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Clinical, Laboratory, and Etiological Spectrum of Urinary Tract Infections in Elderly Women: Implications for Antimicrobial Resistance

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Abstract: ***Background***: Urinary tract infections (UTIs) are a major cause of morbidity among elderly women and are frequently complicated by comorbid metabolic disorders and antimicrobial resistance. Age-related physiological changes, diabetes mellitus, and renal dysfunction predispose this population to severe infection and poor outcomes. Region-specific data integrating clinical, laboratory, and microbiological profiles remain limited in India. Methods: This hospital-based observational cross-sectional study was conducted over one year in a tertiary care center in eastern India. A total of 100 elderly female patients with clinically suspected UTI and microbiological confirmation were enrolled. Demographic characteristics, comorbidities, clinical presentation, and laboratory parameters were recorded using a structured proforma. Urine samples were processed for routine microscopy, culture, organism identification, and antimicrobial susceptibility testing using standard methods in accordance with Clinical and Laboratory Standards Institute guidelines. Descriptive statistical analysis was performed using SPSS version 25.0. Results: The mean age of participants was 71.14 years, with a predominance of patients aged 61–70 years. Diabetes mellitus was the most common predisposing factor (47%), followed by chronic kidney disease (27%). Common clinical features included chills and rigors (73%), burning micturition (71%), and fever (64%). Laboratory evaluation revealed anemia in most patients, leucocytosis in 19%, elevated random blood glucose in 87%, and raised serum creatinine in 36%. Urine culture demonstrated a predominance of Escherichia coli (94%), Klebsiella species (93%), and Enterococcus species (87%). Carbapenems showed the highest antimicrobial sensitivity among Gram-negative isolates. Conclusions: UTIs in elderly women are characterized by significant metabolic comorbidity, atypical clinical presentation, and a predominance of multidrug-resistant uropathogens. Routine culture-guided therapy and region-specific antimicrobial stewardship are essential to optimize management and limit resistance in this vulnerable population.

Keywords: Urinary tract infection; Elderly females; Uropathogenic bacteria; Antimicrobial resistance; Diabetes mellitus; Etiological profile; Clinical presentation; Laboratory biomarkers; Urine culture and sensitivity; Antimicrobial stewardship.

INTRODUCTION

Urinary tract infections (UTIs) remain among the most common bacterial infections worldwide and represent a substantial cause of morbidity, healthcare utilization, and antimicrobial consumption, particularly among elderly women. With advancing age, the incidence, severity, and recurrence of UTIs increase markedly, driven by a convergence of biological, metabolic, and structural risk factors unique to this population. As global life expectancy rises, UTIs in older adults are emerging as an increasingly important public health concern, especially in low- and middle-income countries with ageing populations and limited antimicrobial stewardship infrastructure [1-3].

Elderly females are disproportionately affected by UTIs due to age-related anatomical and physiological

changes, including estrogen deficiency, impaired mucosal immunity, pelvic floor dysfunction, and increased post-void residual urine. These factors are further compounded by a high prevalence of comorbidities such as diabetes mellitus, chronic kidney disease, and hypertension, which independently increase susceptibility to infection and complicate clinical outcomes [4-6]. Diabetes mellitus, in particular, has been consistently identified as a major predisposing factor, through mechanisms involving immune dysregulation, autonomic neuropathy, glycosuria, and enhanced bacterial adherence to uroepithelial cells [5-7].

The clinical presentation of UTIs in elderly women often differs from that seen in younger populations. While classical lower urinary tract symptoms such as dysuria, urgency, and frequency may be present, systemic manifestations—including fever, chills, altered sensorium, and reduced urine output are frequently observed and may dominate the clinical picture [8,9]. Atypical presentations and overlap with other geriatric syndromes can delay diagnosis and treatment, increasing the risk of complications such as sepsis, acute kidney injury, and prolonged hospitalization. Consequently, accurate characterization of the clinical and laboratory profile of UTIs in elderly females is essential for timely diagnosis and appropriate management [10].

