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Urinary Tract Infection Related to Indwelling Catheterization and Associated Factors Among ≥ 50-year-old Females at A Tertiary Care Hospital, Odisha, India

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Abstract

This study determines the association factors of demographic variables with urinary tract infections (UTIs) among females ≥ 50 years or older. Routine microbiological analysis of the urine samples was done to find the dominant microorganisms in these older females and their level of drug resistance. One hundred elderly females with indwelling catheterization were admitted to two different hospitals. The semi-structured questionnaire tool has been used to collect socio-demographic variables and investigate UTIs. A structured 2-point rating scale was used to determine the factors associated with UTIs. A rating scale was employed, assigning a score of 1 for "yes" and 2 for "no". Urine samples were collected from the participants and diagnosed with routine microbiological tests. UTIs related to indwelling catheterization were 20% between the ages of 50–59 years, and 92% were Married older females. There was an association of factors with marital status, P= 4.033782, df=1, and χ^2=0.0446, to be statistically significant. Investigation with demographic variables and duration of indwelling catheterization was not statistically significant. Multidrug-resistant Escherichia coli and four different species of Candida were the dominant microorganisms isolated. The identification of UTIs and associated factors with catheterisation will help in controlling the UTIs related to indwelling catheterization and associated factors among older females≥ 50 years of age and endeavours by nursing staff for the good supervisory arrangement for nursing staff and students during indwelling catheterization of the patient. Further, the microbiological analysis results can help develop a suitable antibiotic usage policy for reducing antibiotic resistance.

Keywords: Antibiotic Resistance, Catheter-Associated Urinary Tract Infection, Old Females, Urinary Tract Infection.

Introduction

Urinary tract infections (UTIs) affect the urethra, bladder, ureters, or kidneys, encompassing the entire urinary tract. While most UTIs are caused by *Escherichia coli* bacteria, other bacteria, fungi, and parasites can also lead to UTIs. The risk of UTIs is higher in females than most males, likely due to anatomical differences. Additionally, conditions that hinder urine flow, such as enlarged prostate, congenital urinary tract abnormalities, and inflammation, can increase the risk of UTIs (1). Patients with catheters or those who undergo urinary surgery, as well as men with enlarged prostates, are particularly susceptible to UTIs (2). The symptoms and signs of UTI can vary depending on the individual's sex, age, and the specific area of the urinary tract affected, with some distinct symptoms manifesting depending on the infecting agent involved (3).

UTI, the most frequently diagnosed infection in long-term care residents, is highly prevalent among older adults and is responsible for over a third of nursing home-associated infections (4). In hospitalized patients and community-dwelling adults over 65, it ranks second to respiratory infections (5). With our ageing population, the burden of UTI in older adults is expected to increase, emphasizing the urgency to enhance diagnostic, management, and prevention approaches to promote the well-being of older individuals (6).

Over the years, certain bacteria that cause UTIs, such as *Escherichia coli*, have resisted commonly prescribed antibiotics. This resistance poses a significant challenge in managing UTIs, as it limits

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the effectiveness of standard treatment options. Factors contributing to this resistance include the overuse and misuse of antibiotics, incomplete courses of treatment, and the ability of bacteria to adapt and evolve. As a result, UTIs that were once easily treatable with common antibiotics now require more potent and specialized drugs, leading to increased healthcare costs and potential patient complications. Addressing UTI bacterial resistance requires a multi-faceted approach, including responsible antibiotic use, improved infection control measures, and developing novel treatment strategies to combat these resilient bacteria. Indwelling urethral catheters were responsible for a significant portion of healthcare-acquired infections, with 70-80% linked to their use. Recent prevalence surveys revealed that urinary catheters were the most common indwelling device, present in around 17.5% of patients in European hospitals and 23.6% in US hospitals (7). In various healthcare settings, including critical care units, medical wards, surgical wards, and rehabilitation units, catheter use was widespread, with percentages ranging from 9% to 23% (8). Consequently, preventing infections associated with these devices became crucial for healthcare infection prevention programs (9, 10). One of the significant reasons for UTI infections in India is the lack of proper medical facilities in Indian hospitals, particularly in Odisha. Also, the lack of awareness among the hospital personnel and nurses attending these elderly women is one of the major risk factors behind these infections. Moreover, there is a big issue: improper disposal of hospital-cum-ICU wastes and sanitization of ICU devices lead to such UTI infections. Women with shorter urinary tracts are more susceptible to such infections. Hence, this study determined the factors associated with demographic variables with UTIs among females ≥ 50 years or older. Also, a routine microbiological analysis was done to determine the dominant microorganisms in these older females and their level of drug resistance.

