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PREVALENCE AND MICROBIAL DYNAMICS OF URINARY TRACT INFECTION IN A TERTIARY HOSPITAL IN CALABAR, CROSS RIVER STATE

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ABSTRACT

Urinary tract infections (UTIs) are common bacterial infections that occur both in the community and healthcare setting. This study surveyed the prevalence, distribution and antibiogram profile of uropathogens isolated from UTIs among in- and out- patients attending General hospital, Calabar by determining the total count bacterial counts of the patients, the distribution of significant bacteriuria according to age groups (5 – 20, 21 – 35, 36 – 50, 51 – 65 years), prevalence rate of UTI according to sex, the etiological agents and their antibiotic susceptibility pattern. A total of 200 freshly voided midstream urine samples were collected into sterile plastic screw capped universal containers and transported to the laboratory for analysis. All positive samples with pyuria were aseptically cultured by standard methods on sterile Cystine Lactose Electrolyte Deficient (CLED) agar and MacConkey agar plates and incubated appropriately. Results showed that of the 200 samples screened, 49% were sterile, 32% were insignificant ($<10^5$ cfu/ml) while 19% had significant bacteriuria. Of the 115 females, 27 (23.5%) came up with positive cultures while 11 (12.9%) of the 85 males were positive. The highest rate of infection was recorded in the age group 21 – 35 and the least was recorded in patients in the age group 51 – 65. There was significant difference in the distribution of significant bacteriuria according to age groups at $P < 0.05$. A total of 85 bacterial species was isolated in this study with *Escherichia coli* (30.6%) being the commonest etiologic agent followed by, *Klebsiella pneumoniae* (17.6%), *Proteus mirabilis* (14.1%), coagulase negative Staphylococci (11.8%), *Pseudomonas* (9.4%), *Staphylococcus aureus* (9.4%) and *Enterococcus faecalis* (7.1%). The findings of this study recorded a prevalence rate of 19% with females being more at risk. The most effective antibiotic for treating *E. coli* and other

uropathogens in this study were Ciprofloxacin and Ofloxacin. Regular monitoring is necessary to establish reliable information about susceptibility pattern of urinary pathogens for optimal empirical therapy for patients with UTI. It is therefore recommended that antibiotic selection for treatment of UTI should be based on local etiology of UTI and antibiogram rather than on global guidelines.

INTRODUCTION

Urinary tract infections (UTIs) are among the common bacterial infections in humans that occur both in the community and healthcare setting (Tabibian *et al*., 2008). UTIs accounts for about 35% of nosocomial infections and it is the second most common cause of bacteremia in hospitalized patients (Kolawole *et al*., 2009). Urinary tract infection is the microbial infiltration of the otherwise sterile urinary tract (Barber *et al*., 2013). The pathogenic invasion of the urinary tract leads to an inflammatory response of the uroepithelium (Swetha *et al*., 2014). UTIs are usually categorized as cystitis (infection of the lower urinary tract or bladder), pyelonephritis (infection of the upper urinary tract or kidneys) and prostatitis (inflammation of the prostate) (Barber *et al*., 2013; Swetha *et al*., 2014).

The risk factors of UTI includes sexual activity, urethral instrumentation, diabetes mellitus, sickle cell disease, pregnancy, use of contraceptives, low vagina estrogen levels, anatomic or functional urinary tract abnormality, individual genetic background (Nicolle, 2008; Dielubanza and Schaeffer, 2011; Komala and Kumar, 2013).

