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ANTIBIOTIC SUSCEPTIBILITY PATTERN OF UROPATHOGENS AMONG CATHETERIZED AND NON-CATHETERIZED HOSPITALIZED PATIENTS AT A TERTIARY CARE CENTRE

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Abstract

Urinary tract infections (UTIs), particularly catheter-associated UTIs (CAUTIs), are major hospital-acquired infections contributing to antimicrobial resistance. To compare uropathogens and antibiotic susceptibility patterns in catheterized and non-catheterized hospitalized patients. A hospital-based comparative study was conducted using urine samples from clinically suspected UTI patients. Isolates were identified by standard microbiological methods, and antimicrobial susceptibility testing was performed using the Kirby–Bauer method. In catheterised patients, the predominant isolates were *Escherichia coli* (22%), *Klebsiella pneumoniae* (30%), *Pseudomonas aeruginosa* (9%), *Enterococcus* spp. (22%), *Candida* spp. (7%), Coagulase-negative *Staphylococcus* (4%), *Citrobacter koseri* (2%), *Acinetobacter baumannii* (4%), *Klebsiella oxytoca* (1%), *Enterobacter aerogenes* (1%), and *Proteus* spp. (1%). Among non-catheterised patients, *E. coli* (46%) was most common, followed by *K. pneumoniae* (16%), *Enterococcus* spp. (11%), *Candida* spp. (12%), *P. aeruginosa* (8%), CoNS (3%), *A. baumannii* (1%), *K. oxytoca* (1%), and *Proteus* spp. (1%). Antibiotic susceptibility testing (Amikacin, Piperacillin-Tazobactam, Nitrofurantoin, Ciprofloxacin, Norfloxacin) demonstrated a higher prevalence of multidrug-resistant organisms in the catheterised group. Catheterization is associated with diverse pathogens and increased antimicrobial resistance, highlighting the need for judicious catheter use and local antibiogram-guided therapy.

Keywords: Urinary Tract Infections; Catheter-Associated Urinary Tract Infection; Uropathogens; Antimicrobial Resistance; Antibiotic Susceptibility.

1. INTRODUCTION

Simple UTI is called if urinary tract does not have an infection in other parts of the body which caused UTI refers to an infection of the urinary tract caused by bacteria that are susceptible to appropriate treatment [1]. This type of infection typically occurs in a non-pregnant, afebrile, and immunocompetent female patient. The presence of pyuria (pus in urine) and/or bacteriuria (bacteria in urine) without any associated symptoms does not constitute a UTI and may not require treatment. For instance, an incidental finding of positive urine culture in an asymptomatic, afebrile, non-pregnant, and immunocompetent female would not be considered a UTI [2]. On the other hand, a complicated UTI (It is a bladder infection in a patient with underlying conditions that increase the risk of serious complications or decrease the effects of treatment) encompasses all UTIs that do not meet the criteria of a simple UTI as described above. This includes infections in immunocompromised patients, males, pregnant individuals, and cases associated with fever, urinary stones, sepsis, urinary

obstruction, catheter use, or those involving the kidneys [3].

The US Centers for Disease Control and Prevention (CDC): National Health Safety Network (NHSN) has a definition of Catheter-Associated Urinary Tract Infection (CAUTI). They consider the presence of a fever, suprapubic tenderness, or costovertebral angle pain, in addition to a colony count exceeding 100,000 with no more than two different organisms as defining criteria for CAUTI.

Catheterized patients typically develop bacteriuria due to colonization and the formation of biofilms. The rate of bacterial colonization ranges from 3% to 10% per day the catheter is in place, resulting in complete bacterial colonization after approximately 30 days. Risk factors associated with this colonization include prolonged Foley catheterization, female gender, advanced age, diabetes, bacterial colonization of the drainage bag, urethral catheterization (compared to suprapubic), and errors in sterile catheter insertion or maintenance [29].

