Case Report ISSN 3065-565X

International Journal of Research in Virology

Spectrum of Urinary Tract Infection and Antibiogram among College Students

Moses Nnaemeka Alo, Uchenna I Ugah, Favour Ugochi Anosike and Charles Chinyere Dike*

Department of Biology/Microbiology/Biotechnology, Federal University, Ndufu Alike Ikwo, Ebonyi State, Nigeria.

***Correspondence:**
Charles C Dike, Department of Biology/Microbiology/Biotechnology, Federal University, Ndufu Alike Ikwo, Ebonyi State, Nigeria, Tel: +2349036079212.

Received: 07 Aug 2024; **Accepted:** 13 Sep 2024; **Published:** 20 Sep 2025

Citation: Moses Nnaemeka Alo, Uchenna I Ugah, Favour Ugochi Anosike, et al. Spectrum of Urinary Tract Infection and Antibiogram among College Students. Int J Res Virol. 2025; 1(2): 1-6.

ABSTRACT

Urinary Tract Infection (UTI) is one of the most common infections in humans both in the community and hospital settings and is the cause of morbidity and mortality among the populace. The study was conducted to assess the prevalence of Urinary Tract Infection among undergraduate students. The study was carried out at Federal University Ndufu Alike Ikwo, within the period of April, 2016 to June, 2016. Twenty milliliter of clean catch mid stream urine was collected from 390 students (219 females and 171 males) within the age range of 17-40. 0.02ml of each urine sample was inoculated onto different bacteriological media and incubated at 370C for 24 hours. The results indicated that the overall prevalence of urinary tract infection in the area was 62.8%. However, the prevalence rate was significantly higher in females than in males (females: 52.4%; males: 41.8%; P = 0.009), hence the χ^2test for trend results showed significant variations (P<0.05) between the female to male ratio variables. The most frequently isolated species was E. coli (49.0%) followed by Klebsiella species (17.1%), Proteus species (13.5%), Staphylococcus aureus (8.2%), and Pseudomonas aeruginosa (7.3%), Enterococcus faecalis (4.9%). Students within ages 21-24 (62.4%) had the highest prevalence while students in 200 level (28.2%) had the highest prevalence rate of Urinary Tract Infections. The isolates were subjected to susceptibility test using the commonly used antibiotics in the University Clinic and the results revealed that Gentamycin was the most effective antibiotic against most isolates followed by Augmentin and Peflacin. In contrast, Septrin, Ampicillin, Ceporex, Streptomycin, Ciprofloxacin, Tarivid and Nalidixic acid were the antibiotics to which most of the isolates developed resistance. There is therefore need to monitor the profile of etiological agents of Urinary Tract Infection and the antimicrobial resistance regularly to keep track of effectiveness of therapeutic agents.

Keywords

Antibiogram, Spectrum, College Student, Urinary Tract Infection.

Introduction

Micro organisms are ubiquitous and found thriving and living in the air, water body, soil, food, living system and also in the urinary tract of human. They thrive and inhabit different environment because of the suitability of such environment. In Africa and South-East Asia, 45% of death was reported by World Health Organization (WHO) to be caused by infection while 48% of premature deaths were also caused by bacterial infection [1]. Urinary tract infection (UTI) is one of the most common bacterial infections that occur in all sexes and age groups of human [2]. According to [3], Urinary Tract infection is seen as one of the oldest diseases of man and was first documented and described in the Ebers Papyrus in 1550 BC. [3] asserted that the Egyptians referred it as "sending forth heat from the bladder" and herbs, bloodletting and rest was recommended as treatment option before 1930 when antibiotics has not been developed.

Urinary Tract infection is defined as a state in which bacteria invade and proliferate within the urinary tract or is also seen as a situation characterized with clinical presentation and presence of more than 100,000 CFU/ml of bacteria in urine sample [3,4]. It could be either acquired by hematogenous or ascending route, the hematogenous infection occurs as resulting of bacteria infecting the urinary tract, while the ascending infection occurs as a result of invasion of bacteria from the gastrointestinal tract, which result from disturbances arising from the normal flora [5]. Urinary Tract Infection could either be symptomatic or asymptomatic

infection. Asymptomatic infection refers to the infection which involves presence of bacteria in urine without corresponding signs or symptoms whereas symptomatic infection are those which involves presence of bacteria as well as corresponding signs and symptoms [6].

