International Journal of Nutrition Sciences

Journal Home Page: ijns.sums.ac.ir

ORIGINAL ARTICLE

Distribution and Antimicrobial Resistance Patterns of Urinary Tract Infection in Southern Iran

Zahra Pourmontaseri[1]*, Maryam Pourmontaseri[2], Mana Baziboroun[3], Mahboobeh Jorjani[4], Somayeh Bakhshizadeh[4]

1. Infectious Diseases and Tropical Medicine Research Center, Fasa University of Medical Science, Fasa, Iran
2. Department of Food Hygiene and Public Health, School of Veterinary Medicine, Shiraz University, Shiraz, Iran
3. Infectious Diseases and Tropical Medicine Research Center, Health Research Institute, Babol University of Medical Science, Babol, Iran
4. Hospital Infection Control Center, Fasa University of Medical Science, Fasa, Iran

ARTICLE INFO

Keywords:
Urinary tract infection
Antibiotic resistance
Uropathogens
Iran

**Corresponding author:*
Zahra Pourmontaseri,
Infectious Diseases and Tropical Medicine Research Center, Fasa University of Medical Science, Fasa, Iran
Tel: +98-71-53350994
Fax: +98-71-53357091
Email: montaserizahra@fums.ac.ir
Received: December 8, 2017
Revised: April 28, 2018
Accepted: May 5, 2018

ABSTRACT

Background: Urinary tract infection (UTI) known as one of the most common diseases in the world. In order to apply the most appropriate antibiotics in the UTI therapy, studies on the vicinity of the epidemiology of common bacterial agents and determining their antibiotic resistance patterns are essential for physicians in different areas. In this study, the distribution and antimicrobial resistance patterns of urinary tract infection in southern Iran was verified.

Methods: 511 suspected patients to UTIs referred to Fasa hospitals, south of Iran, were studied. The frequency of isolated bacteria and their resistance to common antibiotics in the UTIs therapy were investigated.

Results: Out of 497 patients with bacterial UTIs, 8 types of bacterial species were isolated. The main isolated bacteria from both males and females was *Escherichia coli* (88.6%). Also, high rate of antibiotic resistance was shown in males rather than females. The highest antibiotic resistance of *E. coli* was found to nalidixic acid in men (86.8%) and the lowest antibiotic resistance was referred to ciprofloxacin in women (38.1%). Most susceptible cases to *E. coli* was detected for ciprofloxacin antibiotic (52.2% in women and 45.7% in men). Surprisingly, high antibiotic resistance was also observed in children aged 1 year or less.

Conclusion: The high resistance of the first-generation fluoroquinolones (nalidixic acid) in UTIs treatment, seem to be not logical, whilst, the second-generation fluoroquinolone (ciprofloxacin) is nearly still recommended in Fasa region.

Please cite this article as: Pourmontaseri Z, Pourmontaseri M, Baziboroun M, Jorjani M, Bakhshizadeh S. Distribution and Antimicrobial Resistance Patterns of Urinary Tract Infection in Southern Iran. Int J Nutr Sci 2018;3(2):113-119.

Introduction

Urinary tract infections (UTIs) are identified as one of the most common infectious diseases globally, and the second infectious disease after respiratory infections (1). It affects all age groups of women and men and may lead them to death (2). Various infectious agents cause UTIs, through which uropathogenic bacteria are identified as the main responsible for UTIs. Although *Escherichia coli* is principally recognized as the causative agent (more

than 80%) of UTIs (3, 4); a wide range of pathogens, including *Enterobacteriaceae* and *Pseudomonas* species, would complicate the disease and may lead the patients to subsequent hospitalization (5).

Empirical treatments prior to laboratory reports has mostly increased antibiotic resistance (6). Various patterns of antibiotic resistance are reported in different areas depended on the type of prescribed antibiotics. Therefore, an epidemiological study of the bacterial pathogens causing UTIs and also the pattern of their antibiotic resistance, are crucial in selecting an appropriate antibiotic, reducing the excessive costs and finding out response to treatment. Hence, the aim of this study was to investigate the prevalence of bacterial pathogens causing UTIs in patients who referred to the hospitals in Fasa, southern Iran, as well as their antibiotic resistance.

