ARTICOLO

Luca L'Erario
Diagnostic Laboratory: Laboratorio analisi Dott.ssa Dell'Olio Nunzia, Trani, Italy
Angelo L'Erario
Diagnostic Laboratory: Laboratorio analisi Dott.ssa Dell'Olio Nunzia, Trani, Italy,
Department of Drug Chemistry and Technologies, Sapienza University of Rome, Italy,
Department of Clinical and Experimental Medicine, University of Foggia,Italy,
Department of Precision and Regenerative Medicine and Ionian Area (DiMePRe-J), University of Bari Aldo Moro, 70124 Bari, Italy
Alessandro Mastrorosa
IRCCS Istituto Tumori "Giovanni Paolo II", Viale O. Flacco, 70124 Bari, Italy
Andrea Misino
IRCCS Istituto Tumori "Giovanni Paolo II", Viale O. Flacco, 70124 Bari, Italy
Nunzia Dell'Olio
Diagnostic Laboratory: Laboratorio analisi Dott.ssa Dell'Olio Nunzia, Trani, Italy

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Corresponding author:
Luca L'Erario
Email: drlucalerario@gmail.com

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EXPLORING URINARY PATHOGENS AND ANTIBIOTIC RESISTANCE PROFILES IN MALE AND FEMALE PATIENTS FROM THE SOUTH ITALY: A CROSS-SECTIONAL STUDY IN APULIA

ABSTRACT

Introduction
Urinary tract infections (UTIs) are among the most common infectious diseases, with a significantly higher incidence in females than in males.
Escherichia coli remains the predominant causative agent. AMR is a global health threat.
The Global Leaders Group on AMR estimates that without a stronger response, global life expectancy will be 1.8 years lower than otherwise due to AMR by 2035 (1).
One in six laboratory-confirmed bacterial infections responsible for the most common infections in 2023 were found to be resistant to antibiotic treatment (23).
Numerous studies have documented widespread antimicrobial resistance among uropathogens, raising global concerns—particularly regarding the increasing prevalence of multidrug-resistant (MDR) strains (2).

Methodology
This cross-sectional study was conducted between April 2024 and December 2024 using a non-probability purposive sampling method. Informed consent was obtained from all participants.
They were collected from participants with suspected urinary tract infections who were urged by their general practice doctors to go to the laboratory for analysis.
Data were collected from the culture and antibiotic susceptibility reports of the enrolled patients and systematically entered into WinGla database. The results were analyzed and presented using both percentages and absolute values to ensure clarity and comprehensiveness.

Results
Out of 691 participants, 127 were positive. UTIs were more prevalent in females than in males. E. coli and Cocci + KESC group (Klebsiella, Enterobacter, Serratia and Citrobacter) were the most frequently isolated pathogens.
Antibiotic susceptibility testing revealed notable sensitivity to agents such as Ceftriaxone, Ciprofloxacin, Levofloxacin and Aztreonam, whereas high levels of resistance were observed against amoxicillin-clavulanateand nitrofurantoin. These findings underscore the importance of gender-specific pathogen distribution and resistance patterns in guiding targeted therapy.

Conclusion
This study highlights the growing challenge of antibiotic resistance in Apulian patients with UTIs.
The highest resistance rates for all pathogens detected were observed for amoxicillin-clavulanate and Nitrofurantoin (2 of the 3 empirical treatments suggested by "The WHO AWaRe antibiotic book"); in contrast, Ceftriaxone, Ciprofloxacin, Levofloxacin and Aztreonam exhibited considerable efficacy; the oral powder of Fosfomycin, at its maximum dose, can often be used versus Escherichia coli, probably thanks to its high concentration in urinary tract.
These findings emphasize the urgent need for alternative therapeutic strategies and robust antimicrobial stewardship to address the escalating threat of resistance.

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RIASSUNTO

Introduzione
Le infezioni del tratto urinario (IVU) sono tra le malattie infettive più comuni, con un'incidenza significativamente maggiore nelle donne rispetto agli uomini. L'Escherichia coli rimane l'agente eziologico predominante.
La resistenza antimicrobica (AMR) rappresenta una minaccia per la salute globale. Il Global Leaders Group on AMR stima che, senza una risposta più efficace, l'aspettativa di vita globale sarà inferiore di 1,8 anni rispetto a quella altrimenti possibile a causa della resistenza antimicrobica entro il 2035 (1).
Una su sei infezioni batteriche confermate in laboratorio, responsabili delle infezioni più comuni nel 2023, è risultata resistente al trattamento antibiotico (23).
Numerosi studi hanno documentato una diffusa resistenza antimicrobica tra gli uropatogeni, sollevando preoccupazioni globali, in particolare per quanto riguarda la crescente prevalenza di ceppi multifarmaco-resistenti (MDR) (2).

