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Antibiotic Resistance for Urinary Tract Bacteria Among HIV Positive Pregnant Women at Jaramogi Oginga Odinga Teaching and Referral Hospital, Kenya

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Abstract:

- ***Background***

Urinary tract infections (UTIs) in pregnant women can lead to serious maternal and fetal complications, especially among those living with HIV, who are more prone to opportunistic infections. Antimicrobial resistance (AMR) can exacerbate these infections and may vary by pregnancy trimester, HIV clinical stage, and UTI type (symptomatic vs. asymptomatic bacteriuria). This study aimed to assess antibiotic resistance in urinary tract bacteria isolated from HIV-positive pregnant women in relationship to pregnancy trimester, UTI type, and HIV clinical stage.

- ***Methods***

A hospital-based prospective cross-sectional study was conducted at Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH). A total of 168 midstream urine samples were collected from HIV-positive pregnant women attending antenatal clinic and taken to the laboratory for processing. SPSS 25.0 was used for data analysis.

- ***Results***

UTI prevalence was 23.8%(40/168). Majority 62.5%(105/168) were in HIV stage I. Additionally, 47.6%(80/168) were in second trimester. UTI symptoms were showed in 32.1%(54/168) participants. Self-medication was reported in 28.6%(48/168) of participants. *E. coli* was the most common Gram-negative isolate 25%(10/40), followed by *P. aeruginosa* 22.5%(9/40), *K. pneumoniae* 20%(8/40), and *P. mirabilis* 12.5%(5/40). Among Gram-positive bacteria: *S. aureus* was 100% (10/10) sensitive to Clindamycin; Coagulase-negative Staphylococci (CoNS) (5/5)100% sensitive to Nitrofurantoin; and *S. saprophyticus* showed 100%(2/2) sensitivity to Penicillin, Nitrofurantoin, Clindamycin, and Trimethoprim-Sulfamethoxazole. Multidrug Resistance (MDR) was observed in 80%(8/30) of *E. coli*, 77.8%(7/30) of *P. aeruginosa*, and 62.5%(5/30) of *K. pneumoniae*. Significant association was found between antibiotic resistance and age of pregnancy, HIV stage and types of UTIs ($p<0.05$).

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➢ ***Conclusion***

High antibiotic resistance among UTI pathogens complicates empirical treatment. Surveillance of AMR is essential to guide effective therapy, especially in resource-limited settings.

Keywords: *Antibiotic Resistance, UTI, HIV, Pregnant Women.*

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I. INTRODUCTION

Urinary tract infections (UTIs) are the most common health problems affecting women in their reproductive ages in developing countries [1]. Pregnant women are more susceptible to UTIs due to a combination of hormonal and physiologic changes that predispose them to bacteriuria [1,2]. UTIs commonly occur when bacteria, typically originating from the skin or rectum, infiltrate the urethra and contaminate the urinary system [2].

Globally, UTI prevalence in pregnancy ranges between 13% - 33%, with symptomatic bacteriuria occurring in 1% - 18%, while asymptomatic cases are noted in 2% - 10% of women [3], which has remained constant as compared to those from undeveloped countries [2]. The most common agent implicated in symptomatic and asymptomatic bacteriuria is *Escherichia coli*, which is responsible for 70% - 80% of the infections [2, 4]. Other microorganisms include *Staphylococcus spp., Klebsiella pneumoniae, Proteus spp., Pseudomonas aeruginosa, Enterococcus spp.,* and Acinetobacter [5]. Past studies indicate that UTIs among pregnant mothers in Kenya range from 10% to 19% [6]. However, most of these studies concentrate on selected bacterial pathogens, and the larger spectrum of bacterial etiologic agents remains unknown.

Research in Tanzania has extensively investigated UTIs in pregnant women, focusing on the rate, drug resistance, and determining factors of UTIs among those pregnant women who are also HIV-positive [7]. HIV-infected individuals have heightened susceptibility to UTIs, largely attributed to their compromised immune system [8].

For the urinary tract infections treatment during pregnancy, Cephalexin or Nitrofurantoin are commonly prescribed because they are generally considered safe for pregnant women [9]. It is crucial to address UTIs during pregnancy, as a kidney infection at this stage can potentially lead to premature births or pre-eclampsia, the condition characterized by high blood pressure, kidney dysfunction, or seizures [10].

As per the 2019 report by WHO, antimicrobial resistance (AMR) has had a severe impact, causing death of 700,000 individuals. Disturbingly, projections suggest that by 2050, this toll could escalate dramatically, potentially reaching 20 million fatalities and incurring economic costs exceeding $2.9 trillion [11,12].

Antimicrobial resistance is a growing concern in Kenya, just as it is in many other countries [13]. This study sought to address the antibiotic resistance for urinary tract bacteria among HIV positive pregnant women with the relationship to pregnancy trimester, UTI type, and HIV clinical stage.

II. MATERIALS AND METHODS

A. Study Design

This study adopted a prospective cross-sectional research design. Within a three-month timeframe from February to April 2024.

➢ *Study Site*

This study was carried out at Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH) which is the main referral Hospital in Kisumu County in the western region of Kenya. The choice of this study site was also motivated by the higher prevalence of HIV reported in Kisumu County [13].

➢ *Study Population, Sample Size and Eligibility Criteria*

The study was open to all HIV-positive pregnant individuals attending the antenatal clinic (ANC) at JOOTRH during the study period were the target populations. The study used convenient sampling in one site that was easily reachable. A total of 168 participants at the end of the sample collection period were considered.

HIV-positive pregnant patients who were ≥18 years old with or without symptoms of UTI including; lower abdominal or flank pain, dysuria and hematuria, and frequency urinations were included in the study while patients who were mentally ill, patients who received antibiotics in the last 14 days before sample collection and unable to give samples were not included in the study.

