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Antibiogram Profile of Patients Having Urinary Tract Infection Treated with Most Commonly Used Antibiotics

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ABSTRACT

Background: Urinary tract infections (UTIs) are the most common infections in humans, primarily caused by bacteria, with Escherichia coli (E. coli) responsible for 75-90% of cases. The rise in bacterial resistance is largely due to inappropriate antibiotic use, posing significant public health concerns. This study investigated UTI prevalence and antibiotic resistance to inform optimized treatment guidelines. This study aimed to identify the bacterial pathogens causing UTIs and assess their antimicrobial sensitivity and resistance to commonly used antibiotics.

Methods: A descriptive cross-sectional study was conducted over six months at Khyber Teaching Hospital's Microbiology Department to assess the antibiogram profile of uropathogens from urine cultures. Urine samples were cultured on CLED media, and biochemical tests were used to identify the uropathogens. Antimicrobial susceptibility testing was performed on the isolates using the Kirby-Bauer disk diffusion method on Mueller Hinton Agar (MHA), following CLSI guidelines. A total of 384 patients' urine samples were collected through a convenient technique and processed as per standard guidelines. The collected data was analyzed using SPSS-22 and shown in tables.

Results: Escherichia coli was the most common uropathogen, found in 48.17% (n=185) of cases, with a higher prevalence in females at about 48.4% (n=125). Fosfomycin was the most frequently prescribed antibiotic (31.5%) and showed the highest sensitivity (50.2%). Cefotaxime exhibited the highest resistance (38.45%), followed by Amoxicillin-clavulanic acid (34.8%).

Conclusion: Escherichia coli remains the dominant pathogen, with Fosfomycin proving generally effective, while resistance to cefotaxime is notable. These reports show the importance of antibiotic use responsibly. By selecting appropriate antibiotics, we can minimize the resistance rate of uropathogens.

Keywords: Esherichia coli, Uropathogens, Antibiotic, Multi - Drug Resistant, Urinary Tract Infection

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INTRODUCTION

Urinary tract infections (UTIs) are defined as bacteria in the urinary tract, from mild symptoms to severe cases where kidneys are involved[1]. In humans UTIs are the most common infection, affecting both genders and all ages people in hospitals and communities. It is the first hospital-acquired (nosocomial) infection and for hospital visits, it is the second most common reason[2]. The infection that develops 48 hours or more after hospital admission is called Nosocomial urinary tract infection (N-UTIs), where the patient was not already in the incubation phase at the time of admission or within three days of discharge. Around 35% of infections acquired in hospitals are urinary tract infections (UTIs)[3]. In older adults, UTIs account for about 25% of all infections. Although the morbidity associated with UTIs is lower compared to other healthcare-associated infections, UTIs can vary from asymptomatic to severe, chronic, and either uncomplicated or complicated. The clinical presentation depends on factors such as the specific part of the urinary tract involved, the causative organism, the severity of the infection, and the patient's immune response[4]. UTIs are more prevalent in women than men, with an 8:1 ratio, largely due to anatomical and physiological differences. Factors contributing to this include the shorter female urethra, which facilitates bacterial travel to the bladder[5]. UTIs are also more common in pregnant women and sexually active individuals. The use of spermicidal diaphragms can increase the risk, and post-menopausal women face higher susceptibility due to urinary tract changes related to decreased estrogen levels. Other contributing factors include poor hygiene, urinary tract abnormalities, catheter use, and low immunity[6].

The empirical use of broad-spectrum antibiotics without culture or sensitivity testing has led to widespread antibiotic resistance, contributing to the emergence of multi-resistant bacterial strains[7]. The resistance pattern of microorganisms is the leading factor in the selection of empirical antibiotic treatment[8]. It is very important for doctors to know about common uropathogens and their resistance and sensitivity to antibiotics[9]. The abrupt use of inappropriate increases the resistance pattern of bacterial species, which are leading to global health issues[10]. In India and Pakistan, physicians prescribe antibiotics based on signs and symptoms, without the culture sensitivity profile of uropathogens[10, 11]. It is very crucial for healthcare workers to be aware of bacterial profile and their concerning response to antibiotics[12]. Awareness about the coming antibiotic resistance is important to make sure that treatment stays effective in managing the changing pattern of microorganisms. The purpose of this research was to assess the antibiotic susceptibility and resistance patterns of those microorganisms that are identified in UTIs.

