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RESEARCH ARTICLE

Catheter Associated Urinary Tract Infection in Patients Admitted to Katihar Medical College Hospital, Katihar, Bihar

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ABSTRACT

Catheter associated urinary tract infection (CAUTI) is the commonest device associated infection acquired from hospital settings. CAUTI accounts for 80% of all nosocomial urinary tract infection and 40% of all hospital acquired infection. Approximately 15% to 25% of patients in hospitals have to undergo catheterization at some time during their stay. CAUTI according to the Centre of Disease Control and Prevention (CDC) is defined as urinary tract infection where an indwelling urinary catheter was in place for more than two calendar days on the day of event (day one being the day of device placement).

Materials and Methods: This prospective observational study was carried out from April 2024 to September 2025 over a period of 18 months in the department of Microbiology, Katihar Medical College, Katihar, Bihar. Determination of the risk factors and etiological agents associated with CAUTI, antimicrobial and antifungal susceptibility pattern of isolates was done using standard microbiological procedures. CAUTI rate was calculated per 1000 catheter days.

Results: A total of 3826 urine samples were received in the laboratory during the study period, out of which 3453 were voided urine samples and 373 were catheterized urine samples. 621 of the voided urine samples and 57 of the catheterized urine samples showed growth. CAUTI rate was found to be 8.8 per 1000 urinary catheter days. Maximum CAUTI patients were seen in 51-60 years age group 20/57(35.1%) followed by 41-50 years age group 12/57 (21.1%). Female to male ratio was found to be 3:1. The highest number of CAUTI cases were seen from the Obstetrics and Gynaecology department comprising 20/57 (35.1%), followed by General Medicine 17/57 (29.8%) whereas the least number of CAUTI cases were seen from the Orthopaedics department accounting for 2/57 (3.5%). Predominant isolates were *Escherichia coli* 22/57 (38.6%), followed by *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* 7/57 (12.3%) each. Less common ones were *Candida albicans* 5/57 (8.8%), *Enterococcus faecalis* 4/57 (7.0%), *Acinetobacter baumannii* and *Enterobacter* spp. 3/57 (5.3%) each, *Candida tropicalis* and *Candida guilliermondii* 2/57 (3.5%) each, *Enterococcus faecium* and *Serratia* spp. 1/57 (1.7%) each. The association of gender, age group, duration of catheterization with CAUTI was found to be statistically significant (p value<0.05) whereas diabetes and hypertension were independent risk factors of CAUTI. Gram-positive cocci showed 100% resistance to gentamicin high level, ciprofloxacin, levofloxacin and erythromycin. Gram- negative bacilli (fermenters) showed 100% resistance to cefalotin and ampicillin followed by cefixime (94.0%), ceftriaxone (93.9%). Gram- negative bacilli (non-fermenters) showed 100% resistance to cotrimoxazole, levofloxacin, cephalosporins, carbapenems and aztreonam. Antifungal susceptibility pattern of *Candida* species showed 100% sensitivity to amphotericin B, voriconazole, micafungin, flucytosine and fluconazole.

Conclusion: CAUTI rate was found to be 8.8 per 1000 urinary catheter days which is similar to the CAUTI rates reported in several other studies done across India. The duration of urinary catheterization was found to be a predominant risk factor for CAUTI. Maximum CAUTI patients were seen in 51-60 years age group. Female to male ratio was found to be 3:1. There was a predominance of Gram-negative pathogens, majority of which were multidrug resistant.

Keywords: Catheter associated urinary tract infection**,** AST.

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Introduction

Catheter associated urinary tract infection (CAUTI) is the commonest device associated infection acquired from hospital settings.[1] CAUTI accounts for 80% of all nosocomial urinary tract infection and 40% of all hospital acquired infection.[2] CAUTI according to the Centre of Disease Control and Prevention (CDC) is defined as urinary tract infection where an indwelling urinary catheter was in place for more than two calendar days on the day of event (day one being the day of device placement).[3]

$$\text{CAUTI Rate} = \frac{\text{No of CAUTIs}}{\text{No of Catheter Days}} X 1000$$

The CAUTI rate per 1000 urinary catheter days is calculated by dividing the number of CAUTI by the number of catheter days and multiplying the result by 1000.[3]

Escherichia coli, *Klebsiella* spp., Enterococci, *Enterobacter* spp. and *Proteus* spp. are common pathogens that colonize urinary catheters and are responsible for CAUTI. Other organisms causing CAUTI, due to inadequate aseptic precautions during insertions and

