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Prevalence and Susceptibility of Urinary Tract Infections' Bacteria in Catheterized Patients to Commonly Used Antibiotics

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Abstract

This study aimed to isolate bacterial uropathogens from catheterized patients and determine the antibiotics susceptibility patterns of the isolates. Urine samples were collected from 219 catheterized patients and analyzed following standard microbiological methods. Antibiotics susceptibility test was performed on the isolated and identified organisms using the disk diffusion method. A 73.1% of the patients had Catheterized Urinary Tract Infections (CAUTI) and *Escherichia coli* was the most common organisms accounting for 53.7% of the isolates followed by *Pseudomonas aeruginosa* (11.9%), *Klebsiella pneumonia* (11.3%), *Proteus mirabilis* (8.1%), *Staphylococcus aureus* (8.1%) and Enterococcus faecalis (6.9%). The prevalence of urinary tract infectious agents was higher in males (75%) and age group of 56-65 was observed to have the highest prevalence of UTI (21.9%). The antibiogram of *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia* and *Proteus mirabilis* showed that they were sensitive to Netillin (76.9%) and Levofloxacin (76.9%) while showing varying resistances to Amoxyclav (94.7%), Ceftriaxone (94.7%), Ofloxacin (73.7%), Tetracycline (88.9%) and Cotrimoxazole (100%). *Staphylococcus aureus* were resistant to Amoxyclav (100%), Cloxacillin (92.3%) and Cotrimoxazole (84.6%) while *Enterococcus faecalis* were resistant to Cloxacillin (90.9%), Amoxyclav (81.8%) and Cotrimoxazole (72.7%). A large percentage (83.7%) of the isolates had MAR Index > than the critical value of 0.2.

Keywords: *Susceptibility, Antibiotics, Urinary tract infections, Catheterized patients*

1. Introduction

Urinary tract infection is the presence of bacteria or other microorganisms like fungi, parasite in significant number that causes pathologic effect in the urinary tract with or without clinical symptoms (Charles, 2015).

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Catheter-related urinary tract infection (UTI) occurs because urethral catheters inoculate organisms into the bladder and promote colonization by providing a surface for bacterial adhesion and causing mucosal irritation (Vergidis and Patel, 2012). Pathogenic bacteria which are the predominant cause of Urinary tract infection are one of the most common and serious infectious agents which affects all age groups of people including men, women and children worldwide. In hospitals and community settings, UTI emerges as a major cause of morbidity and mortality. It causes many urinary tract disorders as urosepsis, renal scarring and progressive kidney damage that lead to a serious health risk with high morbidity, mortality and economic loss (Aschalew, 2011). Due to the continuous emergence of antibiotic resistance, urinary tract infection is a serious public health issue, particularly in the developing world where apart from high level of poverty, ignorance and poor hygienic practices, there is also a high prevalence of fake and substandard drugs of questionable quality in circulation (Iyad, 2008; Saleh *et al.*, 2009; and Orji *et al.*, 2022). Urinary tract infection (UTI) is considered one of the most common bacterial infections in humans in both community and hospital settings and affects both males and females of all ages. The cumulative incidence rate in children reaches 10%. In adults, almost half of all women experience at least one episode of UTI sometime in their lives (WHO, 2002). The term urinary tract infection describes a variety of conditions relating to the parts of the urinary tract in which microorganisms are present in significant quantities. It is defined as the microbial invasion and subsequent multiplication on a part or the entire urinary tract. The urinary tract consists of the urethra, prostate gland, urinary bladder, ureters, kidneys and seminal vesicles in males (Sadiq *et al.*, 2006; and Alex *et al.*, 2012). Urinary tract infections are mostly caused by retrograde ascent of bacteria of the faecal flora via the urethra to the bladder and kidney especially in the females who have a shorter and wider urethra. The structure of the female's urethra and vagina makes it susceptible to trauma during sexual intercourse as well as bacteria been massaged up the urethra and into the bladder during pregnancy and or child birth (Kolawole *et al.*, 2009; and Johnson *et al.*, 2021). In Nigeria the leading causes of acute and uncomplicated nosocomial UTIs in patients have been reported to be due to *Escherichia coli, Staphylococcus aureus, Proteus* spp, *Klebsiella* spp, *Pseudomonas aeruginosa, and* coagulase-negative staphylococci (Ehinmidu, 2003; and Jombo *et al.*, 2006). This study therefore aimed to determine the prevalence of bacterial uropathogens and their susceptibility profiles in catheterized patients attending hospitals in Sokoto, North-west Nigeria.

