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Original Article

Magnitude and Factors Associated with Catheter Associated Urinary Tract Infection, and Antimicrobial Susceptibility Profile at Hawassa, Sidama Regional State, Ethiopia: A prospective Cross-sectional Study

Marshet Kefeni[1], Tariku Lambiyo Anticho[2], Israel Tsige Tesema[1], Mulugeta Mengistu [2], Musa Mohammed Ali[2*]

[1]Hawassa University Comprehensive Specialized Hospital, Department of Microbiology, Hawassa, Ethiopia
[2]Hawassa University College of Medicine and Health Sciences, School of Medical Laboratory Science, Hawassa, Ethiopia

Corresponding authors*: musam@hu.edu.et

Abstract
Introduction: *The use of urinary catheter benefit patients who are unable to urinate for various medical reasons. Despite its use, a urinary catheter during its application may introduce bacteria to the urinary tract and result in Urinary tract infection (UTI). Even though the burden of catheter-associated UTI is expected to be high in resource-limited countries, there is limited data. The aim of this study was to determine the magnitude of culture- confirmed catheter-associated urinary tract infection (CAUTI), associated factors, and antimicrobial susceptibility profiles of bacteria.*
Methods: *This prospective cross-sectional study was conducted at Hawassa University Comprehensive Specialized Hospital (HUCSH), Sidama region, from May-August 2022. One hundred forty-nine catheterized patients at HUCSH were included. Socio-demographic, clinical, and laboratory data were collected using structured questionnaire. Urine specimens were cultured on blood and MacConkey agar. Culture-confirmed catheter-associated urinary tract infection was established if* $\geq 1 \times 10^5$ *colonies of bacteria per milliliters of urine was detected. The disc diffusion method was used for antimicrobial susceptibility testing. For data analysis, SPSS version 26 was used. Factors associated with culture-confirmed CAUTI were assessed using binary logistic regression.*
Results: *The magnitude of culture confirmed CAUTI was 30.2% (n=45; 95% CI=22.8−37.6). The most common bacterial isolates were Escherichia coli (n=12; 26.7%), followed by Klebsiella species (n=10; 22.2%), and Staphylococcus aureus (n=6; 13.3%). Duration of catheterization (AOR=9.6, 95% CI=3.8−24.2) and comorbidities (AOR=4.1, 95% CI=1.7−9.8) were significantly associated with culture-confirmed CAUTI. Most Gram- negative bacteria were resistant to commonly prescribed antimicrobial agents.*
Conclusions: *The magnitude of culture-confirmed CAUTI at HUCSH was high. E. coli was the leading bacteria and most of them were resistant to various types of antimicrobial agents. Duration of catheterization and comorbidities were significantly associated with culture- confirmed CAUTI.*

Keywords: *Catheterized patients, Antimicrobial Susceptibility, Catheter-associated UTI, Hawassa, Ethiopia*
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Introduction

The urinary tract is the most common site for nosocomial infections. Most of these infections typically occur after urinary tract catheterization (1). Patients who are unable to urinate for a variety of medical reasons benefit from using a urinary catheter. Urinary catheters, even when used properly, have the potential to cause catheter-associated urinary tract infections (CAUTI) by introducing germs into the urinary system during insertion (2).

In healthy individuals, CAUTI is frequently asymptomatic and usually goes away on its own when the catheter is removed. But if the infection doesn't go away, it can cause problems including prostatitis, pyelonephritis, cystitis, epididymitis, and Gram-negative bacteremia. High-risk patients frequently experience these side effects (3-5).

After a single catheterization, the prevalence of CAUTI is usually less than 10%; however, it can reach 100% for individuals with long lasting urethral catheters (1-5). Catheterization for long time, drainage bag colonization, diabetes, mistakes made during catheter care, and catheter insertion outside of the operating room are risk factors for bacteruria in catheterized patients (6). Due to anatomical predisposition, a high bacterial load in the urogenital mucosa, and pregnancy, the prevalence is higher in women than in males (7).