Material and Methodology

Research design and participants

The research approach employed in this study was quantitative. A descriptive survey research design was implemented to accomplish the current study's objectives. The present study was conducted at IMS and SUM Hospital, as well as Gastro Kidney Care Hospital, Bhubaneswar. The sample of this study included 100 indwelling catheterized old-age females admitted to IMS and SUM Hospital, Bhubaneswar, and Gastro and Kidney Care Hospital, Bhubaneswar. The sampling size for the present study consists of 100 hospitalized female patients in IMS and SUM Hospital and Gastro and Kidney Care Hospital Bhubaneswar with indwelling catheterization among older females≥ 50.

Sample Size Estimation and Inclusion Criteria

Considering a pooled standard deviation with mean deference ($Z_{1-\alpha/2}$= 1.96 for α = 5%, and $Z_{1-\beta}$=0.84, at 80% power) UTI of indwelling catheterized old age women in a previous study (26), with a clinically significant difference of UTI level, we estimated the sample size We intended to measure indwelling catheterized old age women with an attrition rate of 20%, resulting in an estimated sample size of 124 indwelling catheterized old-age female patients. The researchers then corrected this sample size based on the expected number of indwelling catheterized old-age female patients attending the clinic over the study period, resulting in a final sample size of 100 indwelling catheterized old-age female patients. Inclusion criteria targeted indwelling catheterized old-age female patients aged ≥50 years and who understood the Odia language, the predominant language in the region. Exclusion criteria included patients with cognitive, speech, or hearing impairments. The participants of this study were chosen using a purposive sampling method. Before conducting the study, ethical permission was taken from the Institutional Ethical Committee vide letter no SOAU/SNC/IRB212/2020.

Data collection tool

The interview schedule was constructed with three sections: Section A, Section B, and Section C. Section A is constructed to collect data regarding age, religion, education, occupation, socio-economic status, living area, marital status, and duration of indwelling catheterization. Section B consists of nine items related to the investigation of UTIs. Such as Pus cells present, epithelial cells, urine culture, urine culture, urine culture report positive, urine culture report bacteria present having cloudy or foul smelling in urine, urine incontinence, the patient has burning maturation,

and urine retention. Section C is constructed to collect data, which has nine items related to associated factors of UTI. The items are: Do you have diabetic mellitus, hypertension, or recurrent UTI? Have you done catheter care every day? The patient has a high fever and 2 to 3 litres of water intake per day; the patient maintains personal hygiene, the health status of the patient is good, and the patient is taking any treatment.

Scoring of rating scale performa

A two-point rating scale was used to assess the investigation of UTI and associated factors. The score was yes = 1 and No = 2.

Data collection procedure

Before collecting data, the researcher sought formal permission from the relevant authorities at the female surgical ward, female medicine, intensive care unit of IMS and SUM, and Gastro and Kidney care hospital, BBSR. The investigators introduced themselves to the subjects, established a good rapport, and explained the study's purpose and significance. Participants were assured that their responses would be kept confidential. Informed consent was obtained from each subject, signifying their willingness to participate in the study.

Method of administration

After obtaining permission from the concerned authority, the data was collected. The researcher visited patients having indwelling catheterization among older females≥ 50 years at IMS and SUM and Gastro and Kidney Care Hospital Bhubaneswar. The investigator interviewed 100 female patients admitted to the hospital. Before the interview, informed consent was obtained from the respondents, and confidentiality was assured to the subject. The privacy of the participants was strictly maintained while conducting the interview. The investigator filled out the response personally. The average time taken to interview each subject was 20 – 30 minutes. After the interview, the investigator thanked the respondents.