Metodologia
Questo studio trasversale è stato condotto tra aprile 2024 e dicembre 2024 utilizzando un metodo di campionamento intenzionale non probabilistico. È stato ottenuto il consenso informato da tutti i partecipanti.

Sono stati raccolti da partecipanti con sospette infezioni del tratto urinario, che erano stati invitati dai loro medici di base a recarsi in laboratorio per le analisi. I dati sono stati raccolti dalle colture e dai report di sensibilità agli antibiotici dei pazienti arruolati e inseriti sistematicamente nel database WinGla.
I risultati sono stati analizzati e presentati utilizzando sia percentuali che valori assoluti per garantire chiarezza e completezza.

Risultati
Su 691 partecipanti, 127 sono risultati positivi. Le infezioni delle vie urinarie erano più diffuse nelle donne che negli uomini. E. coli e il gruppo Cocci + KESC (Klebsiella, Enterobacter, Serratia e Citrobacter) sono stati i patogeni isolati più frequentemente.
I test di sensibilità agli antibiotici hanno rivelato una notevole sensibilità ad agenti come Ceftriaxone, Ciprofloxacina, Levofloxacina e Aztreonam, mentre sono stati osservati elevati livelli di resistenza ad amoxicillina-clavulanato e nitrofurantoina.
Questi risultati sottolineano l'importanza della distribuzione dei patogeni e dei modelli di resistenza specifici per genere nell'orientare la terapia mirata.

Conclusioni
Questo studio evidenzia la crescente sfida della resistenza agli antibiotici nei pazienti pugliesi con infezioni delle vie urinarie.
I tassi di resistenza più elevati per tutti i patogeni rilevati sono stati osservati per amoxicillina-clavulanato e nitrofurantoina (2 dei 3 trattamenti empirici suggeriti da "The WHO AWaRe antibiotic book"); al contrario, ceftriaxone, ciprofloxacina, levofloxacina e aztreonam hanno mostrato una notevole efficacia; la polvere orale di fosfomicina, alla sua dose massima, può spesso essere utilizzata contro Escherichia coli, probabilmente grazie alla sua elevata concentrazione nel tratto urinario.

Questi risultati sottolineano l'urgente necessità di strategie terapeutiche alternative e di una solida gestione antimicrobica per affrontare la crescente minaccia della resistenza.

INTRODUCTION

Urinary tract infections (UTIs) are among the most prevalent infectious diseases worldwide, with an estimated annual incidence exceeding 250 million cases. They represent a frequent clinical concern, particularly in developing countries (3) (4).
UTIs can occur in individuals of any age and gender; however, women are disproportionately affected due to anatomical factors and higher bacterial colonization of the urothelial mucosa. Additional risk factors in females include pregnancy, urinary tract obstructions, and sexual activity. It is estimated that one in two women will experience a UTI at some point in her lifetime. Globally, approximately 30% of children are affected by UTIs.

Multiple gram-positive and gram-negative bacterial species are responsible for UTIs, with Escherichia coli being the primary pathogen.
This gram-negative, facultative anaerobe is well known for its uropathogenic traits (4). In addition to Escherichia coli, other frequently implicated organisms include Enterococcus spp. Among gram-positive bacteria, Staphylococcus saprophyticus and methicillin-resistant Staphylococcus aureus (MRSA) are also notable contributors to UTI cases (5) .

The standard approach to UTI treatment typically involves empirical antibiotic therapy in accordance with The WHO AWaRe Antibiotic Book (Access Lineguide), guided by current knowledge of the antimicrobial resistance patterns of urinary pathogens (6) (22). Numerous studies have reported widespread antimicrobial resistance among

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uropathogens, raising global concerns—particularly in relation to multidrug-resistant (MDR) strains and extended-spectrum beta-lactamase (ESBL) producers [7] [8].

The rising prevalence of antibiotic resistance among urinary pathogens underscores a rapidly evolving and regionally variable landscape. Consequently, identifying specific antibiotics to which resistance has developed is crucial for guiding appropriate therapeutic decisions. Such data provide essential support to clinicians in selecting effective treatments and ensuring optimal patient outcomes.

This study is driven by the urgent need to better understand local and global resistance patterns, with the aim of advancing clinical care and refining treatment strategies for Apulia patients.

