PERINATAL JOURNAL

Original Article

Perinatal Journal 2026; 34(1):464-471

https://doi.org/10.57239/prn.26.03410049

Antibiotic prescribing patterns and antimicrobial resistance among uropathogens causing uncomplicated urinary tract infections: An observational study

Eman Abdulaziz Osman[1*], Rachel Elaine Dunham[2], Ali Shakir Dauod[3]

[1]MBChB, Kurdistan Higher Council of Medical Specialties Trainee in Family Medicine, Duhok, Iraq
[2]MD, DABFM, Consultant in Family Medicine, Duhok Centre Supervisor, Family Medicine Residency Program, Duhok, Iraq.
[3]PhD, MPH, JBFM, Assistant Professor of Family Medicine, Department of Community Medicine, Hawler Medical University. College of Medicine, Erbil, Iraq

Abstract

Urinary Tract Infections (UTIs) are a widespread clinical issue in the community and one of the frequent causes of outpatient antibiotic use. The phenomenon of antibiotic resistance is a major risk to the overall health of the world since it undermines the current treatment methods and increases the chances of developing complications and death. This research seeks to gain insight into the local prescribing rate, study the nature of bacteria associated with UTI, and assess the pattern of antibiotic resistance. The study was a retrospective and cross-sectional observational study involving outcomes of urine culture on patients with UTI symptoms among four laboratories, as referred by 12 physicians in Duhok and Erbil.64% of the samples of the urine culture produced gram-negative possibilities, and 36 percent produced gram-positive possibilities. Among the isolated gram-negative pathogens, Escherichia coli was the commonest. Staphylococcus aureus was the most prevalent among the gram-positive isolates. Cefixime and ciprofloxacin, along with nitrofurantoin, were the highly prescribed antibiotics. This indicated that resistance to amikacin (6%), levofloxacin (13%), and nitrofurantoin (14%) was the lowest, with a large degree of intermediate sensitivity. This study showed that the incidence of growing resistance to antibiotics by uropathogenic bacteria is worrisome with regard to commonly used antibiotics. The tendency of growing resistance highlights the urgency of the need to increase antimicrobial stewardship and the necessity of new empiric treatment guidelines for UTIs.

Keywords: Antimicrobial susceptibility, Antibiotic resistance, Urine culture, Urinary Tract Infections (UTIs)

Introduction

UTIs are known to pose a significant health issue, both at the individual health level (150 million cases each year) and at the healthcare level (over 6 billion US dollars) [1, 2]. UTIs are classified as mild (including cystitis), moderate (pyelonephritis), and severe (sepsis) [3]. UTIs with no complications are usually observed in practice.

Among bacterial uropathogens, Escherichia coli, Klebsiella pneumoniae, and Staphylococcus aureus are the most frequently isolated pathogens, although prevalence may vary by year and region[1, 2, 6]. Empirical prescribing practices for uncomplicated UTIs often deviate from international guidelines, with frequent use of broad-spectrum antibiotics and prolonged courses, contributing to antimicrobial resistance[4, 5]. The effectiveness of first-line antibiotics in reducing UTI morbidity is well established[10,37]. However, the emergence of antibiotic-resistant bacteria presents a significant public health threat[4].

While global data on antibiotic resistance in UTIs are extensive, limited regional surveillance exists in Iraq and particularly in the Kurdistan Region. In Iraq, and especially in the Kurdistan Region, data on the antibiotic susceptibility of uropathogens are scarce.[7–11] Local studies have reported varying resistance rates to frequently used antibiotics[7–9]. An impressive sketch of worldwide and national prescribing trends indicates that empiric therapy and abuse are widespread, which is why the local evidence should be incorporated in treating the patient. This paper seeks to outline the current trends in the prescription of uncomplicated UTIs, characterize the infective bacteria involved, and assess their level of antibiotic susceptibility in Duhok and Erbil. The results should serve to improve the formulation of the locally relevant treatment guidelines.

