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The Prevalence and Trend of Urinary Tract Infection among Patients Attending Hospitals in Rivers State

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Abstract

Urinary tract infection remains one of the most common infections, both in the community and in the hospital. The ever-increasing number of patients presenting with urinary tract infection and the number of relapse cases of urinary tract infections after treatment in rivers state, Nigeria. The prevalence and trend of urinary tract infection, isolation and identification of bacteria isolates from urine samples were examined and the determination of the antibiogram of isolates among patients attending hospitals in rivers state. A total of sixty (60) early morning midstream urine samples were collected from different hospital patients who are sexually active between the ages of 18years and 45years. 30 urine samples were obtained from the University Of Port Harcourt Teaching Hospital (UPTH) and 30 urine samples also O.B. Lulu-Briggs Health Centre respectively and were macroscopically and microscopically examined. Out of the 60 samples, 40 of them were collected from females while 20 of them from males. The bacteria isolates identified during this study include *Escherichia coli*, *Klebsiella sp*., *Staphylococcus aureus*, *Streptococcus sp*., *Proteus sp*. and *Pseudomonas aeruginosa*. The number and percentage frequency of occurrence of bacteria isolated from the urine samples that had growth are *Escherichia coli* 17 (40.4%), *Klebsiella sp*. 6 (14%), *Staphylococcus aureus* 9 (21.4%), *Streptococcus sp.* 3 (7.14%), *Proteus sp.* 4 (9.5%), and *Pseudomonas aeruginosa* 4 (7.14%). For samples collected at Lulu Briggs Health Centre, the bacterial isolates obtained are *Escherichia coli* 7 (38.8%), *Klebsiella sp.* 2 (11%), *Staphylococcus aureus* 5 (27.7%), *Streptococcus sp*. 2 (11.1%), *Proteus sp*. 1 (5.5%), and *Pseudomonas aeruginosa* 1 (5.5%). For samples collected at University of Port Harcourt Teaching Hospital (UPTH), the bacterial isolates obtained are *Escherichia coli* 10 (41.7%), *Klebsiella sp.* 4 (16.6%), *Staphylococcus aureus* 4 (16.6%), *Streptococcus sp*. 1 (4.1%), *Proteus sp.* 3 (12.5%), and *Pseudomonas aeruginosa* 2 (8.3%) (Figure 1).

Keywords: Urinary tract infection • Prevalence • Bacterial • *Escherichia coli* • *Staphylococcus aureus*

Introduction

A urinary tract infection (UTI) is an infection of the urinary system, including the bladder and urethra [1,2]. It is any microbial invasion that results in an inflammatory response in the epithelium of the urinary tract and usually involves any part of the urinary tract (kidney, ureters, bladder and urethra) [3]. Urinary tract infections (UTIs) are among the most common conditions requiring medical treatment with 6% - 10% of all young females demonstrating bacteriuria including males but rare [4].

The incidence of UTIs increases with age and 25% - 50% of females aged 80 or more have bacteriuria [5]. The prevalence of UTIs in men is significantly lower than in women, occurring primarily in men with urologic structural abnormalities and in older adult men.

UTI is the major cause of morbidity in hospital and community settings, and it occurs in all age groups and both genders. It is one of the most common infections to plague man worldwide and causing serious health problems affecting millions of people each year [6-8]. Urinary tract infections may arise from ascending, haematogenous or lymphatic routes, following colonization or periurethral area by enteric microorganism and there are some special features possessed by the microorganism can enable them establish the infection [9].

UTI have ability to adhere to urinary epithelial cells; Adhesins found on the uropathogen are responsible for attachment of the bacteria to the uroepithelial cell membrane of the host. Similarly, some strains of *E. coli* possess pili interacting with galactose containing receptor sites on epithelial cell surface [10,11]. And *Proteus sp*. possesses urease, which raises the pH and cause precipitation of phosphate crystals leading to stone formations.

Some persons are at greater risk than others of developing UTIs which includes sexually active women who are vulnerable, this is because the urethra is only four centimeters long and bacteria have only this short distance to travel from the outside to the inside of the bladder. People with urinary catheters such as people who are critically ill, who can't empty their own bladder also are at high risk of UTI [12].

