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ORIGINAL RESEARCH

Isolation and Antibiotic Susceptibility Pattern of Bacterial Uropathogens and Associated Factors Among Adult People Living with HIV/AIDS Attending the HIV Center at Wolaita Sodo University Teaching Referral Hospital, South Ethiopia

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Background: Urinary tract infection remains one of the major public health problems in developing countries, including Ethiopia. Its prevalence is fuelled by human immunodeficiency virus infection which represents a considerable health problem amongst these populations. This study aimed to assess the prevalence, antimicrobial susceptibility pattern and associated factors of bacterial urinary tract infections among adult PLHIV.

Methods: Cross-sectional study was conducted from May to December, 2018 among adult people living with HIV/AIDS in Wolaita Sodo University Teaching and Referral Hospital. The socio-demographic data and clinical data were collected using structured questionnaire. Mid-stream urine sample was collected for bacterial isolation and identification. Antimicrobial sensitivity testing was done by Kirby-Bauer disk diffusion technique. Logistic regression was conducted to check the association between UTI and associated factors.

Results: The overall prevalence of urinary tract infection was 29 (14.1%). The predominant bacteria isolated was *E. coli* 13 (44.8%) followed by *S. aureus* 5 (17.2%). Gender, CD4 count, history of catheterization, history of hospitalization, and DM status were independent factors for the occurrence of urinary tract infection. *E. coli* species were 100% and 84.6% susceptible to ciprofloxacin and norfloxacin, respectively; whereas, there was a complete resistance to amoxicillin-clavulanic acid and ampicillin. *K. pneumoniae* was pan resistant to gentamicin, amikacin and ampicillin, whereas 100% sensitive to nitrofurantoin. The rate of MDR was 23 (79.3%) with the majority, 16 (69.6%), gram negative and seven (30.4%) gram positive.

Conclusion: The burden of UTI among people living with HIV was considerably high. The findings of this study will help policy makers and other stakeholders as baseline information.

Keywords: urinary tract infection, PLHIV, antibiotic susceptibility pattern, Wolaita, Ethiopia

Introduction

Urinary tract infection (UTI) is the infection of any part of the urinary tract which includes the organs that collect and store urine and release it from the body, the kidneys, ureters and bladder, urethra and accessory structures. It results when microorganisms, usually bacteria from the digestive tract, cling to the opening of the urethra and begin to multiply.[1]

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More than 90% of UTIs are due to enteric gram negative bacteria, mainly *Escherichia coli, Proteus mirabilis, Klebsiella pneumoniae, Pseudomonas aeruginosa* and gram-positive bacteria including *Staphylococcus aureus*.[2] Exogenous hospital acquired UTIs can also occur following invasive procedures in the urinary tract, mainly due to urinary catheterization.[3]

Depending on sex, age, immune status, and the area of the urinary tract that is infected, symptoms and signs of UTI can vary. Pathological conditions that may impede urine flow like enlarged prostate, congenital urinary tract abnormalities, and inflammation have an impact on the occurrence of UTI.[3,4] HIV/AIDS results in progressive failure of the immune system leading to life threatening opportunistic infections thriving.[5] Globally, an estimated 36.7 million people are living with HIV/AIDS with the highest number (26.7 million) in sub-Saharan Africa from which 1.6 million people are newly infected with HIV.[6] On the same report across the globe, from the total number of people infected, 26.5 million were aware of their HIV status and 19.5 million (53%) were on antiretroviral treatment (ART); while 1 million deaths resulted from AIDS were reported. HIV infection is associated with a variety of renal syndromes; patients with low CD4 counts are at risk of the neurological complications of hyperreflexia and hyporeflexia which can lead to urinary stasis and ultimately infection.[7] The emergence of antibiotic resistance in the management of UTIs is a serious public health problem globally, particularly in the developing world.[8] Since bacterial pathogens of UTIs are variable regionally, infection control and treatment depend on local knowledge of common causative organisms and their antibiotic resistance.[9] To the best of our knowledge the prevalence, antimicrobial susceptibility pattern, and associated risk factors of bacterial uropathogens among adult PLHIV in the present study area is unknown. Thus, the current study is planned to determine the prevalence, antimicrobial susceptibility pattern of bacterial uropathogens and associated risk factors among HIV infected patients.

Methods

Study Area and Period

The study was conducted among people living with HIV at HIV center of Wolaita Sodo University teaching referral hospital (WSUTRH) which is situated at Wolaita Sodo town, Ethiopia. A total of 205 people living with HIV were included in the study from May to December, 2018.

