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COMPARATIVE ANALYSIS OF UROPATHOGEN PREVALENCE AND ANTIBIOTIC TREATMENT PATTERNS IN E. coli VERSUS non-E. coli URINARY TRACT INFECTIONS AT A TERTIARY CARE CENTRE IN SOUTH INDIA

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ABSTRACT

Urinary tract infections (UTIs) cause substantial morbidity globally, and rising multidrug resistance complicates empirical therapy. Local data on uropathogen prevalence and antibiotic prescribing is vital for stewardship. **Aim:** To determine the prevalence of causative uropathogens and compare antibiotic prescribing patterns between E. coli and non-E. coli UTIs. **Methods:** A prospective cross-sectional study over six months reviewed 100 culture-proven UTI cases at S.H. Medical Centre, Kerala. Data on demographics, isolated organisms, and antibiotic regimens were collected. Frequencies and percentages were computed, and antibiotic prescription patterns were compared using χ^2 test ($\alpha = 0.05$). **Results:** Females comprised 62%, and 49% of patients were >70 years. Gram-negative organisms represented 94% of isolates. E. coli accounted for 63%, followed by Klebsiella pneumoniae (25%) and Pseudomonas aeruginosa (6%). Carbapenems were the most prescribed class in both groups (E. coli 36.5%, non-E. coli 37.8%), followed by cephalosporins and nitrofurantoin. The overall prescribing patterns between groups did not differ significantly ($\chi^2 = 6.60$, $p = 0.25$). **Conclusion:** E. coli remains the predominant uropathogen. The frequent empirical use of Carbapenems across both E. coli and non-E. coli UTIs—without differentiation—calls for adoption of sensitivity-guided therapy and strengthened antimicrobial stewardship.

KEYWORDS: Urinary tract infection, Escherichia coli, non-E. coli, antibiotic prescribing, antimicrobial resistance, South India.

1. INTRODUCTION

Urinary tract infections (UTIs) are among the most prevalent bacterial infections encountered in both community and hospital settings, affecting individuals of all age groups and genders. They account for a significant proportion of outpatient and inpatient antimicrobial prescriptions, posing a considerable public health burden worldwide. The clinical spectrum of UTIs ranges from uncomplicated lower urinary tract infections to complicated cases such as pyelonephritis and urosepsis.

The microbiological profile of UTIs is dominated by Gram-negative bacilli, with Escherichia coli (E. coli) recognized as the most frequent causative organism, responsible for the majority of community-acquired infections. However, recent trends have shown an increasing involvement of non-E. coli pathogens such as Klebsiella pneumoniae, Pseudomonas aeruginosa, Enterococcus spp., and Staphylococcus spp., especially in complicated and hospital-acquired infections. The distribution and prevalence of these uropathogens vary across geographical regions and healthcare settings, emphasizing the importance of local epidemiological surveillance.

Empirical antibiotic therapy is often initiated before culture results are available. However, the rising incidence of multidrug-resistant uropathogens has complicated the choice of appropriate empirical treatment. In particular, the emergence of extended-spectrum β-lactamase (ESBL)–producing E. coli and Klebsiella strains has reduced the effectiveness of commonly used antibiotics such as cephalosporins and fluoroquinolones. Consequently, there is a growing reliance on broad-spectrum agents like carbapenems, which, if overused, can accelerate antimicrobial resistance and compromise future treatment options.

Given these concerns, understanding the local prevalence of causative organisms and the antibiotic prescribing patterns associated with them is critical for guiding empirical therapy and supporting antimicrobial stewardship.

Therefore, the present study was designed with two specific objectives:

1. To determine the prevalence and distribution of uropathogens isolated from patients with culture-proven urinary tract infections at a tertiary care hospital in South India.
2. To compare the antibiotic treatment patterns prescribed for UTIs caused by E. coli and those caused by non-E. coli pathogens, in order to evaluate whether empirical treatment strategies differ between these groups.

By addressing these objectives, this study aims to provide insight into current prescribing practices and local microbial trends, thereby contributing to evidence-based infection management and rational antibiotic use in clinical practice.

2. MATERIALS AND METHODS

Study Design

A prospective cross-sectional study was conducted to evaluate the prevalence of uropathogens and compare antibiotic treatment patterns in E. coli and non-E. coli urinary tract infections (UTIs).

