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Evaluating the Bacteria Profile and Drug Susceptibility Patterns of Urinary Tract Infectious Pathogens in Pregnant Women in Abakaliki Metropolis, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors investigated the study, did literature searches and did data Validation and Visualization. All the authors reviewed and approved the final draft and are responsible for all aspects of the work.

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ABSTRACT

Patient's demographic data were obtained from a well-structured questionnaire administered before sample collection. A total of two hundred (200) early morning mid-stream urine samples were collected from pregnant women attending Mile 4 hospital to determine the prevalence of UTIs among pregnant women. The collected samples were analysis using Standard Microbiology protocol for isolation and identification of uropathogens. Antibiogram studies of uropathogens were determined using the Kirby–Bauer disk diffusion method and the results were analyzed and were compared with the Clinical Laboratory Standard Institute (CLSI) zone diameter breakpoints. Results of isolation and characterization revealed an overall occurrence rate of 68(34.0%) bacteria consisting of a high distribution of *E. coli* 27(13.5%) followed by *S. aureus* 22 (11.0%) and *Klebsiella pneumoniae* 19 (9.5%). Socio-demographic data of patients revealed that those aged 42-49 years had a high frequency of bacteria 7(70.0%) followed by those aged 34-41 years 50.0%, 18-25 years 31.1% while those aged 26-33 year had the least isolation rate of 26.3%. The occurrence of UTI was highly predominant among patients with no formal level of Education 24(64.9%) than those with formal level of education 17(26.9%). The result of antibiogram studies shows that the isolates exhibited a high percentage of resistance to colistin 100%, azetronam 100% clindamycin 100%, and tetracycline 77.3% but were 92.6%-100% susceptible to cefoxitin, imipenem and amikacin. However, with substantial evidence in this study, cefoxitin, imipenem, and amikacin as drugs of choice could be used for the treatment of UTI, and further studies should be conducted by using highly sensitive and specific techniques such as Polymerase Chain Reaction (PCR), which is the technique used to make numerous copies of a specific segment of the deoxyribonucleic acid quickly and accurately, including genotypic characterization of resistant determinant in bacteria causing UTI among pregnant patients in a larger sample size.

Keywords: Pregnant women; urinary tract infections; susceptibility; bacteria.

1. INTRODUCTION

Urinary Tract Infections (UTIs) is the invasion of any part of the urinary tract by microorganisms [1,2]. Urinary Tract Infections (UTIs) encompasses a wide variety of clinical entities whose common denominator is microbial invasion of any tissue of the tract from the renal cortex to the urethral meatus [2,3]. Any interference in the normal flow of urine will be the risk of UTI [4]. Urinary tract infections (UTIs) are among the most common bacterial infections leading patients to seek medical care [1,5]. The most prevalent community-acquired and hospital-acquired infections, affecting almost 50% of the population at least once in their lifetime with a high mortality rate is UTI [1,3]. It is mainly caused by Gram-negative pathogens such as *Escherichia coli*, *Proteus mirabilis*, *Klebsiella pneumoniae*, and *Enterobacter* species [2]. The symptoms of UTIs such as fever, burning sensations while urinating, lower Abdominal pain (LAP), itching, formation of blisters and ulcers in the genital area, genital and suprapubic pain, and pyuria generally depend on the age of the person infected and the location of the urinary tract infected [1,3]. Several factors such as gender, age, race, circumcision [2,5], HIV [6], diabetes, urinary catheter, genitourinary tract abnormalities [2,5], pregnancy, infants, elderly [2,5,7] and hospitalization status [8] bear significant risk for recurrent UTIs.

The prevalence of UTI is much more common in women than in men, at a ratio of 8:1, due to their anatomical and physiological reasons [2,9]. One in five adult women experiences UTI in her life [5,10,11]. Altered physiological, anatomical, hormonal changes, and challenges in personal hygiene during pregnancy, and other factors make the antenatal mother more prone to infection of the urinary tract than non-pregnant women [2,5]. This is a major health problem reported among 20% of pregnant women and a common cause of admission in obstetrical wards [1,2,3,5]. If the infection is left untreated, it results in low birth weight, fetus, intrauterine growth retardation, preterm labor, and premature babies, intrauterine fetal death, and increased prenatal mortality and morbidity as well as maternal complications including anemia, preeclampsia, renal failure, septicemia, and adult respiratory syndrome [2]. Treatment of UTI is often not started based on susceptibility tests [1,5]. The emergence of antibiotic resistance among urinary pathogens in Pregnant women has been increasing worldwide [2,5] and it becomes a serious global public health issue particularly in

the developing countries where a high level of poverty, ignorance, poor hygienic practices, high prevalence of fake and spurious drugs of questionable quality in circulation are the contributing factors. Since antimicrobial resistance varied regionally, it is necessary to know the distribution of urinary pathogens and their susceptibility to antibiotics in this setting (Mile 4 Hospital, Ishieke, Ebonyi State) that could support the most effective empirical treatment.

2. METHODS

2.1 Sample Collection and Demographic Data

The study was carried out at Mile 4 Hospital, Abakaliki, Ebonyi State, Nigeria. Mile 4 Hospital is the missionary Hospital of secondary level Health care equivalent and is located at 6^{o} 19'23.0^{o}N latitude and 8^{o}06'43.2" ^{o}E longitude in Azuiyi udene, Ishieke Ebonyi State.