Asymptomatic infection occurs when uropathogens enter the bladder without causing any symptom and if the immune system is effective, then the pathogens can be gotten rid of from the body after a short time and if it persist after a long time in the urinary system, symptoms then manifest [7]. Frequency, dysuria, abdominal pain, back pain, fever, cloudy, dark, bloody, or unusual-smelling urine, difficulty in urination and urgency in urinating are some of the symptoms which can be experienced when bacteria infect the urinary tract [4,8]. Kidney damage and scarring occurs most times in patients particularly in children below five years of age, whether they are asymptomatic or symptomatic carriers [9].

Micro organisms implicated in Urinary Tract Infection include *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Staphylococcus saprophyticus, Proteus species, Klebsiella species, Neisseria gonorrhoeae*, and most times yeast like Candida albican and even viruses [10]. *Escherichia coli* is the most commonest and frequent urinary pathogen, accounting for 65% to 90% of Urinary Tract Infection in human [11]. Reports in Nigeria have shown that *E. coli* is the most common organism isolated in cases of urinary tract infection followed by *Staphylococcus aureus* and *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* [12]. Increasing multidrug resistance in bacterial uropathogens is an important and emerging public health problem and as a result, calls for regular monitoring of the antibiotic susceptibility of uropathogens in a particular area. The study is designed to assess the prevalence and antibiogram of bacteria causing UTI among students of Federal University Ndufu Alike Ikwo, Ebonyi State.

Methodology

Study Population

A total of 390 students (219 females and 171 males) were sampled for the study, within April to June, 2016.

Sample Collection

Mid-stream "clean catch" urine samples were collected randomly from FUNAI students, with well labeled wide mouthed universal sterile containers with screw caps. Instructions were given to the students on how to get proper samples. The samples were transported immediately to the Microbiology Laboratory of FUNAI, for investigation.

Bacteriological Analysis

The urine samples were macroscopically observed to identify the colour, turbidity and odour. This was followed by microscopic examination of the urine samples for the presence of bacteria, cyst, crystals, Red Blood Cells (RBC) and pus cells. The urine samples were inoculated onto CLED, Blood and Mac-Conkey agar and incubated at 37°C for 24 hours to check for bacterial growth. After incubation, colonies on both plates were counted as colony forming units (cfu/ml). Representatives of each characteristic and discrete type of colonies on the agar plates were isolated and subjected to microscopical and appropriate biochemical tests as stated by [10].

Antibiotics Susceptibility Testing

The bacterial isolates were subjected to antibiotic susceptibility testing, using the Kirby Bauer agar disc diffusion method as described by [10]. The antibiotics discs (Optun lab) used had different antibiotics impregnated on a disc of about 8 mm. The antibiotic discs composed of Septrin (30mcg), Nalidixic acid (30mcg), Augmentin (30mcg), Ceporex (10mcg), Ampicillin (30mcg), Ciprofloxacin (10mcg), Gentamycin (10mcg), Peflacin (10mcg), Tarivid (10mcg), and Streptomycin (30mcg).

Measurement of Zone of Inhibition

The zone of inhibition were read by measuring the diameter of the zone of clearance on each antibiotics used. Interpretative charts to determine the sensitive pattern was done using the method described by NCCLS [13] and the Zones of inhibition of 18 mm and above were considered sensitive, 13-17 mm intermediate and <13 mm resistant.

Statistical Analysis

The percentage frequency of occurrence of the bacteria isolated from urinary tract infected students in Federal University Ndufu-Alike, Ikwo was calculated using the method described by [14]. The Chi-square was also calculated, where the p-value is a function of the observed sample results.

Results

The study shows that 390 students (219 females and 171 males) that were tested, 166 female samples and 79 male samples tested positive for urinary tract infections, six bacteria species (*Escherichia coli, Klebsiella species, Proteus species, Pseudomonas aeruginosa, Enterococcus faecalis* and *Staphylococcus aureus*) were isolated and identified as shown in Table 1.

