affected in *Enterobacter* Species, 24 (8.85%) patients were affected in *Staphylococcus aureus*, 7 (2.58%) patients were affected in *Pseudomonas aeruginosa*, 39 (14.39%) patients were affected in *Enterococcus* Species, 3 (1.10%) patients were affected in Coagulase Negative *Staphylococcus*, 3 (1.10%) patients were affected in *Proteus Mirabilis*, 3 (1.10%) patients were affected with *Proteus vulgaris* and 1 (0.40%) patient was affected in *Citrobacter* species.

Conclusion: This study suggests that urinary tract infection is the one of the common disease causing morbidity and mortality in under five children. It can cause significant disease burden in the paediatric age group and around thirty to forty percent of neonates and children need admission in hospital.

Keywords: Antibiotic sensitivity and Urinary tract infection, under five age group.

DOI: 10.25258/ijpqa.17.2.14

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Urinary tract infection (UTI) is one of the most common bacterial infections of childhood. Among febrile infants, sick children and older children with urinary symptoms, 6%–8% will have a UTI. [1-2] Prevalence varies with age, peaking in young infants, toddlers and older adolescents. UTI is more common in female and uncircumcised male infants, due to bacterial skin flora concentration under the nappy in infancy, shorter female urethral distance and foreskin surface area in uncircumcised males. During toddler years, lack of toilet training can lead to prolong holding and bladder stasis, promoting UTI.[3] Prevalence peaks again in adolescent females when sexual activity leads to enter commensals bacteria near the urethral orifice enter into urethra. Urinary tract infections (UTI) are

common bacterial infections in children. The diagnosis of UTI is very often missed in young children due to minimal and nonspecific symptoms. The developing renal cortex in young children is vulnerable to renal scarring resulting in hypertension and chronic renal disease.[4]. These morbidities in adults often have their origin in childhood. A clinically suspected case of UTI should be defined and documented with urine culture report. After the diagnosis of UTI, its category should be defined. This helps in guiding a clinician about the appropriate radio/nuclear imaging evaluation, choice of antimicrobial agent, duration of treatment and need of medication. Even a single confirmed UTI should be taken seriously. Acute UTI can cause the full spectrum of severity from mild dysuria in a

child to life-threatening urosepsis. While serious infections are less common but they can and do occur, particularly in neonates. Approximately 5% of infants <12 months with UTI have bacteraemia identified [6], depending on study setting. Bacteraemia can then lead to urosepsis. Meningitis can also occur with haematogenous spread to the cerebrospinal fluid (CSF). The risk of coexisting meningitis and UTI is 1% in the neonatal period, suggesting a low threshold to perform lumbar puncture in this age group. Beyond 1 month, the risk is smaller. Typical empirical UTI antibiotics have poor CSF penetration and inadequate duration to treat bacterial meningitis [7]. This study evaluates the bacterial profile causing urinary tract infections in under-five children attending Bankura Sammilani Medical College & Hospital. It identifies the predominant uropathogens and analyzes their antibiotic sensitivity patterns using culture-positive urine samples. The findings aim to guide effective empirical antibiotic therapy and reduce antimicrobial resistance in pediatric UTI management.

Congenital Anomaly: Conditions that interfere with the uni-directional flow of urine increase susceptibility to UTI. This occurs with vesicoureteric reflux and obstruction. Vesicoureteric reflux, the most common urologic anomaly in children, allows bacteria to ascend from the bladder to the kidney, and also leads to post-void residual urine. Vesicoureteric reflux occurs in 25 to 30% of children who have had a UTI [14].

Materials and Methods

Study Type/ Design: Descriptive Study with Cross sectional design

Study Setting: Department Microbiology, Bankura Sammilani Medical College, Bankura

Place of Study

The study was carried out under Department of Microbiology, Bankura Sammilani Medical College

Period of study: from April 2021 to October 2022.

Study Population: Patients between at birth to 5 years age group attending the outdoor and indoor of the Department of Pediatrics Medicine of Bankura Sammilani Medical College & Hospital with frequent micturition, burning sensation during micturition, irritability, excessive somnolence / lethargy with or without fever, was taken as cases.