2. Materials and Methods

2.1. Sample Size Determination

For this study, the prevalence value 17.2% = 0.172 (Zarb *et al.*, 2012) was used to calculate sample size using the formula stated by Naing *et al.* (2006).

$$n = \frac{Z^2 pq}{d^2}$$

Where;

n = Number of samples (sample size)

Z = Standard normal deviate at 95% confidence interval = 1.96

p = Prevalence from initial studies = 17.2% = 0.172 (Zarb *et al.*, 2012)

d = degree of confidence at = 0.05

q = 1-p = 1 - 0.172 = 0.828

$$n = \frac{1.96^2 \times 0.172 \times 0.828}{0.05^2} = \frac{3.8416 \times 0.142416}{0.0025} = 218.8 \approx 219$$

2.2. Ethical Consideration

Ethical approval was obtained from the research ethical committees of the selected Hospitals, in Sokoto metropolis. For each participant whose specimen is to be included, an informed consent following explanation of the research process in detail was obtained.

2.3. Sample Collection

Catheterized Urine sample was collected through the draining portal of the urinary catheter using aseptic technique into a sterile container. Approximately 15 ml of catheterized urine sample was collected aseptically in a sterile container. Each sample in the container was properly labeled with patient's ID number. The specimens were then transported to the laboratory of Medical Microbiology Department, School of Medical Laboratory Science, Usmanu Danfodiyo University, Sokoto for analyses.

2.4. Sample Analyses

Following collection, the catheterized urine samples were examined immediately after arrival at the Laboratory of Medical Microbiology Department, School of Medical Laboratory Science, Usmanu Danfodiyo University, Sokoto.

2.5. Macroscopy

The urine samples were examined macroscopically for: colour, turbidity, blood tinge and odour.

2.6. Microscopy

This was carried out on the suspension deposit after the centrifugation by wet preparation method.

2.7. Wet Preparation

A 10 ml of urine sample was placed in a centrifuge tube. It was centrifuged in a centrifuge at 3000 rpm for 5 min. The supernatant was discarded. The deposit was placed on a grease free glass slide. The deposit was covered with a coverslip, air bubbles and over floating were avoided. It was examined on a microscope using 10X and 40X objectives respectively. For the presence of pus cells, red blood cells, casts, crystals, bacteria, epithelial cells, white blood cells and yeast cells (Cheesbrough, 2006).

2.8. Culture

Following collection, urine samples were inoculated onto CLED agar plates for the isolation of bacteria before centrifugation. The inoculated agar plates were incubated aerobically for 24 hours at 37 °Cusing the method described by Cheesbrough (2006).

2.9. Preliminary Identification

Presumptive identification of the bacteria in the urine samples was based on standard identification procedures of colony morphology, colonial characteristics on differential media and biochemical reactions of the organisms using the method described by Elmer *et al.* (1997).

2.10. Cultural Characterization

Cultural characterization of the isolates was based on their morphological and growth characteristics on differential media. Growth from samples with positive bacteriuria was sub-cultured onto selective media such as Mannitol Salt Agar for preliminary detection of *Staphylococcus* species (Cheesbrough, 2006).

2.11. Gram Staining

Gram staining technique was used to differentiate between gram positive and gram negative bacteria. This was carried out by making smears of the bacterial isolates on slides. It was allowed to air dry, heat-fixed and then covered with crystal violet solution for 30-60 seconds, and then washed with water. The smears were covered with Lugols iodine solution for 30-60 seconds, then drained and decolourized with acetone for 30-60 seconds. This was immediately washed with water, covered with neutral red stain for 1 minute, rewashed with water and air-dried. The slides were then viewed under the microscope (100X magnification) to observe the shapes of the cells (Cheesbrough, 2006).

