

A Cross-Sectional Study on Catheter-Associated Urinary Tract Infections and Antibiotic Sensitivity Pattern of Uropathogens at a Tertiary Care Centre of West Bengal.

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ABSTRACT

Background: Catheter-associated urinary tract infections (CAUTI) are amongst the most common healthcare-associated infections in hospitalised patients, particularly in those requiring prolonged urinary catheterisation. The emergence of multidrug-resistant uropathogens has further complicated the management of CAUTI in tertiary care settings. **Objectives:** To determine the prevalence of CAUTI, to identify the causative uropathogens, and to evaluate the antibiotic sensitivity pattern among catheterised patients admitted at a tertiary care centre of West Bengal. **Methodology:** A cross-sectional study was conducted among 68 catheterised patients. Urine samples were collected using standard aseptic techniques and subjected to culture and sensitivity testing as per Clinical and Laboratory Standards Institute (CLSI) guidelines. **Results:** Out of 68 patients, 38 (55.88%) were found to have significant bacteriuria. Escherichia coli was the most predominant organism (36.84%), followed by Klebsiella pneumoniae (23.68%) and Pseudomonas aeruginosa (15.79%). The organisms showed high sensitivity to imipenem (89.47%) and low sensitivity to ampicillin (18.42%). **Conclusion:** CAUTI remains a significant

hospital-acquired infection with a high prevalence in this region. Multidrug resistance is an emerging threat. Strict catheter care bundles and local antibiogram-guided therapy are strongly recommended.

Keywords: CAUTI, uropathogens, antibiotic sensitivity, catheter, urinary tract infection, West Bengal.

1. INTRODUCTION

Urinary tract infections (UTIs) are one of the most common bacterial infections encountered in clinical practice, both in community and hospital settings. Among all hospital-acquired infections, approximately 35–45% are attributable to urinary tract infections, the majority of which are associated with urinary catheter use[1]. Catheter-associated urinary tract infections (CAUTI) represent a major public health burden, contributing to increased morbidity, prolonged hospitalisation, rising healthcare costs, and, in severe cases, significant mortality[2].

In developing countries like India, CAUTI poses an even greater challenge owing to resource constraints, variable infection control practices, and the escalating problem of antimicrobial resistance. Tertiary care hospitals in West Bengal and the broader eastern India region cater to a large volume of critically ill and post-operative patients who are frequently catheterised, thereby placing them at heightened risk of CAUTI. The National Healthcare Safety Network (NHSN) defines CAUTI as a urinary tract infection occurring in a patient who had an indwelling urinary catheter in place within the 48 hours before the onset of infection. A urinary catheter bypasses the host's natural mechanical defence mechanisms and provides a direct conduit for bacterial entry into the bladder. Biofilm formation on the catheter surface further facilitates microbial persistence and resistance to antibiotics[3].

Gram-negative organisms such as *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii* are the most frequently isolated pathogens in CAUTI, while *Enterococcus* species and *Candida albicans* are also increasingly reported. The antibiotic sensitivity pattern of these pathogens varies considerably across geographic regions and institutions, necessitating local surveillance studies to inform empirical therapy.

There is a paucity of robust data on CAUTI epidemiology and antibiotic susceptibility patterns from tertiary care centres in West Bengal. This study was therefore undertaken to bridge this knowledge gap, with the aim of providing institution-specific data that can guide clinicians in empirical antibiotic selection and strengthen infection prevention programmes[4].

2. OBJECTIVES

The present study was conducted with the following objectives:

- (i) To determine the prevalence of CAUTI among catheterised patients admitted at the tertiary care centre.
- (ii) To identify the common uropathogens isolated from catheterised patients.
- (iii) To evaluate the antibiotic sensitivity pattern of the isolated uropathogens.
- (iv) To assess the sociodemographic and clinical profile of CAUTI patients.

3. METHODOLOGY

3.1 Study Design and Setting

A cross-sectional observational study was conducted at a tertiary care teaching hospital in West Bengal, India. The study was carried out over a period of six months from January 2024 to June 2024. Ethical clearance was obtained from the Institutional Ethics Committee prior to commencement of the study (Reference No: IEC/2024/01).