Materials and Methods

In this study, 511 patients (140 males and 371 women), suspected to UTI and referred to Vali-e-Asr and Shariati hospitals in Fasa, Fars province, southern Iran from October 1395 to June 1396, were enrolled. The patients' age ranged from 1 to 94 years old (average age of 38/13 years old). Midstream urines were prepared in sterile conditions and the collection bags were also used for the children under 2 years of age. All specimens were cultured on blood agar and MacConkey agar and incubated for 24 hours at 37°C. Identification of isolated bacteria were based on the approved culture standard, Gram staining and biochemical tests (7).

Antimicrobial susceptibility assay was also performed according to the Guideline Clinical and Laboratory Standards Institute (CLSI) using Kirby-Bauer Disk Diffusion assay. Bacterial isolates with the concentration of half-MacFerland, were then sub-cultured on Mueller hinton agar (8). The antibiotic discs used were also consist of ceftriaxone (30 µg), nitrofurantoin (300 µg), cefotaxime (30 µg), ciprofloxacin (5 µg), co-trimoxazole (25 µg), nalidixic acid (30 µg), cefixime (30 µg), gentamicin (10 µg) tetracycline (30 µg), and cephalothine (30 µg). *E. coli* (ATCC 25922) was also used as a susceptible control to the antibiotics. SPSS software (version 16, Chicago, IL, USA) was applied for the statistical analysis. The Percentages and ratios were calculated by the Chi-square test. P value less than 0.05 was statistically considered significant.

Results

The results showed that UTI in females (72.6%) was more than males (27.4%). Also, the averages of the females` age (36.53 years old) were lower than males (42.4 years). Out of 497 UTI patients, 8 different types of bacteria were isolated. The main identified bacteria in both genders was *E. coli*. There was no statistically significant difference in the frequency of this pathogen in both sexes ($p>0.05$). As shown in Figure 1, the major of isolated bacteria were consist of *E. coli* (88.6%), *Enterobacter spp.* (3.9%), *Klebsiella spp.* (2.9%), *Pseudomonas aeruginosa* (2.5%), *Proteus vulgaris* (0.4%), *Citrobacter spp.* (0.4%), *Staphylococcus aureus* (1%), and Coagulase-negative *Staphylococcus* (0.2%).

The analysis of the prevalence of isolates based on age groups (Table 1) showed that the majority of *E. coli* and *P. aeruginosa* bacteria were found in the age group of 1 to 20 years old and the majority of *Klebsiella spp.* was also isolated from the age group of 21 to 40 years old. Surprisingly, of 161 *E. coli*