Study Setting

The study was carried out in the Microbiology Department and Outpatient/Inpatient Departments of SH Medical Centre, Kottayam, Kerala, India.

Study Duration

The study was conducted over a period of six months.

Study Population

The study population included patients diagnosed with urinary tract infections (UTIs) who had positive urine culture and sensitivity reports.

Sampling Technique

A simple random sampling technique was used to select the study subjects.

Sample Size Determination

The sample size was calculated using the following formula:

n = [(Z_{α/2} + Z_{β})^2 × \{p_1(1 - p_1) + p_2(1 - p_2)\}] / (p_1 - p_2)^2

Where:

$Z\alpha/2 = 1.96$ (for 95% confidence level)

$Z\beta = 0.84$ (for 80% power; $\beta = 0.20$)

$p_1 = 0.6$ (expected proportion in one group)

$p_2 = 0.4$ (expected proportion in the other group)

Substituting the values:

$n = [(1.96 + 0.84)^2 \times \{0.6(1 - 0.6) + 0.4(1 - 0.4)\}] / (0.6 - 0.4)^2$

$n = [7.84 \times \{0.24 + 0.24\}] / 0.04$

$n = [7.84 \times 0.48] / 0.04$

$n = 3.7632 / 0.04$

$n = 94.08$

Thus, the final sample size was rounded to 100.

A total of 100 positive culture and sensitivity reports were included in the study.

Inclusion Criteria

- Patients of all age groups and both genders diagnosed with urinary tract infection.
- Culture-positive urine samples with identifiable uropathogens.

Exclusion Criteria

- Patients with mixed or contaminated urine cultures.
- Patients on antibiotic therapy prior to sample collection.
- Pregnant women and critically ill patients.

Data Collection

Urine samples were collected and processed using standard microbiological procedures. Positive culture reports were analyzed to identify the causative organisms. Antibiotic susceptibility patterns were obtained from the culture and sensitivity reports of the Microbiology Department.

Relevant patient data such as age, gender, and clinical diagnosis were collected from hospital records.

Data Analysis

The collected data were entered into Microsoft Excel and analyzed using descriptive statistics. The prevalence of each uropathogen was calculated as a percentage. Comparative analysis of antibiotic susceptibility between E. coli and non-E. coli isolates was performed.

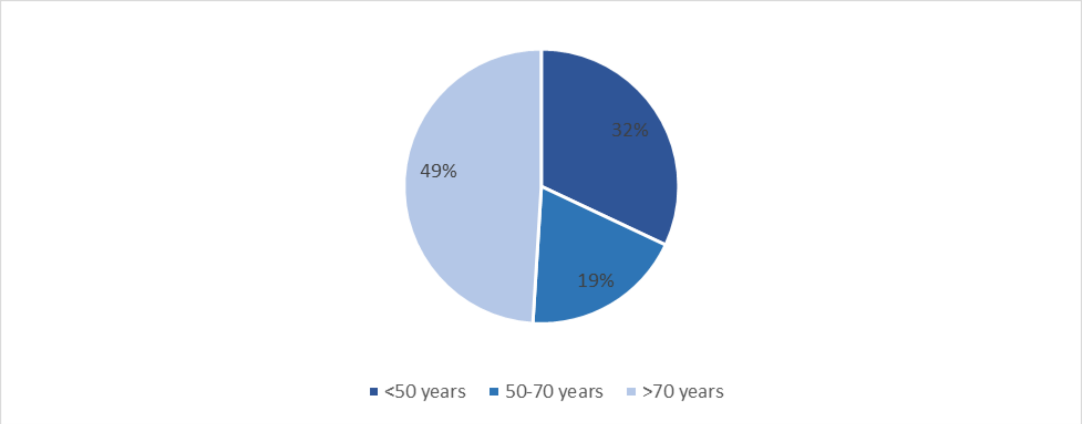
3. RESULTS

3.1 Demographic and Organism Profile

A total of 100 patients met the inclusion criteria and were included in the study.