Materials and Methods

Study design and objectives

The study was done through a two-faceted observational study during the period May 1 to

Correspondence: Eman Abdulaziz Osman, MBChB, Kurdistan Higher Council of Medical Specialties Trainee in Family Medicine, Duhok, Iraq, **e-mail:** emanazeez2016@gmail.com, **Received:** October 21, 2025 **Accepted:** December 13, 2025

November 15, 2024. The main objective of the study was to describe the practices of the prescribing of antibiotics by physicians, and the profile of antimicrobial resistance of uropathogens that cause uncomplicated urinary tract infections. Further, the data on prescribing and laboratory outcomes were also compared on a descriptive basis to determine whether there were some patterns between the prescribing practices of physicians and the rate of resistance that were observed, but never subjected to any statistical test.

Setting and participants

The former aspect was undertaken in two main health centers, three family-based medicine centers, and one urology specialist center in the cities of Duhok and Erbil, Kurdistan Region. Twelve doctors participated and documented the information of about 25 patients. 294 patients were included after the exclusion of six patients who did not fit the inclusion criteria. The criteria used in eligibility were adults (>18 years) with dysuria, frequency, or discomfort in the bladder. The exclusion criteria were indwelling catheters, anatomic abnormalities, and pregnancy. The sample size was calculated and selected according to the possibilities and means, not by means of formal power calculation.

The second dimension encompassed 390 urine culture outcomes that were acquired as a convenience, which were taken at governmental and private labs in the identical urban centers. No other criteria of selection were used.

Data collection and laboratory analysis

Structured forms were used so that physicians could gather non-identifiable patient data. Urine cultures and antimicrobial susceptibility testing were done as per the normal laboratory practices. There were both intermediate resistant and fully resistant isolates. According to the CLSI guidelines, resistance, sensitivity, and intermediate sensitivity (S/I/R) were defined. The pre-defined variables, such as the definition of uncomplicated UTI and the list of antibiotics discussed in this study, were pre-defined to make it reproducible.

Data summary

Result summarization was done the Microsoft Excel. Frequencies and percentages have been used to report the prescribing patterns as well as the rate of resistance. Calculations were not done in cases where data were missing or incomplete. There were no inferential statistical tests because this was a descriptive study.

Ethical considerations

The code requested the ethical approval of the Kurdistan Higher Council of Medical Specialties (Code 1362, May 15, 2024). The informed consents were written and informed to all participating physicians. There were no identifiers of a patient, and the use of anonymized data led to the waiving of the individual patient consent.

Results

A total of 294 outpatients were included, with 220 (75%) females and 74 (25%) males. Fifty patients were from Erbil, and the remainder from Duhok. Each patient was diagnosed with UTI based on clinical symptoms and ≥5 pus cells/HPF in general urine examination. Antibiotics were prescribed for 3–14 days (median 6 days), most commonly nitrofurantoin, and least commonly cefdinir (Figure 1), indicating prescription preferences. Urine culture and sensitivity were obtained from 390 outpatients, with 64% Gram-negative and 36% Gram-positive bacteria.

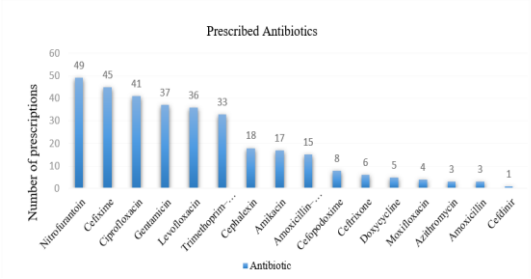

Figure (1): Number of prescribed antibiotics among patients with UTIs

Among the bacterial isolates, Escherichia coli was the most frequent, followed by Staphylococcus aureus, Klebsiella pneumoniae, and Pseudomonas aeruginosa. Less common pathogens, including

Streptococcus spp., Proteus sp., and rare isolates (<2%), including Enterobacter and Bacillus, were also present. Detailed distribution is shown in Figure (2).

