Original Article

Microbial Causes of Urinary Tract Infection and its Sensitivity to Antibiotics at Heevi Pediatric Teaching Hospital/Duhok City

Salah Abdulkareem Ibrahim, Delshad Abdallah Mohamed[1], Sherzad Khudeida Suleman[1]

Department of Pediatric, College of Medicine, University of Duhok, [1]Nursing Department, College of Nursing, University of Duhok, Dahuk, Kurdistan, Iraq

Abstract

Background: Urinary tract infection (UTI) refers to the presence of microbial pathogens within the urinary tract, and it is usually classified by the site of infection as the bladder (cystitis), kidney (pyelonephritis), or urine (bacteriuria). **Objectives:** The objectives of this study were to determine the etiological bacterial pathogens of UTIs and to identify antibiotic sensitivity patterns of pathogens isolated among age groups of children. **Materials and Methods:** In this cross-sectional study, a random sample of the local registry of Heevi pediatric hospital of the patients who were diagnosed with UTI and were sent for antibiotic sensitivity between August 2018 and July 2019 was taken for analysis. Seven hundred and twenty-two patients were included in the present study whose ages ranged from birth to more than 10 years. **Results:** The study showed that 22.8% and 20.6% of the patients were in >3–5 and 7–10 years of age and majority were females (66.5%). The study revealed that 56.2% of the patients had different pathogens, and *Escherichia coli* was the most common pathogen in the diagnosed patients with UTI. The pathogens had different frequency in the urine samples. Most of the cultures were sensitive to gentamycin (23.4%), amikacin (27.6%), and norfloxacin (25.4%). The most resistant cultures were toward trimethoprim (31.2%), cephalothin (32.6%), and cefixime (21.6%). The study showed that *E. coli* was prevalent pathogen in all age groups. The study did show that common antibiotics were not statistically significantly different between male and female patients, including gentamycin ($P = 0.145$), amoxicillin ($P = 0.304$), and norfloxacin ($P = 0.407$). The common antibiotics were more prevalent in >3–5 years group, including gentamycin; amoxicillin; and norfloxacin. **Conclusion:** This study finding showed that *E. coli* isolates were the predominant pathogens and showed increasing sensitivity pattern to antimicrobial gentamycin, amikacin, and norfloxacin.

Keywords: Antibiotic susceptibility, bacteria, children, urinary tract infections

Introduction

Urinary tract infection (UTI) consists of microbial invasion and multiplication in any of the structures of the urinary system. The severity of infection ranges from asymptomatic colonization, or that is, without tissue degeneration through to the symptomatic invasion of the tissues of any of the structures of the urinary system.[1] UTIs refer to the presence of microbial pathogens within the urinary tract, and it is usually classified by the site of infection as the bladder (cystitis), kidney (pyelonephritis), or urine (bacteriuria).[2]

Many different microorganisms can cause UTIs though the most common pathogens causing the simple ones in the community are *Escherichia coli* and other *Enterobacteriaceae*, which accounts for approximately 75% of the isolates.[3] It has been demonstrated that the increasing resistance pattern to the commonly used antimicrobial agents, as a result of their use in UTI treatment without performing a susceptibility test, might be one of the main causes behind the occurrence of complicated UTI.[4] Karlowsky *et al*. stated that accurate and rapid bacterial identification and antimicrobial susceptibility investigations for patients with suspected UTI was the primary step for both correct treatment and antimicrobial resistance prevention.[5]

UTIs are one of the most prevalent extraintestinal bacterial infections. Nowadays, it represents one of the most common diseases encountered in medical practice affecting people of all

Access this article online

Quick Response Code:

Website: www.medjbabylon.org

DOI: 10.4103/MJBL.MJBL_64_19

Address for correspondence: Mr. Delshad Abdallah Mohamed, Nursing Department, College of Nursing, University of Duhok, Dahuk, Kurdistan, Iraq.
E-mail: dilshad_msc14@yahoo.com