The patient's population were made of pregnant women. The women were given instructions on how to collect a clean catch midstream urine sample. They were asked to clean the labia and area around the urethra with sterile water and urine collected with the labia held apart. They were bead iced to pass-out urine into the toilet pot for a few seconds, then collect a portion of the mid-stream urine before emptying their bladder into the toilet pot. A total of 200 early morning mid-stream urine from UTI pregnant women in Mile 4 Hospital were collected for bacteriological analysis.

The demographic and relevant clinical data was collected and recorded in a pretested interviewer well-structured administered questionnaire. Information related to age, Gestational age, Religion, History of UTI, Sexual activity during pregnancy, attendance to the clinic, Level of education, was collected from patients' follow up medical records. Every fundamental study was done in accordance with the ARRIVE guidelines.

2.2 Bacteriological Analyses of Urine Samples

A loopful of the turbid Brain heart infusion broth (Thermo Fisher Scientific Co., U. S. A) culture of the urine sample was streaked on solidified Cetrimide agar, MacConkey agar and Cysteine Lactose Electrolyte Deficient Agar (CLED) plate and Mannitol salt agar. All media were procured from Thermo Fisher Scientific Co., U. S. A. The plates were incubated for 18-24 hrs at 37 ^{o}C. Bacterial colonies with distinct characteristic on overnight incubation was presumptively identified and aseptically sub-cultured onto nutrient agar (Oxoid, UK). The sub-cultured plate was incubated at 37 ^{o}C for 24 hrs [12,13]. The pure culture strain were subsequently identified via Vitex 2 compact 60 next-generation automated system (BIOMERIEUX, U.S.A).

2.3 Antibiotic Susceptibility Testing

This was aseptically carried out using Kirby-Bauer disk diffusion method, and in conformity to the recommended standard of Clinical and Laboratory Standard Institute [14]. A suspension was made from a 24 hours growth of the test organisms in sterile water to match the 0.5 McFarland turbidity standard. This was seeded on the entire surface of solidified Mueller-Hinton agar plate. The following antibiotic discs with their potencies were used: amoxicillin/clavulanic acid (30 µg), aztreonam(30), ceftazidime (30 µg), ceftriaxone (30 µg),cefotaxime(30 µg), cefoxitin(30 µg), chloramphenicol (10 µg), colistin/sulphate(10), erythromycin (15 µg), imipenem (10 µg), tetracycline (30 µg), vancomycin (30 µg), ceftriaxone (30 µg), colistin(30 µg), piperacillin(30 µg), chloramphenicol (10 µg), lincomycin (20 µg), clindamycin (20 µg), oxacillin (10µg). The Mueller-Hinton agar (Sigma-Aldrich, U. S. A) Plates were incubated at (35^{o}C-37^{o}C) in an aerobic atmosphere for 18-24 hours, after percentage susceptibility and resistance was interpreted from the inhibition zone diameters (IZD) produced by the antibiotic disks against the test isolates [14,15].

3. RESULTS AND DISCUSSION

3.1 Results

Prevalence of UTI causing bacteria among pregnant women revealed overall occurrence rate of 68 (34.0%) consisting of high distribution of *E. coli* 27(13.5%) followed by *S. aureus* 22 (11.0%) and *Klebsiella pneumoniae* 19 (9.5%) as shown in Table 1.

In regards to socio-demographic data, patient's age 42-49years had high frequency of bacteria 7 (70.0%), followed by age 34-41 years 50.0%, 18-25 years 31.1% while age 26-33 year had the least isolation rate 26.3%. Incidence of UTI was common among divorced pregnant women and

accounted for 95.0% over widows 65.0%, those that never married 50.0% and married patients 16.2% as presented in Table 2.

The occurrence of UTI was highly predominant among patients with no formal level of Education 24 (64.9%) followed by those with Tertiary level of education 22 (53.7%), Primary level of education 17(26.9%) and Secondary level of education 5(8.5%). The distribution of Uropathogen was higher among student 17 (56.7%) over Business owners 33.8%, Self-employed 14 (28.0%) and Civil Servant 13(26.5%). Incidence of UTI was common among ₦41,000 and above monthly income earners 34 (51.5%) compare to less than ₦20,000 monthly income earners 14(33.3%), ₦31,000 - ₦40,000 13(29.5%) and ₦21,000 - ₦30,000 9(18.8%) as presented in Table 3.

The occurrence of UTI was highly predominant among patients from other religious group 11(91.6%) followed by Muslim 15(75.0%), and Christian 42(25.0%). The distribution of Uropathogen among patients that use Contraceptives was higher in group with other form of contraceptive use 10(50.0%) over condom users 34(30.9%), Pills 8(26.7%) and IUD 16(26.7%). Incidence of UTI was common among those who had sexual activity during pregnancy trimester at 6 month and above 38(38.8%) over 0-5 months 30 (29.4%). The occurrence of bacteria was predominant in gestational age of 0-3 months 29 (58.0%), over 7-9 months 22 (30.6%) and 4-6 months 17(21.85) as presented in Table 4.

Table 5 shows the antibiotic susceptibility profile of *E. coli. E. coli* were more susceptible to Imipenem 25 (92.6%), Amikacin 26 (96.3%) and Cefoxitin 27 (100%) but was resistant to Cefotaxime 27 (100%), Cefepime 27 (100%), Amoxicillin 27 (100%), Colistin 26 (96.3%), Aztreonam 25 (92.6%), Vancomycin 27 (100%), Erythromycin 27 (100%) and Clindamycin 27 (100%).