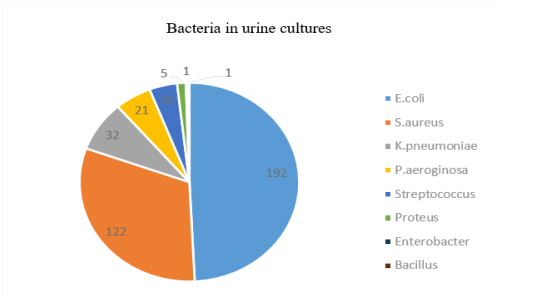

Figure (2): Number of bacterial isolates in urine cultures

The antibiogram of E. coli isolates in Figure (3) E. coli isolates exhibited the highest resistance to cephalexin, amoxicillin, and cefixime, while amikacin showed the lowest resistance and highest sensitivity. However, all antibiotics demonstrated low sensitivity.

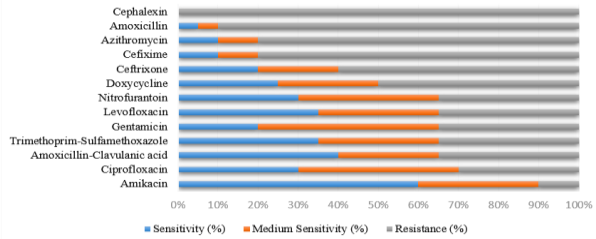

Figure (3): Antibiotic susceptibility profile of *E. coli* isolates

The antibiogram of K. pneumonia isolates are shown in Figure (4). K. pneumonia exhibited complete resistance to amoxicillin and low sensitivity to all tested antibiotics.

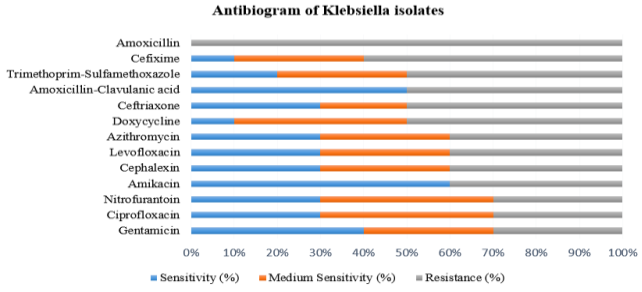

Figure (4): Antibiotic susceptibility profile of *Klebsiella* isolates

The antibiogram of P. aeruginosa Figure (5). P. aeruginosa exhibited the highest resistance to amoxicillin, cephalexin, and cefixime, whereas amikacin showed the lowest resistance and highest sensitivity at 70%.

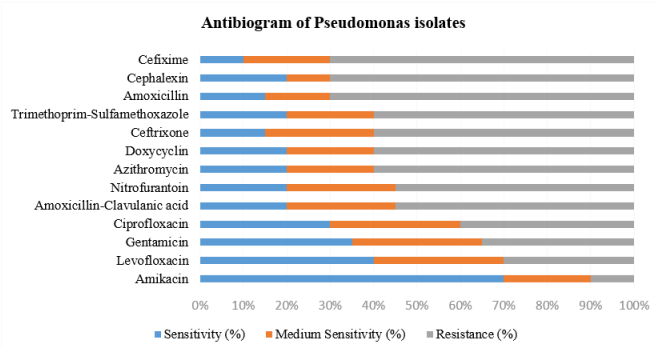

Figure (5): Antibiotic susceptibility profile of Pseudomonas isolates

The antibiogram of Proteus sp. is illustrated in Figure (6). Proteus spp. exhibited complete resistance to amoxicillin, cefixime, and doxycycline. In contrast, the isolates retained good susceptibility to gentamicin, ciprofloxacin, and nitrofurantoin, with these agents showing the highest sensitivity rate (90%). Trimethoprim–sulfamethoxazole and levofloxacin showed no resistance, although the former displayed only intermediate sensitivity.