MATERIALS AND METHODS

This cross-sectional study was conducted within the Clinical Laboratory LAD (Laboratorio Analisi Dott.ssa Dell'Olio) in Trani (Italy), spanning from April 2024 and December 2024. Formal permission for data collection was obtained from the Director, ensuring adherence to ethical guidelines.

All patients with UTIs suspection during the specified period were eligible for inclusion. A non-probability purposive sampling technique was employed to select participants, and informed consent was obtained from them.

Patients with catheterization were excluded from the study to maintain the integrity and validity of the findings, as their urine samples could potentially be contaminated with bacteria from the catheter itself.

Procedure for Bacterial Isolation and Identification

Early morning midstream urine samples were collected from UTI patients who had not received antibiotic treatment in the previous 48–72 hours and who did not have indwelling catheters.
A total of 691 samples were obtained.
The isolation and identification of uropathogens was performed using CHROMID CPS® ELITE bioMerieux and confirmed with biochemical tests (oxidase, catalase and coagulase activity) [9]; At the end, positive samples were confirmed using RT-PCR method. The inoculated media were incubated aerobically at 37 °C for 24 hours. A sample was considered positive for a UTI if a single type of organism was isolated at a concentration equal to or greater than 10^5 CFU/mL.
In this study we included only the positive UTIs belonging to the Entereobacteriaceae class.

Susceptibility Testing

Antimicrobial susceptibility testing was conducted on Müller-Hinton agar and blood agar plates.
The disk diffusion method (Kirby-Bauer method) was employed to evaluate the sensitivity of the isolated uropathogens to various antibiotics, in accordance with the guidelines established by the European Committee on Antimicrobial Susceptibility Testing (The EUCAST breakpoint table 14.0-January 2024).

The antibiotic discs tested included amoxicillin-clavulanate, cotrimoxazole, nitrofurantoin (ACCESS group [22]), ceftriaxone, cefixime, ceftazidime, fosfomycin, ciprofloxavin, levofloxacin (WATCH group [22] and aztreonam [RESERVE group [22]), tested on its maximum dose.
Among the total, 157 patient samples demonstrated the presence of UTI-causing bacterial growth. The selection of ten antibiotics in the various pharmacological classes was carried out with a view to pharmacoeconomic perspective in order to provide the patient with at least one sensitive antibiotic with a single prescription.

Data Analysis

The dataset was carefully entered into WinGLA program for performing statistical analyses.
This facilitated the examination of resistance and susceptibility patterns among the isolated organisms. To explore the association between UTI occurrence and patient gender, the chi-square test was applied. A P-value below 0.05 was interpreted as statistically significant, whereas values above this threshold were considered not significant.

Results were presented using both percentage distributions and absolute values, ensuring a precise and accessible depiction of the data. This

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methodology not only improved the interpretability of the findings but also provided meaningful insights into the complex dynamics of antimicrobial resistance patterns.

RESULTS

In our study, 691 patients participated, and 157 of them showed bacterial growth indicative of a UTI. Out of these 691 patients, 51 (32.5%) were male, while 106 (67.5%) were female. To determine the association between UTI occurrence and gender, we applied the chi-square test. The results showed a significant difference, with a P-value of less than 0.001. This statistical outcome indicates that the prevalence of UTIs is significantly higher among females compared to males (**Figure 1**).

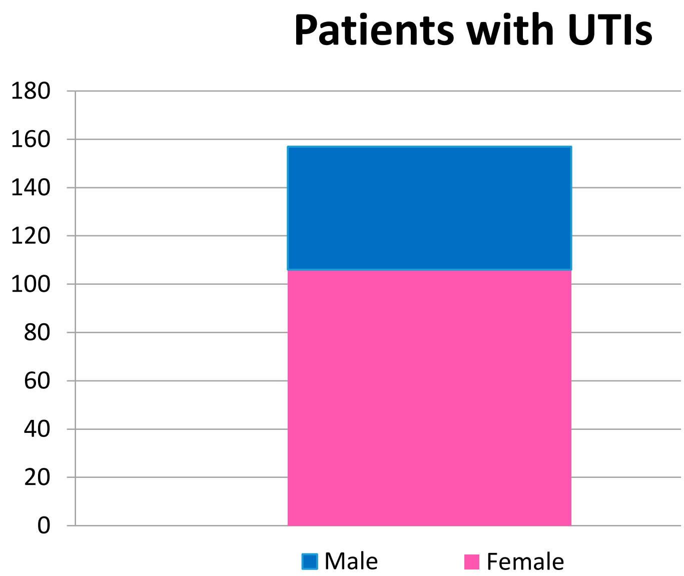

Figure 1
Distribuition of UTIs between males and females.

