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Trends of Catheter associated urinary tract infection in a rural tertiary teaching hospital.

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Abstract
Background: *In recent years, hospital acquired infections (HAI) has emerged as the most common adverse events in delivery of healthcare Catheter Associated Urinary Tract Infections (CA-UTI) contribute 30%-40% of all the HAI and they are associated with substantially increased institutional death rates.The present study was conducted at a rural tertiary care academic hospital with an aim to study the rate of catheter associated urinary tract infection with special emphasis on its clinical and microbiological features.****Materials and Methods:****For the purpose of CA-UTI surveillance the definitions of CDC's National Nosocomial Infections Surveillance (NNIS)systemcriteria,were used.The urine sample was aseptically collected from sampling port of urinary catheter with sterile syringe and needle.The urine specimens were inoculated on blood agar and Mackonkey's agar and incubated at 35°C. Isolates were identified bystandard protocol.****Results:*** *The overall occurrence of CA-UTIrate for three years was 5.42.E. coli (31.2%) followed by Klebsiella spp. (19.1%) and Candida spp. (13.9%) were most common isolates from cases of CA-UTI.* ***Conclusion****: In recent years, most of the health care institutions are adapting surveillance as a tool for monitoring HAI. Surveillance is the major step towards reducing the risk for infection in vulnerable hospitalized patients. The present surveillance study helped us to generate institutional data regarding CA-UTI.*

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I. Introduction.

The field of medical science is advancing at a rapid pace, however infectious diseases still continue to contribute significantly to the morbidity and mortality. Hospital acquired infections are the most common adverse iatrogenic events seen in patients.

Hospital acquired infections (HAI) are infections that occur during hospitalization but are neither present nor incubating upon hospital admission. In developed nations, HAIs concern 5-15% of hospitalized patients and can lead to complications in 25-50% of patientswho are admitted in intensive care units.[1]

In a healthcare setup, surveillance of HAI is a basic and most critical requirement for organizing and maintaining an effective infection prevention and control (IPC)programme.Surveillance of medical device-associated infections (MDAI) has become an integral part of infection control in all hospitals. Catheter associated urinary tract infections(CA-UTI),catheter - related blood stream infections (CRBSI) and ventilator-associated pneumonia (VAP) are most commonly reported MDAI.[2]

Mathur P and Podovik *etal* stated that among MDAIs,CA-UTI are the most commonest.[3][4] UTI are associated with indwelling catheter. As per Centre for Disease prevention and Control (CDC) CA-UTI is defined as a UTI where an indwelling urinary catheter was in place for > 2 calender days on the date of event.(CDC) Estimation of HAI infection rate per 1000 device days allows all hospitals to compare their baseline data , rates and also to acknowledge exclusive problem that need re-assessment.[5][6]

CA-UTI is caused by instrumentation of the urinary tract(Jaggietal stated)[7] andDeepabhani*etal* and Zahranetal documented that it has been associated with increased morbidity, mortality, length of hospital stay and cost.[8][9]

Most of the studies related to MDAI are from developed countries. As very few studies from developing countries provide data of MDAI using the standardized definitions HAI rates per 1000 device associated days, there is dearth of information from developing countries like India.

As Most of Indian studies are from tertiary care hospitals located in urban areas like Mumbai, Delhi etc, the present study was conducted at a rural tertiary care academic hospital with an aim to study the rate of catheter associated urinary tract infection with special emphasis on its clinical and microbiological features.

II. Material And Method:

This study was conducted in the Department of microbiology,Rural medical College and Hospital of Pravara Institute of Medical sciences (Deemed University), Loni, Maharashtra,India. Pravararural hospital is a 1275 bedded super specialty hospital which provides health care services to rural masses.

This cross sectional descriptive retrospective study was conducted for a period of 3 years (January 2017 to December2019).The urine sample was collected aseptically from sampling port of urinary catheter with sterile syringe and needle. The urine specimens were inoculated on blood agar and Mackonkey's agar and incubated at 35°Cfor 24-48 hrs.