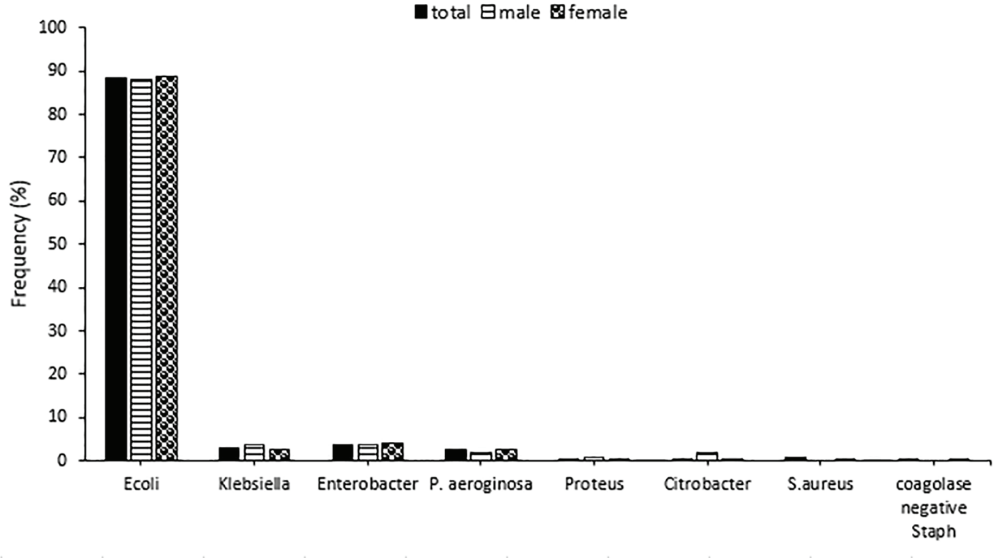

Figure 1: The percentage of bacteria isolated from UTI urine samples based on the gender of the patients.

Table 1: Frequency of isolated pathogens from urine sample in patients with UTI based on the age groups.

Bacteria	Age (year)				
	1-20 n (%)	21-40 n (%)	41-60 n (%)	>60 n (%)	Total n (%)
Escherichia coli	161 (92)	83 (87.4)	59 (83.1)	139 (90.3)	442
Klebsiellaspp	3 (1.7)	6 (6.3)	2 (2.8)	2 (1.3)	13
Enterobacterspp	5 (2.9)	4 (4.2)	6 (8.5)	4 (2.6)	19
Pseudomonas aeruginosa	6 (3.4)	1 (1.1)	2 (2.8)	3 (1.9)	12
Proteus vulgaris	0 (0)	0 (0)	0 (0)	2 (1.3)	2
Citrobacterspp	0 (0)	0 (0)	0 (0)	2 (1.3)	2
Staphylococcus aureus	0 (0)	0 (0)	2 (2.8)	2 (1.3)	4
Staphylococcus (negative coagulase)	1 (1.1)	1 (1.1)	0 (0)	1 (1.1)	3
Total (%)	176 (35.4)	95 (19.1)	71 (14.3)	155 (31.2)	497 (100)

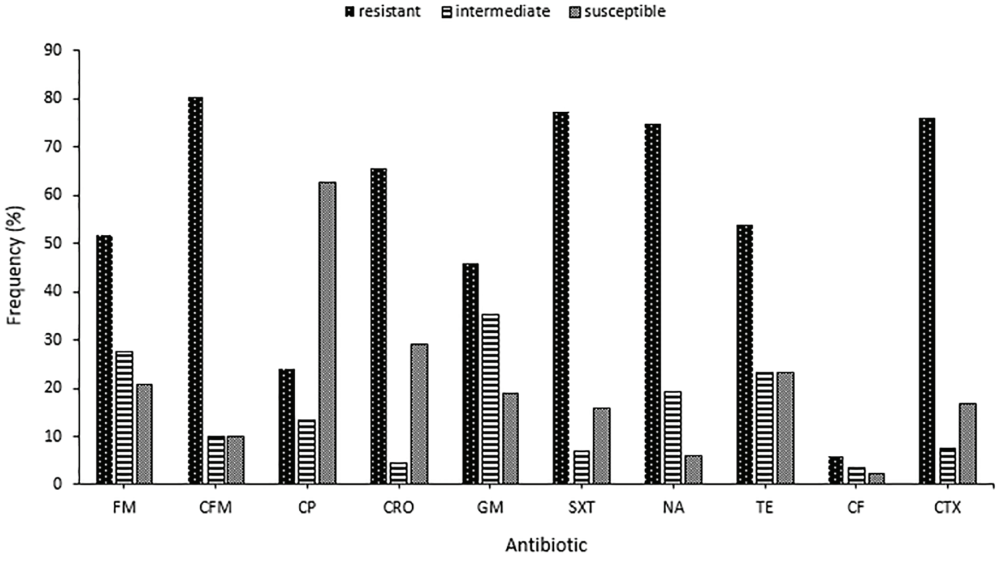

Figure 2: The frequency of antibiotic susceptibility to *E. coli* isolated from children of 1 year or less using Disk Diffusion method. FM: nitrofurantoin, CFM: cefixime, CP: ciprofloxacin, CRO: ceftriaxone, GM: gentamicin, SXT: co-trimoxazole, NA: nalidixic acid, TE: tetracycline, CF: cephalothin, CTX: cefotaxime.

identified in the age group of 1 to 20 years old, 88 bacteria (54.6%) were isolated from the children aged 1 year old or less (54 girls and 34 boys). Furthermore, Of 6 *P. aeruginosa* bacteria isolated from this group, 5 bacteria (83.3%) were isolated from children aged 1 year old or younger.

