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Research article

ASYMPTOMATIC URINARY TRACT INFECTION OCCURRENCE AMONG STUDENTS OF A PRIVATE UNIVERSITY IN WESTERN DELTA, NIGERIA

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ABSTRACT

This study was aimed at extending the scope of knowledge of UTI with respect to its prevalence rate among students of a private University in the western area of Delta, Nigeria. Two hundred and ninety one freshly voided midstream urine samples collected into sterile plastic universal bottles containing boric acid as preservative from UTI symptomatic and asymptomatic students aged between 15-35 (26yrs average) were used for the study. Samples were screened for significant bacteriuria and pus cells (neutrophil) counts. All positive samples with pyuria were aseptically cultured by standard methods on sterile Cystine Lactose Electrolyte Deficient agar (CLED), MacConkey agar and Sabouraud Dextrose agar plates and incubated appropriately. Antibiotic sensitivity testing was done on isolated and identified colonies by Kirby-Bauer agar diffusion disc method. Whereas 225 (77.3%) samples yielded bacterial growth, 66(22.7%) yielded no growth. Uropathogens isolated included *Staphylococcus aureus* (34.8%), *Escherichia coli* (24.4%), *Klebsiella aerogenes* (13.9%), *Candida albicans* (7.8%), *Coliform* organisms (6.1%), *Proteus* spp (4.4%), *Enterobacter* spp (4.4%), *Serratia* spp (1.7%), *Pseudomonas aeruginosa* (1.7%) and *Providencia* spp (0.9%) with gram negative bacilli and gram positive bacteria accounting for 65.2% and 34.8% respectively. Urinary tract mixed infection in male and female students constituted 37.5% and 62.5% respectively of which *E.coli/Staph aureus* mixed infection was the most occurring in female students. Occurrence of UTI in male and female students were 35.1% and 64.9% respectively of which UTI occurred highest in the 16-28, 18-27, 17-33, 19-22 and 22-32 age groups in that decreasing order. *E.coli* and *Staph aureus* occurred most in females of 22 and 23 average ages respectively. A

significantly high microscopic neutrophil count (pyuria) was recorded from deposits of UTI positive students (i.e < 5/HPF). More than 50% of microbial strains isolated were sensitive to gentamicin, ofloxacin and tetracycline. More than 60% of the strains were resistant to erythromycin, augmentin and nitrofurantoin. All isolated strains were multidrug resistant each to 4, 5, 6, 7 and 8 of the selected antibiotics used.

Keywords: UTI, Asymptomatic, Occurrence, Students, University

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Introduction

UTI (which is the microbial invasion of any of the tissues of the urinary tract extending from the renal cortex to the urethral meatus) is one of the most common infectious diseases which have been extremely studied in the field of clinical practice [1]. It is the most common health care – associated group of bacterial infections affecting humans in Africa [2]. UTI is among the most common bacterial infections in humans both in the community and hospital settings which occur in all age groups and in both genders [3, 4]. UTI is the major cause of morbidity in both the hospital and community settings [5] and affects both out and in patients [6].

The microbiological detection of pathogenic micro-organisms in the urinary tract will confirm the existence of urinary tract infection [7, 8]. The infection is considered significant and requires treatment when more than 10^5 microorganisms (CFU/ml) of urine are present in a properly collected specimen [7, 8]. Gram negative bacteria such as *Escherichia coli*, *Proteus* spp, *Klebsiella* spp, *Enterobacter* spp, *Serratia* spp and *Pseudomonas* spp are usually detected in recurrent infections especially in association with stones, obstruction, urologic manipulation and nosocomial catheter – associated infections [9, 7, 10]. Microbial sensitivity tests are done to direct therapy of the urinary tract infection [11].

Escherichia coli and *Klebsiella* spp are the most predominant gram negative bacteria found frequently in UTI cases as reported by several authors [12, 13, 14, 15, 16]. Other bacterial pathogens frequently isolated include *Staph. aureus*, *Staph. epidermidis* and *Strept. faecalis* [14, 15]. For many years, pathogens associated with uncomplicated UTI have remained constant with *E.coli* identified as aetiologic agent in about 75 – 90% of UTIs [17, 18, 5]. The remaining gram negative urinary pathogens are *Klebsiella* spp, *Proteus mirabilis* and *Pseudomonas aeruginosa*. *Enterococci* and coagulase negative *Staphylococci* eg. *Staph saprophyticus* are the most frequently implicated gram positive organisms [19].

According to Abubakar [20], the emergence of antibiotic resistance in the management of urinary tract infections is a serious public health problem particularly in the developing countries of the world where apart from a high level of poverty, ignorance and poor hygiene practices, there is also a high prevalence of fake and spurious drugs of questionable quality in circulation. Hence, the changing spectrum of microorganisms involved in urinary tract infections and emergence of resistance across institutions and geographical areas have informed the necessity to conduct antibiotic susceptibility testing study of UTI pathogens in various regions from time to time.

Oghara is a fast developing town situated in the Western part of Delta State of Nigeria. The people, who are mainly, Urhobos, are known for timber business with a lesser percentage taking to fishing and farming. The private University, whose students were engaged in the study, was established in 2007. About 50% of the students' population is made up of indigenes of the town and neighboring Urhobo, Ijaw and Itsekiri towns. The

rest are a mixture of other tribes such as Ibo, Yoruba, Bini etc. There is no record before 2007 up till date to suggest that the UTI status of the people had been probed into through research. This work is therefore targeted at studying urinary tract infection prevalence among students of Western Delta University in Delta State, Nigeria with the following objectives:

1. To determine the sex and age distribution of students enrolled for the study
2. Determine the effect of drug metabolites and pus cells on the absence of bacterial growth
3. Determine the microscopic content of urine sediments examined
4. Determine the frequency of distribution of microbial pathogens in midstream urine samples processed.
5. Determine the sex distribution of uropathogens in midstream urine samples processed.
6. Determine the frequency occurrence of mixed microbial pathogens isolated
7. Determine the age and sex distribution of Microbial pathogens in relation to significant neutrophil (pus cell) counts in samples of patients
8. Determine the antibiotic susceptibility profiles of isolated uropathogens to selected antibiotics after 24hours incubation at 37^{o}C
9. Determine the multi-drug resistance occurrence of uropathogens in UTI cases of students under study.

Materials and Methods

Study Population

Two hundred and ninety one mid-stream urine samples were collected from students who gave their verbal and written informed consent and who were symptomatic and asymptomatic for urinary tract infection. Samples (which were voided fresh), were collected into sterile screw – capped plastic universal containers containing a few crystals of boric acid as preservative. Recruited students were instructed on how to collect the samples. All obtained samples were appropriately labeled and processed immediately in the Microbiology laboratory of the University. Students were drawn from nine departments namely: Geology, Accounting, Mass Communication, Computer Science, Microbiology and Biotechnology, Business Administration, Biochemistry, Economics and Political Science. Students recruited were grouped into 15 – 20, 21 – 25, 26 – 30, 31 – 35, 36 – 40 and 41 – 45 age groups. The study was carried out between June 2013 and early October, 2013.