The patient was labelled as a case of CA-UTI when he /she develops of one /more of the following conditions: temperature(≥38◦C),suprapubic tenderness , urgency, presence of gram positive yeast cells in Gram stained smear prepared from centrifuged urine sample, and isolation of yeast from urine as a pure growth with colony count $>10^5$colony forming units (CFUs)/mL. In case of bacte-riuria, colony count $>10^5$CFU/mL was considered significant.[1]sachin sir Device associated

The rate of CA-UTI was calculated as per following formula.[6]

$$\frac{\text{The number of patients developing CA-UTI}}{\text{Total number of device days}} \times 1000$$

Exclusion criteria: All the patients with community acquired UTI without catheter, with significant growth on urinary culture prior to catheterization[8][10]Amit verma2016Patients catheterized for <48 hr,patients transferred from other hospitals with catheter.[9]

Inclusion criteria: All the patients above 18 yrswith indwelling catheter ≥48hr with baseline .With sterileurine culture prior to catheterization. [8]

III. Results:

During the study period, a total of 23789 patients had indwelling urinary catheter.The genderwise distribution of catheterized patients is shown in figure 1. Out of 23789 patients with indwelling catheter, 7199(30.3%) were males and 16590(69.7%) were females.

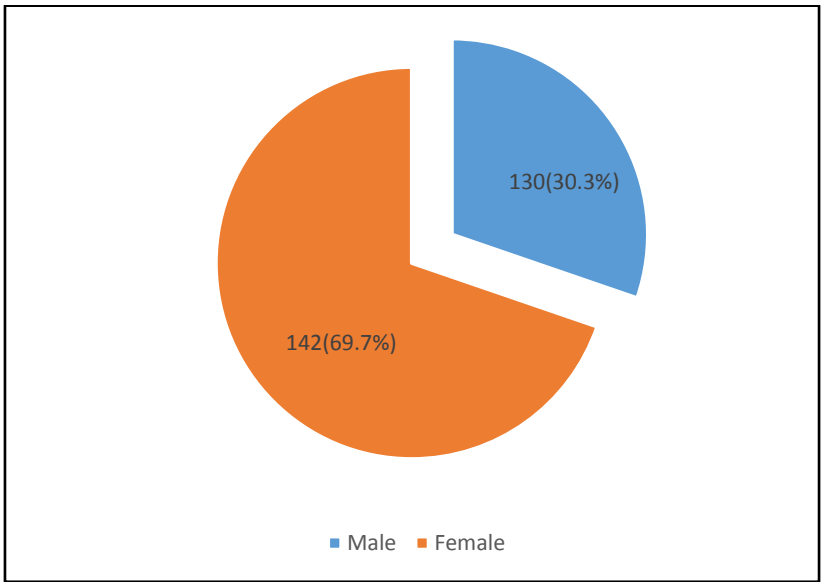

Figure 1:Gender wise distribution of catheterized patients

1-Clinical characteristics of patients with indwelling catheter

Variable	YES	NO	*P* – value(%)

Past medical history of UTI	2378 (10%)	21411(90%)	>0.05
History of surgical operation	2750 (11.55%)	21039(88.44%)	>0.05
Suprapubic pain (symptom)	240 (1%)	23549(99%)	>0.05
Haematuria	250 (1%)	23539 (99%)	>0.05
Fever	1385(5.8%)	22404 (94.17%)	>0.05
Urgency	1280 (5.3%)	22509 (94.61%)	>0.05
Dysuria	1450 (6.09%)	22339 (93.90%)	>0.05
Suprapubic tenderness(examination)	490(2%)	23299(98%)	>0.05

Out of 272 patients suspected of CA-UTI, 130 (47.8%) were males whereas 142 (52.2%) were females.Although female predominance was seen there was no significant difference observed between gender and development of CA-UTI (Fisher's exact test *P*value>0.05). In the present study gender wise distribution of catheterized patients is shown in Figure 1.