UTIs can be caused by a variety of bacteria, both Gram-negative and Gram-positive, as well as fungi. Among these pathogens, Uropathogenic *Escherichia coli* (UPEC) are the predominant cause of UTIs, accounting for 75% of non-complicated UTIs and 65% of complicated UTIs. In cases of complicated UTIs, such as CAUTIs, the most common pathogens following UPEC are *Enterococcus spp.* (11%), *Klebsiella pneumoniae* (8%), *Candida spp* (7%), *Staphylococcus aureus* (3%), *Proteus mirabilis* (2%), *Pseudomonas aeruginosa* (2%), and *Group B Streptococcus* (2%) [44].

Antibiotics are considered the primary treatment for CAUTI; however, the inert surface of the catheter often develops biofilms, making it resistant to antibiotic effects.

The use of antibiotics remains essential in treating CAUTIs, but their effectiveness is increasingly challenged by rising rates of antibiotic resistance, which could lead to a post- antibiotic era where common infections may become life-threatening. Clinical antibiotic use, especially when unnecessary or prolonged, significantly contributes to this problem.

Thus, the AIM of study is to isolate the uropathogens among catheterized and non-catheterized patients and to study the antibiotic susceptibility pattern of isolated uropathogens among catheterized and non-catheterized patients.

Materials and Methods

The study was conducted at the Microbiology Department over a period of 24 months. This was a cross-sectional study designed to assess the antibiotic susceptibility pattern of uro- pathogens among catheterized and non-catheterized patients hospitalized in a tertiary care center. The study included hospitalized patients aged 18 years and above, who met the inclusion criteria of being catheterized with a Foley's catheter for more than two calendar days. Patients with non-catheterized status were also included. Institutional Ethical clearance was taken number of ethical reference no. R cell,2023/35.

Data Collection: Data were collected through a combination of clinical evaluations, laboratory investigations, and imaging studies. Age, Sex, diagnosis at admission, Functional status (ambulatory or non-ambulatory), Indication for catheterization (e.g., urinary retention, incontinence, altered sensorium), Duration of catheterization, Urine routine/microscopy findings were recorded.

Inclusion Criteria:

1. Hospitalized patients aged 18 years and above.
2. Patients who have been catheterized with a Foley's catheter for more than two calendar days at the time of the event
3. Patients with suspected urinary tract infection (UTI) based on clinical presentation and/or laboratory findings.

Exclusion Criteria:

1. Patients who have not been catheterized or have had a Foley's catheter for less than two calendar days.
2. Patients with a history of urinary tract surgery within the past six months.

For catheterized patients, samples were taken using a sterile disposable syringe after proper cleaning and clamping of the catheter tube. Sampling ports were disinfected with alcohol before sample collection. Clean-catch mid-stream urine samples were collected from non- catheterized patients.

Urine samples underwent wet mount examination to assess the presence of pus cells, epithelial cells, red blood cells (RBCs), cast cells, crystals, fungal hyphae and microorganisms.

Processing the Urine Sample. Semi-quantitative culture of urine samples was performed on 5% sheep blood agar and CLED agar (cystine-lactose-electrolyte-deficient agar) and incubated aerobically at 37°C for 24-48 hours. Sabouraud dextrose agar (SDA) was used for fungal cultures. Antibiotic susceptibility testing was performed using Kirby-Bauer's disk diffusion method on Muller-Hinton Agar as per CLSI guidelines.

Isolates were identified based on colony appearance, Gram stain and standard biochemical.

RESULTS

In our study showed the pathogens causing Catheter associated urinary tract infection and non- catheter associated urinary tract infection and their antibiotic susceptibility pattern of 200 Positive urine samples cultured from patients with CAUTI (100) and Non- CAUTI (100) were taken.

The age distribution of patients showed that catheterized patients were predominantly younger, with the highest proportion (38%) in the 20–30 years age group. In contrast, non- catheterized patients were more evenly distributed across age groups, with the highest percentage (22%) in the 61–70 years category. The least represented group in both categories was patients above 70 years, accounting for only 8% in the non-catheterized and 10% in the catheterized groups. Figure 1: Age Distribution of Non-Catheterized and Catheterized Patients

Table 1: Gender Wise Distribution of Non-Catheterized and Catheterized Patients

Sex	Non-Catheterized (n=100)	Catheterized (n=100)
Male	22 (22%)	24 (24%)
Female	78 (78%)	76 (76%)

Female patients comprised the majority in both groups, with 78% in the non-catheterized and 76% in the catheterized patients, whereas male patients accounted for 22% in the non- catheterized and 24% in the catheterized groups.