B. Laboratory analyses

➢ *Specimen Collection*

From each study participant using a leak-proof and a sterile wide-mouthed screw-capped container about 10mL of voided clean-catch midstream fresh urine was collected and labeled. The sample were transported in the microbiology department for the analysis under a cold chain using a cold box (4˚C) within 1 hour of collection [14].

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26feb1096

➢ *Isolation and Identification of Bacteria*

As per the recommended culture and biochemical tests, isolation and phenotypic characterization was performed in which a calibrated loop that delivers 0.001 mL of urine was used to inoculate each urine sample onto the Cysteine Lactose Electrolyte Deficient Agar (Oxoid Ltd, UK). All the plates were incubated overnight at 37˚C, in which for all the colony count growth of ≥104-105CFU/mL (colony-forming units per milliliter) was considered significant while those without growth were further incubated for 24 hours and discarded as negative when the colony count was not significant [15, 16]. Colony characteristics, Gram reactions, and a series of biochemical reactions, including catalase, coagulase, oxidase, urease, indole, citrate utilization, lysine decarboxylase, glucose, lactose fermentation, gas and H_2S production, and motility tests were used for the isolations of bacteria [17].

➢ *Antimicrobial Susceptibility Testing*

Using the Kirby–Bauer disk diffusion method based on the Clinical Laboratory Standards Institute (CLSI) recommendation antimicrobial susceptibility test was performed on all the significant growth [18]. Antimicrobial agents were selected based on CLSI recommendations and local (Kenyan) prescription habits for bacteria. The antimicrobials (Oxoid Ltd) that were used for bacterial susceptibility testing were Amoxicillin-Clavulanic Acid (AMC) 10µg, Ampicillin (AMP) 10µg, Amikacin (Amk) 30µg, Cefotaxime (CTX) 30µg, Ceftriaxone (CRO) 30µg, Trimethoprim-Sulphamethoxazole (SXT) 25µg, Ciprofloxacin (CIP) 5µg, Gentamycin (Gen) 10µg, Ceftazidime (CAZ) 30µg, Nitrofurantoin (F) 300µg, Tetracycline (TE) 30µg and Penicillin (Pen) 10µg [19]. Within 15 minutes after the application of the discs, the plates were incubated at 35˚c for 18 hours. The diameters of zones of inhibition were measured using a digital caliper. The antimicrobial susceptibility test results were interpreted as sensitive, intermediate, or resistant based on the standardized guidelines, and the isolates were considered Multidrug Resistance (MDR), resistant to at least one antimicrobial in three or more antimicrobial categories [19].

➢ *Data Management and Statistical Analysis*

The Social Sciences Statistical Package (SPSS) version 25.0 was used for data analysis. Descriptive statistics were computed and logistic regression was used to determine relationship between variables. All values of diameter zones of inhibition are reported as mean ± standard error of 0.5. For all analyses, $p<0.05$ were considered statistically significant.

C. Ethics approval

Confidentiality and privacy were strictly adhered to, and no names of individuals were recorded or made known in the collection or reporting of information. The study was granted ethical clearance by the School of Graduate Studies (SGS) of Maseno University Ref no. PHD/PH/00064/2020, and ethical approval to conduct the study was sought from the Institutional Research Ethics Committee (IREC) at JOOTRH Ref. No. ISERC/JOOTRH/779/23 and the National Commission of Science, Technology and Innovations (NACOSTI) Ref. No. 304908 (An Institution Review Board established in Nairobi). All the research procedures reported in this paper were done per the Declaration of Helsinki.

III. RESULTS

Table 1. Clinical Characteristics of Study Participants

Variable	Category	Urinary Tract Infection (Positive Cases) and Asymptomatic Bacteriuria (Negative Cases)		Total Participants (N=168)	
		Positive N°(%)	Negative N°(%)	Total N°(%)	Percentage
Age of pregnancy (In trimesters)	Trimester I	15(25.9)	43(74.1)	58	34.5
	Trimester II	20(25)	60(75)	80	47.6
	Trimester III	5(16.7)	25(83.3)	30	17.9
HIV stage	Stage I	25(23.8)	80(76.2)	105	62.5
	Stage II	15(23.8)	48(76.2)	63	37.5
UTI symptoms	YES	29(53.7)	25(46.3)	54	32.1
	NO	11(9.7)	103(90.3)	114	67.9
Self-medication/Antibiotic abuse	YES	12(25)	36(75)	48	28.6
	NO	28(23.3)	92(76.7)	120	71.4

In this study, a total of 168 HIV positive pregnant women were included. Among them, 32.1%(54/168) showed UTI symptoms; 47.6%(80/168) were in trimester II of pregnancy; 62.5%(105/168) were in HIV stage I, and lastly 28.6%(48/168) were practicing self – medication / antibiotic abuse (Table 1).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26feb1096

Table 2. Bacterial Profile of Gram-Negative and Gram-Positive Isolated from Urine

Isolates	Frequency (N=40)
S. aureus	4(10%)
CoNS	2(5%)
Staphylococcus saprophyticus	2(5%)
Escherichia coli	10(25%)
Klebsiella pneumonia	8(20%)
Proteus mirabilis	5(12.5%)
Pseudomonas aeruginosa	9(22.5%)

A total of 40 bacteria isolates were identified. The most frequent bacterium was *E. coli* which accounted for 25%(10/40) followed by *Pseudomons aeruginosa, Klebsiella pneumoniae,* and *Proteus mirabilis,* accounting for 22.5%(9/40), 20%(8/40), and 12.5%(5/40), respectively, among the Gram-negative pathogens. Gram-positive bacteria accounted for only 20%(8/40) of the bacterial isolates, of which 10%(4/40) of the isolates were *Staphylococcus aureus,* followed by *Staphylococcus saprophyticus* and coagulase negative staphylococci (CoNS) both at 5%(2/40) (Table 2).

