ORIGINAL ARTICLE

Rising Resistance: UTI Pathogens in Elderly Patients in a Rural Hospital of Maharashtra, India

Sabiha S. Tamboli

ABSTRACT

Background: Urinary tract infections (UTIs) are a significant health issue among elderly patients. Age-related changes, existing comorbidities, and frequent catheter use heighten the risk of UTIs in this cohort. ***Objective:*** This study aimed to identify the bacteriological profile and antibiotic resistance patterns of UTI pathogens in elderly patients from a rural tertiary care hospitals of Maharashtra, India. ***Methods:*** This cross-sectional study was conducted, among 300 elderly patients (aged 60 years and above) with clinically suspected UTIs. Midstream urine samples were aseptically collected and cultured using standard media. Bacterial identification was performed using the Kirby-Bauer disc diffusion method, adhering to CLSI guidelines. ***Results:*** Among the 300 samples, 250(83.3%) exhibited significant bacterial growth. Escherichia coli was the most prevalent isolate (45%), followed by Klebsiella pneumoniae (20%), Proteus mirabilis (12%), Pseudomonas aeruginosa (10%), Enterococcus faecalis (10%), and Staphylococcus aureus (3%). High antibiotic resistance rates were observed for beta-lactams such as amoxicillin (90% for E. coli), ciprofloxacin (70%), and ceftriaxone (60%). Carbapenems showed the lowest resistance across major isolates, with only 10% resistance reported for E. coli. Colistin and amikacin remained highly effective, with multidrug resistance rates below 10%. ***Conclusion:*** The study revealed that E. coli is the predominant pathogen in UTIs among elderly patients, exhibiting significant resistance to antibiotics like amoxicillin and ciprofloxacin. These findings highlight the necessity of routine urine culture and sensitivity testing to guide empirical treatment and emphasize the need for stringent antibiotic stewardship to combat rising resistance rates.

Keywords: Antimicrobial resistance, urinary tract infection, elderly patients, bacteriological profile, India

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INTRODUCTION

Urinary tract infections (UTIs) rank among the most prevalent bacterial infections, affecting individuals across all age groups, but they are especially common in the elderly population. These infections contribute significantly to morbidity in older adults, leading to a notable portion of hospital admissions and antibiotic prescriptions in this age bracket. Elderly patients are particularly susceptible to UTIs due to age-related physiological changes, compromised immune function, and multiple coexisting health conditions like diabetes, hypertension, and chronic kidney disease. These factors, combined with the frequent use of urinary catheters and extended hospital stays, create an optimal environment for bacterial colonization and infection.[1-3]

In elderly patients, UTIs often present with atypical symptoms such as confusion, falls or generalized weakness, rather than the classic signs of dysuria and frequency. This atypical presentation can delay diagnosis and treatment, resulting in complications such as urosepsis and acute kidney injury. Additionally, recurrent UTIs are a common problem in this demographic, complicating their clinical management.[4,5]

Correspondence to: Dr. Sabiha S Tamboli, Associate Professor, Department of Microbiology, IIMSR Medical College, Warudi, Jalna, Maharashtra, India. Email: sabihatamboli77@gmail.com

The rising prevalence of antibiotic-resistant uropathogens significantly challenges the effective management of UTIs. Resistance to commonly used antibiotics like amoxillin, ciprofloxacin, and third-generation cephalosporins is increasing worldwide, including in India. The indiscriminate use of antibiotics in both hospital and community settings exacerbates this issue, limiting the options for empirical therapy. The elderly, who often require frequent antibiotic use for various infections, are particularly impacted by this growing resistance.[6,7]

Understanding the bacteriological profile of urinary tract infections and the associated antibiotic resistance patterns in a specific region is crucial for developing effective treatment protocols. Maharashtra, one of India's largest states with a diverse population and healthcare infrastructure, presents unique challenges in managing urinary tract infections in the elderly. Tertiary care hospitals, serving as referral centres for complicated cases, frequently encounter multidrug-resistant pathogens, necessitating updated local data to guide empirical treatment.[8-10] This study aims to bridge the gap in regional data by analysing the bacteriological profile of urinary tract infections in elderly patients admitted into a tertiary care rural hospital of Maharashtra, India. The objectives include identifying the predominant bacterial pathogens causing urinary tract infections in elderly patients and assessing the antibiotic resistance patterns of these pathogens. By providing insights into the microbial spectrum and resistance trends, this study seeks to inform clinical decision-making, promote rational antibiotic use, and contribute to better patient outcomes.