The predominant etiologic agents of UTI are Enterobacteriacae like *Escherichia coli* and *Klebsiella sp.* and they are found in 90% of acute complicated infection as reported by Niall Davis and Hugh Flood [13]. Gram positive organisms like *Staphylococcus aureus* and *Enterococcus species* and yeast, protozoa are also agents of UTI Infection [14].

Common clinical symptoms of UTI include burning sensation during urination, pain above pubic bone, cloudy urine, foul smell of urine, fever, urgency and frequency of urination increased back pain, vomit, etc. [15].

The upper urinary tract system is made up of the kidneys and ureters, while the lower urinary tract involves the bladder which is responsible for storage and elimination of urine, and urethra which is the tube through which urine exits and an infection can begin at any part of the urinary system which can be the upper urinary tract or the lower urinary tract [16].

The most common type of urinary tract infection is acute cystitis often

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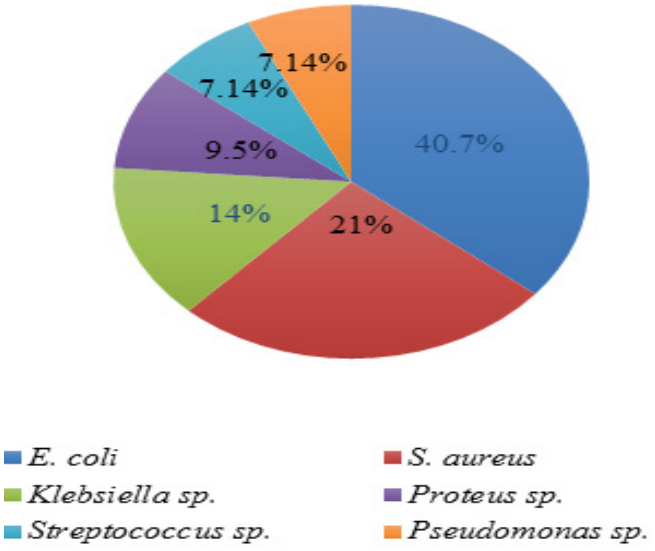


Figure 1. A pie chart showing the distribution of bacteria isolates from samples.

referred to as bladder infection [17] and the microorganisms that causes bacteriuria are normal flora in stool and the large intestine but when they get into the urethra they can travel to infect the bladder and the kidney causing mild or severe infection.

UTI accounted for nearly 7 million office visits and 1 million emergency department visits, resulting in 100,000 hospitalizations [18]. Urinary tract infection (UTI) no doubt is a common clinical encounter in established health settings world over. It is generally estimated that the yearly global episodes of UTI could be in the range of 150 million with a large proportion of the infections being in apparent; many also manifest with obvious clinical features while others still show complications in addition [19].

Up to 60% of women have at least one symptomatic UTI during their lifetime and around 10% of women in the United States have one or more episodes of symptomatic UTIs each year [20]. Young, sexually active women 18–24 years of age have the highest incidence of UTIs. About 25% of these women have spontaneous resolution of symptoms, and an equal number become infected. Almost half of all women will experience 1 UTI during their lifetime and around 150 million people suffer from UTIs each year globally which results in greater than 6 billion dollars in direct health care [21].

The prevalence of UTIs in Algeria among all patients admitted in acute care units for more than 48 hours was reported to be 4.5% [22]. Reports showed Senegal having a prevalence of 0.7% among patients admitted in university hospital, Dakar Senegal, with a higher prevalence in women than men and in Uganda, the prevalence of UTIs was found to be 29/218 (13.3%) and had a 20%–60% drug resistance rate among antenatal mothers in Mulago hospital, Uganda and Recently, UTIs were found to have a prevalence of 54/139 (38.8%) with age, female gender, and married individuals had statistical significant relations with the disease among adults attending hospitals in Uganda [23].

Findings from Japan, India, Poland and Serbia showed varying and high levels of multiple resistance of uropathogenic *Enterococcus species* and other urinary bacterial isolates to quite a large number of antibiotics commonly used in treatment of UTIs, and in Brazil a high rate of vancomycin-resistant uropathogenic bacteria were encountered [24].