Table 2: Distribution of Patients Across Different Hospital Wards

Ward	Non-Catheterized (n = 100)	Catheterized (n = 100)
Surgery	10 (10.0%)	14 (14.0%)
Medicine	42 (42.0%)	12 (12.0%)
Gynaecology	23 (23.0%)	29 (29.0%)
Intensive Care Unit	23 (23.0%)	42 (42.0%)
Emergency	2 (2.0%)	3 (3.0%)

The distribution across hospital wards showed that non-catheterized patients were mostly in the Medicine ward (42%), while the ICU had the highest percentage (42%) of catheterized patients.

Figure shows the distribution of Gram-positive, Gram-negative, and *Candida* isolates in catheterized and non-catheterized patients. Among non-catheterized patients, Gram-negative organisms were the most prevalent, accounting for 74% (74 cases), followed by Gram- positive organisms at 14% (14 cases), and *Candida* at 12% (12 cases). In catheterized patients, Gram-negative organisms also dominated, comprising 67% (67 cases), with Gram- positive organisms at 26% (26 cases), and *Candida* at 7% (7 cases).

Figure:2: Distribution of organisms on the basis of Gram-stain in catheterized and non-catheterized patients.

Table 3: Distribution of Microorganisms in Non-Catheterized and Catheterized Patients

MICROORGANISM	Non-Catheterized (n=100)	Catheterized (n=100)	z-value	p-value
<i>Escherichia coli</i> (E. coli)	46 (46.0%)	22 (22.0%)	3.70	<0.001
<i>Klebsiella pneumoniae</i> (K. pneumoniae)	16 (16.0%)	30 (30.0%)	2.39	0.017
<i>Enterococcus</i> spp.	11 (11.0%)	22 (22.0%)	2.12	0.034
<i>Pseudomonas</i> spp.	8 (8.0%)	9 (9.0%)	0.25	0.800
Coagulase-negative Staphylococci (CoNS)	3 (3.0%)	4 (4.0%)	0.38	0.700
<i>Acinetobacter</i> spp.	1 (1.0%)	4 (4.0%)	1.37	0.172

Citrobacter koseri	0 (0.0%)	2 (2.0%)	1.43	0.153
Enterobacter aerogenes	1 (1.0%)	0 (0.0%)	1.01	0.315
Klebsiella oxytoca (K. oxytoca)	1 (1.0%)	0 (0.0%)	1.01	0.315
Proteus spp.	1 (1.0%)	0 (0.0%)	1.01	0.315

The distribution of microorganisms in non-catheterized and catheterized patients was analyzed using the Gaussian test to assess statistical significance.

Among the isolates, *Escherichia coli* (E. coli) was the most frequently detected organism in both groups; however, it was significantly more prevalent in non-catheterized patients (46.0%) compared to catheterized patients (22.0%), with a z-value of 3.70 and $p < 0.001$, indicating a significant difference.

Conversely, *Klebsiella pneumoniae* (K. pneumoniae) was more commonly found in catheterized patients (30.0%) than in non-catheterized patients (16.0%), with a z-value of 2.39 and $p = 0.017$, also indicating statistical significance. Similarly, *Enterococcus* spp. was significantly higher in catheterized patients (22.0%) than in non-catheterized patients (11.0%) ($z = 2.12$, $p = 0.034$). Other microorganisms, including *Acinetobacter* spp., *Pseudomonas* spp., Coagulase-negative *Staphylococci* (CoNS), *Citrobacter koseri*, *Enterobacter aerogenes*, *Klebsiella oxytoca* (K. oxytoca), *Proteus* spp., and *Candida* spp., did not show significant differences between the two groups ($p > 0.05$).