The age of participants ranged from 10 to 90 years and it was decided not to divide the results by age group.
Among the 157 culture-positive cases, Escherichia coli was identified as the most prevalent uropathogen, detected in 80 patients (51%).
This was followed by Eneterococcus spp. in 40 patients (26%), Pseudomonas spp. in 19 (12%), Proteus spp. in 16 (10%) and Klebsiella spp. in 2 (1%) (**Figure 2**)

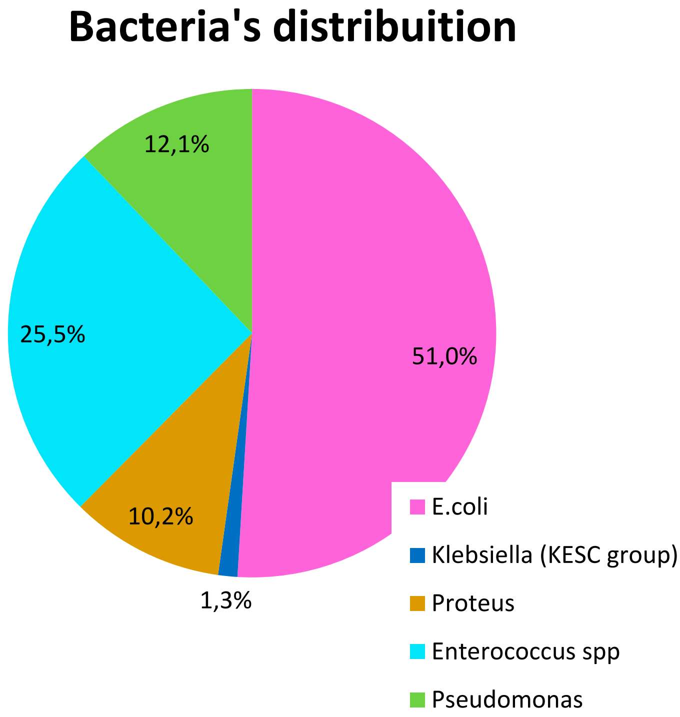

Figure 2
Distribuition of uropathogen.

The results of the antibiogram analysis provided important insights into the drug sensitivities and resistances observed among the UTI-causing bacteria.
Several antibiotics demonstrated notable effectiveness against these pathogens. Specifically, ceftriaxone, ciprofloxacin, levofloxacin and aztreonam were identified as having high sensitivities.
This indicates that these drugs were generally effective in inhibiting the growth of the UTI bacteria identified in our patient cohort.

Conversely, certain antibiotics exhibited higher resistance rates among the isolated pathogens.
Notably, amoxicillin-clavulanate, cefixime, ceftazidime, fosfomycin, nitrofurantoin showed reduced efficacy, with substantial resistance demonstrated across various isolates.
This resistance pattern suggests that these antibiotics may be less appropriate for empirical treatment of UTIs in the studied population (**Figure 3**).