METHODS

This descriptive cross-sectional study was conducted at Khyber Teaching Hospital in Peshawar, the purpose of this study was to understand the antibiotic resistance of those bacteria that are involved in causing urinary tract infections (UTIs). The research was conducted over five months, from June 5, 2023, to November 5, 2023, and involved 384 participants Sample size was calculated through the WHO sample size calculator while taking a maximum 50% prevalence with 95% and 0.5 margins of error[13]. Ethical approval has been granted from Ahmad Medical Institute with Reference No. 1063/AMI/Adm/23. Patients with UTIs were chosen through a convenience sampling approach, meaning they were selected based on their availability and willingness to take part. To be included, participants had to be of any age or gender, have a confirmed UTI, show symptoms, and agree to participate. Those who were excluded included people with incomplete medical records, those without symptoms despite having bacteria in their urine, anyone who had recently taken antibiotics, pregnant or breastfeeding women, and individuals with chronic conditions like diabetes or HIV/AIDS.

Urine samples were collected from patients using sterile, screw-capped containers. In the Microbiology Department, a 0.001 ml aliquot was cultured on CLED media and incubated at 35-37°C for 24 hours. A positive culture for UTI was defined as the presence of a solitary organism at a concentration of 10^5 Colony Forming Units/ml. Following incubation, Gram staining and biochemical tests were performed to identify the uropathogens. Antimicrobial susceptibility was evaluated using the Kirby-Bauer disk diffusion method on Mueller-Hinton Agar (MHA), focusing on the sensitivity and resistance patterns of commonly prescribed antibiotics: Amoxicillin-clavulanic acid, Fosfomycin, Cefotaxime, and Ciprofloxacin[14].

Data was analyzed using Statistical Package for Social Sciences version 22 (SPSS-v22). All descriptive data is shown in tables in the form of frequencies and

percentages. A P-value less than 0.5 was considered significant.

RESULTS

This study analyzed urine samples from 384 patients clinically diagnosed with urinary tract infections (UTIs) to identify uropathogens and determine their sensitivity and resistance to commonly used antibiotics. Out of 384 patients, 258 (67.18%) were female, and 126 (33.33%) were male. The highest prevalence of UTIs occurred in patients aged 49-70 years (n=135), particularly among females (n=98). The next highest prevalence was in the 27-48-year age group (n=112), with the highest incidence in females (n=70) within this group, as shown in Table 1.

Table 1. Age and Gender Distribution of the Participants

Age Group (years)	Male (n)	Female (n)	Total (n)
5-26	27 (25%)	81 (75%)	108 (28.1%)
27-48	42 (37.5%)	70 (62.5%)	112 (29.1%)
49-70	37 (27.4%)	98 (72.6%)	135 (35.1%)
71-90	20 (68.9%)	9 (31.1%)	29 (7.5%)
Total	**126 (32.8%)**	**258**	**384**

Gender-Wise Distribution of Microorganisms

The most common uropathogen was E. coli (48.2%), as shown in Table 2, with a higher prevalence in females (67.6%) compared to males (32.4%). Other pathogens included Klebsiella spp (21.1%), Marganella spp (6.5%), Proteus spp (3.3%), Pseudomonas spp (5.7%), Enterobacter spp (6.77%), Citrobacter spp (4.42%), Serratia spp (1.82%), and S. aureus (2.08%).

Table 2. Gender-wise Distribution of Uropathogens

Uropathogen	Male % (n)	Female % (n)	Total % (n)
E. coli	32.4 (60)	67.6 (125)	48.2 (185)
Marganella spp	24 (6)	76 (19)	6.5 (25)
Proteus spp	53.8 (7)	46.2 (6)	3.3(13)
Klebsiella spp	32.1 (26)	67.9 (55)	21.0(81)
Pseudomonas spp	54.5 (12)	45.5 (10)	5.7(22)
Enterobacter spp	26.9 (7)	73.1 (19)	6.7(26)
Citrobacter spp	23.5 (4)	76.5 (13)	4.4(17)
Serratia spp	28.5(2)	71.4 (5)	1.8(7)
S. aureus	25 (2)	75 (6)	2.0(8)
Total	126	258	384

Commonly Used Antibiotics

The antibiotics used in treating the UTIs and their frequency as presented in Table 3. Fosfomycin was the most commonly used antibiotic (31.5%), followed by Amoxicillin-Clavulanic acid (29.4%), Cefotaxime (24%), and Ciprofloxacin (15.1%).

