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Original Research Article

Shifting landscape of urinary tract infections: A retrospective evaluation of multidrug-resistant uropathogens with demographic and surgical predictors

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Abstract

Background: UTIs are am bong the most frequent bacterial infections globally, yet rising resistance and MDR strains complicate management. Demographic factors such as age and gender, along with surgical interventions, may significantly influence resistance. Understanding these associations is vital to guide empirical therapy and strengthen antimicrobial stewardship.
Aims and Objective: To analyze antibiotic resistance trends and the prevalence of multidrug-resistant (MDR) uropathogens in urinary tract infections (UTIs), with focus on demographic and surgical associations.
Materials and Methods: A retrospective study was conducted at Apollo Rajshree Hospital, Indore, from January–December 2024. Data of 200 culture-positive UTI inpatients were analyzed. Uropathogens were identified using biochemical and automated methods. Antibiotic susceptibility testing was performed by Kirby–Bauer and VITEK II per CLSI guidelines. MDR was defined as resistance to ≥3 antibiotic classes. Statistical analysis was done using Jamovi and Minitab, with Chi-square tests applied.
Results: Among 200 patients, 53.5% were male and 48.5% elderly. Diabetes (32.5%) and hypertension (26.5%) were common comorbidities. Surgical history was present in 54%, mainly DJ stenting and PCNL. Resistance exceeded 90% for β-lactams, cephalosporins, and fluoroquinolones. Fosfomycin (40%), Nitrofurantoin (56%), Colistin (54.5%), and Polymyxin-B (55.9%) retained better activity. MDR prevalence was 67.5%, highest in *K. pneumoniae* (73.4%) and *P. aeruginosa* (73.9%). MDR showed significant association with male gender, advanced age, comorbidities, and surgical history ($p<0.001$).
Conclusion: This study reveals alarming MDR rates in UTI pathogens, strongly influenced by demographics and surgeries, underscoring the need for culture-guided therapy and antimicrobial stewardship.

Keywords: Urinary tract infection, Antibiotic resistance, Multidrug-resistant uropathogens, Demographic factors, Surgical associations.

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1. Introduction

Urinary tract infections (UTIs) are one of the most widespread bacterial infections that are ever-present throughout the lifespan and the rates of healthcare expenditures and patient difficultly.[1-3] The increased threat of antibiotic resistance, specifically the rise of multidrug-resistant (MDR) uropathogens, has complicated the treatment of UTIs and poses a severe threat to the population.[4-6] UTIs are a major source of morbidity in the community and hospitals with Escherichia coli and Klebsiella tops of the list of the causative species.[7] Broad spectrum, and in many cases, unnecessary use of antibiotics in human health care, veterinary practice and in agriculture has hastened the emergence and transmission of antibiotic-resistant bacteria.[8-10] Consequently, the effectiveness of first-line antibiotics is increasingly becoming obsolete, causing treatment failures and longer morbidity, and costing more.[11-13] World Health Organization has named antimicrobial resistance (AMR) as a serious global threat and an estimated 10 million people die each year due to AMR by 2050 which could rise by 2050.[14] Resistance rates against widely used antibiotics such as cephalosporins, quinolones

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and penicillin are worryingly increased as catalogued by various studies, in various parts of the world.[15-17] Indeed, recent study conducted in Romania and Bangladesh revealed that E. coli and- Klebsiella spp. in UTI patients had multidrug resistance of over 70 and almost 50 respectively and were resistant to quinolones, penicillin and cephalosporins.[18,19] In China, Poland, and other locations, an increasing prevalence of MDR among uropathogens is found, as is a concerning degree of resistance to antibiotics of therapeutic importance.[20,21] Risk contributors to the development of MDR UTIs are related to past antibiotics exposure, hospitalization, old age, diabetic condition, past history of UTIs as well as surgical procedures like catheterization.[22-24] The results of this study demonstrate that it is vital to conduct continuous monitoring and specific antibiotic stewardships.[25,26] Demographic type variables like age and gender along with surgical procedures such as catheterization and a previous history of urological surgeries has been found to factor in MDR UTI.[27] Patients over 65, diabetics and patients who have a history of using antibiotics recently or who have had a hospital stay are especially susceptible.[28] CA-UTIs are particularly susceptible to MDR organisms which can cost healthcare facilities and individuals a lot more time and money in addition to health concerns.[29] Research has also demonstrated that uropathogen prevalence and resistance rates may differ geographically, among patient populations, and across care facilities, therefore highlighting the need to utilize local surveillance data.[30]

The main objective of this study is to review the recent trends in antibiotics resistance and the emergence of MDR uropathogens in urinary tract infections, paying particular attention to the role of demographic characteristics (age, gender), and their involvement in surgical procedures (catheterization and previous surgery) that can alter resistance patterns.[31] The scope entails retrospective review of the patient information, and antimicrobial resistance patterns, and risk factors in a variety of populations and healthcare settings.[32] The key hypothesis is that some demographic and surgical determinants are strongly connected with increased MDR uropathogen infections rates, and the resistance pattern evolves over the time, which requires updated surveillance and more personalized approaches to the treatment.[33] The emergence of antibiotic resistance in UTI-causing bacteria has become a grave problem in the community, which requires immediate intervention.[34] By studying the patterns of resistance and influence of demographical and surgical factors, the present research will support evidence that could inform clinical decisions, empirical treatment, and establishment of effective antibiotic stewardship policy to curb the transmission of MDR uropathogens. The results of this research will eventually lead to better patient outcomes, rationalized use of antibiotics, and a better perspective of the changing scenario of UTI management.[35]

2. Materials and Methods

2.1. Study design and setting

The current retrospective observational study conducted at Department of Microbiology and Inpatient Wards of Apollo Rajshree Hospital, Indore (M.P.) is a multispecialty tertiary care facility. Their targets were the investigation of the bacterial profile, and the rates of antibiotic resistance and of the presence of Multidrug resistant (MDR) organisms in the cases of urinary tract infection (UTI). Association with demographic, comorbidity and surgery history were also studied.