In Table 5, it displays the antibiotic susceptibility profile of *S. aureus* isolated from urine samples of pregnant women in ante – natal unit Mile Four Hospital, Abakaliki. *S. aureus* were more susceptible to Cefotaxime 22 (100%), Ceftriaxone 22 (100%), Imipenem 22 (100%), Amikacin 22 (100%), Cefepime 22 (100%), Oxacillin 22 (100%), Erythromycin 22 (100%) and Amoxicillin 20 (90.9%) but was resistant to Colistin 22 (100%), Aztreonam 22 (100%), Vancomycin 21 (95.5%) and Lincomycin 21 (95.5%).

Table 1. Prevalence of UTI causing bacteria among pregnant women

Clinical Sample	Uropathogens			Prevalence (%)
	***E. coli* (%)**	***K. pneumoniae* (%)**	***S. aureus* (%)**	
Total (n=200)	27(13.5)	19(9.5)	22(11.0)	**68(34.0**)

Table 2. Socio-demographic data of pregnant women according to age and marital status

Ages (years)	No. Sampled	*E. coli* (%)	*K. pneumoniae* (%)	*S. aureus* (%)	Prevalence (%)
18-25	61	8(13.1)	5(8.2)	6(9.8)	**19(31.1)**
26-33	95	12(12.6)	6(6.3)	7(7.4)	**25(26.3)**
34-41	34	5(14.7)	8(23.5)	4(11.8)	**17(50.0)**
42-49	10	2(20.0)	0(0.0)	5(50.0)	**7(70.0)**
Total	**200**	**27(13.5)**	**19(9.5)**	**22(11.0)**	**68(34.0)**
Marital Status					
Married	130	10(7.6)	4(3.1)	7(5.4)	**21(16.2)**
Never Married	30	4(13.3)	8(26.7)	3(10.0)	**15(50.0)**
Widow	20	6(30.0)	3(15.0)	4(20.0)	**13(65.0)**
Divorced	20	7(35.0)	4(20.0)	8(40.0)	**19(95.0)**
Total	**200**	**27(13.5)**	**19(9.5)**	**22(11.0)**	**68(34.0)**

Table 3. Socio-demographic data of pregnant women according to level of education, occupation and income

Level of Education	No. Sampled	*E. coli* (%)	*K. pneumoniae* (%)	*S. aureus* (%)	Prevalence (%)
No formal education	37	17(45.9)	5(13.5)	2(5.4)	**24(64.9)**
Primary	63	3(4.8)	3(4.8)	11(17.5)	**17(26.9)**
Secondary	59	1(1.7)	0(0.0)	4(6.8)	**5(8.5)**
Tertiary	41	6(14.6)	11(26.8)	5(12.2)	**22(53.7)**
Total	**200**	**27(13.5)**	**19(9.5)**	**22(11.0)**	**68(34.0)**
Occupation					
Civil Servant	49	4(8.2)	6(12.2)	3(6.1)	**13(26.5)**
Business owners	71	5(7.0)	10(14.1)	9(12.7)	**24(33.8)**
Self-employed	50	8(16.0)	3(6.0)	3(6.0)	**14(28.0)**
Student	30	10(33.3)	0(0.0)	7(23.3)	**17(56.7)**
	200	**27(13.5)**	**19(9.5)**	**22(11.0)**	**68(34.0)**
Income/Month					
Less than ₦20,000	42	9(21.4)	1(2.4)	2(4.8)	**14(33.3)**
₦21,000 - ₦30,000	48	2(4.2)	3(6.3)	4(8.3)	**9(18.8)**
₦31,000 - ₦40,000	44	5(11.4)	2(4.5)	6(13.6)	**13(29.5)**
₦41,000 and above	66	11(16.7)	13(19.7)	10(15.2)	**34(51.5)**
Total	**200**	**27(13.5)**	**19(9.5)**	**22(11.0)**	**68(34.0)**

Table 4. Socio-demographic data of pregnant women according to religious group, use of contraceptives, sexual activity during pregnancy and gestational age

Religious group	No. Sampled	*E. coli* (%)	*K. pneumoniae* (%)	*S. aureus* (%)	Prevalence (%)
Christian	168	19(11.3)	14(8.3)	9(5.4)	**42(25.0)**
Muslim	20	3(15.0)	5(25.0)	7(35.0)	**15(75.0)**
Others	12	5(41.7)	(0.0)	6(50.0)	**11(91.6)**
Total	**200**	**27(13.5)**	**19(9.5)**	**22(11.0)**	**68(34.0)**
Use of Contraceptives					
Condom	110	12(10.9)	9(8.2)	13(11.8)	**34(30.9)**
IUD	30	5(16.7)	(0.0)	3(10.0)	**8(26.7)**
Pills	60	8(13.3)	4(6.7)	4(6.7)	**16(26.7)**
Others	20	2(10.0)	6(30.0)	2(10.0)	**10(50.0)**
Total	**200**	**27(13.5)**	**19(9.5)**	**22(11.0)**	**68(34.0)**
Sexual activity during pregnancy					
0 – 5	102	12(11.8)	8(7.8)	10(9.8)	**30(29.4)**
6 and above	98	15(15.3)	11(11.2)	12(12.2)	**38(38.8)**
Total	**200**	**27(13.5)**	**19(9.5)**	**22(11.0)**	**68(34.0)**
Gestational Age (months)					
0-3	50	9(18.0)	13(26.0)	7(14.0)	**29(58.0)**
4-6	78	2(2.7)	4(5.1)	11(14.1)	**17(21.8)**
7-9	72	16(22.2)	2(2.8)	4(5.5)	**22(30.6)**
Total	**200**	**27(13.5)**	**19(9.5)**	**22(11.0)**	**68(34.0)**

