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Antibiotic Resistance Patterns In Recurrent Urinary Tract Infections: A Cross-Sectional Study

Abdul Azeem[1], Muhammad Zubair Abid[2], Atta Muhammad Khan[3]

1. Associate Professor Pharmacology Watim Medical And Dental College, Rawalpindi
2. Student MBBS Watim Medical And Dental College, Rawalpindi
3. Associate Professor Department of Medicine MTI LRH Peshawar.

Corresponding Author: Atta Muhammad Khan
Associate Professor Department of Medicine MTI LRH Peshawar.
Email: attamuhammadkhan@yahoo.com

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Abstract

Background: Urinary tract infections (UTIs) are prevalent, particularly in women, and recurrent UTIs (ruts) are a serious clinical management issue. Antibiotics resistance is now a significant challenge making treatment outcomes difficult. The knowledge of resistance trends in recurrent UTIs is important in designing specific treatment programs and enhancing patient outcomes.

Objectives: The purpose of the study is to determine the trends that occurred in antibiotic resistance among patients with recurrent urinary tract infections and determine the main factors predictive of resistance to establish effective treatment-based decisions.

Study design: A cross-sectional study.

Place and duration of study: Department of Pharmacology Watim Medical And Dental College, Rawalpindi from jan 2024 to june 2024

Methods: Patients diagnosed with recurrent UTIs within a 6-month period at a tertiary care hospital were recruited to participate in the cross-sectional study. Urine samples were taken and bacterial pathogens were detected. Kirby-Bauer disk diffusion method was used in antibiotic susceptibility testing. Patient demographics, prior use of antibiotics, and presence of co morbidities were gathered to determine their correlations with resistance patterns of antibiotics.

Results: 50 patients with recurrent UTIs were examined whose average age consisted of 45.7 (SD = 12.3). The commonest pathogen was Escherichia coli, where it was detected in 60 percent of samples. Impressive resistance rates were noted against widely used antibiotics such as ampicillin (72%), ciprofloxacin (55%), trimethoprim-sulfamethoxazole (62%). The prior antibiotic use had a strong connection with the high level of resistance as the result of statistical analysis showed (P-value < 0.01). Multivariate analysis demonstrated that co morbidities such as diabetes and often prescribed antibiotics were largely associated with increased rates of resistance.

Conclusion: the simmering problem of developing antibiotic resistance in repeated UTIs, especially to first-line antibiotics. History of use of antibiotics and co morbidities were main characteristics in determining resistance patterns. Individual patient history, antibiotic

stewardship, and available alternatives should be used to formulate effective management strategies to overcome the emerging dominance of antibiotic-resistant UTI pathogens.
Keywords: Recurrent UTI, pathogens, antibiotic resistance, treatment strategies
Introduction: E. coli are one of the most common bacterial infections, especially in women. Urinary infections can be simple cystitis, and complicated recurrent infection (1). The issue of recurrent urinary tract infections (ruts) poses quite a problem in the clinical practice, as the symptoms do recur frequently, usually requiring long (or repetitive) course of antibiotics. Resistance to antibiotics in uropathogens has become a major international public health issue, making it more difficult to treat ruts and a serious hazard to general health (2).The emergence of antibiotic resistance has been widely blamed upon over-susceptibility and misuse of antibiotics leading to the selection of resistant species (3). Regarding ruts, antibiotic resistance does not only influence the efficacy of empirical treatment but also enhances the risk of treatment failure and extended infection and, consequently, results in excessive healthcare expenses and worse patient outcomes (4). Escherichia coli is the most frequently isolated pathogen in UTIs and accounts to about 70-95 per cent of the cases although other pathogens, including Klebsiella pneumonia, Proteus mirabilis, and Enterococcus facials are also related to recurrent infections (5).The development of multidrug resistant (MDR) uropathogens has further compounded this situation. MDR bacteria are deemed resistant to three or more antibiotic classes, which increase the complications of treatment (6). Past surveys have demonstrated a significant rise in the resistance of first-line antibiotics like; Trimethoprim/Sulfamethoxazole, ampicillin and quinolones (7). Furthermore, misuse of antibiotic or ineffective antibiotic treatment in ruts may lead to additional morbidity, greater incidence of complications, and further significant deterioration in the quality of life of affected patients (8).That is why it is crucially important to observe the changing resistance patterns of uropathogenic microorganisms causing ruts. This level of surveillance enables guidance of treatment regimens and formulation of more effective, evidence-based management strategies of recurrent infections. The local epidemiology of antimicrobial resistance and possible risk factors of resistance may assist in the minimization of unjustified antibiotics usage and direct further specialist treatment measures. This study, hence, aims to determine patterns of antibiotic resistance among uropathogens in patients with recurrent UTIs within a tertiary care facility. Our objective is to establish the prevalence of the common pathogens, their resistance patterns and the factors leading to development of resistance in rut cases which would be used in treatment guidelines and devising better management approaches to these obscure infections (9).