Microbial profiling

Urine samples were collected from all 100 patients aseptically and processed for microbiological evaluation by culturing them on hi-media chromogenic agar (Figure 1). Further, an antibiotic/antifungal sensitivity test of isolate bacteria/fungus was carried out per the standard protocols (11).

Ethical permission

The study obtained prior written permission from the college authority after obtaining ethical clearance from the institutional ethical committee**.** The colleges were selected using a random sampling method of lottery. The eligible samples were identified using purposive sampling based on inclusion and exclusion criteria. The purpose of the study and data collection process was explained, and informed written consent was obtained from each of the 100 samples.

Analysis of data

Data were collected using structured questionnaires and entered into IBM SPSS Statistics 20 Version for cleaning, coding, and analysis. The use of appropriate statistical methods allows for the exploration of relationships between variables and the identification of potential predictors of indwelling catheterized old-age female patients. The data was analysed using descriptive and inferential statistics. Demographic data, investigations of UTI and factors related to UTI were presented in terms of frequency and percentage. The relationship between risk-taking behaviour and selected demographic variables was determined using the Chi-square test.

Figure 1: Isolation of UTI-causing microorganisms on hi-chrome chromogenic agar media

Result

Study participant's demographic characteristics

The study findings show that most participants, 43%, are between 50 and 59. 90% of older females were Hindu, 44% of females were primary, 31% were illiterate, and 86% of older females were homemakers. 43 % of older females were >Rs. 80,000 income per year. 47% of the sample belongs to an urban area, 28% to a Rural area, and 25% to a slum.92 % of females were married, 78% of older females had indwelling catheterization within one week, 12% were 1-2 weeks, 8% were one month, and 2% were > two weeks. Show that with UTI (50-59 years) 20%, (60-69 years) 10 %, (70 – 79years) 12%, (>80 years) 5% with UTI urinary tract infection and without UTI 23% in the 50-59 age group, 20 % in the 60-69 age group, 9 % in the 70-79 age group and only 1% in the >80 years age group (Table 1). Cell present, 53% had no epithelial cell,82% had urine culture done, and 18% had urine culture not done.47% had urine culture positives and 53% had negative, 43% had bacteria present, and 57 had no bacteria, 44% had burning maturation and 56% of females did not have burning maturation,41% of females had urine retention, and 59% does not have urine retention (Table 2). Table 3 shows the association between the factors associated with UTI and selected socio-demographic variables. The chi-square test analyzed it. The chi-square is 5.806889 (d f = 3, p= 0.1214 is 0.1214); for age, it is not statistically significant. The chi-square is 2.798308 (d f = 3, p= 0.4238 is 0.4238) of education was not statistically significant, the Chi-square is 0.642021 (d f = 1, p= 0.4230) of socio-economic was not statistically significant, the chi-square is 4.033782(df= 1, p = 0.0446) had marital status was statistically significant. The Chi-square is 4.685271(df= 3, p = 0.1963), and the duration of indwelling catheterization was not statistically significant.

Table 1: Description of study samples according to frequency and percentage with UTI and without UTI (N=100)

SL NO	Age in years	With UTI	(F)	Without UTI	(F)
1	50 – 59	20	20	23	23
2	60 – 69	10	10	20	20
3	70 – 79	12	12	9	9
4	>80	5	5	1	1
	TOTAL	47	47(F)	53	53(F)

Table 2: To identify the frequency and percentage of investigated UTI problems among older female patients≥ 50

SL.NO	Investigated of UTI	Obtain score	
		Yes	No
1	Pus cell present	46	54
2	Epithelial cell present	47	53
3	Urine culture done	82	18
4	The urine culture report is positives	47	53
5	Urine culture bacteria is present	43	57
6	Is having cloudy or foul-smelling urine	40	60
7	The patient is having urine insentience	38	62
8	The patient has burning maturation	44	56
9	The patient has urine retention	41	59