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maintenance of urinary catheter by health care workers are *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Acinetobacter* spp. [4]

There are several risk factors which can affect the occurrence of CAUTI. These include quality of aseptic technique, duration of catheterization, appropriate hand hygiene and care of catheter.[1]

Indwelling urinary catheters provide a surface for the attachment of host cell binding receptors that are recognized by bacterial adhesins, as well as disrupt the uroepithelial mucosa to expose new binding sites for bacterial adhesins. [5]

Biofilms can form on both the inside and outside of a catheter. These are groups of bacteria covered in a sticky layer that protects them from antibiotics and the body's immune system. This makes the infection harder to treat and can also help bacteria share antibiotic resistance. Some bacteria, like *Proteus* species, can break down urea into ammonia. This raises the urinary pH (makes it more alkaline), which can cause minerals to build up and form deposits. This deposit can block the catheter and stop urine from flowing properly.[5]

Complications of CAUTI may be in the form of prostatitis, epididymitis, orchitis, pyelonephritis, cystitis, gram negative bacteraemia, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis and meningitis. [6]

Bacteria can enter urinary tract via various routes such as:

- Organisms may be pushed into the previously uninfected bladder at the time of catheter insertion.
- Ascent of microorganisms through the lumen of the catheter
- Ascent of microorganisms over the surface of catheter leading to extra luminal colonization
- Acquisition of the infection via the haematogenous or lymphatic route is a proven, though minor portal of entry. [7]

Intensive infection surveillance and control programs are needed for control of CAUTI. Decline in incidence of infection can be achieved by reducing unnecessary urinary catheterization, use of alternatives like condom catheterization or intermittent catheterization or suprapubic catheterization. Suprapubic catheterization is an alternative as abdominal skin is less likely to be colonized with uropathogens as compared with the urethra, reduced risk of stricture and urethral trauma, less interference with sexual activity. Short term catheterization allows easy assessment of the appropriate time for catheter removal.[5]

The present study was undertaken for the characterization of the various etiological agents of CAUTI along with their antibiotic susceptibility pattern, rate of occurrence and associated risk factors in patients attending Katihar Medical College.

Materials and Methods

This prospective observational study was carried out from April 2024 to September 2025 over a period of 18 months in the Department of Microbiology, Katihar Medical College, Katihar, Bihar. The purpose of the study was to determine the risk factor associated with CAUTI, isolate the etiological agents and determine the antimicrobial and antifungal susceptibility pattern of these isolates. CAUTI rate per 1000 catheter days was also calculated.

Inclusion Criteria

All catheterized patient with indwelling catheter for >48-hours, in wards including intensive care units of Katihar Medical College were included in this study.

Exclusion Criteria

All paediatric patients with indwelling catheter and patients catheterized for <48-hours duration were excluded from the study.

Collection of Samples

Catheterized Urine

While collecting the urine sample all mandatory aseptic precautions were taken, the site of aspiration of the

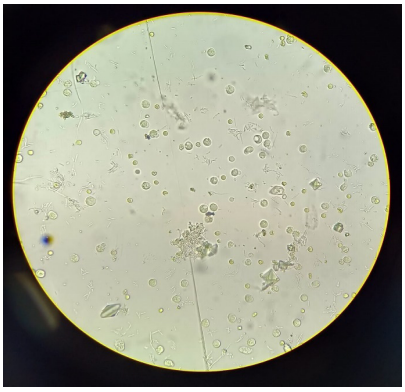

Fig 1: Wet mount of catheterized sample showing bacteria, pus cells, RBC

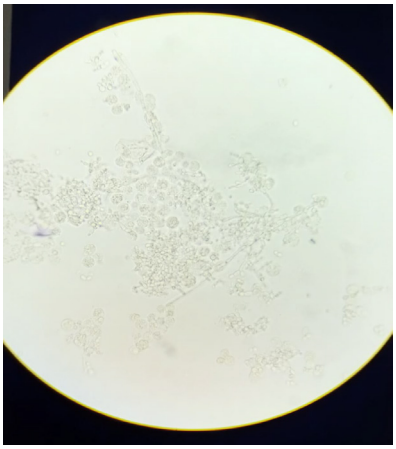

Fig 2: Wet mount of catheterized sample showing budding yeast cells with pseudo hyphae and pus cells

