International Journal of Biomedicine 13(3) (2023) 131-136
http://dx.doi.org/10.21103/Article13(3)_OA14

ORIGINAL ARTICLE

Microbiology

INTERNATIONAL JOURNAL OF BIOMEDICINE

Gender Differences on Prevalence of Uropathogens and Their Antimicrobial Resistance: Results from a Single-Center Study in Peja Region, Kosovo

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Abstract

Background: Urinary tract infection (UTI) is the world's second most common bacterial infection, behind respiratory tract infections, affecting people of all ages worldwide. It is the most common bacterial infection among females. The present study aimed to determine the local bacterial species distribution of UTI isolates between males and females in the Peja region.

Methods and Results: This cohort longitudinal, prospective-retrospective study was conducted in the microbiological laboratories of Peja region, Kosovo. The research includes all urine samples tested for gram-negative bacteria during three years, 2018-2020. The comparison of male and female samples in terms of the type of bacteria isolated showed that the urinary infection in female patients was caused by *E. coli*, significantly more often than in male patients (86.31% vs. 62.87%, *P*=0.0000), while in the samples from male patients, *Klebsiella* spp. (12.05% vs. 3.68%, *P*=0.0000), P. aeruginosa (7.49% vs. 1.59%, *P*=0.0000), and *Acinetobacter* spp. (7.82% vs. 1.59%, *P*=0.0000), were detected significantly more often than female isolates. The prevalence of *Proteus* spp. was similar in male and female isolates (6.19% vs. 5.03%, *P*=0.3926). The results of the statistical analysis showed a statistically significant difference in the resistance of *E. coli* to the analyzed antibiotics depending on the gender of the patients. *E. coli* showed significantly higher resistance in male patients than in female patients to 12 of the 13 antibiotics that were used: ampicillin, amikacin, gentamicin, cefalexin, cefuroxime, cefotaxime, ceftazidime, ofloxacin, imipenem, piperacillin, nitrofurantoin, and trimethoprim/sulfamethoxazole. In both genders, *E. coli* showed the lowest resistance to imipenem and the highest resistance to ampicillin.

Conclusion: Not only does the prevalence of uropathogens gram-negative bacteria differ by gender (greater frequency among women) but their antibiotic resistance also differs by gender (higher resistance among male patients). (**International Journal of Biomedicine. 2023;13(3):131-136.**)

Keywords: urinary tract infection • gram-negative bacteria • gender • antibiotic resistance

For citation: Loxhaj I, Hoxha-Gashi S, Petrovska S, Loxha S. Gender Differences on Prevalence of Uropathogens and Their Antimicrobial Resistance: Results from a Single-Center Study in Peja Region, Kosovo. International Journal of Biomedicine. 2023;13(3):131-136. doi:10.21103/Article13(3)_OA14

Introduction

Urinary tract infections (UTIs) are frequent worldwide, and the pattern of antibiotic resistance differs by region. A UTI is a medical illness marked by pathogenic bacteria in the urine, bladder, urethra, kidney, and prostate.[1] It is the world's second most common bacterial infection, behind respiratory tract infections, affecting people of all ages worldwide.[2] It is the most common bacterial infection among females. An estimated 50.0% of women will get a UTI at least once, and UTIs are most common in people aged 16 to 64.[3] Recurrence of urinary infections is common in women. Recurring UTIs in women are defined as at least 2 UTIs occurring within a 6-month period or at least 3 UTIs in 12 months. The frequency of recurring UTIs in women is estimated to be 25%-50% of all infections.[4-7] Recurrent UTIs, on the other hand, demand several clinical visits and antibiotic therapy.[8] UTI therapy is estimated to account for 15% of all antibiotic use in humans.