The agewise distribution of patients suspected of CA-UTI was shown in Table 2.
Most vulnerable age group for CA-UTI was above 55 (51%)years followed by age group 18-25 (21.3%) and 25-35(15.4%). The incidence of CA-UTIwas significantly high in age group above 55 years (Fisher's exact test *P*value <0.05)

Table 2:Agewise distribution of CA-UTI patients

Age	No of CA-UTI patients	Percentage %
18-25	58	21.3
25-35	42	15.4
35-45	15	5.5
45-55	18	6.6
Above 55	139	51.1
Total	272	100%

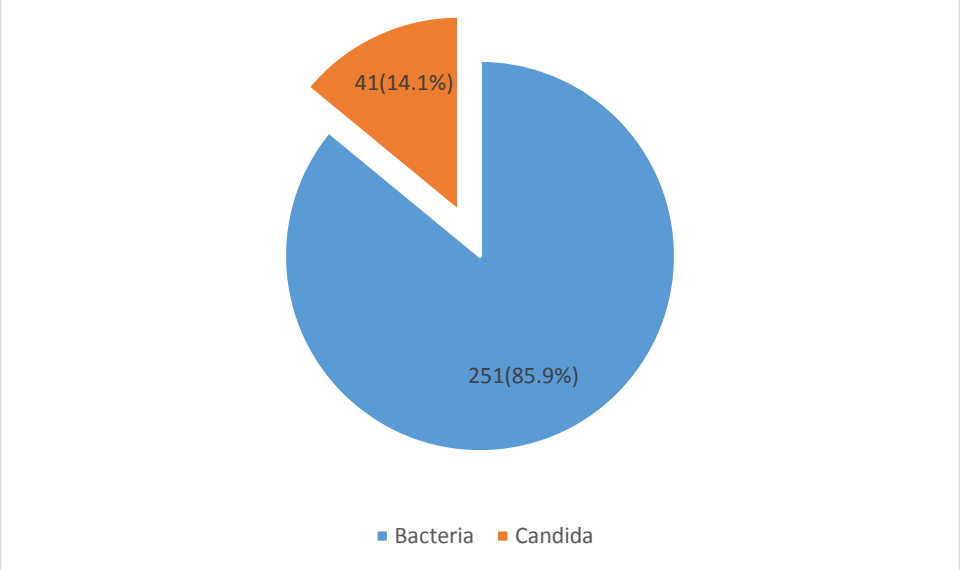

Figure 2: Distribution of isolates in catheterized patients

Table 2: Distribution of isolates

Microorganisms	Number(N) %
1. *E.coli*	91(31.2)
2. *Klebsiella* spp.	56 (19.1)
3. *Candida* spp.	41 (13.9)
4. *Enterococcus* spp.	32 (11)
5. *Pseudomonas* spp.	24 (8.30)
6. *Staphylococcus aureus*	20 (6.9)
7. *Enterobacter* spp.	16(5.5)
8. *Citrobacter* spp.	12(4.1)
Total	N=292

A total of 292 microorganisms were isolated from 272 CA-UTI patients.Out of these 252 (85.9%)were single isolates whereas 40 (14.1%) were mixed culture. As shown in figure 2

In present study bacteria was significant cause of CA-UTI(Fisher's exact test *P*value<0.05)