Age-wise distribution

Age Group	Frequency (n)	Percentage (%)
<50 years	32	32%
50–70 years	19	19%
>70 years	49	49%

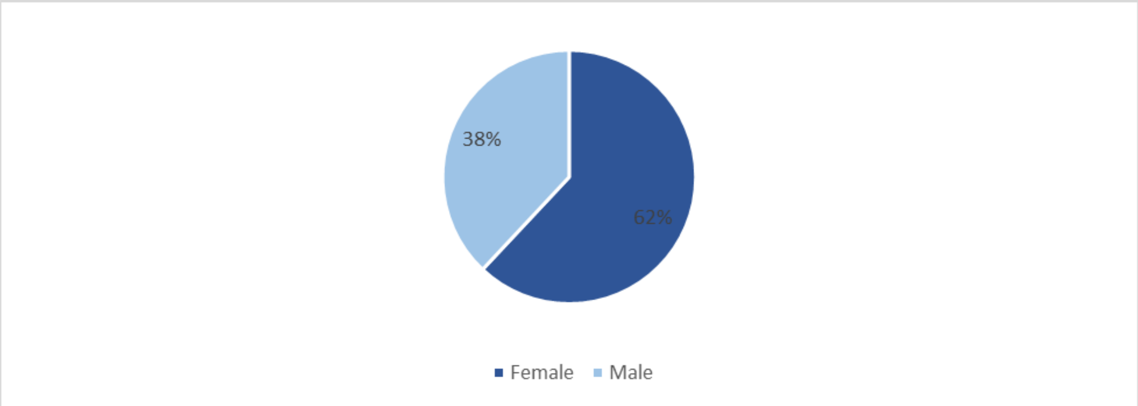


Frequency and percentage distribution according to age group.

Inference: UTIs were more common in older patients (>70 years), reflecting age-related susceptibility due to declining immunity and comorbidities.

Gender-wise distribution

Gender	Frequency (n)	Percentage (%)
Female	62	62%
Male	38	38%

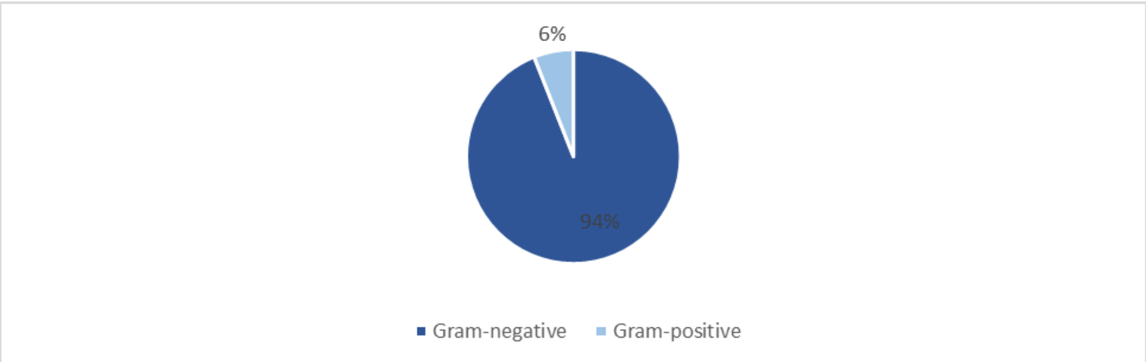


Frequency and percentage distribution according to gender.

Inference: UTIs were more prevalent in females, likely due to anatomical and physiological factors increasing susceptibility.

Organism type

Organism Type	Frequency (n)	Percentage (%)
Gram-negative	94	94%
Gram-positive	6	6%