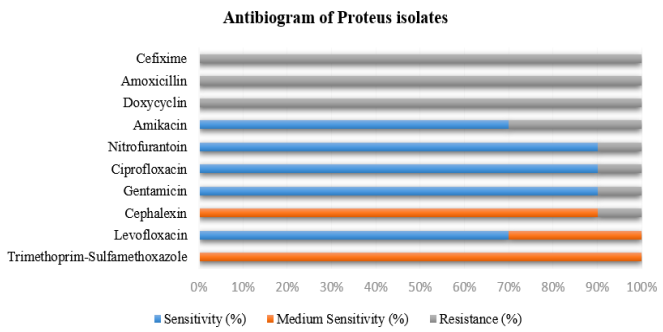

Figure (6): Antibiotic susceptibility profile of *Proteus* isolates

The antibiogram of S. aureus is displayed in Figure (7). S. aureus exhibited considerable resistance, with all antibiotics showing over 30% resistance. Amikacin demonstrated the highest susceptibility at 40%.

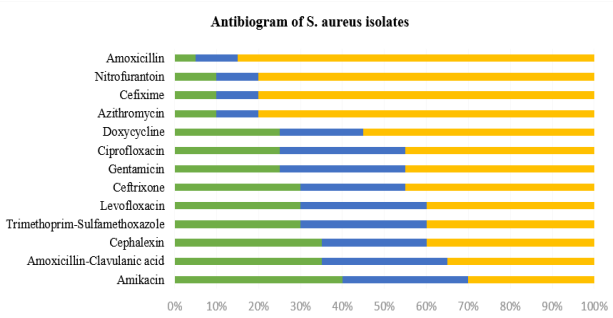

Figure (7): Antibiotic susceptibility profile of *Staphylococcus aureus* isolates

The antibiogram of Streptococcus is shown in Figure (8). Streptococcus sp. exhibited high resistance, with all antibiotics showing resistance rates of 30% or higher. Amikacin demonstrated the highest susceptibility at 60%.

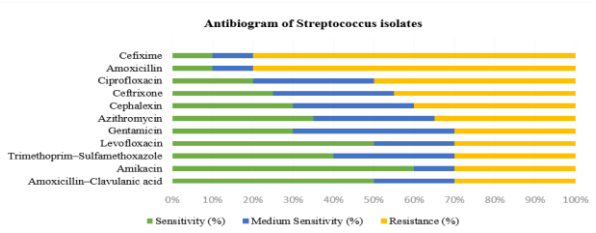

Figure (8): Antibiotic susceptibility profile of *Streptococcus* isolates

The antibiogram of uropathogens isolated from all collected cultures is illustrated in Figure (9). Overall, uropathogens isolated from all cultures exhibited the highest resistance to amoxicillin, followed by cefixime and doxycycline. Nitrofurantoin showed the highest susceptibility at 54%, while amikacin and levofloxacin also demonstrated favorable activity. Nitrofurantoin, being the most prescribed antibiotic, showed the highest susceptibility, suggesting partial alignment between prescribing patterns and observed resistance.

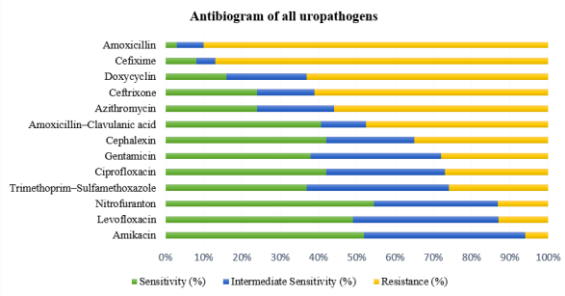

Figure (9): Combined antibiotic susceptibility profile of all urine culture pathogens