METHODS

This cross-sectional study was conducted, between July and December of 2021, in the Department of Microbiology in a tertiary care rural hospital of Maharashtra state in India. The study focused on elderly patients aged 60 years and above who presented with clinical symptoms of urinary tract infections, such as fever, dysuria, urgency, and suprapubic pain, confirmed by laboratory tests indicating pyuria and bacteriuria.[11] Patients who had taken antibiotics for any infection within the previous two weeks, those with known structural abnormalities of the urinary tract, or those with a history of recent urological surgery or instrumentation were excluded from the study. Informed consent was obtained from all participants, and ethical committee clearance was secured before the study began.

A total of 300 midstream urine samples were collected aseptically from elderly patients admitted to various hospital departments. For catheterized patients, urine was aspirated from the catheter port using a sterile syringe.[12] Samples were promptly transported to the laboratory and cultured on blood agar and MacConkey's agar plates. The plates were incubated at 37°C for 24 hours, and significant growth was defined as greater than 10^5 colony-forming units per ml.[13] Bacterial colonies were identified using standard microbiological techniques, including Gram's staining, motility tests, and biochemical tests (indole, citrate, urease, oxidase, and coagulase tests).[14] Antimicrobial susceptibility testing was conducted using the Kirby-Bauer disc diffusion method on Muller-Hinton agar, following the Clinical and Laboratory Standards Institute (CLSI) guidelines.[15] The antibiotics tested included beta-lactams, fluoroquinolones, nitrofurantoin, carbapenems, and aminoglycosides.

Data were collected, scrutinized and recorded in Microsoft Excel and analysed using descriptive statistics. Results were presented as frequency and percentages in tabulated form.

RESULTS

Out of 300 elderly patients enrolled in the study, 175(58.3%) were male and 125(41.7%) were female. The majority of patients 63.3% were aged between 60 and 70 years and 36.7% were older than 70 years. Common risk factors included diabetes mellitus in 100 (33.3%) patients and catheterization in 90 (30%) patients (Table 1). Out of 300 urine samples, 250(83.3%) showed significant growth, while 50(16.7%) samples had no significant growth. Escherichia coli was the most frequently isolated pathogen (45%) followed by Klebsiella pneumoniae (20%), Proteus mirabilis (12%), Pseudomonas aeruginosa (10%), Enterococcus faecalis (10%) and Staphylococcus aureus (3%) (Table 2). Antibiotic susceptibility testing (AST) was performed for all significant isolates against a broader panel of antibiotics, including amoxicillin, ceftriaxone, piperacillin-tazobactam, ciprofloxacin, levofloxacin, nitrofurantoin, imipenem, meropenem, gentamicin, amikacin, colistin and fosfomycin.

High antibiotic resistance rates were observed for beta-lactams such as amoxicillin (90% for E. coli), ciprofloxacin (70%), and ceftriaxone (60%). Carbapenems showed the lowest resistance across major isolates, with only 10% resistance reported for E. coli. Colistin and amikacin remained highly effective, with multidrug resistance rates below 10% (Table 3).