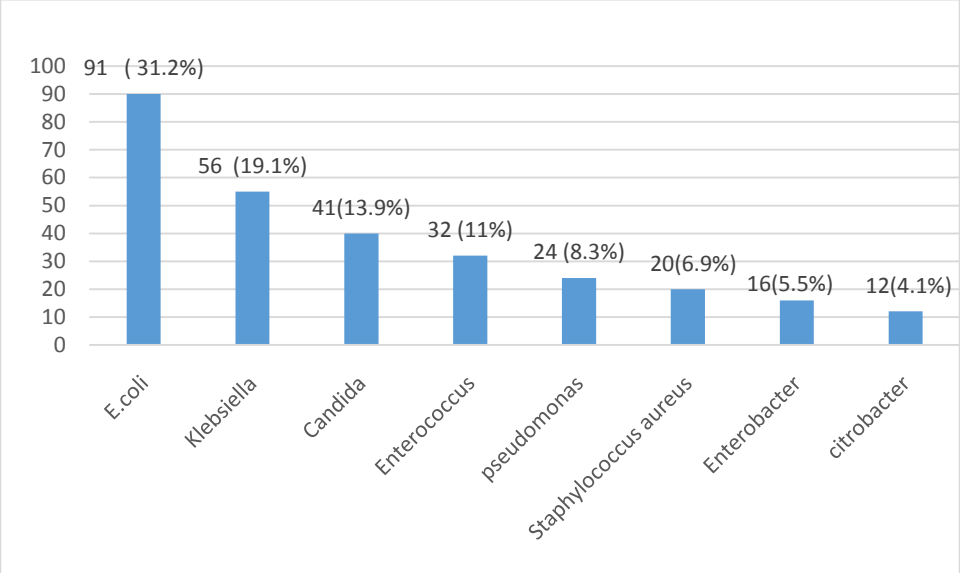

Figure 3: Distribution of isolatesin catheterized patients

Non albicans were significant cause of CandidaCA-UTI. The species distribution of Candida is shown in figure 3 .

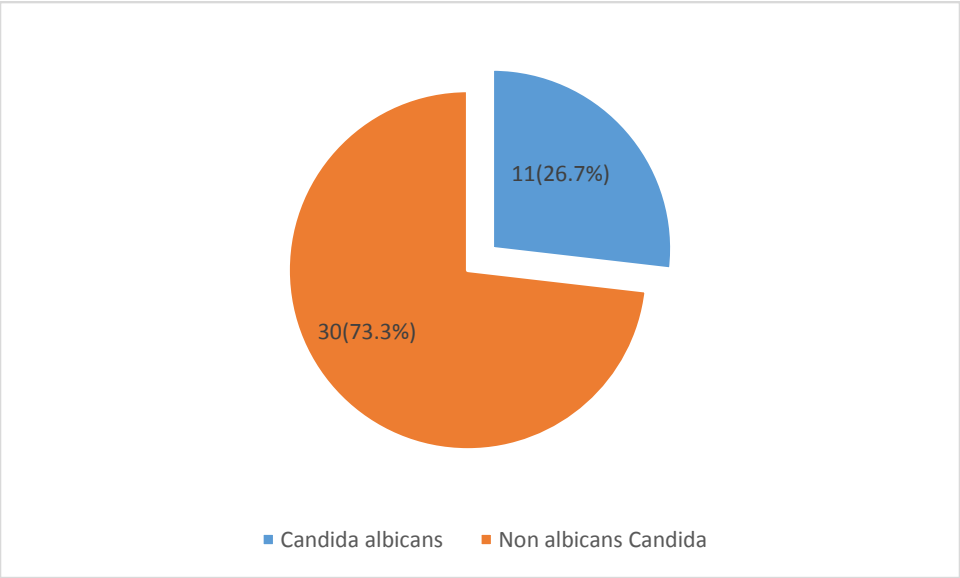

Figure 4: Species wise distributionof Candidain catheterized patients

Table 2: Species wise distribution of Candida

Species	Number
C.albicans	11(26.7%)
C.tropicalis	21(51.2%)
C.glabrata	4(9.7%)
C.krusei	4(9.7%)

During the study period (January 2017 to December 2019), a total of 23789 patients had indwelling urinary catheter. The total catheter days were 559128. A total of 272 patients developed CA-UTI. Therefore as per the formula of CDC for calculation of CA-UTI rate, the overall rate of CA-UTI for 3 years was 5.42 per 1000 catheter associated days. The year wise rate of CA-UTI is shown in table 3

Table 3: Year wise distribution of CA-UTI rates.