Study Design: Urine samples comes for culture sensitivity in microbiology department from different department of the hospital, among them under five age group children urine samples from pagediatrics ward included in this study for culture and sensitivity. Data collection was continued for 12

months, total sample size for study is 271. Sample was selected randomly by simple random sampling.

Inclusion Criteria

- Under five children with symptom of UTI more than 5-7 days.
- Any congenital urogenital anomaly.
- Those children whose parents will give written consent for study

Exclusion Criteria

- Children with cough and cold with wheeze sore throat or any other obvious cause which can explain the existing fever.
- Children with treatment for malignancy and on chemotherapy.
- Child with immune compromised disorder like HIV, Thalassemia,

Result

Among the population, the age and sex distribution were studied in under five urinary tract infection. Out of 271 cases 94 cases was less than 1 year (34.7%) and Followed by 1-5 year age in 147 cases 65.3%. Out of 271 cases female child was 119 (43.9%) and male child 152 (56.1%).

Among total 271 cases 94 (35%) was from indoor patient department of paediatric ward of BSMCH and 177 cases (65%) urine sample collected from outpatient department. Among total 271 cases of culture positive cases isolated 191 cases (70.5%) were diagnosed as gram negative bacilli (GNB) microscopically and 80 cases (29.5%) were Gram positive cocci (GPC). 99 (36.90%) patients were affected in *Escherichia coli.*, 35 (12.91%) patients were affected in *Klebsella pneumoniae*, 4 (1.40%) patients were affected in *Citrobacter koseri*, 42 (15.49%) patients were affected in *Klebsella oxytoca*, 11 (4.05%) patients were affected in *Enterobacter* Species, 24 (8.85%) patients were affected in *Staphylococcus aureus*, 7 (2.58%) patients were affected in *Pseudomonas aeruginosa*, 39 (14.39%) patients were affected in *Enterococcus* Species, 3 (1.10%) patients were affected in Coagulase Negative *Staphylococcus*, 3 (1.10%) patients were affected in *Proteus Mirabilis*, 3 (1.10%) patients were affected in *Proteus vulgaris* and 1 (0.40%) patient was affected in *Citrobacter* Species. Among 271 cases, 222 child was sensitive Nitrofurantoin (81.91%), followed by Piperacillin + Tazobactam (71.58%), Gentamycin (26.56%), Levofloxacin (40.22%), Amikacin (21.03%) and Cotrimoxazole (49.07%). Among 99 case of isolated organism of *Escherichia coli*, 84 case are sensitive to Amikacin (84.84%), and Nitrofurantoin (88.88%), followed by (77.77%), Levofloxacin (38.38%), Gentamycin (28.28%). (100%) Sensitive to Nitrofurantoin, Followed by Gentamycin

(35.89%), Piperacilin+Tazobactam (61.5%), Ceftriaxone (38.46%).

Statistical Analysis: *Klebsiella oxytoca* showed high sensitivity to Amikacin (92.85%) and Nitrofurantoin (90.47%), with the results being statistically significant ($z = 6.4641$, $p < 0.00001$). Enterobacter species also demonstrated significant sensitivity, particularly to Amikacin (100%) and Levofloxacin (81.81%) ($z = 4.82$, $p < 0.00001$). *Staphylococcus aureus* isolates showed good sensitivity to Amikacin

and Doxycycline (83.33% each), though the results were not statistically significant ($z = 1.0435$, $p = 0.29834$).

Enterococcus species exhibited high sensitivity to Amikacin (89.74%) and Nitrofurantoin (87.17%), while *Pseudomonas aeruginosa* showed 100% sensitivity to Amikacin and Piperacillin–Tazobactam, indicating these antibiotics as the most effective options for pediatric UTIs in this study.

Table 1: Distribution Children with congenital anomaly, Fever present, Fever with /Without chill and rigor and Any Difficulty in Micturation

Clinical Parameter	Category	Frequency	Percentage (%)
Congenital Anomaly	No	264	96.4
	Yes	7	3.6
Fever Present	No	23	8.5
	Yes	248	91.5
Fever with Chill and Rigor	Yes	54	21.77
	No	194	78.23
Difficulty in Micturition	Yes	108	39.15
	No	163	60.85