Discussion

1.Summary of key findings

Simple UTIs continue to be a challenge to manage. Internationally, guidelines recommend several antibiotics as first-line treatment for UTIs, including nitrofurantoin, trimethoprim–sulfamethoxazole (if local resistance is less than 20%), fosfomycin, and pivmecillinam[12]. In this study, high resistance rates to some of these drugs were demonstrated. Resistance to trimethoprim–sulfamethoxazole was observed, along with significant intermediate sensitivity, making it not an ideal empiric treatment choice. Furthermore, while nitrofurantoin demonstrated a resistance rate of 14%, it had a sensitivity rate of only 54%, similar to the 57% reported in a previous study[13]. This finding suggests that nitrofurantoin may have reduced effectiveness as a first-line drug in Kurdistan and should be interpreted with caution. High resistance to some of these first-line drugs has also previously been reported in this region and elsewhere[11]. This inconsistency between international recommendations and local effectiveness raises questions about empirical management. It is possible that recommending medications not commonly used locally, such as fosfomycin or pivmecillinam, may help address this gap. In this study, no doctor prescribed fosfomycin, and no laboratory performed sensitivity testing for this drug, though it is a recommended first-line agent for treating UTI and is available. Further research on fosfomycin would be beneficial in light of the growing resistance to other common antibiotics.

2. Comparison with Literature

This may be attributed to non-standard prescribing habits. For example, in this study, there were instances of physicians prescribing two antibiotics for simple UTIs, as well as physicians prescribing respiratory quinolones for UTIs. Additionally, parenteral antibiotic use was commonly observed (i.e., gentamicin, amikacin, ceftriaxone). Another surprising finding in this study was the frequency of cefixime use as a first-line treatment for UTIs despite the extremely high resistance to it. Although inappropriate prescribing was observed, a basic

comparison between the most commonly used antibiotics and their corresponding resistance rates suggests a potential relationship between prescribing patterns and local antimicrobial resistance. Nevertheless, this correlation could not be quantified for accurate estimation and measurement within the present study design. The variations demonstrate the disconnect between the clinical practice and microbiological evidence. Various causes can be the causes of non-standard prescribing patterns, such as a lack of knowledge by physicians of the local resistance trends, the non-standard antibiotics are readily available, and the patients require the treatment fast. The outcomes of such practices may be detrimental, such as the development of antimicrobial resistance and a subsequent rise in healthcare expenses, since alternative treatment methods or hospitalization are necessary. To resolve this problem, it is important to improve the education of physicians regarding antimicrobial stewardship, introduce protocols according to which the choices of antibiotics have to be made based on the local culture and sensitivity data. Monitor the practice of prescription in the healthcare facilities in order to ensure the rational and effective use of antibiotics, and limit the ability of patients to freely buy antibiotics without a prescription from a physician.

The most widespread causative agents of UTIs are gram-negative bacteria[7, 14–19]. Among gram-negative bacteria, E. coli was the most prevalent in this study, which is in line with previous studies[20–23]. In the present study, S. aureus was the second most common pathogen identified. This finding differed from the outcomes of most other studies that found K. pneumoniae as the second most common uropathogen [3, 24–28]. While UTIs caused by S. aureus can sometimes be warning signs of more serious conditions, these isolates may reflect contamination or colonization rather than true infection[29].

The lack of providing patients with instructions or wipes for obtaining clean-catch urine samples may contribute to this finding, potentially increasing the number of gram-positive urine cultures seen regionally. Future studies should validate this observation using standardized clean-catch urine collection protocols. If a high rate of S. aureus or other gram-positive UTIs persists despite proper sampling, this should prompt further reconsideration of the optimal empiric antibiotic for the region.

In this study, the lowest resistance rates were to levofloxacin (13%) and amikacin (6%). This is similar to the resistance rates reported in other studies [9, 29–33]. This may highlight the need to re-evaluate, including levofloxacin as a first-line agent in Kurdistan. Amikacin has remained more effective in UTI cases. This should be the last option of treatment because of its parenteral administration, as recommended by only culture-confirmed and clinically resistant cases. The resistance rates of K. pneumoniae to nitrofurantoin (30%) and trimethoprim-sulfamethoxazole (50%) are generally consistent with other studies in the present study[7,14,15,32, 34, 35], namely, the fact that the said antibiotics are not 100 percent effective in the local area is not new. Nevertheless, P. aeruginosa showed greater resistance rates to these drugs than other research articles did [7,14,15,32,34,36]. The findings enable the significance of culture-directed treatment as opposed to evidence-based treatment[3].