TABLE 4: Showing Sensitivity profile of *Klebsiella* spp.:

Antibiotics	Non-Catheterized (Total = 17)		Catheterized (Total = 30)	
	Sensitive	Intermediate	Sensitive	Intermediate
AK	13 (75%)		14 (46.66%)	
PIT	14 (82.35%)		18 (60%)	
NIT	14 (82.35%)		19 (63.33%)	
CIP	10 (58.82%)		8 (26.6%)	
NX	10 (58.82%)		6 (20%)	
GEN	11 (64.70%)		11 (36.66%)	
DO	14 (82.82%)		23 (76.66%)	
NET	11 (64.70%)		21 (70%)	
TOB	13 (75%)	4 (25%)	18 (60%)	

CPM	9 (52.94%)	8 (47.05%)	7 (23.33%)	
CZ	7 (41.17%)		-	
CTR	9 (52.94%)	8 (47.05%)	4 (13.33%)	
MRP	14 (82.35%)	3 (17.65%)	13 (43.33%)	4 (13.33%)
IMP	14 (82.35%)	3 (17.65%)	7 (23.33%)	5 (16.6%)
CFS	14(82.35%)		16 (53.33%)	

Note: Klebsiella spp. from non-catheterized patients showed higher overall antibiotic sensitivity, notably to NIT, PIT, DO, and MRP (all above 80%). In catheterized patients, sensitivity rates were generally lower, with the highest being for DO (76.66%) and NET (70%), indicating greater resistance in catheter-associated infections.

Table 5: Showing Sensitivity profile of Pseudomonas spp.

Antibiotics	Non-Catheterized (Total = 8)		Catheterized (Total = 9)	
	Sensitive	Intermediate	Sensitive	Intermediate
PIT	6 (75%)		4 (44.44%)	
CAZ	4 (50%)		4 (44.44%)	
IPM	7 (87.5%)		3 (33.33%)	
GEN	5 (62.5%)		5 (55.55%)	
TOB	5 (62.5%)		3 (33.33%)	
CPM	5 (62.5%)		4 (44.44%)	
NX	5 (62.5%)		3 (33.33%)	
AK	6 (75%)		5 (55.55%)	
DORI	7 (87.5%)		5 (55.55%)	
CFS	6 (75%)		5 (55.55%)	
NIT	6 (75%)		4 (44.44%)	
CIP	5 (62.5%)		2 (21.33%)	
MRP	5 (62.5%)	1 (13%)	5 (55.55%)	

Note: In the case of *Pseudomonas spp.*, non-catheterized isolates exhibited strong sensitivity to imipenem (87.5%), doripenem (DORI) (87.5%), and amikacin (AK) (75%), indicating their effectiveness in treating such infections. However, catheterized *Pseudomonas* strains showed considerably lower sensitivity to these same drugs, with imipenem dropping to 33.33% and ciprofloxacin (CIP) to just 21.33%.

Table 6: Showing Sensitivity profile of *E. coli*

Antibiotics	Non-Catheterized (Total = 46)		Catheterized (Total = 22)	
	Sensitive	Intermediate	Sensitive	Intermediate
AK	41 (89%)		12 (54.54%)	
PIT	42 (91.30%)		14 (63.63%)	
NIT	39 (84.78%)		11 (50%)	
CFS	40 (86.95%)		11 (50%)	
CPM	32 (69.56%)	6 (13.04%)	6 (27.27%)	
CTR	30 (65.21%)	5 (10.86%)	4 (18.18%)	
NET	36 (78.26%)		11 (50%)	
TOB	31 (67.39%)	9 (19.56%)	9 (40.90%)	
AMC	29 (63.04%)	10 (21.73%)	-	
CIP	32 (69.56%)	8 (17.39%)	-	
NX	27 (58.69%)	7 (15.21%)	-	
GEN	40 (86%)		7 (31.81%)	
DO	42 (91.30%)		14 (63.63%)	

Note: For *E. coli*, non-catheterized samples were highly susceptible to most antibiotics, especially PIT (91.3%), doxycycline (DO) (91.3%), and amikacin (AK) (89%), making these suitable choices for empirical therapy. Catheterized *E. coli* isolates.