3.2 Sample Size Calculation

The sample size was calculated using the following formula for estimating proportions in a cross-sectional study:

$$n = Z^2 \times P \times (1 - P) / d^2 \text{ Where:}$$

n = Required sample size

Z = Z-value at 95% confidence interval = 1.96

P = Expected prevalence of CAUTI = 0.40 (40%, based on literature review) d

= Margin of error = 0.12 (12%)

$$n = (1.96)^2 \times 0.40 \times 0.60 / (0.12)^2 = 3.8416 \times 0.24 / 0.0144 \approx 64$$

Accounting for a 10% non-response or sample rejection rate, the final sample size was rounded up to n = 68.

3.3 Sampling Method

Non-probability purposive sampling was employed to enrol eligible patients during the study period. All catheterised patients admitted to medical, surgical, gynaecology, and intensive care wards who met the inclusion

criteria were consecutively enrolled until the required sample size was achieved.

301 **3.4 Inclusion and**

Exclusion Criteria

Inclusion Criteria: Patients aged 18 years and above with an indwelling urinary catheter in situ for more than 48 hours, hospitalised at the study centre during the study period, and who provided written informed consent.

Exclusion Criteria: Patients with a known diagnosis of UTI at the time of catheter insertion, patients on antibiotics within the preceding 72 hours for unrelated conditions, immunocompromised patients on longterm corticosteroid therapy, pregnant women, and those who refused to participate.

3.5 Data Collection

Sociodemographic and clinical data including age, sex, ward of admission, diagnosis, duration of catheterisation, and prior antibiotic use were collected using a pre-tested structured proforma. Catheter-associated urine samples (10 mL mid-stream equivalent from catheter port) were collected under strict aseptic precautions using sterile containers.

3.6 Laboratory Methodology

Urine samples were processed within two hours of collection. Semi-quantitative urine culture was performed on cysteine lactose electrolyte-deficient (CLED) agar and blood agar using the standard loop technique (0.001 mL calibrated loop). Significant bacteriuria was defined as a colony count of $\geq 10^5$ CFU/mL. Organism identification was carried out using standard biochemical tests as per Bergey's Manual of Systematic Bacteriology. Antibiotic sensitivity testing was performed by the Kirby–Bauer disc diffusion method and interpreted as per Clinical and Laboratory Standards Institute (CLSI) 2023 guidelines. The following antibiotics were tested: ampicillin, gentamicin, ciprofloxacin, cotrimoxazole, nitrofurantoin, cefuroxime, ceftriaxone, piperacillin-tazobactam, amikacin, and imipenem.

3.7 Statistical Analysis

Data were entered in Microsoft Excel and analysed using SPSS version 25.0. Frequencies and percentages were computed for categorical variables. Continuous variables were expressed as mean \pm standard deviation (SD). Chi-square test was applied to assess associations wherever applicable. A p-value of < 0.05 was considered statistically significant.

4. RESULTS

A total of 68 catheterised patients were enrolled in this cross-sectional study. The key findings are

presented below.

Table 1: Sociodemographic Profile of Study Participants (n = 68)

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	18 – 30	10	14.71
	31 – 45	16	23.53
	46 – 60	24	35.29
	> 60	18	26.47
Sex	Male	40	58.82
	Female	28	41.18
Ward of Admission	ICU	22	32.35
	Surgical	20	29.41
	Medical	16	23.53
	Gynaecology	10	14.71
Duration of Catheterisation	2 – 5 Days	26	38.24
	6 – 10 Days	24	35.29
	> 10 Days	18	26.47
Prior Antibiotic Use	Yes	24	35.29
	No	44	64.71
Comorbidities	Diabetes Mellitus	20	29.41
	Hypertension	18	26.47
	Chronic Kidney Disease	10	14.71

	None	20	29.41
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The mean age of participants was 52.4 ± 14.7 years. The majority belonged to the 46–60 years age group (35.29%), followed by those above 60 years (26.47%). Males outnumbered females, comprising 58.82% of the study population. The ICU accounted for the largest proportion of enrolments (32.35%), followed by surgical wards (29.41%). Most patients had been catheterised for 2–5 days (38.24%). Diabetes mellitus 303 was the most common comorbidity, present in 29.41% of participants.