Because of the rise of drug-resistant uropathogens, managing UTIs has become a public health priority.[9] Because UTIs are not reportable infections, it is impossible to assess their prevalence correctly. The situation may be exacerbated because, in most outpatient settings, a positive urine culture result is not necessary to make a diagnosis based on symptoms.[10] However, studies show that, despite UTI symptoms, women do not seek medical attention. As a result, the real picture of UTIs is likely to be understated in the literature.[11] A large proportion of uncontrolled antibiotic usage has contributed to the emergence of resistant bacterial infections. Resistance rates to the most common prescribed drugs used in treating UTIs vary considerably in different areas. Estimating local etiology and susceptibility profile could support the most effective empirical treatment.[12] So far, there has not been extensive research in the Peja region on differences in urine bacteriology characteristics and susceptibility patterns between males and females.

The present study aimed to determine the local bacterial species distribution of UTI isolates between males and females in the Peja region, their susceptibility pattern to antibiotics, and to get fundamental, appropriate antimicrobial therapies. One of the main tasks was to determine gender differences in the prevalence of uropathogens and their antimicrobial resistance in urine samples.

This cohort longitudinal, prospective-retrospective study was conducted in the microbiological laboratories at the Regional Hospital in Peja and the Regional Center of Public Health in Peja.

Materials and Methods

The research includes all urine samples tested for gram-negative bacteria in the Peja region during three years, 2018-2020. The epidemiological method was used to collect and analyze the data, focusing on gram-negative pathogenic bacteria and their medication resistance.

Exclusion criteria: isolates from patients under 18; patients with more than two species of bacteria, and isolates of *Candida* spp.[13]

The procedures of bacteriological examination of urine samples and determination of susceptibility to antibiotics are described in detail in another paper.[14]

Statistical analysis was performed using the statistical software package SPSS version 22.0 (SPSS Inc, Armonk, NY: IBM Corp). Baseline characteristics were summarized as frequencies and percentages for categorical variables and as mean ± standard deviation (SD) for continuous variables. For data with normal distribution, inter-group comparisons were performed using Student's t-test. The frequencies of categorical variables were compared using chi-square test with Yates' correction or Fisher's exact test (2-tail), when appropriate. A probability value of $P<0.05$ was considered statistically significant.

Results

A total of 12791 urine samples were analyzed in the study, of which 2316(18.11%) were positive for the growth of gram-negative pathogenic strains, and 10475(81.89%) were negative. From positive cases (n=2316) male were 307(13.26%) and female – 2009(86.74%). The patients from the group with gram-negative isolates were aged 19 to 95 years, with an average age of 54.4±18.1 years. Female patients were more often aged 19 to 40 and 41 to 60 years, while male patients were more often older than 61 years (P=0.0000). The average age of male patients was 63.6±17 years, and that of female patients was 52.9±18 years. According to the results of statistical analysis, male patients were significantly older (P=0.0000) (Table 1).

Table 1.

Patients by gender and age groups.

Age-group, years	Total n (%)	Gender		*P*-value
		Male n (%)	Female n (%)	
19 – 40	595 (25.7%)	45 (14.66)	550 (27.38)	0.0000
41 – 60	707 (30.5%)	49 (15.96)	658 (32.75)	
≥ 61	1014 (43.8%)	213 (69.38)	801 (39.87)	
mean±SD	54.4 ± 18.1	63.58 ± 16.99	52.99 ± 17.9	0.0000
min – max	19 – 95	19 – 95	19 – 95	

The comparison of male and female samples in terms of the type of bacteria isolated showed that the urinary infection in female patients was caused by *E. coli*, significantly more often than in male patients (86.31% vs. 62.87%, P=0.0000), while in the samples from male patients, *Klebsiella* spp. (12.05% vs. 3.68%, P=0.0000), *P. aeruginosa* (7.49% vs. 1.59%, P=0.0000), and *Acinetobacter* spp. (7.82% vs. 1.59%, P=0.0000), were detected significantly more often than female isolates. The prevalence of *Proteus* spp. was similar in male and female isolates (6.19% vs. 5.03%, p=0.3926), (Table 2).

Table 2.

Prevalence of gram-negative bacteria by gender.