2.2. Study duration and population

All the data observed were taken in the period January 2024 to December 2024. As this was a retrospective study, data were extracted and analyzed in 2025 following ethical approval. The patients of both genders and all ages were included in the study, hospitalized with clinically and microbiologically identified UTIs. A total of 300 patient records with suspected or confirmed UTI were screened, and 200 records meeting the eligibility criteria were included in the final analysis. Excluded records are detailed in the study flowchart (**Figure 1**).

2.3. Inclusion criteria

1. Inpatients with clinical and microbiologic diagnosis of UTI.
2. A positive urine culture reports of the uropathogens present.
3. All age groups of patients and both sexes.
4. Patients with comprehensive records, including demographic, clinical symptoms, antibiotic sensitivity results, comorbidity, and treatment in combination.
5. Both surgical and non-surgical inpatients.

2.4. Exclusion criteria

1. Patients with negative urine culture reports.
2. Patients who had missing clinical or microbiological data.
3. Recurrence of UTI in an individual patient (considering first urinary infection only).
4. Cases of viral, fungal or parasitic infection of the urinary tract.
5. Patients on prolonged antibiotic therapy (>48 hours before sample collection).
6. Pregnant women, as physiological and diagnostic differences in pregnancy could confound microbiological and treatment outcomes.

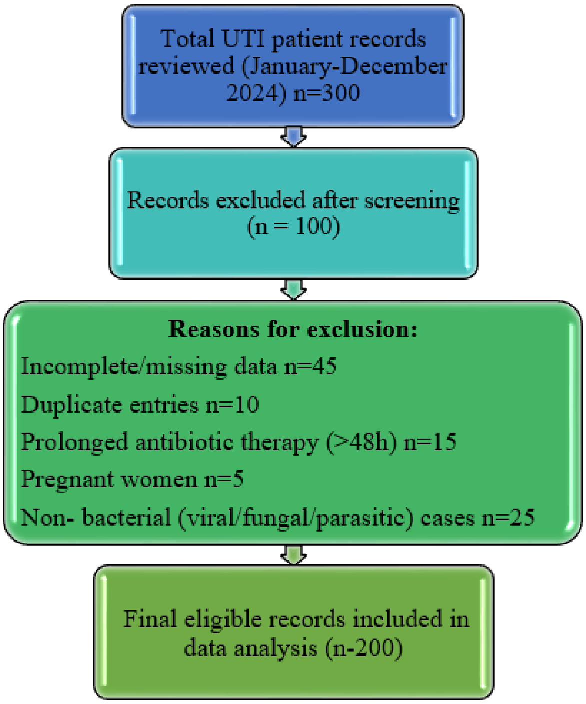

Figure 1: Flowchart of study record screening and selection

2.5. Data collection

The information on patient was obtained at the medical records department of the hospital and the Microbiology laboratory information system. Data that were collected were:

1. Age, gender, date of admission/discharge.
2. Clinical symptoms (fever, dysuria, urgency, frequency, flank pain).
3. Comorbidities (e.g., diabetes mellitus, hypertension, CKD and others).
4. Surgical history (e.g., PCNL, DJ stenting, TURP).
5. Urine culture results, antibiotic susceptibility patterns.
6. Details of empirical and definitive antibiotic treatment.
7. Clinical outcomes (cure vs. non-cure).
8. All data were recorded in a pre-structured Excel sheet, and patient identifiers were anonymized for confidentiality.

2.6. Laboratory methods

The urine samples were collected using aseptic sterile vessels. Midstream clean-catch and catheter-derived urine samples were included, whereas suprapubic aspirates were excluded. Significant bacteriuria was defined as growth of $\geq 10^5$ CFU/mL for midstream specimens and $\geq 10^3$ CFU/mL for catheterized samples. Cultures were inoculated on Chromogenic UTI agar, Blood agar, and MacConkey agar. Bacterial identification was performed using classical biochemical tests and confirmed by the VITEK II Compact system (bioMérieux, version 9.03). Antimicrobial susceptibility testing (AST) was carried out using the Kirby–Bauer disk diffusion method and VITEK II automated system, and interpreted as per CLSI guidelines (2024 edition). Quality control was performed using *E. coli* ATCC 25922, *P. aeruginosa* ATCC 27853, and *E. faecalis* ATCC 29212, tested weekly in accordance with CLSI quality ranges. For colistin testing, results were generated using the VITEK II system. As broth microdilution is the reference method, we have acknowledged this limitation and recommend interpreting colistin resistance rates with caution. Multidrug resistance (MDR) was defined according to Magiorakos et al., 2012 as non-susceptibility to at least one antimicrobial agent in three or more different antimicrobial classes. The antimicrobial classes included in this study were beta-lactams (e.g., amoxicillin, cefepime, ceftazidime), carbapenems (e.g., imipenem, meropenem, ertapenem), aminoglycosides (e.g., gentamicin, amikacin), fluoroquinolones (e.g., ciprofloxacin), polymyxins (e.g., colistin), glycopeptides (e.g., vancomycin, teicoplanin), macrolides (e.g., erythromycin), sulfonamides (e.g., cotrimoxazole), and nitrofurantoin, limited to the antibiotics tested in this study. Organisms with natural or intrinsic resistance to certain antibiotics were excluded from the MDR calculation; for example, Proteus spp. are intrinsically resistant to colistin, so colistin resistance was not counted toward MDR for these isolates. Additionally, isolates with "intermediate" susceptibility results were treated as resistant for a conservative estimation of MDR.