2.12. Biochemical Tests

Biochemical tests were performed on colonies from primary cultures for final identification of the presumptive

bacterial isolates. Tests such as catalase, oxidase, urease, coagulase, sugar fermentation, Indole, and Citrate tests were carried out as described by Cheesbrough (2006).

2.13. Oxidase Test

This was carried out on Gram negative.

A piece of filter paper was place on a cleaned Petri dish and 2 or 3 drops of freshly prepared oxidase reagent (1% Tetramethyl paraphenylene diamine dihydrochloride) was added. A sterilized piece of stick (not wire loop) was use to pick some colonies of the test organism which was emulsify onto the filter paper.

2.14. Antibiotic Susceptibility Testing

Susceptibility testing was performed on isolates based on the agar disc diffusion technique developed by Bauer *et al.* (1966) on Muller-Hinton agar. The antibiotics used were obtained from Oxoid limited, Basingstoke, UK in the following concentrations: Ceftriaxone (30 µg), Gentamicin (10 µg), Levofloxacin (5 µg), Netillin (30 µg), Ofloxacin (5 µg), Co-Trimoxazole (25 µg) Tetracycline (30 µg), Amoxyclav (30 µg), Cefalexin (10 µg), Ciprofloxacin (5 µg), Clindamycin (2 µg), Cloxacillin (1 µg), and Erythromycin (15 µg).

2.15. Preparation of Barium Sulphate Standard (McFarland 0.5)

One percent (v/v %) solution of sulphuric acid was prepared by adding 1 ml of concentrated sulphuric acid to 99 ml of water. One percent (w/v%) solution of barium chloride was then prepared by dissolving 0.5 g of dihydrate barium chloride ($BaCl_2.2H_2O$) in 50 ml of distilled water. A 0.6 ml of the barium chloride solution was added to 99.4 ml of the sulphuric acid solution and mixed. Small volume of the turbid solution was then transferred to a screw cap bottle of the same types as used for preparing the test and control inoculum (Cheesbrough, 2000).

2.16. Inoculum Preparation

The inoculum was prepared by picking 3-5 discreet colonies of the test organism with a sterile wire loop. This was suspended in a sterile peptone water and incubated at 37 °Cfor about two hours to allow organisms reach their log phase in growth. This was then diluted to match the turbidity standard (McFarland 0.5) which contains approximately$1.5x10^8$ CFU/ml (McFarland, 1907).

2.17. Performing the Disk Diffusion Test

In 15 minutes after the bacterial inoculum was prepared by suspending the freshly isolated bacteria in 5 ml sterile nutrient broth and adjusted to 0.5 MacFarland standard, a sterile cotton swab was used to streak the surface of Mueller-Hinton agar (MHA) plates. After the agar surface has dried, the appropriate antibiotic disks were placed on it with a sterilized forceps at reasonable equidistance, on the seeded MHA. Inoculated plates were incubated at 37 °C for 24 hours. On the next day, plates were read by taking measurement of zone of inhibition. The diameter of the zone of inhibition produced by each antibiotic disk was measured using metric ruler and recorded in millimeter (CLSI, 2016). The result was interpreted as either susceptible (S), intermediate (I) or resistant (R) to the antibiotic agent used, depending on the diameter of zone of inhibition produced as defined by CLSI (2016) standard zone size interpretive manual.

2.18. Statistical Analysis

The data was collected and analyzed using SPSS for windows, version 23.0. Chi square (X^2) test was utilized to assess significant difference. A difference was taken as significant at a p-value < 0.05.