Table 3. Relationship Between Antibiotic Resistance and Age of Pregnancy

			Age of pregnancy						Total				
			Trimester I		Trimester II		Trimester III				Logistic Regression		
ATBCs			Nt	R	Nt	R	Nt	R	Nt	R	OR	CI95%	p-value
	AMI	n	8	3	48.6	0	11	0	37	3	0.70	0.3-0.7	0.316
		%	21.6	8.1	18	0	29.8	0	100	8.1	-	-	-
	GEN	n	8	1	48.6	5	11	0	37	6	2.10	1.5-1.8	0.000
		%	21.6	2.7	18	13.5	29.8	0	100	12.2	-	-	-
	CIP	n	8	0	48.6	3	11	0	37	3	0.11	0.5-0.8	0.250
		%	21.6	0	18	8.1	29.8	0	100	8.1	-	-	-
	MEM	n	8	1	48.6	0	11	0	37	1	0,34	0.4-0.6	0.851
		%	21.6	2.7	18	0	29.8	0	100	2.7	-	-	-
	PPT	n	8	0	48.6	0	11	1	37	1	0.45	0.6-0.7	0.773
		%	21.6	0	18	0	29.8	2.7	100	2.7	-	-	-
	CPM	n	8	0	48.6	1	11	0	37	1	0.34	0.2-0.6	0.087
		%	21.6	0	18	2.7	29.8	0	100	2.7	-	-	-
	AMC	n	8	4	48.6	6	11	0	37	10	2.25	1.7-2.3	0.000
		%	21.6	10.8	18	12.2	29.8	0	100	27	-	-	-
	CTR	n	8	2	48.6	6	11	3	37	11	1.65	0.5-0.8	0.000
		%	21.6	5.4	18	12.2	29.8	8.1	100	29.7	-	-	-
	PEN	n	8	0	48.6	3	11	0	37	3	0.23	1.1-1.8	0.365
		%	21.6	0	18	8.1	29.8	0	100	8.1	-	-	-
	AMP	n	8	3	48.6	10	11	0	37	13	1.10	1.1-1.2	0.006
		%	21.6	8.1	18	2.7	29.8	0	100	35.1	-	-	-
	FUR	n	8	1	48.6	0	11	0	37	1	0.10	0.5-0.8	0.778
		%	21.6	2.7	18	0	29.8	0	100	2.7	-	-	-
	DA	n	8	1	48.6	0	11	0	37	1	0.75	0.4-0.6	0.455
		%	21.6	2.7	18	0	29.8	0	100	2.7	-	-	-
	AZI	n	8	3	48.6	0	11	0	37	3	0.45	0.6-0.7	0.565
		%	21.6	8.1	18	0	29.8	0	100	8.1	-	-	-
	CXT	n	8	1	48.6	0	11	0	37	1	0.25	0.2-0.6	0.986
		%	21.6	2.7	18	0	29.8	0	100	2.7	-	-	-
	VAN	n	8	0	48.6	1	11	0	37	1	0.95	0.4-0.9	0.886
		%	21.6	0	18	2.7	29.8	0	100	2.7	-	-	-
	TS/SXT	n	8	0	48.6	0	11	1	37	1	0.80	1.2-2.0	0.244
		%	21.6	0	18	0	29.8	2.7	100	2.7	-	-	-
	TET	N	8	1	48.6	0	11	0	37	1	0.55	0.1-0 .5	0.110
		%	21.6	2.7	18	0	29.8	0	100	2.7	-	-	-
	COT	N	8	0	48.6	0	11	0	37	0	0.25	1.5-1.8	0.235
		%	21.6	0	18	0	29.8	0	100	0	-	-	-

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	CHL	N	8	0	48.6	2	11	0	37	2	0.95	0.5-0.7	0.233
		%	21.6	0	18	5.4	29.8	0	100	5.4	-	-	-
	NO	N	8	0	48.6	0	11	0	37	0	0.65	0.2-0.3	0.980
		%	21.6	0	18	0	29.8	0	100	0	-	-	-
	ERY	N	8	0	48.6	1	11	2	37	3	1.01	1.2-1.5	0.020
		%	21.6	0	18	2.7	29.8	5.4	100	8.1	-	-	-
	AML	N	8	0	48.6	1	11	0	37	1	0.75	1.3-0.8	0.072
		%	21.6	0	48.6	2.7	29.8	0	100	2.7	-	-	-
	CTZ	N	8	1	18	1	11	0	37	2	0.25	0.4-0.7	0.345
		%	21.6	2.7	48.6	2.7	29.8	0	100	5.4	-	-	-

Keys: Nt, number of isolates tested against each antimicrobial agent; R, isolates resistance to antimicrobial agents. AMI-Amikacin, GEN-Gentamycin, CIP-Ciprofloxacin, MEM-Meropenem, PPT-Piperacillin/Tazobactam, CPM-Cefepime, AMC-Amoxicillin +Clavulanate, CTR-Ceftriaxone, PEN-Penicillin, AMP-Ampicillin, FUR-Nitrofurantoin, DA-Clindamycin, AZI-Azithromycin, CXT-Cefoxitin, VAN-Vancomycin, TS/SXT-Trimethoprim/Sulphamethoxazole, TET-Tetracycline, COT-Cotrimoxazole, CHL-Chloramphenicol, NO-Novobiocin, ERY-Erythromycin, CTZ-Ceftazidine, AML-Amoxicillin, (% within total).