Processing of Samples

Test for Significant Bacteriuria

Samples were tested for significant bacteriuria by use of a modified semi – quantitative technique described by Mbata [21]. 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^{0}C for 18 – 24 hours. The number of bacterial colonies were counted and multiplied by 100 to give an estimate of the number of bacteria per milliliter of urine. A significant bacterial count was taken as any count equal to or in excess of 10^{5} per milliliter.

Confirmation of Significant Bacterial Count by Microscopy

All samples that recorded significant bacterial counts were subjected to urine microscopy test to detect presence of five pus cells per high power focus (5PC/HPF) or 10 white blood cells (pus cells) /mm^{3} in

urine sediments or deposits [22] using x40 objective microscopically. All samples that were positive for significant bacterial count and also recorded 5PC/HPF or 10PC/mm^3 or more were cultured on suitable laboratory media.

Cultural Studies

Urine samples that recorded 5PC/HPF or 10PC/mm^3 and were positive for significant bacteriuria test were cultured aseptically on sterile MacConkey agar (LabM, UK), CLED agar (LabM, UK), Blood agar and Saboraud Dextrose agar (LabM, UK) plates according to standard methods. All inoculated plates were incubated at 37^{o}C for 24hours. Pure isolates were then obtained and identified according to schemes provided by Cowan and Steel [23], Cheesbrough [24] and Alexopoulous [25]. All identified isolates were subjected to sensitivity testing. Fungal isolates were excluded from antibiotic sensitivity testing. All urine samples that yielded no bacterial growth were noted.

Antibiotic Sensitivity Testing

The agar diffusion disc technique described by Bauer *et al*. [26] was applied. A colony of each pure (axenic) isolate was streaked on sterile Mueller Hinton agar plates aseptically using sterile inoculating wire loop. The appropriate multi discs containing minimum inhibitory concentrations (MIC) of ciprofloxacin (10ug), ampicillin (30µg), nitrofurantoin (300µg), ceftriaxone (30µg), gentamicin (10µg), cefuroxime (30µg), ofloxacin (10µg), cefixime (10µg), ceftazidime (30µg) and augmentin (30µg) were then aseptically placed (impregnated) firmly onto the surface of the dried plates using sterile forceps. The plates were left at room temperature for one hour to allow diffusion of the different antibiotics from the disc into the medium.

The plates were then incubated at 37^{0}C for 18hours. Interpretation of results was done using the length of inhibition of zone diameter. Zones of inhibition greater than 10mm were considered sensitive, 5 – 10mm moderate sensitive and no zone of inhibition, resistant [27].

Results

Table 1 shows the sex and age distribution of students recruited for the study. Students of nine departments who gave their informed consent, volunteered their midstream urine samples and included 60(18.8%), 39(13.4%), 36(12.4%), 30(9.4%), 27(8.5%), 21(6.6%) and 15(4.7%) volunteering students of Mass Communication, Business Administration, Geology, Microbiology and Biotechnology, Accounting, Biochemistry, Political Science, Economics and Computer Science departments respectively. The highest and lowest urine samples were collected from students of Mass Communication and Computer Science departments respectively.

Table 1 also shows the age brackets of students used for the study. In decreasing order, 180(61.9%), 96(33.0%), 12(4.1%) and 3(1.0%) number of students belonged to 15 – 20 (average age 19yrs), 21 – 25 (average age 24yrs), 26 – 30 (average age 27yrs) and 31 – 35 (average age 33yrs) respectively. Out of the total 291 students enrolled in each age group, 75(41.7%), 60(62.5%), 9(75.0%) and 3(100.00%) represented male students in 15 – 20, 21 – 25, 26 – 30 and 31 – 35 age brackets respectively while 105(58.3%), 36(37.5%), 3(25.0%) and 0(0.0%) represented female students in the same age groups respectively.

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Table 1: Sex and Age Distribution of Students Recruited for Study.

		AGE BRACKETS OF STUDENTS.			
DEPARTMENTS n = 9	**SEX**	**15 – 20 n = 180(61.9%) av. age: 19yrs**	**21 – 25 n = 96(33.0%) av. age: 24yrs**	**26 – 30 n = 12(4.1%) av. age: 27yrs**	**31 – 35 n = 03(1.0%) av. age: 33yrs**
Geology	M 24	09	12	0	03
n = 36(12.4%)	F 12	12	0	0	0
Accounting	M 15	12	03	0	0
n = 30(9.4%)	F 15	09	06	0	0
Mass Comm.	M 30	15	15	0	0
n= 60(18.8%)	F 30	21	06	03	0
Comp. Sci.	M 09	03	06	0	0
n = 15(4.7%)	F 06	06	0	0	0
Microbiology	M 09	0	06	03	0
n= 36(12.4%)	F 27	21	06	0	0
Bus. Admin.	M 18	09	06	03	0
n=39(13.4%)	F 21	15	06	0	0
Biochemistry	M 18	15	03	0	0
n=27(8.5%)	F 09	09	0	0	0
Economics	M 06	0	03	03	0
n=21(6.6%)	F 15	06	09	0	0
Pol. Sci	M 18	12	06	06	0
n=27(8.5%)	F 06	06	03	03	0
Total n=291	**M 147(50.5%) F 144 (49.5%)**	**60(75.0%) 36(37.5%)**	**60(62.5%) 36(37.5%)**	**09(75.0%) 03(25.0%)**	**03(100.0%) 0**

Data on the effect of drug metabolites and pus cells on the absence of bacterial growth after 24hours incubation are presented in **Table 2**. Out of the 291 midstream urine samples processed, 225(77.3%) yielded bacterial growth while 66(22.7%) yielded no bacterial growth. Out of the 66(22.7%) samples that did not yield bacterial growth, 21(31.8%) had drug metabolites (such as calcium oxalate and triple phosphate crystals) present in their sediments as observed microscopically. The drug metabolites were absent in the sediments of 45(68.2%) samples. A total of 36(54.6%) and 30(45.4%) samples had pus cells less than 5/HPF and greater than 5/HPF respectively in their sediments as viewed microscopically. Out of the 21(31.8%) urine samples that had drug metabolites present in their sediments, 12(57.1%) and 9(42.9%) of the samples had pus cells of less than 5/HPF and greater than 5/HPF respectively in their sediments. Finally, 24(53.3%) and 21(46.7%) samples had less than 5/HPF and greater than 5/HPF pus cells respectively in the 45(68.2%) samples in which drug metabolites were absent.

Table 2: Effect of drug related metabolites and pus cells on absence of bacterial growth after 24hours incubation at 37^{o}C

Drug related metabolites in urine sediments	No. of samples that yielded no Growth	Pus cells/HPF	
		Less than 5	Greater than 5
Drug related metabolites present	21(31.8%)	12(57.1%)	9(42.9%)
Drug related metabolites absent	45(68.2%)	24(53.3%)	21(46.7%)
Total	**66(100.0%)**	**36(54.6%)**	**30(45.4%)**

Drug related metabolites in urine included:
a.Tripple Phosphate crystals
b. Calcium oxalate crystals

In **Table 3**, the observed urine deposits (sediments) content are shown. Urine deposits were microscopically observed in the samples of 102 (35.1%) and 189(64.9%) male and female students respectively. Pus cells, bacteria, yeast cells, schistosoma eggs and spermatozoa were observed in 134(46.1%), 109(37.5%), 33(11.3%), 0(0.0%) and 15(5.2%) urine samples respectively. No schistoma larva or egg was seen at all in all the samples processed. Whereas pus cells were the most observed urine deposits, spermatozoa were the least observed. No spermatozoa were seen in the female urine samples. There were more pus cells and yeast cells in female urine samples than in male samples.

