Original Article

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Determination of Rate of Catheter Associated Urinary Tract Infection in a Tertiary Care Hospital: An Emergence to Establish IPC Department

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ABSTRACT

Background: *Hospital Acquired Infections (HAIs) are posing an imminent threat to patient safety as well as the general well-being of healthcare personnel on a worldwide scale. The World Health Organization (WHO) estimates that at any given time, around 1.4 million people suffer from infectious complications because of HAI. One of the most common healthcare associated infections is Catheter Associated Urinary Tract Infection (CAUTI). This current study was aimed to identify base line CAUTI rate and risk factors responsible for it.*

Materials and methods: *A longitudinal study was conducted from July 2022 to June 2023 in the Department of Microbiology, Chittagong Medical College. The current study brought attention to highlight the rate of CAUTI in the Chittagong Medical College Hospital. The data were analyzed by using SPSS version 27 and the results were summarized by using tables and graphs. The protocol was approved by the Committee of the research cell and ethical clearance was taken from the Ethical Review Committee (ERC) of Chittagong Medical College.*

Results: *330 catheterized urine sample were collected for research purpose from clinically suspected CAUTI. 52.42% were confirmed CAUTI. Current study showed most of the CAUTI patients were female (69.09%) and from Obstetrics and Gynaecology ward (45.66%) with a CAUTI rate 8.12 per thousand catheter days. Whereas overall CAUTI rate was 7.39 per thousand catheter days. Current study shows type 2 diabetes mellitus was the most common comorbidities associated with CAUTI cases (39.88%).*

Conclusions: *The study's findings provide valuable insights into the rate and risk factors associated with CAUTIs.*

Key words: Catheter Associated Urinary Tract Infection (CAUTI); Hospital Acquired Infection (HAIs). Infection Prevention and Control (IPC).

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Introduction

A HAI is defined by the WHO as "An infection that a patient acquires while undergoing treatment in a hospital or other healthcare facility, provided that the illness is not active or incubating at the time of admission". This includes illnesses contracted while a patient is being treated as well as illnesses picked up while a patient was receiving treatment but developing after discharge. These infections typically develop after being hospitalized and show up 48 hours after being admitted. WHO found HAI prevalence ranged from 5.7% to 19.1% in low-income and middle-income countries.[1]

Approximately 10% of infected people die as a consequence of HAIs affects, 7% of patients in industrialized and 10% in poor nations on average at any moment. To assess the burden of endemic HAIs, pinpoint high-risk groups, practices and direct initiatives to lower HAI incidence is crucial. The complicated case definitions employed in HAI surveillance by the National Healthcare Safety Network (NHSN) or the European Centre for Disease Prevention and Control (ECDC) necessitate specialized financial resources, human resources, infection control, epidemiology and

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diagnostic knowledge. Due to these multifactorial causation, in 2010, only 16% of Low and Middle-Income Countries (LMICs) had national HAI surveillance.[2]

Catheter-Associated Urinary Tract Infections (CAUTIs) are one of the most common infections associated with medical treatment worldwide. CAUTIs are responsible for 80% of healthcare associated UTIs and 40% of all hospital-acquired infections.[3] CAUTI defined by Centers for Disease Control and Prevention (CDC) as "A UTI where an indwelling urinary catheter was in place for more than two consecutive days in an inpatient location on the date of event, with day of device placement being Day 1 and an indwelling urinary catheter was in place on the date of event or the day before. If an indwelling urinary catheter was in place for more than two consecutive days in an inpatient location and then removed, the date of event for the UTI must be the day of device discontinuation or the next day for the UTI to be catheter-associated".[4]

Indwelling urinary catheters are standard medical devices utilized in both hospital and nursing home settings. It is considered that about 15-25% of hospitalized patients are catheterized at any given time[5]. The risk of developing Urinary Tract Infection (UTI) increases significantly due to frequent and sometimes unnecessary use of indwelling catheters during hospitalization.[6,7] The duration of catheterization is strongly correlated with the risk of infection.[6,7] Bacteremia (bacterial colonization) is said to be expected and occurs in half of the patients catheterized within 2 weeks and within 4-5 weeks after catheter insertion all patients develop bacteremia. It has further been approximated that the CAUTI risk goes up by 5–10% each day the catheter remains in situ.[8]

The difference between short-term and long-term catheterization is thought to be defined by the daily risk of bacteriuria associated with catheterization, which ranges from 3% to 10% and approaches 100% after 30 days.[9] One study showed prevalence of CAUTI 6.54% with more than 8 catheter days, 75% with 15-21 catheter days, almost 100% with >22 catheter days.[10]

The present study was done to assess the incidence of CAUTI in a tertiary care hospital. This plays a significant role in initiating appropriate antibiotics which decreases complications and hospital stay and helps the infection control team to implement proper care bundles which reduces the hospital stay of patients there by reducing the CAUTI rate along with morbidity and mortality.