Table 5. Antibiotic susceptibility profile of bacteria isolates collected from pregnant women in ante – natal unit

	E. coli (*n*=27)		*S. aureus* (*n*=21)		*K. pneumoniae* (*n*=19)	
Antibiotics (µg)	**R (%)**	**S (%)**	**R (%)**	**S (%)**	**R (%)**	**S (%)**
Cefotaxime (30)	27 (100)	0 (0.0)	0 (0.0)	22 (100)	18 (94.7)	1 (5.3)
Piperacillin (30)	15 (55.6)	12 (44.4)	7 (31.8)	12 (68.2)	9 (47.4)	10 (52.6)
Ceftriaxone (30)	17 (63.0)	10 (37.0)	0 (0.0)	22 (100)	11 (57.9)	8 (42.1)
Imipenem (10)	2 (7.4)	25 (92.6)	0 (0.0)	22 (100)	2 (10.5)	17 (89.5)
Tetracycline (30)	15 (55.6)	12 (44.4)	4 (18.2)	17 (77.3)	11 (57.9)	8 (42.1)
Amikacin (30)	1 (3.7)	26 (96.3)	0 (0.0)	22 (100)	1 (5.3)	18 (94.7)
Cefepime (30)	27 (100)	0 (0.0)	0 (0.0)	22 (100)	19 (100)	0 (0.0)
Amoxicillin (30)	27 (100)	0 (0.0)	2(9.1)	20 (90.9)	19 (100)	0 (0.0)
Colistin (10)	26 (96.3)	1 (3.7)	22 (100)	0 (0.0)	19 (100)	0 (0.0)
Aztreonam (30)	25 (92.6)	2 (7.4)	22 (100)	0 (0.0)	18 (94.7)	1 (5.3)
Cefoxitin (30)	0 (0.0)	27 (100)	3 (13.6)	19 (86.4)	0 (0.0)	19 (100)
Vancomycin (30)	27 (100)	0 (0.0)	21 (95.5)	1 (4.5)	19 (100)	0 (0.0)
Lincomycin (2)	9 (33.3)	18 (66.7)	21 (95.5)	1 (4.5)	6 (31.6)	13 (68.4)
Oxacillin (1)	20 (74.1)	7 (25.9)	0 (0.0)	22 (100)	17 (89.5)	2 (10.5)
Erythromycin (15)	27 (100)	0 (0.0)	0 (0.0)	22 (100)	19 (100)	0 (0.0)
Clindamycin (2)	27 (100)	0 (0.0)	3 (13.6)	18 (81.8)	19 (100)	0 (0.0)

Key: Resistance (R), Percentage (%), Susceptible (S), number of isolate (n)

The antibiotic susceptibility profile of *Klebsiella pneumoniae* isolated from urine samples of pregnant women in ante – natal unit Mile Four Hospital, Abakaliki. *Klebsiella* species were more susceptible to Amikacin 18 (94.7%), Cefoxitin 19 (100%), Imipenem 17 (89.5%) and Lincomycin 13 (68.4%) but was resistant to Cefepime 19 (100%), Amoxicillin 19 (100%), Colistin 19 (100%), Vancomycin 19 (100%), Erythromycin 19 (100%), Clindamycin 19 (100%), Aztreonam 18 (94.7%) and Cefotaxime 18 (94.7%) as shown in Table 5.

3.2 Discussion

Urinary tract infections (UTIs), which occur frequently in both hospital and community settings, are some of the most common bacterial infections. In this study, the prevalence of uropathogens accounted for 68(34.0%) among pregnant women. This observation were in tandem with the earlier studies where a prevalence rate of 37.3%, 38.6%, 35.5%, 38% and 40.0% were reported in India, Lagos, Algeria, Niger Delta and Jos [16,17,18,19] but disagree with earlier report which accounted for 45.7, 53.8, 65.4%, 79.9%, 90.1% and 97.3% [20,21,22,23,24]. The different in prevalence rates reported may be due to factors like number of sample and duration of study, deployment of diverse methodologies, sexual intercourse, studied group influence, low socio-economic status among Nigerian Women.

Among pregnant women, *E. coli* 13.5% was the most predominant bacteria and is in line with other studies in different parts of the world [25,26,27,28,29,30,31,32]. The high predominant rate of *E. coli* might be due to the high abundance of *E. coli* as fecal flora, which ascends through the genitalia to cause UTI [33]. In addition, it might be due to numerous virulence factors used for colonization and invasion of the urinary epithelium such as P-fimbriae or pili adherence factors, which mediate the attachment of *E. coli* to uroepithelial cells [34].

On the other hand, *S. aureus* 22(11.0%) was the second most common species identified in the present study whereas it was the most predominant one in a study conducted in Nigeria and third most common bacteria from a study in Ethopia [19, 35]. Gram-positive cocci play a lesser role in causing UTI, moreover, during pregnancy, it is usual for women to experience physical changes in the genital tract, which may increase the risk of colonization by Gram-positive bacteria [36,37].