Bacteria		n	Gender		*P*-value
			Male n (%)	Female n (%)	
E. coli	No	389	114 (37.13)	275 (13.69)	0.0000
	Yes	1927	193 (62.87)	1734 (86.31)	
Klebsiella spp.	No	2205	270 (87.95)	1935 (96.32)	0.0000
	Yes	111	37 (12.05)	74 (3.68)	
Proteus spp.	No	2196	288 (93.81)	1908 (94.97)	0.3926
	Yes	120	19 (6.19)	101 (5.03)	
P. aeruginosa	No	2261	284 (92.51)	1977 (98.41)	0.0000
	Yes	55	23 (7.49)	32 (1.59)	
Acinetobacter spp.	No	2260	283 (92.18)	1977 (98.41)	0.0000
	Yes	56	24 (7.82)	32 (1.59)	

Table 3 shows the distribution of resistant isolates from the *E. coli* strain depending on the gender of the patients. The results of the statistical analysis showed a statistically significant difference in the resistance of *E. coli* to the analyzed antibiotics depending on the gender of the patients. *E. coli* showed significantly higher resistance in male patients than in female patients to 12 of the 13 antibiotics that were used: ampicillin, amikacin, gentamicin, cefalexin, cefuroxime, cefotaxime, ceftazidime, ofloxacin, imipenem, piperacillin, nitrofurantoin, and trimethoprim/sulfamethoxazole. In both genders, *E. coli* showed the lowest resistance to imipenem and the highest resistance to ampicillin.

Table 3.

Distribution of resistant (R) E. coli strain isolates by gender.

Resistance / *E. coli*				
Antibiotic	Gender			*P-value*
	Total	Male R / n / (%)	Female R / n / (%)	
Ampicilin	911	111 / 187 / (59.36)	800 / 1685 / (47.48)	0.0020
Amikacin	30	9 / 157 / (5.73)	21 / 1334 / (1.57)	0.0013*
Gentamicin	163	34 / 185 / (18.38)	129 / 1639 / (7.87)	0.0000
Tobramicin	16	2 / 25 / (8)	14 / 325 / (4.31)	0.7226*
Cefalexin	327	50 / 119 / (42.02)	277 / 1098 / (25.23)	0.0001
Cefuroxime	95	15 / 26 / (57.69)	80 / 326 / (24.54)	0.0002
Cefotaxime	75	12 / 25 / (48)	63 /319 / (19.75)	0.0010
Ceftazidime	62	9 / 22 / (40.91)	53 / 283 / (18.73)	0.0267*
Ofloxacin	79	11 / 19(57.89)	68 /266 / (25.56)	0.0024
Imipenem	22	5 / 130 / (3.85)	17 / 118 / (1.43)	0.0035
Piperacillin	207	29 / 60 / (48.33)	178 / 578 / (30.8)	0.0057
Nitrofurantoin	142	39 / 184 / (21.2)	103 / 1633 / (6.31)	0.0000
Trimethoprim /Sulfamethoxazole	682	87 / 178 / (48.88)	595 / 1632 / (36.46)	0.0012

**Yates' P-value*

In both genders, *Klebsiella* spp. showed the highest resistance to ampicillin and the lowest to imipenem (Table 4).

Table 5 shows the distribution of resistant isolates from the *Proteus* spp. strain depending on the gender of the patients. A statistically significant difference in the gender distribution of resistant isolates of *Proteus* spp. was not found. In the group of male patients, *Proteus* spp. showed no resistance to 7 of the 13 tested antibiotics, the highest resistance was shown to nitrofurantoin. In the group of female patients, the lowest resistance of *Proteus* spp. was registered to amikacin, then to ofloxacin and imipenem, and the highest to nitrofurantoin and ampicillin.