The antibiotic susceptibility of isolated bacteria to different antibiotics used in UTI therapy was detailed in Table 2. The antibiotic resistance of *E. coli* (as the main cause of UTI) to nitrofurantoin, cefixime, ciprofloxacin, ceftriaxone, gentamicin, co-trimoxazole, nalidixic acid, and cephalothin antibiotics was higher in men than women; in which, the highest resistance belonged to nalidixic acid (86.8%) in men, and the lowest resistance was shown to ciprofloxacin (38.1%) in women. The highest susceptibility of *E. coli* was observed to ciprofloxacin (52.2% in women and 45.7% in men). Moreover, *Enterobacter spp.* as the second isolated agent, indicated a high antibiotic resistance to the most of the antibiotics in men; among which, the highest and the lowest resistance were related to co-trimoxazole (80%) in men and nitrofurantoin (18.2%) in women, respectively.

The highest susceptibility of this bacterium was observed in ciprofloxacin (71.4% in women and 80% in men). The antibiotic resistance of *Klebsiella spp.* was also higher in males rather than females, with the highest resistance to tetracycline (100% in males). The most susceptibility of this bacterium belonged to cefotaxime (100% in males) and then, to ciprofloxacin (62.5% in females and 50% in males). Also, the most antibiotic resistance was shown in *P. aeruginosa*, with 100% resistance to nitrofurantoin, cefixime, co-trimoxazole, tetracycline and nalidixic acid. The highest susceptibility of this bacterium

Table 2: The Percentage of antibiotic susceptibility of bacteria isolated from both males and females by Disk Diffusion method.

Antibiotic	Susceptibility (%)	Sex	Bacteria				
			E. coli	*Klebsiella*	*Enterobacter*	*P. aeruginosa*	*S. aureus*
FM	Resistant	Male	64.6	50	50	100	-
		Female	45.7	11.1	18.2	100	-
	Intermediate	Male	29.2	0	0	0	-
		Female	29.3	33.3	9.1	0	-
	Susceptible	Male	6.2	50	50	0	-
		Female	25	55.6	72.7	0	-
CFM	Resistant	Male	82.9	50	66.7	100	100
		Female	69.1	28.6	50	100	0
	Intermediate	Male	6.8	25	0	0	0
		Female	14.1	42.9	33.3	0	100
	Susceptible	Male	10.3	25	33.3	0	0
		Female	16.7	28.6	16.7	0	0
CP	Resistant	Male	47.4	50	20	33.3	66.7
		Female	38.1	37.5	28.6	22.2	0
	Intermediate	Male	6.9	0	0	0	0
		Female	9.7	0	0	11.1	100
	Susceptible	Male	45.7	50	80	66.7	33.3
		Female	52.2	62.5	71.4	66.7	0
CRO	Resistant	Male	69.1	60	60	66.7	50
		Female	54.2	44.4	35.7	90	0
	Intermediate	Male	4.9	20	20	0	0
		Female	10.5	11.1	14.3	10	50
	Susceptible	Male	26	20	20	33.3	50
		Female	35.1	44.4	50	0	50
GM	Resistant	Male	56.9	60	40	50	33.3
		Female	38.4	20	21.4	55.6	0
	Intermediate	Male	28.4	40	20	0	66.7
		Female	38.8	50	28.6	44.4	0
	Susceptible	Male	14.7	0	40	50	0
		Female	22.8	30	50	0	100
SXT	Resistant	Male	75.4	60	80	100	100
		Female	73.4	50	66.7	100	-
	Intermediate	Male	5.7	0	20	0	0
		Female	6.1	10	33.3	0	-
	Susceptible	Male	18.9	40	0	0	0
		Female	20.5	40	0	0	-
NA	Resistant	Male	86.8	80	50	100	-
		Female	77.5	71.4	36.4	88.9	-
	Intermediate	Male	10.7	20	0	0	-
		Female	12.4	14.3	27.3	11.1	-
	Susceptible	Male	2.5	0	50	0	-
		Female	10.1	14.3	36.4	0	-
TE	Resistant	Male	52.9	100	75	100	66.7
		Female	63	33.3	30.8	-	50
	Intermediate	Male	29.4	0	25	0	0
		Female	7.4	22.2	7.7	-	50
	Susceptible	Male	17.6	0	0	0	33.3
		Female	29.6	44.4	61.5	-	0