In most parts of sub-Saharan Africa as well as other developing parts of the world, UTIs are among the most common findings in everyday clinical practice while in the United States it was reported that UTIs in women are very common and approximately 25%-40% of women aged 20-40 years have had a UTI [25].

UTIs have been well studied in Sweden and other parts of Europe which have shown that 1 in 5 adult women experience a UTI at some point, confirming that it is an exceedingly common worldwide problem [26]. A longitudinal cohort study of Swedish women showed a higher mortality in women with a history of UTI than in age-matched women without such a history (37% versus 28% in 10 y), but these cohorts were not matched for other mortality-related factors, making it difficult to attribute the increased mortality to UTIs [27].

There are 250,000 estimated cases of pyelonephritis caused by the etiological agents of UTI annually in the US, with a higher frequency among females aged 18–49 years of which the estimated incidence is 28/10,000; 7% of cases require hospital admission. Cultural and genetic factors may influence prevalence (as shown in South Korea 59/10,000 patients experience pyelonephritis). Recurrence is less common than with uncomplicated UTIs, with 9% of females and 5.7% of males having a second episode within a year. Over the years, treatment of UTI has thrown up a lot of challenges due to the increasing level of antimicrobial resistance.

Effective management of these infections is often hampered by the lack of adequate facilities for proper microbial isolation as well as for their antimicrobial susceptibility testing. This often gives rise to urologic or otherwise complications arising from untreated, undetected as well as improperly treated UTIs.

The mortality associated with acute uncomplicated cystitis in women aged 20-60 years appears to be negligible. In contrast; the morbidity in terms of quality of life and economic measures is tremendous. Each episode of UTI in a young woman results in an average of 6.1 days of symptoms, 1.2 days of decreased class/work attendance, and 0.4 days in bed [28].

In Nigeria, different studies have been carried out to determine the prevalence of urinary tract infection; the reports have stated the high prevalence of UTI with data similar to those shown around the globe. It is also indicated in a study conducted among 12,458 urine samples, that reported prevalence of community-acquired and nosocomial UTIs were 12.3% and 9.3%, respectively [29].

In a research done on UTIs in a tertiary hospital in Abuja showed that in a total of 14700 urine samples that were sent to the Medical microbiology department for urine microscopy, culture and sensitivity within a three-year study period, 4125 (61%) were from females while 2638 (39%) were from males.; there were 5380 (80%) adult samples and 1383 (20%) from children. 6215 (92%) samples were from outpatients while 548 (8%) samples were from in-patients [30].

Also reports from healthy inidividuals in Ikare-Akoko, Ondo state gave that among the 300 samples, 75(25.0%) showed significant growth, 60 (20.0%) had insignificant growth while 165(55%) of the urine samples showed no growth, the presence of non-bacterial organisms; 2(0.7%) of the samples showed the presence of *Schistosomes*. The incidence of UTI was high (31.4%) among the age group of 31 years to 40 years, and also high among females (30%) than in males with the same causative agents responsible for the infection.

Results obtained from a study on urinary tract infection in a tertiary hospital in calabar, cross river state 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 (<105 cfu/ml of urine) while 38 (19%) yielded significant bacteriuria. The incidence rates of UTI according to age group for male and female shows that females had more risk of the infection than males in that from the age group 5 – 65 and above, 11(12.9%) of males were positive for UTI and 27(23.5%) females were also positive for UTI (Figure 2).

Other studies revealed similar reports such as in Federal Teaching Hospital Abakaliki (FETHA), Ebonyi state in which out of one thousand patients (500 males and 500 females) that were presented with UTI attending outpatient clinics of FETHA, a total of 262 (52.8%) of the females while 156 (31.2%) are males positive for UTIs. The UTI prevalence rate was 42.0% in all patients; however, the prevalence rate was significantly higher in females than in males (females: 52.8%; males: 31.2%), hence proves higher incidence in females than in males. Bacterial isolates were obtained from the females positive for UTI namely *Escherichia coli* (35.8%), followed by *Staphylococcus aureus* (18.2%), *Proteus* species (8.0%), *Klebsiella* species (7.3%), *Enterobacter*

Figure 2. Frequency distribution of bacteria isolated from urine samples obtained from female and male patients attending Lulu Briggs Health Centre.

species (7.3%), *Streptococcus viridans* (1.5%), *Streptococcus pyogenes* (1.5%) and *Citrobacter* species (1.5%). In males positive for UTIs the following organisms were isolated *E. coli* (54.3%), followed by *S. aureus* (18.5%), *Enteroccus faecalis* (1.2%) and *Staphylococcus saprophyticus* (1.2%).