UTI occur among different age groups irrespective of sex, although sexually active young women are at greater risk of the infection as a result of short urethral anatomy and other behavioural factors (Soto, 2014). According to Ebie *et al*. (2001), the moist environment of the females favours microbial growth and predisposes the female bladder to bacterial contamination and it has been reported that urine of females have more suitable pH and osmotic pressure for the growth of *Escherichia coli* than urine from males (Obiogbolu *et al*., 2009; Antai and Anozie, 1987). The etiologic agents of UTIs are gram-negative and gram-positive bacteria as well as certain fungi (Flores-Mireles *et al*., 2015). The gram negative bacteria include *Escherichia coli*, *Klebsiella* spp., *Proteus* spp., & *Pseudomonas* spp. with *E. coli* causing about 60 – 90% of the infections (Cheesebrough, 2002). The gram positive bacterial pathogens frequently isolated include *Staphylococcus aureus*, *Staphylococcus epidermidis* and *Enterococcus* spp. formerly known as *Streptococcus faecalis* (Kashef *et al*., 2010). UTIs caused by *Pseudomonas* spp., *Proteus* spp., *Klebsiella* spp. and *Staphylococcus*

aureus are associated with nosocomial infections often following catherization or gynaecological surgery (Nicolle, 2008; Antai, 1987).

UTI is diagnosed by urine microscopy to determine the presence of red blood cells, white blood cells and bacteria by urine culture showing the presence of $\geq 10^5$ colony forming units of bacteria in 1ml of a clean – catch midstream urine sample is termed significant bacteriuria (Nicolle, 2008).

The etiologic agents of UTIs vary in regions and geographical locations. Knowledge of the local etiology patterns is therefore necessary to trace any change that might have occurred overtime (Kibret and Abera, 2014). Although there is much awareness on UTI and its severe health implications, the incidence of UTIs among males and females of different age groups is on the increase. This study is therefore aimed at investigating the occurrence of UTIs among males and females of different age groups and also to determine the etiological agents and their antibiotic sensitivity pattern in order to ascertain appropriate antibiotic treatment therapy.

MATERIALS AND METHODS

Study population

Urine samples were collected from a total of two hundred (200) patients between the ages of 5 and 75 years during the period of November 2017 to January 2018. Samples were grouped according to age in the order of 5 – 20, 21 – 35, 36 – 50, 51 – 65 years. The samples were collected from both in and outpatients attending Calabar General hospital, Calabar, South-South, Nigeria. In collecting urine from patients, the following exclusion criteria were used: - patients less than 5 years old and patients who have been on antibiotics for the past 3 days.

Urine collection

Clean voided mid-stream urine samples were obtained from patients in sterile universal bottles and transported to the Microbiology laboratory of the University of Calabar, Calabar for analysis. The samples were analyzed within 5 hours of collection.

Microscopic Analysis

Using x40 objective lens, urine samples were screened for the presence of five pus cells per high power field (5PC/HPF) or 10 white blood cells (pus cells)/mm^3 in urine sediments

(Otajevwo and Amedu, 2015). All positive samples were cultured on suitable laboratory media.

Processing of urine samples

Samples were tested for significant bacteriuria by use of a modified semi quantitative technique described by Mbata (2007). A standard bacteriological loopful of each urine sample (0.01ml) was spread over the surface of sterile Cystine Lactose Electrolyte Deficient (CLED) agar plates (LabM, UK). After inoculation, the plates were inverted and incubated at 37^{o}C for 18 – 24 hrs. the number of bacterial colonies was counted and multiplied by 100 to give an estimate of the number of bacterial organisms per milliliter of urine. A significant bacterial count was taken as any count $\geq 10^5$/ml.

Microbiological analysis

All samples that had $\geq$5PC/HPF or 10PC/mm^3 and were positive for significant bacteriuria were cultured aseptically on sterile CLED agar and MacConkey agar (Lab M, UK) plates following standard methods. All inoculated plates were incubated at 37^{o}C for 18 – 24 hrs.

Biochemical Analysis and Identification of Isolates

Biochemical tests were carried out on pure isolates for characterization and the isolates were identified according to schemes provided by Cowan and Steel (1993). All identified isolates were subjected to antibiotic sensitivity testing.