The most frequent cause of UTIs in people on catheters is Escherichia coli. Urinary tract pathogens such as Enterobacter, Klebsiella, Enterococcus, and Proteus are prevalent endogenous flora that have the ability to colonize urinary catheters. Healthcare personnel and infected medical equipment may be the source of the pathogen. Healthcare-associated colonic ulcerative therapy (CAUTI) can also be caused by non-intestinal or environmental organisms, such as Pseudomonas aeruginosa, Staphylococcus epidermidis, Staphylococcus aureus, and Acinetobacter (8).

While several patient groups in Ethiopia have been studied for community-acquired UTIs, there are limited studies on the prevalence of UTIs and the bacterial profile of CAUTI (9– 11). There are factors which can predict occurrence of CAUTI such as age, duration of catheterization. According to study conducted in Southern part of Ethiopia Urine output measurement, long duration of catheterization, underlying medical condition, hospitalization form more than or equal to 10 days were significantly associated with CAUTI (11). The aim of this study was to determine the magnitude of culture-confirmed CAUTI, etiology, the antimicrobial profile of the bacteria, and related variables.

Method

Study design and area

A prospective cross-sectional study was carried out From May to August 2022 at Hawassa University Comprehensive Specialized Hospital (HUCSH) among admitted patients who were using urinary catheters for a variety of causes. Sidama Regional State, located in the southern region of Ethiopia, is home to Hawassa City. Hawassa, which is the capital of the region, is situated 273 kilometers to south of Addis Ababa. HUCSH provides services to around 12 million individuals. Clinical services are provided to patients seeking medical attention at various outpatients and inpatient facilities (surgery, gynecology, obstetrics, internal medicine, pediatrics, ophthalmology, psychiatry, radiology, and pathology).The laboratory in the hospital analyzes arrays of tests, including parasitological, microbiological, immunological, haematological, and biochemical analysis

Study population

The study included all patients who were admitted to the Medical, Surgical, Gynecology, ICU, Emergency, and Orthopedics wards at HUCSH and who had been using a urinary catheter for more than 48 hours. Individuals who had a history of urinary tract infection (UTI) within the previous six months, those who had a catheter inserted outside of HUSCH, those who had cystitis and prostatic enlargement, those who were using a suprapubic catheter, nephrostomy tube, or condom catheter, and those who had taken antibiotics within the previous two weeks were all excluded from the study.

Data collection

After reviewing similar studies (9−11), a structured questionnaire was developed for the purpose of gathering socio-demographic and clinical data. The questionnaire was created in English and translated into Amharic; in-person interviews were performed to gather data using the Amharic version. Socio-demographic and clinical information about the patient was gathered, including age, residential location, comorbidities, grounds for admission, admission ward, length of hospital stay, length of catheterization, and purpose of catheterization

Urine collection and isolation of bacteria

Ten milliliters urine specimens from catheterized individuals were aseptically collected after the catheter's outlet was cleaned with 70% alcohol. Urine was aspirated straight from the tubing through a punctured collecting port using a syringe and sterilized needle. Urine was collected, and within an hour it was sent to the HUCSH microbiology laboratory in a sterile, labeled container. Urine samples were stored in a refrigerator at 4oC for less than 24 hours in situations when delays of more than an hour were unavoidable. Two trained professional nurses from each ward collected the data and urine sample. Using a sterile calibrated wire loop, a loop full of urine sample (equivalent to 0.001 ml) was inoculated onto both blood agar and MacConkey agar concurrently. The samples were then incubated aerobically at 37 °C for a duration of 24 hours. After a 24-hour incubation period, bacterial growth was checked on the incubated plates. The colony-forming units (CFU) per milliliter of urine were calculated by counting the number of bacteria colonies. Clinically significant bacteruria, defined as more than or equal to 1×10^5 colonies per milliliter of urine, were identified (12). According to conventional procedures, colony morphology, hemolytic criteria, staining characteristics, pigment synthesis, and biochemical assays were used to confirm the identity of the bacteri(12–13).

Using the Kirby Bauer disc diffusion method and the Clinical and Laboratory Standard Institute (CLSI) recommendations, antimicrobial susceptibility testing was carried out (14). To prepare turbidity equal to 0.5 McFarland standards, morphologically similar bacterial colonies were suspended in 5 milliliters of normal saline. The suspension was injected onto Mueller Hinton agar (MHA) using a sterilized swab. The antimicrobial discs were equally positioned using sterile forceps. The plates were incubated aerobically at 35oC for 16–20 hours within 30 minutes of applying the discs, with the exception of Acinetobacter, which was incubated for 20–24 hours. Amikacin, ciprofloxacin, piperacillin, trimethoprim-sulfamethoxazole, nitrofurantoin, penicillin, vancomycin, and cefazolin were among the antimicrobials contained in the mixture. Following an overnight incubation period, each zone of inhibition's diameter was measured in millimeters. The zone diameter was considered to be intermediate and resistant.