3. Results and Discussion

A total of 219 catheterized urine samples were collected from both Male and Female patients attending some hospitals in Sokoto metropolis. Out of the 219 samples analyzed, 160(73.3%) of them developed CAUTI while 59(26.7%) of them were found to be negative. In this study, 73.1% prevalence of bacterial isolates associated with CAUTIs was reported with the highest prevalence observed in *Escherichia coli* 86(53.7%), followed by *Pseudomonas aeruginosa* 19(11.9%), *Klebsiella pneumonia* 18(11.3%), *Proteus mirabilis* 13(8.1%), *Staphylococcus*

aureus 13(8.1%) and *Enterococcus faecalis* 11(6.9%), as shown in Table 1. The high rate of prevalence in this study may be due to factors such as prolonged catheterization, diabetes mellitus, older age, female sex, rapidly fatal underlying diseases, nonsurgical diseases, faulty aseptic management of the indwelling catheter, periurethral colonization with uropathogens, bacterial colonization of drainage bag or not receiving system antibiotic therapy. Therefore, proper maintenance and care of catheter is required to reduce the incidence of CAUTI (Sabir *et al.*, 2014). The finding in this study is in line with the findings by Kulkarni *et al.* (2014) who reported 21.47% prevalence, and indicates that *Escherichia coli* was the commonest isolate (47.36%), followed by *Klebsiella pneumoniae* (19.2%), *Pseudomonas aeruginosa* (14.10%), *Staphylococcus aureus* (3.5%) and *Enterococcus faecalis* (5.2%). It also corroborates the findings of Orji *et al.* (2022) and Vicar *et al.* (2023).

Table 1: Distribution of Bacterial Isolates Associated with CAUTIs

Organisms	No. Isolated	Prevalence (%)
Escherichia coli	86	53.7
Pseudomonas aeruginosa	19	11.9
Klebsiella pneumonia	18	11.3
Proteus mirabilis	13	8.1
Staphylococcus aureus	13	8.1
Enterococcus faecalis	11	6.9
Total	**160**	**100.0**

Table 2 shows the prevalence of bacterial isolates associated with CAUTIs in relation to gender. In this study, occurrence of UTI is more among male patients (75%) compared to the female patients (71.9%). This high rate of prevalence among male were likely associated with some factors such as patients with other active sites of infection or a major preexisting chronic condition (such as diabetes, malnutrition, or renal insufficiency). Prolonged catheterization, inserting the catheter outside the operating room or late in hospitalization, presence of a ureteral stent, or using the catheter to measure urine output further increase the risk (Platt *et al.*, 1986; and Maki *et al.*, 2000). The result of this study is in line with the findings of Dawa *et al.* (2014) which also indicates that the occurrence of UTI is more among male patients (26.3%) compared to the female patients (19.3%). This is also in line with the study conducted by Kulkarni *et al.* (2014) which indicates that the occurrence of CAUTI was more in male patients compared to female patients and male predominance (males 68.18% compared to females 31.81%) was noted in CAUTI cases, although the association was not found to be significant. In contrast, previous studies by Alavaren *et al.* (2008) and Elpern *et al.* (2009) found that the risk of developing UTI in women exceeds that of men. It is also against the result of this study that they say, Males are less prone to UTIs possibly because of their longer urethra and the presence of antimicrobial substances in prostatic fluid (Adedeji and Abdulkadir, 2009; Farajnia *et al.*, 2009; and Oluremi *et al.*, 2011).

Table 2: Prevalence of Bacterial Isolates Associated with CAUTIs in Relation to Gender

Gender	No. of Samples Examined	No. of Positive Samples	Prevalence (%)
Male	84	63	75
Female	135	97	71.9
Total	**219**	**160**	**73.1**

Table 3 shows the prevalence of bacterial isolates associated with CAUTIs in relation to age. The age group 56-65 had the highest prevalence (21.9%) while age group 86-95 had the least prevalence (0.6%). This higher rate of prevalence among elderly persons is likely associated with some factors such as poor nutrition, immobility leading to poor hygiene, chronic illnesses, and increased stress on the body and strain on the body's defense mechanisms. Pathological factors such as prostatic hypertrophy and degenerative nerves which can cause urine stasis predisposes people to urinary tract infection (Dewit, 2005). This finding is in line with the findings by Alavaren *et al.* (2008), which indicates that the incidence of UTI increases with age among catheterized patients, and then concluded that age is a significant risk factor for the development of UTI among catheterized patients with older people being more susceptible than younger people.