Table 3: Microscopic content of urine sediments examined.

Observed urine deposits	Frequency Occurrence		
	Males (%)	**Females (%)**	**Total (%)**
Pus cells	45(33.6)	89(66.4)	134(46.1)
Bacteria	39(35.8)	70(64.2)	109(37.5)
Yeast cells	03(9.1)	30(90.9)	33(11.3)
Schistosoma eggs	0(0.0)	0(0.0)	0(0.0)
Spermatozoa	15(100.0)	0(0.0)	15(5.2)
Total	**102(35.1)**	**189(64.9)**	**291(100.0)**

Table 4 shows the uropathogens that were isolated and identified. Gram negative, mucoid, non – motile, lactose, adonitol, inositol, glucose fermenting, voges praskauer positive, urease positive, citrate positive and indole negative bacilli strains were identified as *Klebsiella aerogenes*. All gram negative, raised, entire, circular, motile, lactose, glucose fermenting, indole positive, methyl red positive, voges praskauer negative, citrate negative and urease negative bacilli strains were identified as *Escherichia coli*. Bacterial strains that were gram positive in clusters, catalase positive, coagulase positive, DNAase negative, mannitol fermenting, raised, round and smooth colonies were identified as *Staphylococcus aureus*. Gram positive yeast cells, pseudohyphae positive, chlamydospores positive, germ tube positive, glucose, maltose, galactose and sucrose assimilation positive strains were identified as *Candida albicans.*

Gram negative, motile, non – sporing, non – encapsulated, gelatinase positive, DNAase positive, indole negative, lactose negative, glucose positive, mannitol positive, sucrose positive, citrate positive and serrated colonies were identified as *Serratia* spp. Gram negative, swarming fish odour colonies on sodium chloride – containing media, indole negative and urease positive strains were identified as *Proteus* spp. Large, flat, opaque, aerobic, irregular colonies having grape – like smell, yellow green pyocyannin pigment producing colonies on common culture media, oxidase positive colonies which grew at 42^0C were identified as *Pseudomonas aeruginosa*. Gram negative, motile, non – sporing, lactose fermenting, indole negative, methyl red negative, voges praskaeur positive and citrate positive colonies were confirmed to be *Enterobacter* spp. Gram negative, non – sporing, non lactose fermenting, methyl red positive, voges praskaeur negative and phenylalanine deaminase positive colonies were identified as *Providencia* spp strains. Coliform organisms were mixed cultures made of *Escherichia coli*, *Enterococcus faecalis* and *Clostridium perfringes*.

The frequency of occurrence of the isolates and their strains therefore were as follows: *Staphylococcus aureus* (34.8%), *Escherichia coli* (24.4%), *Klebsiella aerogenes* (13.9%), *Candida albicans* (7.8%), *Coliform* organisms (6.1%), *Proteus* spp (4.4%), *Enterobacter* spp (4.4%), *Serratia* spp. (1.7%), *Pseudomonas aeruginosa* (1.7%) and *Providencia* spp (0.9%)

Table 4: Frequency distribution of microbial uropathogens isolated from samples.

Isolated Uropathogens	No. of Strains	Frequency Occurrence (%)
Staphylococcus aureus	40	34.8
Escherichia coli	28	24.4
Klebsiella aerogenes	16	13.9
Candida albicans	9	7.8
Coliform organisms	7	6.1
Proteus spp	5	4.4
Enterobacter spp	5	4.4
Serratia spp	2	1.7
Pseudomonas aeruginosa	2	1.7
Providencia spp	1	0.9
n=10	**115**	**100.0%**

Gram negative bacteria: **65.2%**
Gram positive bacteria: **34.8%**
Enterobacteriaceae: **55.7%**
Non - Enterobacteriaceae: **44.3%**

The sex distribution of the microbial strains isolated is shown in **Table 5**. Out of the total 115 strains isolated, 42(36.5%) and 73(63.5%) strains were isolated from male and female students respectively. In a decreasing order, the highest occurring uropathogens in male students were *Staphylococcus aureus* (35.7%), *Escherichia coli* (21.4%), *Klebsiella aerogenes* (16.7%), *Proteus* spp (9.5%), *Candida albicans* (7.1%), *Serratia* spp (4.8%) and *Coliforms* organisms (4.8%). *Enterobacter* spp, *Pseudomonas aeruginosa* and *Providencia* spp were not isolated from male students. In decreasing order, the uropathogens isolate from female students were *Staphylococcus aureus* (30.1%), *Escherichia coli* (22.9%), *Klebsiella aerogenes* (10.8%), *Pseudomonas aeruginosa* (14.5%), *Candida albicans* (7.2%), *Coliform* organisms (6.0%), *Enterobacter* spp (6.0%), *Proteus* spp (1.2%) and *Providencia* spp (1.2%). *Serratia* spp was not isolated from female students.

Table 5: Sex distribution of uropathogens isolated from processed samples

Isolated Uropathogens	No. of Strains (Males)	Males (%)	no. of strains Females	Females (%)	Total
Staphylococcus aureus	15	35.7	25	30.1	40
Escherichia coli	9	21.4	19	22.9	28
Klebsiella aerogenes	7	16.7	9	10.8	16
Candida albicans	3	7.1	6	7.2	9
Coliform organisms	2	4.8	5	6.0	7
Proteus spp	4	9.5	1	1.2	5
Enterobacter spp	-	-	5	6.0	5
Serratia spp	2	4.8	-	-	2
Pseudomonas aeruginosa	-	-	2	14.5	2
Providencia spp	-	-	1	1.2	1
Total	**42(36.5%)**		**73(63.5%)**		**115(100.0)**

In **Table 6**, the frequency occurrence of mixed cultures (growth) of uropathogens isolated is shown. Out of a total of 291 samples processed, 225(77.3%) yielded significant growth of which 120(53.3%) yielded mixed growth of two – three organisms in mixed culture. Of this number, 45(37.5%) and 75(62.5%) mixed culture samples were isolated from male and female students respectively. Mixed cultures consisting of two organisms included *E.coli/Candida albicans, Kleb. aerogenes/Staph. aureus, Enterobacter* spp*/Candida albicans, Staph aureus/Coliforms, E.coli/Staph aureus, Kleb.aerogenes/Candida albicans, Proteus* spp*/Staph aureus,, Staph aureus/Candida albicans, Serratia* spp*/Proteus* spp, *Staph aureus/Serratia* spp *and E.coli/Coliforms.* Mixed cultures made up of three organisms included: *Coliforms/E.coli/Staph.aureus, E.coli/Kleb.aerogenes/Staph.aureus, Kleb.aerogenes/Staph.aureus,/Candida albicans, Coliforms/Kleb.aerogenes/Staph aureus and Serratia* spp*/E.coli/ Staph aureus*.