Fig 3: Klebsiella pneumoniae grown on MacConkey agar

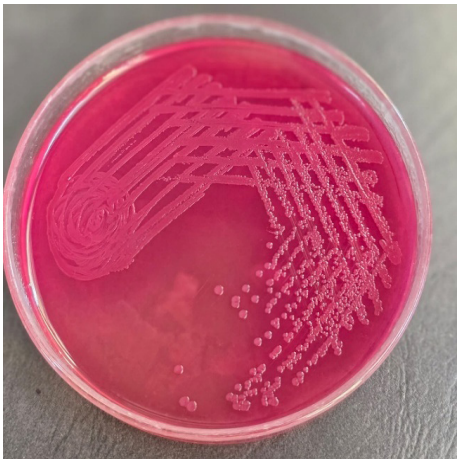

Fig.4: *Escherichia coli* grown on MacConkey agar media

catheter tube was primarily cleaned with 70% ethanol. The catheter tube was clamped and urine was collected with sterile disposable syringe in sterile wide mouthed universal container. The samples were immediately sent to the Microbiology department for culture and sensitivity testing. [1,8]

Processing of samples

Identification and speciation of isolates was done as per the standard protocol.

Direct Microscopy

Wet mount examination of catheterized urine was done for the presence of pus cells, epithelial cells, RBCs, microorganisms and budding yeast cells with pseudo hyphae. Fig. 1 and 2

Culture

Blood and MacConkey agar

All samples were inoculated on Blood agar and MacConkey agar plates and incubated at 37ºC for 24-48 hour. The urine cultures of colony count 10^3 - 10^5 colony forming units (CFU)/ml with no more than two species of microorganisms were considered as positive for CAUTI.[9]

Identification of cultures

Identification and speciation of isolates was done as per the standard microbiological procedures using automated system viz. Vitek Compact 2 system

Gram stain

Gram stain was performed from the colonies to categorize the organisms as Gram positive cocci, Gram negative bacilli and yeasts. Fig. 5 and 6

Vitek 2 compact system

Final identification and antibiotic susceptibility testing of isolates was done using Vitek2 compact system. Vitek 2 employs ID and AST cards, which deliver identification and susceptibility data in 10 to 18 hours. For inoculum preparation pure sub- cultures were suspended in aqueous 0.45% (wt./vol) NaCl to achieve a turbidity equivalent 0.5 McFarland standard according to the manufacturer's recommendation and measured on the Densi Chek turbidity meter (Biomerieux, India). [10]