Table 3: Analysis of factors of UTI with selected demographic variables like age, education, socio-economic status, and duration of indwelling catheterization by Chi-square

VARIABLE FACTOR	FREQUENCY OF ASSOCIATED FACTORS			x^2	DF	VALUE (P)	INFERENCE
1. Age	normal	abnormal	total				
50 – 59years	32	11	43				

60 – 69years	22	7	29	5.806889	3	0.1214	Not statistically significant.
70 – 79years	13	9	22				
>80	2	4	6				
2. Education	33	11	44				
Primary	33	11	44				
Secondary	11	5	16	2.798305	3	0.4238	Not statistically significant.
Higher. Secondary	7	2	9				
Illiterate	18	13	31				
3. Socio-economic status							
>80.000	32	11	43	0.642021	1	0.4230	Not statistically significant.
<80.000	37	20	57				
4. Marital status							
Married	66	26	92	4.033782	1	0.0446	To be statistically significant.
Unmarried	3	5	8				
5. Duration of I/C							
1 Week	57	21	21				
1 – 2week	8	4	4				
>2 week	1	1	1	4.685271	3	0.1963	Not statistically significant
One month	3	5	5				

Table 4: Details of all bacteria isolated from the UTI Patients with antibiotic susceptibility pattern, N=100

Sl.No.	Organisms	Frequency (n)	Percentage	Resistance to antibiotics in percentage
1	*Escherichia coli*	24	24	AMP -100; AMX-100; TI -100; PI-100; CEF-100; CEFAX -100; CIS-100; CFS -100; CPM -100; ETP – 100; IMP-100; MRP-100; AK-100; GEN-100; NA-100; CIP – 100; TGC -12.5; NIT -37.5; CL-50; TR-75
2	*Klebsiella spp*	20	20	AMP -ND; AMX -ND; TI -100; PI -100; CEF -100; CEFAX -ND; CIS -100; CFS -ND; CPM -100; ETP –ND;IMP -60; MRP -100; AK -85; GEN -60; NA -ND; CIP –95; TGC -85; NIT-ND; CL-20; TR-90
3	*Pseudomonas aeruginosa*	13	13	AMP -ND; AMX -ND; TI -100; PI -92.3; CEF -100; CEFAX -ND; CIS -92.3; CFS -ND; CPM -84.61; ETP–ND; IMP -92.3; MRP -92.3; AK -84.61; GEN -84.61; NA -ND; CIP–84.61; TGC -100; NIT -ND; CL-30.76; TR-ND
4	*Acinetobacter baumannii*	10	10	AMP -ND; AMX -ND; TI -100; PI -100; CEF -100; CEFAX -ND; CIS -100; CFS -ND; CPM

				-100; ETP –ND;IMP -100; MRP -100; AK -90; GEN -100; NA -ND; CIP –100; TGC -0;NIT -ND; CL-10; TR-80
5	*Staphylococcus aureus*	8	8	BEN-PEN -100; OX -100; GEN -26.09; CIP -82.61; LE -86.96; E -91.3; CD -60.87; LZ -17.39; DAP -17.39; TEI -13.04; VA -4.35; TE - 21.74; TGC -0; NIT -0; RIF -21.74; TMP -65.2
6	*Candida albicans*	4	4	KT -75; IT- 100; FLC-75; AMP- 75;COT-100; MIC- 100; NS-50
10	*Candida tropicalis*	7	7	KT -100; IT- 100; FLC-100; AMP-100; COT-100; MIC- 100; NS-100
11	*Candida glabrata*	8	8	KT -100; IT- 100; FLC-0; AMP- 100;COT-100; MIC- 100; NS-100
12	*Candida krusei*	6	6	KT -100; IT- 100; FLC-100; AMP- 0;COT-0; MIC- 100; NS-100