Materials and methods

It was a longitudinal type of study conducted in Chittagong Medical College Hospital for one year from July 2022 to June 2023. Patients admitted in Internal Medicine, Gynae-Obstetrics and Neuromedicine Ward who have underwent urinary catheter insertion with or without sign symptoms of CAUTI was included as study population.The calculated sample size was 330.

Inclusion criteria

Patients having catheter in situ (>48 hours) with sign symptom of CAUTI was taken as a study sample.[4]

Exclusion criteria

- Patients with known UTI with or without treatment prior to admission
- With known sexually transmitted disease
- Those catheterized outside the hospital
- Patients on immunosuppressive drugs within 2 weeks
- Those who did not gave consent.[11,12]

Convenient sampling technique used for this study. All patients with inclusion criteria visited at least once a day. A history and clinical examination conducted for each patient, laboratory and clinical data reviewed carefully. Urinary catheter carebundle was implemented among all catheterized patients. Follow up of catheterized patients was done meticulously on dailybasis and observed for local and systemic signs of UTI. On clinical suspicion of UTI in catheterized patients,urine sample was sent to microbiology laboratory along with proper documentation. Culture positivity obtainedin less than 2 calendar days of urinary catheterization was not considered as CAUTI.[4]

Fresh urine samples were collected in a sterile, leak-proof universal container from patients under aseptic technique by applying a non traumatic clamp a few centimeters distal to the catheter tube for 10-20 minutes. Wiping of catheter tube with 2% chlorhexidine and 70% isopropyl alcohol (Alcohol wipe) and allowed drying for 30 seconds. Using a needle less system, inserted syringe firmly into center of the catheter tube, aspiration of the 10ml of urine, removed syringe and unclamp catheter tubing. Collected urine in sterile C/S tube and put it in the cold box for transport it to Microbiology Lab for immediate processing.[13]

Figure 1 Sample collection from Catheter tube

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The urine samples were subjected to direct wet mount and culture using semi-quantitative standard loop technique.[11] Inoculation was done on Cystine Lactose Electrolyte Deficient medium (CLED) agar, Chromogenic agar, MacConkey agar and Blood agar. A significant count was considered. Discrete bacterial isolates thus obtained were subjected to Gram staining, other necessary tests including biochemical tests for further identification. The species identification of bacterial and fungal isolates was done based on standard laboratory procedures. Kirby-Bauer disc diffusion method was adopted for antimicrobial susceptibility testing using appropriate antimicrobial discs as per CLSI guidelines 2022.[13]

Statistical analysis was performed with SPSS software, versions 27.0 Continuous data that were normally distributed were summarized in terms of the mean, standard deviation, median, minimum, maximum and number of observations, Categorical or discrete data were summarized in terms of frequency counts and percentages.

The protocol was approved by the Committee of courses and studies of Microbiology department and ethical clearance was taken from the Ethical Review Committee (ERC) of Chittagong Medical College. After proper explanation regarding the nature of the study, written informed consent was taken from the patients. If the patient was unconscious or too ill, then written consent was taken from the legal guardians.

Results

A total 1453 catheterized patients were screened for Catheter Associated Urinary Tract Infection (CAUTI) during the study period. Three hundred forty-five (345) patients were excluded due to loss of follow up. A total of eleven hundred eight patients (1108) were enrolled. Within these, 778 (29.78%) patients with no symptoms were excluded and 330 patients with >48 hours catheter with symptoms (Fever) were included for taking urine sample. Frequency of clinically suspected CAUTI was 330 (29.8%) and confirmed CAUTI 173(15.6%) cases among the entire study population, n= 1108. (Figure 2).