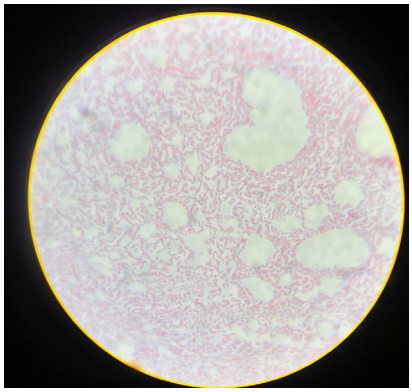

Fig 5: Gram staining showing gram positive cocci

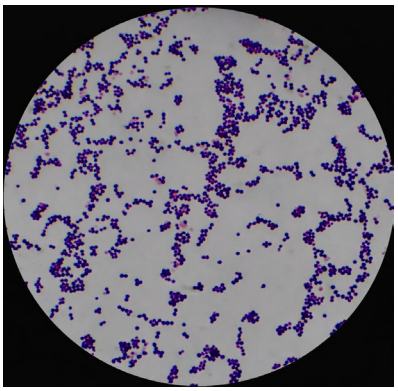

Fig 6: Gram staining showing gram negative bacilli

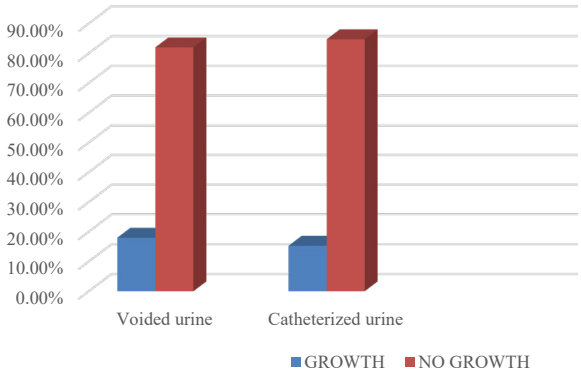

Fig 7: Distribution of samples

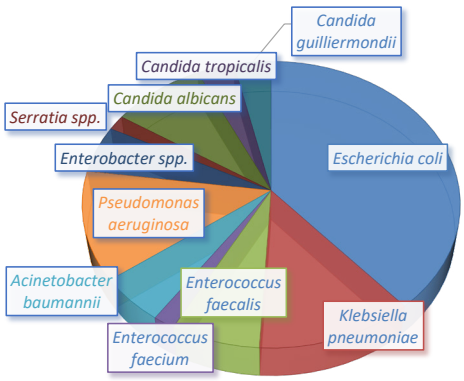

Fig 8: Causative organisms of CAUTI

Results & Analysis

This prospective observational hospital-based study was conducted in the Department of Microbiology at Katihar Medical College, Katihar, Bihar over a duration of 18 months from April 2024 to September 2025. A total of 3826 urine samples were received in the laboratory during the study period, out of which 3453 were voided urine samples and 373 were catheterized urine samples. 621 of the voided urine samples and 57 of the catheterized urine samples showed growth. CAUTI rate was found to be 8.8 per 1000 urinary catheter days.

Distribution of Samples

Growth was observed in 621/3453 (18%) of voided urine and 57/373 (15.3%) of catheterized urine samples. Fig. 7

Table 1: Age and Gender-wise Distribution of CAUTI patients

Age in years	*Male (%)*	*Female (%)*	*Total (%)*
0-10	0	0	0
11-20	0	1 (2.3)	1 (1.8)
21-30	0	11 (25.7)	11 (19.2)
31-40	0	5 (11.6)	5 (8.8)
41-50	3 (21.4)	9 (20.9)	12 (21.1)
51-60	8 (57.2)	12 (27.9)	20 (35.1)
61-70	1 (7.1)	5 (11.6)	6 (10.5)
>70	2 (14.3)	0	2 (3.5)
Total	14 (24.6)*	43 (75.4) *	57 (100)

*Percentage calculated horizontally

Table 2: Risk factors for CAUTI

Risk factor		*CAUTI*		*Total*	*P-value*
		Absent (%)	*Present (%)*		
Age in years	11-20	35 (97.2)	1 (2.8)	36	<0.05
	21-30	47 (81.0)	11 (19.0)	58	
	31-40	81 (94.2)	5 (5.8)	86	
	41-50	82 (87.2)	12 (12.8)	94	
	51-60	41 (67.2)	20 (32.8)	61	
	61-70	26 (81.3)	6 (18.7)	32	
	>70	4 (66.7)	2 (33.3)	6	
Gender	Female	172(80.0)	43 (20.0)	215	0.003
	Male	144 (91.1)	14 (8.9)	158	
Diabetes mellitus	Present	124 (84.4)	23 (15.6)	147	0.88
	Absent	192 (85)	34 (15)	226	
Hypertension	Present	100 (85.5)	17 (14.5)	117	0.77
	Absent	216 (84.4)	40 (15.6)	256	
Duration of catheterization	<6 days	215 (91.9)	19 (8.1)	234	<0.001
	>6 days	101 (72.7)	38 (27.3)	139	

All Percentages calculated horizontally

Age and Gender-wise Distribution of CAUTI patients

Maximum CAUTI patients were seen in 51-60 years age group 20/57(35.1%) followed by 41-50 years age group 12/57 (21.1%). Female preponderance was seen. The female to male ratio was found to be 3:1. Table 1

Department wise distribution of patients with CAUTI

The highest number of CAUTI cases were seen from the Obstetrics and Gynaecology department comprising 20/57 (35.1%), followed by General Medicine 17/57 (29.8%) whereas the least number of CAUTI cases were seen from the Orthopaedics department accounting for 2/57 (3.5%).

Causative organisms of CAUTI

Predominant isolates were *Escherichia coli* 22/57 (38.6%), followed by *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* 7/57 (12.3%) each. Less common ones were *Candida albicans* 5/57 (8.8%), *Enterococcus faecalis* 4/57 (7.0%), *Acinetobacter baumannii* and *Enterobacter* spp. 3/57 (5.3%) each, *Candida tropicalis* and *Candida guilliermondii* 2/57 (3.5%) each, *Enterococcus faecium* and *Serratia* spp. 1/57 (1.7%) each. Fig. 8

Risk factor for CAUTI

The association of gender, age group, duration of catheterization with CAUTI was found to be statistically significant (p value<0.05) whereas diabetes and hypertension were independent risk factors of CAUTI. Overall diabetes mellitus was present in 147/373 (39.45%) patients and hypertension was present in 117/373 (31.4%). Table 2

Clinical findings in suspected CAUTI cases

Significant corelation (p value <0.001) was found between pyuria and CAUTI. Association of other clinical findings like fever, chills and rigor, suprapubic pain, flank pain, haematuria with CAUTI was not found to be significant.