Operational definition

UTI signs and symptoms: Individuals were classified as having symptomatic CAUTI if they had at least two signs and symptoms of acute UTI, such as fever, suprapubic tenderness, costovertebral angle pain or tenderness, urgency, frequency, and dysuria, and if they had an indwelling urethral catheter that had been in place for longer than two days.

Culture-confirmed CAUTI: Urinary tract infection that occur among patient who are on catheter.
Symptomatic UTI is a type of UTI if there is significant bacteriuria ($\geq 10^5$ CFU/ mL) with at least two signs and symptoms of acute UTI (from the following: fever, suprapubic tenderness, costovertebral angle pain or tenderness, urinary urgency, urinary frequency and dysuria) with an indwelling urethral catheter in place for more than two days.

Quality assurance

The questionnaire was pretested at Adare Hospital to check for its consistency. After pretest, the questionnaire was revised and modified particularly variables that were not clear. All laboratory procedures were conducted according to Standard Operational Procedures (SOP) of HUCSH. Reference strain bacteria: *S. aureus* ATCC 25923, *E. coli* ATCC 25922, and *Pseudomonas aeruginosa* ATCC 27853 were used to check the performance of the culture media

Statistical analysis

Epidata was used to enter the data, and SPSS version 26 was used for analysis. Sociodemographic and clinical data were summarized using descriptive statistics including mean, standard deviation (SD), and frequency. In order to evaluate independent variables related to the severity of CAUTI, logistic regression was employed. Multivariable logistic regression was used to examine variables that showed a p-value of less than 0.25 in the bivariable logistic regression study. A 95% confidence level was applied to determine statistical significance for a $p<0.05$.

Ethical consideration

Ethical clearance was obtained from the Institutional Review Board (IRB) Hawassa University College of Medicine and Health Sciences (Reference number: IRB/155/14). Prior to enrolment written informed consent were obtained from all participants. For participant aged less than 18 years, assent and consent from children and parents respectively.

Result

Socio-demographic characteristics

One hundred forty-nine (149) catheterized patients were enrolled in this study. The majority of the study participants were males 91(61.1%). thirty nine (26.2%) of the study participants were in the age group of 21−30 years, with a mean and standard deviation (SD) of 40.8(±16.2) years (Table 1).

Table 1. Socio-demographic characteristics of catheterized patients at HUCSH between May−August 2022 (N=149).

Variable	Category	Frequency (%)
Gender	Male	91 (61.1)
	Female	58 (38.9)
Age (in Years)	<20	14 (9.4)
	21−30	39 (26.2)
	31−40	33 (22.1)
	41−50	22 (14.8)
	51−60	21 (14.1)
	61−70	15 (10.1)
	>71	5 (3.4)
Place of residence	Urban	56 (37.5)
	Rural	93 (62.4)
Marital status	Married	119 (79.9)
	Single	30 (20.1)
Occupation	Employed	10 (6.7)
	Farmer	60 (40.2)
	Merchant	8 (5.4)
	Non employed	71 (47.7)
Educational status	Unable to read and write	67 (45.0)
	Completed primary	56 (37.6)
	Completed secondary	16 (10.7)
	Completed College and above	10 (6.7)
Monthly income in ETB	<2000	125 (83.9)
	2000−3500	17 (11.4)
	3501−5000	5 (3.4)
	>5000	(1.3)

ETB: Ethiopian birr

Clinical characteristics

The emergency ward accounted for the majority of study participants (n = 53, 35.6%), with the surgical ward accounting for another 28.9%. Every study participant had a folly-type catheter, and 33.6% (33/6) of them had catheterizations for drainage before or after surgery. Of them, 16(10.7%) had previously been catheterized, and 41 (27.5%) had been thus for longer than seven days.