Submission: 26-08-2019 **Accepted:** 02-12-2019 **Published Online:** 17-03-2020

How to cite this article: Ibrahim SA, Mohamed DA, Suleman SK. Microbial causes of urinary tract infection and its sensitivity to antibiotics at Heevi pediatric teaching hospital/Duhok City. Med J Babylon 2020;17:109-14.

ages from the neonate to the geriatric age group.[6] Worldwide, about 150 million people are diagnosed with UTI each year, and most infections are caused by the retrograde ascent of bacteria from the fecal flora via the urethra to the bladder and kidney, especially in the females who have a shorter and wider urethra and are more readily transferred by microorganisms.[7]

Data of Iraq and Kurdistan

There are few studies conducted in Iraq and Kurdistan region which show different results according to their communities. One study was conducted in Duhok city to determine the prevalence of pathogens that causes UTI, also to determine the antibiotics sensitivity to pathogens. Therefore, it shows that the high infection was due to *E. coli*; 74.32% (55/74) showed sensitivity to vancomycin, linezolid, tigecycline, and nitrofurans.[8] A study conducted in Iraq-Tikrit showed that the majority of the Gram-negative bacteria was *E. coli* with the prevalence of 31%.[9] A study conducted in Basrah, Iraq showed that *E. coli* was the important causative factor of UTIs with high rate in females. Imipenem and amikacin are the first-line medicine according to the causative agent for UTIs.[10] Furthermore, a study conducted in Irbil, Iraq, shows the two most common causes of UTI in children were *Klebsiella pneumoniae* (28%) and *E. coli* (16.8%).[11] *E. coli* was the most common organism causing UTI in children. The most of urinary isolates had high level of resistance to commonly used antibiotics.[11]

The objectives of this study were to determine the etiological bacterial pathogens of UTIs and to identify antibiotic sensitivity patterns of pathogens isolated among age groups of children in both genders.

Materials and Methods

In this cross-sectional study, a convenience sample of the patients who were clinically suspected to UTIs and were sent to a medical laboratory for antibiotic sensitivity was taken. The local registry for Heevi Pediatric Hospital in Duhok city was checked for the eligibility criteria. The data of the patients who met eligibility were included in the analysis. The medical laboratory of the hospital has its registry for different kinds of medical investigations. The administrative and ethical approval of the study was taken from the local contributed departments. The information of the patients between August 2018 and July 2019 who met the eligibility criteria was included in the analysis. In this study, 772 cases met all inclusions and exclusion criteria and were included in the final analysis.

Inclusion and exclusion criteria

Inclusion criteria were including of those patients who were already on antibiotic treatment, and from both genders and their ages between 1 month and more than 10 years, and those who were diagnosed medically with UTI and the doctors were sent them to do urine culture in the laboratory. The patients with other medical conditions and had more than 20% missing data were not included in the study.

Samples' collection

To collect a urine sample of each patient, the patients were advised to collect a clean-catch midstream urine specimen in a sterile, wide-mouthed leak-proof container supplied by the laboratory. The samples were collected by the laboratory as early as possible. Isolation and identification of bacterial pathogens were performed based on culture methods.[9,12]

Measurement

The information which was collected from the registry was age categorized as 1–6 months; 7–12 months; >1–3 years; >3–5 years; >5–7 years; 7–10 years; and more than 10 years and gender (male/female). The cultures were tested for the following pathogens: *E. coli; Klebsiella*; *Staphylococcus; Pseudomonas*; Enterococci; nonlactose fermenter; *Proteus*; Lactose fermenter; and *Streptococcus*. The cases in which the technicians did not find any growth of bacteria were recorded as no growth.