Table 2: Distribution of Different Type of Bacteria with Their Number

Name of Bacteria	Frequency	Percentage (%)
<i>Escherichia coli</i>	99	36.9
<i>Klebsiella pneumonia</i>	35	12.91
<i>Citrobacter koseri</i>	4	1.4
<i>Klebsiella oxytoca</i>	42	15.49
Enterobacter species	11	4.05
<i>Staphylococcus aureus</i>	24	8.85
<i>Pseudomonas aeruginosa</i>	7	2.58
Enterococcus species	39	14.39
Coagulase-negative <i>Staphylococcus</i>	3	1.1
<i>Proteus mirabilis</i>	3	1.1
<i>Proteus vulgaris</i>	1	0.4
<i>Citrobacter species</i>	1	0.4

Table 3: Sensitivity of Different Antibiotics *Echerichia Coli*

Name of Antibiotic	Frequency of Sensitivity	Percentage (%)
Amikacin	84	84.84
Nitrofurantoin	88	88.88
Piperacillin + Tazobactam	77	77.77
Cotrimoxazole	44	44.44
Levofloxacin	38	38.38
Gentamicin	28	28.28
Ceftriaxone	10	10.1
Ofloxacin	10	10.1
Amoxicillin + Clavulanic acid	6	6.06
Ciprofloxacin	5	5.05

Table 4: Distribution of Sensitivity of Different Antibiotic on *Klebsiella Pneumoniae*

Name of Antibiotic	Frequency of Sensitivity	Percentage (%)
Amikacin	13	33.33
Nitrofurantoin	39	100
Gentamicin	14	35.89
Piperacillin + Tazobactam	24	61.5
Cotrimoxazole	11	28.2
Levofloxacin	8	20.05
Ceftriaxone	15	38.46
Ofloxacin	8	20.51
Ceftazidime	1	2.56

Table 5: Distribution of Sensitivity of Different Antibiotic on *Klebsella Oxytoca*

Name of Antibiotic`	Number of Sensitive Disks	Percentage (%)
Amikacin	39	92.85
Nitrofurantoin	38	90.47
Gentamicin	14	33.33
Piperacillin + Tazobactam	30	71.42
Levofloxacin	19	45.23
Ceftriaxone	15	35.71
Ofloxacin	8	19.04
Cotrimoxazole	21	50

Table 6: Distribution of Sensitivity of Different Antibiotic on Enterobactor Species

Name of Antibiotic	Frequency of Sensitivity	Percentage (%)
Amikacin	11	100
Gentamicin	8	72.27
Nitrofurantoin	7	63.63
Levofloxacin	9	81.81
Ceftriaxone	6	54.54
Piperacillin + Tazobactam	8	72.72

Table 7: Distribution of Sensitivity Different Antibiotic On Staphylococcus Aureus

Name of Antibiotic	Frequency of Sensitivity	Percentage (%)
Amikacin	20	83.33
Nitrofurantoin	19	79.16
Gentamicin	2	8.33
Piperacillin + Tazobactam	16	66.66
Linezolid	14	58.33
Vancomycin	16	66.66
Clindamycin	10	41.66
Doxycycline	20	83.33
Amoxicillin + Clavulanic Acid	1	3.84
Imipenem + Cilastatin	4	16.66

Table 8: Distribution of Sensitivity of Different Antibiotic on Enterococcus Species

Name of Antibiotic	Frequency of Sensitivity	Percentage (%)
Amikacin	35	89.74
Nitrofurantoin	34	87.17
Gentamicin	2	5.12
Piperacillin + Tazobactam	17	43.58
Ceftriaxone	1	2.56
Linezolid	24	61.53
Vancomycin	29	74.35
Cotrimoxazole	17	43.58
Clindamycin	16	41.02
Doxycycline	26	66.66

Table 9: Distribution of Sensitivity of Antibiotic on Pseudomonas Aeruginosa

Name of Antibiotic	Frequency of Sensitivity	Percentage (%)
Amikacin	7	100
Gentamicin	2	28.57
Nitrofurantoin	4	57.14
Levofloxacin	5	71.42
Piperacillin + Tazobactam	7	100
Ceftriaxone	2	28.57

Discussion

Urinary tract infection continued to be the main cause of morbidity and mortality in the under five children who were admitted to hospital and also attending outpatient department. The purpose of this article is to familiarize physicians with an overview of the assessment and management of children with UTI. In this study a total 271 samples was taken as culture positive urinary tract infection from under five children from indoor patient of pediatrics department, and children attending out patients department.