Table 3 also summarizes the resistivity and sensitivity of antibiotics among the study participants. The results indicate an overall resistivity of 195 out of 384 samples (50.8%) and a sensitivity of 189 out of 384 samples (49.2%).

Table 3. Commonly prescribed Antibiotics for UTIs

Variable		n %
Antibiotic	Fosfomycin	121 (31.5%)
	Amoxicillin-Clavulanic acid	113 (29.4%)
	Cefotaxime	92 (24.0%)
	Ciprofloxacin	58 (15.1%)
	Total	384 (100%)
Antibiotic Activity	Resistance	195 (50.8%)
	Sensitive	189 (49.2%)
	Total	384 (100%)

Distribution of Antibiotics, Drug Activity, and Microorganisms

the resistance and sensitivity patterns of different microorganisms to various antibiotics is presented in Table 4. *E. coli* showed the highest sensitivity to Fosfomycin (76.8%%) and the highest resistance to Cefotaxime (79.5%).

Table 4. Antibiotic Susceptibility of Different Uropathogens to Commonly Used Antibiotics

Uropathogen	Susceptibility Profile	Amoxicillin-Clavulanic Acid (%)	Fosfomycin (%)	Cefotaxime (%)	Ciprofloxacin (%)	Total (n)
E. coli	Resistant	54.8 (34)	23.0 (13)	79.5 (35)	56.5 (13)	95
	Sensitive	45.2 (28)	76.8 (43)	20.5 (9)	43.5 (10)	90
Marganella spp	Resistant	50.0 (2)	16.7 (2)	100 (4)	20.0 (1)	9
	Sensitive	50.0 (2)	83.3 (10)	0 (0)	80.0 (4)	16
Proteus spp	Resistant	100 (2)	0 (0)	80.0 (4)	0 (0)	6
	Sensitive	0 (0)	100 (5)	20.0 (1)	100 (1)	7
Klebsiella spp	Resistant	50.0 (11)	28.0 (7)	75.0 (15)	50.0 (7)	40
	Sensitive	50.0 (11)	72.0 (18)	25.0 (5)	50.0 (7)	41
Total	Resistant	35.1 (68)	21.5 (26)	81.5 (75)	44.8 (26)	195
	Sensitive	39.8 (45)	78.5 (95)	18.5 (17)	55.2 (32)	189
Total (n)		113	121	92	58	384

Drugs Activity and Antibiotics Cross-tabulation

The cross-tabulation of the overall resistivity and sensitivity of each antibiotic is presented in Table 5. Fosfomycin was the most sensitive antibiotic, with 50.2% sensitivity, while Cefotaxime showed the highest resistance at 38.45%.

Table 5. Susceptibility Profile of Commonly Used Antibiotics

Susceptibility Profile	Amoxicillin-Clavulanic acid	Fosfomycin	Cefotaxime	Ciprofloxacin	Total (n)
Resistance	68 (60.2%)	26 (21.5%)	75 (81.5%)	26 (44.8%)	195 (50.8%)
Sensitive	45 (39.8%)	95 (78.5%)	17 (18.5%)	32 (55.2%)	189 (49.2%)
Total (n)	**113 (29.4%)**	**121 (31.5%)**	**92 (24.0%)**	**58 (15.1%)**	**384**

DISCUSSION

This study identified Escherichia coli as the predominant uropathogen, accounting for 48.17% (n=185) of cases, with a slightly higher prevalence in females (48.4%, n=125). Fosfomycin was the most commonly prescribed antibiotic (31.5%) and demonstrated the highest sensitivity rate (50.2%). Conversely, Cefotaxime showed the highest resistance rate (38.45%), closely followed by Amoxicillin-clavulanic acid (34.8%). Urinary tract infection (UTI) is a common global health issue that affects individuals across all genders and age groups[15, 16]. This study offers a thorough analysis of the antibiogram of uropathogens, focusing on their resistance and sensitivity patterns to commonly prescribed antibiotics. These patterns can change over time and differ across regions, even within the same country[17, 18]. Key factors, such as patient age, gender, and previous antibiotic use, play an essential role in accurately identifying resistance and sensitivity trends. UTIs are most commonly seen in females, largely due to their shorter urethra and other contributing risk factors[19].
In this study, UTIs were more common in females, with 258 cases (67.18%) compared to 126 cases (33.3%) in males. The most common uropathogen identified was E. coli, which was found in 185 out of 384 cases (48.17%). Of those, E. coli was present in 60 male patients (32.43%) and 125 female patients (67.56%). The study revealed that 46.3% of the isolates were obtained from male patients, with the majority of patients (highest percentage) falling within the 21–30 year age group. Notably, female patients exhibited higher resistance to antibiotics compared to their male counterparts[20]. A comparable study undertaken at Karakoram International University in Gilgit, Pakistan, revealed a significantly higher incidence of Urinary Tract Infections (UTIs) among females (68.18%) than males (39.83%). In their study, E. coli was also the most common pathogen, accounting for 55 cases (48.67%), aligning closely with our findings[21].