Take-home message

The interventions that are suggested to enhance the empiric management of UTIs in Kurdistan and minimize the problem of antibiotic resistance are as follows:

1. Introduce the method of prescription-only dispensing of antibiotics to prevent self-medication.

2. Local guidelines on the treatment of UTI according to regional patterns of resistance.

3. Increase culture and sensitivity testing, organized culture and sensitivity testing, and reporting.

Study limitations

It is necessary to take into consideration the limitations of the study before analyzing such findings. The few samples used of 12 doctors and 4 laboratories restrict this study. Moreover, 2 doctors were considered only out of the city of Erbil, and none out of other big cities, which can diminish the extrapolation possibilities of these results. The other weakness is that urine samples were retrieved in laboratories through convenience sampling and were

not associated with the assessed patients, which restricted the effectiveness of comparing the results of bacterial analysis to the clinical conditions. To allow more clinically relevant and generalizable findings, future research should cover a larger and more varied sample size in different areas and sample systematically, in addition to the data of the patients.

Conclusion

The paper illustrates a very high proportion of antibiotic resistance in UTI-related pathogens in the Kurdistan region, where E. coli toxins are the most prevalent than S. aureus. The high prevalence of S. aureus isolates implied that the prevalence of contaminated urine cultures is high; this is the reason why better strategies to collect and handle the specimen are required. The results of the study highlight the necessity of more regional surveillance and stewardship of antibiotics and the necessity of a new empiric treatment regimen of uncomplicated UTIs in the Kurdistan Region.

Conflict of interest: The authors state that they do not know of any conflicts of interest, financial or otherwise.

References

1.Tandogdu Z, Wagenlehner FME. Global epidemiology of urinary tract infections. *Curr Opin Infect Dis*. 2016;29(1):73-79. doi:10.1097/QCO.0000000000000228/

2.Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nat Rev Microbiol*. 2015;13(5):269-284. doi:10.1038/nrmicro3432/

3.Thass N, Kumar M, Kaur R. Prevalence and antibiogram of bacterial pathogens causing urinary tract infection in a tertiary care hospital. *Int J Med Sci Public Health*. 2019;7(11):1. doi:10.5455/ijmsph 2019.0926517102018/

4.Bosch FJ, van Vuuren C, Joubert G. Antimicrobial resistance patterns in outpatient urinary tract infections--the constant need to revise prescribing habits. *S Afr Med J*. 2011;101(5):328-331. doi:10.7196/samj.4346/

5.Djordjevic Z, Folic M, Jankovic S. Community-acquired urinary tract infections: Causative agents and their resistance to antimicrobial drugs. *VSP*. 2016;73(12):1109-1115. doi:10.2298/VSP150122218D/

6.Ronald A. The etiology of urinary tract infection: traditional and emerging pathogens. *Dis Mon*. 2003;49(2):71-82. doi:10.1067/mda.2003.8/

7.Naqid IA, Balatay AA, Hussein NR, Ahmed HA, Saeed KA, Abdi SA. Bacterial Strains and Antimicrobial Susceptibility Patterns in Male Urinary Tract Infections in Duhok Province, Iraq. *Middle East J Rehabil Health Stud*. 2020;7(3). doi:10.5812/mejrh.103529/

8.Abdulrahman IS. Antimicrobial Susceptibility Pattern of Pathogenic Bacteria Causing Urinary Tract Infections at Azadi Hospital In Duhok City\Kurdistan Region of Iraq. *SJUOZ*. 2018;6(2). doi:10.25271/2018.6.2.435/

9.AlFatlawi B, Jasim A. Determining the Prevalence of Upper and Lower Urinary Tract Infections' Pathogens and Their Antibiotic Susceptibility Profile for Adult Patients in Al-Diwaniya, Iraq (Conference Paper). *IJPS*. 2023;31(Suppl.):86-91. doi:10.31351/vol31issSuppl.pp86-91/

10.De Francesco MA, Ravizzola G, Peroni L, Negrini R, Manca N. Urinary tract infections in Brescia, Italy: etiology of uropathogens and antimicrobial resistance of common uropathogens. *Med Sci Monit*. 2007;13(6):BR136-144.