Antibiotic susceptibility of Gram-positive cocci

Maximum sensitivity was seen to linezolid, teicoplanin, tigecycline (100%) each followed by daptomycin, tetracycline, vancomycin (60%) each. 100% resistance was seen to gentamicin high level, ciprofloxacin, levofloxacin and erythromycin. **Table 3**

Antibiotic susceptibility of gram-negative bacilli (fermenter)

Maximum sensitivity was seen to ertapenem (97%) followed by cefoxitin, amikacin, gentamicin (30.3%). 100%

Table 3: Antibiotic susceptibility of Gram-positive cocci

Antibiotic	*Antibiotic susceptibility of Gram-positive cocci (n=5)*		
	*Sensitive (%) **	*Resistant (%) **	*Intermediate (%) **
Benzyl penicillin	1 (20.0)	4 (80.0)	0
Gentamicin high level	0	5 (100)	0
Ciprofloxacin	0	5 (100)	0
Levofloxacin	0	5 (100)	0
Erythromycin	0	5 (100)	0
Linezolid	5 (100)	0	0
Daptomycin	3 (60.0)	0	2 (40.0)
Teicoplanin	5 (100)	0	0
Tetracycline	3 (60.0)	2 (40.0)	0
Tigecycline	5 (100)	0	0
Vancomycin	3 (60.0)	2 (40.0)	0
Nitrofurantoin	1 (20.0)	2 (40.0)	2 (40.0)

* Percentages calculated horizontally

Table 4: Antibiotic susceptibility of Gram-negative bacilli (fermenter)

Antibiotic	*Antibiotic susceptibility of Gram-negative bacilli (fermenter n=33)*		
	*Sensitive (%) **	*Resistant (%) **	*Intermediate (%) **
Amoxicillin/Clavulanic acid	5 (15.2)	28 (84.8)	0
Piperacillin/Tazobactam	9 (27.3%)	24 (72.7)	0
Cefalotin	0	33 (100)	0
Cefoxitin	10 (30.3)	23 (69.7)	0
Cefixime	1 (3.0)	31 (94.0)	1 (3.0)
Ceftazidime	5 (15.2)	26 (78.8)	2 (6.1)
Ceftriaxone	2 (6.1)	31 (93.9)	0
Amikacin	10 (30.3)	21 (63.6)	2 (6.1)
Gentamicin	10 (30.3)	23 (69.7)	0
Ciprofloxacin	3 (9.1)	30 (90.9)	0
Norfloxacin	6 (18.2)	27 (81.8)	0
Ofloxacin	5 (15.2)	28 (84.8)	0
Trimethoprim/ Sulfamethoxazole	8 (24.2)	25 (75.8)	0
Ampicillin	0	33 (100)	0
Ticarcillin	8 (24.2)	25 (75.8)	0
Nitrofurantoin	6 (18.2)	19 (57.6)	8 (24.2)
Ertapenem	32 (97.0)	1 (3.0)	0

* Percentages calculated horizontally

Table 5: Antibiotic susceptibility of Gram-negative bacilli (non-fermenter)

Antibiotic	*Antibiotic susceptibility of Gram-negative bacilli (non- fermenter, n=10)*		
	*Sensitive (%) **	*Resistant (%) **	*Intermediate (%) **
Ticarcillin	0	8 (80)	2 (20)
Piperacillin/Tazobactam	1 (10)	9 (90)	0
Ceftazidime	0	10 (100)	0
Ceftriaxone	0	10 (100)	0
Amikacin	2 (20)	8 (80)	0
Gentamicin	3 (30)	7 (70)	0
Ciprofloxacin	3 (30)	7 (70)	0
Trimethoprim/Sulfamethoxazole	0	10 (100)	0
Norfloxacin	3 (30)	7 (70)	0
Ofloxacin	3 (30)	7 (70)	0
Cefoperazone /Sulbactam	0	10 (100)	0
Cefepime	0	10 (100)	0
Aztreonam	0	10 (100)	0
Levofloxacin	0	10 (100)	0
Meropenem	0	10 (100)	0
Imipenem	0	10 (100)	0
Colistin	0	0	10 (100)

* Percentages calculated horizontally

Table 6: Antifungal susceptibility of *Candida* species

Antifungal agents	*Antifungal susceptibility of Candida species (n=9)*		
	Sensitive(%)*	*Resistant*(%)*	*Intermediate*(%)*
Amphotericin B	9 (100)	0	0
Voriconazole	9 (100)	0	0
Caspofungin	7 (77.8)	2 (22.2)	0
Micafungin	9 (100)	0	0
Flucytosine	9 (100)	0	0
Fluconazole	9 (100)	0	0