Klebsiella pneumoniae the least uropathogen in this study are primarily responsible for catheter-associated UTIs in adults. However, their presence is suggestive of a history of previous UTI episodes [19,24,38]. Their unique structures such as flagella and pili, which help for their attachment to the uroepithelium are essential for increased risks of infection.

Pregnant women aged 42-49 year showed high occurrence of bacteria 70.0% and it mirrored the findings of the study in Ethiopia (20–29 years, 37.5%), Jaipur (21–50 years, 41.3%) and Meerut (26–36 years, 90.7%), as pregnancy makes them more vulnerable and prone to this disease [20,21,39].

Marital status of pregnant women revealed high bacteria profile among divorced 95.0% and widow 65.0%. This may indicate recurrent of complicated UTI, incontinence, and improper toilet habits may contribute to a higher rate of UTI among married female's pregnant women.

UTI uropathogen was common among those with 'No Formal Education' 24(64.9%), other studies in Ethopia, Abakaliki and United Arab Emirate have also reported illiteracy as a risk factor for UTIs [35,40,41]. Despite earlier report in the same settings by Alo and Saidu. [40] in Abakaliki, there is need for awareness of the risk of UTI developing acute pyelonephritis during labor, which can cause several adverse events in newborn such as preterm rupture of the membrane, chorioamnionitis, preterm birth, and neonatal sepsis [26,37,42].

Regarding occupation, pregnant Student accounted increase bacteria occurrence rate of 56.7% over other categories**.** This observation maybe linked to peer group influence, indiscriminate sexual behaviors and low socio-economic status, are common among most of the studied participant.

Those patients with high monthly income of ₦41, 000.00 and above harbored 51.5% of bacteria isolate. This observation hypothesizes the role of recurrent complicated UTIs among high income earners as they are able to afford different antibiotics indiscriminately, thus increase the risk of infection or treatment failure. Inadequate follow-up and study of these conditions can generate a high rate of antimicrobial resistance, which in developing countries is aggravated by limited access to therapeutic alternatives [37,43].

Sexual activity during 6 months and above of pregnancy 38(38.8%) was higher over 0 – 5months 29.4%. These findings postulate that increase in month or trimester of pregnancy increases the risk of UTI due to decrease in normal vaginal flora (*Lactobacilli*), less acidic P^H of vaginal surfaces, poor hygienic condition, short and wider urethra and proximity to the anus [1,19].

In recent years, there have been substantial changes in the susceptibility patterns of most urinary pathogens, *Klebsiella* species were resistant to Cefepime 19 (100%), Amoxicillin 19 (100%), Colistin 19 (100%), Vancomycin 19 (100%), Erythromycin 19 (100%), Clindamycin 19 (100%), Aztreonam 18 (94.7%) and Cefotaxime 18 (94.7%). It is a well-known fact that *Klebsiella* species are inherently resistant to; beta-lactams, cephalosporin and macrolide due to the increasing acquisition of resistant plasmid [19,44,45,46,47].

E. coli and *K. pneumoniae* resistant to colistin was commonly observed in this study and may depict the persistence of colistin resistant in this study area. Such trend could be linked to exposure to sublethal doses of colistin by the pregnant female counterpart as last-line antibiotic in treatment of recurrent or complicated enterobacteria infections.

The percentage of *E. coli* resistant obtained in our study to Aztreonam 92.6% agrees with the study by Al-Zahrani *et al*. [48] which showed a remarkable resistance of *E. coli* strains to Aztreonam (71.4%). This may be associated with the high prescribing rate of these antibiotics in the treatment of bacterial infections in Abakaliki.

S. aureus resistant was common with aztreonam 100%, vancomycin 95.5% and Lincomycin 95.5%. However, Lincomycin resistant substantiate or echoes with that of earlier studies [15,49,50,51] while similar vancomycin resistant agrees with existing literature [52,53]. It is clear that the evolution of *S. aureus* strain has been traced to the acquisition of the exogenous gene (*mec*A) which is part of the *Staphylococcal* cassette chromosome *mec*A (SCCmec) (types I–VII) and is under the control of *Mec*I (a repressor) and *Mec*R1 (a transducer) and represent the regulatory/signalling proteins of the *blaZ* system [15]. The *mec A* gene codes for additional penicillin-binding protein (PBP2a), a peptidoglycan transpeptidase, which can confer resistance to all *β*-lactam and other antibiotics class as evidence in this current study.

The increase rate of resistant in bacteria from UTI patients toward β-lactam antibiotics, other antibiotic classes like: aminoglycosides, macrolides, Glycopeptide, flouroquinolones and lincosamide might be a reflection of inappropriate use of antimicrobials, lack of laboratory diagnostic tests, and lack of guidelines for the selection of antibiotics. The data obtained from this research was found to be similar to the study

conducted by other researchers [15,35]. The susceptibility profiles of uropathogen demonstrate the high efficacy of cefoxitin, imipenem and amikacin, which has an *in vitro* susceptibility ranged of 92.6% to 100% showing that these three antibiotic drugs are totally viable as a therapeutic alternative for UTIs. The easy, uncontrolled access to this effective antibiotic at local pharmacies, as well as the widespread failure to complete the treatment cycle, often due to the low income of the population and the sale of medication on a single-dose basis could pose a serious problem of antibiotic resistance to the use of this drugs if not monitored.