11.Abdullah I. Multiple Drugs Resistance Among Urinary Tract Infection Patients in Duhok City –Kurdistan Region –Iraq. *Duhok Medical Journal*. Published online January 1, 2019. doi:10.31386/DMJ.2019.13.1.3/

12.Gupta K, Hooton TM, Naber KG, et al. International Clinical Practice Guidelines for the Treatment of Acute Uncomplicated Cystitis and Pyelonephritis in Women: A 2010 Update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. *Clinical Infectious Diseases*. 2011;52(5):e103-e120. doi:10.1093/cid/ciq257/

13.Idrees MM, Rasool MF, Imran I, et al. A Cross-Sectional Study to Evaluate Antimicrobial Susceptibility of Uropathogens from South Punjab, Pakistan. *Infect Drug Resist*. 2022;

15:1845-1855. doi:10.2147/IDR.S356489/
14.Vakilzadeh MM, Heidari A, Mehri A, et al. Antimicrobial Resistance among Community-Acquired Uropathogens in Mashhad, Iran. *J Environ Public Health*. 2020;2020:3439497. doi:10.1155/2020/3439497/
15.Wanja F, Ngugi C, Omwenga E, Maina J, Kiiru J. Urinary Tract Infection among Adults Seeking Medicare at Kiambu Level 5 Hospital, Kenya: Prevalence, Diversity, Antimicrobial Susceptibility Profiles and Possible Risk Factors. *Advances in Microbiology*. 2021;11(8):360-383. doi:10.4236/aim.. 2021.118028/
16.Alkhudhairy MK, Alshammari MMM. Extended-spectrum β-lactamase-producing Escherichia coli isolated from pregnant women with asymptomatic UTI in Iraq. *EurAsian Journal of BioSciences*. 2019; 13:1881-1889.
17.Sierra-Díaz E, Hernández-Ríos CJ, Bravo-Cuellar A. Antibiotic resistance: Microbiological profile of urinary tract infections in Mexico. *Cir Cir*. 2019;87(2):176-182. doi:10.24875/CIRU.18000494/
18.Al-Tulaibawi N. Prevalence and Sensitivity of Bacterial Urinary Tract Infection among Adult Diabetic Patients in Misan Province, Iraq. *J Pure Appl Microbiol*. 2019;13(2):847-853. doi:10.22207/JPAM.13.2.20/
19.Aljanaby A. Urinary tract infections in Al-Kufa City, Iraq, and phenotypic detection of antimicrobial sensitivity pattern of bacterial isolates. *INTERNATIONAL JOURNAL OF PHARMACEUTICAL RESEARCH*. 2017; July-September. doi: 10.31838/IJPR/2020.SP1.222/
20.Al-Badr A, Al-Shaikh G. Recurrent Urinary Tract Infections Management in Women. *Sultan Qaboos Univ Med J*. 2013;13(3):359-367.
21.Ibrahim MS, Khalid HM, Mero WMS. The Prevalence Of Uropathogenic Escherichia Coli Strains Among Outpatients with Urinary Tract Infection In Zakho City, Iraq. *Al-Qadisiyah Journal of Pure Science*. 2021;26(5):26-40. doi:10.29350/qjps.2021.26.5.1366/
22.Tan CW, Chlebicki MP. Urinary tract infections in adults. *Singapore Med J*. 2016;57(9):485-490. doi:10.11622/smedj.2016153/
23.Aypak C, Altunsoy A, Düzgün N. Empiric antibiotic therapy in acute uncomplicated urinary tract infections and fluoroquinolone resistance: a prospective observational study. *Ann Clin Microbiol Antimicrob*. 2009; 8:27. doi:10.1186/1476-0711-8-27/
24.Al-Gasha'a FAS, Al-Baker SM, Obiad JM, Alrobiai FA. Prevalence of Urinary Tract Infections and Associated Risk Factors Among Patients Attending Medical City Hospital in Baghdad City, Iraq. *American Journal of Infectious Diseases*. 2020;16(2):77-84. doi:10.3844/ajidsp.2020.77.84/
25.Kaleem Baloch B, Ali K, Memon N, et al. Antibiotic Antibiogram in Patients With Complicated Urinary Tract Infections in the Nephrology Unit of South Waziristan. *Cureus*. 14(10):e29803. doi:10.7759/cureus. 29803/
26.Utami MDT, Wahyunitisari MR, Mardiana N, Setiabudi RJ. Bacterial and Antibiogram Profile of Urinary Tract Infection Patients in Tertiary Hospital, Surabaya, Indonesia. *FMI*. 2022;58(3):195-202. doi:10.20473/fmi. v58i3.33186/
27.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; 36:100716. doi: 10.1016/j.nmni.2020.100716/
28.Bhargava K, Nath G, Bhargava A, Kumari R, Aseri GK, Jain N. Bacterial profile and antibiotic susceptibility pattern of uropathogens causing urinary tract infection in the eastern part of Northern India. *Front Microbiol*. 2022; 13:965053. doi:10.3389/fmicb.2022.965053/
29.Mason CY, Sobti A, Goodman AL. Staphylococcus aureus bacteriuria: implications and management. *JAC Antimicrob Resist*. 2023;5(1):dlac123. doi:10.1093/jacamr/dlac123/
30.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(6):380-382.
31.Hussein NR, Daniel S, Salim K, Saleh Assafi M. Urinary Tract Infections and Antibiotic Sensitivity Patterns Among Women Referred to Azadi Teaching Hospital, Duhok, Iraq.