Study Design and Study Population

Hospital based cross-sectional study was conducted among PLHIV in HIV center of WSUTRH.

Inclusion and Exclusion Criteria

HIV infected adults ≥18 years old were included and patients on antibiotics for more than two weeks prior to the time of enrolment, seriously ill patients, and pregnant mothers were excluded.

Sample Size Determination and Sampling Technique

Single population proportion formula was used to determine sample size by considering the following assumptions: P = 0.107,[10] Z score for 95% confidence interval = 1.96, level of precision (d) = 4%. Sample size (n_o) = $\left(z\frac{\alpha}{2}\right)$2.p(1-p)/d n_o = ((1.96)2 x 0.107x (1–0.107))/(0.04) 2=229, since the total population less than 10,000, correction formula was used.

$$\frac{n}{1+\frac{n}{N}} = \frac{229}{1+\frac{229}{1485}} = \ 197$$

By considering 10% non-response rate; the overall sample size is found to be 217.

Study participants were selected using systematic random sampling technique by using Kth value, Kth value = total population/sample size = 1485/217= 7.

After the 1st participant was chosen from 7 early comers to the ART clinic by lottery method, the following were selected every 7 individuals until the required sample size was fulfilled.

Data Collection and Laboratory Processing

Socio-demographic data was collected through interview with a pre-tested structured questionnaire adapted from similar previous National and International studies. The questionnaire contained two parts: socio-demographic characteristics and associated factors. Secondary data on medical and clinical history and current use of anti-tuberculosis drugs were retrieved from patient's charts. The socio-demographic data, history of exposure for the possible associated factors, and misuse of antibiotic drugs and other relevant information was collected using structured questionnaire. The participants' current CD4 value and viral load was collected from their medical records.

Sample Collection, Handling, and Transport

A clean catch mid-stream urine (MSU) was collected in sterile, wide mouthed, screw capped containers. They were requested to collect 10mL of urine after instruction on self-collection of midstream urine. The collected urine specimen was divided into two sterile test tubes; one container for microscope investigation and the other for culture inoculation. Female patients were instructed to wash their hands, cleanse the area around the urethral opening with clean water, dry the area with a sterile gauze pad, and collect the middle urine with labia held apart, while male collecting a middle of the urine flow. All urine specimens were placed in a cold box and sent to the Central laboratory within 30 minutes of collection.[11] Capillary blood was collected to check blood glucose level of PLHIV.

Sample Processing and Identification

Microscopic Examination of Urine

The urine samples were centrifuged at 2000g for 5 minutes. After centrifugation, the supernatant was discarded and a drop or two of the sediment placed on the grease free slide, cover slip applied and examined under the microscope using the high-power field. Reporting system for microscopic identification is at high magnification for pus cells, red blood cells, epithelial cells, casts, crystals, and yeast cells.

Culture and Identification

Well-mixed un-centrifuged urine was cultured on blood agar, Cysteine Lactose Electrolyte Deficient (CLED) medium MacConkey agar (MAC) and Mannitol salt agar. A positive urine culture was defined as colony count $\geq 10^5$CFU/mL for midstream urine. Pure isolate was sub-cultured onto nutrient broth and incubated aerobically at 37 °C for 12–24 hours for biochemical testing.[12] All positive cultures were further identified by their colony characteristics; Gram staining was done to identify Gram positives from Gram negatives. A single isolated bacterium was also inoculated onto nutrient agar slant and stored in a refrigerator after 24 hours of incubation for the maintenance of the isolated bacteria. Gram negative bacterial identification was done following standard procedures, by using a series of biochemical tests which include Kligler iron agar, Simmons citrate agar, lysine iron agar, urea, glucose and lactose fermentation, lysine decarboxylation, gas and H_2S production, motility tests, and indole.[12] Cultures from MacConkey and blood agar were sub-cultured onto nutrient agar for carrying out the appropriate biochemical tests. Gram staining, catalase, coagulase, and novobiocin were used to identify gram positive bacteria (Oxoid Ltd. Company, UK).