Table 3: Prevalence of Bacterial Isolates Associated with CAUTIs in Relation to Age Group

Age Group	No. of Samples Examined	No. of Positive Samples	Prevalence (%)
5-15	16	11	6.9
16-25	46	28	17.5
26-35	42	29	18.1
36-45	25	17	10.6
46-55	26	19	11.9
56-65	39	35	21.9
66-75	18	16	10
76-85	6	4	2.5
86-95	1	1	0.6
Total	**219**	**160**	**100**

The result of susceptibility test of *Staphylococcus aureus* indicates that 92.3% of *Staphylococcus aureus* were sensitive to Ciprofloxacin, 69.2% to Erythromycin, 53.8% to Clindamycin and Cefalexin while the organism was 100% resistant to Amoxyclav with varying resistances to other antibiotics (Table 4).

Table 4: Susceptibility Profile of the Isolated *Staphylococcus aureus*. n = 13

Antibiotics	No. Sensitive (%)	No. Moderate (%)	No. Resistant (%)
Cotrimoxazole	1(7.7)	1(7.7)	11(84.6)
Tetracycline	3(23.1)	4(30.8)	6(46.2)
Amoxyclav	0(0.0)	0(0.0)	13(100)
Cefalexin	7(53.8)	2(15.4)	4(30.8)
Ciprofloxacin	12(92.3)	1(7.7)	0(0.0)
Clindamycin	7(53.8)	4(30.8)	2(15.4)
Cloxacillin	0(0.0)	1(7.7)	12(92.3)
Erythromycin	9(69.2)	2(15.4)	2(15.4)

Note: n = Total number of isolates, % = Percent.

In Table 5 the result of susceptibility test of *Enterococcus faecalis* indicates that 72.7% of *Enterococcus faecalis* were sensitive to Ciprofloxacin, 63.6% to Clindamycin and 54.5% to Erythromycin while the organisms were 90.9%, 81.8% and 72.7% resistant to Cloxacillin, Amoxyclav and Cotrimoxazole respectively. It is possible that the high resistant to Amoxyclav, Cloxacillin, Ceftriaxone, Ofloxacin, Tetracycline and Cotrimoxazole observed in this study could be due to the widespread use of these antibiotics and their use for a long period of time in the community and hospital settings which may have enhanced development of resistance.

Table 5: Susceptibility Profile of the Isolated *Enterococcus faecalis*. n = 11

Antibiotics	No. Sensitive (%)	No. Moderate (%)	No. Resistant (%)
Cotrimoxazole	2(18.2)	1(9.1)	8(72.7)
Tetracycline	1(9.1)	5(45.5)	5(45.5)
Amoxyclav	0(0.0)	2(18.2)	9(81.8)
Cefalexin	5(45.5)	3(27.3)	3(27.3)
Ciprofloxacin	8(72.7)	0(0.0)	3(27.3)
Clindamycin	7(63.6)	3(27.3)	1(9.1)
Cloxacillin	0(0.0)	1(9.1)	10(90.9)
Erythromycin	6(54.5)	2(18.2)	3(27.3)

Note: n = Total number of isolates, % **=** Percent.

Table 6 shows the susceptibility test's result for *Escherichia coli* indicating that 73.3% of the organisms were sensitive to Netillin and resistant to Cotrimoxazole, Amoxyclav, Ceftriaxone and Tetracycline at 81.4%, 81.4%, 73.3% and 68.6% respectively.