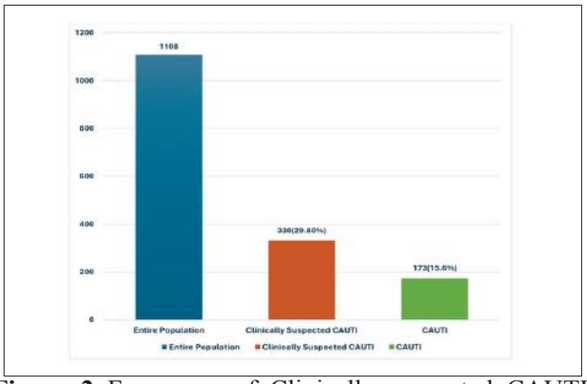

Figure 2 Frequency of Clinically suspected CAUTI and confirmed CAUTI case among entire population

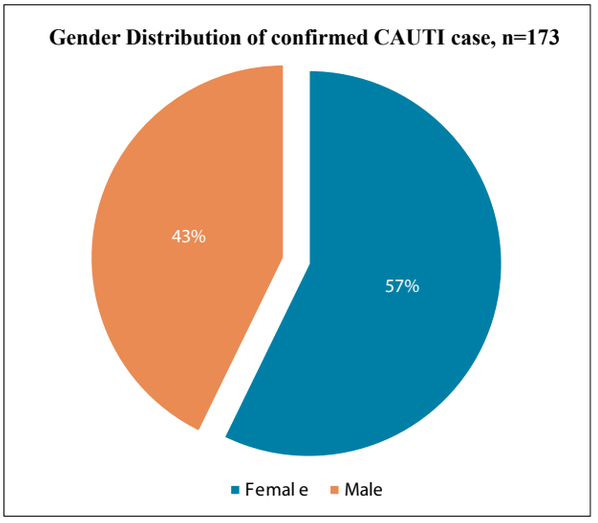

Figure 3 Gender Distribution of confirmed CAUTI case

Out of 173 confirmed CAUTI patients there was female preponderance 99(57.22%) and the rest was male 74 (42.78%).

Table I shows Association of different clinical history among clinically suspected CAUTI and CAUTI cases. Here (125, 37.88%) patients stayed in the hospital for seven days or more than seven days, on the other hand (205, 62.12%) patients stayed for eight days or more than 8 days. Within 8 days or more than 8 days growth positivity was more (98; 56.65%) and the test was significant in clinically suspected cases (χ^2= 19.39, p= <0.0001) and in CAUTI (χ^2= 6.78, p= <0.0092).

Table I Duration of stay in the hospital of clinically suspected CAUTI and confirmed CAUTI Patients

Length of the day in hospital	Clinically Suspected CAUTI (%) n=330	Interference of P value <0.05=S	Confirmed CAUTI, (n = 173), (%)	Interference of p value <0.05=S
≤7	125 (37.88)	<0.0001	75 (43.35)	0.0092
≥8	205(62.12)		98 (56.65)	

*Chi Square (χ^2) test done. Level of significance <0.05

*S= Significant * Number within parentheses indicates percentage.

Table II shows indication of catheterization was mainly due to pre and post operative cases (130, 39.39%) and bacterial growth was more in those cases (94, 54.34%) the test shows significant differences from others that is urinary retention and monitoring of urine output in chronic ill patients shows statistically significant (χ^2= 37.47, p= <0.0001).

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Table II Indication of catheterization in clinically Suspected CAUTI and confirmed CAUTI patients

Indication of catheterization	Clinically Suspected CAUTI (%)	Interference of p value <0.05=S	Confirmed CAUTI, (n =173), (%)	Interference of p value <0.05=S
Pre and post operative cases	130 (39.39)	0.0521	94 (54.34)	<0.0001
Urinary retention and others	105 (31.82)		49 (28.32)	
Monitoring of urine output in chronic ill patients	95 (28.79)		30 (17.34)	

*Chi Square (χ^2) test done. Level of significance <0.05. *S= Significant * Number within parentheses indicates percentage.

Table III shows that type 2 diabetes mellitus was the most common comorbidities associated with suspected CAUTI cases (110, 33.33%), followed by hypertension (77, 23.33%) and ischemic heart diseases (45, 13.64%), then chronic kidney diseases (27, 8.18), Chronic obstructive pulmonary diseases (25, 7.58%). This test shows statistically significant with (χ^2= 21.20, p= 0.0007) at 95% confidence interval. In CAUTI growth positivity was more (69, 39.88) with type 2 diabetes mellitus showing significant difference from others (χ^2= 87.30, p= <0.0001).