Table 6 shows the distribution of resistant isolates from the *Pseudomonas aeruginosa* strain depending on the gender of the patients. Resistance of *Pseudomonas aeruginosa* to amikacin, gentamicin, ofloxacin, and imipenem was significantly higher in male patients than in female patients. *Pseudomonas aeruginosa* was non-significantly more often resistant to cefalexin in female than in male patients. In the group of men, 100% resistance was registered to cefuroxime, cefotaxime, and ofloxacin. In the group of female patients, *Pseudomonas aeruginosa* showed no resistance to 2 (tobramycin and ofloxacin) of the 13 tested antibiotics and low resistance to amikacin and imipenem.

Table 4.

Distribution of resistant (R) Klebsiella spp. strain isolates by gender.

Resistance / *Klebsiella* spp.				
Antibiotic	Gender			*P*-value
	Total	Male R / n / (%)	Female R / n / (%)	
Ampicilin	92	34 / 35 / (97.14)	58 / 74 / (78.38)	0.0117
Amikacin	2	2 / 31 / (6.45)	0 / 68 / 0	0.0958^
Gentamicin	16	11 / 36 / (30.56)	5 / 73 / (6.85)	0.0010
Tobramicin	7	2 / 18 / (11.11)	5 / 44 / (11.36)	0.6792*
Cefalexin	47	19 / 25 / (76)	28 / 65 / (43.08)	0.0051
Cefuroxime	30	15 / 19 / (78.95)	15 / 44 / (34.09)	0.0011
Cefotaxime	29	14 / 19 / (73.68)	15 / 45 / (33.33)	0.0030
Ceftazidime	26	12 / 16 / (75)	14 / 39 / (35.9)	0.0083
Ofloxacin	17	12 / 17 / (70.59)	5 / 34 / (14.71)	0.0001
Imipenem	8	3 / 31 / (9.68)	5 / 68 / (7.35)	1.0*
Piperacillin	55	27 / 32 / (84.38)	28 / 66 / (42.42)	0.0001
Nitrofurantoin	30	12 / 29 / (41.38)	18 / 65 / (27.69)	0.1885
Trimethoprim /Sulfamethoxazole	57	20 / 27 / (74.07)	37 / 70 / (52.86)	0.0571

** Yates' P-value, ^Fisher's Exact Test (two-tailed)*

Table 5.

Distribution of resistant (R) Proteus spp. strain isolates by gender.

Resistance / *Proteus* spp.				
Antibiotic	Gender			*P*-value
	Total	Male R / n / (%)	Female R / n / (%)	
Ampicilin	61	9 / 19 / (47.37)	52 / 97 / (53.61)	0.618
Amikacin	2	0 / 15 / 0	2 / 77 / (2.6)	1^
Gentamicin	18	4 / 19 / (21.05)	14 / 97 / (14.43)	0.7024*
Tobramicin	4	0 / 4 / 0	4 / 20 / (20)	1^
Cefalexin	20	2 / 11 / (18.18)	18 / 70 / (25.71)	0.8719*
Cefuroxime	5	0 / 5	5 / 21 / (23.81)	0.5451^
Cefotaxime	3	0 / 5	3 / 20 / (15)	1^
Ceftazidime	3	0 / 4	3 / 19 / (15.79)	1^
Ofloxacin	1	0 / 4	1 / 19 / (5.26)	1^
Imipenem	4	0 / 15	4 / 74 / (5.41)	1^
Piperacillin	16	3 / 11 / (27.27)	13 / 64 / (20.31)	0.9025*
Nitrofurantoin	60	12 / 17 / (70.59)	48 / 85 / (56.47)	0.2802
Trimethoprim / Sulfamethoxazole	50	7 / 17 / (41.18)	43 / 93 / (46.24)	0.7004

**Yates' P-value, ^Fisher's Exact Test (two-tailed)*

Table 6.

Distribution of resistant (R) Pseudomonas aeruginosa strain isolates by gender.