Year	Total number of patients on urinary catheter	Total patient days	Number of patients developing CAUTI	Rate of CAUTI per thousand catheter days
2017	6518	10300	70	6.9
2018	8070	19771	82	4.1
2019	9201	22748	120	5.3

The rate of CA-UTI for the year 2017 was 6.9 per 1000 catheter associated days. The month wise distribution of the year 2017 is shown in figure. The rate of CA-UTI was highest in the month of September (11 per 1000 catheter associated days) followed by the month of June (9.8 per 1000 catheter associated days) and July (8.3 per 1000 catheter associated days) whereas low rate was seen in the month of February (1.1 per 1000 catheter associated days) followed by January (1.1 per 1000 catheter associated days) followed by April (1.1 per 1000 catheter associated days).

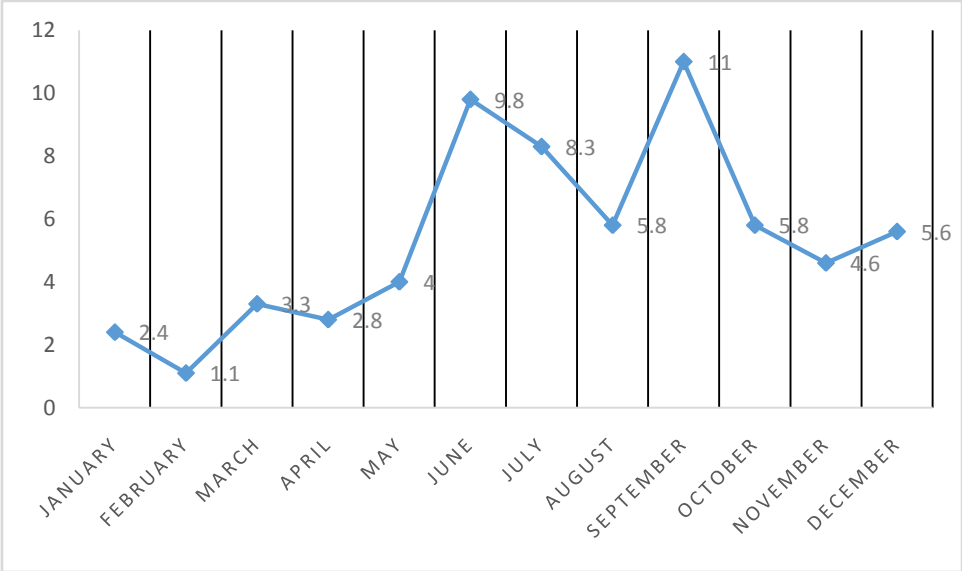

Figure 5: Monthwisedistribution of CA-UTI rate of Year 2017

The CAUTI rate for the year 2018 was 6.9 per 1000 catheter associated days. The month wise distribution of the year 2018 is shown in figure 6. The rate of CA-UTI was highest in the month of November(6.6 per 1000 catheter associated days) followed by the month of December(6.1per 1000 catheter associated days) and June,July (4.7per 1000 catheter associated days) whereas low rate was seen in the month of April (0.6 per 1000 catheter associated days) followed by March(2 per 1000 catheter associated days) followed byFebruary (2.2per 1000 catheter associated days).