Age and Sex

Among total 271 under five children 94 (34.7%) was less than 1 year, and 147(65.3%) was between one to five years. Out of 271 cases, 119 (43.9%) was female and 152 (56.1%) cases was male child. During the first year of life, the incidence of UTI is approximately 0.7% in girls and 2.7% in uncircumcised boys. In febrile infants in the first two months of life, the incidence of UTI is approximately 5% in girls and 20% in uncircumcised boys [11]. During the first 6 months, uncircumcised boys have a 10 to 12-fold increased risk of developing UTI. In the neonatal period, UTI is more common in premature infants than term infants [12] In this study among 271 children only 7(3.6%) children have diagnosed as congenital anomaly with vesicoureteric reflex, other 264 (96.3%) have no Congenital anomaly.

Sign and Symptoms of UTI: In the neonatal period, the symptoms and signs are nonspecific. A neonate might present with signs of sepsis, such as temperature instability, peripheral circulatory failure, lethargy, irritability, apnea, seizure, or metabolic acidosis. Alternatively, a neonate might present with anorexia, poor sucking, vomiting, suboptimal weight gain, or prolonged jaundice [15].

Foul-smelling urine is an uncommon, but more specific symptom of UTI. The symptoms of UTI usually remain nonspecific throughout infancy. Unexplained fever is the most common during the first two years of life [16-17]. In fact, it may be the only presenting symptom of UTI in this age group. In general, the prevalence of UTI is greater in infants with temperatures $\geq 39^{\circ}\text{C}$ than those with temperatures $< 39^{\circ}\text{C}$. Other nonspecific manifestations include irritability, poor feeding,

anorexia, vomiting, recurrent abdominal pain, and failure to thrive [18]. In this study among total 271 cases of children, most of the children total 248 have fever (91.5%) and 23 children (8.5%) have no fever. In this 248 children, 54(22%) children presented with chill and rigor and 194 (78%) patient presented without chill and rigor.

Aetiology

In this study, total 271 cases, bacteriological culture shows *Escherichia coli* (GNB) (36.90%) highest number of isolated organism. *Klebsiella oxytoca* (GNB) total number 42 cases (15.49%) is the second highest organism causing UTI. *Klebsiella pneumoniae* (GNB), total number 39 cases (12.91%) was isolated. other gram negative organism *Citobactor koseri* caused 4 cases, *Enterobacter* species total no 11,(4.05%), *Pseudomonas aeruginosa* ,total no 7,(2.58%), *Protes mirabilis* caused 3 cases, *Proteus vulgaris* caused 1 cases. In case of gram positive cocci *Staphylococcus aureus* total no 24(8.85%) *Enterococcus* species total number 39(14.39%), Coagulase negative *Staphylococci* total number 3 (1.1%) was isolated organism. As per microscopical observation total 80 cases are gram positive cocci (GPC) 29.5% and total 191 cases are gram negative bacilli(GNB) 70.5% among over all 271 cases.

Pattern of Antibiotic Sensitivity: Prompt antibiotic therapy is indicated for symptomatic UTI based on clinical findings and positive urinalysis while waiting for the culture results to eradicate the infection and improve clinical outcome. Asymptomatic bacteriuria, on the other hand, does not need to be treated. The empiric antibiotic chosen should provide adequate coverage for Gram-negative rods notably *Escherichia coli* and Gram-positive Cocci. The ideal antibiotic should be easy to administer, achieve a high concentration in the urine, have minimal or no effect on the fecal or vaginal flora, have a low incidence of bacterial resistance, have minimal or no toxicity, and have a low cost. The least broad-spectrum antibiotic should be used. Empiric antimicrobials that have been used in the treatment of acute uncomplicated UTI in children include cephalosporins such as cefixime, cefdinir, ceftibuten, cefpodoxime, cefuroxime, and cefprozil, fluoroquinolones such as ciprofloxacin, nitrofurantoin, trimethoprim-sulfamethoxazole (TMP-SMX), ampicillin,

amoxicillin and amoxicillin-clavulanate [19]. The choice of antibiotics should take into consideration local data of antibiotic resistance patterns. The antibiotic may have to be adjusted based on the response to treatment and sensitivity testing of the isolated uropathogen. In recent years, resistance to antimicrobials is increasing as extended spectrum beta-lactamase-producing organisms are emerging.