Resistance / *Pseudomonas aeruginosa*				
Antibiotic	Gender			*P*-value
	Total	Male R / n / (%)	Female R / n / (%)	
Ampicilin	41	17 / 19 / (89.47)	24 / 27 / (88.89)	0.6757*
Amikacin	6	5 / 17 / (29.41)	1 / 28 / (3.57)	0.0434*
Gentamcin	12	8 / 22 / (36.36)	4 / 32 / (12.5)	0.0382
Tobramicin	1	1 / 5 / (20)	0 / 9 / 0	0.3571^
Cefalexin	22	7 / 9 / (77.78)	15 / 18 / (83.33)	0.8602*
Cefuroxime	7	3 / 3 / (100)	4 / 6 / (66.67)	0.4500^
Cefotaxime	7	3 / 3 / (100)	4 / 7 / (57.14)	0.4750^
Ceftazidime	9	5 / 6 / (83.33)	4 / 9 / (44.44)	0.3328*
Ofloxacin	2	2 / 2 / (100)	0 / 5 / 0	0.0476^
Imipenem	8	7 / 22 / (31.82)	1 / 24 / (4.17)	0.0373*
Piperacillin	20	11 / 19 / (57.89)	9 / 23 / (39.13)	0.2255
Nitrofurantoin	37	17 / 22 / (77.27)	20 / 27 / (74.07)	0.7958
Trimethoprim / Sulfamethoxazole	39	14 / 18 / (77.78)	25 / 30 / (83.33)	0.9244*

**Yates' P-value, ^Fisher's Exact Test (two-tailed)*

Table 7.

Distribution of resistant (R) Acinetobacter spp. strain isolates by gender.

Resistance / *Acinetobacter* spp.				
Antibiotic	Gender			*P*-value
	Total	Male R / n / (%)	Female R / n / (%)	
Ampicilin	38	21 / 24 / (87.5)	17 / 32 / (53.13)	0.0064
Amikacin	6	6 / 17 / (35.29)	0 / 22 / 0	0.0038^
Gentamcin	21	14 / 22 / (63.64)	7 / 32 / (21.88)	0.0020
Tobramicin	No resistance			
Cefalexin	15	9 / 14 / (64.29)	6 / 12 / (50)	0.4624
Cefuroxime	1	0 / 1 / 0	1 / 2 / (50)	1^
Cefotaxime	1	0 / 1 / 0	1 / 2 / (50)	1^
Ceftazidime	1	0 / 1 / 0	1 / 2 / (50)	1^
Ofloxacin	2	0 / 1 / 0	2 / 2 / (100)	0.3333^
Imipenem	1	0 / 16 / 0	1 / 22 / (4.55)	1^
Piperacillin	15	6 / 14 / (42.86)	9 / 21 / (42.86)	1.0
Nitrofurantoin	30	17 / 20 / (85)	13 / 28 / (46.43)	0.0065
Trimethoprim / Sulfamethoxazole	32	19 / 23 / (82.61)	13 / 28 / (46.43)	0.0078

**Yates' P-value, ^Fisher's Exact Test (two-tailed)*

Table 7 shows the distribution of resistant isolates from the *Acinetobacter* spp. strain depending on the gender of the patients. *Acinetobacter* spp. showed significantly higher resistance in male patients than in female patients to ampicillin, amikacin, gentamicin, nitrofurantoin, and trimethoprim/sulfamethoxazole. *Acinetobacter* spp did not show resistance to tobramicin in both sexes, to cefuroxime, cefotaxime, ceftazidime, ofloxacin, and imipenem in male patients, and to amikacin in female patients. This bacterium showed high resistance to ampicillin and trimethoprim/sulfamethoxazole in male patients, to ampicillin in female patients.