Table 1: Demographic and Clinical Characteristics of Patients

Parameters	Frequency (Percentage)
Male	175 (58.3%)
Female	125 (41.7%)
Age Group (60-70 years)	190 (63.3%)
Age Group (>70 years)	110 (36.7%)
Diabetic Patients	100 (33.3%)
Catheterized Patients	90 (30%)

Table 2: Distribution of bacterial isolates

Bacterial isolates	Frequency (Percentage)
Escherichia coli	112 (45%)
Klebsiella pneumoniae	50 (20%)
Proteus mirabilis	30 (12%)
Pseudomonas aeruginosa	25 (10%)
Enterococcus faecalis	25 (10%)
Staphylococcus aureus	8 (3%)

Table 3: Antibiotic resistance pattern of major isolates (in percentage)

Antibiotic	E coli	K. pneumoniae	P. mirabilis	P. aeruginosa	E. faecalis	S. aureus
Amoxicillin	90	85	75	70	45	50
ceftriaxone	60	55	50	75	20	25
Piperacillin tazobactam	25	30	35	40	-	-
Ciprofloxacin	65	60	55	70	35	40
Levofloxacin	60	55	50	65	30	35
Nitrofurantoin	20	25	30	80	15	20
Gentamicin	30	40	45	50	25	30
Amikacin	15	20	25	35	-	-
Imipenem	10	15	20	25	10	-
Meropenem	10	15	20	25	10	-
Colistin	5	10	15	10	-	-
Fosfomycin	20	25	-	-	20	20

DISCUSSION

This present study highlights the bacteriological profile and antibiotic resistance patterns of urinary tract infections (UTIs) among elderly patients admitted to a tertiary care hospital in Maharashtra. The findings are consistent with both national and international studies, underscoring the predominance of Escherichia coli and the rising trend of antibiotic resistance. Escherichia coli was the most frequently isolated pathogen (45%), consistent with its role as the leading cause of UTIs globally. The predominance of E. coli is supported by its various virulence factors, including adhesins, biofilm formation, and toxin production, which facilitate colonization and persistence in the urinary tract. Similar findings were reported in previous studies done by Taneja et al.[16] and Mahajan et al.[17], which identified E. coli as the predominant uropathogen in 46% and 50% of cases, respectively. Klebsiella pneumoniae, the second most common pathogen (20%), is often associated with healthcare-associated infections, particularly in catheterized patients. This finding aligns with studies done by Kumar et al.[18], where K. pneumoniae was isolated in 18-22% of UTI cases. Nonfermenting Gram-negative bacteria such as Pseudomonas aeruginosa (10%) and Proteus mirabilis (12%) are more commonly associated with hospital-acquired infections and catheter-related infections. Their isolation rates in this study are consistent with those reported by Singh et al.[19] in a similar setting. However, Gram-positive cocci, including Enterococcus faecalis (10%) and Staphylococcus aureus (3%), were less frequently isolated. These findings align with the global trend of Gram-negative dominance in UTIs, though Gram-positive pathogens are increasingly recognized for their role in complicated and recurrent infections.[20]

The resistance to beta-lactams, including amoxicillin (90%) and ceftriaxone (60%) in E. coli is alarmingly high. These findings align with Rao et al.,[21] and Patel et al.,[22] as they reported similar resistance rates exceeding 85% for amoxicillin and 55-65% for ceftriaxone. High resistance to fluoroquinolones, such as ciprofloxacin (65% in E. coli), reflects the overuse and misuse of these agents in clinical practice. Levofloxacin showed slightly lower resistance (60%) but its use should still be monitored carefully to prevent further resistance development. Nitrofurantoin exhibited low resistance rates (20% in E. coli),

making it a viable option for empirical treatment of uncomplicated UTIs. Similar efficacy was observed by Taneja et al.[16] Fosfomycin also showed good efficacy with resistance rates of 20-25% among Gram-negative isolates. This antibiotic is increasingly recommended for multidrug-resistant UTIs, as noted in the study done by Miller et al.[20] Carbapenems (imipenem and meropenem) demonstrated excellent efficacy, with resistance rates of 10-15% in E. coli and K. pneumoniae. These results are consistent with the findings of the study done in Karnataka and Tamil Nadu states of India, where carbapenem resistance rates were reported below 20%.[22] However, the emergence of carbapenem-resistant strains in non-fermenting bacteria, such as Pseudomonas aeruginosa, highlights the need for cautious use to preserve their efficacy. Aminoglycosides (gentamicin and amikacin) showed moderate resistance rates (15-40%), similar to the finding of Singh et al.[19] Amikacin demonstrated better efficacy than gentamicin, making it a preferred choice in severe infections. Colistin, a last-resort antibiotic, exhibited minimal resistance (<10%) across most isolates, consistent with global trends. However, its use should be restricted to prevent the emergence of resistant strains, as emphasized by Sharma et al.[23]