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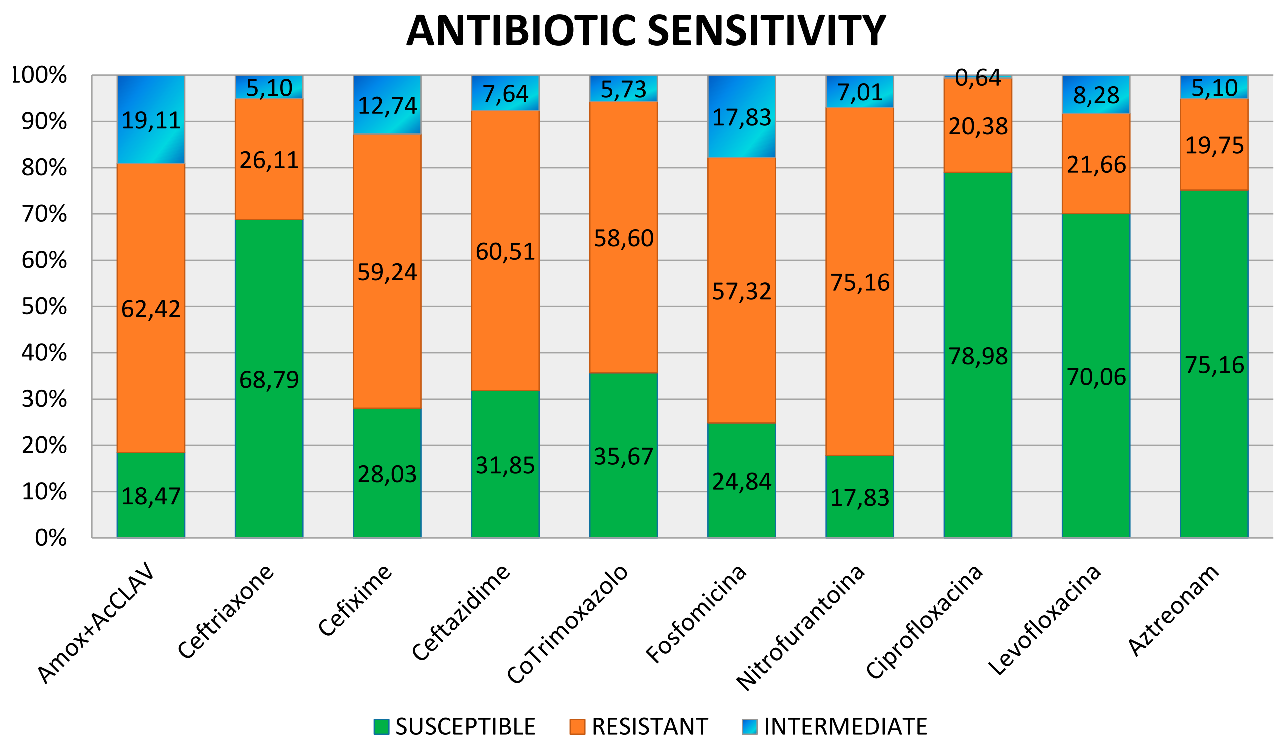

Figure 3
Antibiotic sensitivity among the isolated pathogens.

Furthermore fosfomycin, given a greater activity in a low-pH milieu, and predominant excretion in active form into the urine, can be used as an empirical treatment against Escherichia coli infections thanks to its 73,75 % of efficacy (**Figure 4**)