Avicenna J Clin Microbiol Infect. 2017;5(2):27-30. doi:10.34172/ajcmi.2018.05/

32.Osman AA. Antibiotic Resistance of Bacteria Isolated in Urinary Tract Infections in Erbil City. *ZJPAS*. 2019;31(4). doi:10.21271/zjpas.31.4.5/

33.Jihad, M., & Salih, M. Microbial Detection and Antibiotic Susceptibility Patterns of Clinical Isolates from Women with Urinary Tract Infection in AL-Nasiriyah City/Iraq. *University of Thi-Qar Journal of Science*, 2024 *11*(1), 45-54. https://doi.org/10.32792/utq/utjsci/v11i1.1168

34.Kwame Opare-Asamoah, Ezekiel Kofi Vicar, Jerry Xola Sosu, Eunice Nyarko, Sulemana Zakariah Mustapha, Kanyite Ayisha Mumuni, Nana Kofi Yeboah Aboagye, Saeed F Majeed, Philomena Ajanaba Asakeboba, Vida Nyagre Yakong, Kwadwo Fosu Antwi, Julius T Dongdem. Prevalence of urinary tract infections and antibiotic susceptibility patterns of bacterial isolates in first-time ANC attendees at a secondary health facility in Ghana: a cross-sectional study, BMC Pregnancy Childbirth. 2025 Apr 24; 25:483. doi: 10.1186/s12884-025-07614-z

35.Rafat D, Agrawal A, Khalid S, Khan AU, Nawab T, Sultan A. Bacterial abundance and antimicrobial resistance patterns of uropathogens among pregnant women with asymptomatic bacteriuria: Association with glycemic status. Eur J Obstet Gynecol Reprod Biol. 2024; 21:100263. https://doi.org/10.1016/j.eurox.2023.100263

36.Eskezia A, Teklemichael AM, Alemayehu T. The prevalence and risk factors of vaginal Candida species and group B Streptococcus colonization in pregnant women attending antenatal care at Hawassa University Comprehensive Specialized Hospital in Hawassa City, Southern Ethiopia. BMC Pregnancy Childbirth. 2025;25(1):299. https://doi.org/10.1186/s12884-025-07402-9

37. Jam, F. A., Ali, I., Albishri, N., Mammadov, A., & Mohapatra, A. K. (2025). How does the adoption of digital technologies in supply chain management enhance supply chain performance? A mediated and moderated model. Technological Forecasting and Social Change, 219, 124225.