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility testing was done using the Kirby-Bauer disk diffusion method on Mueller Hinton agar (Oxoid Ltd.) prepared with 4mm thickness.[13]

Panels of eleven antimicrobial disks including ampicillin (10µg), amoxicillin-Clavulanic acid (10µg), cefoxitin (30µg), ciprofloxacin (5µg), gentamicin (10µg), norfloxacin (10µg), cefepime (30µg), ceftriaxone (30µg), nitrofurantoin (F) 300µg, amikacin (10µg), and azithromycin (30µg) (Oxoid Ltd.) were used for susceptibility tests. Then, the bacterial isolates were classified as sensitive (S), intermediate (I), or resistance (R) by comparing against the inhibition zone diameter of interpretative standards as indicated in the CLSI guideline.[13]

Results

Socio-Demographic Factors

From 217 study participants who were approached, 205 consented to be involved in the study, with a response rate of 94.5%. Out of 205 PLHIV included in study, 124 (60.5%) were females. The majority of study participants, 94 (45.6%), were in age range of 28–37, while 11 (5.4%) were older than 48 years old. Most of the HIV infected patients, 159 (77.6%), were urban dwellers (Table 1).

Culture Results

Urinary tract infections were detected in 29 (14.1%). From total positive culture results, 24 (19.4%) were found in females and 5 (6.2%) in males. Age group 18–27 years had the highest number of bacterial isolates, 7 (23.3%). There was high occurrence of bacterial isolate among people with no formal education, 7 (19.4%), followed by grade 9–12, 10 (17.5%), and the least was identified among 1–8 grade level, 7 (8.5%). Prevalence of bacterial isolate was more common among students, 6 (27.3%) and least among farmers, 4 (10.5%) and regarding income and UTI, individuals with low-income level (19.7%) showed high prevalence of bacterial isolates as shown in Table 1.

As shown in Table 2, out of 205 study participants, 169 (82.4%) were currently using ART, while the remaining 36 (17.6%) have not started treatment. From a total of 205

Table 1 UTI and socio-demographic characteristics among PLHIV (N=205) attending ART Clinic, WSUTRH, Ethiopia, 2018

Socio-Demographic Characteristics	Number (%)	Urine Culture	
	Total	Positive N (%)	Negative N (%)
Sex			
Male	81	5 (6.2)	76 (93.8)
Female	124	24 (19.4)	100 (80.6)
Age			
18–27	30	7 (23.3)	23 (76.7)
28–37	94	10 (10.6)	84 (89.4)
38–47	70	10 (14.3)	60 (85.7)
>48	11	2 (18.2)	9 (81.2)
Education			
Illiterate	36	7 (19.4)	29 (80.6)
1–8 grade	82	7 (8.5)	75 (91.5)
9–12 grade	57	10 (17.5)	47 (82.5)
Diploma and above	30	5 (16.7)	25 (83.3)
Marital status			
Single	56	10 (17.8)	46 (82.2)
Married	114	12 (10.5)	102 (89.5)
Divorced	17	4 (23.5)	13 (76.5)
Widowed	18	3 (16.7)	15 (83.3)
Residence			
Urban	159	26 (16.4)	133 (83.6)
Rural	46	3 (6.5)	43 (93.5)
Occupation			
Government employed	33	4 (12.2)	29 (87.8)
Private employed	46	6 (13)	40 (87)
Farmer	38	4 (10.5)	34 (89.5)
Business	54	6 (11.1)	48 (88.9)
Student	22	6 (27.3)	16 (72.7)
Other	12	3 (25)	9 (75)

study participants, 34 (16.6%) were symptomatic while 171 (83.4%) were asymptomatic. Eighteen people with diabetes were identified from the total of 205 participants and among those, UTI was found in 7 (38.9%). Thirty-two adults had a history of hospitalization of all the PLHIV, among which 9 (28.1%) had UTI. Five individuals who had history of catheterization were identified from the total study participants and among those UTI was discovered in 3 (60%) and the remaining 2 did not have UTI. Concerning CD4, 55 (26.8%) had CD4+ cell count < 200cell/mm^3 and among those 19 (34.5%) had significant bacterial growth while the remaining 36 (65.5%) did not have significant bacteriuria.

Table 2 UTI and clinical characteristics among PLHIV (N=205) attending ART Clinic, WSUTRH, Ethiopia, 2018