CF	Resistant	Male	80	-	100	-	50
		Female	42.3	50	20	-	-
	Intermediate	Male	0	-	0	-	50
		Female	11.5	25	20	-	-
	Susceptible	Male	20	-	0	-	0
		Female	46.2	25	60	-	-
CTX	Resistant	Male	71.6	0	-	-	0
		Female	70.8	-	100	100	100
	Intermediate	Male	12.2	0	-	-	0
		Female	8.1	-	0	0	0
	Susceptible	Male	6.2	100	-	-	100
		Female	21.1	-	0	0	0

FM: nitrofurantoin, CFM: cefixime, CP: ciprofloxacin, CRO: ceftriaxone, GM: gentamicin, SXT: co-trimoxazole, NA: nalidixic acid, TE: tetracycline, CF: cephalothin, CTX: cefotaxime.

belonged to ciprofloxacin antibiotics (66.7% in females and 66.7% in males). *S. aureus*, the main isolated gram-positive bacterium, revealed 100% resistance to cefixime, co-trimoxazole, cefotaxime, ampicillin which were higher in men than women. The most susceptibility of this bacterium was to ceftriaxone (50% in females and 50% in males). The antibiotic resistance of *E. coli* isolated from children aged 1 year or younger showed that the highest and lowest resistance was related to cefixime (80.2%) and cephalothin (5.7%), respectively and the highest susceptibility also belonged to ciprofloxacin (62.7%) (Figure 2).

Discussion

Antibiotic resistance of UTIs is known as one of a serious challenge in medical therapy in Iran (9, 10). Uncontrolled usage of antibiotics and non-scientific treatments of UTI, have reduced the antibiotics sensitivity to uropathogenic bacteria (6, 11, 12). In the current study, the prevalence of UTI bacteria and their antibiotic resistance pattern were studied. Urinary tract infection in women was 5.2 times higher than that of men due to their specific anatomy of the urinary tract. Furthermore, the mean age of female patients (36.53 years old) was lower than that of males (42.4 years old). According to the results, *E. coli* was the main bacterium isolated from the both sexes, which showed the highest frequency between the ages of 1 - 20 as well as older than 60. According to previous studies, this pathogen has been presented as the most important UTI causative agent in Iran as in the world (1, 3, 6, 13-16).

The prevalence of further uropathogens including *Klebsiella spp.*, *Enterobacter spp.*, *P. aeruginosa*, *Proteus spp.* and *S. aureus* reported in our study were consistent with former researches (1, 14, 15, 17, 18). It was also observed that the most isolated bacteria (*E. coli* and *P. aeruginosa*) were from the age group of 1 - 20, which were highly detected in children aged 1 year old or younger. Prior studies have also reported a high prevalence of *E. coli* in children with UTI (15, 19-23). In this study, the antibiotic susceptibility of isolated bacteria to common antibiotics used in UTI treatment was also investigated using Kirby-Bauer Disk Diffusion assay. Generally, antibiotics resistance were higher in men than women. The pattern of *E. coli* antibiotic resistance is varied based on different regions. In our study, the highest resistance of *E. coli* was related to nalidixic acid in men (86.8%); however a high resistance was also shown to the other antibiotics such as cefixime (82.9%), cephalothin (80%), co-trimoxazol (75.4%), and cefotaxime (71.6%). The results of the current study were consistent with those of the previous studies (4, 24, 25).