Note: AMP: Ampicillin; **AMX:** Amoxicillin; **TI**: Ticarcillin; **PI**: Piperacillin; **CEF**: Cefuroxime; **CEF-AX:** Cefuroxime Axetil; **CIS**: Ceftriaxone; **CFS:** Cefoperazone; **CPM:** Cefepime; **ETP:** Ertapenem; **IMP:** Imipenem; **MRP:** Meropenem; **AK:** Amikacin; **GEN:** Gentamicin; **NA:** Nalidixic Acid; **CIP:** Ciprofloxacin; **TGC**: Tigecycline; **NIT**: Nitrofurantoin; **CL**: Colistin; **TR**: Trimethoprim; **BEN-P**: Benzylpenicillin; **OX**: Oxacillin; **LE**: Levofloxacin; **E:** Erythromycin; **CD**: Clindamycin; **LZ**: Linezolid; **DAP**: Daptomycin; **TEI**: Teicoplanin; VA: Vancomycin; **TE**: Tetracycline; **RIF**: Rifampicin; **TMP**: Trimethoprim

On microbiological analysis of the urine samples, the gram-negative bacteria *Escherichia coli* was a major UTI pathogen isolated from 24% of the samples. *Klebsiella species* (20%), *Pseudomonas aeruginosa* (13%), and *Acinetobacter baumannii* (10%) followed it, and finally, the gram-positive bacteria *Staphylococcus aureus* (8%). Similarly, the four different species of the fungus *Candida* were also isolated from the urine samples. From the analysis, it was evident that all the bacteria isolated were multidrug-resistant, and to some antibiotics and antifungals, the resistance was recorded up to 100% (Table 4)

Discussion

The findings revealed that 92% of married older females had UTIs associated with indwelling catheterization, with 20% of cases occurring in those between the ages of 50 and 59. A statistically significant correlation was found between the factors and marital status (P = 4.033782, df = 1, and x^2 = 0.0446). Nonetheless, there was no correlation between other factors and demographic variables. The length of the indwelling catheterization and demographic variables were not statistically significant in the investigation. Four species of *Candida* were isolated from the samples, with *E. coli* emerging as the predominant organism. The antibiotic sensitivity test results verified every organism's multidrug resistance.

A study from a government hospital in South India in 2014 investigated the association between UTIs and diabetes mellitus (DM) in patients. The presence of UTI was determined by testing urine samples for albumin using the sulphosalicylic acid precipitation method, while DM was diagnosed using the dipstick method. SPSS version 16.0 was used for data analysis. The results were like our results. Out of 135 urine samples, 76.3% were found to have UTI, 23.7% showed signs of DM, and 6.8% had UTI associated with DM. The study revealed a higher prevalence of UTI and DM among males than females during the study period (12).

Another study in Tainan investigated risk factors for Eurosceptic shock in hospitalized patients over 80 with urinary tract infections. The study included 1043 patients, with a mean age of 67±17 years. Most patients were female (72.9%). Among UTI patients, 25.5% had severe sepsis, 19.2% had urosepsis shock, and 14.5% experienced acute kidney injury during hospitalization. The overall mortality rate was 0.67%, varying across age groups (0% for young patients, 0.3% for old patients, and 2.2% for very old patients) (13).

In the present study, 43% of catheterized females had bacteria in their urine culture; similarly, V. Sangamithra et al. (2017) catheterized patients in ICU, and 46% had an infection (14). Similarly, in a study from North India, 9.4% of urinary catheter days were associated with CAUTIs, with an overall magnitude of 14.67%. Escherichia coli was the

most common pathogen, and it was most reported in the 51–70-year age group (34%). Females (63.63%) outnumbered males (36.36%). The third week of catheterization was the time of highest incidence, with diabetes being the leading risk factor (17.24%) (15).

Healthcare facilities often have surveillance programs to monitor and track CAUTI rates. This data helps identify areas for improvement and assess the effectiveness of prevention measures. CAUTIs can lead to complications, especially in vulnerable patient populations, such as the elderly or those with compromised immune systems. Complications may include spreading infection to the bloodstream (sepsis) or kidney infection (pyelonephritis, 16). Preventing CAUTIs is a critical aspect of patient safety in healthcare settings. Healthcare providers follow evidence-based guidelines and best practices to minimize the use of catheters and reduce the risk of infection when catheterization is necessary (17). Additionally, patient and caregiver education plays a role in preventing CAUTIs, as proper care and hygiene can help reduce the risk of infection associated with urinary catheter use (18).