Variables	Total	Urine Culture	
		Positive N (%)	Negative N (%)
ART status			
ART naïve	36	6 (16.7)	30 (83.3)
ART started	169	23 (13.6)	146 (86.4)
Current CD4 cell count			
<200	55	19 (34.5)	36 (65.5)
>200	150	10 (6.7)	140 (93.3)
HIV RNA Viral load (copies/mL)			
0–999	77	6 (7.7)	71 (92.3)
1000–9999	89	15 (16.8)	74 (83.2)
>10,0000	39	8 (20.5)	31 (79.5)
TB-HIV co-infection			
Yes	30	7 (23.4)	23 (76.6)
No	175	22 (12.6)	153 (87.4)
WHO clinical stage			
I	137	18 (13.2)	119 (86.8)
II	53	5 (9.4)	48 (90.6)
III	9	3 (33.4)	6 (66.6)
IV	6	3 (50)	3 (50)
Use of cotrimoxazole			
Yes	97	11 (11.3)	86 (88.7)
No	108	18 (16.7)	90 (83.3)
Mis-use of antibiotics			
Yes	52	9 (17.3)	43 (82.7)
No	153	20 (13.1)	133 (86.9)
Previous UTI history			
Yes	46	9 (19.6)	37 (80.4)
No	159	20 (12.6)	139 (87.4)
Current UTI symptom			
Symptomatic	34	21 (61.7)	13 (38.3)
Asymptomatic	171	8 (4.7)	163 (95.3)
History of catheterization			
Yes	5	3 (60)	2 (40)
No	200	26 (13)	174 (87)
Hospitalization history			
Yes	32	9 (28.1)	23 (71.9)
No	173	20 (11.6)	153 (88.4)
DM status			
Diabetic	18	7 (38.9)	11 (61.1)
Non-diabetic	187	22 (11.7)	165 (88.3)

Abbreviation: DM, diabetes mellitus.

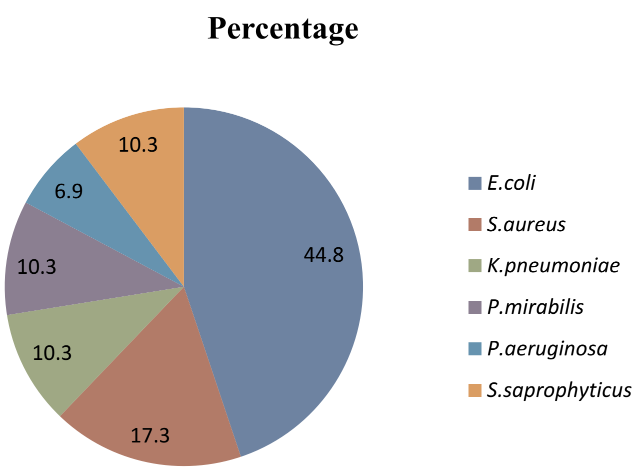

Figure 1 Distribution of bacterial isolates among PLHIV (n=205) attending ART clinic, WSUTRH, Ethiopia, 2018.

Most of the participants, 89 (43.4%), had viral load range of 1000–9999. The occurrence of UTI was high (20.5%) among individuals with viral load of >10, 0000. Forty-six PLHIV had a previous history of UTI from which UTI was found in 9 (19.6%) participants. Thirty participants had current TB/HIV coinfection and from those UTI was found in 7 (23.4%) participants. Regarding WHO clinical stage of HIV, the majority, 137 (66.8%), of participants were in clinical stage I and the least, 6 (2.9%), were clinical stage IV (Table 2).

Microscopic Findings

The majority of microscopic examination showed epithelial cells, 90 (43.9%), followed by pus cells, 50 (24.4%).

Etiologic Agents

A total of 29 uropathogenic bacterial species in five genera including Escherichia, Staphylococcus, Proteus, Klebsiella, and Pseudomonas were identified, of which 21 (72.4%) were Gram negative and 8 (27.6%) were gram positive. *E. coli,* 13 (44.8%), were the most common, followed by *S. aureus,* 5 (17.3%) (Figure 1).

Risk Factors Associated with Urinary Tract Infections

After excluding the confounding factors, sex [AOR=8.53:95% CI, 1.970–36.929] and CD4 count <200/mm3 with [AOR=0.59, 95% CI, 0.009, 0.368] revealed significant association with UTI. Current symptom of UTI and history of catheterization with AOR (95% CI) 0.35[0.010, 0116] p-value = 0.000 and AOR (95% CI) 0.048[0.003, 0.828], P-value = 0.014 respectively became the independent factor with UTI. The likelihood of developing UTI among those who had no history of hospitalization and being non-diabetic was 0.33 and 0.21 times lower respectively than those who had history of hospitalization and being diabetic (Table 3).