The highest susceptibilities of *E. coli* and *Enterobacter spp.*, were observed in ciprofloxacin as similar as earlier study (6). Moreover, *Klebsiella* spp. showed more than 50% antibiotic resistance in men. The most susceptibility of this pathogen was to cefotaxime and then to ciprofloxacin. Feizabadi et al. (2004), reported that the susceptibility of this bacterium to ciprofloxacin was 55%, which was similar to our study (10). The highest antibiotic resistance belonged to *P. aeruginosa*, which showed high resistance to most common antibiotics and the lowest resistance was related to ciprofloxacin. Also, *S. aureus*, the main isolated gram-positive bacteria, showed high resistance to the most of antibiotics; while, it was susceptible to ceftriaxone. In addition, the children aged 1 year old or less, indicated a high prevalence of antibiotic resistance, which is confirmed by previous studies (14, 23).

Conclusion

Selecting the first-generation fluoroquinolones (nalidixicadic) as suitable antibiotics for UTI

therapy, seems to be illogical owing to high resistance of the uropathogens. While, the second-generation fluoroquinolone (ciprofloxacin) is still approximately suggested in Fasa area. Therefore, the administration of the antibiotics should be based on the frequency of the uropathogens in each region as well as their susceptibilities to the antibiotics. Hence, the scientific and well-ordered prescription of antibiotics should extremely be considered to control antibiotic resistance.

Acknowledgement

Authors are wished to thank the staffs of Vali-e-Asr and Shariati hospitals, Fasa University of Medical Science, Fasa, Iran

Conflict of Interest

None declared.

References

1 Moroh JL, Fleury Y, Tia H, et al. Diversity and antibiotic resistance of uropathogenic bacteria from Abidjan. *Afr J Urol*. 2014;20:18-24. DOI:1016/j.afju.2013.11.005.

2 Fatima SS, Al Mussaed E. Urinary Tract Infection. Bacterial Identification and Drug Susceptibility Patterns in Pregnant and Non Pregnant UTI Patients: Springer; 2018. p.1-22. DOI:10.1007/978-981-10-4750-3.

3 Farajnia S, Alikhani MY, Ghotaslou R, et al. Causative agents and antimicrobial susceptibilities of urinary tract infections in the northwest of Iran. *Int J Infect Dis*. 2009;13:140-4. DOI:1016/j.ijid.2008.04.014. PMID:18703368.

4 Paniagua-Contreras GL, Monroy-Pérez E, Rodríguez-Moctezuma JR, et al. Virulence factors, antibiotic resistance phenotypes and O-serogroups of *Escherichia coli* strains isolated from community-acquired urinary tract infection patients in Mexico. *J Microbiol Immunol Infect*. 2017;50:478-85. DOI:1016/j.jmii.2015.08.005. PMID:26433755.

5 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. DOI:4314/ejhs.v21i2.69055. PMID:22434993.

6 Kashef N, Djavid GE, Shahbazi S. Antimicrobial susceptibility patterns of community-acquired uropathogens in Tehran, Iran. *J Infect Dev Ctries*.2010;4:202-6. DOI:3855/jidc.540. PMID:20440056.

7 Bonadio M, Meini M, Spitaleri P, et al. Current microbiological and clinical aspects of urinary tract infections. *Eur Urol*. 2001;40:439-4. DOI:1159/000049813. PMID:11713400.

8 CLSI. Performance standards for antimicrobial disk susceptibility test, Approved standard M2-A9. 2006.

9 Fatholahzadeh B, Hashemi FB, Emaneini M, et al. Detection of vancomycin resistant enterococci (VRE) isolated from urinary tract infections (UTI) in Tehran, Iran. *Daru*.2006;14:141-5.