Frequency of presence of pus, bacteria, epithelial cells, crystal, mucus, and red blood cells under microscope was recorded as none; a few; 1–2; 3–4; 4–6; +; ++; +++; and >+++. The sensitivity to the antibiotics was determined as no sensitive; moderate sensitivity; resistant; and sensitive. For determination of antibiotic susceptibility, modified Kirby–Bauer disc diffusion test was used against the following antibiotics which were placed on the culture (MHA plates): gentamycin; trimethoprim; amoxicillin; amikacin; nitrofurantoin; nalidixic acid; cephalothin; norfloxacin; ceftriaxone; ampicillin; imipenem; cefotaxime; cefixime; amoxiclav; vancomycin; ciprofloxacin; Azethromicin; and carbenicillin.[8,11]

Statistical methods

The descriptive purposes of the study were presented in frequency and percentage, such as the number of cases in each age group and gender. The prevalence of types and Frequency of pathogens which were found in culture sensitivity was determined in frequency and percentage. The prevalence of antibiotics in urine samples of UTI patients was determined in frequency and percentage as well. The prevalence of pathogens in patients with different age categories and gender was examined in Fishers' exact and Pearson Chi-squared test, respectively. The prevalence of the most sensitive pathogens between male and female patients and different age groups was examined in the Pearson Chi-squared test. The statistical calculations were performed by Statistical Package for Social Sciences version 24 (SPSS 24; IBM Corp; Washington; USA).

Ethical consideration

The approval was obtained from the general directorate of health and Laboratory of Heevi Teaching Hospital, and Scientific Committee from the College of Nursing/University of Duhok. The information of the patents was deidentified before the data analysis.

Results

The study revealed that most of the cases were >3–5 years (22.8%) followed by 7–10 years (20.6%) and were females (66.5%), as shown in Table 1.

The study showed that 56.2% of the cases had bacterial pathogens, in which *E. coli* was the most common type of bacteria (24.7%) found in urine culture of the patients who were diagnosed with UTI. *Streptococcus* was the least common type of bacteria (0.4%) that was found in urine cultures of the patients with UTI. The growth was not presented in 43.8% of the samples [Table 2].

The urine cultures were screened under a microscope for the frequency of pathogens. The study showed that the pus (77.3%) and bacteria (63.9%) were the most prevalent with different severities. Crystals (16.5%) were the least common types in the urine samples [Table 3].

Table 1: General characteristics of urinary tract infection patients

Characteristics (*n*=772)	*n* (%)
Age	
1-6 months	50 (6.5)
7-1 2 months	75 (9.7)
>1-3 years	136 (17.6)
>3-5 years	176 (22.8)
>5-7 years	153 (19.8)
7-10 years	159 (20.6)
>10 years	23 (3.0)
Gender	
Male	259 (33.5)
Female	513 (66.5)

Table 2: The types of bacterial pathogens in the urine sample of urinary tract infection patients

Pathogens (*n*=772)	*n* (%)
Escherichia coli	191 (24.7)
Klebsiella spp.	65 (8.4)
Staphylococcus spp.	68 (8.8)
Pseudomonas spp.	18 (2.3)
Enterococci spp.	21 (2.7)
Nonlactose fermenter	38 (4.9)
Proteus spp.	19 (2.5)
Lactose fermenter	11 (1.4)
Streptococcus spp.	3 (0.4)
No growth	338 (43.8)

The sensitivity tests of the urine cultures showed that most of the cultures were sensitive to gentamycin (23.4%), amikacin (27.6%), and norfloxacin (25.4%). The most resistant cultures were toward trimethoprim (31.2%), cephalothin (32.6%), and cefixime (21.6%) [Table 4].

The study showed that *E. coli* was the most prevalent pathogen in all age groups, including 1–6 months (22%), 7–12 months (26.7%), >1–3 years (26.5%), >3–5 years (26.1%), >5–7 years (23.5%), 7–10 years (23.9%), and >10 years (17.4%). In addition, *E. coli* was prevalent in both male (25.5%) and female (24.4%) patients [Table 5].

The study showed that common antibiotics were not statistically significantly different between male and female patients, including gentamycin (P = 0.145), amoxicillin (P = 0.304), and norfloxacin (P = 0.407) [Table 6].

The common antibiotics were more prevalent in >3–5 years' group, including gentamycin; amoxicillin; and norfloxacin [Table 7].

Discussion

This study showed that *E. coli* is the most common bacteria in pediatric patients diagnosed with UTI. The bacteria showed more sensitivity to gentamycin, amoxicillin, and norfloxacin with different sensitivity pattern. Recurrent and unorganized using of antibiotics may lead to make the pathogens resistant to antibiotics.