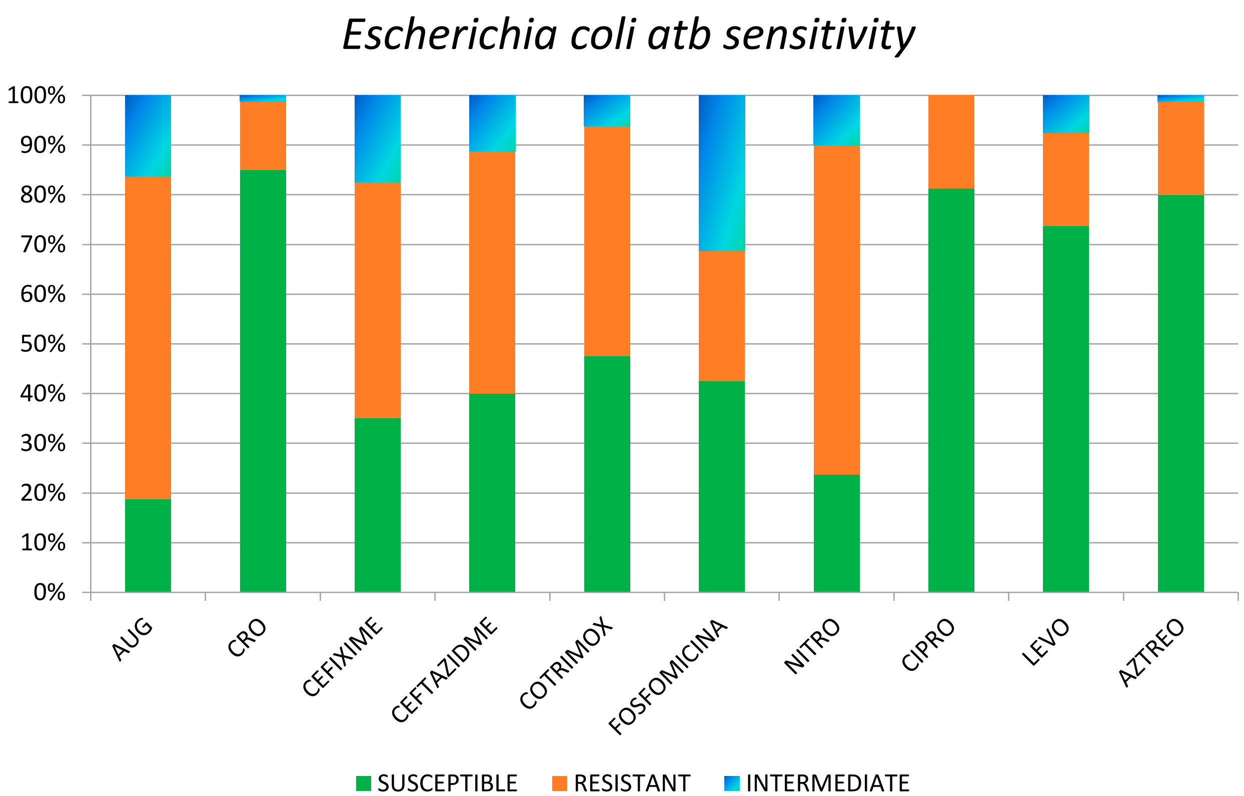

Figure 4
Antibiotic's sensitivity for Escherichia coli.

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The findings underscore the critical importance of performing routine antibiogram analyses to guide appropriate antimicrobial therapy.
By identifying antibiotics with higher efficacy and avoiding those with established resistance patterns, clinicians can improve treatment outcomes and contribute to the more rational use of antimicrobials. Detailed results of the susceptibility patterns are illustrated in Figures 3–4-5.

DISCUSSION

The rise of antibiotic resistance is becoming a significant global issue. UTIs, which impact many people each year, are caused by bacteria exhibiting a range of resistance to different antibiotics (10).
Hence, identifying the resistance and sensitivity profiles of antibiotics in patients with UTIs is crucial. This knowledge enables healthcare providers to select the most effective treatment, ensuring better patient outcomes and helping to combat the growing issue of antibiotic resistance.

In our study, the prevalence of UTIs was higher in females than in males, consistent with the findings of other research (11). The higher prevalence of UTIs among females can be attributed to several factors that predispose women to these infections (12).
Our study reveals that E. coli is the most common organism responsible for UTIs, a finding that aligns with research conducted in both Iran (13) and Scotland (14). While various studies indicate that E. coli is typically followed by Klebsiella in prevalence, our research identified KESC group (Klebsiella, Enterobacter, Serratia and Citrobacter) as the last common organism causing UTIs (15).

These variations depend on multiple factors, including geographic region, ethnicity, types of pollution, non-hospitalized patients and other environmental influences (16).
Understanding these variations is crucial for developing targeted treatment strategies and preventive measures. The identification of KESC group (Klebsiella, Enterobacter, Serratia and Citrobacter) as a significant UTI pathogen in our study suggests that regional microbial profiles should be closely monitored to ensure effective clinical management.

Furthermore, the impact of environmental factors on pathogen prevalence underscores the need for comprehensive public health approaches that address not only medical treatment but also environmental and societal conditions. Future research should aim to explore these factors in greater depth to enhance our understanding of UTI etiology and improve patient outcomes across different regions.

Pseudomonas aeruginosa is the most difficult bacterium to eradicate with the quinolone class of antibiotics being effective (**Figure 5**).