5. CONCLUSION

Based on these findings*, E. coli, S. aureus*, and *K. pneumoniae* were isolated from the urine samples of the pregnant women. However, with substantial evidence in this study, cefoxitin, imipenem and amikacin as drugs of choice could be used for treatment of UTI. The main factor fueling resistance is improper usage of antibiotics that needs to be checked. Every pregnant women should be screened for UTI and if find positive appropriate treatment should be applied. UTI patients should not be neglected and follow up studies are required to supplement the present finding for appropriate management of urinary tract bacteria in patients. Further studies should be conducted by using highly sensitive and specific techniques such as PCR, including genotypic characterization in resistant determinant in bacteria causing UTI among pregnant patients in a larger sample size. Resistance to bacterial uropathogens is becoming a public health issue due to lack of appropriate microbiological laboratories, leading to fewer microbiological assessments and increased empirical antibiotic use. Typically, urine samples are sent for microbiological testing only after treatment failure, recurrent or relapsing infection. These findings emphasize the significance of local antibiotic resistance patterns, which may subsequently be used to develop hospital and regional antibiotic policies. To avoid/contain the emergence of antibiotic resistance in bacteria, the government must introduce laws requiring the prudent us of these antibiotics.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Nomeh OL, Chukwu EB, Ogba RC, Akpu PO, Peter IU, Nwuzo AC, Iroha IR. Prevalence and antibiogram Profile of carbapenem-resistant *Escherichia coli and Klebsiella pneumoniae* among Patients with Urinary Tract Infection in Abakaliki, Nigeria. Int J Pathogen Res. 2022;11(3): 14-28.
2. Ejerssa AW, Gadisa DA, Orjino TA. Prevalence of bacterial uropathogens and their antimicrobial susceptibility patterns among pregnant women in Eastern Ethiopia: Hospital-based cross-sectional study. BMC Women's Health. 2021; 21:291-231.
3. Nomeh LO, Federica OI, Joseph OV, Moneth EC, Ogba RC, Nkechi OA, Peter IU, Akpu PO, Edemekong CI, Iroha IR. Detection of carbapenemase-producing *Escherichia coli* and *Klebsiella pneumoniae* implicated in urinary tract infection. Asian J Res Infectious Dis. 2023;2 (1):15-23.
4. Razzaque SA, Aziz Q, Hassan SF, SharmeenNaz MS, Maheshwary N, Wajid Z, Anwar A. A cross sectional study highlighting the sensitivity patterns and incidence of extended spectrum beta lactamase producing *Klebsiella oxytoca* in Patients with Urinary Tract Infection. Int J Pul Infect Dis. 2017;1(1):1-5.
5. Ngong, I N, Fru-Cho J, Yung M A, Akoachere, J K T. Prevalence, antimicrobial susceptibility pattern and associated risk factors for urinary tract infections in pregnant women attending ANC in some integrated health centers in the buea health district. BMC Preg Childbirth. 2021; 21:673-674
6. Banu A, Jyothi R. Asymptomatic bacteriuria in HIV positive individuals in a tertiary care hospital. J HIV and Human Reproduction. 2013;1(2):54-60
7. Nelson J M, Good E. Urinary tract infections and asymptomatic bacteriuria in