*Percentages calculated horizontally

resistance was seen to cefalotin and ampicillin followed by cefixime (94.0%), ceftriaxone (93.9%). **Table 4**

Antibiotic susceptibility of gram-negative bacilli (non-fermenter)

100% resistance was seen to cotrimoxazole, levofloxacin, cephalosporins, carbapenems and aztreonam. 80% of isolates were sensitive to amikacin and 70% were sensitive to gentamicin and quinolones (except levofloxacin). All the isolates were intermediate sensitive to colistin. **Table 5**

Table 7: Advanced Expert System Phenotypes of Gram-negative bacilli (fermenter)

Phenotypic mechanism of resistance	*Escherichia coli (%)*	*Klebsiella pneumoniae (%)*	*Enterobacter spp. (%)*
ESBL	8 (36.4)	2 (28.6)	
Impermeability to carbapenems +ESBL+HL AmpC + Carbapenemase	14 (63.6)	5 (71.4)	2 (66.7)
Acquired penicillinase			1 (33.3)
Total	22	7	3

Table 8: Advanced Expert System Phenotypes of Gram-negative bacilli (non-fermenter)

Phenotypic mechanism of resistance	*Pseudomonas aeruginosa (%)*	*Acinetobacter baumannii (%)*
ESBL+ Impermeability to carbapenems+ Carbapenemase	3 (42.9)	
ESBL (clavulanate inhibited) + Impermeability to Carbapenems +High level cephalosporinase +Carbapenemase	4 (57.1)	
High level cephalosporinase+ Carbapenemase +ESBL (clavulanate inhibited)		2 (66.7)
High level cephalosporinase+ Carbapenemase		1 (33.3)
Total	7	3

Antifungal susceptibility of Candida species

All the isolates (100%) were sensitive amphotericin B, voriconazole, micafungin, flucytosine and fluconazole. 77% of the isolates were sensitive to caspofungin. **Table 6**

Advanced Expert System Phenotypes of Gram-negative bacilli (fermenter)

Out of 22 *Escherichia coli* strains 8 (36.4%) were ESBL producers and 14 (63.6%) showed impermeability to carbapenems+ ESBL+ HL AmpC + carbapenemase production. Among the 7 *Klebsiella pneumoniae* strains 2 (28.6%) were ESBL producers and 5 (71.4%) showed impermeability to carbapenems+ ESBL+ HL AmpC + carbapenemase production, and in *Enterobacter* spp. 2 (66.7%) isolates were impermeable to carbapenems+ ESBL+ HL AmpC + carbapenemase producer and 1 (33.3%) showed resistance via acquired penicillinase. **Table 7**

Advanced Expert System Phenotypes of Gram-negative bacilli (non-fermenter)

Out of 10 strains, 3 (42.9%) *Pseudomonas aeruginosa* were ESBL + Carbapenemase producer with impermeability to carbapenems and 4 (57.1%) showed impermeability to carbapenems + ESBL (clavulanate inhibited) + high level cephalosporinase + carbapenemase producer. 2 (66.7%) *Acinetobacter baumannii* were high level cephalosporinase+ carbapenemase +ESBL (clavulanate inhibited) producer and 1 strain (33.3%) was high level cephalosporinase+ carbapenemase producer. **Table 8**

Discussion

A total of 3826 urine samples were received in the laboratory during the study period, out of which 3453 were voided urine samples and 373 were catheterized urine samples. 621 of the voided urine samples and 57 of the catheterized urine samples showed growth. CAUTI rate in our study was found to be 8.8 per 1000 catheter days. Parihar S et al. (2023) conducted a study which enrolled 150 patients with indwelling urinary catheters and reported a CAUTI rate of 9.4 per 1,000 catheter days.[11] Khan AA et al. (2025) in their study reported a CAUTI rate of 7.39 per 1,000 catheter days.[12] Kazi MM et al. (2015) reported that the CAUTI rate in their study was 4.9 per 1,000 catheter days.[13]
In the present study, growth was observed in 621/3453 (18%) of voided urine and 57/373 (15.3%) of catheterized urine samples. Verma S (2017) in their study reported that 26/163 (15.95%) patients were diagnosed with CAUTI. [14] Binda et al. (2019) in their study reported CAUTI prevalence of 17%.[15] These findings are similar to our study where the CAUTI prevalence was found to be 15.3%.