10 Feizabadi MM, Asadi S, Aliahmadi A, et al. Drug resistant patterns of enterococci recovered from patients in Tehran during 2000-2003. *Int J Antimicrob Agents*. 2004;24:521-2. DOI:1016/j.ijantimicag.2004.08.004. PMID:15519491.

11 Noorbakhsh Sabet N, Japoni A, Mehrabani D, et al. Multi drug resistance bacteria in Qom hospitals, Central Iran. Iran Red Crescent Med J 2010;12(4):501-503.

12 Rashedmarandi F, Rahnamayefarzami M, Saremi M, et al. A survey on urinary pathogens and their antimicrobial susceptibility among patients with significant bacteriuria. *Iran J Pathol*. 2008;3:191-6.

13 Esmaeili M. Antibiotics for causative microorganisms of urinary tract infections. *Iran J Pediatr*. 2005;15:165-73.

14 Kalantar E, Motlagh M, Lornezhad H, et al. Prevalence of urinary tract pathogens and antimicrobial susceptibility patterns in children at hospitals in Iran. *Iran J Clin Infect Dis*. 2008;3:149-153.

15 Sharifian M, Karimi A, Tabatabaei SR, Anvaripour N. Microbial sensitivity pattern in urinary tract infections in children: a single center experience of 1,177 urine cultures. *Jpn J Infect Dis*. 2006;59:380. PMID:17186957.

16 Mansouri S, Shareifi S. Antimicrobial resistance pattern of *Escherichia coli* causing urinary tract infections, and that of human fecal flora, in the southeast of Iran. *Microb Drug Resist*. 2002;8:123-8. DOI:1089/107662902760190662. PMID:12118516.

17 Fluit AC, Jones ME, Schmitz FJ, et al. Antimicrobial resistance among urinary tract infection (UTI) isolates in Europe: results from the SENTRY Antimicrobial Surveillance Program 1997. *Antonie Van Leeuwenhoek*. 2000;77:147-52. PMID:10768473.

18 Jalali M, Asteraki T, Emami-Moghadam E, et al. Epidemiological study of asymptomatic bacteriuria among nursery school children in Ahvaz, Iran. *Africa J Clin ExpMicrob*. 2005;6:159-61. DOI:4314/ajcem.v6i2.7416.

19 Akram M, Shahid M, Khan AU. Etiology and antibiotic resistance patterns of community-

acquired urinary tract infections in JNMC Hospital Aligarh, India. *Ann Clin Microbiol Antimicrob*. 2007;6:4. DOI:1186/1476-0711-6-4.

20 Mashouf RY, Babalhavaeji H, Yousef J. Urinary tract infections: bacteriology and antibiotic resistance patterns.*Indian Pediatr*. 2009;46:617-20. PMID:19430071.

21 Schlager TA. Urinary tract infections in infants and children. *Microbiol Spectr*. 2016;4. DOI:1128/microbiolspec.UTI-0022-2016.PMID:28087926.

22 Yüksel S, Öztürk B, Kavaz A, et al. Antibiotic resistance of urinary tract pathogens and evaluation of empirical treatment in Turkish children with urinary tract infections. *Int J Antimicrob Agents*. 2006;28:413-6.DOI:1016/j.ijantimicag.2006.08.009.PMID:17000085.

23 Haghi-Ashteiani M, Sadeghifard N, Abedini M, et al. Etiology and antibacterial resistance of bacterial urinary tract infections in Children's Medical Center, Tehran, Iran. *Acta Med Iran*. 2007;45:153-7.

24 Ali I, Rafaque Z, Ahmed S, et al. Prevalence of multi-drug resistant uropathogenic Escherichia coli in Potohar region of Pakistan. *Asian Pac J Trop Biomed* 2016;6:60-6. DOI:1016/j.apjtb.2015.09.022.

25 Khoshbakht R, Salimi A, Shirzad Aski H, et al. Antibiotic susceptibility of bacterial strains isolated from urinary tract infections in Karaj, Iran. *Jundishapur J Microbiol*. 2013;6:86-90. DOI:5812/jjm.4830.