	Cell Morphology	Gram Stain	Catalase Test	Oxidas Test	Coagulase Test	Citrate Test	Methyl Red Test	Indole Test	Motility Test	Glucose	Lactose	
Pink	Mucoid colonies	-	+	-	NA	+	+	-	-	+	+	*Klebsiella species*
Bluish Greenish	Small round colonies	-	+	-	NA	+	+	-	+	+	-	*Proteus species*
Creamy	Raised/ smooth edge	+	+	-	+	+	-	-	-	+	-	*Staphylococcus aureus*
Light Yellow	Slightly raised	-	+	+	NA	+	-	-	-	+	-	*Pseudomonas aeruginosa*
White	Small rough raised surface	-	+	-	NA	-	+	+	+	+	+	*Escherichia coli*
White mucoid	Small smooth colonies	+	-	-	NA	+	+	+	-	+	+	*Enterococcus faecalis*

Table 1: Characteristics of bacteria isolates isolated from Urinary Tract

Infection among FUNAI student.

Keys: +: Present: -: Absent; N/A: Not Applicable

From the study, *Escherichia coli* was the highest bacterial isolate implicated in the etiology of UTI in this study, with a percentage of 49% (120), followed by *Klebsiella species, Proteus species, Staphylococcus aureus, Pseudomonas aeruginosa* and *Enterococcus faecalis*, with a percentage of 17.1% (42), 13.5% (33), 8.2% (20), 7.3% (18) and 4.9% (12) respectively (Table 2).

Level of Education	*Escherichia coli*	*Klebsiella species*	*Proteus species*	*Staphylococcus aureus*	*Enterococcus faecalis*	*Pseudomonas aeruginosa*
100 level	29(46.0%)	8(12.7%)	10(15.9%)	6(9.5%)	4(6.3%)	6(9.5%)
200 level	27(39.1%)	15(21.7%)	11(15.9%)	4(5.8%)	7(10.1%)	5(7.2%)
300 level	26(53.1%)	9(18.4%)	5(10.2%)	6(12.2%)	0(0.0%)	3(6.1%)
400 level	38(59.4%)	10(15.6%)	7(10.9%)	4(6.2%)	1(1.6%)	4(6.2%)
Total	120(49.0%)	42(17.1%)	33(13.5%)	20(8.2%)	12(4.9%)	18(7.3%)

Table 2: Prevalence of uropathogens among UTI positive students by species of bacteria.

Out of the 390 (219 females and 171 males) samples enrolled for the study, 32.2% of the males and 67.8% of the females were shown to be infected with the etiological agents (Table 3).

Sex	No. Examined	No. Positive (%)
Male	171	79 (32.2)
Female	219	166 (67.8)
Total	390	245 (62.8)

Table 3: Prevalence of Urinary Tract Infection among FUNAI students, according to demographic data (sex).

From the study, higher prevalence of UTI were observed in the age group of 21-24, with a percentage of 62.4%, while the least prevalence were observed in the age group of 33-36, with a percentage of 0.4 % (Figure 1).

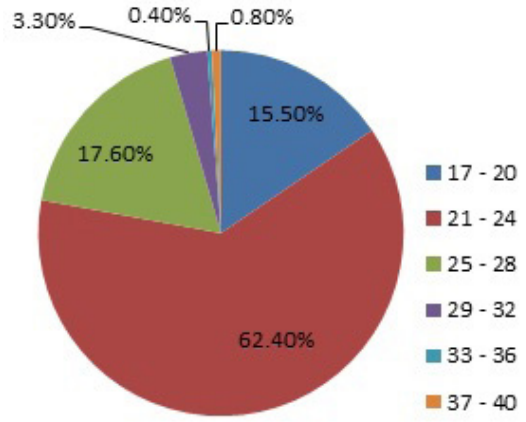

Figure 1: Prevalence of Urinary Tract Infection among FUNAI students, according to demographic data (age).

With respect to level of education among the students, 200 level students showed the highest prevalence rate of urinary tract infection (28.2%) followed by the 400 level students (26.1%), 100 level students (25.7%) and the least prevalence in 300 level students (20.0%) (Table 4).