The urine cultures showed that *E. coli* pathogen was the most common pathogen (24.7%), followed by Staphylococcus (8.8%), and Klebsiella (8.4%). Pathogenic *E. coli* is the leading cause for near to 90% of all society-acquired UTIs whereas *Klebsiella*, *Pseudomonas*, *Proteus*, and other pathogens are more found in hospital-acquired complicated UTI.[1] *E. coli* as the most common cause of UTI may be due to certain virulence factors such as hemolysin production and presence of fimbriae.[13] Different pathogens are responsible for UTIs. *E.Coli* and other Enterobacteriaceae are responsible for approximately 75% of the samples.[3] Worldwide, a different groups of entering pathogenic bacteria are considered to be the leading cause of UTI.[3,13] *E. coli* is the most causative factor in community practice. Other

Table 3: Frequency of pathogens in the urine sample of urinary tract infection patients

Pathogen frequency	Pus	Bacteria	Epithelial cell	Crystal	Mucus	RBCs
None	175 (22.7)	279 (36.1)	565 (73.2)	645 (83.5)	601 (77.8)	436 (56.5)
Few	21 (2.7)	142 (18.4)	34 (4.4)	17 (2.2)	5 (0.6)	13 (1.7)
1-2	70 (9.1)	44 (5.7)	26 (3.4)	32 (4.1)	27 (3.5)	163 (21.1)
3-4	100 (13.0)	28 (3.6)	25 (3.2)	25 (3.2)	28 (3.6)	62 (8.0)
4-6	160 (20.7)	36 (4.7)	34 (4.4)	19 (2.5)	31 (4.0)	56 (7.3)
+	118 (15.3)	130 (16.8)	59 (7.6)	18 (2.3)	52 (6.7)	26 (3.4)
++	68 (8.8)	66 (8.5)	24 (3.1)	12 (1.6)	23 (3.0)	7 (0.9)
+++	43 (5.6)	32 (4.1)	5 (0.6)	4 (0.5)	4 (0.5)	4 (0.5)
>+++	17 (2.2)	15 (1.9)			1 (0.1)	5 (0.6)

The data are in *n* (%). RBCs: Red blood cells, +, ++, +++: Each plus means 10 pathogens

bacterial agents include species of *Klebsiella, Enterobacter, Proteus, Pseudomonas, Staphylococcus, Streptococcus,* and *Enterococcus faecalis*.[12]

As is evident from the result, this study demonstrated amikacin to be the predominant antibiotic and the most sensitive medicine in the ratio of 27.6% to *E. coli*, *Klebsiella, Enterobacter, Proteus, Pseudomonas, Staphylococcus, Streptococcus,* and *E. faecalis*. Norfloxacin has a sensitivity ratio was 25.4%, while gentamycin sensitivity ratio was 23.4%. While the most common antibiotic and the highest resistant to all kinds of pathogens were cephalothin –32.6% and nalidixic acid –22.9%, and cefixime –21.6%; these three

Table 4: Microbial sensitivity to the antibiotics in urine samples of *urinary* tract infection patients