From a microbiological perspective, *Escherichia coli* continues to be the most commonly isolated uropathogen across age groups and geographical regions. However, recent studies from both India and other countries have demonstrated an increasing contribution of other Enterobacterales, particularly *Klebsiella* species and *Enterococcus* species, in elderly and hospitalized populations [11-14]. This shift has been accompanied by a worrying rise in antimicrobial resistance, including extended-spectrum β-lactamase (ESBL) production and reduced susceptibility to fluoroquinolones and third-generation cephalosporins [15-17]. These trends have significantly narrowed empirical treatment options and have led to increasing reliance on carbapenems and other last-line agents.

The global emergence of multidrug-resistant uropathogens poses a serious threat to effective UTI management, particularly in resource-limited settings. Surveillance studies and genomic analyses conducted between 2018 and 2026 have documented the widespread dissemination of high-risk resistant clones of *E. coli* and *Klebsiella*, with substantial regional variation in resistance patterns [18-21]. In India, several hospital-based studies have reported high resistance rates to commonly prescribed antibiotics, underscoring the importance of local epidemiological data to guide empirical therapy and antimicrobial stewardship strategies [11,16,22].

Despite the growing burden of UTIs in elderly women, there remains a relative paucity of comprehensive studies that integrate clinical presentation, laboratory abnormalities, etiological agents, and antimicrobial susceptibility patterns within this high-risk group, particularly from eastern India. Most existing studies focus either on microbiological profiles or on selected clinical aspects, limiting their translational relevance for bedside decision-making. Moreover, variations in comorbidity burden, healthcare access, and antimicrobial use across regions necessitate context-specific data to inform clinical guidelines and public health interventions [23-25].

In this context, the present study was undertaken to systematically evaluate the etiological profile, clinical features, and laboratory characteristics of urinary tract infections in elderly female patients admitted to a tertiary care center in India. By correlating demographic factors, comorbid conditions, symptomatology, laboratory parameters, urine culture isolates, and antibiotic sensitivity patterns, this study aims to provide clinically relevant insights that may assist in early recognition, rational antimicrobial selection, and improved management of UTIs in this vulnerable population.

MATERIALS & METHODS:

This was a hospital-based observational cross-sectional study conducted over a period of one year, from January 2025 to December 2025, in the Department of Medicine, GMCH, Sundargarh, Odisha, India.

A total of 100 consecutive patients admitted with a clinical diagnosis of urinary tract infection (UTI) were enrolled in the study using a universal sampling method. Patients were included if they had: Evidence of pyuria on urine routine microscopy, and Positive urine culture confirming bacterial growth.

Inclusion criteria comprised adult patients of either sex admitted with symptomatic UTI, fulfilling microbiological confirmation criteria. Exclusion criteria included patients with sterile pyuria, contaminated urine samples, those already on prolonged antibiotic therapy prior to admission, and patients unwilling to provide informed consent.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee. All eligible participants were informed about the nature and purpose of the study, and written informed consent was obtained prior to enrolment, in accordance with the principles of the Declaration of Helsinki.

Data Collection and Clinical Evaluation

A predesigned and pretested structured questionnaire

was used to collect demographic and clinical data. Information obtained included age, residential status (urban/rural), occupation (labourer, housewife, retired, others), and relevant past medical history, particularly diabetes mellitus, hypertension, chronic kidney disease, and other comorbidities.

Patients were evaluated for the presence of one or more symptoms suggestive of UTI, irrespective of duration, based on modified McGeer and Loeb criteria. These included: Burning micturition; Urgency and increased frequency of micturition; Fever with or without chills and rigors; Altered sensorium; Lower abdominal pain; Loin tenderness; Backache; Hematuria; Reduced urine output; and Pyuria

A detailed general and systemic physical examination was performed for all patients, and findings were recorded systematically.

Laboratory Investigations

All patients underwent baseline laboratory evaluation including: Complete blood count with total leukocyte count; Renal function tests, including serum urea and creatinine; Urine routine examination and microscopy: Urine culture and antibiotic sensitivity testing; Imaging studies (ultrasonography or other modalities), where clinically indicated

Urine Sample Collection and Culture

Urine samples were collected in pre-sterilized, dry, wide-mouthed, leak-proof universal containers. A clean-catch midstream urine sample was obtained in most patients, while suprapubic aspirates were collected in those unable to provide midstream samples. Approximately 50 mL of urine was collected per patient.