Level of Education	No. Examined	No. Positive (%)
100 Level	98	63 (25.7)
200 Level	97	69 (28.2)
300 Level	97	49 (20)
400 Level	98	64 (26.1)
Total	390	245 (62.8)

Table 4: Prevalence of Urinary Tract Infection among FUNAI students, according to level of education.

Antibiotics susceptibility test was carried out on 245 bacterial isolates. Organisms showed highest resistance to Septrin (73.6%) and Ampicillin (66.8%) followed by Nalidixic Acid (62.3), Streptomycin (57.6%), Tarivid (53.8), Ciprofloxacin (55.0%), and Ceporex (53.8%), whilst Gentamycin (63.3%) showed the highest susceptibility followed by Augmentin (62.2%) and Peflacin (59.1%) (Table 5 and Figure 2).

Antibiotics	*Escherichia coli* n=120		*Klebsiella species* n=42		*Proteus species* n=33		*Staphylococcus aureus* n=20		*Enterococcus faecalis* n=12		*Pseudomonas aeruginosa*		Mean total	
	S R		S R		S R		S R		S R		S R		S R	
	%		%		%		%		%		%		%	
Gentamicin	66.7	33.3	66.7	33.3	69.7	30.3	60	40	33.3	66.7	83.3	16.7	63.3	36.7
Tarivid	46.7	53.3	11.9	88.1	51.5	48.5	65	35	41.7	58.3	50	50	44.5	55.5
Peflacin	83.3	16.7	52.4	47.6	63.6	36.4	25	75	75	25	55.6	44.4	59.1	40.9
Ciprofloxacin	52.5	47.5	19	81	66.7	33.3	65	35	0	100	66.7	33.3	45.0	55.0
Augmentin	63.3	36.7	59.5	40.5	81.8	18.2	60	40	41.7	58.3	66.7	33.3	62.2	37.8
Streptomycin	14.2	85.8	50	50	15.2	84.8	25	75	66.7	33.3	83.3	16.7	42.4	57.6
Ceporex	30	70	14.3	85.7	66.7	33.3	55	45	50	50	61.1	38.9	46.2	53.8
Nalidixic Acid	10.8	89.2	16.7	83.3	78.8	21.2	70	30	16.7	83.3	33.3	66.7	37.7	62.3
Septrin	8.3	91.7	11.9	88.1	12.1	87.9	65	35	50	50	11.1	88.9	26.4	73.6
Ampicillin	30	70	16.7	83.3	9.1	90.9	10	90	33.3	66.7	100	0	33.2	66.8

Table 5: Antibiotic sensitivity pattern of bacterial isolates from FUNAI students.

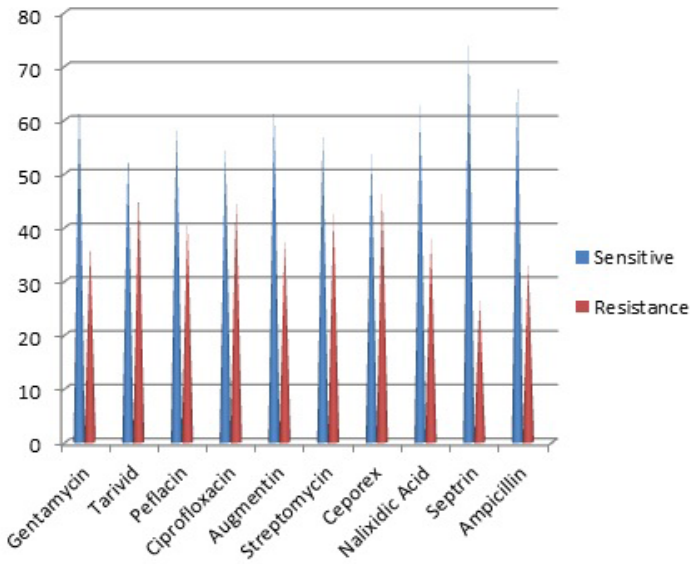

Figure 2: Overall percentage of Bacteria isolates sensitivity and resistance.

Discussion

Urinary tract infection (UTI) is one of the most common bacterial infections that occurs in all sexes and age groups of human [2]. Urinary tract infection is the cause of morbidity in both community and hospital related infection. It is the most common infection in the world after infection of the respiratory system [15] and they account for majority of the visits to seek medical care in hospital [16]. [14] asserted that the global population of people suffering from UTI stands at about 150 million people, which result to about USD 6 billion health care expenditures. It is not only a problem because of the large number of infections that occur but its diagnosis is not always straight forward [8].