Antibiotics (*n*=772)	No sensitive	Moderate sensitivity	Resistant	Sensitive
Gentamycin	365 (47.3)	69 (8.9)	157 (20.3)	181 (23.4)
Trimethoprim	375 (48.6)	50 (6.5)	241 (31.2)	106 (13.7)
Amoxicillin	606 (78.5)	60 (7.8)	66 (8.5)	40 (5.2)
Amikacin	371 (48.1)	88 (11.4)	100 (13.0)	213 (27.6)
Nitrofurantoin	388 (50.3)	80 (10.4)	209 (27.1)	95 (12.3)
Nalidixic acid	456 (59.1)	66 (8.5)	177 (22.9)	73 (9.5)
Cephalothin	395 (51.2)	71 (9.2)	252 (32.6)	54 (7.0)
Norfloxacin	398 (51.6)	51 (6.6)	127 (16.5)	196 (25.4)
Ceftriaxone	617 (79.9)	51 (6.6)	65 (8.4)	39 (5.1)
Ampicillin	646 (83.7)	39 (5.1)	57 (7.4)	30 (3.9)
Imipenem	611 (79.1)	25 (3.2)	19 (2.5)	117 (15.2)
Cefotaxime	560 (72.5)	20 (2.6)	130 (16.8)	62 (8.0)
Cefixime	543 (70.3)	22 (2.8)	167 (21.6)	40 (5.2)
Amoxiclav	545 (70.6)	27 (3.5)	164 (21.2)	36 (4.7)
Vancomycin	693 (89.8)	13 (1.7)	25 (3.2)	41 (5.3)
Ciprofloxacin	729 (94.4)	15 (1.9)	15 (1.9)	13 (1.7)
Azethromicin	738 (95.6)	12 (1.6)	12 (1.6)	10 (1.3)
Carbenicillin	673 (87.2)	12 (1.6)	9 (1.2)	78 (10.1)

Table 5: Prevalence of pathogens in patients with different age categories and gender

Pathogens (*n*=772)	Age categories						
	1-6 months	7-1 2 months	>1-3 years	>3-5 years	>5-7 years	7-10 years	>10 years
Escherichia coli	11 (22.0)	20 (26.7)	36 (26.5)	46 (26.1)	36 (23.5)	38 (23.9)	4 (17.4)
Klebsiella	3 (6.0)	12 (16.0)	12 (8.8)	21 (11.9)	10 (6.5)	7 (4.4)	0 (0.0)
Staphylococcus	3 (6.0)	6 (8.0)	17 (12.5)	21 (11.9)	12 (7.8)	7 (4.4)	2 (8.7)
Pseudomonas	3 (6.0)	4 (5.3)	5 (3.7)	5 (2.8)	1 (0.7)	0 (0.0)	0 (0.0)
Enterococci	2 (4.0)	1 (1.3)	4 (2.9)	6 (3.4)	2 (1.3)	5 (3.1)	1 (4.3)
Nonlactose fermenter	3 (6.0)	3 (4.0)	3 (2.2)	9 (5.1)	11 (7.2)	7 (4.4)	2 (8.7)
Proteus	2 (4.0)	2 (2.7)	6 (4.4)	4 (2.3)	3 (2.0)	2 (1.3)	0 (0.0)
Lactose fermenter	1 (2.0)	3 (4.0)	0 (0.0)	4 (2.3)	1 (0.7)	2 (1.3)	0 (0.0)
No growth	21 (42.0)	24 (32.0)	53 (39.0)	60 (34.1)	76 (49.7)	90 (56.6)	14 (60.9)
Streptococcus	1 (2.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.7)	1 (0.6)	0 (0.0)

Pathogens (*n*=772)	Gender	
	Male	Female
Escherichia coli	66 (**25.5**)	125 (**24.4**)
Klebsiella	28 (10.8)	37 (7.2)
Staphylococcus	22 (8.5)	46 (9.0)
Pseudomonas	7 (2.7)	11 (2.1)
Enterococci	10 (3.9)	11 (2.1)
Nonlactose fermenter	14 (5.4)	24 (4.7)
Proteus	6 (2.3)	13 (2.5)
Lactose fermenter	2 (0.8)	9 (1.8)
No growth	102 (39.4)	236 (46.0)
Streptococcus	2 (0.8)	1 (0.2)

Fishers' exact (P<0.001) and Pearson Chi-squared test (P=0.396) were performed for statistical analysis. The bold numbers show the most prevalent pathogens

antibiotics have high resistance to pathogens. This pattern of resistance has also been reported within the country from different states.[14]

To prevent or decrease resistance to antibiotics, the use of antibiotics should be kept under supervision and advice of doctors and should be given in appropriate doses for an appropriate period of time. Because resistance of drugs among pathogens is an enhancing process, so orderly observation and controlling are indispensable to supply physician's awareness on the updated and more active experimental therapy of UTIs.[8] While the antibiotics with moderate sensitivity to pathogens were amikacin, norfloxacin, cephalothin, 11.4%, 10.4%, 9.2% respectively.