The first four highest mixed cultures (in decreasing order) were *E.coli/ Staph aureus* (27.5%), *Staph aureus/Coliforms* (17.5%), *Kleb.aerogenes/Candida albicans* (10.0%) and *Proteus* spp*/Staph aureus* (7.5%). The frequency occurrence of the above mixed pathogens in male and female students in the order they occurred above were 9(20.0%) and 24(32.0%) respectively (for the first), 12(26.7%) and 9(12.0%) respectively (for the second), 3(6.7%) and 9(12.0%) respectively (for the third) and 6(13.3%) and 3(4.0%) respectively (for the fourth). Five mixed cultures made of (four) double organisms cultures and (one) triple organisms cultures were absent or not isolated from male students while two mixed cultures both made of three pathogens were absent or not isolated from female students.

Table 6: Frequency occurrence of mixed cultures of uropathogens isolated from processed samples.

Mixed Organisms in culture	Frequency of Occurrence (%)		
	Males (%)	**Females (%)**	**Total (%)**
E.coli/Staph. aureus	9(20.0)	24(32.0)	33(27.5)
Staph. aureus/Coliforms	12(26.7)	9(12.0)	21(17.5)
kleb. aerogenes/Candida albicans	3(6.7)	9(12.0)	12(10.0)
Proteus spp/*Staph. aureus*	6(13.3)	3(4.0)	09(7.5)
kleb.aerogenes/Staph aureus	3(6.7)	3(4.0)	06(5.0)
E.coli/Coliforms	0(0.0)	6(8.0)	06(5.0)
Coliforms/E.coli/Staph. aureus	0(0.0)	6(8.0)	06(5.0)
E.coli/Candida albicans	0(0.0)	3(4.0)	03(2.5)
Enterobacter spp/*Candida albicans*	0(0.0)	3(4.0)	03(2.5)
Staph. aureus/Candida albicans	0(0.0)	3(4.0)	03(2.5)
Serratia spp/*Proteus* spp	3(6.7)	0(0.0)	03(2.5)
Staph. aureus/Serratia spp	3(6.7)	0(0.0)	03(2.5)
E.coli/Kleb.aerogenes/Staph. aureus	0(0.0)	3(4.0)	03(2.5)
Kleb. aerogenes/Staph. aureus/Candida albicans	0(0.0)	3(4.0)	03(2.5)
Coliforms/Kleb. aerogenes/Staph. aureus.	3(6.7)	0(0.0)	03(2.5)
Serratia spp/*E.coli/Staph. aureus*	3(6.7)	0(0.0)	03(2.5)
Total.	**45(37.5%)**	**75(62.5%)**	**120(100.0)**

The age and sex distribution of isolated uropathogens in relation to significant neutrophil (pus cells) count is shown in **Table 7**. In male students, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella aerogenes*, *Candida albicans*, *Coliform* organisms, *Proteus* spp and *Serratia* spp were isolated from 18 – 33 (average 26yrs), 16 – 25 (average 21yrs), 20 – 24 (average 22yrs), 19-29 (average 24yrs), 24-30 (average26yrs), 22-32 (average 25yrs) and 18 – 22 years (average 20yrs) age groups respectively. *Escherichia coli* and *Serratia* spp were isolated from the youngest students of average ages of 21 and 20 years respectively. *Staph. aureus* and *Coliform* organisms were isolated from the older students of 26yrs average age. On the whole, average age bracket of the male students sampled was 20 – 26 years. *Staph. aureus*, *Escherichia coli*, *Klebsiella aerogenes*, *Candida albicans*, *Coliform* organisms, *Proteus* spp. *Enterobacter* spp, *Pseudomonas aeruginosa* and *Providencia* spp were isolated from 18 – 27 (average 23 yrs), 16 – 28 (average 22yrs), 17 – 23 (average 20yrs), 19 – 22 (21yrs average), 19 – 28 (24yrs average), 20 – 21 (average 21yrs), 16 – 22 (19yrs average), 19 – 23(21yrs average) and 23 – 25 (22yrs average) female students age brackets respectively. *Klebsiella aerogenes* and *Enterobacter* spp were isolated from the youngest

female students having average ages of 20 and 19yrs respectively. On the whole, the average age group of female students sampled was 19-24yrs. Coliform organisms were isolated from the oldest female age group of 24yrs average.

The highest pus cell count (neutrophil count) of 12/HPF was obtained from the midstream urine deposit of 16 – 28 yrs old female students (22yrs average age). This group of students consisted of very young female students. Average pus cell counts of 10/HPF, 6/HPF, 6/HPF, 6/HPF and 6/HPF were obtained microscopically from urine deposits of male students and from which *Escherichia coli, Staph. aureus*, *Candida albicans*, *Coliform* organisms, and *Serratia* spp were isolated respectively. The least count of 4/HPF was obtained each for *Proteus* spp and *Pseudomonas aeruginosa.* Average pus cells counts of 10HPF, 9/HPF, 8/HPF, 8/HPF and 7/HPF were obtained from deposits of female students and from which *Staph. aureus*, *Candida albicans, Klebsiella aerogenes, Proteus* spp and *Coliform* organisms were isolated respectively.

The least counts of 4/HPF and 4/HPF were obtained from urine samples infected with *Providencia* spp and *Pseudomonas aeruginosa* respectively. Pus cell counts of 29/HPF, 26/HPF, 20/HPF, 19/HPF, 15/HPF and 12/HPF were obtained microscopically from urine deposits infected with *Staph. aureus*, *Candida albicans*, *Klebsiella aerogenes*, *Proteus* spp, *Enterobacter* spp and *Escherichia coli* uropathogens respectively. Mean neutrophil count of 10/HPF was recorded for both male and female urine samples.

Table 7: The age and sex distribution of microbial pathogens in relation to significant neutrophil (pus cells) count in urine samples of students.

Isolated Uropathogens	Sex/No of Patients	Age Bracket of Patients showing sig. cultural yield (yrs)	Average age of patients showing sig. cultural yield (yrs)	Average pus cells(neutrophil) count/HPF
Staph aureus	M 35	18-33	26	6
n=40(34.8%)	F 55	18-27	23	29
Escherichia coli	M 20	16-25	21	10
n=28(24.4%)	F 57	16-28	22	12
Klebsiella aerogenes	M 11	20-24	22	20
n=16(13.9%)	F 25	17-33	20	8
	M 09	19-29	24	26
Candida albicans	F 18	19-22	21	9
n=9(7.8%)				
Coliform organisms	M 06	24-30	26	6
n=7(6.1%)	F 10	19-28	24	7
Proteus spp	M 12	22-32	25	19
n=5(4.4%)	F 03	20-21	21	8
Enterobacter spp	M 0	NA	NA	NA
n=5(4.4%)	F 15	16-22	19	15
Serratia spp	M 06	18-22	20	6
N=2(1.7%)	F 0	NA	NA	0
Pseudomonas	M 0	NA	NA	4
aeruginosa	F 06	19-23	21	NA
n=2(1.7%)				
Providencia spp	M 0	NA	NA	NA
n=1(0.9%)	F 03	23-25	22	4
Total	**M 99** **F 192**			**Means:** **M =9.7 or 10/HPF** **F = 9.2 or 9HPF**

NA = Not Available, HPF = High Power Focus

Table 8 displays the antibiotic susceptibility patterns of all the isolated uropathogens (with exception of *Candida albicans*) to selected antibiotics. The antibiotic sensitivity profiles of the 115 uropathogens to ciprofloxacin, pefloxacin, gentamicin, ofloxacin, streptomycin, erythromycin, tetracycline, cotrimoxazole, augmentin, nalidixic acid, nitrofurantoin, amoxicillin and chloramphenicol are shown. Fourteen(35.9%), 13(46.4%), 8(50.0%), 3(42.9%), 3(60.0%), 2(40.0%), 1(50.0%) and 1(50.0%) strains of *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella aerogenes*, *Coliform* organisms, *Proteus* spp, *Enterobacter* spp, *Serratia* spp and *Pseudomonas aeruginosa* respectively were sensitive to all the 12 (twelve) antibiotics on the average.