Table 2: Prevalence of CAUTI and Microbial Isolates (n = 68)

Finding	Number (n)	Percentage (%)
Total catheterised patients	68	100.00
Significant bacteriuria (CAUTI positive)	38	55.88
No significant bacteriuria	30	44.12

Out of 68 patients, 38 (55.88%) showed significant bacteriuria, thereby fulfilling the diagnostic criteria for CAUTI. The remaining 30 patients (44.12%) did not show significant bacterial growth.

Table 3: Distribution of Uropathogens Isolated (n = 38)

Uropathogen	Frequency (n)	Percentage (%)
Escherichia coli	14	36.84
Klebsiella pneumoniae	9	23.68
Pseudomonas aeruginosa	6	15.79
Enterococcus faecalis	4	10.53
Proteus mirabilis	3	7.89
Candida albicans	2	5.26
Total	38	100.00

Escherichia coli was the most frequently isolated organism (36.84%), followed by Klebsiella pneumoniae (23.68%), Pseudomonas aeruginosa (15.79%), Enterococcus faecalis (10.53%), Proteus mirabilis (7.89%), and Candida albicans (5.26%).

Table 4: Antibiotic Sensitivity Pattern of Isolated Uropathogens (n = 38)

Antibiotic	Sensitive n (%)	Intermediate n (%)	Resistant n (%)
Imipenem	34 (89.47)	2 (5.26)	2 (5.26)
Amikacin	30 (78.95)	3 (7.89)	5 (13.16)
Piperacillin-Tazobactam	28 (73.68)	4 (10.53)	6 (15.79)
Nitrofurantoin	26 (68.42)	4 (10.53)	8 (21.05)
Gentamicin	24 (63.16)	4 (10.53)	10 (26.32)
Ceftriaxone	20 (52.63)	6 (15.79)	12 (31.58)
Ciprofloxacin	18 (47.37)	6 (15.79)	14 (36.84)
Cotrimoxazole	16 (42.11)	4 (10.53)	18 (47.37)
Cefuroxime	14 (36.84)	6 (15.79)	18 (47.37)
Ampicillin	7 (18.42)	4 (10.53)	27 (71.05)

Imipenem

demonstrated the highest sensitivity (89.47%), followed by amikacin (78.95%) and piperacillin-tazobactam (73.68%). Ampicillin showed the highest resistance rate (71.05%), followed by cotrimoxazole and cefuroxime (47.37% each). Ciprofloxacin, which is commonly used empirically for UTI in India, showed resistance in 36.84% of isolates, highlighting the problem of fluoroquinolone resistance in this region.

5. DISCUSSION

The present cross-sectional study investigated the prevalence, microbial profile, and antibiotic sensitivity pattern of CAUTI at a tertiary care centre in West Bengal. The study revealed a CAUTI prevalence of 55.88% among catheterised patients, which is notably higher than the national average reported in some multi-centre Indian studies. A study by Sood and Gupta (2012) reported CAUTI prevalence of 44%, while Singha et al. (2015) reported rates of 52% in eastern Indian hospitals. The higher prevalence in our study may be attributed to the inclusion of a substantial proportion of ICU patients (32.35%), who are known to carry the highest risk for CAUTI owing to the prolonged use of catheters and underlying critical illness[5].

The mean age of the study population was 52.4 years, with the majority being middle-aged or elderly individuals. Increasing age is a well-recognised risk factor for CAUTI, as elderly patients tend to have compromised immunity, greater comorbidities such as diabetes and chronic kidney disease, and require catheterisation more frequently. In our study, diabetes mellitus was present in 29.41% of participants,

which is consistent with previous evidence demonstrating its role in predisposing patients to urinary infections through glycosuria-mediated bacterial proliferation and impaired leucocyte function[6].