2.7. Data analysis

The data were inserted in Microsoft Excel and statistically analyzed by Jamovi and Minitab software. Frequencies and percentages were used to present the characteristics of patients, distribution of the pathogens, and resistance patterns.

2.8. Statistical analysis

To ascertain the relationship between a few categorical variables, which included uropathogen distribution and age groups, surgical history and multidrug resistance (MDR), comorbidities and the severity of the infection, and gender-based antibiotic resistance, the Chi-square (χ^2) test was applied. To represent the data more adequately, and interpret it conveniently, graphs and bar charts were created to exemplify the key outcomes, e.g., the rate of the resistance to the specific antibiotics, the prevalence of MDR organisms and the pattern of the distribution of the uropathogens among the subgroups of patients. The analyses were considered significant at p -value having < 0.05.

2.9. Ethical considerations

This Retrospective study used anonymized hospital data from January-December 2024. Institutional Ethics Committee approval for retrospective analysis was obtained on 18 June 2025 (IEC Application No.: AHR-BMR-02/2025/006). The committee granted a waiver of informed consent as no direct patient contact was involved. The study complied with the

Declaration of Helsinki (2013) and the ICMR National Ethical Guidelines for Biomedical Research (2017). Patient confidentiality was maintained at all stages, and data were used solely for research purposes.

3. Results

3.1. Demographic and clinical data

Out of 200 positive culture urinary tract infection (UTI) patients, men comprised 53.5 percent and women 46.5 percent. The highest percentage (48.5%) was amongst the old-old age group (60-99 years), and the next and consequently lowest proportion was the middle-aged adults (30-59 years, 38%). As far as comorbid diseases, Type 2 Diabetes Mellitus was identified in 32.5%, Hypertension in 26.5%, and CKD in 4 percent of patients. One hundred and eight patients (54%) had a prior surgical history including urological operations (e.g., DJ stents, PCNL, TURP, etc.,), and general surgeries (cardiac, GI, etc.,). Demographic and clinical profile is tabulated in **Table 1**.

Out of the 200 culture-positive UTI patients, 108 (54%) had undergone surgical intervention and 92 (46%) had no prior surgical procedure reported. Among the surgical group, the widely reported procedures were DJ stenting (16%, n=32), Percutaneous Nephrolithotomy (PCNL) (6%, n=12) and Transurethral resection of the Prostate (TURP) (4%, n=8). Also 56 (28%) patients had comorbid surgeries such as cardiovascular, gastrointestinal, and general abdominal surgeries (**Table 2**).

3.2 Overall resistance patterns

3.2.1. Antibiotic resistance trends

The prevalence, susceptibility and resistance to 40 antibiotics as tested on 200 uropathogenic isolates presented a bleak picture of the resistance levels to most of the first-line agents tested. The resistance to many drugs were 90% and more, such as 1 > 1 and 2 > 1 and fluoroquinolones. By contrast, few antibiotics retained strong efficacy, with resistance rates of less than 60%. Bar chart of the resistance rates of the 10 most resistant antibiotics (e.g. Aztreonam, Oxacillin, Ampicillin) with the 5 lowest ones (e.g: Fosfomycin, Colistin, Nitrofurantoin).

Table 1: Demographic and clinical profile of UTI patients (n = 200)

S. No	Parameter	Category	Number (n)	Percentage (%)
1.	**Gender**	Male	107	53.5%
		Female	93	46.5%
2.	**Age group (years)**	Pediatric (0-9 years)	12	6.00%
		Young Adults (10-29 years)	15	7.50%
		Middle-aged (30-59 years)	76	38.00%
		Elderly (60-99 years)	97	48.50%
3.	**Comorbidities**	Type2 diabetes mellitus	65	32.5%
		Hypertension	53	26.5%
		CKD (chronic kidney disease)	8	4.0%
		Others (e.g. CAD, CVA, COPD, hypothyroidism)	19	9.5%
		No Comorbidities	55	27.5%
4.	**Surgical History**	UTI with Surgery	108	54%
		UTI without Surgery	92	46%

Table 2: Surgical history distribution (n = 200)

Surgical Procedure	Number (n)	Percentage (%)
DJ stenting	32	16%
Percutaneous Nephrolithotomy (PCNL)	12	6%
Transurethral Resection of Prostate (TURP)	8	4%
Other surgical procedures	56	28%
No surgical history	92	46%