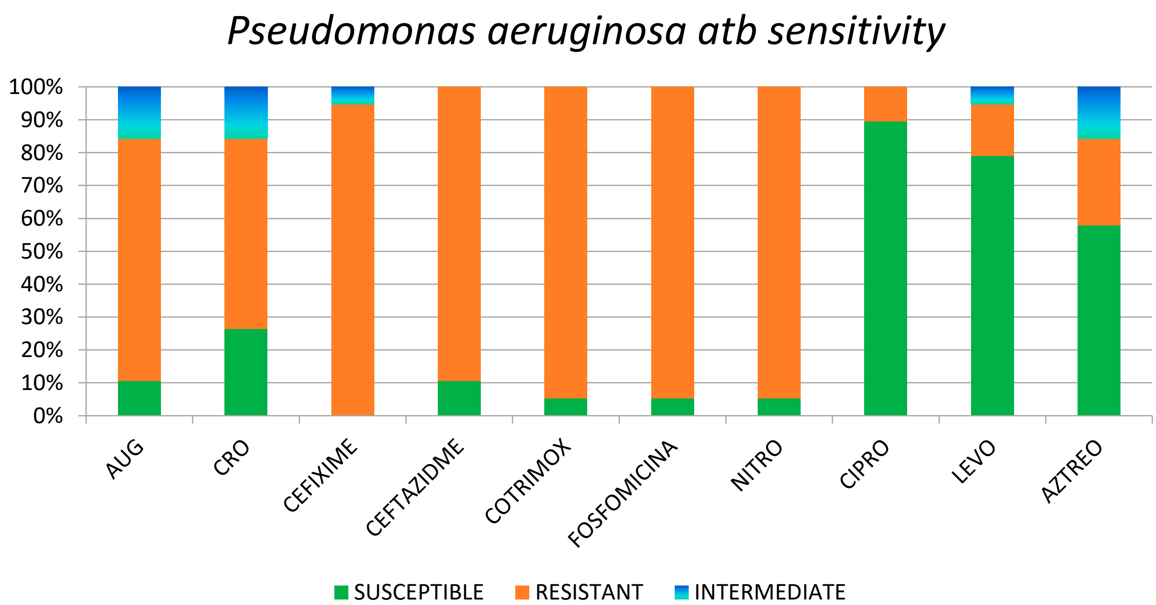

Figure 5
Antibiotic's sensitivity for Pseudomonas aeruginosa.

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The highest resistance was developed to amoxicillin-clavulanateand nitrofurantoin, which is consistent with the findings of other research (17) (18).
This widespread resistance can be attributed to the extensive and prolonged use of ampicillin in clinical settings, leading to selective pressure and the proliferation of resistant bacterial strains.

Our study shows higher sensitivity to ciprofloxacin and aztreonam, while other studies show resistance to it (19) (20).
This discrepancy may be due to regional differences in antibiotic prescribing practices or variations in local bacterial populations. Additionally, variations in resistance patterns can arise from differences in study design, sample size, and the specific patient populations being studied. Understanding these variations highlights the importance of local antimicrobial susceptibility testing to guide effective antibiotic therapy.

Our study identified a notable resistance to nitrofurantoin, contrasting with other research that reports sensitivity to this antibiotic in multi-drug-resistant pathogens (21).
This unexpected finding raises serious concerns about evolving resistance patterns and suggests that local variations in antibiotic usage and resistance mechanisms may be at play.
The emergence of resistance to nitrofurantoin, underscores the urgent need for enhanced surveillance and innovative approaches to combat antimicrobial resistance. Our findings highlight the importance of continuous monitoring and adapting treatment strategies to effectively address the dynamic landscape of bacterial resistance.

CONCLUSIONS

Our study of 691 patients highlights a significant prevalence of UTIs among females compared to males. Escherichia coli and Enterococcus spp. were predominant.
Antibiotic sensitivity analysis revealed promising results for Ceftriaxone, Ciprofloxacin, Levofloxacin and Aztreonam, while resistance was notable against amoxicillin-clavulanateand Nitrofurantoin, 2 of the 3 empirical treatments suggested by “The WHO AWaRe antibiotic book”(22) .
These findings emphasize the need for targeted antibiotic therapy based on local resistance patterns to effectively manage UTIs.