Antibiotic resistance can occur when bacteria undergo genetic changes that allow them to survive exposure to these medications. This may occur because of mutations or the bacterial acquisition of resistance genes. Antibiotic overuse and misuse, unfinished treatment regimens, and broad-spectrum antibiotics when narrower-spectrum alternatives would be preferable are all factors leading to antibiotic resistance in UTIs (19, 20). One common bacterium that causes a lot of UTIs is *E. coli*. Research has indicated a growing resistance to frequently administered antibiotics, including trimethoprim-sulfamethoxazole and fluoroquinolones (21, 22). As a result, the suggested first-line treatments have changed. Bacteria that produce enzymes known as ESBLs, which confer resistance to a wide range of antibiotics, including penicillin and cephalosporins, are the source of some UTIs. This is a big problem because these enzymes can degrade many antibiotics (23-26). Our study also revealed that almost all bacteria were MDR.

Strength Of Study

The study demonstrates methodological rigour, clear objectives, and adherence to ethical standards, strengthening the validity and reliability of its findings regarding UTIs related to indwelling catheterization among females aged 50 years and above at a tertiary care hospital in Odisha, India.

Limitations

The presence of confounding variables, such as other medical conditions or treatments, may influence the relationship between urinary tract infections and indwelling catheterization. Failure to account for these variables adequately could confound the study's results. The study's findings may be generalizable to only some populations or settings outside the specific tertiary care hospital in Odisha, India. Factors such as demographics, healthcare practices, and prevalence of urinary tract infections may differ in other regions or healthcare facilities.

Conclusion

The study revealed a significant impact of urinary infection on elderly patients with chronic indwelling urethral catheters. As a result, it becomes crucial to prioritize assessing patients with urethral catheters to identify potential urinary infections. There is a need to instruct older females above 50 to improve and enhance their knowledge regarding UTIs related to indwelling catheterization. They should be required to attend regular interviews and meetings to remain current with theoretical, clinical, and research findings. The prevalence of bacterial resistance to commonly used antibiotics increased, making treating UTIs more challenging. Hence, alternative treatment options should be undertaken to counter UTIs in older people.

Abbreviation

DM: Diabetes Mellitus; **UTI**: Urinary Tract Infection; **CAUTI**: Catheter-associated Urinary Tract Infection; **AMP**: Ampicillin; **AMX:** Amoxicillin; **TI**: Ticarcillin; **PI**: Piperacillin; **CEF**: Cefuroxime; **CEF-AX:** Cefuroxime Axetil; **CIS**: Ceftriaxone; **CFS:** Cefoperazone; **CPM:** Cefepime; **ETP:** Ertapenem; **IMP:** Imipenem; **MRP:** Meropenem; **AK:** Amikacin; **GEN:** Gentamicin; **NA:** Nalidixic Acid; **CIP:** Ciprofloxacin; **TGC**: Tigecycline; **NIT**: Nitrofurantoin; **CL**: Colistin; **TR**: Trimethoprim; **BEN-P**: Benzylpenicillin; **OX**: Oxacillin; **LE**: Levofloxacin; **E:** Erythromycin; **CD**: Clindamycin; **LZ**: Linezolid; **DAP**: Daptomycin; **TEI**: Teicoplanin; VA: Vancomycin; **TE**:

Tetracycline; **RIF**: Rifampicin; **TMP**: Trimethoprim.

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Author Contributions

RP and PT conceptualized the study. RP conducted the study and collected the data. RP, DK, and PM analysed and interpreted the data. SR did the microbiological analysis. RP and SR drafted the manuscript. All five authors critically reviewed the final manuscript.

Conflict of Interest

The author declares no conflict during the study.

Ethics Approval

Not applicable.

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