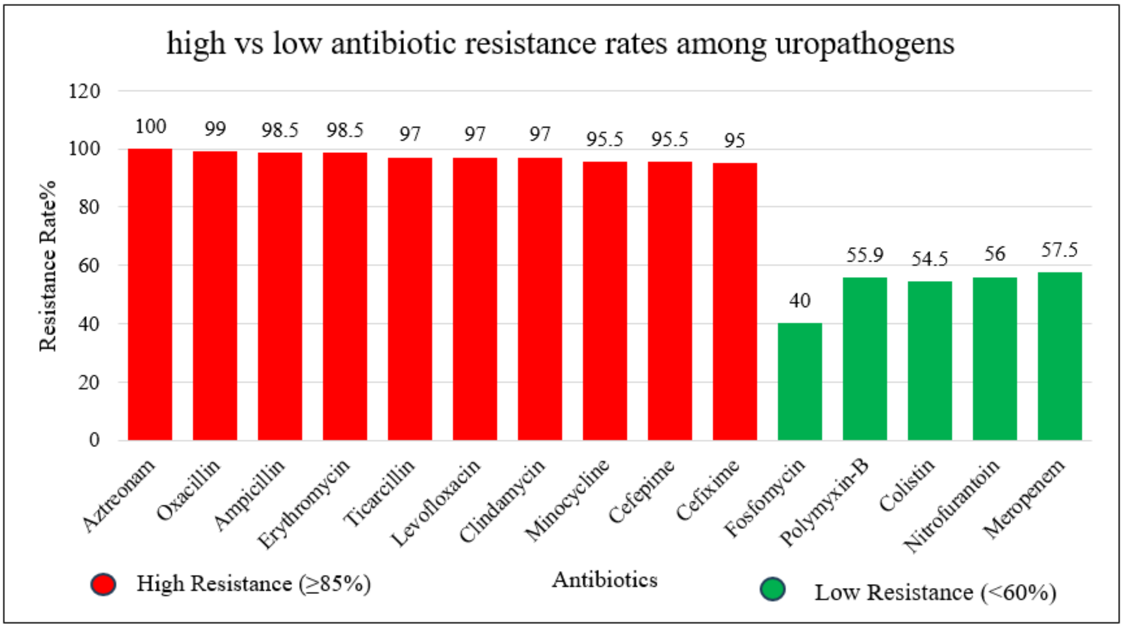

Figure 2: Comparison of high and low antibiotic resistance rates among uropathogens isolated from UTI patients

Table 3: Organism-wise antibiotic resistance in *E. coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*

Category	Antibiotic	*E. coli* (n=102)	*Klebsiella pneumoniae* (n=45)	*Pseudomonas aeruginosa* (n=23)
Top 10 Highly Resistant Antibiotics	Aztreonam	102/102 (100%)	45/45 (100%)	23/23 (100%)
	Penicillin	102/102 (100%)	45/45 (100%)	23/23 (100%)
	Levofloxacin	102/102 (100%)	45/45 (100%)	23/23 (100%)
	Nalidixic acid	99/102 (97.06%)	41/45 (91.1%)	23/23 (100%)
	Cefepime	97/102 (95.1%)	44/45 (97.8%)	20/23 (87.0%)
	Ticarcillin	97/102 (95.1%)	45/45 (100%)	23/23 (100%)
	Minocycline	96/102 (94.12%)	43/45 (95.6%)	23/23 (100%)
	Ciprofloxacin	94/102 (92.16%)	40/45 (88.9%)	20/23 (87.0%)
	Cefixime	96/102 (94.12%)	42/45 (93.3%)	23/23 (100%)
	Cefalotin	97/102 (95.1%)	43/45 (95.6%)	23/23 (100%)
Top 6 Low Resistant Antibiotics	Fosfomycin	12/102 (11.76%)	20/45 (44.4%)	20/23 (87.5%)
	Meropenem	32/102 (31.37%)	36/45 (80.0%)	20/23 (87.0%)
	Nitrofurantoin	40/102 (39.22%)	36/45 (80.0%)	23/23 (100%)
	Colistin	72/102 (70.59%)	7/45 (15.6%)	2/23 (8.7%)
	Polymyxin-B	73/102 (71.57%)	11/45 (24.4%)	2/23 (8.7%)
	Amikacin	39/102 (38.24%)	14/45 (31.1%)	18/23 (78.3%)

The analysis illustrates an extreme variation on the efficacy of antibiotics. First-line antibiotics turned out to be near-useless and Aztreonam was completely resistant. Fosfomycin (40% resistances) and Nitrofurantoin (56% resistances) were the most effective oral agent yet, reserve drugs including Colistin and Polymyxin-B remained potent. The extreme resistance pattern also demonstrates that the problem of antimicrobial resistance in UTIs is a crisis situation and the use of antimicrobial agents based on the local antibiogram data should be high on the agenda with preference to less resistant agents.

3.2.2. Resistance patterns in common uropathogens

In this part, a comparative discussion of uropathogen resistance to antibiotics was performed using *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa* as the most commonly isolated pathogens from the urinary tract infection samples. These pathogens represented the highest proportion of culture-positive cases of UTI. The study tested a total of 40 different antibiotics on 200 uropathogenic isolates to determine resistance trends. The findings highlight the top 10 antibiotics with the highest resistance rates and the six antibiotics with the lowest resistance rates against the three organisms, presented in n/N format. Such an organism-specific resistance profile is crucial for guiding empirical antibiotic therapy and for developing targeted antimicrobial strategies.

The three major causative agents showed high resistance to commonly used antibiotics such as aztreonam, penicillin, and levofloxacin. *Pseudomonas aeruginosa* demonstrated full resistance to several agents, including nitrofurantoin and many β-lactams. In contrast, resistance rates were relatively low for Fosfomycin, amikacin, colistin, and polymyxin-B, particularly against *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. These results underscore the importance of pathogen-specific antibiotic selection and ongoing surveillance of resistance patterns to guide appropriate intervention in UTIs.

3.3. Distribution of uropathogens in community- and hospital-acquired UTIs

Among the 200 culture-positive urinary tract infection (UTI) cases analyzed, 130 (65%) were community-acquired (CA) and 70 (35%) were hospital-acquired (HA). *Escherichia coli* was the most frequently isolated uropathogen, accounting for 102 cases—of which 68.6% were CA and 31.4% HA. *Klebsiella pneumoniae* was identified in 45 cases, with 66.7% CA and 33.3% HA distribution. *Pseudomonas aeruginosa* and other uropathogens were less common, though their relative proportions were slightly higher in HA infections. Overall, the uropathogen profile was comparable across both settings, with *E. coli* remaining the predominant pathogen in both CA and HA UTIs.