Out of the 390 samples enrolled for the study, 166 (67.8%) female samples were positive, while 79 (32.2%) male samples were positive. This finding is in line with the work of [14] in the same state (Ebonyi state), who recorded a higher prevalence of UTI in female (62.9%) than in male (37.1%). This result is consistent with those reported by [17] and [18] who observed that the prevalence of UTI was higher in females than in males. The differences in UTI prevalence among both sexes could be attributed to the anatomical differences in the urogenital organs between the two sexes. The higher prevalence observed in females from the study could be attributed to the shortness of the urethra and its proximity to the anus [19].

In the same vein, the highest prevalence of UTI were seen among the students within the age range of 21-24 years, with a percentage of 62.4%, followed by 25-28 years (17.6%), 17-20 year (15.5%), 29-32 years (3.3%), while 33-36 and 37-40 years showed the lowest prevalence (0.4% and 0.8% respectively). The low prevalence rate of UTI reported among the age group of 33-36 and 37-40 is basically due to the fact that only few students who fall into that age group are still in the school. This result is contrary to the findings of [14], who observed higher prevalence in the age group of 37-47. The highest prevalence of UTIs among the 200 level students might be attributed to the extremely poor hygienic state of their hostel popularly referred to as "BUNGALOW" as most of the students are always complaining of toilet infection and they visit the school medical centre regularly. The low prevalence rate of urinary tract infection reported among the 300 level students in this study is basically due to the fact during the period of this study; most of the students in this level were on their Industrial Training programmes and as a result were not exposed to poor hygiene in toilet facilities.

Escherichia coli was the highest bacterial isolate implicated in the etiology of UTI in this study, with a percentage of 49% (120), followed by *Klebsiella species, Proteus species, Staphylococcus aureus, Pseudomonas aeruginosa* and *Enterococcus faecalis*, with a percentage of 17.1% (42), 13.5% (33), 8.2% (20), 7.3% (18) and 4.9% (12) respectively. The result is almost similar to the findings of [20]. The 17.1% prevalence rate reported by *Klebsiella species* in this study brings to light the fact that they are achieving more prominence as etiological agents of UTI than that previously reported by [6]. Contrary to the findings of this study, [21] reported low prevalence rate of *Escherichia coli* (13.0%) from urinary tract infection patients.

From the result of the study, it can be deduced that there is significant difference in the prevalence of urinary tract infection among male and female students tested at Microbiology Laboratory, FUNAI ($P<0.05$). The highest prevalence rate of *Escherichia coli* obtained from the students in this study (52.4% in females and 41.8% in males) is in line with the findings of [14] which had *Escherichia coli* as the highest occurring bacterial isolate in both males and females. This is a clear indication that *Escherichia coli* can be isolated from urinary tract infections. Usually, *Escherichia species* originate as harmless micro organism in the intestine and spreads to the vagina passage where they invade and colonize the urinary tract [22]. The second most prevalent bacteria isolate obtained from the students in this work is *Klebsiella species* for males and females are 13.9% and 18.7% respectively. [10] revealed that *Klebsiella species* are likely to be associated with infections of the urinary tract where they may cause infection especially in immunocompromised patients. The third most prevalent bacteria are the *Proteus species* for females (7.8%), males (25.3%). A single colony of *Proteus species* in the urine is of health significance since the urine is supposed to be sterile. Also, owing to the fact that *Proteus species* is not a normal flora of the urine; its presence is a sign that the urine is contaminated.