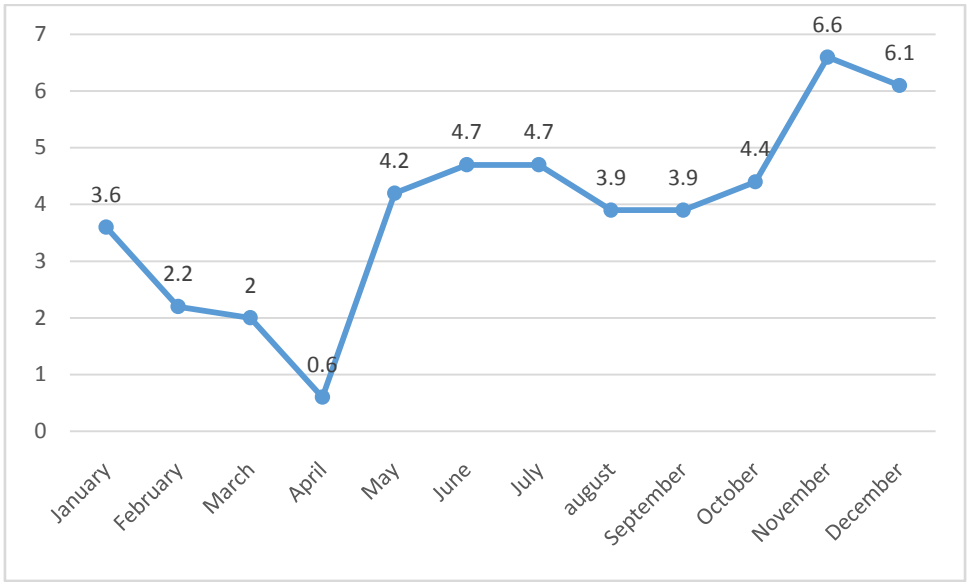

Figure 6: Monthwise distribution of CA-UTI rate of Year 2018

The overall rate of CA-UTI in the year 2018 was 4.4 per 1000 catheter associated days. As shown in figure 4,highest rate of CA-UTIwas seen inmonth of November(6.6 per 1000 catheter associated days) where as lowest rate was noted in the month of April (0.6per 1000 catheter associated days).

The rate of CA-UTI for the year 2019 was 9.1 per 1000 catheter associated days. The month wise distribution of the year 2017 is shown in figure. The rate of CA-UTI was highest in the month of September (9.1 per 1000 catheter associated days) followed by the month of December(8.1 per 1000 catheter associated days) and January (8 per 1000 catheter associated days) whereas low rate was seen in the month of April(3.3 per 1000 catheter associated days) followed by August(3.6per 1000 catheter associated days) followed byJuly (3.9 per 1000 catheter associated days).