In one study, of the 584 UTI cases caused by *Escherichia coli* or *Klebsiella* spp., 91 (15.5%) cases were caused by spectrum beta-lactamase-producing organisms. A significant linear increase in resistance to all generations of cephalosporins ($r^2 = 0.442$) and fluoroquinolones ($r^2 = 0.698$) were found. Currently, a second- or third-generation cephalosporin and amoxicillin-clavulanate are drugs of choice. In this study total of 271 cases, Nitrofurantoin (n=222) has the highest 81.91 % sensitive overall, followed by Piperacillin+Tazobactam (n= 194) second highest 71.58%, Cotrimoxazole 133 (n=49.07%) is the third highest sensitivity. Other injectable antibiotic like Amikacin (n=57) 21.03%, Ceftriaxone (n=54) 19.92%, Gentamycin (n=72) 26.56%, Linezolid (n=66) 24.35%, Vancomycin (n=51) 18.81%, Cefuroxime (n=39) 14.39% sensitivity. Among other oral antibiotics Levofloxacin (n=109) 40.22%, Ofloxacin (n=31) 11.43% also high range of sensitivity. Most common isolate *Escherichia coli* showed moderate sensitivity with commonly used first line drugs like Amikacin (84.84%), Nitrofurantoin (88.88%), Piperacillin+Tazobactam (77.77%), Cotrimoxazole (44.44%), Levofloxacin (38.38%). Second most common *Klebsella oxytoca* isolate shows most commonly used drugs like Amikacin (92.85%), Nitrofurantoin (90.47%), Piperacillin+Tazobactam (71.42%), Levofloxacin (45.23%), Cotrimoxazole (50%). Other gram negative bacilli isolate *Klebsella pneumonia* shows highest sensitivity to first line antibiotic Nitrofurantoin (100%), followed by Amikacin (68.2%), Ceftriaxone (38.46%). Other gram negative bacilli Enterobacter species shows good sensitivity to Amikacin (100%), Gentamycin (72.27%), Levofloxacin (81.81%), Piperacillin+Tazobactam (72.72%). *Pseudomonas aeruginosa* shows 100% sensitive to Amikacin (100%), Levofloxacin (71.42%), Nitrofurantoin (57.14%), Piperacillin+Tazobactam (100%). Among gram positive isolates *Staphylococcus aureus* shows good sensitivity to Amikacin (83.33%), Nitrofurantoin (79.16%), Vancomycin (66.66%), Linezolid (58.33%), Doxycycline (83.83%), Piperacillin+Tazobactam (66.66%). Among other gram positive isolate Enterococcus species shows good sensitivity to Amikacin (89.74%), Linezolid (61.53%), Vancomycin (74.35%), Doxycycline (66.66%). We found that 6 (25%) isolates of *Staphylococcus aureus* were methicillin resistant. (MRSA). Resistant to

Cefoxitin disc. MRSA infection rate has been increasing few decades. In India, the MRSA rate is around 30-40%. Methicillin-resistant *Staphylococcus aureus* (MRSA) is a substantial public health problem worldwide, causing significant morbidity and mortality and elevated health care costs. Methicillin-resistant *S. aureus* is a common problem in health care facilities, sports facilities, clinics, and the community. The MRSA strains associated with hospitals are referred to as hospital-acquired MRSA (HA-MRSA) and are the most common cause of hospital-acquired infections.

Conclusion

This study suggests that urinary tract infection is the one of the common cause of morbidity and mortality in under five children. It can cause significant disease burden in the paediatric age group and around thirty to forty percent of neonates and children need admission in hospital. Empirical antibiotic therapy should be start before culture sensitivity reports available, but always antibiotic should be used according to antibiotic sensitivity and culture report.

Empirical use of antibiotics like third generation cephalosporin (Ceftazidime, Ceftriaxone, Cefotaxime) shows higher range of resistance pattern which denotes for ESBL (Extended spectrum of beta lactamase) producing bacteria. Increase degree of susceptibility to cotrimoxazole among the gram positive isolates including MRSA and some gram negative isolates suggest adequate antibiotic holidays can be allowed to those drugs which suffer extensive resistance like Ampicillin, Erythromycin and Cephalexin for a short course of time.