Using a calibrated loop method (4 mm loop diameter), 10 µL of uncentrifuged urine was inoculated onto culture media and streaked using the modified Mayo's technique, without flaming the loop between streaks. Plates were incubated at 35–37°C for 24 hours. A urine culture was considered positive when a single bacterial organism grew at a concentration of $>10^5$ colony-forming units (CFU)/mL.

Identification of Microorganisms

Bacterial isolates were initially differentiated by Gram staining into Gram-positive and Gram-negative organisms. Further identification to genus or species level was performed using standard biochemical tests. For Gram-negative organisms, the following tests were employed: Sugar fermentation tests; Indole test; Oxidase test; Methyl red test; and Urease test

For Gram-positive organisms, identification was carried out using:

- Catalase test
- Coagulase test

Routine culture media included nutrient agar, blood agar, and MacConkey's agar.

Antibiotic Sensitivity Testing

Antimicrobial susceptibility testing was performed for all culture-positive isolates using the modified Kirby–Bauer disc diffusion method, following Clinical and Laboratory Standards Institute (CLSI) guidelines. The antibiotics tested included: Imipenem; Meropenem; Piperacillin–tazobactam; Ceftriaxone; Cefotaxime; Levofloxacin

Commercially available antibiotic discs (Piramal Healthcare and Diasys Diagnostic Systems) were used, and results were interpreted as sensitive, intermediate, or resistant according to CLSI breakpoints.

Statistical analysis:

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 25.0. Descriptive statistics were used to summarize the data. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation (SD). Graphical representations were generated using bar charts and pie charts.

RESULTS:

Table 1: Socio-Demographic, Occupational, Obstetric Characteristics

Parameter	Value
Age 51–60	1 (1%)
Age 61–70	52 (52%)
Age 71–80	34 (34%)
Age >80	13 (13%)
Urban residence	49 (49%)
Rural residence	51 (51%)
Housewife	40 (40%)
Laborer	20 (20%)
Retired	30 (30%)
Others	10 (10%)

Nulliparous	5 (5%)
Parity 1	37 (37%)
Parity 2	40 (40%)
Parity >3	18 (18%)
History of PID	47 (47%)
History of Hysterectomy	21 (21%)

Table 1 shows the socio-demographic, occupational, obstetric, and gynecological characteristics. The present study included 100 female patients diagnosed with urinary tract infection. The majority of patients belonged to the 61–70 years age group (52%), followed by 71–80 years (34%). Patients aged above 80 years constituted 13%, while only 1% were in the 51–60 years age group. The mean age of the study population was 71.14 years, indicating a predominance of elderly women. Regarding residential status, 51% of the patients were from rural areas, while 49% resided in urban areas. Occupational distribution showed that 40% were housewives, 30% were retired, 20% were laborers, and 10% belonged to other occupations. In terms of obstetric history, 95% of women were parous and 5% were nulliparous. Among parous women, 40% had two children, 37% had one child, and 18% had more than three children. A history of pelvic inflammatory disease (PID) was present in 47% of patients, while 53% had no such history. Previous hysterectomy was reported in 21% of women, whereas 79% had not undergone hysterectomy.

Table 2: Clinical Features, Predisposing Factors, Laboratory Findings

Parameter	Value
Burning micturition	71%
Fever	64%
Chills & rigors	73%
Diabetes mellitus	47%
CKD	27%
Hydroureteronephrosis	24%
Hemoglobin (Mean ± SD)	9.6 ± 1.77 g/dL
TLC >11000	19%
RBS >140 mg/dL	87%
Serum Creatinine >1 mg/dL	36%