Majority of study participants, 47.6%(80/168) were at their second trimester of pregnancy, of which 25%(20/80) of them having UTIs. While both Gram-negative and Gram-positive uropathogens displayed varying sensitivity to tested antibiotics within gestation periods, the regression revealed statistically significant variation for Gentamycin (OR: 2.10, IC: 1.5-1.8, p=0.000); Amoxicillin + Clavulanate (OR: 2.25, IC: 1.7-2.3, p=0.000); Ceftriaxone (OR: 1.65, IC: 0.5-0.8, p=0.000); Ampicillin (OR: 1.10, IC: 1.1-1.2, p=0.006); Erythromycin: (OR: 1.01, IC: 1.2-1.5, p=0.020) (Table 3.).

Table 4. Relationship Between Antibiotic Resistance and HIV Clinical Stages

			HIV clinical stages				**Total**				
			Stage I		**Stage II**				**Logistic Regression**		
ATBCs			**Nt**	**R**	**Nt**	**R**	**Nt**	**R**	**OR**	**CI95%**	**p-value**
	AMI	n	21	1	16	2	37	3	1.15	1.2-1.5	0.025
		%	56.8	2.7	43.2	5.4	100	8.1	-	-	-
	GEN	n	21	4	16	2	37	6	1.85	1.6-1.9	0.002
		%	56.8	10.8	43.2	5.4	100	12.2	-	-	-
	CIP	n	21	1	16	2	37	3	1.30	1.5-1.8	0.001
		%	56.8	2.7	43.2	5.4	100	8.1	-	-	-
	MEM	n	21	1	16	0	37	1	0.95	0.2-0.5	0.750
		%	56.8	2.7	43.2	0	100	2.7	-	-	-
	PPT	n	21	1	16	0	37	1	0.65	0.6-0.9	0.555
		%	56.8	2,7	43.2	0	100	2.7	-	-	-
	CPM	n	21	1	16	0	37	1	0.25	0.1-0.4	0.535
		%	56.8	2.7	43.2	0	100	2.7	-	-	-
	AMC	n	21	2	16	8	37	10	1.25	1.4-1.8	0.000
		%	56.8	5.4	43.2	21.6	100	27	-	-	-
	CTR	n	21	4	16	7	37	11	1.70	1.2-1.6	0.000
		%	56.8	10.8	43.2	18.9	100	29.7	-	-	-
	PEN	n	21	3	16	0	37	3	2.00	1.8-2.00	0,010
		%	56.8	8.1	43.2	0	100	8.1	-	-	-
	AMP	n	21	5	16	8	37	13	2.05	1.5-1.8	0.000
		%	56.8	13.5	43.2	0	100	35.1	-	-	-
	FUR	n	21	1	16	0	37	1	0.15	0.2-0.4	0.655
		%	56.8	2.7	43.2	0	100	2.7	-	-	-
	DA	n	21	1	16	0	37	1	0.05	0.1-0.5	0.425
		%	56.8	2.7	43.2	0	100	2.7	-	-	-
	AZI	n	21	3	16	0	37	3	1.80	1.5-1.8	0.020
		%	56.8	8.1	43.2	0	100	8.1	-	-	-
	CXT	n	21	1	16	0	37	1	0.55	0.5-0.7	0.245
		%	56.8	27	43.2	0	100	2.7	-	-	-
	VAN	N	21	1	16	0	37	1	0.35	0.1-0.5	0.096
		%	56.8	2.7	43.2	0	100	2.7	-	-	-

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26feb1096

	TS/SXT	N	21	1	16	0	37	1	0.05	0.3-0.8	0.110
		%	56.8	2.7	43.2	0	100	2.7	-	-	-
	TET	N	21	1	16	0	37	1	0.09	0.4-0.6	0.115
		%	56.8	2.7	43.2	0	100	2.7	-	-	-
	COT	N	21	0	16	0	37	0	0.65	0.2-0.4	0.292
		%	56.8	0	43.2	0	100	0	-	-	-
	CHL	N	21	0	16	2	37	2	0.35	0.6-0.9	0.993
		%	56.8	0	43.2	5.4	100	5.4	-	-	-
	NO	N	21	0	16	0	37	0	0.75	0.3-0.4	0,737
		%	56.8	0	43.2	0	100	0	-	-	-
	ERY	N	21	0	16	3	37	3	1.55	1.2-1.8	0.035
		%	56.8	0	43.2	8.1	100	8.1	-	-	-
	AML	N	21	1	16	0	37	1	0.56	0.1-0.6	0.925
		%	56.8	2.7	43.2	0	100	2.7	-	-	-
	CTZ	N	21	0	16	2	37	2	0.85	0.5-0.9	0.245
		%	56.8	0	43.2	5.4	100	5.4	-	-	-

Keys: Nt- number of isolates tested against each antimicrobial agent; R- isolates resistance to antimicrobial agents. AMI-Amikacin, GEN-Gentamycin, CIP-Ciprofloxacin, MEM-Meropenem, PPT-Piperacillin/Tazobactam, CPM-Cefepime, AMC-Amoxicillin + Clavulanate, CTR-Ceftriaxone, PEN-Penicillin, AMP-Ampicillin, DA-Clindamycin, AZI-Azithromycin, CXT-Cefoxitin, VAN-Vancomycin, TS/SXT-Trimethoprim/Sulfamethoxazole, TET-Tetracycline, COT-Cotrimoxazole, CHL-Chloramphenicol, NO-Novobiocin, ERY-Erythromycin, FUR-Nitrofurantoin, CTZ-Ceftazidine, AML-Amoxicillin, (% within total).