In the case of *Staph aureus*, total antibiotics used was 11(eleven) because nalidixic acid and nitrofurantoin were not used for it and whereas erythromycin was used for *Staph. aureus*, it was not used for the other uropathogens. Both nalidixic acid and nitrofurantoin were used for the other uropathogens except *Staph aureus*. The only *Providencia* spp isolated was not sensitive to any of the 12 selected antibiotics. On the average, a higher percentage of pathogens resisted all twelve antibiotics compared to those that were sensitive.

In terms of effectiveness of each antibiotic, 67(63.2%), 65(61.3%), 62(58.5%), 41(38.7%), 41(38.7%), 40(37.7%), 37(34.9%), 36(34.0%), 32(30.2%), 31(29.3%), 30(28.3%) and 15(14.1%) strains of all isolated pathogens were sensitive to gentamicin, ofloxacin, tetracycline, nalidixic acid, chloramphenicol, cotrimoxazole, amoxicillin, streptomycin, ciprofloxacin, pefloxacine, nitrofurantoin and augmentin respectively. The two most sensitive drugs were therefore gentamicin and ofloxacin whereas nitrofurantoin and augmentin were least sensitive. In decreasing order, 91(85.9%), 76(71.7%), 75(70.7%), 74(69.8%), 70(66.0%), 69(65.1%), 66(62.3%), 65(61.3%), 65(61.3%), 44(41.5%), 41(38.7%) and 39(36.8%) of all isolated strains were resistant to augmentin, nitrofurantoin, pefloxacine, ciprofloxacin, streptomycin, amoxicillin, cotrimoxazole, chloramphenicol, nalidixic acid, tetracycline, ofloxacin and gentamicin respectively. This suggests that the two most resisted drugs were augmentin and nitrofurantoin with ofloxacin and gentamicin as the least resisted.

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Table 8: Susceptibility profile of isolated uropathogens to selected antibiotics after 24 hours incubation at 37 ^{o}C

SELECTED ANTIBIOTICS USED														
Isolated Uropathogens	CIP(%) S R	PEF(%) S R	GEN(%) S R	OFL(%) S R	STREP(%) S R	ERY(%) S R	TET(%) S R	COT(%) S R	AUG(%) S R	NAL(%) S R	NIT(%) S R	AMX(%) S R	CHL(%) S R	MEAN(%) S R
Staph aureus n=40(34.8%)	15 25 37.562.5	16 24 40 60	21 19 52.547.5	15 25 37.562.5	15 25 37.5 62.5	12 28 30 70	17 23 42.5 57.5	07 33 17.5 82.5	02 38 5.0 95.0	NA	NA	13 27 32.5 67.5	25 15 62.5 37.5	14 28 35.9 64.1
Escherichia coli n=28(24.4%)	07 21 25.0 75.0	07 21 25.075.0	16 12 57.1 42.9	23 05 82.1 17.9	10 18 35.7 64.3	NA	20 08 71.4 28.6	13 15 46.4 53.6	06 22 21.4 78.6	20 08 71.4 28.6	09 19 32.167.9	13 15 46.4 53.6	08 20 28.6 71.4	13 15 46.4 53.6
Klebsiella aerogenes n=16(13.9%)	04 12 25.0 75.0	04 12 25.075.0	13 03 81.3 18.7	12 04 75.0 25.0	05 11 31.2 68.8	NA	14 02 87.5 12.5	13 03 81.3 18.7	02 14 12.5 87.5	11 05 68.8 31.2	06 10 37.562.5	05 11 31.3 68.7	04 12 25.075.0	08 08 50.0 50.0
Candida albicans n=9(7.8%)	**NOT APPLICABLE (DOES NOT RESPOND TO ANTIBIOTICS)**													
Coliform organisms n=7(6.1%)	01 06 14.3 85.7	01 06 14.385.7	05 02 71.4 28.6	06 01 85.7 14.3	02 05 28.6 71.4	NA	05 02 71.4 28.6	02 05 28.6 71.4	01 06 14.3 85.7	03 04 42.9 57.1	04 03 57.142.9	03 04 42.9 57.1	01 06 14.3 85.7	03 04 42.9 57.1
Proteus spp *n=5(4.4%)*	03 02 60.0 40.0	02 03 40.060.0	04 01 80.0 20.0	03 02 60.0 40.0	03 02 60.0 40.0	NA	04 01 80.0 20.0	02 03 40.0 60.0	03 02 60.0 40.0	02 03 40.0 60.0	04 01 80.020.0	02 03 40.0 60.0	01 04 20.0 80.0	03 02 60.0 40.0
Enterobacter spp *n=5(4.4%)*	01 04 20.0 80.0	01 04 20.080.0	04 01 80.0 20.0	03 02 60.0 40.0	01 04 20.0 80.0	NA	01 04 20.0 80.0	02 03 40.0 60.0	01 04 20.080.0	03 02 60.0 40.0	04 01 80.020.0	01 04 20.0 80.0	02 03 40.0 60.0	02 03 40.0 60.0
Serratia spp *n=2(1.7%*	01 01 50.0 50.0	0 02 0.0 100.0	02 0 100.0 0.0	02 0 100.0 0.0	0 02 0.0 100.0	NA	0 02 0.0 100.0	01 01 50.0 50.0	0 02 0.0 100.0	01 01 50.0 50.0	0 02 0.0100.0	0 02 0.0 100.0	0 02 0.0 100.0	01 01 50.0 50.0
Pseudomonas aeruginosa n=2(1.7%)	0 02 0.0 100.0	0 02 0.0 100.0	01 01 50.0 50.0	01 01 50.0 50.0	0 02 0.0 100.0	NA	01 01 50.0 50.0	0 02 0.0 100.0	0 02 0.0 100.0	01 01 50.0 50.0	02 0 100.00.0	0 02 0.0 100.0	0 02 0.0 100.0	01 01 50.0 50.0
Providencia spp *n=1(0.9%)*	0 01 0.0 100.0	0 01 0.0 100.0	01 0 100.0 0.0	0 01 0.0 100.0	0 01 0.0 100.0	NA	0 01 0.0 100.0	0 01 0.0 100.0	0 01 0.0 100.0	0 01 0.0 100.0	01 0 100.00.0	0 01 0.0 100.0	0 01 0.0 100.0	0 01 0.0 100.0
Total n=106	**32 74** 30.2 69.8	**31 75** 29.3 70.7	**67 39** 63.2 36.8	**65 41** 61.3 38.7	**36 70** 34.0 66.0	**12 28** 30.0 70.0	**62 44** 58.5 41.5	**40 66** 37.7 62.3	**15 91** 14.1 85.9	**41 65** 38.7 61.3	**30 76** 28.3 71.7	**37 69** 34.9 65.1	**41 65** 38.7 61.3	

CIP = ciprofloxacin, PEF = pefloxacin, GEN = gentamicin, OFL = ofloxacin, STREP = streptomycin, ERY = Erythromycin, TET = tetracycline, COT = cotrimoxazole, AUG = augmentin, NAL = nalidixic acid, NIT = nitrofurantoin, AMX = amoxicillin, CHL = chloramphenicol.