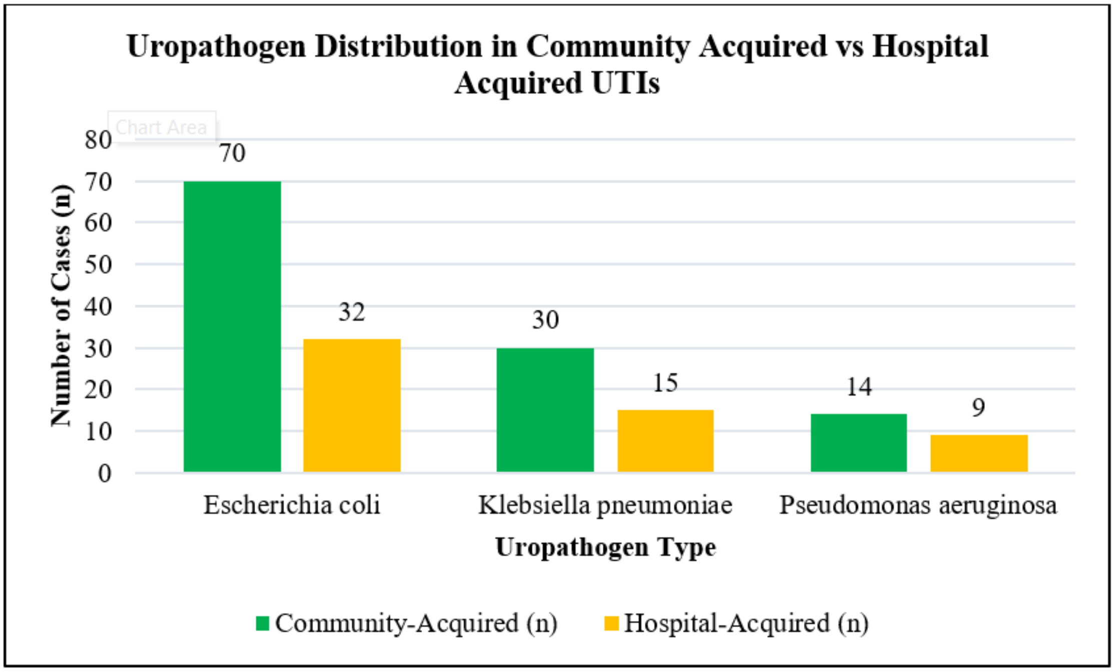

Figure 3: Distribution of uropathogens in community- and hospital-acquired UTIs

3.4 Multidrug resistance (MDR) patterns

Multi drug resistance (MDR) is an important clinical issue within treatment of urinary tract infections. In this work, MDR was the resistance to at least one agent in three or more antimicrobial categories. The total MDR burden of culture-positive UTI isolates was determined to access its extent and the concomitant impact on treatment with empirical therapy. The pie diagram represents the percentage MDR and non MDRO organisms among the 200 UTI patients, a consideration that gives an idea of the prominence of the antimicrobial resistance in the study sample.

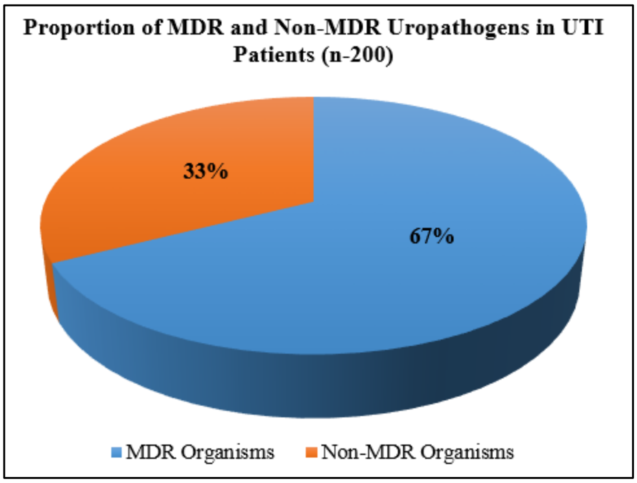

Figure 4: Proportion of multidrug-resistant (MDR) and non-MDR uropathogens isolated from UTI patients (n = 200)

Among 200 isolates of uropathogens, 135 (67.5%) were identified to be multidrug resistant. The high need of MDR is associated with an alarming clinical challenge that lessens the effectiveness of widely used antimicrobial agents. The results are a clarion call on culture sensitivity testing and robust antimicrobial stewardship on a routine basis to curb the prevalence of resistant infections.

3.5. Organism-wise MDR pattern

The organism-wise distribution of multidrug resistance (MDR) among the uropathogens was analyzed to determine the organism(s) that poses a greater resistance risk, and the results have been shown in **Figure 5**.

This evaluation of 200 isolates revealed that the highest MDR phenomenon was found in the group of others (27 out of 30, 90.0%), *Pseudomonas aeruginosa* (17 out of 23, 73.9%) and *Klebsiella pneumoniae* (33 out of 45, 73.4%). Although the most frequently isolated pathogen (n=102), *Escherichia coli* had a comparatively lower, but significantly high, MDR rate of 56.8 percent (58 isolates). The MDR prevalence rate was 67.5 percent (135/200) regarding the overall prevalence. These results indicate that although *E. coli* is the leading cause of UTI, other pathogens such as *K. pneumoniae* and *P. aeruginosa* have a significantly higher risk of multidrug resistance, and differentiated treatment and strict control of antimicrobials are required.

3.6. Association between gender and uropathogen

The common uropathogens at different proportions were assessed in accordance with the gender of patients. *Escherichia coli* was the most prevalent isolate in general (51 percent). A statistical analysis was carried out to see whether the distribution of the pathogens were dissimilar in both the sexes. *Staphylococcus* spp., *Enterococcus* spp.), and *P. aeruginosa* which is clearly showing the high level of isolation of *P. aeruginosa* (**Figure 6**.) Indeed, there are more differences between male and female UTI patients (Others).