Table 6: Susceptibility Profile of the Isolated *Escherichia coli*. n = 86

Antibiotics	No. Sensitive (%)	No. Moderate (%)	No. Resistant (%)
Ceftriaxone	20(23.3)	3(3.5)	63(73.3)
Gentamycin	30(34.9)	12(14.0)	44(51.2)
Levofloxacin	37(43.0)	5(5.8)	44(51.2)
Netillin	63(73.3)	2(2.3)	21(24.4)
Ofloxacin	37(43.0)	2(2.3)	47(54.7)
Cotrimoxazole	13(15.1)	3(3.5)	70(81.4)
Tetracycline	14(16.3)	13(15.1)	59(68.6)
Amoxyclav	8(9.3)	8(9.3)	70(81.4)

Note: n = Total number of isolates, % = Percent.

For *Pseudomonas aeruginosa* in Table 7, the susceptibility test shows sensitivity of these organisms to Netillin and Levofloxacin at 63.2% and 57.9% respectively with resistance percentages of 100%, 94.7% and 94.7% to Cotrimoxazole, Ceftriaxone and Amoxyclav respectively.

Table 7: Susceptibility Profile of the Isolated *Pseudomonas aeruginosa*. n = 19

Antibiotics	No. Sensitive (%)	No. Moderate (%)	No. Resistant (%)
Ceftriaxone	1(5.3)	0(0.0)	18(94.7)
Gentamycin	8(42.1)	1(5.3)	10(52.6)
Levofloxacin	11(57.9)	0(0.0))	8(42.1)
Netillin	12(63.2)	1(5.3)	6(31.6)
Ofloxacin	5(26.3)	0(0.0)	14(73.7)
Cotrimoxazole	0(0.0)	0(0.0)	19(100)
Tetracycline	0(0.0)	3(15.8)	16(84.2)
Amoxyclav	0(0.0)	1(5.3)	18(94.7)

Note: n = Total number of isolates, % = Percent.

Table 8 shows susceptibility test's result for *Klebsiella pneumoniae* indicating that 66.7% of the organisms were sensitive to Netillin while resistant to Amoxyclav, Cotrimoxazole, Tetracycline and Ceftriaxone at 94.4%, 88.9%, 88.9% and 83.3% respectively.

Table 8: Susceptibility Profile of the Isolated *Klebsiella pneumoniae*. n = 18

Antibiotics	No. Sensitive (%)	No. Moderate (%)	No. Resistant (%)
Ceftriaxone	3(16.7)	0(0.0)	15(83.3)
Gentamycin	7(38.9)	2(11.1)	9(50.0)
Levofloxacin	6(33.3)	3(16.7)	9(50.0)
Netillin	12(66.7)	2(11.1)	4(22.2)
Ofloxacin	6(33.3)	0(0.0)	12(66.7)
Cotrimoxazole	1(5.6)	1(5.6)	16(88.9)
Tetracycline	1(5.6)	1(5.6)	16(88.9)
Amoxyclav	0(0.0)	1(5.6)	17(94.4)

Note: n = Total number of isolates, % = Percent.

In the case of *Proteus mirabilis* as shown on Table 9, the susceptibility test's result recorded sensitivity of the organisms to Netillin, Levofloxacin and Gentamycin at 76.9%, 76.9% and 69.2% respectively while the organisms were resistant to Amoxyclav, Cotrimoxazole, Tetracycline and Ceftriaxone at 92.3%, 92.3%, 76.9% and 76.9% respectively. Generally, the susceptibility profiles of isolated organisms indicate that the organisms were sensitive to Netillin and Levofloxacin and resistant to Amoxyclav, Ofloxacin, Ceftriaxone, Tetracycline and Cotrimoxazole. The higher level of susceptibility to Netillin, Levofloxacin, Ciprofloxacin, Clindamycin and Erythromycin could be due to their restricted use in the clinical practice. There are many factors that may have contributed to the decreased sensitivity of uropathogens to many of these antimicrobial agents. They range from the use of antimicrobial agents as prophylactic in the presence of bacteriuria in patients, antibiotic use in animal feeds and under dosing of antibiotics. Resistance could also occur in the community as a result of clustering and overcrowding, widespread use of broad-spectrum antibiotics, the sale of antibiotics over the counter, self-treatment with antibiotics, the inappropriate use of antibiotics and decreased funding for public