Table 7: Showing Sensitivity profile of *Proteus* spp .

Antibiotics	Sensitivity (S)	Resistance (R)
PIT	100%	AMC
CTR	100%	NIT
CPM	100%	AK
CFS	100%	DO
CIP	100%	
NX	100%	
TGC	100%	
MRP	100%	
GEN	100%	
NET	100%	
TOB	100%	

Note: Highly sensitive to most antibiotics tested, except for resistance noted to AMC, NIT, AK, and DO.

Table 8: Showing Sensitivity profile of *Enterobacter aerogenes*.

Antibiotics	Sensitivity (S)	Intermediate sensitive
CFS	100%	NIT
CPM	100%	PIT
CTR	100%	CPZ
GEN	100%	
AK	100%	
TOB	100%	
MRP	100%	

IPM	100%	
NX	100%	

Enterobacter aerogenes showed 100% sensitivity to all tested antibiotics including CFS, CPM, CTR, GEN, AK, TOB, MRP, IPM, and NX, indicating excellent antimicrobial response. Intermediate sensitivity was observed to NIT, PIT, and CPZ, suggesting limited resistance.

Table 9: Showing Sensitivity profile of *Enterococcus* spp. Catheterized and Non- Catheterized patients.

S.No	Antibiotic	Catheterized Total-22	Non-Catheterized (Total-11)
1	AMP	11 (100%)	8 (72.72%)
2	NX	7 (31.81%)	5 (45.45%)
3	NIT	16(72.72%)	10 (90.90%)
4	HLG	10 (45.45%)	9 (81.81%)
5	VA	22 (100%)	11 (100%)
6	DO	17(77.27%)	8 (72.72%)
8	CIP	14 (63.63%)	7 (63.63%)
9	TE	16 (72.72%)	6(54.54%)
10	LZ	22(100%)	11(100%)
11	TE	22(100%)	11(100%)
		—	—

Note: Catheter-associated strains showed higher resistance compared to non-Catheterized strains for most antibiotics, especially HLG and NX. However, both groups showed 100% sensitivity to VA,LZ,andTE.

In catheterized patients with *Citrobacter koseri*, 100% sensitivity was observed to most antibiotics including IMP/MRP, PIT, AK, GEN, CFS, NET, and TOB. Moderate sensitivity (50%) was noted for CIP and NIT, while resistance was observed to AMC and CZ.

Table 10: Distribution of *Candida* Species and Germ Tube Test Results in Catheterized and Non-Catheterized Patients.

	CATHETERIZE D	NON- CATHETERIZED	CATHETERIZED	NON- CATHETERIZE D

GERM TUBE TEST	3	5	4	7
NON-CANDIDA ALBICANS				
	CATHETERIZED	NO. of isolates	NON-CATHETERIZED	No.of isolates
B/C TEST	C. tropicalis	1	C.tropicalis	2
	C.dublinensis	2	C.dublinensis	4
	C.glabrata	1	C.glabrata	1

Among catheterized patients, germ tube test was positive in 3 and 4 cases, while in non-catheterized patients, it was positive in 5 and 7 cases. Non-*Candida albicans* isolates included *C. tropicalis* (1 vs. 2), *C. dubliniensis* (2 vs. 4), and *C. glabrata* (1 each), with *C. dubliniensis* being the most frequent, especially in non-catheterized cases.