Table 9 shows the occurrence frequency of multidrug resistance among the isolated uropathogens. All the nine bacterial uropathogens were resistant to more than three drugs at a time. For clarity and for the purpose of this study. a pathogen is described as multi resistant to any of the selected antibiotics if more than 50% of its strains are resistant to it. A pathogen is multi drug resistant if it resists up to three drugs at a time. Hence, all the nine bacterial pathogens were multi drug resistant (Table 9).

None was resistant to 3 drugs. Only Proteus spp resisted 4 drugs. Klebsiella aerogenes, Serratia spp and Pseudomonas aeruginosa were each resistant to 5drugs. Escherichia coli was resistant to 6 drugs while Coliform organisms and Enterobacter spp each was resistant to 7 drugs. Staph. aureus and Providencia spp were each resistant to 8 drugs (Table 9).

Table 9: Multidrug resistance occurrence of uropathogens in UTI of students under study.

Bacterial Uropathogens	**Resistance to:**					
	3 drugs	**4 drugs**	**5 drugs**	**6 drugs**	**7 drugs**	**8 drugs**
Proteus spp *n = 5*	–	+	–	–	–	–
Klebsiella aerogenes *n = 16*	–	–	+	–	–	–
Serratia spp *n = 2*	–	–	+	–	–	–
Pseudomonas aeruginosa *n = 2*	–	–	+	–	–	–
Escherichia coli *n = 28*	–	–	–	+	–	–
Coliform organisms *n = 7*	–	–	–	–	+	–
Enterobacter spp *n = 5*	–	–	–	–	+	–
Staph. aureus *n = 40*	–	–	–	–	–	+
Providencia spp *n = 1*	–	–	–	–	–	+

Discussion

This work was carried out in order to extend the frontiers of knowledge as far as urinary tract infections are concerned both in Nigeria and around the world but with particular attention to its occurrence among symptomatic and asymptomatic students of the study area. In **Table 2,** 66(22.7%) samples yielded no bacterial growth and out of that number, the urine sediments of 30(45.4%) samples showed significant pus cell count greater than 5/HPF [22]. It therefore suggests that 30(45.4%) urine samples' sediments with significant pyuria ought to have yielded bacterial growth on suitable laboratory media in view of the pus cells count which implied that there was on – going UTI infection. The absence of bacterial growth therefore, despite the corresponding significant pyuria, may be because the 30 students (from whom the 30 urine samples were obtained), may have had urinary tuberculosis, viral infection or Chlamydia infection of the urinary system since the aetiologic agents of these diseases cannot be grown on laboratory culture media [24].

The absence of growth may have also been due to a disease of unknown origin. The absence of bacterial growth in 36(54.6%) urine samples is justifiable in that absence of bacterial growth is clearly established as such when microscopically, a non-significant pus cell count (less than 5) is observed. There was presence and absence of drug metabolites in the sediments of 21(31.8%) and 45(68.2%) samples respectively. The drug metabolites as observed microscopically, implied that 21(31.8%) students (in whose urine sediments the crystals were observed), may have been under antibiotic medication before presenting themselves for sample collection. This is supported by the work of an earlier author [28]. As a consequence, the antibiotics taken may have inhibited bacterial growth particularly in the case of the 9(42.9%) urine sediments in which significant pyuria was observed. The use of midstream urine was aimed at reducing or eliminating the influence of normal flora and other contaminants on expected results.

The 45(68.2%) urine sediments in which drug metabolites were absent and out of which 24(53.3%) samples recorded less than 5/HPF or no significant pyuria was expected as students concerned were probably not on any antibiotic therapy and there was no microscopic evidence of significant pyuria with the corresponding absence of bacterial growth in culture (**Table 2**). Pyuria with a negative urine culture may be found when there is infection with *Chlamydia trachomatis, Ureaplasma or Neisseria gonorrhoeae* or when a patient has taken antimicrobials [29]. More females (66.4%) has pus cells in their urine sediments than males (33.6%) Table 3.

Bacteriuria (presence of bacteria in urine) was also recorded much more in the sediments of female students (64.2%) than in male students (35.8%). Presence of bacteria in freshly voided urine indicates infection [24]. This implies that more females had UTI than male students. The female genitor-urinary tract is more susceptible to colonization with enteric bacteria due to the shortness of its urethra [30]. Besides, the close proximity of the urethral orifice to the rectum (which is in direct contact with perineal microbes), makes females to be more vulnerable to UTI. Also, the anatomical position of the female urethra in relation to the vagina makes it liable to trauma during sexual intercourse, pregnancy or childbirth [31, 32, 16]. Other factors that predispose females to bladder contamination and UTI include improper cleaning of the perineum, the use of napkins and sanitary towel [30]. In males, the sterility of the proximal two-thirds of the urethra, its longer length and the bactericidal effect of prostatic secretion constitute an excellent immunological defense against bacterial infection [30].

Bacteriuria without pyuria may occur in diabetes, enteric fever, bacterial endocarditis or when the urine contains contaminating organisms [29]. Yeast cells occurred as much as 90.0% in the sediments of females as against 9.1% in males (Table 3). According to Cheesbrough [24], yeast cells are found in the urine of women with acute vaginal candidiasis (occasionally seen in the urine of men) and occasionally in specimens from diabetics and those with immunosuppression. The occurrence of spermatozoa in 5.2% of the total samples processed is due to contamination from the genito – urinary tract.

In this study, since out of 291 samples processed, 225(77.3%) yielded significant microbial growth, a urinary tract prevalence rate of 77.3% was obtained. This is consistent with prevalence rates of 71.6% and 77.9% obtained by earlier authors [33, 21]. It is on record that lower rates of 30.0%, 35.5%, 38.6%, 39.0%, 39.7%, 46.5%, 47.5%, 54.0%, 58.0%, 60.0% and 66.0% have been reported by some authors [34, 16, 35, 36, 37, 38, 39, 30, 40, 41, 42]. Other previous authors recorded much lower UTI prevalence rates of 11.9%, 16.5%, 22.0%, 22.3%, 25.6%, 26.7% and 28.1% [43, 44, 45, 15, 46, 47, 48]. The high or low UTI incidence rates may be attributed to the environmental conditions where the subjects reside. This may also be attributed to the lack of proper personal and environmental hygiene, low socio-economic status, sexual intercourse or sexual promiscuity, pregnancy etc, among Nigerian men and women [49, 35, 41].