Methods: This was a cross-sectional study carried out in a Department of Pharmacology Watim Medical And Dental College, Rawalpindi from jan 2024 to june 2024. One hundred and fifty patients who had repeated UTIs were recruited. Written informed consent was obtained by all participants before they were included in the study. The urine samples were obtained through midstream urine collection procedures and transported to the microbiology laboratory to isolate the bacteria through bacterial cultures and identification procedures. Susceptibility test to antibiotics was conducted using Kirby-Bauer disk diffusion plates as per the Clinical and Laboratory Standards Institute (CLSI) guidelines. Standard microbiological methods were used to determine pathogens and antibiotic susceptibilities in a group of commonly used antibiotics, ampicillin, ciprofloxacin and trimethoprim-sulfamethoxazole. Demographic data such as age,

sex, history of prior UTI episodes, and co morbidities (e.g., diabetes mellitus) were obtained by interviewing the patients and searching the medical records. Associations between the characteristics of patients and patterns of antibiotic resistance were analyzed by statistical analysis with SPSS version 24.0.

Declaration of Ethical Approval:

The Institutional Review Board (IRB) of Watim Dental College Rawat, Rawalpindi approved the study to meet ethical standards regarding human study. The study complied with the Declaration of Helsinki, with all participants giving their informed consent to take part in the study, and preserving their privacy and confidentiality.

Inclusion Criteria:

The study included patients with history of two or more UTIs in the previous six months, aged between 18 and 65 years, and patients that gave informed consent.

Exclusion Criteria:

Individuals who were currently or previously treated with broad-spectrum antibiotics, and those with urinary tract abnormalities or using indwelling catheters or pregnant were not included in the study.

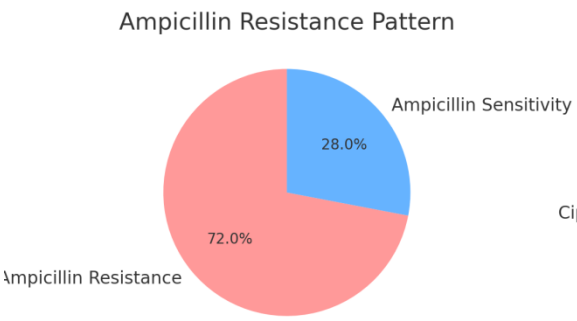
Data Collection:

The information was gathered by interviewing the patients and accessing the medical records. Collected information was demographics (age, sex), history of UTI (frequency, duration), co morbid conditions (e.g., diabetes), and patterns of antibiotic use. Microbiological data were documented about urinary cultures such as identification of pathogens and antibiotic resistance.

Statistical Analysis:

Statistical analysis of data was performed using SPSS version 24.0 (IBM Corp, Armonk, NY). Patient demographics, type of pathogen, and pattern of resistance have been summarized in descriptive statistics. Chi-square tests were used to detect possible correlations between patient factors (age, sex, co morbidities) and resistance to antibiotics. Lower than 0.05 was regarded as statistically significant to p-value.

Results: 50 patients with recurrent UTIs, of which the mean age was 45.7 years (SD = 12.3). Patients had co morbidities (diabetes mellitus or hypertension in 20 percent) and were mainly females (85 percent). The most frequently isolated pathogen was Escherichia coli which occurred in 60 percent of the cases, followed by Klebsiella pneumonia (15 percent) and Enterococcus facials (10 percent). Ampicillin, 72 percent of the E. coli isolates was resistant, ciprofloxacin, 55 percent of E. coli isolates was resistant, and finally, trimethoprim-sulfamethoxazole, out of the E. coli isolates, 62 percent was resistant to it. Statistical assessment showed significant correlations between previous use of antibiotics and increased resistance (p-value = < 0.01). There were also significantly higher rates of resistance among patients who had received antibiotics within the three months preceding their visit. Moreover, resistance was higher in co morbid conditions such as diabetes (p-value < 0.05). The second-line antibiotics resistance to ciprofloxacin and trimethoprim-sulfamethoxazole was at an alarming rate, which represented a change in resistance patterns. According to the study, in cases of recurrent UTIs, the resistance of uropathogens was seen to be 65% overall. Multivariate analysis demonstrated frequent UTI episodes and past antibiotic usage as relevant risks to the emergence of resistant infections.



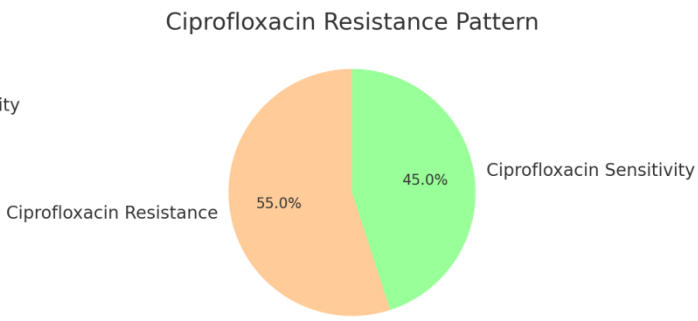


Table 1: Pathogen Frequency

Pathogen	Frequency (%)
Escherichia coli	60
Klebsiella pneumonia	15
Enterococcus facials	10