Antimicrobial Susceptibility Pattern of Bacterial Uropathogens

The antimicrobial susceptibility pattern of *E. coli* species were 100%, 84.6%, 76.9%, 69.2% and 62.2% susceptible to ciprofloxacin, norfloxacin, amikacin, nitrofurantoin, and cefepime respectively. There was higher rate resistance to amoxicillin-clavulanic acid (100%) and ampicillin (100%)

Table 3 Factors associated with UTI among PLHIV (N=205) attending ART Clinic, WSUTRH, Ethiopia, 2018

Variables	Category	Bacterial Culture		COR (95% CI)	AOR (95% CI)	p-value
		Positive (%)	Negative (%)			
Sex	Male	5 (6.2)	76 (93.7)	1	1	
	Female	24 (19.3)	100 (80.7)	3.648 (1.331, 10.002)	8.53 (1.970, 36.929)	0.012
CD4	<200	19 (34.5)	36 (65.5)	0.62 (0.014, 0.282)	0.59 (0.009, 0.368)	0.014
	>200	10 (6.7)	140 (93.3)	1	1	
Symptom of UTI	Yes	21 (61.7)	13 (38.3)	1		
	No	8 (4.7)	163 (95.3)	0.3 (0.011, 0.082)	0.35 (0.010, 0.116)	0.000
History of catheterization	Yes	3 (60)	2 (40)	1	1	
	No	26 (13)	174 (87)	0.1 (0.016, 0.625)	0.048 (0.003, 0.828)	0.014
History of hospitalization	Yes	9 (28.1)	23 (71.9)	1		
	No	20 (11.6)	153 (88.4)	0.334 (0.136, 0.822)		0.017
DM status	Diabetic	7 (38.9)	11 (61.1)	1		
	Non-diabetic	22 (11.7)	165 (88.3)	0.21 (0.074, 0.597)		0.003

Table 4 Antimicrobial susceptibility patterns of gram-negative bacterial isolates (N= 21) among PLHIV attending ART Clinic, WSUTRH, Ethiopia, 2018

Bacterial Isolate	Classification		Antibiotics								
		CXT	NOR	CTR	CFP	GEN	AMC	AMP	NIT	AMK	CPR
E. coli (n=13)	S I R	4 (31%) 3 (23%) 6 (46%)	11 (85%) 2 (23%) 0 (0.0)	6 (46%) 5 (39%) 2 (15%)	9 (69%) 3 (23%) 1 (8%)	8 (62%) 1 (8%) 4 (31%)	0 (0.0) 0 (0.0) 13 (100%)	0 (0.0) 0 (0.0%) 13 (100%)	9 (69%) 2 (23%) 2 (23%)	10 (77%) 2 (23%) 1 (8%)	13 (100%) 0 (0.0) 0 (0.0)
K. pneumoniae (n=3)	S I R	0 (0.0%) 1 (33.3%) 2 (67%)	2 (67%) 0 (0.0) 1 (33%)	1 (33%) 0 (0.0) 2 (67%)	1 (33%) 0 (0.0) 2 (67%)	0 (0,0) 0 (0.0) 3 (100%)	0 (0.0) 0 (0.0) 3 (100%)	0 (0.0) 0 (0.0) 3 (100%)	3 (100%) 0 (0.0) 0 (0.0)	1 (33%) 0 (0.0) 2 (67%)	1 (33%) 0 (0.0) 2 (67%)
P. mirabilis (n=3)	S I R	0 (0.0) 1 (33%) 2 (66.7%)	3 (100%) 0 (0.0) 0 (0.0)	2 (67%) 1 (33%) 0 (0.0)	2 (67%) 1 (33%) 0 (0.0)	3 (100%) 0 (0.0) (0.0)	0 (0.0) 0 (0.0) 3 (10%)	0 (0.0) 0 (0.0) 3 (100%)	1 (33%) 1 (33%) 1 (33%)	2 (67%) 1 (33%) 0 (0.0)	3 (100%) 0 (0.0) 0 (0.0)
P. auroginosa (n=2)	S I R	1 (50%) 1 (50%) 0 (0.0)	1 (50%) 0 (0.0) 1 (50%)	2 (100%) 0 (0.0) 0 (0.0)	2 (100%) 0 (0.0) 0 (0.0)	2 (100%) 0 (0.0) 0 (0.0)	0 (0.0) 0 (0.0) 2 (100%)	0 (0.0) 0 (0.0) 2 (100%)	2 (100%) (0.0) 0 (0.0)	1 (50%) 1 (50%) 0 (0.0)	2 (100%) 0 (0.0) (0.0)

Abbreviations: CXT, cefoxitin; NOR, norfloxacin; CTR, ceftriaxone; CFP, cefepime; GEN, gentamicin; AMP, ampicillin; NIT, nitrofurantoin; AMK, amikacin; CPR, ciprofloxacin; AMC, amoxicillin-clavulanic acid.