Table III Co-morbidity of clinically suspected CAUTI and confirmed CAUTI patients

Co-morbidity	Clinically Suspected CAUTI (%)	Interference of P value <0.05=S	Confirmed CAUTI, (n = 173), (%)	Interference of p value <0.05=S
Type 2 Diabetes mellitus	110 (33.33)		69 (39.88)	
Hypertension	77 (23.33)		39 (22.54)	
Chronic Kidney disease	27(8.18)		10 (5.78)	
Ischemic heart disease	45(13.64)	0.0007	27 (15.61)	<0.0001
Chronic obstructive pulmonary disease	25(7.58)		13 (7.51)	
No comorbidity	46(13.94)		15 (8.67)	

*Chi Square (χ^2) test done. Level of significance <0.05.

*S= Significant * Number within parentheses indicates percentage.

Table IV Association between catheter insertion duration and urinary tract infections among the respondent patients

Catheter Days	Clinically Suspected CAUTI n=330(%)	Median value	Confirmed CAUTI n=173(%)	Median value
3-7	125(37.88)	-	75(43.35)	
8-12	92(27.88)	8-12days	41(23.70)	8-12days
13-17	46(13.94)		22(12.72)	
18-22	33 (10)		19(10.98)	
23-27	21(6.36)		10(5.78)	
28-32	13(3.94)		6(3.47)	
Total	330(100)		173(100)	

* Number within parentheses indicates percentage.

Among the clinically suspected CAUTI, 125 (37.88%) had 3-7 catheter days, 92(27.88%) had 8-12 catheter days, only 13(3.94%) catheterized for 28-32 days. Out of 173 confirmed CAUTI cases 75(43.35%) had 3-7 catheter days, only 10(5.78%) catheterized for 23-27 days.

Table V Calculation of CAUTI rate

Total no. of CAUTI cases x 1000 [NHSN, 2022]
No. Of catheter days

$$=\frac{173 \times 1000}{23409}$$

So, the CAUTI rate is 0.0073903x 1000.
= 7.39 Per thousand catheter days.

* CAUTI rate calculated was 7.39 per thousand catheter days.

* Reference range 0-5 per thousand catheter days, CDC, NHSN, 2022.[4]

Table VI Ward wise catheterization days of confirmed CAUTI patients (n=173)

Department	Total Patient on Urinary catheter for 6 months	CAUTI Patient	CAUTI Rate
Gynecology and Obstetrics Ward	9661	79	8.18 Per thousand catheter days
Internal Medicine Ward	8826	64	7.25 Per thousand catheter days
Neuro-medicine ward	4922	30	6.10 Per thousand catheter days
Total	23409	173	7.39 Per thousand catheter days

Table VI shows calculation of catheter days from different ward, where it showed most catheter days were found in Obstetrics and gynecology department, followed by internal medicine ward and neuro-medicine ward.

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Discussions

The most frequent HAI among hospitalized patients is CAUTI. Long-term urinary catheterization, extended hospital stays, female gender, previous systemic antibiotic medication and co-morbid diseases in admitted patients are risk factors linked to the development of CAUTI.[14] This study was carried out to identify baseline CAUTI rate and the organisms responsible for it. It will help as a guide for further advance surveillance of CAUTI and reduction of rate of CAUTI at hospital level by introducing Infection Prevention and Control (IPC) practices and thus will prevent antibiotic resistance.

A total fourteen hundred fifty-three (1453) catheterized patients were screened for CAUTI during study period from the month of September 2022 to February 2023. Three hundred forty-five (345) patients were excluded due to loss of follow up. A total of eleven hundred eight patients (1108) were enrolled. Within these, seven hundred seventy-eight (778) patients with no symptoms were excluded and three hundred thirty (330) patients with >48 hours catheter with symptoms (fever) were included for taking urine sample. Frequency of clinically suspected CAUTI was 330 (29.8%) and confirmed CAUTI was 173 (15.6%) cases among the entire study population.