Antibiotic Susceptibilty Testing

The antibiotic susceptibility tests of confirmed uropathogens were carried out following procedures of Kirby-Bauer disc diffusion method as recommended by the Clinical Laboratory Standard Institute (CLSI, 2014). The multidiscs containing their respective minimum inhibitory concentrations were used and included gentamicin (10µg), augmentin (30µg), ofloxacin (5µg), ciprofloxacin (5µg), nitrofurantoin (300µg), ceftazidime (30µg), cefuroxime (30µg) and ampicillin (10µg). Discs were aseptically placed onto the surface of dried plates using sterile forceps and then incubated. After incubation, the zones of inhibition were measured and compared with zone diameter interpretative chart to determine susceptibility of isolates to antibiotics.

Statistical analysis

The data obtained from this study were managed and analysed using MS Excel 2010 version.

RESULTS

The total bacterial count profile of 200 midstream urine samples is shown in Table 1. Forty – nine percent (49%) of the patients were not infected, 32% had $10^2 – 10^4$ cfu/ml and 19% had $\geq 10^5$ cfu/ml. Result of statistical analysis showed that there was no significant difference in the total bacterial counts of the patients at P = 0.05. Bacterial counts of at least 10^5 cfu/ml is reported to be significant bacteriuria (Aiyegoro *et al.*, 2007). Of the 200 patients sampled, 38 (19%) had significant bacteriuria that is, they had at least 10^5cfu of bacteria per ml of urine. Table 2 shows the sex and age group of patients with significant bacteriuria. Of the 115 females, 27 (23.5%) had positive cultures while 11 (12.9%) of the 85 males had significant bacteriuria. Age group 21 – 35 years had the highest percentage (21.1%) of patients with significant bacteriuria followed by age groups 36 – 50 years with 18.4%. Age groups 5 – 20 and 51 – 65 had percentage bacteriuria of 15.8% and 13.3%, respectively. There was a significant difference at P = 0.05 on the distribution of significant bacteriuria according to age groups.

Table 1: Total bacteria count in urine sample from patients.

Total count range (cfu/ml)	No. of patients (n = 200)	Percentage (%)
No growth	98	49
$10^2 – 10^4$	64	32
10^5 - $\geq 10^5$	38	19

***P < 0.05**

Table 2: Age and sex distribution of patients with significant bacteriuria.

Age group (years)	Number tested	Males	Females	No. (%) of patients with significant bacteriuria		
				Males	Females	Total
5 – 20	38	13	25	2 (5.3)	4 (10.5)	6 (15.8)
21 - 35	109	40	69	5 (4.6)	18 (16.5)	23 (21.1)
36 - 50	38	27	11	2 (5.3)	5 (13.2)	6 (18.4)
51 - 65	15	5	10	1 (6.7)	1 (6.7)	2 (13.3)
Total	200	85	115	11 (12.9)	27 (23.5)	38 (19.0)

***P > 0.05**

The etiologic agents of UTI among the patients is presented in (Table 3). Seven different microorganisms were isolated and identified from thirty-eight (38) positive samples. A total of 85 bacterial isolates were recovered including *Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, Enterococcus faecalis., Staphylococcus aureus* and coagulase negative Staphylococci. The predominant organism was *Escherichia coli* with a frequency of 26 (30.6%) followed by *K. pneumoniae* and *P. mirabilis* with frequencies of

15(17.6%) and 12 (14.1%) respectively. The least commonly identified organism was *Enterococcus faecalis* with 6 (7.1%) isolates. On the whole, the total gram negative and gram positive bacterial isolates were 71.8% and 28.2%, respectively.

Table 3: Frequency of occurrence of uropathogens isolated from urine samples.

Isolated uropathogens	No. of strains	Frequency
Escherichia coli	26	30.6
Klebsiella pneumoniae	15	17.6
Proteus mirabilis	12	14.1
Coagulase negative Staphylococci	10	11.8
Pseudomonas aeruginosa	8	9.4
Staphylococcus aureus	8	9.4
Enterococcus faecalis	6	7.1
Total	85	100.0

Table 4 shows the sex distribution of bacterial strains isolated. Out of the total 85 strains isolated, 29 (34.1%) and 56 (65.9%) were obtained from males and females respectively. *E. coli* was the highest occurring uropathogen in both males and females 24.1% and 73.1%, respectively.