Twenty patients (13.5%) out of the thirty (20.1%) with comorbidities had heart or kidney problems. Clinically, 42 (28.2%) of the participants developed symptomatic UTIs related to catheter use (Table 2).

Table 2. Clinical characteristics of catheterized patients at HUCSH between May−August 2022 (N=149).

Variable	Category	Frequency (%)
Ward admitted	Emergency	53 (35.6)
	Surgical	43 (28.9)
	ICU	22 (14.8)
	Others*	31 (20.8)
Reason for admission	Surgery	75 (50.4)
	Follow up	60 (40.3)
	Others**	14 (9.4)
Reason for catheterization	Pre/post-operative drainage	50 (33.6)
	Urine output measurement	45 (30.2)
	Urine retention	33 (22.1)
	Others***	21 (14.1)
Size of the catheter in Fr	<18	142 (95.3)
	>18	7 (4.7)
Duration of catheterization in days	<7	108 (72.5)
	≥7	41 (27.5)
Lubricant application	Yes	148 (99.3)
	No	1 (0.7)
Previous catheterization	Yes	16 (10.7)
	No	133 (89.3)
Previous antimicrobial use	Yes	72 (48.3)
	No	77 (51.7)
Chronic disease	Yes	30 (20.1)
	No	119 (79.9)
Type of chronic disease	Kidney disease	8 (5.4)
	Heart disease	12 (8.1)
	DM	3 (2.0)
	Other****	6 (4.0)
Symptomatic	Yes	42 (28.2)
	No	107 (71.8)

DM: Diabetes mellitus, HIV: Human Immunodeficiency virus, Fr: French size, ICU: Intensive care unit *=Gynecology=11, Orthopedic=4, medical=16 ; **=acute febrile illness (AFI)=1,for treatment=6,medical reason=3,trauma=1,ischemic stroke=1,traumatic brain injury=2;*** keeping patient dry=19,urine incontinence=2;****=breast cancer=2, hypertension=1, HIV=3.

Magnitude of culture-confirmed CAUI and distribution of bacteria

In this study, the magnitude of culture-confirmed CAUI was 30.2% (n=45, 95% CI=22.8−37.6). The majority of bacteria (n=33: 73.3%) were Gram-negative. Of the patients with Gram-negative bacteria, 17 (51.5%) had bacteruria with symptoms. Out of the 12 patients (26.1%) who were infected with Gram-positive bacteria, 7 individuals (58.3%) showed signs of bacteruria. The most frequent bacterial isolates were *E. coli* 12 (26.7%), *Klebsiella* species 10 (22.2%), and *S. aureus* 6 (13.3%) (Figure 2).

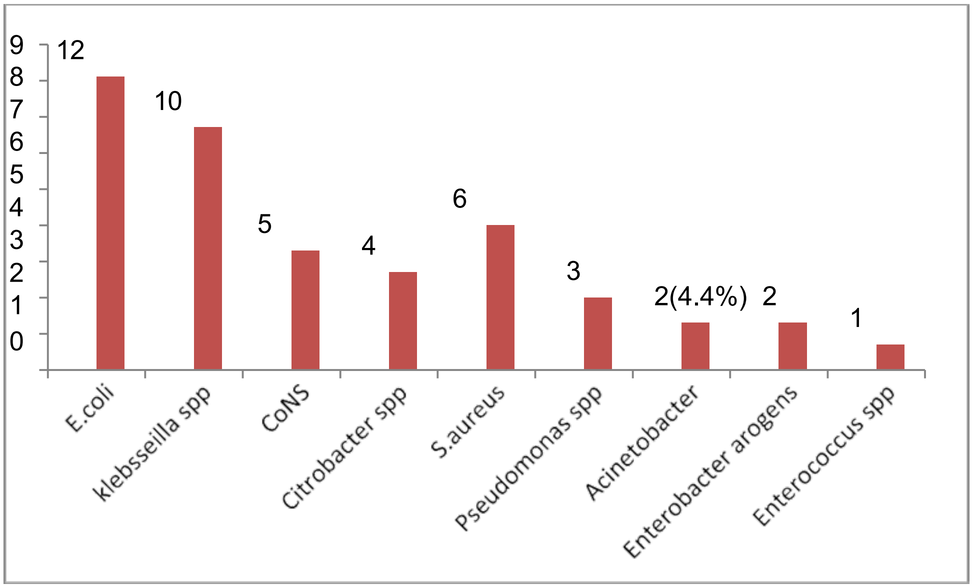

Figure 1. Distribution of bacteria isolated from the urine of catheterized patients at HUCSH between May−August 2022 (N=45). CONS: Coagulase negative staphylococcus