UTIs were most common in patients aged 5-48 years. On the other hand, Ahmed et al., study found the highest prevalence in patients between 21 and 50 years old[21]. Other bacterial isolates identified in this study included Klebsiella spp. (81, 21.09%), Morganella spp. (25, 6.51%), Proteus spp. (13, 3.38%), Pseudomonas spp. (22, 5.72%), Enterobacter spp. (26, 6.775%), Citrobacter spp. (17, 4.42%), Serratia spp. (7, 1.82%), and S. aureus (8, 2.08%). A study from Afghanistan reported a range of uropathogens, including Enterococcus (11.1%), Serratia spp. (10.8%), S. aureus (8.2%), Klebsiella spp. (2.9%), Proteus spp. (1.8%), and Pseudomonas spp. (1.2%)[22].

In this study, Fosfomycin showed the highest sensitivity, with a rate of 95 out of 189 cases (50.2%). Amoxicillin-Clavulanic acid followed as the second most sensitive antibiotic, with a sensitivity rate of 45 out of 189 cases (23.8%).Cefotaxime was found to be the most resistant antibiotic, with an overall resistance rate of 75/195 (38.45%). Amoxicillin-Clavulanic acid was the second most resistant drug, with a resistance rate of 68/195 (34.8%). A study conducted in New Delhi, India, revealed differing antimicrobial susceptibility patterns, with Amoxicillin-Clavulanic acid showing 30% sensitivity and 44% resistance, Ciprofloxacin exhibiting 49% sensitivity and 25% resistance, and Cefotaxime demonstrating 55% sensitivity and 19% resistance[23].

The variation in antibiotic activity (resistance and sensitivity) is likely due to factors such as the irrational use of antibiotics, patient age, gender, lifestyle, and the geographical distribution of uropathogens. In our study, E. coli was most sensitive to Fosfomycin (43/90, 47.7%), followed by Amoxicillin-Clavulanic acid (28/90, 30.1%), Ciprofloxacin (10/90, 11.1%), and Cefotaxime (9/90, 10%). E. coli showed the highest resistance to Cefotaxime (35/95, 36.85%), followed by Amoxicillin-Clavulanic acid (34/95, 35.7%), Fosfomycin (13/95, 13.6%), and Ciprofloxacin (13/95, 13.6%). These results indicate that E. coli has lower resistance to Fosfomycin. Another study revealed that Fosfomycin exhibited exceptional efficacy against Escherichia coli, with a remarkable potency rate of 89.97%[24]. Klebsiella spp. in our study

was sensitive to Fosfomycin (43.9%) and resistant to Cefotaxime (36.55%). Marganella spp. showed sensitivity to Fosfomycin (62.2%) and resistance to Cefotaxime (25%). A study found that Klebsiella spp. exhibited limited susceptibility to Ciprofloxacin (21.1%) and Amoxicillin-Clavulanic acid (23.7%)[25].

Managing UTIs should follow established guidelines for diagnosis and treatment. Diagnosis is usually based on symptoms such as frequent, painful urination, cloudy urine, and lower abdominal pain. Physical exams, urine analysis, and cultures help identify the bacteria causing the infection and their antibiotic sensitivity. Antibiotic choice should depend on the severity of the infection, the patient's history, and local resistance patterns. It is important to complete the full course of antibiotics to ensure the infection is fully treated. Practicing good personal hygiene and consuming clean food and water can also help reduce the risk of UTIs.

CONCLUSION

Urinary tract infections (UTIs) represent a significant global health issue, affecting individuals of all ages and genders. Our study identified E. coli as the most prevalent uropathogen and Fosfomycin as a highly effective treatment option. Tailoring antimicrobial therapy to local antibiograms, with Fosfomycin as a first-line choice, can improve patient outcomes, reduce antibiotic misuse, and combat resistance. The rise in antimicrobial resistance, particularly in the context of frequently occurring uropathogens like Escherichia coli, Klebsiella spp., and Staphylococcus aureus highlights the need for prudent antibiotic use and local surveillance to guide treatment. This study underscores the importance of continuous monitoring of bacterial resistance patterns to ensure appropriate therapeutic interventions. By tailoring treatment strategies to local antibiograms, healthcare providers can enhance patient outcomes, reduce unnecessary antibiotic use, and help control the rise of multi-drug-resistant organisms. Early detection and targeted treatments are essential for preventing complications related to UTIs.