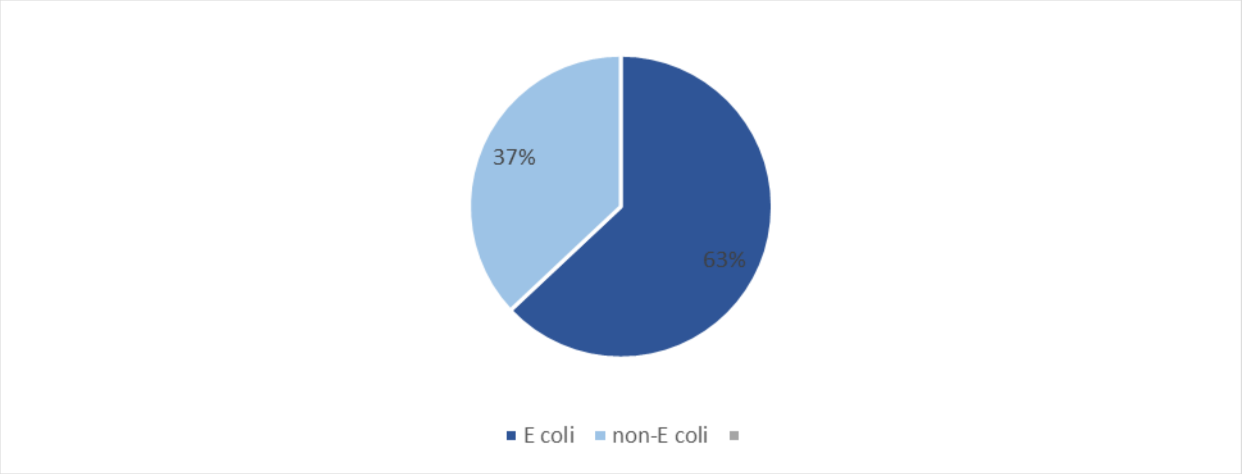


Frequency and percentage distribution according to type of organism.

Inference: Gram-negative organisms predominated, consistent with E. coli being the most frequent uropathogen.

Frequency and Percentage Distribution of E coli and non-E coli

Organism	Frequency (n)	Percentage (%)
E coli	63	63%
Non-E coli	37	37%

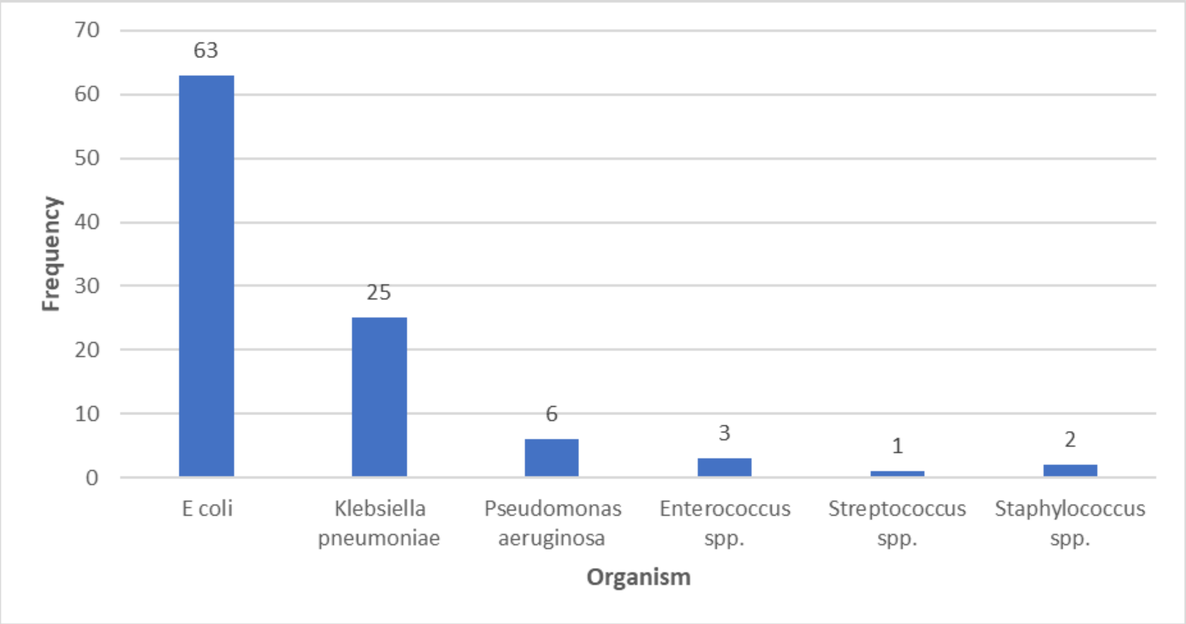


Frequency and percentage distribution of E coli and non-E coli.

Inference: The data indicates that E coli is the predominant uropathogen, whereas non-E coli comprises 37%.