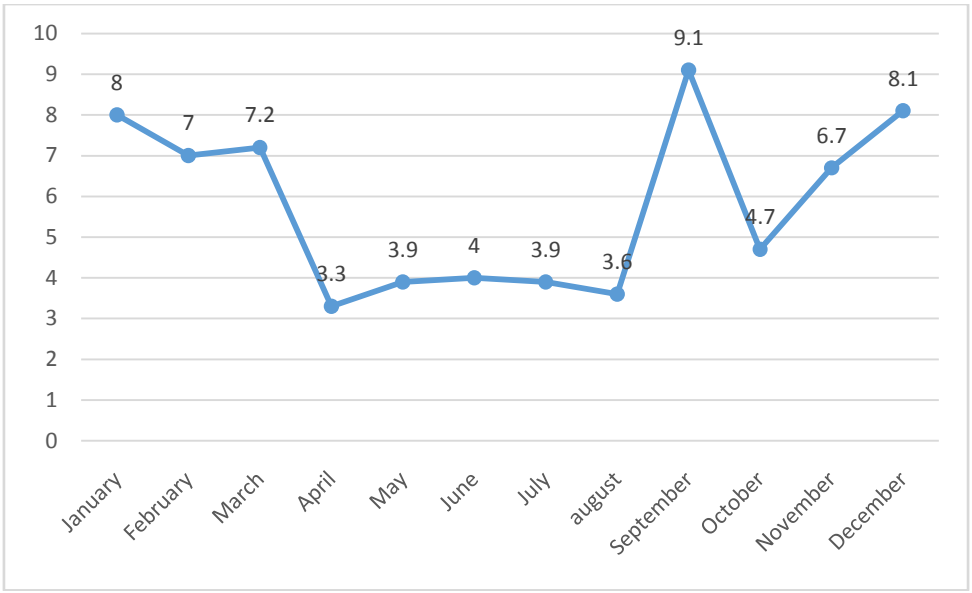

Figure 7: Monthwise distribution of CAUTI rate of Year 2019

The overall rate ofCA-UTI in the year 2019 was 5.27 per 1000 catheter associated days. As shown in figure 7,highest rate of CA-UTI was seen inmonth of September (9.1per 1000 catheter associated days) whereas lowest rate was noted in the month of April(3.3 per 1000 catheter associated days)

From January 2017 to December 2019, there were 23789 catheterizations for these patients. The 23789 catheterization events for this time period of three years totaled 55918 catheter days with total CA-UTIpatients of 272. In the present study, the overall rate of CA-UTI was5.4 per 1000 catheter-days.

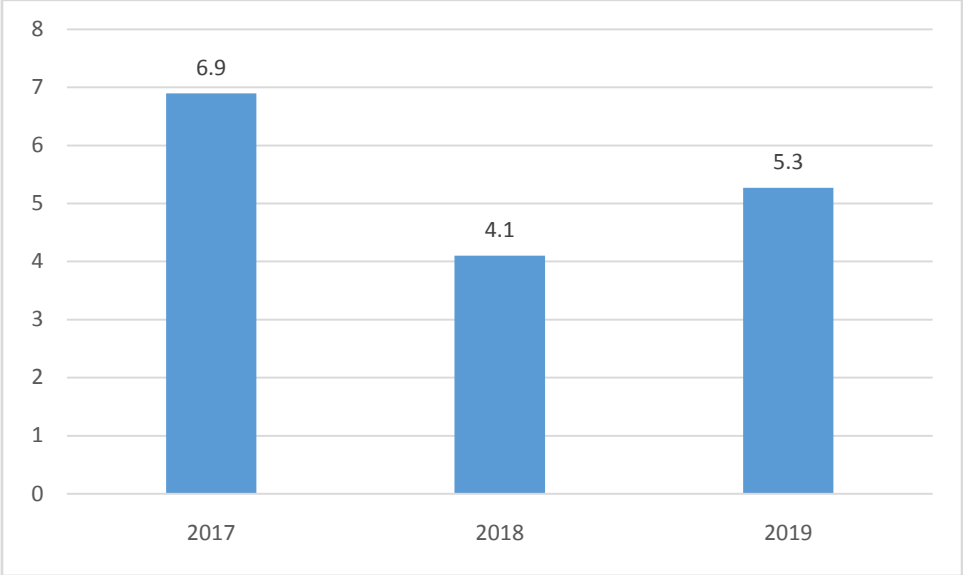

Figure 8: Year wise distribution of CA-UTI rate

The CA-UTI rates for the year 2017, 2018 and 2019 were6.9, 4.1 and 5.3per 1000 catheter-days,respectively.

IV. Discussion:

In recent years, HAI has emerged as the most common adverse events in delivery of healthcare.It has also became a major public health problem with an impact on morbidity, mortality, expected treatment cost and outcome, and quality life of patient admitted in a healthcare setup. By and large many HAIs can be prevented through effective IPC measures.

Surveillance of HAI is an important tool to assess the burden of HAI and monitor its trends. It helps to develop evidence –based policies to prevent and control occurrence of infections in a healthcare setup. As per the definition,"Surveillance is a continuous, systematic collection, analysis and interpretation of data on specific health related event followed by timely dissemination of the report to the stakeholders who can improve the outcomes".