Most of the study participants, 62.5%(105/168) were at stage I of HIV, 23.8%(25/105) of them, having UTIs. While both Gram-negative and Gram-positive uropathogens displayed varying sensitivity to tested antibiotics within stages of HIV, the regression revealed statistically significant variation for Amikacin (OR : 1.15, IC : 1.2-1.5, p=0.025) ; Gentamycin (OR : 1.85, IC : 1.6-1.9, p=0.002) ; Ciprofloxacin (OR : 1.30, IC : 1.5-1.8, p=0.001) ; Amoxicillin + Clavulanate (OR : 1.25, IC : 1.4-1.8, p=0.000) ; Ceftriaxone (OR : 1.70, IC : 1.2-1.6, p=0.000) ; Penicillin (OR : 2.00, IC : 1.8-2.0, p=0.010) ; Ampicillin (OR : 2.05, IC : 1.5-1.8, p=0.000) ; Azithromycin (OR : 1.80, IC : 1.5-1.8, p=0.020) ; Erythromycin (OR : 1.55, IC : 1.2-1.8, p=0.035) (Table 4).

Table 5. Relationship Between Antibiotic Resistance Rates and Types of UTIs

			Types of Urinary Tract Infections				**Total**				
			Non – symptomatic		**Symptomatic**				**Logistic Regression**		
ATBCs			**Nt**	**R**	**Nt**	**R**	**Nt**	**R**	**OR**	**CI95%**	**p-value**
	AMI	n	17	2	20	1	37	3	0.75	0.3-0.4	0.737
		%	45.9	5.4	54.1	2.7	100	8.1	-	-	-
	GEN	n	17	2	20	4	37	6	0.55	1.2-1.8	0.015
		%	45.9	5.4	54.1	10.8	100	12.2	-	-	-
	CIP	n	17	2	20	1	37	3	0.56	0.1-0.6	0.925
		%	45.9	5.4	54.1	2.7	100	8.1	-	-	-
	MEM	n	17	0	20	1	37	1	0.85	0.5-0.9	0.245
		%	45.9	0	54.1	2.7	100	2.7	-	-	-
	PPT	n	17	0	20	1	37	1	0.75	0.3-0.4	0.737
		%	45.9	0	54.1	2.7	100	2.7	-	-	-
	CPM	n	17	0	20	1	37	1	0.25	0.1-0.4	0.535
		%	45.9	0	54.1	2.7	100	2.7	-	-	-
	AMC	n	17	8	20	2	37	10	1.10	1.3-1.5	0.000
		%	45.9	21.6	54.1	5.4	100	2.7	-	-	-
	CTR	n	17	7	20	4	37	11	0.05	0.3-0.8	0.110
		%	45.9	18.9	54.1	10.8	100	29.7	-	-	-
	PEN	n	17	0	20	3	37	3	0.09	0.4-0.6	0.115
		%	45.9	0	54.1	8.1	100	8.1	-	-	-
	AMP	n	17	8	20	5	37	13	1.05	1.2-1.8	0.000
		%	45.9	0	54.1	13.5	100	35.1	-	-	-
	FUR	n	17	0	20	1	37	1	0.15	0.2-0.4	0.655

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		%	45.9	0	54.1	2.7	100	2.7	-	-	-
	DA	n	17	0	20	1	37	1	0.05	0.1-0.5	0,425
		%	45.9	0	54.1	2.7	100	2.7	-	-	-
	AZI	n	17	0	20	3	37	3	0.70	1.2-1.6	0.400
		%	45.9	0	54.1	8.1	100	8.1	-	-	-
	CXT	n	17	0	20	1	37	1	0.10	0.8-0.2	0.255
		%	45.9	0	54.1	2.7	100	2.7	-	-	-
	VAN	N	17	0	20	1	37	1	0.75	0.3-0.4	0.737
		%	45.9	0	54.1	2.7	100	2.7	-	-	-
	TS/SXT	N	17	0	20	1	37	1	0.55	0.1-0.6	0.925
		%	45.9	0	54.1	2.7	100	2.7	-	-	-
	TET	N	17	0	20	1	37	1	1.55	1.2-1.8	0.035
		%	45.9	0	54.1	2.7	100	2.7	-	-	-
	COT	N	17	0	20	0	37	0	0.85	0.5-0.9	0.245
		%	45.9	0	54.1	0	100	0	-	-	-
	CHL	N	17	2	20	0	37	2	0.35	0.6-0.9	0.993
		%	45.9	5.4	54.1	0	100	5.4	-	-	-
	NO	N	17	0	20	0	37	0	0.60	0.2-0.7	0.065
		%	45.9	0	54.1	0	100	0	-	-	-
	ERY	N	17	3	20	0	37	3	1.50	1.6-1.8	0.000
		%	45.9	8.1	54.1	0	100	8.1	-	-	-
	AML	N	17	0	20	1	37	1	0.2	0.2-0.5	0.845
		%	45.9	0	54.1	2.7	100	2.7	-	-	-
	CTZ	N	17	1	20	1	37	2	0.7	0.4-0.6	0.945
		%	45.9	2.7	54.1	2.7	100	5.4	-	-	-

Keys: Nt, number of isolates tested against each antimicrobial agent; R, isolates resistance to antimicrobial agents. AMI-Amikacin, GEN-Gentamycin, CIP-Ciprofloxacin, MEM-Meropenem, PPT-Piperacillin/Tazobactam, CPM-Cefepime, AMC-Amoxicillin+Clavulanate, CTR-Ceftriaxone, PEN-Penicillin, AMP-Ampicillin, FUR-Nitrofurantoin, DA-Clindamycin, AZI-Azithromycin, CXT-Cefoxitin, VAN-Vancomycin, TS/SXT-Trimethoprim/Sulfamethoxazole, TET-Tetracycline, COT-Cotrimoxazole, CHL-chloramphenicol, NO-novobiocin, ERY-erythromycin, CTZ-Ceftazidine, AML-Amoxicillin, % within total (18) UTI positive patients.