Factors associated with culture-confirmed CAUI

Variables with p<0.25 in bivariate logistic regression such as admission ward, reason for catheterization, length of catheterization, and comorbidities were selected for multivariable binary logistic analysis. Culture-confirmed CAUI was strongly correlated with catheterization duration (AOR=9.6, 95% CI=3.8−24.2) and comorbidities (AOR=4.1, 95% CI=1.7−9.8) (Table 3).

Table 3. Factors associated with culture-confirmed catheter associated urinary tract infection at HUCSH May−August 2022 (N=149).

Variables	Category	Culture result n (%)		COR (95% CI)	p-value	AOR (95% CI)	P-value
		Positive	Negative				
Gender	Female	18(31.0)	40(69.0)	1.1(0.5-2.2)	0.9		
	Male	27(29.7)	64(70.3)	1		1	
Place of residence	Urban	18(32.1)	38(67.9)	1.2(0.6-2.4)	0.7		
	Rural	27(29.1)	66(70.9)	1		1	
Age in years	<20	4(28.6)	10(71.4)	1		1	
	21-30	14(35.9)	25(64.1)	0.6(0.1-5.1)	0.6		
	31-40	7(21.2)	26(78.8)	0.8(0.1-5.6)	0.9		
	41-50	8(36.4)	14(63.6)	0.4(0.1-2.9)	0.4		
	51-60	6(28.6)	15(71.4)	0.9(0.1-6.3)	0.9		
	61-70	4(26.7)	11(73.3)	0.6(0.1-4.5)	0.6		
	>71	2(40.0)	3(60.0)	0.5(0.1-4.5)	0.6		
Educational level completed	Unable to read and write	22(32.8)	45(67.2)	0.7(0.2-2.4)	0.5		
	Primary	16(28.6)	40(71.4)	0.9(0.2-3.7)	0.9		
	Secondary	4(25.0)	12(75.0)	0.8(0.4-1.8)	0.6		
	College and above	3(30.0)	7(70.0)	1		1	
Admission ward	Emergency	12(22.6)	41(77.4)	0.5(0.2-1.4)	0.2	0.4(0.1-1.3)	0.1
	Surgical	15(34.9)	28(65.1)	0.9(0.4-2.6)	0.9		
	ICU	7(31.8)	15(68.1)	0.8(0.3-2.7)	0.8		
	other*	11(35.4)	20(64.5)	1		1	
Reason for Catheterization	Pre/post-operative drainage	14(28.0)	36(72.0)	0.8(0.3-2.3)	0.7		
	Urine output measurement	14(31.1)	31(68.9)	0.9(0.3-2.7)	0.2	1.3(0.3-5.2)	0.7
	Urine retention	10(30.3)	23(69.7)	0.9(0.3-2.8)	0.9		
	Other**	7(33.3)	14(66.7)	1		1	
Duration of catheterization	<7	18(16.7)	90(83.3)	1		1	
	>7	27(65.9)	14(34.1)	0.1(0.0-0.2)	<0.0001	9.6(3.8-24.2)	<0.001
Catheterization history	Yes	4(25.0)	12(75.0)	0.7(0.2-2.5)	0.6		
	No	41(30.8)	92(69.2)	1			
Comorbidity	Yes	26(52.0)	24(48.0)	4.6(2.2-9.6)	<0.0001	4.1(1.7-9.8)	0.001
	No	19(19.2)	80(80.8)	1		1	
Types of comorbidity	Heart diseases	4(30.8)	9(69.2)	1.0(0.3-3.5)	0.9		
	Kidney disease	2(25.0)	6(75.0)	0.8(0.1-3.9)	0.7		
	Others***	0(0.0)	8(100.0)	1		1	

Medical = (16); Gynecology = (18); orthopedic=(4); **=keeping patient dry=(26); urine incontinence=(2); ***= breast cancer=(2); hypertension=(1); Diabetes mellitus=(3); HIV= (3).