Also, in this study, of the ten microbial isolates obtained, gram negative bacilli constituted 65.2% while gram positive bacteria accounted for 34.8%. Isolates that belonged to enterobacteriaceae and non–enterobacteriaceae families constituted 55.7% and 44.3% respectively (Table 4). Whereas *Staphylococcus aureus* was the only gram positive bacterium, *Candida albicans* represented the only member of the non – enterobacteriaceae. The other eight isolates were gram negative bacteria and indeed, members of the enterobacteriaceae. Finding is not consistent with the report of a previous author who isolated 86.1% gram negative bacilli and 13.9% gram positive bacteria of which enterobacteriaceae accounted for 49.9% [36]. Finding in this study is also not in tandem with a report by Oluremi *et al.*[50] which stated 85.0% gram negative bacilli and 15.0% gram negative bacteria of which enterobacteriaceae organisms constituted 66.7%.

Results obtained in this study showed that the most and second most isolated uropathogens were *Staphylococcus aureus* (34.8%) and *Escherichia coli* (24.4%). Other uropathogens isolated were *Klebsiella aerogenes* (13.9%), *Candida albicons* (7.8%), Coliforms (6.1%), *Proteus* spp (4.4%), *Enterobacter* spp (4.4%), *Serratia* spp (1.7%), *Pseudomonas aeruginosa* (1.7%) and *Providencia* spp (0.9%). This indicates that the two least isolated uropathogens in the study area are *Pseudomonas aeruginosa* and *Providencia* spp. The occurrence of *Staphylococcus aureus* and *Escherichia coli* as the most and second most implicated organisms in UTI in this study is similar to reports of previous authors (though in reverse order) which stated *E.coli* and *Staph. aureus* as the most and second most implicated organisms in UTI [39, 51]. The present report does not however agree with results of other studies [50, 36, 52, 53, 54, 55, 56, 57, 20, 5, 58]. Report in this study does not also agree with some other previous reports which recorded *Pseudomonas aeruginosa* and *Klebsiella* spp respectively as the predominant bacteria [59, 60]. UTI caused by *Pseudomonas aeruginosa*, *Proteus* spp, *Klebsiella* spp and *Staph aureus* are associated with hospital acquired infections often following catherization or gynaecological surgery [24, 61]. *Proteus* infection is also associated with renal stones [24].

There has been disparity in findings of previous researchers as to which of *Escherichia coli and /or Klebsiella* spp is/are predominant in UTI cases. In this study, *E.coli* and *Klebsiella aerogenes* were the second

and third most occurring unlike other studies which reported *E.coli* as the most occurring [30, 35, 28, 13, 14, 40, 43, 21, 37, 62, 16] and other workers who maintained that *Klebsiella* spp was the most implicated [15, 58, 63, 64]. Some other workers maintained that *Klebsiella* spp was the second most implicated compared to the finding of this study which recorded the organism as the third most occurring [65, 66, 67, 68, 57, 20, 30, 21]. This study, however, further confirmed the prominent involvement of both bacterial pathogens in UTI cases as earlier established by Logoria and Gonzalez [69] and Obiogbolu *et al.* [30].

The low occurrence of *Pseudomonas aeruginosa* (1.7%) in this study agrees with a low occurrence rate of 5.5% reported in a similar study by an author [36] but is not in agreement with mush higher rates recorded by other authors in similar UTI investigations [50, 53, 70, 71, 41, 5]. Overall, UTI prevalence rate was far higher in females (63.3%) than in the male students (36.5%) of which *Staph. aureus* occurred more in the male students than in female students (Table 5). The reason for this, was not clear but lack of circumcision, receptive anal intercourse (as in homosexuals) and HIV infection may predispose males to UTI [3].

Candida albicans occurrence was higher in female students compared to the males. According to Ochei and KolhatKar [29], yeast cells appear in urine as a result of contamination from women with vaginal candidiasis (occasionally seen in the urine of men) or may be seen in the urine of diabetic patients due to presence of sugar in the urine. Yeasts may also cause recurrent infections in debilitated and immuno compromised patients [29, 24]. The occurrence of *Coliform* organisms up to 6.1% should not be ignored because the importance of *Coliform* bacilli in UTI among pregnant women has long been known in developed countries [72]. Behzardi and Behzardi [73] and Moore *et al.* [74] had earlier reported that UTI is caused by *Coliforms* and *Enterococcus* spp due to their presence in high numbers on the perineum.

This study has therefore confirmed reports of other studies which stated that UTI occurs more in females than in males except at the extremes of life [16, 41]. Other reasons (besides those mentioned earlier) to justify higher UTI prevalence rate in females compared to the male students may be due to the use of diaphragms as a contraceptive by the females. It has been stated that the use of diaphragm contraceptive can lead to UTIs because diaphragms push the urethra and make it harder to completely empty the bladder and therefore, urine that stays in the bladder is more likely to grow bacteria and cause infections [75]. Based on data in Table 1, average ages of 61.9% and 33.0% of the total sample size who occurred in the 15 – 20 and 21 – 25 age groups respectively were 19yrs and 24yrs respectively with female students consisting 58.3% of the first group. Some authors have reported that UTI is more frequent in females than in males during youth and adulthood [76, 77, 78, 21].

To buttress further the fact that UTI occurs more in females than males, a mixed microbial infection occurrence rate of 62.5% was recorded from cultural studies done on female urine samples as against 37.5% for the male students of which the most and second occurring uropathogens in mixed culture were *E.coli/Staph. aureus* (27.5%) and *Staph aureus/Coliform* organisms (17.5%) Table 6. The last two least occurring mixed infections were due to the mixed cultures of *Coliforms/Kleb aerogenes/Staph. aureus* (2.5%) and *Serratia* spp/*E.coli/Staph. aureus* (2.5%). Clearly, multiple bacterial infection in females as indicated in this study due mainly to *E.coli* and *Staph. aureus* as well as *Staph. aureus* and *Coliform* organisms may be due to some (if not all) of these organisms being accidentally transferred from the large intestine via the anus to the vagina due to the proximity between them [16, 41]. These organisms are resident or transient microflora in the bowels (large intestine) but may become opportunistic pathogens when fortuitously introduced into the vaginal environment.

UTI in this study, occurred highest in the 18 – 27 (23yrs average) followed by 16 – 28 (22yrs average) and 17 – 33(20yrs average) age groups. Others were 16 – 25 (21 average) and 19 – 22 (21yrs average) age groups (Table 7). These age brackets consist of teenagers, adolescents and young people. These young students are characteristically vulnerable to increased sexual activity which predisposes them to UTI and this view is supported by reports of similar studies on UTI by earlier authors [50, 37]. Finding is not in agreement however, with reports of other workers [79, 80, 21, 35, 76]. Data in this study are also incongruous with reports of Oluremi *et al.* [50], Shigemura *et al.* [70], Oladeinde *et al.* [37] and McCue [81].

Average (mean) neutrophil (pus cells) count of 10/HPF obtained each for both male and female students' urine deposits indicates that almost all the students were significantly infected with UTI. This is because against the baseline of ≤ 5/HPF for infection to be established, 10/HPF is a significant pyuria.