3.2 Uropathogen Prevalence

Organism	Category	Frequency (n)	Percentage (%)
Escherichia coli	E. coli	63	63
Klebsiella pneumoniae	Non-E. coli	25	25
Pseudomonas aeruginosa	Non-E. coli	6	6
Enterococcus spp.	Non-E. coli	3	3
Streptococcus spp.	Non-E. coli	1	1
Staphylococcus spp.	Non-E. coli	2	2
Total Non-E. coli		37	37

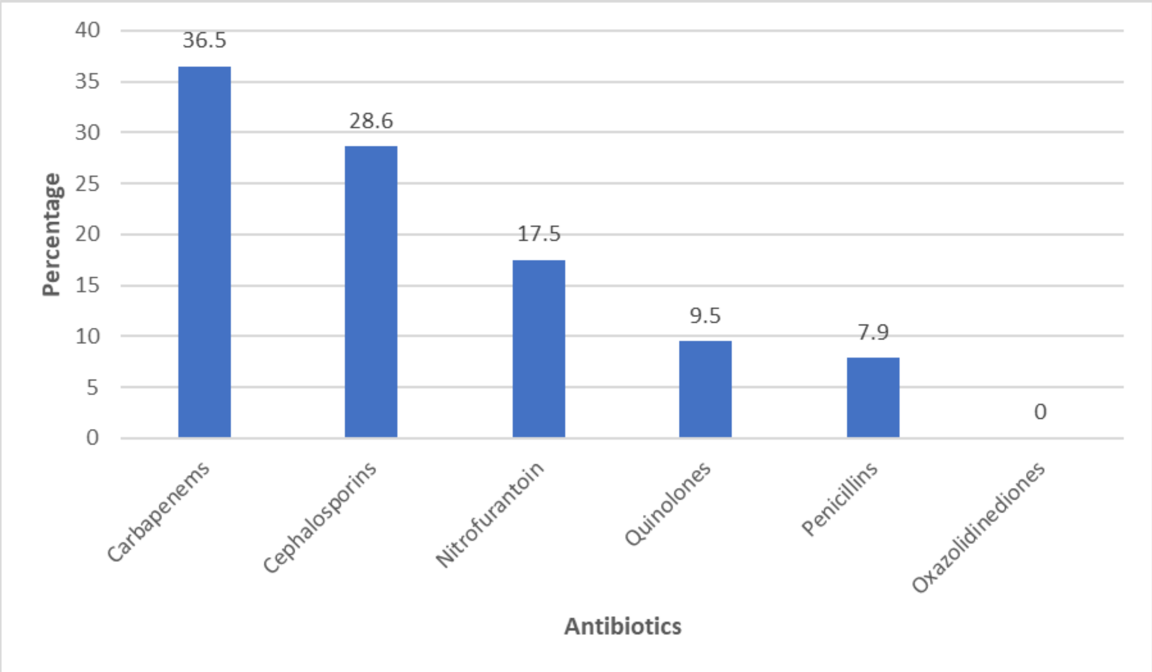


Frequency and percentage distribution of uropathogens.

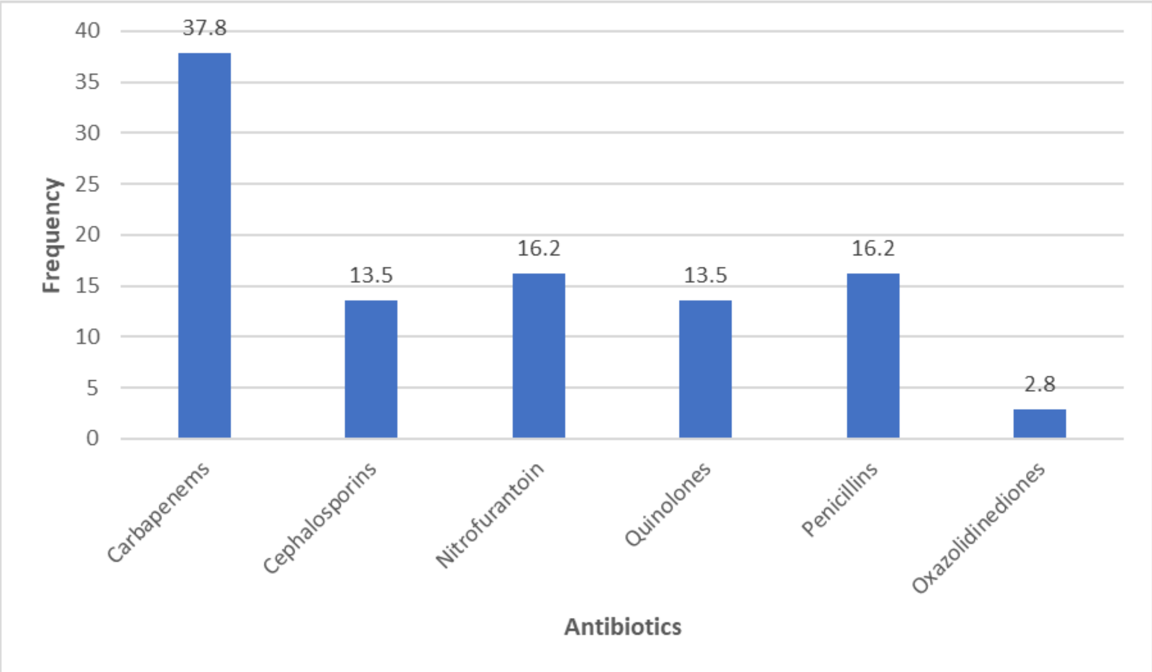
Inference: E. coli was the predominant isolate (63%), while non-E. coli pathogens accounted for 37% of infections.