From the 168 participants, 32.1%(54/168) showed UTI symptoms. Both Gram-negative and Gram-positive uropathogens isolated displayed varying sensitivity to tested antibiotics within the asymptomatic bacteriuria and symptomatic ones. The regression revealed statistically significant variation for Gentamycin (OR: 0.55, CI: 1.2-1.8, p=0.015); Amoxicillin + Clavulanate (OR: 1.10, CI: 1.3-1.5, p=0.000); Ampicillin (OR: 1.05, CI: 1.2-1.8, p=0.000); Tetracycline (OR: 1.55, CI: 1.2-1.8, p=0.035) and Erythromycin (OR: 1.50, CI: 1.6-1.8, p= .000) (Table 5).

IV. DISCUSSION

➢ *Clinical Characteristics of Study Participants*

In this study, results mentioned in table 1 are not consistent with a previous study on acute uncomplicated UTIs reporting 50% symptomatic cases [20]. While other studies have reported a 4–7% prevalence of bacteriuria in pregnancy [21], and typically associate more severe UTI symptoms with immunosuppressed patients in HIV stage III and first-trimester pregnancies [22], our findings indicate that most UTI cases occurred in patients in HIV stage I in second trimester. This variation may be due to differences in sample size, immune status, geographic setting, and socio-economic conditions.

➢ *Bacterial Profile of Gram-Negative and Gram Positive Isolated from Urine*

The Gram-negative bacterial isolates were respectively *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Proteus mirabilis*. Similar findings were reported in Ethiopia, confirming *E. coli* as the predominant uropathogen [8]. In the current study, most of the Gram-negative isolates were susceptible to Ceftriaxone. However, high resistance rates were observed against Tetracycline (84.4%), Trimethoprim-Sulfamethoxazole (81.3%), Ampicillin and Amoxicillin-Clavulanic acid (both 65.6%), Nitrofurantoin (62.5%), Ciprofloxacin and Ceftazidime (53.1%), Cefotaxime (46.9%), Gentamicin (43.8%), Amikacin (37.5%), and Ceftriaxone (28.1%). These findings are consistent with another study where urinary isolates showed high sensitivity to Ceftazidime (95%) and Ciprofloxacin (88%), while resistance to Sulfamethoxazole, Nitrofurantoin, and Ceftazidime was also noted [23]. Notably, resistance was especially high in *E. coli* and *K. pneumonia* strains, at 80% and 87.5%, respectively, for Tetracycline and Trimethoprim-Sulfamethoxazole [24].

For Gram-positive bacteria, *Staphylococcus aureus* was the most common isolate, accounting for 50%, followed by *Staphylococcus saprophyticus* and coagulase-negative staphylococci (CoNS), both at 25%. Among these isolates, 75% were susceptible to Erythromycin. Resistance was most commonly observed against Chloramphenicol and

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Tetracycline (62.5% each), followed by Penicillin, Cefotaxime, Ciprofloxacin, Trimethoprim-Sulfamethoxazole, and Cefoxitin (50% each), Nitrofurantoin (37.5%), Erythromycin (25%), and Clindamycin (12.5%). Notably, *S. aureus* demonstrated 100% sensitivity to Clindamycin, CoNS showed 100% sensitivity to Nitrofurantoin, and *S. saprophyticus* was 100% sensitive to Penicillin, Nitrofurantoin, Clindamycin, and Trimethoprim-Sulphamethoxazole. In line with us, in Northern Tanzania, Gram-positive bacteria were the most frequent isolates (67.6%), with high susceptibility to Nitrofurantoin (88.2%) and Gentamicin (69.2%), but high resistance to Ciprofloxacin (77.8%) [25]. The similarity in findings may be due to comparable clinical profiles of the study participants across these regions.

- *Relationship Between Antibiotic Resistance and Age of Pregnancy*

The majority of participants, 47.6%(80/168), were in second trimester of pregnancy, with 25% of them (20/80) diagnosed with UTIs. Gram-negative and Gram-positive uropathogens demonstrated varying antibiotic susceptibility across different gestational ages, statistical analysis revealed significant associations for several antibiotics (Table 3). The positive association between the second trimester and UTI occurrence was statistically significant (p=0.001). In contrast, a study conducted in Zambia found that women with UTIs had a lower gestational age than those without UTIs, with a mean difference of three weeks. Gestational age was independently associated with UTI (OR: 0.96, 95% CI: 0.91–0.99) [27]. Meanwhile, another recent study reported that being in the third trimester increased the risk of developing UTIs [28].

These findings align with an extensive study which showed a strong association between UTI occurrence and HIV infection in pregnant women. Most bacterial isolates in this study were susceptible to ciprofloxacin, ceftriaxone, gentamicin, nitrofurantoin, and norfloxacin, whereas resistance was high against ampicillin, tetracycline, and co-trimoxazole. The presence of multidrug-resistant bacteria was also notable [8]. The overall consistency of these findings may be attributed to the similar clinical profiles of the study participants, as immunosuppression in HIV-positive individuals increases susceptibility to UTIs.

- *Relationship Between Antibiotic Resistance and HIV Clinical Stages*

In the current study, the majority of participants, 62.5% (105/168), were classified as being in HIV stage I, with 23.8% (25/105) of them diagnosed with urinary tract infections (UTIs). Both Gram-negative and Gram-positive uropathogens demonstrated varying susceptibility to antibiotics across different stages of HIV. Logistic regression showed significant associations between HIV stage and resistance patterns for several antibiotics (Table 4). Additionally, when antibiotic susceptibility was analyzed according to gestational age, significant variation was also observed for Amikacin, Gentamicin, Piperacillin-Tazobactam, Amoxicillin-Clavulanate, Clindamycin, Cefoxitin, Trimethoprim/Sulfamethoxazole, Cotrimoxazole, and Chloramphenicol, with a positive association between antibiotic resistance and pregnancy trimester (p = 0.001).