LIST OF ABBREVIATIONS

UTIs: Urinary tract infections
E. coli: Escherichia coli
MHA: Mueller Hinton Agar

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ETHICAL APPROVAL

Ethical approval has been granted from Ahmad Medical Institute with Reference No. 1063/AMI/Adm/23.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

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AUTHORS CONTRIBUTIONS

All authors equally contributed to this research write-up.

REFERENCES

1. Kaur R, Kaur R. Symptoms, risk factors, diagnosis and treatment of urinary tract infections. Postgraduate medical journal. 2021;97(1154):803-12. DOI: 10.1136/postgradmedj-2020-139090
2. Kanda N, Hashimoto H, Sonoo T, Naraba H, Takahashi Y, Nakamura K, et al. Gram-negative organisms from patients with community-acquired urinary tract infections and associated risk factors for antimicrobial resistance: a single-center retrospective observational study in Japan. Antibiotics. 2020;9(8):438. Doi: 10.3390/antibiotics9080438
3. Chooramani G, Jain B, Chauhan PS. Prevalence and antimicrobial sensitivity pattern of bacteria causing urinary tract infection; study of a tertiary care hospital in North India. Clinical Epidemiology and Global Health. 2020;8(3):890-3. doi.org/10.1016/j.cegh.2020.02.018
4. Anwar HAH, Yousaf AYA, Khalid HKH, Chaudhary SCS, Raza ABRAB, Tahir MTM. Spectrum of organisms causing urinary tract infection (uti) in children in tertiary care hospital. Journal of Akhtar Saeed Medical & Dental College. 2022;4(04). https://amdc.edu.pk/Ojs/ojs-3.3/index.php/jamdc/article/view/215
5. Sujith S, Solomon AP, Rayappan JBB. Comprehensive insights into UTIs: from pathophysiology to precision diagnosis and management. Frontiers in Cellular and Infection Microbiology. 2024;14:1402941. doi.org/10.3389/fcimb.2024.1402941
6. Seid M, Markos M, Aklilu A, Manilal A, Zakir A, Kebede T, et al. Community-acquired urinary tract infection among sexually active women: risk factors, bacterial profile and their antimicrobial susceptibility patterns, Arba Minch, Southern Ethiopia. Infection and drug resistance. 2023:2297-310. DOI: 10.2147/IDR.S407092
7. Ramzan M, Raza A, un Nisa Z, Abdel-Massih RM, Al Bakain R, Cabrerizo FM, et al. Detection of antimicrobial resistance (AMR) and antimicrobial susceptibility testing (AST) using advanced spectroscopic techniques: A review. TrAC Trends in Analytical Chemistry. 2024;172:117562. doi.org/10.1016/j.trac.2024.117562
8. Islam MA, Islam MR, Khan R, Amin MB, Rahman M, Hossain MI, et al. Prevalence, etiology and antibiotic resistance patterns of community-acquired urinary tract infections in Dhaka, Bangladesh. Plos one. 2022;17(9):e0274423. DOI: 10.1371/journal.pone.0274423