However, the result of this work shows that the incidence of *Proteus* induced urinary tract infection among the male students of FUNAI is relatively high (25.3%) compared to the female students (7.8%) and is in line with the work done by [23] who had a *Proteus species* prevalence of 18.5% and 17.4% in males and female respectively. The fourth most prevalent bacteria are *Staphylococcus aureus* for females (9.0%), males (6.3%). This is in accordance with the findings of [24] who reported *Staphylococcus aureus* to be the more prominent microorganism in females than males. This may have been as a result of infection of the anterior urinary tract

or possible human contamination. This result is contrary to the findings of [25], who observed that *Staphylococcus aureus* is the second most prevalent bacteria pathogens associated with urinary tract infections. Subsequently, the lowest bacteria isolates were *Pseudomonas aeruginosa* (6.3% in males and 7.8% in females), followed by *Enterococcus faecalis* (6.3% in males and 4.2% in females). The presence of *Proteus species, Pseudomonas species, Enterococcus faecalis* and *Klebsiella species* in the urine sample however should not be overlooked as they are also implicated in nosocomial infections. This result is also in accordance with the report of [14] and [26] who reported the presence of *Proteus species*, *Pseudomonas species* and *Klebsiella species* in urine samples of patients.

The high resistance of *Escherichia coli* to most antibiotics in this work is also similar to what was reported in Ibadan-Nigeria by [27] and also in Mumbai- India by [28] and Kermanshah-Iran by [29]. The resistance of *Escherichia species* to most antibiotics is often mediated by β-lactamases which are unaffected by exposure of the bacterium to the potential drugs [14]. Antibiotics are the main treatment for all UTIs. A variety of antibiotics are available, and choices depend on many factors, including whether the infection is complicated or uncomplicated or primary or recurrent [30] Worldwide data show that there is increasing resistance among urinary tract pathogens to conventional drugs [14].

The result of the overall antibiotic susceptibility test showed that the isolates were generally highly susceptible to Gentamycin (63.3%), followed by Augmentin (62.2%), Peflacin (59.1%), Ceporex (46.2%), Ciprofloxacin (45%), Tarivid (44.5%), Streptomycin (42.4%) while Nalidixic acid (37.7%), Ampicillin (33.2%) and Septrin (26.4%) showed low susceptibility. Gentamycin had the highest susceptibility (63.3%) while Septrin had the highest resistance (73.6%). Ciprofloxacin is one of the most commonly used fluoroquinolone for serious UTIs but it could have serious side effects such as damage to hearing, sense of balance and kidneys [22]. The high efficacy of Gentamycin in the treatment of UTIs has also been reported [31]. A high susceptibility of overall bacterial isolates to Peflacin with an activity of 75.0% was recorded according to [14]. *Staphylococcus aureus* was reasonably susceptible to Ciprofloxacin (65%). It is also in line with the work of [32].

Conclusion

UTI is one of the most common problems throughout the world and in the study area as well. In addition, bacterial resistance to commonly used antibiotic agents is widespread phenomenon all over the world. The importance of this study lies in its contribution in assessing the prevalence of bacterial uropathogens and their in vitro susceptibility pattern to commonly used antibiotic agents amongst students of FUNAI. Statistical analysis revealed that there was a significant relationship between sex and UTI causing microorganisms (P=0.009) and also age and UTI causing microorganisms (P=0.024). Poor hygienic practice of the students living in the hostels, improper urine storage and lack of genital hygiene were important risk factors for the high prevalence of UTI. The high resistance profile of the overall bacteria to Septrin, Ampicillin, Ceporex, Streptomycin, Ciprofloxacin, Tarivid and Nalidixic acid observed in this study might be associated with frequent use of the antibiotics within FUNAI community as most students undergo self-medication. Due to reasonable susceptibility pattern shown by Gentamycin, Augmentin and Peflacin, these antibiotics should be the drugs of choice in the treatment of UTIs among students of FUNAI. Also, early diagnosis of UTI is advised to prevent chronic renal damages.

Generally, as there was no previous study and published information on UTI in the study area, this study has provided baseline data on the prevalence, drug sensitivity, and some potential risk factors of UTI and is, therefore, of clinical and epidemiological significance. I hereby recommend that similar studies should be carried out in other institution in the country and also, good hygiene should be practiced by students. School management should enact laws that will encourage school hostel occupants to practice good hygiene in the hostels. Apart from enacting laws, government should provide more hostel accommodations to government owned institution, so as to decongest the number of people leaving in each room in the hostel and also reduce the number of persons sharing the same convenience. Health education (Personal hygiene) should be incorporated as a compulsory General Studies (GST) course every undergraduate must offer in the university, irrespective of discipline.

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