Table 2 shows the clinical presentation, predisposing factors, and laboratory findings. The most common presenting symptom was chills and rigors (73%), followed by burning micturition (71%). Fever and increased frequency of micturition were observed in 64% of patients each. Urgency of micturition was reported by 34%, while dysuria was present in 22% of the study population. Other symptoms included pain abdomen (30%), loin tenderness (21%), backache (21%), altered sensorium (25%), reduced urine output (11%), and hematuria (6%). Among the predisposing factors, diabetes mellitus was the most common, seen in 47% of patients. Chronic kidney disease was present in 27%, hydroureteronephrosis in 24%, and hypertension in 22% of cases. Catheter dependence was noted in 12%, while 10% of patients were in an immunocompromised state. Urinary calculi were identified in 4% of the study population. Laboratory evaluation revealed that most patients were anaemic, with a mean hemoglobin level of 9.6 ± 1.77 g/dL. Leucocytosis (TLC >11,000 cells/mm^3) was observed in 19% of cases. Random blood sugar levels >140 mg/dL were seen in 87% of patients. Elevated serum creatinine (>1 mg/dL) was noted in 36% of women.

Table 3: Urine Findings, Culture and Antibiotic Sensitivity

Parameter	Value
Pus cells >15/HPF	76%
Albuminuria present	60%
Urine glucose present	32%
E. coli	94%
Klebsiella	93%
Enterococcus	87%
Most sensitive drug (E. coli)	Imipenem (91%)
Most sensitive drug (Klebsiella)	Imipenem (89%)

Table 3 shows the urine examination, culture isolates, and antibiotic sensitivity pattern. Urine routine and microscopy showed significant inflammatory findings. Pus cells exceeding 15 per high-power field were observed in 76% of patients. Albuminuria was present in 60%, while glycosuria was detected in 32% of urine samples. Red blood cells were present in 14%, and urinary casts were identified in 34% of cases. Urine culture revealed polymicrobial growth in several patients. The most frequently isolated organism was Escherichia coli (94%), followed by Klebsiella species (93%) and Enterococcus species (87%). Pseudomonas species were isolated in 27%, and Staphylococcus aureus in 22% of samples. Antibiotic sensitivity testing showed that E. coli isolates were most sensitive to imipenem (91%) and meropenem (89%). Klebsiella isolates demonstrated highest sensitivity to imipenem (89%) and meropenem (82%). These findings indicate increased resistance to commonly used antibiotics.

DISCUSSION:

In this prospective cohort of 100 elderly women with urinary tract infection (UTI), we observed a predominance of advanced age (mean 71.1 years) and a high burden of metabolic comorbidity principally diabetes (47%) together with notable renal dysfunction (36% with serum creatinine >1 mg/dL). Clinically, systemic features (chills/rigors 73%, fever 64%) and lower urinary tract symptoms (burning micturition 71%, frequency 64%) were common. Microbiologically, cultures showed predominant isolation of *Escherichia coli* (94%), *Klebsiella* spp. (93%) and *Enterococcus* spp. (87%), and antibiotic sensitivity favoured carbapenems (imipenem/meropenem) for Gram-negatives while levofloxacin and third-generation cephalosporins showed variable activity against Gram-positives. These findings illustrate three interrelated themes: the demographic and co-morbid profile predisposing to complicated UTI in the elderly, the dominance of Enterobacterales as causative agents often with multidrug-resistant (MDR) phenotypes, and the narrowing of reliable empirical options in the face of rising resistance.

First, our demographic and clinical observations accord with prior reports that UTI burden shifts toward older age groups and that diabetes is a major predisposing factor. Several Indian and international series found advanced age and diabetes to be strongly associated with UTI incidence and complications, particularly in hospitalized or catheterized cohorts [1–4]. For example, cohort analyses and risk models in elderly diabetics report similar associations between glycaemic dysregulation and increased UTI risk, likely mediated by immune dysfunction, autonomic neuropathy, glycosuria, and structural urinary tract disease [3,5,6]. Our high proportion of patients with elevated RBS (>140 mg/dL, 87%) and renal impairment supports the concept that metabolic and renal comorbidity cluster in this population and contribute to more severe presentations and an increased likelihood of complicated or recurrent infection.