Among 330 catheter urine samples collected from patients with clinically suspected CAUTI, 173 (15.6%) were confirmed as CAUTI. This finding is consistent with the results reported by Someshwaran, R. et al. and Islam MA et al. who found 20% CAUTI patients.[15,16] However, a discrepancy was observed in a Saudi study conducted by Sheik et al. where 49.7% of samples were positive for CAUTI. El Magrahi et al. reported CAUTI in 51.67% of cases. Additionally, Zacharias Sumi et al. identified CAUTI in 40% of their samples.[17-19]

Most participants 99 (57.22%) in the current study were female, and they exhibited a higher growth positivity in culture. This finding aligns with the study by Harsha V. Patil et al. who reported that 63.69% of females developed CAUTI.[20] Similarly, a study by El Magrahi et al. observed 61.29%.[18] In contrast, Saleem M et al. found that males were predominant (53%).[21] The increased risk associated with females can be attributed to their shorter urethra and its proximity to the perineum.[18]

A significant risk factor identified in this study was the duration of catheterization (≥8 days) with a higher incidence of growth observed in catheterizations lasting 8 days or longer (56.65%). A similar finding was reported by Rubi et al. who noted that catheterizations exceeding 6 days were more likely to result in CAUTI (49.65%).[22] In contrast, Letica-Kriegel AS et al. reported a lower incidence (16.5%) of CAUTI development with prolonged catheterization, which was less than observed in the present study.[23] This discrepancy may be attributed to the fact that extended catheterization duration is associated with an increased likelihood of ascending infections, either intraluminal or extraluminal. Additionally, catheter insertion outside the operating room or late in hospitalization, the presence of a ureteral stent, or using the catheter for urine measurement further elevate the risk of CAUTI. [24] Current study shows type 2 diabetes mellitus was the most common comorbidities associated with CAUTI cases (39.88%) and this result was similar to a study which was conducted in India by Ahmed et al. was (39.30%).[25] The possible explanation is that diabetics have an increased colonization of organisms in their perineum and urine in diabetics also supports the growth of microorganisms. Altered host immunity in diabetics may also play a role though yet to be investigated.[25]

In the present study, indication of catheterization was mostly due to pre and post operative cases (54.34%). In this study, frequency of catheter days was within 8-12 days similar with Podkovik S et al. which was 8-9 days.[26]

In this current study, the CAUTI rate calculated was 7.39 per 1000 catheter days. Similar findings were reported by Gupta P, et al. where the CAUTI rate was 7.6/1000 catheter days.[27] An article in an Indian Journal by Lalitha et al. demonstrated a CAUTI rate of 7.2/1000 catheter-days.[28] In a Saudi Journal by Izna et al. the rate was 6.1 per thousand catheter days. The findings of the present study regarding CAUTI rate were somewhat elevated, potentially due to inadequate implementation of infection prevention and control measures in the hospital, including insufficient adherence to bundle care protocols, suboptimal hand hygiene practices, improper catheter insertion techniques, inadequate catheter care, overcrowded healthcare facilities and antibiotic resistance. [29]

In this study from individual department, CAUTI rate was higher in case of obstetrics and gynaecologyward 8.18 per thousand catheter days, similar findings were found by Panjwani, et al. maximum CAUTI rate found from Obestetric and Gynaecology Ward. The explanation behind this might be due to lack of proper bundle care for catheter, insertion bundle and maintainance bundle.[30]

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Limitations

During the conduct of the study on Catheter-Associated Urinary Tract Infections (CAUTIs) in Chittagong Medical College Hospital, several limitations were encountered: The small sample size and the inclusion of patients solely from a specific department or unit within the hospital led to potential selection bias, thereby limiting the applicability of the results to the broader hospital population. Consequently, selection bias was present. An additional limitation pertained to inaccurate or incomplete data collection related to catheter insertion, maintenance and removal practices of the catheter.

Conclusion

In the current study,diagnosis of Catheter-Associated Urinary Tract Infections (CAUTIs) presents both opportunities and challenges. The study's findings provide valuable insights into the prevalence, risk factors, bacteriological profile and outcomes associated with CAUTIs in Chittagong Medical College Hospital. This study found CAUTI rate was 7.39 per 1000 catheter days, which was higher than reference range by NHSN, 2024, might be due to proper implementation of IPC practices.

Recommendations

Preventing Catheter-Associated Urinary Tract Infections (CAUTIs) involves following proper protocols for catheter insertion, maintenance and removal. Some recommendations for preventing CAUTIs include: Avoiding unnecessary catheterization and early removal of catheters when no longer needed, Every hospital should follow strict aseptic techniques during catheter insertion and maintenance, so that insertion bundle and maintenance bundle can be applied through proper monitoring sheet by IPC nurses, Ensuring proper hand hygiene before and after handling catheters, maintaininga closed drainage system and avoid unnecessary manipulation of the catheter.

Disclosure

The authors declare no conflict of interest.

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