Discussion

In this work, we described the relationships between gender. isolated bacterial agents and antibiotic resistance of UTIs. The comparison of male and female samples in terms of the type of bacteria isolated showed that the urinary infection in female patients significantly more often than in male patients was caused by *E. coli* (86.31% vs. 62.87%, *P*=0.0000), while in the samples from male patients, *Klebsiella* spp., *P. aeruginosa*, and *Acinetobacter* spp. were detected significantly more often than female isolates (12.05% vs. 3.68% [*P*=0.0000], 7.49% vs. 1.59% [*P*=0.0000], and 7.82% vs. 1.59% [*P*=0.0000], respectively). The prevalence of *Proteus* spp. was similar in male and female isolates (6.19% vs. 5.03%, *P*=0.3926). Similar to a study conducted by Raka et al.[15] in Kosovo in 2001. In a study by Amin et al.[16] in Iran, of the total number of positive cultures for UTI, 68% were in females and 32% in males. The most frequently isolated bacteria was *E.coli*, with 59.0% (F 75.5% vs. M 24.5), and the second was *Klebsiella* with 11.6% (F 67.7 % vs. M 32.3%). In this study, *Klebsiella* was more frequent among females.

A study in Italy [17] found that among the 2741 urine samples, 1702(62.1%) and 1309(37.9%) were negative and positive for bacterial growth, respectively. Of 1309 patients with infection, 760(73.1%) were females, and 279(26.9%) were males. The three most isolated pathogenic strains were *E.coli* (72.2%), *Klebsiella pneumoniae* (12.4%), and *Proteus mirabilis* (9.0%). And other studies found that UTIs are twice more likely to occur in women than men over all age groups [18] and account for 1.2% of all office visits by women.[19] A third of women are diagnosed with a UTI before the age of 24 years, and half develop at least one episode by 35 years of age. [20] Several predisposing factors might contribute to the higher prevalence of UTIs among women.[21,22] It is well recognized that UTI is more prevalent in females than in males, and our data corroborate this generalization and correspond with a previous study conducted by Deshpande et al.[23]

Similarly, our observation on the prevalence of uropathogens is consistent with other prior reports.[24] We found that women of reproductive age are the most susceptible to UTIs. Vaginal colonization with pathogens and sexual activity have been identified as risk factors for UTI in women of this age group in previous studies.[25-27] Besides, the prevalence of UTI was also high in post-menopausal women. This phenomenon might be a result of genito-urinary atrophy and vaginal prolapse after menopause that alters the vaginal pH, decreasing the normal vaginal flora. This condition allows for gram-negative bacteria to grow as uropathogens.[28]

The results of our study showed a statistically significant difference in the resistance of *E.coli* to the analyzed

antibiotics, depending on the gender of the patients, higher resistance in male patients than in female patients to 12 of the 13 used antibiotics (ampicillin, amikacin, gentamicin, cefalexin, cefuroxime, cefotaxime, ceftazidime, ofloxacin, imipenem, piperacillin, nitrofurantoin, and trimethoprim/sulfamethoxazole) we used. In both sexes, *E.coli* showed the lowest resistance to imipenem (3.85% and 1.43%, respectively, in male and female patients) and the highest resistance to ampicillin (59.36% and 47.48%, respectively, in male and female patients)..

Similar to our study, in a study by Gu et al.,[29] higher susceptibility trends were observed in females than in males regarding major gram-negative bacteria *E. coli* and *K. pneumoniae*. In other studies,[30-32] *E. coli* isolated from males showed resistance to the majority of antibiotics.

Conclusion

Results of our study showed that not only does the prevalence of uropathogens gram-negative bacteria differ by gender (greater frequency among women) but their antibiotic resistance also differs by gender (higher resistance among male patients).

Limitations of the study

Limitations are the same as published elsewhere. Finally, this is a single-center study, and further multi-center and prospective studies are required.

Ethical considerations

Study approval was obtained from the Committee on Ethical Issues, Kosovo Doctors Chamber nr. 16/2022.

Competing Interests

The authors declare that they have no competing interests.