DISCUSSION

Our study found that younger adults were disproportionately represented among catheterized patients, with 38% in the 20–30 age group, contrasting with non-catheterized patients, where the highest proportion (22%) was seen in the 61–70 age group. This is in contrast with prevailing literature which often implicates the elderly as the primary demographic affected by catheter-associated urinary tract infections (CAUTIs). Shen et al. (2023) ^[93] reported that patients aged ≥ 74 years had higher rates of CAUTIs and associated complications, while Shimoni et al. (2023) ^[94] documented inappropriate catheterization in nearly 26% of hospitalized elderly patients. However, our findings resonate with Isath et al. (2024) ^[95], who observed high catheter use in <40-year-old ICU patients with acute cardiac conditions. The relatively low catheterization rate among the elderly in our cohort may reflect clinical restraint, aimed at avoiding complications like prolonged hospitalization and increased mortality, as noted by Eiroa-Hernández et al. (2023) ^[96]. This divergence from established patterns underscores the importance of evaluating catheter use within institutional and demographic contexts.

Gender-wise, female patients predominated in both groups, comprising 78% of non-catheterized and 76% of catheterized patients. These proportions closely align with studies by Shen et al. (2023) ^[93], Rosenthal et al. (2024) ^[97], and Lathe & Lathe (2024) ^[98], attributing higher female UTI rates to anatomical susceptibility. However, the slightly higher male proportion in the catheterized group (24%) is clinically significant. Studies by Lai et al. (2024) ^[99] and Köse & Çiftçi (2024) ^[100] suggest that while UTIs are more frequent in females, catheterized males face more severe complications due to factors like biofilm formation and chronic retention. D’Incau et al. (2023) ^[101] further supported this, highlighting increased resistance and persistent infections in catheterized male patients. These findings advocate for gender-specific catheter management strategies to mitigate adverse outcomes.

Antibiotic resistance patterns demonstrated significant divergence between catheterized and non-catheterized urinary tract infection (UTI) cases across multiple bacterial species, reinforcing the influence of device-associated infections on therapeutic efficacy. The notable decline in sensitivity among catheter-associated isolates is likely attributable to prolonged exposure to hospital flora, selective antimicrobial pressure, and biofilm formation.

Klebsiella spp. exhibited substantially higher sensitivity in non-catheterized isolates to carbapenems such as imipenem (82.35%) and meropenem (82.35%), as well as to piperacillin-tazobactam (PIT) and

nitrofurantoin (both 82.35%). However, catheterized strains showed marked resistance, with imipenem and meropenem sensitivity dropping to 23.33% and 43.33%, respectively. These findings align with prior research by Ashraf et al. (2015) [124] and Sharma et al. (2024) [118], which attributed increased resistance to ESBL production and biofilm-associated resistance mechanisms in catheterized settings. Interestingly, doxycycline retained effectiveness even in catheterized cases (76.66%), potentially reflecting empirical adjustments or environmental selection, warranting further investigation into its sustained efficacy.

Pseudomonas spp. followed a similar trend, with non-catheterized isolates showing high sensitivity to imipenem (87.5%), doxycycline (87.5%), and amikacin (75%). In contrast, catheterized isolates exhibited significant resistance, with imipenem sensitivity dropping to 33.33% and ciprofloxacin to 21.33%. These findings corroborate studies by Soni et al. (2024) [125] and Eladawy et al. (2023) [126], which documented plasmid-mediated resistance and biofilm-induced tolerance in catheter-related *Pseudomonas* infections. Despite reduced overall sensitivity, agents like colistin maintained partial activity, though emerging resistance patterns highlight the need for cautious use of last-line drugs.

E. coli remained the predominant pathogen, especially in non-catheterized patients (46%) and catheterized (22%). The antimicrobial profile of non-catheterized isolates was robust, with sensitivity exceeding 89% for amikacin, 91.3% for Piperacillin tazobactam, and 91.3% for doxycycline. However, in catheterized patients, sensitivity to these agents declined markedly—e.g., amikacin dropped to 54.54%, nitrofurantoin to 50%, and gentamicin to 31.81%. These patterns mirror those reported by Tanwar et al. (2024) [119] and Nawaz et al. (2025) [128], suggesting that catheter-associated environments foster multidrug-resistant *E. coli* strains. Despite this, doxycycline retained moderate efficacy (63.63%), reinforcing its utility as part of empiric regimens, particularly in mixed-resistance profiles.