The ever increasing number of patients presenting with urinary tract infection and the number of relapse cases of urinary tract infections after treatment in rivers state, have resulted in this research being carried out, with a view to addressing this over increasing antibiotic resistance to organisms causing urinary tract infections.

Methodology

A total of sixty (60) samples were used for this research project and they were obtained from hospital patients. 30 of the urine samples were collected from patients at The University of Port Harcourt Teaching Hospital (UPTH) and remaining 30 urine samples from the O.B. Lulu-Briggs Health Centre, Rivers state.

Clean catch mid-stream urine was collected with sterile dry, universal sample containers. This was done by properly educating the patients on how to collect the sample after giving them the sterile universal container. They were told to clean the area around the opening of the urethral with very clean water, dry the area and collect about 20ml of urine. This careful procedure is to avoid contamination by skin flora.

The samples were promptly labelled with the name of the patients, sex and time of collection and immediately transported to the laboratory for analysis and culture. Each container contained 0.2 g of boric acid as preservative so that in situation where there is delay, the urine is kept at a temperature of 40°C and cultured as soon as possible.

Spread plate method of inoculating was used by using a pipette to collect 0.01ml of urine and inoculating on the dried Cysteine Lactose Electrolyte Deficient Agar (CLED) and MacConkey agar plates which was also used. The inoculation was done by using the pipette the drop 0.01ml of the mixed urine using a sterile glass hockey stick. The glass hockey stick was made sterile by dipping it into 70% alcohol then passing it over flame to sterilize and allowed to cool for 5 seconds before using to spread from side to side of each plate until it was evenly distributed around all sides of the plate.

The plates were observed for colonies after 24 hours of incubation aerobically at 37°C and also their growth characteristics were taken note of both in Cysteine Lactose Electrolyte Deficient Agar (CLED) and MacConkey Agar. It helped to further distinguish between lactose fermenters and non-lactose fermenters. If any colonies were present it was confirmed to see if they were significant enough to indicate a clinical urinary tract infection. The number of colonies per ml of urine was recorded. If contaminant were present it was ensured that the colonies of main bacteria were reported and not contaminants. The colonies were summed up in each plate which gave a total colony count.

Colonies from the significant plates were subculture on nutrient agar to obtain pre colonies. Distinct colonies were inoculated on nutrient agar and streaked using a standard wire loop under aseptic conditions. The plates were then incubated for 24 hours at 37°C in inverted position.

28 grams of Nutrient agar powder was suspended in one liter of distilled water in a conical flask and covered with clean cotton wool and foil and mixed and boiled to dissolve and homogenize. The medium was poured into bijou bottles and then sterilized by autoclaving at 121°C for 15 minutes at 15 psi. The bottles were then placed in a slanting position and allowed to cool and solidify (Tables 1-3).

Isolates from pure culture were inoculated on the prepared slant bottles using a wire loop under aseptic conditions. They were incubated at 24 hours at 37°C and then stored in refrigerator for biochemical characterization and identification. These stock cultures were sub cultured frequently to obtain fresh cultures for the biochemical test and sensitivity testing (Tables 4a and 4b).

Table 1. Macroscopic examination of the urine samples.

Color of samples	No of patients	Percentage of patients
Yellow and clear	21	35%
Yellow and cloudy	11	18.33%
Pale and clear	7	11.66%
Pale and cloudy	10	16.66%
Amber and clear	5	8.33%
Amber and cloudy	6	10%
Total	60	100%

Table 2. Incidence of growth among hospital patients.