Table 6: Prevalence of the most sensitive pathogens between male and female patients

Sensitivity of pathogens (n=772)	Gender		P (two-sided)
	Male	Female	
Gentamycin			
No sensitive	110 (42.5)	255 (49.7)	0.145
Moderate sensitivity	30 (11.6)	39 (7.6)	
Resistant	56 (21.6)	101 (19.7)	
Sensitive	63 (24.3)	118 (23.0)	
Amoxicillin			
No sensitive	196 (75.7)	410 (79.9)	0.304
Moderate sensitivity	20 (7.7)	40 (7.8)	
Resistant	29 (11.2)	37 (7.2)	
Sensitive	14 (5.4)	26 (5.1)	
Norfloxacin			
No sensitive	126 (48.6)	272 (53.0)	0.407
Moderate sensitivity	18 (6.9)	33 (6.4)	
Resistant	40 (15.4)	87 (17.0)	
Sensitive	75 (29.0)	121 (23.6)	

Pearson Chi-squared test was performed for statistical analyses

It must be borne in mind that the variations in antimicrobial susceptibility in different countries and within states in our country may depend on the easy availability of antimicrobial drugs over the counter. Amikacin, gentamycin, norfloxacin, cephalothin, and cefixime are very commonly used over-the-counter drugs for UTI in our country. In this study, we have shown a growing resistance pattern to these antimicrobial agents.

In addition, our results are obviated that the victorious pathogens are becoming dramatically resistant to most antibiotics in course of time. This resistance might be due to indiscriminate use of antibiotics and incomplete course of antibiotic use by the patients that lead to an ultimate fate of endangering the people in treatment perspective.

There is proof that the most sensitive antibiotics have the same sensitivity to both genders with no significant relationship, between antimicrobials and the gender. From the comparative data, it is also clear that the bacteria representing as the predominant causes of UTI are becoming resistant to the most commonly used antibiotics for UTI treatment. In addition, wrong diagnosis of diseases may lead to proscribing wrong antibiotics to patients leading to resistance to pathogens. Gentamycin was very sensitive to pathogens in the age group >1–3 years (P = 0.006), whereas amoxicillin and norfloxacin have a significant sensitivity to pathogens in the age group >3–5 years.

Escherichia coli, *Klebsiella*, and *Staphylococcus* were antibiotics that had resistance to the pathogens in the age group >3–5 years in the same pattern. Higher rate using of antibiotic by families in the absence of prescriptions is a critical risk, since UTIs are the most common diseases in the early age.[11-14] The authors confirm that bacterial resistance would be the greatest and frightening problem in our community; a new generation of antibiotics is still locally working at a higher rate.

Table 7: Prevalence of the most sensitive pathogens between patients with different age groups

Pathogens	Age							P
	1-6 months	7-1 2 months	>1-3 years	>3-5 years	>5-7 years	7-10 years	>10	
Gentamycin								
No sensitive	25 (50.0)	29 (38.7)	58 (42.6)	67 (38.1)	78 (51.0)	94 (59.1)	14 (60.9)	0.006
Moderate sensitivity	3 (6.0)	11 (14.7)	5 (3.7)	19 (10.8)	19 (12.4)	12 (7.5)	0 (0.0)	
Resistant	12 (24.0)	18 (24.0)	34 (25.0)	40 (22.7)	25 (16.3)	23 (14.5)	5 (21.7)	
Sensitive	10 (20.0)	17 (22.7)	39 (28.7)	50 (28.4)	31 (20.3)	30 (18.9)	4 (17.4)	
Amoxicillin								
No sensitive	40 (80.0)	48 (64.0)	100 (73.5)	127 (72.2)	125 (81.7)	144 (90.6)	22 (95.7)	0.001
Moderate sensitivity	1 (2.0)	10 (13.3)	15 (11.0)	16 (9.1)	14 (9.2)	4 (2.5)	0 (0.0)	
Resistant	6 (12.0)	10 (13.3)	11 (8.1)	21 (11.9)	11 (7.2)	7 (4.4)	0 (0.0)	
Sensitive	3 (6.0)	7 (9.3)	10 (7.4)	12 (6.8)	3 (2.0)	4 (2.5)	1 (4.3)	
Norfloxacin								
No sensitive	27 (54.0)	27 (36.0)	64 (47.1)	79 (44.9)	84 (54.9)	103 (64.8)	14 (60.9)	0.003
Moderate sensitivity	2 (4.0)	10 (13.3)	8 (5.9)	17 (9.7)	12 (7.8)	2 (1.3)	0 (0.0)	
Resistant	5 (10.0)	17 (22.7)	28 (20.6)	30 (17.0)	23 (15.0)	19 (11.9)	5 (21.7)	
Sensitive	16 (32.0)	21 (28.0)	36 (26.5)	50 (28.4)	34 (22.2)	35 (22.0)	4 (17.4)	