During the study period, a total of 195054 patients were admitted to various inpatient departments of the hospital. Out of this 12346 (6.3%) were admitted to critical care units, whereas 182708 (93.7%) were admitted to general wards. In the present study, during the study period 12.2% (n=23789) had indwelling catheter. As per CDC, approximately 12-16% of adult hospital inpatients will have an indwelling urinary catheter at some time during their hospitalization.[5]

Each day with indwelling urinary catheter, a patient has a 3-7% of risk of acquiring CAUTI. [5] The rates of CA-UTI significantly varies as per the study duration, the country (developed/developing), the economic status of the country (high/middle/lower)[3], the type of heath care setup, the type of healthcare unit (general wards/critical care unit) and type of patient population studied.[6] In the present study, the surveillance of CA-UTI was done for a period of 3 years. The rates of CA-UTI varied between 0.6 to 11 per 1000 catheter days in this study.In a one year study of Jaggi*etal*(2012)[7] the rate of CA-UTI varied between 2.3 to 25.3 per 1000 catheter days. In a study by Singh S*etal*[6]overall rate of CA-UTI is 0.23% -0.60 per 1000device days.

A total of 272, out of 23789 patients with indwelling developed CA-UTI. The overall percentage of CAUTI in the present study was 1.1%. Out of these 272 CA-UTI patients, 26 (9.6%) were admitted in ICUs and 246 (90.4%) were admitted to general wards. In the study of Datta*et al*(2014) [11], UTI episodes were reported in 10.7% of ICU patients who had indwelling urinary catheter.Similar to our observation Zahran*et al*(2019)[9] reported CA-UTI to be more common in patients admitted to general wards (82%) compared those admitted in ICUs. In general wards, the incidence of CA-UTI may be high due to large number of patients and less nurse to patient ratio compared to ICU setup. The infection prevention and control protocols are more strictly followed in critical careareas like ICUs compared to general wards.

In the present study, CA-UTI was more common in females (52.2%) compared to males (47.8%). Our observation is in accordance to other researchers. Anatomical structure of female urinary tract facilitates easier access to the perennial flora to the urinary bladder along the indwelling catheter.[9]Although, the incidence of CA-UTI was high in females compared to males, there was no statistical significance observed. Therefore CA-UTI can be occur in either of sexes in the presence of specific predisposing factors and non or poor compliance with catheter care bundle.

CA-UTI was more common in age group above 55 years. Similar observation was reported by researchers like Hussain*et al* (1996)[12] ,Trautner*et al*,[13] Chao *et al* (2007)[14] Various risk factors like waning of immune function, exposure to nosocomial pathogens and increasing number of co-morbid conditions increases the risk of infections in elderly population.

A total of 292 microorganisms were isolated from 272 CA-UTI patients. Out of these 252 (85.9%)were single isolates whereas 40 (14.1%) were mixed culture (not more than 2 species). *E. coli* (31.2%) followed by *Klebsiella* spp. (19.1%) and *Candida* spp. (13.9%) were most common isolates from cases of CA-UTI.Although the type of pathogen varies with thehospital, the microorganisms isolated from HAI cases are usually the nosocomial pathogens prevalent in the hospital environment.[1] Therefore IPC measures like hand hygiene, barrier use, skin preparation practices and disinfection policy should be strictly followed.

Among isolated Candida,Non*albicansCandida*(NAC) (73.3%) was predominant over C. albicans (26.7%).Similar observation was noted byDeorukhkar et al, Alvarez-Lerma et al andKauffmann.[29][30][31] and where >50% of Candida isolates from urinary tract belonged to NAC spp. NAC spp. are not only well adapted to the urinary tract but also are more difficult to eradicate compared than *C. albicans*.

Conclusion: Surveillance is an effective tool that can be used to improve infection prevention and control practices. The primary aim of surveillance of HAI is to establish benchmark for a particular type of HAI in a particular health care setup. Once these baseline rates are known, the surveillance can continue and further trends can be effectively monitored. The present surveillance helped us to generate institutional benchmark for CA-UTI.

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