Table 4: Sex distribution of uropathogens isolated from urine samples.

Isolated uropathogens	No. of strains males(%)	No. of strains females(%)	Total (%)
Escherichia coli	7 (24.1)	19 (33.9)	26 (30.6)
Klebsiella pneumoniae	5 (17.2)	10 (17.9)	15 (17.6)
Proteus mirabilis	5 (17.2)	7 (12.5)	12 (14.1)
Coagulase negative Staphylococci	3 (10.3)	7 (12.5)	10 (11.8)
Pseudomonas aeruginosa	5 (17.3)	3 (5.4)	8 (9.4)
Staphylococcus aureus	2 (6.9)	6 (10.7)	8 (9.4)
Enterococcus faecalis	2 (6.9)	4 (7.1)	6 (7.1)
Total	29 (34.1)	56 (67.1)	85 (100.0)

The percentage occurrence of the uropathogens according to age groups is presented in Table 5. *Escherichia coli* is shown to be the most common etiologic agent of UTI in the sampled population. It was identified in all the age groups. The highest and lowest uropathogen strains of 40 (47.1%%) and 9 (10.6%) were isolated from the age groups 21-35 and 51-65, respectively.

Table 5: Distribution of isolated uropathogens according to age group.

Uropathogens Isolated	Age groups			
	5 – 20	21 – 35	36 – 50	51 – 65
Escherichia coli	6 (46.2)	12 (30.0)	6 (26.1)	2 (22.2)
Klebsiella pneumoniae	4 (25.0)	7 (23.3)	3 (13.0)	1 (11.1)
Proteus mirabilis	0 (0.0)	6 (15.0)	4 (17.4)	2 (22.2)
Coagulase negative Staphylococci	3 (18.8)	4 (10.0)	3 (13.0)	0 (0.0)
Pseudomonas aeruginosa	0 (0.0)	4 (10.0)	2 (8.7)	2 (22.2)
Staphylococcus aureus	0 (0.0)	4 (10.0)	3 (13.0)	1 (11.1)
Enterococcus faecalis	0 (0.0)	3 (7.5)	2 (8.7)	1 (11.1)
Total (n = 85)	13 (15.3)	40 (47.1)	23 (27.1)	9 (10.6)

The antibiotic susceptibility patterns of all isolated uropathogens to some selected antibiotics is shown in Table 6. The antibiotic sensitivity profiles of the 85 uropathogens to ciprofloxacin, ofloxacin, nitrofurantoin, augmentin, gentamicin, cefuroxime, ceftazidime and ampicillin are shown. Three (11.5%), 3 (20.0%), 2 (16.7%) and 2 (25.0%) strains of *Escherichia coli*, Klebsiella pneumonia, *Proteus mirabilis* and *Pseudomonas aeruginosa* respectively were resistant to all the antibiotics tested. In terms of effectiveness of antibiotics used, 75 (88.2%), 75 (88.2%), 60 (70.6%) 52 (61.2%), 42 (49.4%), 42 (49.4%), 20 (23.5%) and 5 (5.9%) strains of isolated uropathogens were sensitive to ciprofloxacin, ofloxacin, nitrofurantoin, gentamicin, ceftazidime, cefuroxime, augmentin and ampicillin (Fig.1). The two most effective antibiotics in this study were ciprofloxacin and ofloxacin whereas augmentin and ampicillin were the least effective antibiotics.

Table 6: Antibiotic susceptibility pattern of uropathogens isolated from urine samples.