K. pneumoniae was 100% sensitive to nitrofurantoin but completely resistant to gentamicin, amoxicillin-clavulanic acid, and ampicillin. All *P. mirabilis* isolates susceptible to norfloxacin, gentamicin, and ciprofloxacin and totally resistant to amoxicillin-clavulanic acid and ampicillin (Table 4). *S. aureus* showed 100%, 80%, 60%, and 60% sensitivity to nitrofurantoin, ciprofloxacin, gentamicin, and azithromycin respectively, but it showed pan resistance for ampicillin and cefoxitin. *S. saprophyticus* depicted total resistance for ampicillin, amoxicillin-clavulanic acid, and cefoxitin, but it became 100% sensitive for gentamicin (Table 5)

Multiple Drug Resistance Patterns of Uropathogenic Bacterial Isolates

As revealed in the Figure 2, out of 29 uropathogenic isolates, 23 (79.3%) isolates were MDR of which gram negative accounts for 16 (69.6%) and gram positive 7 (30.4%). Among gram negatives all *K. pneumoniae* isolates and two *P. mirabilis* isolates were resistant to six classes of antibiotics. Regarding gram positives, single isolates of *S. saprophyticus* and *S. aureus* were resistant to six and five class of antibiotics respectively.

Discussion

The overall prevalence of UTI in the current study was 14.1%. This finding is in agreement with previous studies elsewhere.[10,14–17] On the contrary, findings disparately higher than this study were also noted including 93.8%[18] in Nigeria, and 77.5%[19] and 41.7%[20] in India. On the other hand, the prevalence of UTI in the current study was higher than previous studies conducted in Iran 8.06%,[21] London 5.7%,[22] and Bangalore 7.1%[7] among HIV

Table 5 Antimicrobial susceptibility patterns of gram-positive bacteria isolates (N=8) among PLHIV Attending ART Clinic, WSUTRH, Ethiopia, 2018

Bacterial Isolate	Classification	Antibiotics						CPR
		AMP	AMC	AZM	CXT	GEN	NIT	
S. aureus (n=5)	S I R	0 (0.0) 0 (0.0) 5 (100%)	1 (20%) 2 (40%) 2 (40%)	3 (60%) 2 (40%) 0 (0.0)	0 (0.0) 1 (20%) 4 (80%)	3 (60%) 2 (40%) 0 (0.0)	5 (100%) 0 (0.0) 0 (0.0)	4 (80%) 0 (0.0) 1 (20%)
S. saprophyticus (n=3)	S I R	0 (0.0) 0 (0.0) 3 (100%)	0 (0.0) 0 (0.0) 3 (100%)	1 (33%) 0 (0.0) 2 (67%)	0 (0.0) 0 (0.0) 3 (100%)	3 (100%) 0 (0.0) 0 (0.0)	2 (67%) 0 (0.0) 1 (33%)	2 (67%) 0 (0.0) 1 (33%)

Abbreviations: AMP, ampicillin; AMC, amoxicillin-clavulanic acid; AZM, azithromycin; CXT, cefoxitin; GEN, gentamicin; NIT, nitrofurantoin; CPR, ciprofloxacin.