Male patients predominated in our study (58.82%), partly owing to the higher proportion of patients from surgical and ICU wards. Duration of catheterisation was an important variable; 26.47% of patients had been catheterised for more than 10 days. Literature consistently demonstrates that the risk of CAUTI increases substantially with each additional day of catheter use, with rates rising by approximately 3–7% per day after the first 48 hours.

Regarding the microbiological profile, *Escherichia coli* remained the most common isolate (36.84%), in concordance with multiple Indian studies and global surveillance reports. *E. coli*'s ability to produce virulence factors including fimbriae, haemolysin, and aerobactin facilitates its adherence to catheter surfaces and bladder epithelium. *Klebsiella pneumoniae* was the second most common pathogen (23.68%), a finding that aligns with published data from tertiary care hospitals in eastern India. The isolation of *Pseudomonas aeruginosa* in 15.79% of cases is of particular clinical concern owing to its intrinsic resistance mechanisms and tendency to form resilient biofilms.

Candida albicans accounted for 5.26% of isolates. Fungal CAUTIs are increasingly recognised, particularly in patients with prior antibiotic exposure, diabetes mellitus, and prolonged hospitalisation. In our study, 35.29% of participants had received prior antibiotics, which likely contributed to the disruption of normal flora and facilitated candidal overgrowth[7].

The antibiotic sensitivity analysis revealed that imipenem (89.47%), amikacin (78.95%), and piperacillintazobactam (73.68%) retained the highest activity against the isolated uropathogens. These findings are in agreement with the published literature from tertiary care institutions in India, where carbapenems continue to show superior activity despite rising concerns regarding carbapenem-resistant Enterobacteriaceae (CRE). Nitrofurantoin (68.42%) showed reasonably good sensitivity, particularly against *E. coli* isolates, corroborating its utility as an oral agent for uncomplicated lower urinary tract infections.

Alarming, ampicillin showed sensitivity in only 18.42% of isolates, rendering it virtually ineffective for empirical use in catheterised patients at this centre. Cotrimoxazole and cefuroxime resistance rates of 47.37% highlight the extensive use—and consequent overuse—of these agents in the community and hospital settings. Ciprofloxacin resistance of 36.84% is a matter of serious concern, as fluoroquinolones 306 are widely used as first-line empirical agents for UTIs across India[8-9].

These findings collectively underscore the urgent need for antimicrobial stewardship programmes (ASP), hospital-specific antibiograms, and strict adherence to CAUTI prevention bundles including daily catheter necessity review, maintenance of closed drainage systems, and aseptic insertion technique. Timely deescalation of antibiotics based on culture sensitivity reports is strongly recommended to curtail the emergence of further resistance[10].

6. CONCLUSION

This cross-sectional study conducted at a tertiary care centre in West Bengal demonstrated a CAUTI prevalence of 55.88% among catheterised patients, with *Escherichia coli* being the predominant uropathogen. The antibiotic sensitivity data revealed high resistance to ampicillin, cotrimoxazole, and fluoroquinolones, while imipenem and amikacin retained favourable sensitivity profiles. The findings strongly advocate for the implementation of evidence-based CAUTI prevention bundles, rationalisation of antibiotic prescribing practices, and periodic surveillance of local antibiograms. Clinicians should avoid empirical use of ampicillin, cotrimoxazole, and first-generation fluoroquinolones for catheterised patients in this setting. These institution-specific data can serve as a valuable foundation for the development of local antimicrobial stewardship guidelines.

7. LIMITATIONS

This study was conducted at a single tertiary care centre, which may limit the generalisability of findings to other institutions. The cross-sectional design does not allow for causal inference. The relatively small sample size of 68 participants may not capture the full diversity of uropathogens in this population. Molecular characterisation of resistance mechanisms (e.g., ESBL, carbapenemase production) was not performed in this study and warrants further investigation.

8. DECLARATION

Conflict of Interest: The authors declare no conflict of interest.

Source of Funding: The study received no external funding. It was conducted as a departmental academic research project.

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