Susceptibility pattern	CPR	OFL	AUG	NIT	AMP	CAZ	CRX	GEN
Escherichia coli **(26)**								
Sensitive (%)	23(88.5)	23(88.5)	7(26.9)	19(73.1)	3(11.5)	10(38.5)	12(46.2)	16(61.5)
Resistant (%)	3(11.5)	3(11.5)	19(73.1)	7(26.9)	23(88.5)	16(61.5)	14(53.8)	10(38.5)
Klebsiella pneumoniae **(15)**								
Sensitive (%)	12(80.0)	12(80.0)	4(26.7)	12(80.0)	2(13.3)	8(53.3)	6(40)	8(53.3)
Resistant (%)	3(20.0)	3(20.0)	11(73.3)	3(20.0)	13(86.7)	7(46.7)	9(60)	7(46.7)
Pseudomonas aeruginosa **(8)**								
Sensitive (%)	6(75.0)	6(75.0)	0(0.0)	2(25.0)	0(0.0)	3(37.5)	4(50.0)	6(75.0)
Resistant (%)	2(25.0)	2(25.0)	8(100)	6(75.0)	8(100)	5(62.5)	4(50.0)	2(25.0)
Proteus **spp. (12)**								
Sensitive (%)	10(83.3)	10(83.3)	3(25)	5(41.7)	0(0.0)	5(41.7)	4(33.3)	4 (33.3)
Resistant (%)	2(16.7)	2(16.7)	9(75)	7(58.3)	12(100)	7(58.3)	8(66.7)	8(66.7)
Staphylococcus aureus **(8)**								
Sensitive (%)	8(100)	8(100)	3(37.5)	7(87.5)	0(0.0)	6(75)	6(75)	4(50.0)
Resistant (%)	0(0)	0(0)	5(62.5)	1(12.5)	8(100)	2(25)	2(25)	4(50.0)

***Enterococcus* spp. (6)**								
Sensitive (%)	6(100)	6(100)	1(16.7)	6(100)	0(0.0)	5(83.3)	4(66.7)	6(100)
Resistant (%)	0(0)	0(0)	5(83.3)	0(0)	6(100)	1(16.7)	2(33.3)	0(0)
Coagulase negative Staphylococci (10)								
Sensitive (%)	10(100)	10(100)	2(20)	9(90)	0(0.0)	6(60)	6(60)	8(80)
Resistant (%)	0(0)	0(0)	8(80)	1(10)	10(100)	4(40)	4(40)	2(20)

Key: CPR – Ciprofloxacin, OFL – ofloxacin, AUG – augmentin, NIT – nitrofurantoin, AMP – ampicillin, CAZ - ceftazidime, CRX - cefuroxime, GEN – gentamicin