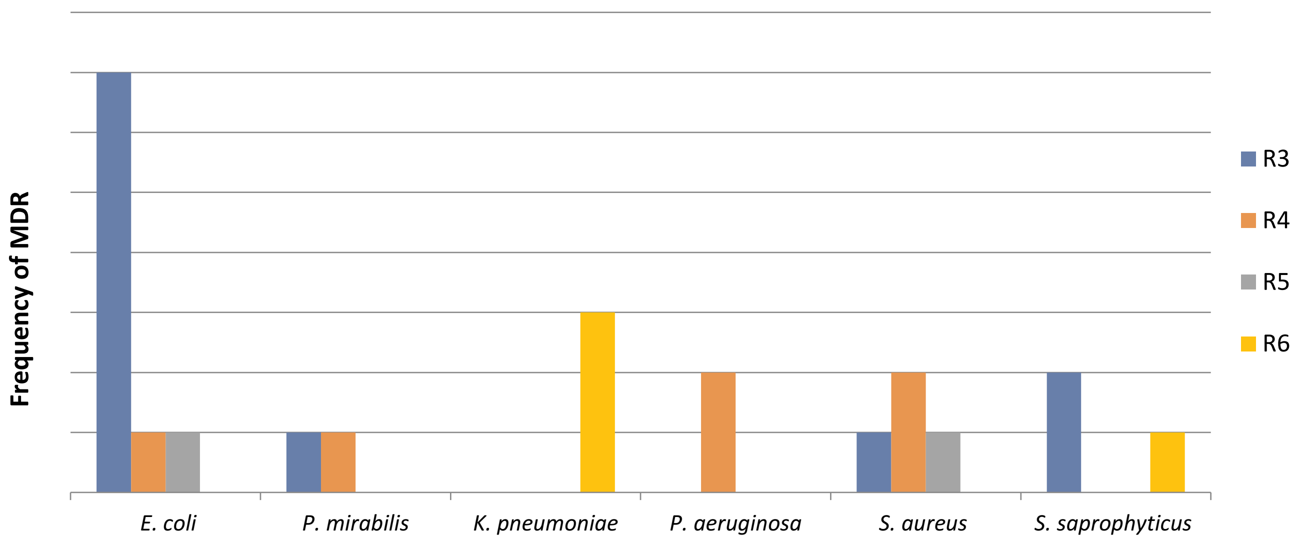

Figure 2 Multidrug resistance patterns of uropathogenic isolates among PLHIV attending ART clinic, WSUTRH, Ethiopia, 2018.

seropositive participants. Variation in prevalence of UTI across studies could be multifactorial in which differences in study set up, social habits of the community, socio-economic status, standard of personal hygiene, sexual activity, history of UTI, diabetes mellitus, anatomic or functional genitourinary tract abnormalities and health education practices play a pivotal role.[3,23,24]

Our finding shows that *E. coli* 13 (44.8%) was the predominant isolate. This finding corroborated with previous findings in Addis Ababa 49%,[14] Gondar 56.1%,[10] Jimma 54.3%,[15] India 52.04%,[9] and Nigeria 47.3%.[25] But this finding was higher than other studies conducted in Saudi Arabia *E. coli* 19.5%[26] and South Africa *E. coli* (17.9%).[27] On the other hand, there are previous findings where Klebsiella were the most prevalent isolate according to studies in the country 28%.[15,28] The preponderance of *E. coli* could be due to having of unique structure that helps these species for attachment to uroepithelial cells allowing multiplication and tissue invasion. The overall variation of bacterial species may indicate a changing pattern in local prevalence of uropathogen depending upon age, sex, catheterization, study participants, and hospitalization.[29,30]

The second most common uropathogen in this study was *S. aureus* (17.3%). This finding is in line with commonly isolated bacteria in other studies of the general population elsewhere in the world and in Ethiopia.[25,31,32]

The prevalence of UTI among participants with CD4+ count <200/mm^3 (34.5%) was higher than participants whose CD4+ count >200/mm^3 (6.7%). This finding is in line with other studies which showed a high prevalence of UTI 26.3% in Nigeria,[23] 50.4% in Nigeria,[24] 24.6% in Gondar[10] and, 36% in Addis Ababa.[14] The results may imply that the more immune compromised the patient, the higher the risk of UTI and possibly more vulnerable to other opportunistic infections.[33] Out of 18 confirmed diabetic mellitus patients, UTI was identified among seven (38.9%) participants. This finding was higher than a study from Gondar and Addis Ababa which reported 17.8%[34] and 10.9% respectively.[15]

All gram negative bacteria (*E. coli*, *K. pneumoniae*, *P. mirabilis,* and *P. aeruginosa*) showed total resistance for ampicillin and amoxicillin-clavulanic acid in the present study. Similar findings to this study were also reported in Addis Ababa where both antibiotics showed complete resistance.[14] Likewise, comparative findings were also documented in Nigeria[36] where 88% of the *E. coli* isolates showed resistance for ampicillin, and 77% for *P. aeruginosa*. There was also a higher rate of resistance to ampicillin (90%) and amoxicillin-clavulanic acid (100%) in Nigeria.[37]

The high resistance to ampicillin and amoxicillin-clavulanic acid may be due to easy access and availability as well as uncontrolled and indiscriminate use of these antibiotics.