Antimicrobial susceptibility profile of bacteria

All strains of *E. coli* were susceptible to amikacin and nitrofurantoin, but over 80% of *Klebsiella* species were resistant to most antimicrobial drugs. Each and every *Citrobacter* species was vulnerable to amikacin and nitrofurantoin. Half of the tested antimicrobials did not work on any *Citrobacter.* Penicillin did not affect any *S. aureus* (Tables 4 and 5).

Table 4. Antimicrobial susceptibility pattern of Gram−negative bacterial isolates recovered from urine of cathetrized patintes at HUCSH, May−August 2022 (n=33).

Tested bacteria		Ampicillin	Gentamicin	Nitrofurantoin	Cefazolin	Cefepime	Ceftriaxone	Amikacin	Piperacillin	Ciprofloxacin	Cotrimoxazole
E. coli (n=12)	S	-	10(83.3)	12(100)	1(8.3)		10(83.3)	12(100)	1(15.4)	10(83.3)	5(41.7)
	R	12 (100)	2(16.7)	-	11(91.7)		2(16.7)	-	11(84.6)	2(16.7)	7(58.3)
Klebsiella species (n=10)	S	1(10)	2(20)	10(100)	-		-	10(100)	1(9.1)	8(80.0)	6(60)
	R	9(90)	8(80)	-	10(100)		10(100)	-	9(90.9)	2(20.0)	4(40)
Citrobacter species (n=4)	S	-	1(25)	4(100)	-		-	4(100)	1(25)	3(75.0)	3(75)
	R	4(100)	3(75)	-	4(100)		4(100)	-	3(75)	1(25.0)	1(25)
Pseudomonas species (n=3)	S	-	3(100)	3(100)	-	3(100)	3(100)	3(100)	2(66.7)	3(100)	2(66.7)
	R	3(100)	-	-	3(100)	-	-	-	1(33.3)	-	1(33.3)
Acinetobacter species (n=2)	S	-	2(100)		1(50)	1(50.0)	1(50)	1(50)	1(50)	2(100)	1(50)
	R	2(100)	-		1(50)	1(50.0)	1(50)	1(50)	1(50)	-	1(50)
Enterobacter species (n=2)	S	-	2(100)	2(100)	1(50)	2(100)	1(50)	2(100)	1(50)	2(100)	-
	R	2(100)	-	-	1(50)	-	1(50)	-	1(50)	-	2(100)

S: Susceptible, R: Resistant

Table 5. Antimicrobial susceptibility pattern of Gram−positive bacteria recovered from catheterized patients at HUCSH, May−August 2022 (n=12).

Tested bacteria		Penicillin	Gentamicin	Nitrofurantoin	Vancomycin
CoNS(n=5)	S	-	3(60)	5(100)	4(80)
	R	5(100)	2(40)	-	1(20)
S. aureus (n=6)	S	-	5(83.3)	6(100)	
	R	6(100)	1(16.7)	-	
Enterococcus Species (n=1)	S	-	1(100)	1(100)	1(100)
	R	1(100)	-	-	-

Discussion

he magnitude of culture-confirmed CAUTI found in the current study (30.2%) is comparable with study conducted in India (15, 16). However, it is higher than studies conducted in Addis Ababa, Ethiopia (21.0%) (17), Chennai, India (21.6%) (18), Vadodara, India (20.2%) (19), Saudi Arabia (21.0%) (20), Arbaminch, Ethiopia (16.8%) (11), China(15.8%) (21), Uganda (15.3%) (22), Sudan 16.4% (23), and Chhattisgarh, India (10.6%) (24). Our finding is lower than studies conducted in India 42.9% (25), and Nigeria 60.9% (26). The variation could be due difference in socio-demographic characteristics, infection prevention policies, duration of catheterization, and immunological status of participants. The proportion of CAUTI in this study was high among male participant which is in line with the study from Saudi Arabia (20).