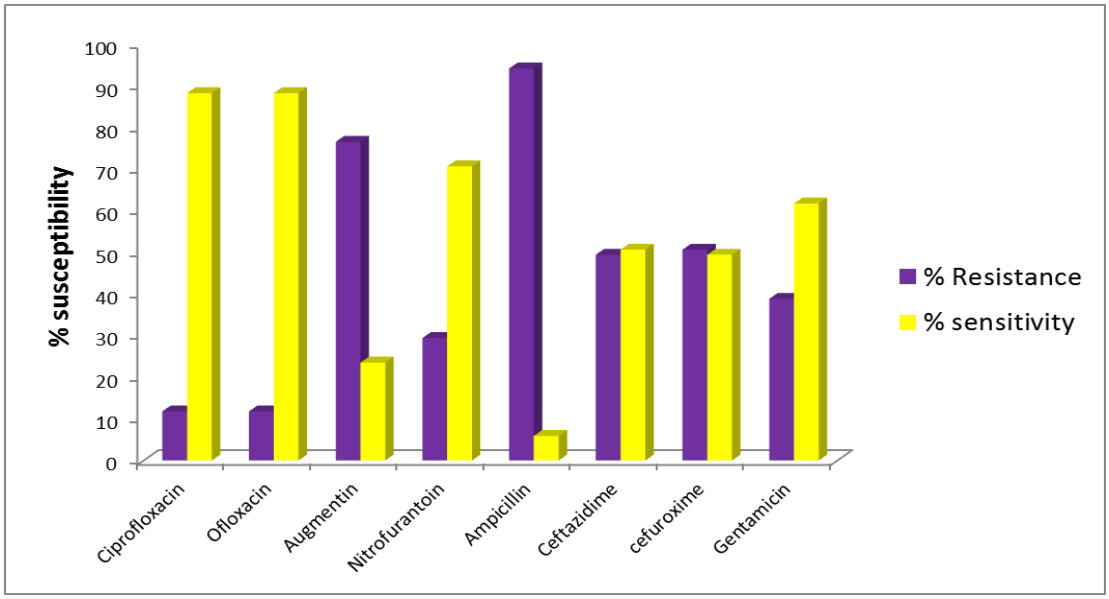

Fig. 1: Percentage susceptibility of bacterial isolates to selected antibiotics.

Table 7 shows the occurrence of multi drug resistance among the isolated uropathogens. *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis* and *Pseudomonas aeruginosa* were resistant to more than three antibiotics at a time. A pathogen is said to be multidrug resistant to any of the selected antibiotics if more than 50% of its strains are resistant to it and hence, a pathogen is multidrug resistant if it resists up to three drugs at a time (Otajvewo and Amedu, 2015). In this study, only four out of the seven bacterial uropathogens isolated were multidrug resistant. Klebsiella pneumonia strains were resistant to 3 antibiotics, *Pseudomonas aeruginosa*, *Escherichia coli* and *Proteus mirabilis* were resistant to 4, 5 and 6 antibiotics, respectively.

Table 7: Occurrence of Multidrug Resistance among bacterial uropathogens isolated from urine samples.

Bacterial uropathogen	3 drugs	4 drugs	5 drugs	6drugs	>6drugs
Escherichia coli	–	–	+	–	–
Klebsiella pneumoniae	+	–	–	–	–
Proteus mirabilis	–	–	–	+	–
Pseudomonas aeruginosa	–	+	–	–	–
Coagulase negative staphylococci	–	–	–	–	–
Staphylococcus aureus	–	–	–	–	–
Enterococcus faecalis	–	–	–	–	–

DISCUSSION

Urinary tract infection is a very common disease and its diagniosis and treatment have important implications for not only for the patients health but also for development of antibiotic resistance and etiological agents and their percentage health care cost (Magliano *et al*., 2012). Therefore knowledge of local UTI etiology as well as the antibiotic susceptibility pattern is a useful guide to empirical therapy as prevalence of uropathogens vary with time and geographical location (Livermore and Pearson, 2007). In this study, a survey of urinary tract infections (UTIs) among in and out patients visiting General hospital, Calabar was carried out by determining the total bacterial count of each patient's urine sample, the distribution of significant bacteriuria according to patient's age group (5 – 20, 21 – 35, 36 – 50 and 51 – 65 years), the prevalence rate for UTI according to sex, percentage occurrence and the antibiotic susceptibility patterns of the etiologic agents. Results obtained from this study has revealed that out of the 200 urine samples processed (85 males, 115 females), 98 (49%) samples yielded no growth, 64 (32%) had insignificant bacteriuria ($<10^5$ cfu/ml of urine) while 38 (19%) yielded significant bacteriuria. The absence of bacterial growth in 49% of the processed samples was confirmed when microscopically, a non-significant pus cell count (<5PC/HPF) was observed. According to Cheesebrough (2002), bacterial counts less than $<10^5$cfu/ml is considered not significant and counts $\geq 10^5$ cfu/ml is significant bacteriuria.

Hence bacterial count of 81% of the patients were insignificant i.e the patients were not infected while 19% of the patients were significant i.e the patients had urinary tract infection.

The distribution of significant bacteriuria revealed that those within the age group 21 – 35 years had the highest percentage of 21.1% followed by age group 36 – 50 years with 18.4%. The reason for this preponderance in this groups could be because of regular sexual activity

and also use of one form of contraceptive or another which are positive risk factors for urinary tract infection (Nicolle, 2008; Dielubanza and Schaeffer, 2011). Also, subjects within these age groups tend to hide UTI and usually engage in self medication and visit the hospital only when the infection is beyond their control.