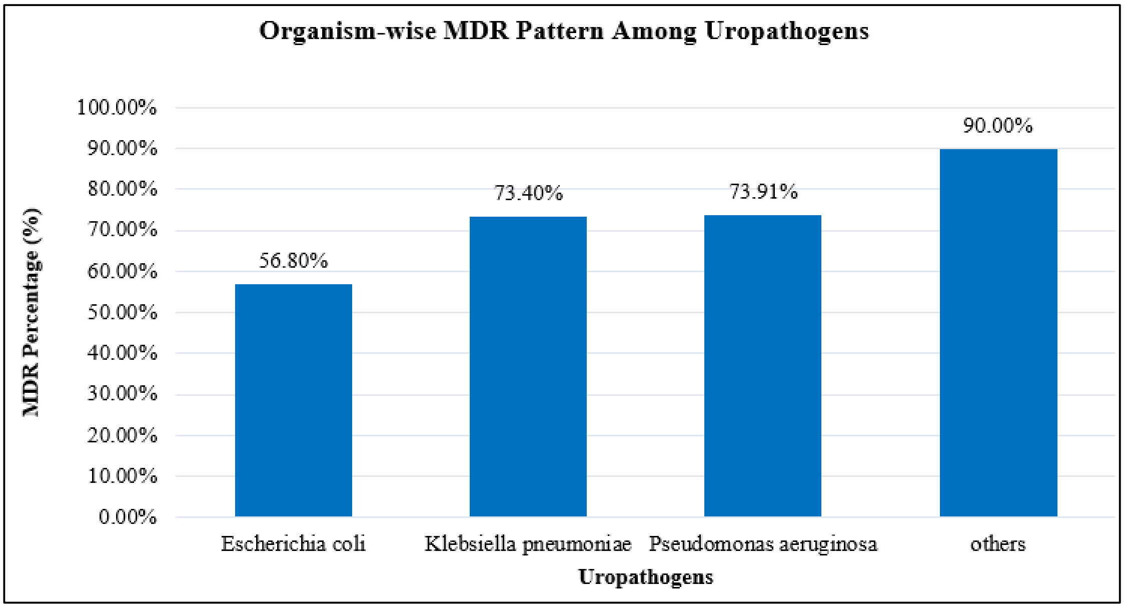

Figure 5: Organism-wise MDR patter among uropathogens

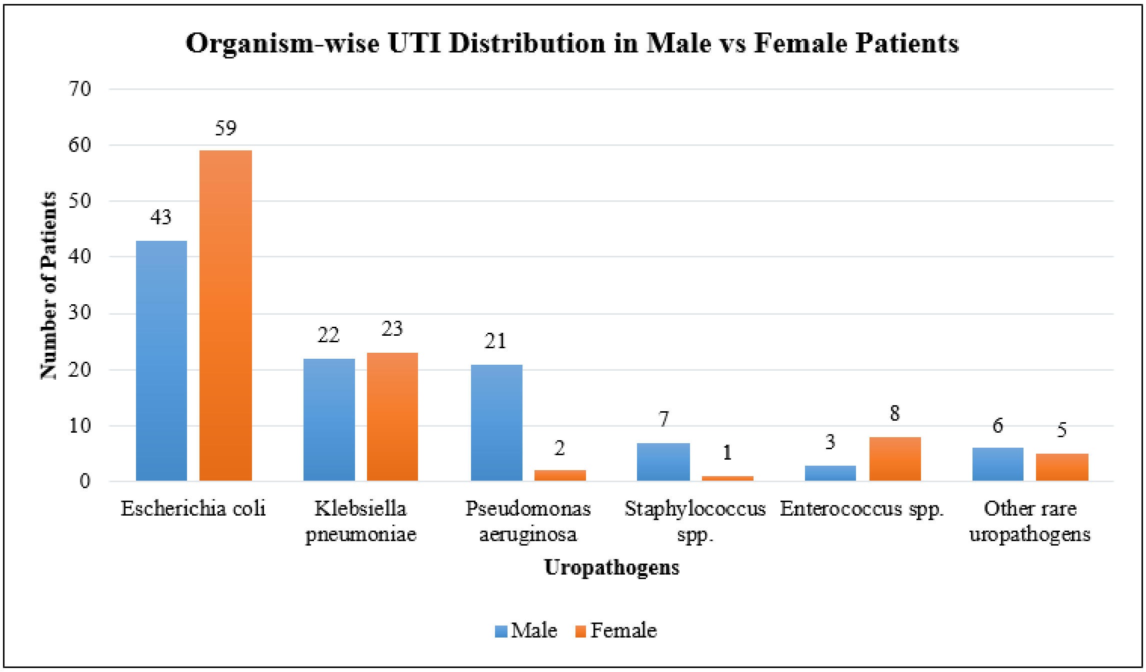

Figure 6: Organism-wise UTI distribution in male and female patients

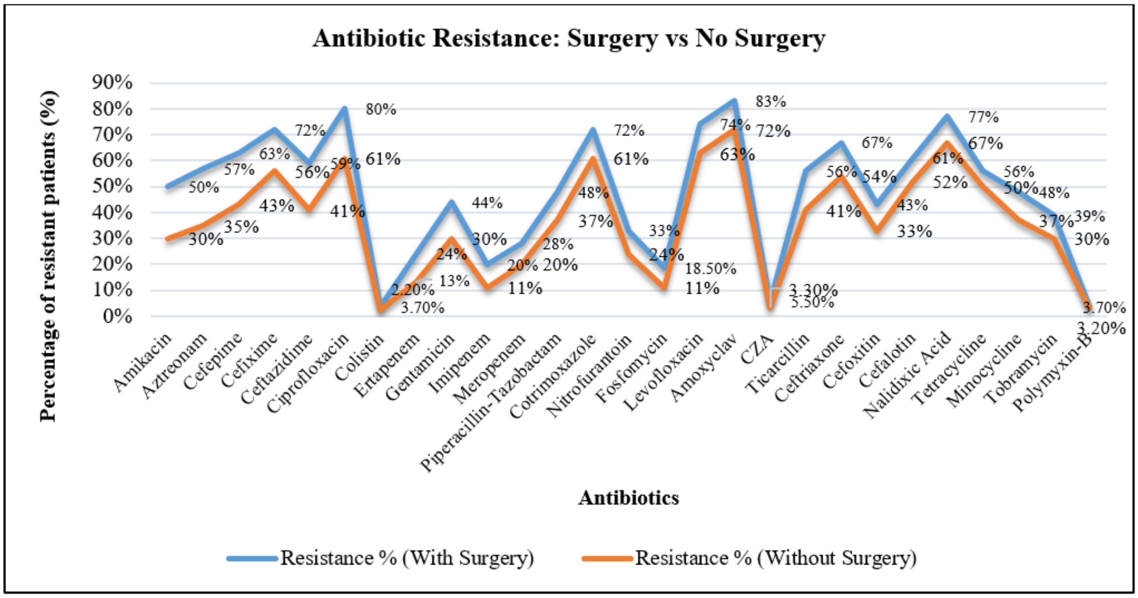

Figure 7: Comparison of antibiotic resistance patterns in UTI patients with and without surgical history

A significant correlation also emerged between the gender of the patients and the kind of uropathogen isolated ($p < 0.001$). *E. coli* showed preponderance in females and *Pseudomonas aeruginosa* infection was exclusively prevailing in male patients (21 vs. 2 isolates). Distribution of *Klebsiella pneumoniae* was restricted equally between the genders this unique pathogen population indicates that gender-specific determinants (e.g., predisposing factors (e.g., catheterization, prostate disease in men), or biomechanical differences have a substantial effect on the etiology of UTIs.

3.7. Impact of surgical history on antimicrobial resistance

The difference in antibiotic resistance between UTI patients with (n=108) and without (n=92) a history of surgical intervention was also determined. Rates of resistance were significantly and much higher in nearly all classes of antibiotics of surgery patients, indicating a definite connection with surgical exposure to developing multidrug-resistant infections. **Figure 7**: Bar chart the difference between the percentage resistance to different classes of antibiotics (e.g., Fluoroquinolones, Cephalosporins, Penicillin, Carbapenems) between patients with and patients without a surgical history having UTIs.