References

1. Sammon JD, Sharma P, Rahbar H, Roghmann F, Ghani KR, Sukumar S, Karakiewicz PI, Peabody JO, Elder JS, Menon M, Sun M, Trinh QD. Predictors of admission in patients presenting to the emergency department with urinary tract infection. World J Urol. 2014 Jun;32(3):813-9. doi: 10.1007/s00345-013-1167-3.
2. Prestinaci F, Pezzotti P, Pantosti A. Antimicrobial resistance: a global multifaceted phenomenon. Pathog Glob Health. 2015;109(7):309-18. doi: 10.1179/2047773215Y.0000000030.
3. Tandogdu Z, Wagenlehner FM. Global epidemiology of urinary tract infections. Curr Opin Infect Dis. 2016 Feb;29(1):73-9. doi: 10.1097/QCO.0000000000000228.
4. Foxman B. Recurring urinary tract infection: incidence and risk factors. Am J Public Health. 1990 Mar;80(3):331-3. doi: 10.2105/ajph.80.3.331.
5. Geerlings SE. Clinical Presentations and Epidemiology of Urinary Tract Infections. Microbiol Spectr. 2016 Oct;4(5). doi: 10.1128/microbiolspec.UTI-0002-2012.
6. Gupta K, Trautner BW. Diagnosis and management of recurrent urinary tract infections in non-pregnant women. BMJ. 2013 May 29;346:f3140. doi: 10.1136/bmj.f3140.
7. Scholes D, Hooton TM, Roberts PL, Stapleton AE, Gupta K, Stamm WE. Risk factors for recurrent urinary tract infection in young women. J Infect Dis. 2000 Oct;182(4):1177-82. doi: 10.1086/315827.
8. Al-Badr A, Al-Shaikh G. Recurrent Urinary Tract Infections Management in Women: A review. Sultan Qaboos Univ Med J. 2013 Aug;13(3):359-67. doi: 10.12816/0003256.
9. Bader MS, Loeb M, Brooks AA. An update on the management of urinary tract infections in the era of antimicrobial resistance. Postgrad Med. 2017 Mar;129(2):242-258. doi: 10.1080/00325481.2017.1246055.
10. Almukhtar SH. Urinary tract infection among women aged (18–40) years old in Kirkuk City, Iraq. Open Nurs J. 2018;12. doi: 10.2174/1874434601812010248
11. Abou Heidar NF, Degheili JA, Yacoubian AA, Khauli RB. Management of urinary tract infection in women: A practical approach for everyday practice. Urol Ann. 2019 Oct-Dec;11(4):339-346. doi: 10.4103/UA.UA_104_19.
12. Gharavi MJ, Zarei J, Roshani-Asl P, Yazdanyar Z, Sharif M, Rashidi N. Comprehensive study of antimicrobial susceptibility pattern and extended spectrum beta-lactamase (ESBL) prevalence in bacteria isolated from urine samples. Sci Rep. 2021 Jan 12;11(1):578. doi: 10.1038/s41598-020-79791-0.
13. Mulliqi-Osmani Gj, Raka L. Mostrimi në mikrobiologjinë klinike, Prishtinë. 2013;43-47(83).
14. Loxhaj I, Hoxha-Gashi S, Petrovska S, Loxha S. Prevalence of Isolated Bacteria from Urinary Tracts and Antibiotic Resistance Trend in Peja Region, Kosovo. International Journal of Biomedicine. 2023;13(2):313-320. doi:10.21103/ Article13(2)_OA22
15. Raka L, Mulliqi-Osmani G, Berisha L, Begolli L, Omeragiq S, Parsons L, Salfinger M, Jaka A, Kurti A, Jakupi X. Etiology and susceptibility of urinary tract isolates in Kosova. Int J Antimicrob Agents. 2004 Mar;23 Suppl 1:S2-5. doi: 10.1016/j.ijantimicag.2003.09.009.
16. Mehdinejad M, Pourdangchi Z, Amin M. Study of bacteria isolated from urinary tract infections and determination of their susceptibility to antibiotics. Jundishapur Journal of Microbiology. 2009;2(3):118-123
17. Maione A, Galdiero E, Cirillo L, Gambino E, Gallo MA, Sasso FP, Petrillo A, Guida M, Galdiero M. Prevalence, Resistance Patterns and Biofilm Production Ability of Bacterial Uropathogens from Cases of Community-Acquired Urinary Tract Infections in South Italy. Pathogens. 2023 Mar 29;12(4):537. doi: 10.3390/pathogens12040537.
18. Foxman B. Urinary tract infection syndromes: occurrence, recurrence, bacteriology, risk factors, and disease burden. Infect Dis Clin North Am. 2014 Mar;28(1):1-13. doi: 10.1016/j.idc.2013.09.003.