3.3 Antibiotic Treatment Patterns in E. coli vs Non-E. coli UTIs.

Antibiotic Class	E. coli (n = 63)	% (n)	Non-E. coli (n = 37)	% (n)
Carbapenems	23	36.5%	14	37.8%
Cephalosporins	18	28.6%	5	13.5%
Nitrofurantoin	11	17.5%	6	16.2%
Quinolones	6	9.5%	5	13.5%
Penicillins	5	7.9%	6	16.2%
Oxazolidinediones	0	0.0%	1	2.8%



Frequency and percentage distribution of antibiotics in UTI caused by E coli.



Frequency and percentage distribution of antibiotics in UTI caused by non-E coli.

Inference: The χ^2 test for antibiotic class distribution yielded $\chi^2 = 6.60$, $p = 0.252$, indicating no significant difference in prescribing patterns between E. coli and non-E. coli UTIs.

4. DISCUSSION

This study reaffirms E. coli as the leading uropathogen (63%) in UTIs, consistent with global trends. Klebsiella pneumoniae and Pseudomonas aeruginosa were the next most frequent isolates, often associated with more complicated or nosocomial infections. The predominance in females and the elderly aligns with known epidemiologic risk factors.

The striking finding is the high empirical usage of Carbapenems in both E. coli and non-E. coli cases—even though prescribing did not differ significantly between groups. Such practice raises concerns: Carbapenems should ideally be reserved for multidrug-resistant organisms, and indiscriminate use risks accelerating carbapenem resistance (such as CRE). The moderate use of nitrofurantoin is a more favorable sign, as it is a narrow-spectrum agent appropriate for uncomplicated UTIs.

Limitations: This is a single-center study with a modest sample size, which may affect generalizability. Exclusion of catheter-associated and polymicrobial UTIs could underestimate non-E. coli incidence. Future work should incorporate molecular resistance testing (e.g., ESBL, carbapenemase genes) and assess patient outcomes relative to antibiotic choice.

5. CONCLUSION

This study provides important insights into the prevalence of uropathogens and antibiotic prescribing trends among urinary tract infection (UTI) patients in a tertiary care centre in South India. The study population was predominantly female, with a higher occurrence of infections among elderly individuals, reflecting the known epidemiological risk factors for UTIs. Escherichia coli (E. coli) emerged as the most common causative organism, accounting for 63% of isolates, reaffirming its global predominance as the leading uropathogen.

Among the non-E. coli pathogens, Klebsiella pneumoniae and Pseudomonas aeruginosa were frequently identified, often associated with more complicated or hospital-acquired infections. The antibiotic utilization pattern revealed a high empirical use of Carbapenems in both E. coli and non-E. coli cases, despite the absence of statistically significant differences in prescribing patterns ($\chi^2 = 6.60$, $p = 0.25$). This finding highlights a concerning trend of broad-spectrum antibiotic use, which could accelerate the development of antimicrobial resistance.

The study emphasizes the need for culture-based, sensitivity-guided antibiotic therapy and antimicrobial stewardship programs to rationalize the use of high-end antibiotics and preserve their effectiveness for future use. Regular surveillance of resistance patterns and adherence to institutional antibiotic policies are crucial to optimize UTI management and prevent the emergence of multidrug-resistant strains.

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DECLARATIONS

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Conflict of interest: None Declared
Ethical approval: The study was approved by the Institutional Ethics Committee.

CONFLICT OF INTEREST

The authors declare no conflict of interest in conducting this study, the design, data collection, analysis, interpretation, reporting its findings or publication of this research.

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