older adults. Nurse Practitioner. 2015; 40(8):43–48.
8. Adukauskiene D, Cicinskaite I, Vitkauskiene A, Macas A, Tamosiunas R, Kinderyte A. Hospital Acquired Urinary Tract Infections. J Medicinia. 2006; 45(12):957–964.
9. Shirishkumar P, Taviad PP, Mala S, Javadekar T B, Chaudhari VP. Urinary Tract Infections among Patients (UTI) among patients at GG Hospital and Medical College, Jamnagar. Nat J Comm Med. 2012;3(1):138–41
10. Okonko IO, Ijandipe LA, Ilusanya OA. Incidence of Urinary Tract Infection (UTI) among Pregnant Women in Ibadan, South-Western Nigeria. African J Biotech. 2009; 8(23):6649–57.
11. Behzadi P, Behzadi E, Yazdanbod H. A survey on urinary tract infection associated with two most common uropathogenic bacteria. Med J Clinical Med. 2010;5(1):111–5.
12. Iroha IR, Orji JO, Onwa NC, Nwuzo AC, Okonkwo EC, Ibiam EO, Nwachi AC, Afuikwa FN, Agah VM, Ejikeugwu EPC, Agumah NB, Moses IB, Ugbo E, Ukpai EG, Nwakaeze E A, Oke B, Ogbu L and Nwunna E. Microbiology practical handbook. (Editor; Ogbu. O), 1st Edition. Charlieteximage Africa (CiAfrica Press). 2019;344.
13. Uzoije UN, Moses IB, Nwakaeze EA, Uzoeto HO, Otu JO, Egbuna NR, Ngwu JN, Chukwunwejim CR, Mohammed DI, Peter IU, Oke B, Iroha IR. Prevalence of multidrug-resistant bacteria isolates in waste water from different hospital environment in Umuahia, Nigeria Int. J. Pharm. Sci. Rev. Res. 2021;69(2):25-32.
14. Clinical and Laboratory Standards Institute (CLSI). Performance standards for antimicrobial susceptibility testing; twenty-eighth edition (M100). Wayne, PA: Clinical and Laboratory Standards Institute; 2019.
15. Peter IU, Okolo IO, Uzoeto HO, Edemekong CI, Thompson MD, Chukwu EB, Mohammed, ID, Ubom, IJ, Joseph, OV, Nwuzo, AC, Akpu PO, Iroha, IR. Identification and antibiotic resistance profile of biofilm-forming methicillin resistant staphylococcus aureus (MRSA) causing infection among orthopedic wound patients. Asian J Res Med Pharm Sci. 2022;11(4): 45-55.
16. Ait-Mimoune N, Hassaine H, Boulanoir M. Bacteriological profile of urinary tract infections and antibiotic susceptibility of *Escherichia coli* in Algeria. Iranian J Microbiol. 2022;14(2):156-160
17. Ebie MY, Kandakai-Olukemi YT, Ayanbadejo J, Tanyigna KB.Urinary tract infection in a Nigerian military Hospital. Nigerian J Microbiol. 2001;15:31-37.
18. Kemebradikumo P, Oluwatoyosi O, Onyaye EK. Antimicrobial susceptibility pattern of microorganisms associated with urinary tract infection in the Niger Delta Region of Nigeria. Afri J Microbiol Res.2012;23:4976-4982
19. Anejo-Okopi JA, Okojokwu OJ, Ramyi SM, Bakwet P B, Okechalu J, Agada G, Bassi PA, Adeniyi SD. Bacterial and antibiotic susceptibility pattern of urinary tract infection isolated from asymptomatic and symptomatic diabetic patients attending Tertiary Hospital in Jos, Nigeria. Trends Med. 2017;10:15-761.
20. Seifu WD, Gebissa AD. Prevalence and antibiotic susceptibility of uropathogens from cases of urinary tract infections (UTI) in Shashemene Referral Hospital, Ethiopia. BMC Infectious Dis. 2018;18:30-45.
21. Prakash D, Saxena RS. Distribution and antimicrobial susceptibility pattern of bacterial pathogens causing urinary tract infection in urban community of Meerut city, India. ISRN Microbiol. 2013;74:96-29.
22. Critchley IA, Cotroneo N, Pucci MJ, Mendes R. The burden of antimicrobial resistance among urinary tract isolates of *Escherichia coli* in the United States in 2017. PLOS. 2019;14:220-265.
23. Patel HB, Soni ST, Bhagyalaxmi A, Patel NM. Causative agents of urinary tract infections and their antimicrobial susceptibility patterns at a referral center in Western India: An audit to help clinicians prevent antibiotic misuse. J Fam Med Prim health Care. 2019;8:154–159.
24. Bhargava K, Nath G, Bhargava A, Kumari R, Aseri GK, Jain N. Bacterial profile and antibiotic susceptibility pattern of uropathogens causing urinary tract infection in the eastern part of Northern India. Front Microbiol. 2022;13:965-053.
25. Odoki M, Almustapha AA, Tibyangye J, Nyabayo MJ, Wampande E, Drago Kato C. Prevalence of bacterial urinary tract infections and associated factors among patients attending Hospitals in Bushenyi District, Uganda. Int J Microbiol. 2019;19: 4246780.