The incidence rates of UTI according to age group for male and female shows that females are more at risk of the infection than males. The study revealed that in the age group 21 – 35 with 40 males and 69 females, 5 (4.6%) of males were positive for UTI as against 18 (16.5%) females. In the age group 36 – 50 years with 27 males and 11 females, 2 (5.3%) of males were positive for UTI as against 5 (13.2%) for females. This result is in agreement with other studies by Agbagwa *et al*., Kibret and Abera, Swetha *et al*., where UTI was higher in females compared to males (Agbagwa and Ifeanacho, 2015; Kibret and Abera, 2014; Swetha, 2014). The high incidence of UTI in females could be as a result of the physiological and anatomical differences between both sexes. With respect to anatomy, the female urethra is shorter and closer to the anus. There is also a chance of bacteria been massaged up the urethra into the bladder during pregnancy and childbirth (Nicolle, 2008; Swetha *et al*., 2014). According to Hooton and Stamm (1997), alteration of the vagina microflora allows colonization of the vagina by some microorganisms that can cause UTI. The higher incidence of UTI in females could also be attributed to menopause and use of contraceptives. Report by Dielubanza and Schaeffer (2011) revealed that as a woman' estrogen levels decrease with menopause, her risk of urinary tract infections increases due to loss of protective vaginal flora.

Seven uropathagens were isolated in this study (Table 3) of which gram negative bacilli accounted for 72.9% while gram positive bacteria accounted for 27.1%. this finding is somewhat consistent with the report of a previous investigator who isolated 65.2% gram negative bacilli and 34.8% gram positive bacteria (Otajevwo and Eriagbor, 2014) and also 69.1% gram negative bacilli and 27.4% gram positive bacteria was reported by Agbagwa and Ifeanacho (2015). The prevalence of gram negative bacilli in UTI could be because majority of the gram negative organisms are commensals of the digestive system and UTI is caused by ascending infection from the anogenital region due to poor hygiene and the proximity of the external urethral meatus to this region (Idris *et al*., 2014).

The most and second most occurring uropathogens were *Escherichia coli* (30.6%) and *Klebsiella pneumoniae* (17.6%). The other uropathogens isolated include *Proteus mirabilis* (14.1%), coagulase negative staphylococci (11.8%), *Pseudomonas aeruginosa* (9.4%),

Staphylococcus aureus (9.4%) and *Enterococcus feacalis* (7.1%). The occurrence of *E. coli* and *K. pneumoniae* as the most commonly occurring uropathogen is consistent with the report of Ahmed *et al*., 2014. *E. coli* is widely documented from several studies as the commonest causative agent for both symptomatic and asymptomatic UTI (Idris *et al*., 2014; Igwegbe *et al*., 2012). This agrees with the findings in this study werein *E.coli* made up 30.6% of the isolates. This is due to presence of the P-fimbria and S-fimbria with which it adheres to and colonizes the epithelium of the Urinary tract. (Anozie *et al*., 2016). This is interestingly different from the finding by Yakasai *et al* in Kano where *Proteus mirabilis* (33.3%) was the predominant organism (Yakasai *et al*., 2012) and in Rivers state were *Klebsiella* spp. was the predominant organism (Agbagwa and Ifeanacho, 2015). The reasons may be attributed to differences in the study design and patient selection and also differing environmental conditions in various study locations. In this study, *Proteus mirabilis* and *S. aureus* were isolated and these organisms have been incriminated in hospital acquired infections often following catherization or gynaecological surgery (Cheesbrough 2002).