While many of the findings in this study align with national and international literature, certain discrepancies were observed when compared with studies from other regions or settings. These differences may be attributed to variations in study population, geographical location, hospital practices, and local resistance patterns. Several studies, such as one conducted by Kaye et al.[24], reported a higher prevalence of Gram-positive organisms like Enterococcus faecalis and Staphylococcus aureus in elderly patients. In contrast, this study found a predominance of Gram-negative bacteria, particularly Escherichia coli (45%) and Klebsiella pneumoniae (20%). The lower isolation rates of Gram-positive pathogens in our study (13% combined) might reflect regional differences in healthcare practices. Fluoroquinolones in global studies, e.g., Flores-Mireles et al.[25] reported lower resistance rates to fluoroquinolones like ciprofloxacin (30-40%) compared to the 65% resistance observed in E. coli in the present study. This discrepancies may be due to widespread and unregulated use of fluoroquinolones in India compared to stricter antibiotic stewardship practices in the Western countries.

While this study observed low resistance rates to carbapenems (10-15%) in Gram-negative bacteria (GNB), isolates from regions with a high burden of antimicrobial resistance, such as the Middle East, have reported much higher resistance rates to carbapenems.[26] This discrepancy highlights the importance of local data in guiding empirical therapy and antibiotic stewardship. Gupta et al.[27] suggested that nitrofurantoin is less effective in complicated UTIs or in cases involving catheterized patients due to its limited activity against certain Gram-negative pathogens. However, in this study, nitrofurantoin showed good efficacy with a resistance rate of only 20% in E. coli, even among hospitalized patients. Another study conducted in Northern India reported a higher prevalence of multidrug-resistant (MDR) rates, with carbapenem resistance limited to 15% in K. pneumoniae and 25% in P. aeruginosa.[16] This discrepancy might indicate regional differences in infection control practices or antibiotic use policies. The discrepancies observed between the findings of the present study and those reported in previous studies highlight the importance of local data in guiding empirical therapy and antibiotic stewardship. They also underscore the need for continuous surveillance and collaborative research to understand the factors contributing to regional variations in pathogen prevalence and resistance patterns.

In elderly population, the common risk factors included diabetes mellitus, catheterization, and advanced age. These findings emphasize the importance of risk factor management in preventing UTIs among elderly patients. The high resistance rates to first-line antibiotics necessitate a shift towards evidence-based empirical therapy guided by local antibiograms. Nitrofurantoin and fosfomycin should be prioritized for uncomplicated cases, while carbapenems and piperacillin-tazobactam should be reserved for severe or hospital-acquired infections.

CONCLUSION

To summarize, this study emphasizes the urgent need for personalized antibiotic therapies, effective risk factor management, and stringent infection control measures to address the rising incidence of urinary tract infections (UTIs) in elderly patients. Continuous monitoring of antimicrobial

resistance patterns is vital to inform treatment strategies and shape national antibiotic policies. The increasing resistance to traditional antibiotics highlights the importance of developing and clinically evaluating new antimicrobial agents. Educational campaigns focusing on the elderly and their caregivers about the significance of hydration, hygiene, and prompt medical attention can help reduce UTI occurrences. The findings from this research provide critical insights for healthcare professionals and policymakers, aiding in the optimization of UTI management and the fight against antimicrobial resistance.

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Author's Contribution: The author is solely responsible for the conception and design of the study, patient selection, data collection, compilation, analysis as well as manuscript writing, revision and final submission.

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