Pearson Chi-squared test was performed for statistical analyses

Conclusion

This study showed that *E. coli* isolates were the predominant pathogens and showed increasing sensitivity pattern to antimicrobial gentamycin, amikacin, and norfloxacin.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Foxman B. Epidemiology of urinary tract infections: Incidence, morbidity, and economic costs. Am J Med 2002;113 Suppl 1A: 5S-13S.
2. Foxman B. The epidemiology of urinary tract infection. Nat Rev Urol 2010;7:653-60.
3. Beyene G, Tsegaye W. Bacterial uropathogens in urinary tract infection and antibiotic susceptibility pattern in Jimma university specialized hospital, Southwest Ethiopia. Ethiop J Health Sci 2011;21:141-6.
4. Abat C, Desboves G, Olaitan AO, Chaudet H, Roattino N, Fournier PE, *et al*. Increasing burden of urinary tract infections due to intrinsic colistin-resistant bacteria in hospitals in Marseille, France. Int J Antimicrob Agents 2015;45:144-50.
5. Karlowsky JA, Jones ME, Thornsberry C, Critchley I, Kelly LJ, Sahm DF. Prevalence of antimicrobial resistance among urinary tract pathogens isolated from female outpatients across the US in 1999. Int J Antimicrob Agents 2001;18:121-7.
6. Al-Jebouri MM, Atalah N. A study on the interrelationship between renal calculi hormonal abnormalities and urinary tract infections in Iraqi patients. Open J Urol 2012;2:6.
7. Inabo H, Obanibi H. Antimicrobial susceptibility of some urinary tract clinical isolates to commonly used antibiotics. Afr J Biotechnol 2006;5:487-9.
8. Assafi MS, Ibrahim NM, Hussein NR, Taha AA, Balatay AA. Urinary bacterial profile and antibiotic susceptibility pattern among patients with urinary tract infection in Duhok city Kurdistan region Iraq. Intl J Pure Appl Sci Technol 2015;30:54.
9. Al-Jebouri MM, Mdish SA. Antibiotic resistance pattern of bacteria isolated from patients of urinary tract infections in Iraq. Open J Urol 2013;3:124.
10. Hadi AM, Sheri FH, Jaccob AA. Urinary tract infection prevalence and antibiotic resistance a retrospective study in Basrah governorate Iraq. AlMustansiriyah J Pharml Sci 2014;14:129-35.
11. Mansoor IY, AL-Otraqchi KI, Saeed CH. Prevalence of urinary tract infections and antibiotics susceptibility pattern among infants and young children in Erbil city. Zanco J Med Sci 2015;19:915-22.
12. Gorbach SL, Bartlett JG, Blacklow NR. Infectious Diseases. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2004.
13. Manikandan S, Ganesapandian S, Singh M, Kumaraguru A. Antimicrobial susceptibility pattern of urinary tract infection causing human pathogenic bacteria. Asian J Med Sci 2011;3:56-60.
14. Tankhiwale SS, Jalgaonkar SV, Ahamad S, Hassani U. Evaluation of extended spectrum beta lactamase in urinary isolates. Indian J Med Res 2004;120:553-6.