These findings differ from those of a study conducted in Tanzania, where most Gram-positive bacterial isolates showed high sensitivity to Nitrofurantoin (88.2%) but exhibited notable resistance to Ciprofloxacin (77.8%) and Erythromycin (60%) [25, 27]. However, in agreement with the current study, that same Tanzanian study reported that most Gram-negative isolates were tested against Amoxicillin-Clavulanic acid, Ceftriaxone, Gentamicin, Trimethoprim-Sulfamethoxazole, and Nitrofurantoin, and showed high sensitivity to Amoxicillin-Clavulanic acid (100%), Ceftriaxone (91%), Gentamicin (80%), and Nitrofurantoin (66.7%), A significant association between antibiotic resistance and gestational age was also observed (p < 0.05) [25]. These differences and similarities in susceptibility patterns may be attributed to local distribution of resistant and sensitive bacterial strains, as well as the overuse and misuse of antibiotics.

- *Relationship Between Antibiotic Resistance Rates and Type of UTI*

Among the study participants diagnosed with UTIs, 53.7%(54/168) were symptomatic. Both Gram-negative and Gram-positive uropathogens isolated from symptomatic and asymptomatic individuals displayed varying levels of antibiotic susceptibility. Logistic regression revealed statistically significant associations between infection type and resistance to several antibiotics (Table 5). These results contrast with findings from a study done in Addis Ababa reporting high levels of resistance to Trimethoprim-Sulfamethoxazole (86.4%), Gentamicin (70.0%), and Ciprofloxacin (50.5%) [24]. The high levels of resistance observed in these settings may be attributed to the misuse and overuse of antibiotics, as well as poor infection control practices.

V. CONCLUSION

The highest levels of antibiotic resistance were recorded against Tetracycline and Trimethoprim-Sulfamethoxazole, particularly among *E. coli* (the most frequently isolated pathogen) and *K. pneumoniae* strains. Multidrug resistance (MDR) was most commonly observed in *E. coli, P. aeruginosa,* and *K. pneumoniae*. Notably, *S. aureus* demonstrated complete sensitivity to Clindamycin, while all coagulase-negative staphylococci (CoNS) were fully sensitive to Nitrofurantoin. Additionally, *Staphylococcus saprophyticus* showed hundred percent sensitivity to Penicillin, Nitrofurantoin, Clindamycin, and Trimethoprim-Sulfamethoxazole. The study revealed three key associations: a positive relationship between antibiotic resistance and gestational age, a significant association between resistance and HIV clinical stage, and also between antibiotic resistance and type of UTI. These findings support the need for tailored antibiotic therapy for HIV-positive pregnant women with UTIs, in order to safeguard both maternal and fetal health. To ensure effective treatment and minimize complications, it is recommended that HIV-positive pregnant women maintain strict adherence to Highly Active Antiretroviral Therapy

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(HAART), undergo routine UTI screening, and avoid self-medication.

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AUTHORS' CONTRIBUTIONS

- *Conceptualization and Project Administration:*
  Kambale Kisuba Jacques;

- *Methodology, Writing Original Draft Preparation Review and Final Editing*
  Kambale Kisuba Jacques, Guyah Bernard, Collins Ouma and Silas Awuor.

- *Consent for Publication*
  All participants have provided written informed consent for this project

- *Competing Interests*
  No competing interests were declared

REFERENCES

[1]. Aseel, M., Meer, F.A., Kuwari, M.A. and Ismail, M. Prevalence and Predictors of Asymptomatic Bacteriuria among Pregnant Women Attending Primary Health Care in Qatar. Qatar National Research Strategy, 2011, 1715. https://www.scirp.org/reference/referencespapers?referenceid=2234971, accessed on 4th December 2023.

[2]. CDC. Suffering from a urinary tract infection? Centers for Disease Control and Prevention. 2022. https://www.cdc.gov/antibiotic-use/uti.html, accessed on 4th December 2023.

[3]. Schnarr, J. and Smaill, F. Asymptomatic Bacteriuria and Symptomatic Urinary Tract Infections in Pregnancy. European Journal of Clinical Investigation; 2008. 38, 50-57.

[4]. Masinde, A., Gumodoka, B., Kilonzo, A. and Mshana, S.E. Prevalence of urinary Tract Infection among Pregnant Women at Bugando Medical Centre, Mwanza, Tanzania. Tanzania Journal of Health Research, 2009. 11, 154-159. https://doi.org/10.4314/thrb.v11i3.47704

[5]. Delzell John E., J., & Lefevre, M. L. Urinary Tract Infections During Pregnancy. American Family Physician, 2000. 61(3), 713–721

[6]. Gilbert, N.M., O'brien, V.P., Hultgren, S., Macones, G., Lewis, W.G. and Lewis, A.L. Urinary Tract Infection as a Preventable Cause of Pregnancy Complications: Opportunities, Challenges, and a Global Call to Action. Global Advances in Health and Medicine, 2013. 2, 59-69. https://doi.org/10.7453/gahmj.2013.061

[7]. Foxman, B. Epidemiology of urinary tract infections: Incidence, morbidity, and economic costs. The American Journal of Medicine, 2002. 113(1, Supplement 1), 5–13. https://doi.org/10.1016/S0002-9343(02)01054-9

[8]. Tessema, N. N., Ali, M. M., & Zenebe, M. H. Bacterial associated urinary tract infection, risk factors, and drug susceptibility profile among adult people living with HIV at Haswassa University Comprehensive Specialized Hospital, Hawassa, Southern Esthiopia. Scientific Reports, 2020. 10(1):1-9. https://doi.org/10.1038/s41598-020-67840-7

[9]. Dielubanza, E. J., & Schaeffer, A. J. Urinary tract infections in women. The Medical Clinics of North America, 2011. 95(1), 27–41. https://doi.org/10.1016/j.mcna.2010.08.023

[10]. WHO. Ten health issues WHO will tackle this year. 2019. https://www.who.int/news- room/spotlight/ten-threats-to-global-health-in-2019, accessed on 4th December 2023.