This study recommends for judicious use of antibiotic to prevent drug resistance. In this area in Bankura, this study suggest to use oral antibiotic Nitrofurantoin has the highest sensitivity has low cost also, followed by intravenous Amikacin, Gentamycin for indoor admitted child as a first line drug. Piperacillin+Tazobactam can be used as second line drug indoor admitted serious child with urinary tract infection. Intravenous Linezolid and vancomycin can be used for gram positive isolates incase of drug resistant serious patient. Oral antibiotic like Levofloxacin, Ofloxacin can be used as first line oral antibiotic.

References

1. Zorc JJ, Kiddoo DA, Shaw KN. Diagnosis and management of pediatric urinary tract infections. *Clin Microbiol Rev* 2005;18:417-22.
2. Vaillancourt S, McGillivray D, Zhang X, Kramer MS. To clean or not to clean: effect on contamination rates in midstream urine collections in toilet-trained children. *Pediatrics*. 2007 Jun;119(6):e1288-93.

3. Prajapati BS, Prajapati RB, Patel PS. Advances in management of urinary tract infections. *Indian J Pediatr* 2008;75:809-14.
4. Tebruegge M, Pantazidou A, Clifford V, et al. The age-related risk of co-existing meningitis in children with urinary tract infection. *PLoS One* 2011;6:e26576.
6. Yoon JE, Kim WK, Lee JS, Shin KS, Ha TS. Antibiotic susceptibility and imaging findings of the causative microorganisms responsible for acute urinary tract infection in children: a five-year single center study. *Korean journal of pediatrics*. 2011 Feb;54(2):79.
7. Edlin RS, Shapiro DJ, Hersh AL, et al. Antibiotic resistance patterns of outpatient pediatric urinary tract infections. *J Urol* 2013;190:222–7.
8. Greenhow TL, Hung Y-Y, Herz AM, et al. The changing epidemiology of serious bacterial infections in young infants. *Pediatr Infect Dis J* 2014;33:595–9.
9. Korbel L., Howell M., Spencer J.D. The clinical diagnosis and management of urinary tract infections in children and adolescents. *Paediatr. Int. Child Health*. 2017;37(4):273– 279.
10. Leung A.K. Urinary tract infection. Common problems in ambulatory pediatrics: Specific clinical problems. Vol. 1. New York: Nova Science Publishers, Inc; 2011. pp. 173–181.
11. Chang S.L., Shortliffe L.D. Pediatric urinary tract infections. *Pediatr. Clin. North Am*. 2006;53(3):379–400.
12. Schlager T.A. Urinary tract infections in infants and children. *Microbiol. Spectr*. 2016;4(5) doi: 10.1128/microbiolspec.UTI-0022-2016.
13. Tebruegge M, Pantazidou A, Clifford V, et al. The age-related risk of co-existing meningitis in children with urinary tract infection. *PLoS One* 2011;6:e26576.
14. Yoon JE, Kim WK, Lee JS, Shin KS, Ha TS. Antibiotic susceptibility and imaging findings of the causative microorganisms responsible for acute urinary tract infection.
15. Bell L.E., Mattoo T.K. Update on childhood urinary tract infection and vesicoureteral reflux. *Semin. Nephrol*. 2009;29(4):349–359.
16. Garout W.A., Kurdi H.S., Shilli A.H., Kari J.A. Urinary tract infection in children younger than 5 years. Etiology and associated urological anomalies. *Saudi Med. J*. 2015;36(4):497–501.
17. Glissmeyer E.W., Korgenski E.K., Wilkes J., Schunk J.E., Sheng X., Blaschke A.J., et al. Dipstick screening for urinary tract infection in febrile infants. *Pediatrics*. 2014;133(5):e1121–e1127.
18. Zhang H., Yang J., Lin L., Huo B., Dai H., He Y. Diagnostic value of serum procalcitonin for acute pyelonephritis in infants and children with urinary tract infections: An updated meta-analysis. *World J. Urol*. 2016;34(3):431–441.
19. Baumer J.H., Jones R.W. Urinary tract infection in children, National Institute for Health and Clinical Excellence. *Arch. Dis. Child. Educ. Pract. Ed*. 2007;92(6):189–192.