Antimicrobial resistance is recognized as an increasing public health threat. In this study, the antibiogram showed susceptibility reactions of 75 (88.2%), 75 (88.2%), 60 (70.6%) 52 (61.2%), 42 (49.4%), 43 (50.6%), 20 (23.5%) and 5 (5.9%) to ciprofloxacin, ofloxacin, nitrofurantoin, gentamicin, ceftazidime, cefuroxime, augmentin and ampicillin. The observed rate of resistance were 11.8%, 11.8%, 29.4%, 38.8%, 49.4%, 50.6%, 76.5% and 94.1% to ciprofloxacin, ofloxacin, nitrofurantoin, gentamicin, ceftazidime, cefuroxime, augmentin and ampicillin.

The most effective antibiotic for eliminating *E.coli* and other uropathogens from UTI cases in this study was Ciprofloxacin, Ofloxacin, Nitrofurantoin and Gentamicin since more than 50% of the uropathogens implicated in this study were sensitive to them. This finding with respect to gentamicin is consistent with the reports of some previous studies (Otajevwo and Eriagbor, 2014; Otajevwo and Amedu, 2015; Lennox *et al*., 2006). The floroquinolone, ofloxacin recorded a high sensitivity of 88.2%. Anigilaje and Bitto (2013) recorded a high sensitivity of uropathogens to gentamicin (100%) while more than 50% ofloxacin sensitivity was reported by Ezeokoli *et al*. (2016). Nwadioha *et al*. (2010) recorded a high sensitivity (80.0%) of UTI bacterial agents to ciprofloxacin this is in line with the present study. The high sensitivity to nitrofurantoin recorded in this study agrees with that of previous studies by Haruna *et al*. (2014), Alabi *et al*. (2014), Ashang *et al.* (2017) and Antai *et al.* (2018). The

least sensitive antibiotics were augmentin and ampicillin, (23.5% and 5.9%, respectively). The less than 50% sensitivity of augmentin is very low and disturbing in view of its usefulness in the treatment of UTI's and other diseases. Otajevwo and Amedu, (2015) recorded less than 4% sensitivity of uropathogens to augmentin. The almost total resistance of uropathogens to augmentin is alarming as it may have lost its potency in the treatment of UTI (Oladeinde *et al.*, 2011). There are various mechanisms by which these organisms develop resistance to antibiotics either by producing beta lactamases which destroy the antibiotics, by blocking the entry of these antibiotics or by efflux pumps which actively pump out these antibiotics (Arias and Murray, 2009; Tiku *et al.*, 2016). The geographical variations in resistance pattern may be due to different local antibiotic practices.

Four out of the seven isolated uropathogens were resistant to more than three antibiotics and hence they were all multi–drug resistant (MDR). In this study, *Klebsiella pneumoniae* strains were resistant to 3 drugs while *Pseudomonas aeruginosa*, *Escherichia coli* and *Proteus mirabilis* were resistant to 4, 5 and 6 antibiotics respectively (Table 5). The extensive multidrug resistance pattern observed among uropathogens in this study and the continuous rise in infections makes the effective empirical treatment of UTI difficult in our environment. The influence of inappropriate use of antibiotics on the development of resistant strains has been demonstrated. A reduction in the number of prescriptions and injudicious use of antibiotics can lead to reduction in resistance rates (Manji *et al.*, 2012; Dalal *et al.*, 2016).

CONCLUSION

The study has revealed a high prevalence of UTI in females between age groups 21 – 35 and it could be due to unsafe sexual practices with multiple partners or poor hygiene. The most effective antibiotics for eliminating *E. coli* and other uropathogens in this study were Ciprofloxacin, Ofloxacin, Nitrofurantoin and Gentamicin since more than 50% of the uropathogens implicated in this study were sensitive to them. Therefore, there is need for increased awareness of UTI, the risk factors associated with it, prompt diagnosis and treatment so as to reduce the high rate of occurrence. Regular monitoring is also required to establish reliable information about susceptibility profiles of urinary pathogens for optimal empirical therapy for patients with UTI. We therefore recommend that antibiotic selection for treatment of UTI should be based on local etiology of UTI and antibiogram rather than on global guidelines.

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