Table 2: Antibiotic Resistance

Antibiotic	Resistance Rate (%)	Sensitivity Rate (%)
Ampicillin	72	28
Ciprofloxacin	55	45
Trimethoprim-Sulfamethoxazole	62	38

Table 3: Risk Factor Resistance

Risk Factor	Increased Resistance (%)	No Increased Resistance (%)
Previous Antibiotic Use	80	20
Co morbid Conditions (e.g., Diabetes)	60	40

Discussion:

Recurrent urinary tract infections (ruts) present an issue that significantly impacts mortality and morbidity in society. Ruts are a prevalent clinical problem that afflicts a large percentage of the population, particularly women, and pose a considerable burden to the healthcare industry worldwide (10). The issue of antibiotic resistance in ruts is getting bigger in a way that treatment regimes become more complicated, which causes extended illness, higher expenditures on care, and potential of more drastic complications. The purpose of this study was to evaluate the antibiotic resistance of uropathogens in patients with recurrent UTIs in a tertiary care facility (11). Our results point to the fact of an alarming increase in the level of

antimicrobial resistance during the treatment of ruts, which corresponds to the growing literature demonstrating a trend towards multidrug-resistant (MDR) uropathogens (12).The most common pathogen isolated in this study was Escherichia coli, which was also reported in previous studies because, according to their evidences, 70%-95% of UTI are usually caused by E. coli (13). A study by Gupta et al. (14) supports this finding by demonstrating that E. coli caused the majority of uncomplicated and recurrent UTIs (15). The resistance rates noted in this study are alarming. There was a high level of resistance against common first-line drugs, including ampicillin (72%) and trimethoprim-sulfamethoxazole (62%). Such a finding reflects the results of various studies, one of those that was conducted by Anderson et al. (16), who described the rising resistance to these antibiotics among UTIs pathogens. The resistance rates to ciprofloxacin, reported in our study (55 percent) are corresponding to the increasing rates of fluoroquinolones resistance, recorded in various environments across the world (17). This trend in quinolones resistance has proved to be a great challenge in combating the UTIs compared to the time when quinolones were applied as the empiric therapy given the fact that it had a wide spectrum of activity. Our results ($p < 0.01$) are in line with previous studies on the correlation of prior antibiotic use with resistance. A report developed by Cake et al. (18) highlighted that the previous exposure to antibiotics has a high probability of causing antibiotic-resistant organisms to recurrent UTI. The literature on the involvement of antibiotic overuse in causing resistance has been well reported (19). The study findings showed that patients with a history of antibiotics in the last three months had significant rates of resistance to commonly used antibiotics thus supporting the need to monitor antibiotic use and stewardship efforts to curb development of resistance (20).Besides clinical history of antibiotics, co morbidities were also found to have increased rates of resistance in this study with diabetes mellitus being key among them. This is in line with what Kilometer and others have proved that patients who have diabetes face more gravitational risk of contracting resistant UTIs. It is possible that the hyperglycemic state of diabetics encourages bacterial growth and the development of biofilms, making it more difficult to treat infections using regular antibiotics. Moreover, diabetes patients might be prescribed with a more frequent use of antibiotics, which also increases the risk of developing resistance.

Conclusion:

This study highlights the increasing interest of antibiotic resistance in recurrent urinary tract infection, especially towards first-line antibiotics. The results demonstrate the significance of antimicrobial stewardship and patient-specific treatment. The surveillance of resistance patterns is essential in providing effective management of affected patients by ensuring that appropriate and timely therapy is provided.

Limitations:

A single-center nature of the study is one of its weaknesses and possibly is not representative of population trends. Also, the sample was rather small and depending on various factors like patient adherence to the prescribed antibiotics and unrecorded environmental factors the observed patterns of resistance could be different and therefore the findings may not be easily general sable.

Future Findings:

Large multicentre cohorts should be the object of future studies to increase the generalisablility of results. Additional studies will also be required on the mechanism of the resistance in ruts,

effectiveness of alternative treatments, and the development of some targeted interventions such as through development of vaccines or robotic therapies in order to decrease recurrence and resistance.

Abbreviations

1. **ruts**: Recurrent Urinary Tract Infections
2. **E. coli**: Escherichia coli
3. **MDR**: Multidrug-Resistant
4. **UTIs**: Urinary Tract Infections
5. **C. L. S. I**: Clinical and Laboratory Standards Institute
6. **SPSS**: Statistical Package for the Social Sciences
7. **IRB**: Institutional Review Board
8. **JAMA**: Journal of the American Medical Association
9. **M. D.**: Doctor of Medicine
10. **B. S.**: Bachelor of Science

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Authors Contribution

Concept & Design of Study: **Abdul Azeem**[1]
Drafting: **Muhammad Zubair Abid**[2]
Data Analysis: **Atta Muhammad Khan**[3]
Critical Review: **Abdul Azeem**[1]
Final Approval of version: All Mention Authors Approved the final Version .

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