[11]. Reygaert, W. C. An overview of the antimicrobial resistance mechanisms of bacteria. AIMS Microbiology, 2018. 4(3), 482–501. https://doi.org/10.3934/microbiol.2018.3.482

[12]. Bigwan E, Wakjissa F. Prevalence of urinary tract infections among HIV patients attending a non-governmental health facility in Jos, Plateau State, Nigeria. International Journal of Biomedical and Advance Research.; 2013. 4(8):528–33.

[13]. Kenyan Ministry of Health. Kenya develops national policy to combat antimicrobial resistance – Ministry of Health. 2017. https://www.health.go.ke/kenya-develops-national- policy-to-combat-antimicrobial-resistance, accessed on 4th December 2023.

[14]. Murray PR, Rosenthal KS, Pfaller MA. Medical Microbiology E-book: Elsevier Health Sciences, 2020.

[15]. Pezzlo M. Laboratory diagnosis of urinary tract infections: guidelines, challenges, and innovations. Clinical Microbiology Newsletter; 2014. 36(12):87–93.

[16]. Bullock NO, Aslanzadeh J. Biochemical profile-based microbial identification systems. Advanced techniques in diagnostic microbiology: Springer; 2013. p. 87–121.

[17]. Iskandr K, Molinier L, Hallit S et al. Surveillance of antimicrobial resistance in low- and middle-income countries: a scattered picture. Antimicrob Resist Infect Control; 2021; 10: 63–82. https://doi.org/10.1186/s13756-021-00931-w

[18]. Clinical and Laboratory Standards Institute (CLSI). Performance Standards for Antimicrobial Susceptibility Testing. 29th ed. CLSI supplement, Pennsylvania, 19087, USA; 2024. M100, ISBN 978-1-68440-033-1

[19]. 19. Clinical and Laboratory Standard Institute. Performance standards for antimicrobial susceptibility testing; twenty first information supplement. 2020. https://clsi.org/media/3481/m100ed30_sample.pdf, accessed on 16th January 2024.

[20]. Bent S, Nallamothu BK, Simel DL, Fihn SD, Saint S. Does this woman have an acute uncomplicated urinary tract infection? Journal of the American Medical Association, 2002. 287(20): 2701-2710. PMID: 12020306: https://doi.org/10.1001/jama.287.20.2701

[21]. Amaya-Tapia G, Ibarra-Nieto G, Campollo Rivas O, Luis González Sánchez J. Urinary Tract Infection in HIV/AIDS Patients. Urinary Tract Infections - New Insights. Intech Open; Available from. 2023: http://dx.doi.org/10.5772/intechopen.110017

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26feb1096

[22]. Akinbami A, Bode-Shojobi I, Ajibola S, Oshinaike O, Adediran A, Ojelabi O, et al. Prevalence of asymptomatic bacteriuria in HIV infected patients in a tertiary Hospital in Lagos, Nigeria. World Journal of AIDS. 2013. 3(2):105-110. https://doi.org/10.4236/wja.2013.32014

[23]. Nwadioha S, Nwokedi E, Ikeh I, Egesie J, Kashibu E. Antibiotic susceptibility pattern of uropathogenic bacterial isolates from AIDS patients in a Nigerian tertiary hospital. J Med Med Sci; 2010. 1(11):530–40.

[24]. Teklu DS, Negeri AA, Legese MH, Bedada TL, Woldemariam HK, Tullu KD. Extended-spectrum beta-lactamase production and multi-drug resistance among Enterobacteriaceae isolated in Addis Ababa, Ethiopia. Antimicrobial Resistance & Infection Control. 2019;8(1):1–12. pmid:30815254

[25]. Ngowi BN, Sunguya B, Herman A, Chacha A, Maro E, Rugarabamu LF, Bartlett J, Balandya E, Mteta KA, Mmbaga BT. Prevalence of Multidrug Resistant UTI Among People Living with HIV in Northern Tanzania; 2021. Vol. 21:14 Pages 1623—1633, DOI https://doi.org/10.2147/IDR.S299776 accessed on 14th March 2025.

[26]. Marami D, Balakrishnan S, Seyoum B. Prevalence, Antimicrobial Susceptibility Pattern of Bacterial Isolates, and Associated Factors of Urinary Tract Infections among HIV-Positive Patients at Hiwot Fana Specialized University Hospital, Eastern Ethiopia. Canadian Journal of Infectious Diseases and Medical Microbiology. 2019; 2019. https://doi.org/10.1155/2019/6780354

[27]. Moses Mukosha, Lukundo Nambela, Chiluba Mwila, Micheal Chigunta, Aubrey Chichonyi Kalungia, Mwansa Ketty Lubeya, Bellington Vwalika. Urinary tract infections and associated factors in HIV infected pregnant women at a tertiary hospital in Lusaka, Zambia, Pan African Medical Journal. 2020; 37:328. https://doi.org/10.11604/pamj:2020.328.20245

[28]. Srija Voruganti, Saif Ali Khan, Prevalence and Risk Factors of Urinary Tract Infection in Pregnant Women: Systematic Review and Meta-Analysis; 2023. vol. 5, I. 6, 2582-2160; 1-14. https://doi.org/10.36948/ijfmr.2023.v05i06.9117, accessed on 10th March 2025.