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19. Schappert SM. Ambulatory care visits of physician offices, hospital outpatient departments, and emergency departments: United States, 1995. Vital Health Stat 13. 1997 Jun;(129):1-38. PMID: 9198408.
20. Foster RT Sr. Uncomplicated urinary tract infections in women. Obstet Gynecol Clin North Am. 2008 Jun;35(2):235-48, viii. doi: 10.1016/j.ogc.2008.03.003.
21. Grigoryan L, Trautner BW, Gupta K. Diagnosis and management of urinary tract infections in the outpatient setting: a review. JAMA. 2014 Oct 22-29;312(16):1677-84. doi: 10.1001/jama.2014.12842.
22. August SL, De Rosa MJ. Evaluation of the prevalence of urinary tract infection in rural Panamanian women. PLoS One. 2012;7(10):e47752. doi: 10.1371/journal.pone.0047752.
23. Deshpande KD, Pichare AP, Suryawanshi NM, Davane MS, Article O. Antibiogram of gram negative uropathogens in hospitalized. Int J Recent Trends Sci Technol. 2011;1(2):56–60.
24. 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 Dec;59(6):380-2.
25. Haque R, Akter ML, Salam MA. Prevalence and susceptibility of uropathogens: a recent report from a teaching hospital in Bangladesh. BMC Res Notes. 2015 Sep 5;8:416. doi: 10.1186/s13104-015-1408-1.
26. Abou Heidar NF, Degheili JA, Yacoubian AA, Khauli RB. Management of urinary tract infection in women: A practical approach for everyday practice. Urol Ann. 2019 Oct-Dec;11(4):339-346. doi: 10.4103/UA.UA_104_19.
27. Medina M, Castillo-Pino E. An introduction to the epidemiology and burden of urinary tract infections. Ther Adv Urol. 2019 May 2;11:1756287219832172. doi: 10.1177/1756287219832172.
28. Muhammad A, Khan SN, Ali N, Rehman MU, Ali I. Prevalence and antibiotic susceptibility pattern of uropathogens in outpatients at a tertiary care hospital. New Microbes New Infect. 2020 Jun 13;36:100716. doi: 10.1016/j.nmni.2020.100716.
29. Gu J, Chen X, Yang Z, Bai Y, Zhang X. Gender differences in the microbial spectrum and antibiotic sensitivity of uropathogens isolated from patients with urinary stones. J Clin Lab Anal. 2022 Jan;36(1):e24155. doi: 10.1002/jcla.24155.
30. Linhares I, Raposo T, Rodrigues A, Almeida A. Frequency and antimicrobial resistance patterns of bacteria implicated in community urinary tract infections: a ten-year surveillance study (2000-2009). BMC Infect Dis. 2013 Jan 18;13:19. doi: 10.1186/1471-2334-13-19.
31. Chatterjee N, Ghosh RR, Chatterjee M, Chattopadhyay S. Correlation of demographic profile and antibiotic resistance in patients with urinary tract infection attending a teaching hospital in Kolkata. J Med Sci Clin Res. 2014;2(11):2806-2816.
32. Hossain A, Hossain SA, Fatema AN, Wahab A, Alam MM, Islam MN, Hossain MZ, Ahsan GU. Age and gender-specific antibiotic resistance patterns among Bangladeshi patients with urinary tract infection caused by *Escherichia coli*. Heliyon. 2020 Jun 8;6(6):e04161. doi: 10.1016/j.heliyon.2020.e04161.