26. Alemu A, Moges F, Shiferaw Y, Tafess K, Kassu A, Anagaw B, Agegn A. Bacterial profile and drug susceptibility pattern of urinary tract infection in pregnant women at University of Gondar Teaching Hospital, Northwest Ethiopia. BMC Research Notes. 2012;5:1-97.
27. Chen HE, Tain YL, Kuo HC, Hsu CN. Trends in antimicrobial susceptibility of *Escherichia coli* isolates in a taiwanese child cohort with urinary tract infections between 2004 and 2018. Antibiotics. 2020;9:501-502.
28. Daoud N, Hamdoun M, Hannachi H, Gharsallah C, Mallekh W, Bahri O. Antimicrobial susceptibility patterns of *Escherichia coli* among tunisian outpatients with community-acquired urinary tract infection (2012- 2018). Current Urol. 2020;14:200–205.
29. Ali AH, Reda DY, Ormago MD. Prevalence and antimicrobial susceptibility pattern of urinary tract infection among pregnant women attending Hargeisa Group Hospital, Hargeisa, Somali land. Sci Report. 2022;12:1419.
30. Huang L, Huang C, Yan Y, Sun L, Li H. Urinary tract infection etiological profiles and antibiotic resistance patterns varied among different age categories: A retrospective study from a tertiary general hospital during a 12-year period. Front Microbiol. 2022;12:813145.
31. Jagadeesan S, Tripathi BK, Patel P, Muthathal S. Urinary tract infection and diabetes mellitus—Etio-clinical profile and antibiogram: A North Indian perspective. J Fam Med Prim health Care. 2022;11:1902–1906.
32. Komagamine J, Yabuki T, Noritomi D, Okabe T. Prevalence of and factors associated with atypical presentation in bacteremic urinary tract infection. Sci Report. 2022;12:5197.
33. Wiles TJ, Kulesus RR, Mulvey M A. Origins and virulence mechanisms of uropathogenic *Escherichia coli*. Exp Mol Pathol. 2008;85 (1):11–19.
34. Mulvey MA. Adhesion and Entry of Uropathogenic *Escherichia coli*. *Cell Microbiol.* 2002;4(5):257–271.
35. Alemu M, Belete MA, Gebreselassie S, Belay A, Gebretsadik D. Bacterial profiles and their associated factors of urinary tract infection and detection of extended spectrum beta-lactamase producing gram-negative uropathogens among patients with diabetes mellitus at Dessie Referral Hospital, Northeastern Ethiopia. Diab, Meta Synd Obesity: Targets Ther. 2020;13 2935–2948.
36. Omulo S, Thumbi SM, Njenga MK, Call DR. A review of 40 years of enteric antimicrobial resistance research in Eastern Africa: What can be done better?. Antimicrob. Resist Infect Cont. 2015;4:1-23.
37. Carrasco Calzada F, Aguilera-Correa J J, Cuadros González J, Esteban Moreno J, Roca Biosca D, Pérez-Tanoira R. Urinary tract infection and antimicrobial susceptibility of bacterial isolates in Saint Joseph Kitgum Hospital, Kitgum, Uganda. Antibiotics, 2022;11:67-504.
38. Fenta A, Dagnew M, Eshetie S, Belachew T. Bacterial profile, antibiotic susceptibility pattern and associated risk factors of urinary tract infection among clinically suspected children attending at felege-hiwot comprehensive and specialized hospital, Northwest Ethiopia. A Prospective Study. BMC Infectious Dis. 2020;20:20: 673.
39. Sood S, Gupta R. Antibiotic resistance pattern of community acquired uropathogens at a Tertiary Care Hospital in Jaipur, Rajasthan. Indian J Comm Med. 2012;37:39–44.
40. Alo M, Saidu A. Prevalence and antbiogram of bacterial isolates causing urinary tract infections at Federal Teaching Hospital Abakaliki I (FETHA I). Microbiol Res J. 2015;12:403–417.
41. Mubarak AA, Ashraf AM, El-hag M. Prevalence of urinary tract infections among diabetes mellitus and non-diabetic patients attending a Teaching Hospital in Ajman, UAE. Gulf Medical J. 2012;1(1): 228–232.
42. Guglietta A. Recurrent urinary tract infections in women: Risk factors, etiology, pathogenesis and prophylaxis. Future Microbiol. 2017;12:239–246
43. Kiguba R, Karamagi C, Bird SM. Extensive antibiotic prescription rate among hospitalized patients in Uganda: But with frequent missed-dose days. J Antimicrob Agent Chemother. 2016; 71:1697–1706.
44. Yang J, Ye L, Guo L, Zhao Q, Chen R, Luo Y. A Nosocomial Outbreak of KPC-2-producing *Klebsiella pneumoniae* in a Chinese Hospital: Dissemination of ST11 and Emergence of ST37, ST392 and

ST395. J Clin Microbiol Infect Dis. 2013; 19:509–515.
45. Di Mento G, Cuscino N, Carcione C, Cardinale F, Conaldi PG, Douradinha B. Emergence of a *Klebsiella pneumoniae* ST392 clone Harbouring KPC-3 in an Italian Transplantation Hospital. J Hos Infect. 2018 98:313–314.
46. García-Morúa A, Hernández-Torres A, Salazar-de-Hoyos JL, Jaime-Dávila R, Gómez-Guerra LS. Community-acquired urinary tract infection etiology and antibiotic resistance in a Mexican Population Group. Rev Mexican De Urol. 2009;69:45–48.
47. Sakkas H, Bozidis P, Ilia A, Mpekoulis G, Papadopoulou C. Antimicrobial resistance in bacterial pathogens and detection of carbapenemases in *Klebsiella pneumoniae* Isolates from Hospital Wastewater. J Microb Drug Resist. 2019;8:85-90
48. Al-Zahrani J, Al Dossari K, Gabr AH, Ahmed AF, Al Shahrani SA, Al-Ghamdi S. Antimicrobial resistance patterns of Uropathogens Isolated from Adult Women with Acute Uncomplicated Cystitis. BMC Microbiol. 2019;19:237-239.
49. Garoy E Y, Gebreab Y B, Achila OO, Tekeste DG, Kesete R, Ghirmay R, Kiflay R, Tesfu T. Methicillin-resistant *Staphylococcus aureus* (MRSA): Prevalence and antimicrobial sensitivity pattern among patients: A multicenter study in Asmara, Eritrea. Can J Infect Dis Med Microbiol. 2019;12:45-89.
50. Ghanem S, Bahashwan SA, El Shafey HM, Fayed AA, Alhhazmi A, Manzoor N. Antimicrobial resistance pattern of MRSA strains isolated from patients of a hospital in Madinah, Kingdom of Saudi Arabia. Afri J Microbiol Res. 2018;12(47):1044-1049
51. Seni J, Bwanga F, Najjuka C F, Makobore P, Okee M. Molecular Characterization of *Staphylococcus aureus* from Patients with Surgical Site Infections at Mulago Hospital in Kampala, Uganda. PLOS. 2013;8(6):66-153.
52. Chelkeba L, Melaku T. Epidemiology of *Staphylococci* Species and their antimicrobial-resistance among patients with wound infection in Ethiopia: A Systematic review and meta-analysis. J Glob Antimicrob Resist. 2021;23:34-78.
53. Tania N, Shamsuzzaman SM, Islam A. Antimicrobial resistance and quorum sensing genes detection among the biofilm forming *Staphylococcus aureus* isolated from admitted patients of Dhaka Medical College Hospital, Dhaka, Bangladesh. Fort J Health Sci. 2021;4(3):441-455.

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