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Bibliografia

1. Ahmed, S. S., et al. "Uropathogens and Their Antimicrobial Resistance Patterns: Relationship with Urinary Tract Infections." International Journal of Health Sciences (Qassim), vol. 13, 2019, pp. 48–55. https://pubmed.ncbi.nlm.nih.gov/30983946/.
2. August, S. L., and M. J. De Rosa. "Evaluation of the Prevalence of Urinary Tract Infection in Rural Panamanian Women." PLoS One, vol. 7, 2012, doi:10.1371/journal.pone.0047752.
3. Balkhi, B., et al. "Antimicrobial Susceptibility of Microorganisms Causing Urinary Tract Infections in Saudi Arabia." Journal of Infection in Developing Countries, vol. 12, 2018, pp. 220–227, doi:10.3855/jidc.9517.
4. Barisić, Z., et al. "Urinary Tract Infections in South Croatia: Aetiology and Antimicrobial Resistance." International Journal of Antimicrobial Agents, vol. 22, no. 2, 2003, pp. 61–64, doi:10.1016/s0924-8579(03)00233-4
5. Bidell, M. R., et al. "Effect of Prior Receipt of Antibiotics on the Pathogen Distribution and Antibiotic Resistance Profile of Key Gram-Negative Pathogens among Patients with Hospital-Onset Urinary Tract Infections." BMC Infectious Diseases, vol. 17, 2017, p. 176, doi:10.1186/s12879-017-2270-7.
6. Bitew, G., et al. "Burden of Multi-Drug Resistant Bacterial Isolates and Its Associated Risk Factors among UTI-Confirmed Geriatrics in Gondar Town." Scientific Reports, vol. 15, 2025, p. 14270, doi:10.1038/s41598-025-89123-9.
7. Bonadio, M., et al. "Current Microbiological and Clinical Aspects of Urinary Tract Infections." European Urology, vol. 40, 2001, pp. 439–444, doi:10.1159/000049813.
8. Drazich-Taylor, Stuart, et al. "Resistance to Empirical Antibiotics in Urinary Tract Infections Caused by Enterobacterales in the East of England." JAC-Antimicrobial Resistance, vol. 7, no. 1, Feb. 2025, article dlaf003.
9. Farajnia, S., et al. "Causative Agents and Antimicrobial Susceptibilities of Urinary Tract Infections in the Northwest of Iran." International Journal of Infectious Diseases, vol. 13, 2009, pp. 140–144, doi:10.1016/j.ijid.2008.04.014.
10. Flores-Mireles, A. L., et al. "Urinary Tract Infections: Epidemiology, Mechanisms of Infection and Treatment Options." Nature Reviews Microbiology, vol. 13, 2015, pp. 269–284, doi:10.1038/nrmicro3432.
11. Ghady Haidar, et al. "Emergence of High-Level Aztreonam–Avibactam and Cefiderocol Resistance Following Treatment of an NDM-Producing Escherichia coli Bloodstream Isolate Exhibiting Reduced Susceptibility to Both Agents at Baseline." JAC-Antimicrobial Resistance, vol. 6, no. 5, Oct. 2024, article dlae141.
12. Global Leaders Group. Towards Specific Commitments and Action in the Response to Antimicrobial Resistance: Recommendations for Consideration by UN Member States in the Outcome Document of the High-Level Meeting on AMR in September 2024, 2024.
13. Khodabandeh, M., et al. "High-Level Aminoglycoside Resistance in Enterococcus faecalis and Enterococcus faecium: A Serious Threat in Hospitals." Infectious Disorders - Drug Targets, vol. 20, 2020, pp. 223–228, doi:10.2174/1871526519666181130095954.
14. Kuruvilla, Thomas S., et al. "To Explore the In Vitro Sensitivity of Nitrofurantoin and Its Efficacy in Treating Multidrug-Resistant Escherichia coli Urinary Isolates amongst Inpatients at a Tertiary Care Centre." Hamdan Medical Journal, vol. 16, no. 3, Jul.–Sep. 2023, pp. 260–262, doi:10.4103/hmj.hmj_68_23.
15. Ronald, A. R., et al. "Urinary Tract Infection in Adults: Research Priorities and Strategies." International Journal of Antimicrobial Agents, vol. 17, 2001, pp. 343–348, doi:10.1016/s0924-8579(01)00303-x.
16. Rubiñan, P., et al. "Ciprofloxacin for the Treatment of Infections Caused by Carbapenemase-Producing Gram-Negative Bacteria." Antibiotics, vol. 13, 2024, p. 1138, doi:10.3390/antibiotics13121138.
17. Salm, J., et al. "High Antimicrobial Resistance in Urinary Tract Infections in Male Outpatients in Routine Laboratory Data, Germany, 2015 to 2020." Eurosurveillance, vol. 27, no. 30, 2022, article 2101012, doi:10.2807/1560-7917.ES.2022.27.30.2101012.
18. Schwartz, D. J., et al. "Uropathogenic Escherichia coli Superinfection Enhances the Severity of Mouse Bladder Infection." PLoS Pathogens, vol. 11, 2015, article e1004599, doi:10.1371/journal.ppat.1004599.
19. Shaifali, I., et al. "Antibiotic Susceptibility Patterns of Urinary Pathogens in Female Outpatients." North American Journal of Medical Sciences, vol. 4, 2012, pp. 163–169, doi:10.4103/1947-2714.94940.
20. Shirvani, M., et al. "Evaluating the Pattern of Antibiotic Resistance of Urinary Tract Infection (UTI)-Causing Bacteria in the Urine Culture Samples of Patients in the Infectious Ward of Imam Khomeini Hospital, Kermanshah, in Iran from 2016–2018." African Journal of Urology, vol. 32, 2023, doi:10.1186/s12301-023-00364-4.
21. Wilson, M. L., and L. Gaido. "Laboratory Diagnosis of Urinary Tract Infections in Adult Patients." Clinical Infectious Diseases, vol. 38, 2004, pp. 1150–1158, doi:10.1086/383029.
22. The WHO AWaRe (Access, Watch, Reserve) antibiotic book. Geneva: World Health Organization; 2022. Licence: CC BY-NC-SA 3.0 IGO
23. Global antibiotic resistance surveillance report 2025 - WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS) October 2025 Geneva - ISBN 978-92-4-011633-7 (electronic version)

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