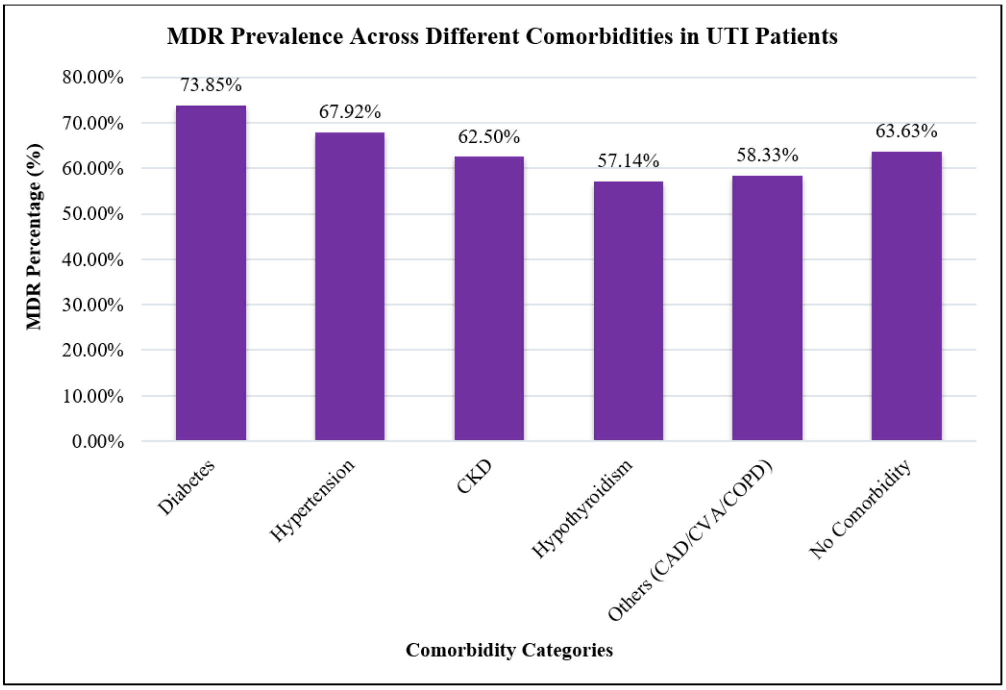

Figure 8: Multidrug-resistant (MDR) patterns in patients with and without comorbidities

The resistance profile in the two groups was significantly different to the point of statistical insignificance ($p < 0.001$). Significant differences have been found in Ciprofloxacin (80% vs. 61% resistance in an operative versus a non-operative population) and Amoxiclav (83% vs. 72%). This stark reversal highlights that a history of surgery is a significant risk factor of antimicrobial resistance, presumably since it involves sources of risk, including exposure to healthcare, invasive procedures including catheterization and prior antibiotic exposure. These findings are highly conducive to the approach of personalized empirical treatment and improved antimicrobial stewardship of post-surgical patients with UTIs.

3.8. Impact of comorbidities on multidrug-resistant (MDR) UTI

The study analyzed the distribution of multidrug-resistant (MDR) cases in relation to the presence of comorbidities. It assessed MDR patterns among patients diagnosed with diabetes mellitus, hypertension, and other chronic conditions, as well as among patients who did not have any comorbid illness.