Maximum 20/57 (35.1%) CAUTI patients were seen in 51-60 years age group followed by 12/57 (21.1%) patients in 41-50 years age group. The female to male ratio was found to be 3:1. Similar findings were reported by other authors where females were affected more than males. Parihar S (2023) in their study reported that CAUTI cases were predominantly reported in 51-70 years age group (34%) and females 14/22 (63.6%) outnumbered males 8/22 (36.4%).[11] Omer SA et al. (2020) in their study reported that 48/59 (81.4 %) CAUTI cases were females and 11/59 (19.6%) were males.[16] Verma D et al. (2019) in their study reported a higher prevalence of CAUTI in males 18/33 (55%) as compared to females 15/33 (45%), which is against the present study.[17] Ramesh A et al. (2018) in their study reported that CAUTI was commonly seen among patients with > 80 years age, which is against the findings of the present study where 51-60 years was the most common age group.[3]

The highest number of CAUTI cases were seen from the Obstetrics and Gynaecology department comprising 20/57 (35.1%), followed by General Medicine 17/57 (29.8%) whereas the least number of CAUTI cases were seen from the Orthopaedics department accounting for 2/57 (3.5%). Similar findings were reported Khan AA et al. (2025) in their study where highest number of CAUTI cases were seen from the Obstetrics and Gynaecology department comprising 79/173 (45.7%) followed by Internal Medicine ward 64/173 (37%), Neuro-medicine ward 30/173 (17.3%).[12]

In the present study, predominant isolates were *Escherichia coli* 22/57 (38.6%), followed by *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* 7/57 (12.3%) each. Less common ones were *Candida albicans* 5/57 (8.8%), *Enterococcus faecalis* 4/57 (7.0%), *Acinetobacter baumannii* and *Enterobacter* spp. 3/57 (5.3%) each, *Candida tropicalis* and *Candida guilliermondii* 2/57 (3.5%) each, *Enterococcus faecium* and *Serratia* spp. 1/57 (1.7%) each.

Predominance of *Escherichia coli* in the present study is concordance with other studies from India. Verma D et al in 2019 conducted a similar study where *Escherichia coli* was the predominant pathogen, responsible for 23/33 (69.69%) of CAUTI cases, followed by *Klebsiella* species 5/33 (15.15%) *Acinetobacter and Candida albicans* 2/33 (6.1%) each, *Enterococcus* 1/33 (3.0%).[17] In a similar study conducted by Sharma AK et al (2019), the most frequently isolated pathogens were *Escherichia coli* (40%) and *Klebsiella pneumoniae* (40%) followed by *Pseudomonas aeruginosa* (10%) and *Acinetobacter* species (10%) from the cases of CAUTI.[6] Malini S et al. (2025) reported that the most prevalent uropathogen identified in their study was *Klebsiella pneumoniae* 38/81 (46.91%) followed by *Escherichia coli* 24/81 (29.63%), which is in contrast to the findings of the present study.[18]

The association of gender, age group, duration of catheterization with CAUTI was found to be statistically significant (p value<0.05) whereas diabetes and hypertension were independent risk factors. Verma S et al. (2017) in their study reported the association of duration of catheterization with CAUTI was found to be statistically significant (p value= 0.03) whereas age group, gender and diabetes were independent risk factors of CAUTI.[14] Unlike the findings of our study, Poovvizhi M et al. (2025) reported significant association of diabetes mellitus (p value= 0.003) and hypertension (p value< 0.001) with CAUTI whereas age group, gender, duration of catheterization were reported as independent risk factors.[19]

Significant corelation (p value <0.001) was found between pyuria and CAUTI cases. Association of other clinical findings like fever, chills and rigor, suprapubic pain, flank pain, haematuria with CAUTI was not found to be significant. Poovvizhi M et al. in their study found significant association between CAUTI cases and symptoms such as fever (p value= 0.007), chills and rigor (p value= 0.041), suprapubic pain (p value= 0.011) and costovertebral angle pain (p value=0.0003).[19]

Gram-positive cocci showed maximum sensitivity to linezolid, teicoplanin, tigecycline (100%) followed by daptomycin, tetracycline, (60%). All the isolates (100%) were resistant to gentamicin high level, ciprofloxacin, levofloxacin and erythromycin. Parihar S et al. (2023) in their study reported that among Gram positive cocci, *Enterococcus* species showed maximum susceptibility to gentamicin high level, linezolid and nitrofurantoin (100%) followed by vancomycin (83.3%).[11] Malini S et al. (2025) in their study reported that among Gram positive cocci, *Enterococcus* species showed maximum sensitivity to linezolid (100%) followed by ampicillin and fosfomycin (83.3%). Maximum resistance was seen to nitrofurantoin (83.33%) followed by meropenem (66.67%).[18]

Gram- negative bacilli (Fermenter) showed maximum sensitivity to ertapenem (97%) followed by cefoxitin, amikacin, gentamicin (30.3%). 100% resistance was seen to cefalotin and ampicillin followed by cefixime (94.0%), ceftriaxone (93.9%). Verma D et al. (2019) in their study reported that Gram negative bacilli showed high level of resistance to norfloxacin (82%), azithromycin (81%), cotrimoxazole (68%), piperacillin/tazobactam (64%).