Proteus spp. showed broad susceptibility to most antibiotics, with resistance noted primarily to amoxicillin-clavulanate, nitrofurantoin, amikacin, and doxycycline. This profile suggests selective resistance possibly influenced by prior drug exposure or intrinsic resistance mechanisms. Such findings are consistent with Ashraf et al. (2015) [124], who reported similar patterns of resistance and emphasized the role of drug stewardship in limiting emergent resistance.

Enterobacter aerogenes displayed good susceptibility to carbapenems and aminoglycosides, though intermediate responses were observed for nitrofurantoin, ciprofloxacin, and netilmicin. This suggests the need for careful selection of empiric therapy in suspected cases and aligns with Miftode et al. (2024) [120], who advocated for carbapenems in treating complex Gram-negative infections with intermediate resistance profiles.

Enterococcus spp. isolates from catheterized patients demonstrated higher resistance rates compared to non-catheterized counterparts, particularly to high-level gentamicin (45.45% vs. 81.81%) and norfloxacin (31.81% vs. 45.45%). However, 100% sensitivity was preserved to vancomycin, linezolid, and teicoplanin across both groups, mirroring observations by Yadav et al. (2015) [103] and Gargan et al. (2024) [107], and affirming these agents as reliable therapeutic options in Enterococcal UTIs, especially in hospital settings.

Citrobacter koseri, though limited in sample size (2 patients), demonstrated complete sensitivity to carbapenems and colistin. Partial resistance to commonly used antibiotics such as ciprofloxacin and piperacillin-tazobactam was observed, suggesting the early development of multidrug resistance even in low-prevalence pathogens. These findings align with Rosenthal et al. (2024) [114], emphasizing the necessity of individualized therapy in rare but emerging uropathogens. Candida growth were showed in 7 in catheterized patients and 12 in non-catheterized patients. Germ tube test was done for identification of *Candida albicans* and non-*Candida albicans*, were it was positive in 3 In catheterized patients and 5 in non- catheterized patients. Which showed growth of *Candida albicans*. Rest samples non-*Candida albicans* were further analysed by the sugar assimilation test, urease test, inverted Durham's test and sugar fermentation test for identification of species of *Candida*. where it were identified for 1 *C. tropicalis*, 2 *C. dublinensis*, 1 *C. glabrata* in catheterized patients. Whereas 2 *C. tropicalis*, 4 *C. dublinensis* and 1 *C. glabrata* in non- catheterized patients. In our study showed that *C. dublinensis* were found maximum in both groups, which followed by *C. tropicalis* via different biochemical tests. Whereas *Candida albicans* showed maximum by germ tube test in non-Catheterized patients. Which is similar to Pramodhini S et al and Esmailzadeh A et al.

Overall, the data reinforces that catheter use significantly alters both pathogen distribution and antibiotic susceptibility, with greater resistance observed in catheterized patients. The enhanced resistance is consistent with literature associating biofilm formation, prolonged hospitalization, and empirical antibiotic exposure with

decreased drug efficacy (Murugesan et al., 2024 [117]; Bhavsar et al., 2024 [116]). Drugs like amikacin, PIT, and doxycycline remain effective in non-catheterized cases, while carbapenems and colistin retain their role in severe, catheter-associated infections despite emerging resistance trends.

These findings support the need for routine antibiotic surveillance, ward-specific empirical protocols, and timely de-catheterization strategies, in line with stewardship demonstrated by Mrziglod et al. (2023) [106] and Majumder et al. (2014) [123]. Incorporating antibiogram trends into practice can help curb resistance evolution and optimize patient outcomes.

CONCLUSIONS

Urinary tract infections (UTIs) remain a major public health concern, particularly among women. This study identified *Escherichia coli*, *Klebsiella pneumoniae*, and *Staphylococcus aureus* as the predominant pathogens responsible for UTIs. A concerning observation was the widespread resistance of these isolates to commonly prescribed antibiotics, underscoring the urgent need for routine antimicrobial surveillance and monitoring to improve patient management and treatment outcomes. The findings strongly advocate for judicious catheter use, strict infection control practices, and evidence-based antibiotic stewardship programs.

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