Second, the microbiological profile in our series confirms the global primacy of Enterobacterales in community and hospital UTIs but highlights unusually high isolation rates and frequent polymicrobial growth. *E. coli* remains the most common uropathogen across continents and in multiple Indian studies, followed by *Klebsiella* and Enterococcus species [7–11]. However, the extremely high culture percentages in our dataset (E. coli 94%, Klebsiella 93%, Enterococcus 87%) suggest that many samples yielded polymicrobial growth or that denominators differ across studies; this should be made explicit in methods and can occur in selected high-risk cohorts (catheterized patients, post-operative or referred tertiary cases) [8,9]. Nevertheless, the dominance of Gram-negative Enterobacterales is consistent with large surveillance series and with genomic studies showing expansion of MDR lineages (for example ST131 *E. coli* and carbapenemase-producing *Klebsiella*) that drive both community-onset and hospital-acquired infections [10,12].

Third, antimicrobial susceptibility patterns in our study show preserved activity of carbapenems (imipenem 89–91%, meropenem 82–89%) against *E. coli* and *Klebsiella*, while other commonly used agents (fluoroquinolones, third-generation cephalosporins, some β-lactams) displayed lower efficacy. This is in keeping with recent regional and global surveillance reports that document rising resistance to fluoroquinolones and extended-spectrum β-lactams among uropathogens and a growing reliance on carbapenems or last-line agents for empirical therapy in severe infections [11,13–16]. At the same time, several contemporary studies have reported increasing carbapenem resistance and emergence of carbapenemase genes in Enterobacterales an evolving threat that our dataset may not yet fully capture but which suggests caution in interpreting carbapenems as a permanent safeguard [14,17]. Importantly, recent Indian surveillance has documented alarming resistance to ciprofloxacin and cephalosporins in community isolates, reinforcing the need for stewardship and updated local antibiograms to guide empirical choices.

Comparative analysis with Indian literature reveals similar risk-factor patterns but heterogeneity in pathogen distribution and resistance rates. Multiple Indian centre studies report *E. coli* as the predominant isolate (rates varying 30–80% depending on patient selection and inclusion criteria) with *Klebsiella* and Enterococcus as frequent co-pathogens; resistance to fluoroquinolones and third-generation cephalosporins has been consistently high, whereas nitrofurantoin

and fosfomycin retain activity for many lower UTIs [11,18–21]. Internationally, multicentre surveillance and genomic studies echo these trends, documenting the global spread of MDR uropathogenic strains and emphasizing the role of tailored empirical therapy based on local surveillance data [12,22,23].

From a clinical and policy perspective, our findings underscore several actionable conclusions. First, given the high prevalence of diabetes and renal dysfunction, management protocols for elderly women with UTI should include prompt metabolic and renal evaluation and early microbiological sampling to detect complicated infection. Second, empirical antibiotic guidelines must be locally informed and updated frequently our data support using agents with retained activity (guided by culture), but the spectre of increasing carbapenem resistance mandates antimicrobial stewardship to preserve last-line drugs. Third, prevention strategies—optimizing glycaemic control, minimizing unnecessary catheterization, and addressing obstructive uropathy remain central to reducing UTI burden and subsequent antimicrobial exposure. These recommendations align with recent WHO and national calls for integrated AMR containment and stewardship in high-burden settings [16,24].

Limitations of our study include its single-centre design, absence of molecular resistance typing (carbapenemase/ESBL gene detection), and the potential selection bias inherent to hospitalized/tertiary referrals which may inflate MDR prevalence. Future work should integrate longitudinal surveillance, genomic characterization of uropathogens, and evaluation of outcomes (mortality, recurrence) by pathogen and resistance phenotype to better define empiric therapy thresholds and stewardship metrics. Recent multi-centre genomic and epidemiological studies provide a road map for such integrated surveillance [12,13,22].

CONCLUSION:

In conclusion, this elderly cohort demonstrates the intersection of metabolic disease, renal impairment, and a microbiological landscape dominated by Enterobacterales with significant resistance to commonly used agents. Our results call for routine culture-guided therapy, locally tailored empirical protocols, strengthened antimicrobial stewardship, and preventative measures targeting diabetes and urinary tract pathology to curb morbidity from complicated UTI in ageing populations.

Conflict of interest:
None.

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