MDR prevalence was found to be higher among patients with comorbidities, with diabetes showing the greatest proportion (73.8%), followed by hypertension (67.9%). Patients without comorbid conditions exhibited a comparatively lower MDR rate (63.6%). Statistical analysis using the chi-square test indicated a significant association between comorbidity status and MDR occurrence ($p = 0.049$; $p < 0.05$). These findings suggest that comorbidities moderately contribute to an increased risk of MDR infections, consistent with previously reported evidence.

4. Discussion

This retrospective investigation provides valuable insights into the burden of urinary tract infections (UTIs) and the alarming rise of multidrug-resistant (MDR) uropathogens in a tertiary care setting. Demographic analysis showed a predominance of male patients (53.5%), a finding consistent with Bajracharya et al. who reported higher proportions of hospitalized males, likely due to complicated or catheter-associated infections.[36] Nearly half of the study population comprised elderly patients (48.5%), in line with Shrestha et al. who emphasized the contribution of age-related immune decline, chronic comorbidities, and prolonged hospitalization to infection susceptibility.[37] Microbiological profiling identified *Escherichia coli* as the leading pathogen (51%), corroborating Gupta et al.[38] However, the notable emergence of *Klebsiella pneumoniae* (22.5%) and *Pseudomonas aeruginosa* (11.5%) both strongly associated with nosocomial infections raises significant clinical concern. Similar observations were reported by Mohamed et al. predominantly in hospital-acquired infections, highlighting the clinical importance of nosocomial pathogens.[8] In contrast, *E. coli* was more frequent in community-acquired UTIs, consistent with expected epidemiology. These observations emphasize the distinction between community- and hospital-acquired UTIs, with the latter associated with higher rates of antimicrobial resistance and greater complexity due to prior healthcare exposure, highlighting the need for stringent infection control practices. Antibiotic susceptibility testing revealed extremely high resistance rates (>90%) to commonly prescribed agents such as ampicillin, cephalosporins, and fluoroquinolones, rendering them unsuitable for empirical use. These findings are comparable to the ICMR-AMR surveillance report,[39] which also documented widespread resistance to first-line drugs. In contrast, relatively lower resistance was observed with Fosfomycin (40%), nitrofurantoin (56%), colistin (54.5%), and polymyxin-B (55.9%), suggesting these agents may remain viable alternatives when supported by culture-based confirmation. Of particular note, *Pseudomonas aeruginosa* demonstrated resistance to nearly all tested agents except colistin and polymyxin-B, in agreement with the findings of Huang et al.[34] The clinical implications are considerable. The results strongly advocate for routine culture and sensitivity testing before initiating therapy, as reliance on empirical first-line regimens is increasingly ineffective. Strengthened hospital-based antimicrobial stewardship programs, coupled with regular audits of perioperative prophylaxis policies, are essential to minimize unnecessary antibiotic exposure. From a public health standpoint, the convergence of resistance patterns between community and hospital settings underscores the need for stricter regulation of antibiotic distribution and greater public education on responsible usage.

This study has limitations: being single-center and retrospective, it could not capture confounding factors such as prior antibiotic exposure, catheter use, length of stay, or ward type. Colistin and polymyxin testing was performed using VITEK II rather than the reference broth microdilution method, which may affect resistance interpretation. Nonetheless, the sample size provides meaningful hospital-level insights. Future investigations should adopt multicenter, prospective designs with larger cohorts to validate these findings, explore molecular resistance mechanisms, and evaluate adjunctive strategies such as combination therapy, probiotics, and bacteriophage therapy. Additionally, the integration of rapid diagnostic tools would enable earlier detection of resistant pathogens, ultimately improving clinical outcomes. In conclusion, this study reinforces the growing ineffectiveness of empirical therapy for UTIs, highlights the urgent need for culture-directed management, and provides a robust hospital antibiogram to guide rational prescribing. The evidence presented should inform both clinical practice and policy while encouraging further research to address the escalating challenge of antimicrobial resistance.

5. Conclusion

In this retrospective study conducted at a single tertiary care hospital, multidrug-resistant (MDR) uropathogens were found to be a significant concern. Among the 200 culture-confirmed UTI cases, *Escherichia coli* was the predominant pathogen, while increasing resistance was observed in *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. The overall prevalence of MDR isolates was 67.5%, with higher incidence noted among elderly patients, males, and those with comorbid conditions or a history of surgical procedures. First-line antibiotics such as ampicillin, cephalosporins, and fluoroquinolones showed limited efficacy, suggesting that these agents may not be reliable for empirical therapy in this setting. In contrast, Fosfomycin, nitrofurantoin, colistin, and polymyxin-B demonstrated comparatively better activity, highlighting the importance of culture- and sensitivity-guided therapy in optimizing treatment outcomes. These findings provide region-specific antibiogram data that may inform evidence-based prescribing and rational antimicrobial use within similar clinical settings. The study emphasizes the need for robust antimicrobial stewardship programs, stringent infection control practices, and continuous surveillance to monitor evolving resistance trends. Future research should consider multicentric and prospective designs to improve generalizability, explore molecular mechanisms of resistance, and evaluate novel therapeutic strategies, including combination therapy, probiotics, bacteriophage therapy, and rapid diagnostic tools for timely detection of resistant organisms. Collectively, these measures are essential to help mitigate the growing threat of antimicrobial resistance in urinary tract infections.

6. Source of Funding

None.

7. Conflict of Interest

None.

8. Ethical Committee Approval

The ethical approval for this study was obtained from the Institutional Ethics Committee (IEC) of Apollo Rajshree Hospital, Indore (IEC Application No.: AHR-BMR-02/2025/006). The study involved retrospective analysis of pseudonymized hospital data, with no direct patient contact.

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