The distribution of isolated uropathogens with respect to age groups as presented in Table 7 indicates that from the youngest to the oldest in terms of average ages, *Enterobacter* spp, *Klebsiella aerogenes*, *Candida albicans*, *Escherichia coli* and *Staph. aureus* were isolated from students of 19yrs, 20yrs, 21yrs, 22yrs and 23yrs (average ages) respectively. *Proteus* spp and *Coliform* organisms were isolated from older students of 25yrs and 26yrs (average ages) respectively. Finding in this regard is inconsistent with an author's earlier report which stated *Alcaligens* spp, *Proteus mirabilis*, *Klebsiella aerogenes* and *Staphylococcus aureus* as occurring in out patients of 38yrs, 33yrs, 34yrs and 44yrs (average ages) respectively [36]. *Enterobacter* spp, *Pseudomonas aeruginosa* and *Providencia* spp were not isolated from urine of male students of any of the studied age groups. This may have occurred by chance and not necessarily suggesting that these organisms may have preference for females. In the same vein, none of the *Serratia s*pp recorded in this work was isolated from any of the female age groups.

UTI is the second most common clinical indication for empirical antimicrobial treatment in primary and secondary care [82]. There is considerable evidence of practice variation in use of diagnostic tests, interpretation of signs or symptoms and initiation of antibiotic treatment such as drug selection, dose, duration and route of administration [83]. For patients with symptoms of UTI and bacteriuria, the main aim of treatment is to get rid of bacteria causing the symptoms. Besides, there is the need to obtain sensitivity reports before the start of antibiotic treatment to checkmate emergence of resistance strains and thus help in proper patient management. However, the decision to use a particular antibiotic depends on its toxicity, cost and attainable level [76].

For this purpose, antibiotic sensitivity testing was done on all 9 isolate (minus *Candida albicans* – a fungal uropathogen in this study) and the resulting profile showed susceptibility reactions of 67(63.2%), 65(61.3%), 62(58.5%), 41(38.7%), 41(38.7%), 40(37.7%), 37(34.9%), 36(34.0%), 32(30.2%), 31(29.3%), 30(28.3%), 15(14.1%) and 12(30.0%) for gentamicin, ofloxacin, tetracycline, nalidixic acid, chloramphenicol, cotrimoxazole, amoxicillin, streptomycin, ciprofloxacin, pefloxacin, nitrofurantoin, augmentin and erythromycin respectively. This suggests that more than 50.0% of the bacterial uropathogens implicated in UTI in this study were sensitive to gentamicin, ofloxacin and tetracycline (Table 8). This is both surprising and cheering. Surprising because gentamicin and tetracycline due to their cheapness and availability, ought to be prone to abuse with the attendant development of resistance genes by pathogens to it. It is cheering because

patients who go down with UTI can afford them if prescribed. Their use and administration, however, should be closely monitored in order to avoid any possible abuse owing to their accessibility, availability and cheapness.

Less than 50.0% of all the bacterial pathogens implicated in this study were sensitive to nalidixic acid, chloramphenicol, cotrimoxazole, amoxicillin, streptomycin and ciprofloxacin. The fluoroquinolones (apart from ofloxacin which recorded 61.3% sensitivity) recorded below moderate sensitivities i.e. ciprofloxacin (30.2%) and pefloxacine (29.3%). This is quite low when compared with 71.4% sensitivity recorded for ciprofloxacin by Oluremi *et al.* [50]. The sensitivity recorded for ciprofloxacin and pefloxacine in this study are quite low when related to the reports of some previous workers [59, 84, 70, 66, 85, 86, 21, 87, 41, 5].

A high sensitivity recorded however for Ofloxacin in this work was expected as it is a drug that is not commonly abused due to its high cost. Hence the low sensitivity recorded for ciprofloxacin and pefloxacin was worrisome as these drugs are expensive and therefore, are not readily accessible for abuse. In a similar study, Nakhjavani *et al*. [18] reported that the widespread use of flouroqunolones in medical centres is a possible cause of high level resistance to fluoroquinolones in UTI patients. Nwadioha *et al.* [58] surprisingly recorded a high sensitivity (80.0%) and above of UTI bacterial agents with ciprofloxacin. This is however open to re–evaluation through further studies by other workers.

The high sensitivity recorded for gentamicin (63.2%) was quite an enigma because the reverse was expected owing to its cheapness and widespread use in the hospital and health care centres. Resistance of UTI pathogens to commonly used antibiotics may not be unconnected with their frequent prescription in hospitals, their easy availability in the community without prescription and their low cost which make them subject to abuse [20]. Augmentin recorded 14.1% sensitivity which was disturbing in view of its usefulness in the treatment of UTIs and other diseases. The total or complete resistance of augmentin is worrisome as it may have lost its value in the treatment of UTI [50]. Erythromycin recorded a sensitivity rate of (30.0%) and this also calls for concern as erythromycin is one of the first line drugs used in the treatment of infections/diseases caused by *Staph. aureus.*

All the nine bacterial organisms were resistant (each) to more than 3 drugs and hence they were all multi – drug resistant (MDR). A pathogen is multidrug resistant (MDR) when it is resistant to three more antibiotics [88]. In this study, *Proteus* spp, *Klebsiella aerogenes, Serratia* spp, *Pseudomonas aeruginosa, Escherichia coli, Coliforms, Enterobacter* spp, *Staph. aureus* and *Providencia* spp were resistant to 4 drugs, 5 drugs, 5 drugs, 5 drugs, 6 drugs, 7 drugs, 7 drugs, 8drugs and 8 drugs respectively (Table 9). *Staph aureus* resisted 8 drugs. This may be due to penicillinase encoding genes it carries on its plasmids as well as other extracellular and intracellular factors on the organism. Besides, multidrug resistant *Staph. aureus* strains have been widely reported in some studies [65, 43, 20]. The multidrug resistant nature of *P. aeruginosa* is well known [89]. This high prevalence of multiple antibiotic resistant strains in this study is a possible indication that very large population of bacterial isolates has been exposed to several antibiotics [50].

Conclusion

Most of the uropathogens (if not all) isolated in this study are excretable through urine to the environment. The high prevalence rate of UTI therefore amongst the students enrolled for the study calls for a re-assessment of the source of their drinking water and indeed Oghara town in general. Besides, the students

would need to step up their personal hygiene in their hostels and immediate environment. Where signs and symptoms of UTI are noticed notwithstanding the above, healthcare providers of the University may administer one or two of gentamicin, ofloxacin or tetracycline for therapy. Such prompt therapeutic intervention will prevent asymptomatic UTI cases recorded in this study from becoming symptomatic at a later time with the consequent renal damage that may follow.

Be that as it may, the healthcare policy of antibiotics prophylaxis should be reviewed in order to address emergence of resistance genes as a consequence. Such a review should be directed at regular reporting of sensitivity patterns of UTI pathogens and other diseases, before commencement of therapy, the use and type of which should depend on its toxicity, affordability and effectiveness. The University authority should endeavor to regularly check pipe–borne water it provides the students within the school premises and in their hostels. Health care delivery agencies in and around Oghara should encourage residents to imbibe improved personal hygiene techniques through extensive education and landlords in the town must be made to provide standard and clean toilet facilities for their tenants (some of whom may be off campus students of the University) and erring landlords should be sanctioned.

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