9. Ali S, Khalid H, Muhammad N, Shuaib SL, Muhammad A. Frequency of bacterial isolates and antibiotics resistance patterns in urine and pus samples. The Professional Medical Journal. 2021;28(11):1571-7. DOI: https://doi.org/10.29309/TPMJ/2021.28.11.5987
10. Eshwarappa M, Dosegowda R, Aprameya IV, Khan M, Kumar PS, Kempegowda P. Clinico-microbiological profile of urinary tract infection in south India. Indian journal of nephrology. 2011;21(1):30-6. doi: 10.4103/0971-4065.75226
11. Sana F, Tayyab N, Shujaat U, Iqbal H, Ahsan J. Antimicrobial susceptibility pattern of common bacterial uropathogens, a comprehensive study at tertiary care Hospital of balochistan. Pakistan Journal of Pathology. 2023;34(3):89-95. Doi.org/10.55629/pakjpathol.v34i3.768
12. Sharma P, Netam AK, Singh R. Prevalence and in vitro antibiotic susceptibility pattern of bacterial strains isolated from tribal women suffering from urinary tract infections in District Anuppur, Madhya Pradesh, India. Biomedical Research and Therapy. 2020;7(8):3944-53. Doi.org/10.15419/bmrat.v7i8.625
13.Ahmed SK. Research Methodology Simplified: How to Choose the Right Sampling Technique and Determine the Appropriate Sample Size for Research. Oral Oncology Reports. 2024:100662. Doi.org/10.1016/j.oor.2024.100662
14. Potter RF, Wallace MA, Muenks CE, Alvarado K, Yarbrough ML, Burnham C-AD. Evaluation of Variability in Interpretation of Disk Diffusion Testing for Cefiderocol Using Different Brands of Mueller–Hinton Agar. The journal of applied laboratory medicine. 2023;8(3):523-34. DOI: 10.1093/jalm/jfac131
15. Hossain A, Hossain SA, Fatema AN, Wahab A, Alam MM, Islam MN, et al. Age and gender-specific antibiotic resistance patterns among Bangladeshi patients with urinary tract infection caused by Escherichia coli. Heliyon. 2020;6(6). Doi: 10.1016/j.heliyon.2020.e04161
16. Idrees MM, Rimsha R, Idrees MD, Saeed A. Antimicrobial susceptibility and genetic prevalence of extended-spectrum β-lactamases in gram-negative rods isolated from clinical specimens in Pakistan. Antibiotics. 2022;12(1):29. DOI: 10.3390/antibiotics12010029
17. Hassni MA, Hussain A, Rahman MZU, Khan MS, Iftikhar H, Hasni K, et al. Antimicrobial Resistance Patterns of Urine Culture in Tertiary Care Teaching Hospital Islamabad, Pakistan. National Journal of Life and Health Sciences. 2022;1(2):33-7. DOI: 10.62746/njlhs.v1n2.27
18. Muhammad A, Khan S, Ali N, Rehman M, Ali I. Prevalence and antibiotic susceptibility pattern of uropathogens in outpatients at a tertiary care hospital. New Microbes and new infections. 2020;36:100716. doi: 10.1016/j.nmni.2020.100716
19. Ullah S, Khan SA, Iftikhar SH, Shah T, Osama M, Ullah I, et al. Emerging Antibiotic Resistance Profiles in Urinary Tract Infections Among the Elderly: A Critical Review. International journal of health sciences.8(S1):648-62. doi.org/10.53730/ijhs.v8nS1.14875
20. Muhammad A, Ali N, Ali S, Shuaib SL, Afridi IQ, Saeed W, et al. Antibiotics resistance of extended spectrum beta lactamases uropathogenic Escherichia coli in Peshawar-Pakistan. Pure and Applied Biology (PAB). 2020;9(3):1840-8. http://dx.doi.org/10.19045/bspab.2020.90196
21. Khalil A. Prevalence and antibiogram of uncomplicated lower urinary tract infections in human population of Gilgit, Northern Areas of Pakistan. Pakistan Journal of Zoology. 2008;40(4). http://zsp.com.pk/pdf2/295-301%20(10).pdf
22. Joya M, Aalemi AK, Baryali AT. Prevalence and antibiotic susceptibility of the common bacterial uropathogen among UTI patients in French Medical Institute for Children. Infection and drug resistance. 2022:4291-7. DOI: 10.2147/IDR.S353818
23. Akhtar MS, Mohsin N, Zahak A, Ain MR, Pillai P, Kapur P, et al. Antimicrobial sensitivity pattern of bacterial pathogens in urinary tract infections in South Delhi, India. Rev Recent Clin Trials. 2014;9(4):271-5. DOI: 10.2174/1574887109666141127104220
24. Ahmad S, Ali F, Qureshi SA, Uzma B, Shakeela Q, Sabir MS, et al. The evaluation of antibiotic susceptibility pattern and associated risk factors of UTI in tertiary care hospital of Peshawar. Pak J Pharm Sci. 2022;35(3):897-903. https://pubmed.ncbi.nlm.nih.gov/35791585/
25. Khan IU, Mirza IA, Ikram A, Afzal A, Ali S, Hussain A, et al. Antimicrobial susceptibility pattern of bacteria isolated from patients with urinary tract infection. J Coll Physicians Surg Pak. 2014;24(11):840-4. https://pubmed.ncbi.nlm.nih.gov/25404444/