Maximum sensitivity was seen to colistin (89.2%) followed by nitrofurantoin and ceftazidime (71.4%).[17]

Gram-negative bacilli (non-fermenter) showed 100% resistance to cotrimoxazole, levofloxacin, cephalosporins, carbapenems and aztreonam. 80% of isolates were sensitive to amikacin and 70% were sensitive to gentamicin and quinolones (except levofloxacin). All the isolates were intermediate sensitive to colistin. Sharma AK et al. (2019) in their study reported that Gram negative bacilli (non-fermenters) were 100% resistant to ampicillin, amoxicillin, cefazolin, ceftazidime, cefuroxime.[6] Patel R et al. (2024) in their study reported that Gram negative bacilli (non-fermenters) were resistant to ciprofloxacin, ceftazidime, cefoperazone-sulbactam, piperacillin/tazobactam (100%) followed by imipenem, meropenem (71.4%).[20] In all studies including ours, high level of resistance to commonly used antibiotics was seen in Gram-negative isolates both fermenters and non-fermenters.

All the candida isolates (100%) were sensitive amphotericin B, voriconazole, micafungin, flucytosine and fluconazole. 77% of the isolates were sensitive to caspofungin. Singhal et al. (2024) in their study reported that all *Candida s*pecies were found to be sensitive to voriconazole, amphotericin B, caspofungin and micafungin (100%).[21]

AES phenotypes of gram-negative bacilli (fermenter). Out of 22 *Escherichia coli* strains 8 (36.4%) were ESBL producers and 14(63.6%) showed impermeability to carbapenems+ ESBL+ HL AmpC + carbapenemase production. Among the 7 *Klebsiella pneumoniae* strains 2 (28.6%) were ESBL producers and 5 (71.4%) showed impermeability to carbapenems+ ESBL+ HL AmpC + carbapenemase production, and in *Enterobacter* spp. 2 (66.7%) isolates were impermeable to carbapenems+ ESBL+ HL AmpC + carbapenemase producer and 1 (33.3%) showed resistance via acquired penicillinase. Verma D et al. (2019) in their study reported that among Gram negative bacilli, 25% isolates were extended spectrum β lactamase producers.[17]

AES phenotypes of gram-negative bacilli (non-fermenters). Out of 10 strains, 3 (42.9%) *Pseudomonas aeruginosa* were ESBL + Carbapenemase producer with impermeability to carbapenems and 4 (57.1%) showed impermeability to carbapenems + ESBL (clavulanate inhibited) + high level cephalosporinase + carbapenemase production. 2 (66.7%) *Acinetobacter baumannii* were high level cephalosporinase+ carbapenemase +ESBL (clavulanate inhibited) producer and 1 strain (33.3%) was high level cephalosporinase+ carbapenemase producer.

Conclusion

In the present study, overall CAUTI rate was found to be 8.8 per 1000 urinary catheter days. The rates are similar those reported by various authors in their studies.

There was a predominance of Gram-negative pathogens in our study, majority of which were multidrug resistant. The emergence of MDR organisms is a huge problem which is plaguing the entire world. Creating awareness about this gigantic problem among the doctors, especially the clinicians is of utmost importance.

Several risk factors of CAUTI were identified, amongst which the duration of catheterization, gender and age group showed significant association with an increased risk of CAUTI (p value<0.001).

The duration of urinary catheterization is a predominant risk factor for CAUTI. Preventive measures directed at limiting the placement and early removal of urinary catheter, maintaining a closed drainage system, keeping the urinary bag below the bladder level and regularly emptying it have a significant impact on decreasing CAUTI rates. Bladder bundles, education, surveillance of CAUTI are powerful tools for implementing appropriate preventive measures against CAUTI. In health care centers, Continuing Medical Education (CME), interdisciplinary training programs and audits should be conducted from time to time with checklist about catheter care to improve the knowledge and practice of health care professionals.

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