health surveillance (Amyes, 2000). The result of this finding agrees with results obtained in Zaria by Sadiq *et al.* (2006) in a study that evaluated the level of drug utility in UTI patients in Zaria. They established that Gentamicin, Ampicillin/Cloxacillin, Cotrimoxazole, Amoxicillin/Clavulanate and ciprofloxacin were the most commonly utilized antibiotics in the hospital. A previous study carried out in the same environment also established Ciprofloxacin and Gentamicin as the most effective drugs whereas Penicillin, Amikacin and Amoxicillin were ineffective (Ehinmidu, 2003). While the finding in this study that Cotrimoxazole, Ofloxacin, Tetracycline and Ceftriaxone are not very effective against a high proportion of the isolates, the observations by Jombo *et al*. (2005, 2006 and 2011) and Nwadioha *et al*. (2010) seems to contradict this finding.

Table 9: Susceptibility Profile of the Isolated *Proteus mirabilis*. n = 13

Antibiotics	No. Sensitive (%)	No. Moderate (%)	No. Resistant (%)
Ceftriaxone	1(7.7)	2(15.4)	10(76.9)
Gentamycin	9(69.2)	1(7.7)	3(23.1)
Levofloxacin	10(76.9)	0(0.0)	3(23.1)
Netillin	10(76.9)	1(7.7)	2(15.4)
Ofloxacin	6(46.2)	0(0.0)	7(53.8)
Cotrimoxazole	1(7.7)	0(0.0)	12(92.3)
Tetracycline	0(0.0)	3(23.1)	10(76.9)
Amoxyclav	0(0.0)	1(7.7)	12(92.3)

Note: n = Total number of isolates, % = Percent.

Table 10 shows the Multiple Antibiotic Resistance Indices (MARI) of all the isolated organisms. Isolates with MAR Index < 0.2 were 26(16.25%) while isolates with MAR Index > 0.2 were 134(83.75%). The higher percentage of MAR Index > 0.2 in this study might be due to inappropriate use of antibiotics in these

Table 10: Multiple Antibiotic Resistance Indices (MARI) of all the Isolated Organisms

Mari	A	B	C	D	E	F	Total(%)
0.0	2	0	0	0	0	0	2(1.3)
0.1	3	0	0	0	0	1	4(2.5)
0.2	7	1	2	2	3	5	20(12.5)
0.3	3	0	1	0	0	0	4(2.5)
0.4	11	1	1	2	6	2	23(14.4)
0.5	15	3	2	2	2	0	24(15.0)
0.6	16	5	7	5	2	2	37(23.1)
0.8	7	1	2	1	0	0	11(6.9)
0.9	4	2	1	1	0	0	8(5.0)
1.0	18	6	2	0	0	1	27(16.9)

Note: A: Escherichia coli, B: Pseudomonas aeruginosa, C: Klebsiella pneumoniae, D: Proteus mirabilis, E: Staphylococcus aureus and F: Enterococcus faecalis.

environments. This result is in accordance with that of Krumperman (1983) where he reported multiple-antibiotic-resistant *E. coli* organisms existing in large numbers within the major reservoirs of enteric diseases for humans while existing in comparatively low numbers elsewhere.

4. Conclusion

The prevalence of cathe-ter-associated UTIs in this study population was 73.3% and caused mostly by *Escherichia coli*, *Pseudomonas aeruginosa, Klebsiella pneumoniae, Proteus mirabilis, Staphylococcus aureus* and *Enterococcus faecalis* respectively. These bacteria showed resistance to several antibiotics (such as Amoxyclav, Cloxacillin, Ceftriaxone, Ofloxacin, Tetracycline and Cotrimoxazole) while sensitive to some antibiotics (such as Netillin, Levofloxacin, Ciprofloxacin, Clindamycin and Erythromycin). The empirical use of commonly used antibiotics without culture is majorly responsible for antibiotic-resistant phenomenon and the more reason why this should be strongly discouraged.

Conflicts of Interest

No conflicts of interest are declared by the authors.

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