The most prevalent bacteria was *E. coli* (26.6%) which is lower than report from Arbaminch, Ethiopia (40.5%) (11), Jimma, Ethiopia (42.0%) (27), Yemen (46.3%) (28), and most parts of India (31%-38%) (15, 16, 18, 19, 24). Studies conducted in Yemen (18.5%) (28), Chhattisgarh, India(17%) (24), Maharashtra, India (16.4%) (16), and Chhattisgarh, India (24), reported low proportion of *Klebsiella* species unlike our study (22.2%) which is the second most prevalent bacteria. The proportion of *Klebsiella* species we found were lower than the study from Vadodara, India (24%) (19).

The proportion of *Pseudomonas* species was 6.7% which is lower than report from Yemen (11.9%) (28), Vadodara, India (24%) (19), and Maharashtra, India (8.2%) (16). The proportion of *S. aureus* among the study participants was 13.3% which is higher than the study from Yemen (5.3%) (28).

From the total 45 isolates, the proportion of Gram-positive bacteria was 12 (26.7%), which is lower than report from Addis Ababa (36.7%) (29). S. aureus prevalence (50.0%) was higher than the study done in Nepal 5.9% (30).

E. *coli* was the most frequently isolated bacterium throughout the majority of investigations, despite the fact that the prevalence of specific bacteria varies. Because these bacteria are common in the gut flora and can contaminate the urethra and ascend into the bladder following catheter insertion, they may cause an infection in the urinary tract. These findings were in contrast with studies from Italy (31), Thailand (32), and Sudan (23), where *P. aeruginosa* or *Enterococcus* species were the most frequent bacterial isolates. In studies conducted in Saudi Arabia and Nigeria (18), the predominant bacteria was *Klebsiella* ***pneumoniae*** (20%) (20). The difference in the distribution of bacteria may be due to differences in environmental conditions duration of catheterization, and the organisms' uniqueness to each facility. It may also be explained by the differences in the population studied, such as mean age, pre-morbid state and the reasons for admission.

Catheterized patients with comorbidities were four times more likely to develop culture- confirmed CAUTI. Our result is in line with the studies from Ethiopia (11), India (25), and Korea (23). This may be due to impairment of host defence's, including decreased polymorph nuclear leukocyte mobilization, chemo taxis, and phagocytic activity related to hyperglycemia, which increases the adherence of bacteria to the bladder epithelial cells (34). Patients who were on catheter for more than seven days were about ten times more likely to develop culture-confirmed CAUTI. Our finding is in line with the study done in Arbaminch (11), Addis Ababa (17), and India (19).

Majority of *E. coli, Klebsiella* Species*, pseudomonas* Species, and *Citrobacter* identified in this study were resistant to commonly prescribed antimicrobial agents such as ampicillin, cefazolin, ceftriaxone, and piperacillin. Our finding is in partial agreement with study conducted in Arbaminch general hospital (11) where all bacteria were resistant to ampicillin. In addition, study from Nigeria (1) reported high proportion of Gram-negative bacteria resistant to commonly used antimicrobial agents such as ampicillin (100%), cotrimoxazole (87.3%), and ciprofloxacin (56.4%).

Irrational use and or self-medication of antimicrobials might contribute to the study area's resistance rates. Most Gram-negative bacteria tested were susceptible to nitrofurantoin and amikacin, which is in line with the study conducted in Arbaminch general hospital (11). The lower resistance to this drug could be due to their rare local availability and higher cost than others. In contrast to our study, high proportion of bacteria resistant to nitrofurantoin was reported from Uganda (22) and Nigeria (1). One of the limitation of our study was the small sample size used in the study use of convenient sampling technique.

Conclusions:

This study revealed high magnitude of catheter associated urinary tract infection among patients attending Hawassa University Comprehensive Specialized Hospital.*E. coli* was the leading cause of urinary tract infection, followed by *Klebsiella* species and *S. aureus.* Duration of catheter and comorbidities were significantly associated with culture- confirmed catheter associated urinary tract infection. Majority of Gram-negative bacteria were resistant to commonly prescribed antimicrobial agents while most were susceptible to nitrofurantoin and amikacin.

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Authors' contributions
MK: proposal development, data collection, manuscript preparation TLA: Supervision, manuscript review ITT: Participant identification, protocol development, supervision, MM: Checking the quality of data collection tool, provided professional comments MMA Proposal review, supervision during data collection, data analysis, and manuscript preparation. All authors read and approved the final version of the manuscript.

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Competing interests
The authors declare that they have no competing interests. The final version was approved by all authors.

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