Norfloxacin and ciprofloxacin were effective antibiotics for *E. coli* with >80% sensitivity in this study. Likewise, similar findings were also noted in Gondar (100% and 92.3%),[10] Jimma (100%, 84%),[16] and Addis Ababa (100% and 90%), Ethiopia.[15] This is comparable with the study done in Ghana which showed 83.3% sensitivity to the *E. coli*.[38] In contrast to our study, the study done in Addis Ababa, *E. coli* showed high sensitivity (100%) to ceftriaxone, nitrofurantoin, and amikacin.[14] *P. mirablis* depicted total sensitivity to norfloxacin, ciprofloxacin, and gentamicin in the current study, which was also reported in Addis Ababa where they became 100% sensitive to ciprofloxacin and gentamicin.[39] This finding is similar with a study done in Gondar which showed 100% sensitivity to ceftriaxone, ciprofloxacin, and gentamicin.[34] Regarding *P. aeruginosa*, all isolates showed 100% susceptibility to ceftriaxone, cefotaxime, gentamicin, nitrofurantoin, and ciprofloxacin. Ceftriaxone resistance level of 77% and 100% were also reported in Nigeria[36] and south west Ethiopia.

S. aureus showed 80% and 100% sensitivity for ciprofloxacin and nitrofurantoin whereas all of the isolates were resistant to ampicillin and 80% are cefoxitin resistant. This finding was comparable to other studies conducted in Ethiopia.[10,32,39] *S. saprophyticus* became 100% sensitive for gentamicin and completely resistant for ampicillin, amoxicillin-clavulanic acid, and cefoxitin in the current study. In agreement with our study, *S. saprophyticus* showed 100% sensitivity to gentamicin in Addis Ababa[14] with complete resistance to ampicillin and cefoxitin. It was also in agreement with the study conducted in Jimma[16] and Iran[21] where all isolates were fully resistant to ampicillin. The similarity and differences between reports on resistance patterns may be due to the distribution of resistant strains across the country.

In the current study, twenty-three (79.3%) uropathogenic bacterial isolates showed multidrug resistance (MDR). This finding was in line other studies done in Addis Ababa 78.4%,[14] 74%.[40] MDR pattern in this study was lower than previous studies conducted in Gondar, Ethiopia 91.7%[34] and 95%.[32] In contrast, our finding of MDR pattern was more common than the study conducted in India 70.0%. This changing MDR pattern in the country and across the country may be due to difference in antibiotic use practices, including self-medication, high frequency of antibiotic use, and indiscriminate use. MDR pattern was more common in gram negative 69.6% than gram positive bacteria 30.4%.

The strength of our study was that it evaluated urine samples for uropathogenic bacteria and highlighted the pattern of antimicrobial resistance that provides precise scientific data for appropriate treatment, prevention, and control of UTI. However, the study was done at one hospital; it may not represent UTI in all HIV infected patients. Other causative agents of UTI (anaerobic bacteria, viruses, and fungus) in HIV-positive patients were not done due to a lack of testing facilities.

Conclusion

The prevalence of UTI in this study was considerably high. Sex, CD4 count, history of catheterization, and hospitalization were risk factors significantly associated with UTI. *E. coli* and *S. aureus* were the major causative agents of UTI. Isolation of MDR bacteria shows the emerging challenge to treat UTI. The health professionals should be aware of local resistance patterns to consider updating empirical treatment for UTI. Measures including health education, continuous monitoring of bacteria, and antimicrobial surveillance are crucial among this group of individuals to mitigate infection and antimicrobial resistance. Further study is needed on large number of PLHIV from several health facilities to infer prevalence of UTI for all HIV patients.

Abbreviations

AIDS, acquired immunodeficiency syndrome; ART, antiretroviral therapy; CFU, colony forming unit; CLED, cystine lactose electrolyte deficient; CLSI, Clinical and Laboratory Standards Institute; HIV, human immunodeficiency virus; MDR, multidrug resistance; MSU, midstream urine; UTI, urinary tract infection; WHO, World Health Organization; WSUTRH, Wolaita Sodo University Teaching and Referral Hospital.

Data Sharing Statement

The data presented in this study contain confidential and private information about the patients and their locations. To share this information is ethically not allowed. However, the analyzed data without patient's personal information and hospital and private labs can be requested from the corresponding author if required. All data generated and analyzed during this study period were included in the manuscript.

Ethical Approval and Consent to Participate

Ethical clearance was obtained from the ethics committee of the Department of Microbiology, Immunology and Parasitology, College of Health Sciences, Addis Ababa University. Official permission was obtained from study site. Written informed consent was obtained from each study participant. Urine culture and antimicrobial sensitivity test results were reported to the attending physician for subsequent treatment and follow up. This study was conducted in accordance with the Declaration of Helsinki.

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Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests.

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