Variables	No of patients
Growth	42 (70%)
No growth	18 (30%)
Total	60 (100)

Table 3. Percentage frequency of samples with UTI.

Sex	Presence of UTI	Non presence of UTI
Female	36 (86%)	4 (7%)
Male	6 (14%)	14 (23.3
Total	42 (70%)	18 (30%)

Table 4a. Cultural/colonial characteristics of bacteria isolate of samples collected from O.B. Lulu-Briggs Health Centre.

S. No	Isolate code	Color	Size (mm)	Shape	Margin	Opacity	Elevation	Texture
1	L1	Cream	1.5 mm	Circular	Entire	Translucent	Flat	Smooth
2	L2	Pink	1.5 mm	Circular	Entire	Opaque	Raised	Shiny
3	L3	Cream	1.0 mm	Punctiform	Entire	Opaque	Convex	Granular
4	L4	Pink	2.5 mm	Round	Entire	Opaque	Raised	Smooth
5	L5	Pink	2 mm	Round	Entire	Opaque	Raised	Smooth
6	L6	Cream	1.5 mm	Circular	Entire	Translucent	Flat	Smooth
7	L7	Cream	1.5 mm	Punctiform	Entire	Opaque	Convex	Granular
8	L8	Cream	1.5 mm	Punctiform	Entire	Opaque	Convex	Granular
9	L9	Pink	2.5 mm	Round	Entire	Opaque	Raised	Smooth
10	L10	Cream	0.5 mm	Punctiform	Entire	Opaque	Convex	Granular
11	L11	Colorless	1.5 mm	Round	Undulating	Opaque	Flat	Wrinkled
12	L12	Cream	0.1 mm	Punctiform	Entire	Opaque	Convex	Granular
13	L13	Cream	2.5 mm	Circular	Entire	Opaque	Raised	Shiny
14	L14	Pink	0.5 mm	Circular	Entire	Opaque	Raised	Shiny
15	L15	Pink	1.5 mm	Circular	Entire	Opaque	Raised	Mucoid
16	L16	Pink	2 mm	Circular	Entire	Opaque	Raised	Shiny
17	L17	Bluegreen	1.5 mm	Round	Entire	Translucent	Flat	Rough
18	L18	Pink	2 mm	Circular	Entire	Opaque	Raised	Shiny
19	L19	Pink	2 mm	Circular	Entire	Opaque	Raised	Mucoid

Keys: L: Lulu Briggs Health Centre

Table 4b. Cultural/colonial characteristics of bacteria isolate of samples collected from UPTH.

S/no	Isolate code	Color	Size (mm)	Shape	Margin	Opacity	Elevation	Texture
1	U1	Green	1.5 mm	Circular	Entire	Translucent	Flat	Rough
2	U2	Colorless	1.5 mm	Round	Undulating	Opaque	Flat	Wrinkled
3	U3	Colorless	1.0 mm	Round	Entire	Opaque	Flat	Rough
4	U4	Pink	2.0 mm	Circular	Entire	Opaque	Raised	Shiny
5	U5	Cream	1.5 mm	Circular	Entire	Translucent	Flat	Smooth
6	U6	Pink	1.5 mm	Circular	Entire	Opaque	Raised	Shiny
7	U7	Pink	1.0 mm	Circular	Entire	Opaque	Raised	Mucoid
8	U8	Pink	2.5 mm	Round	Entire	Opaque	Raised	Shiny
9	U9	Pink	2 mm	Round	Entire	Opaque	Raised	Shiny
10	U10	Pink	1.5 mm	Circular	Entire	Opaque	Raised	Shiny
11	U11	Cream	1.5 mm	Punctiform	Entire	Opaque	Convex	Granular
12	U12	Cream	1.5 mm	Punctiform	Entire	Opaque	Convex	Granular
13	U13	Pink	2.5 mm	Round	Entire	Opaque	Raised	Shiny
14	U14	Cream	0.5 mm	Punctiform	Entire	Opaque	Convex	Granular
15	U15	Colorless	1.5mm	Round	Undulating	Opaque	Flat	Wrinkled
16	U16	Cream	0.1mm	Punctiform	Entire	Opaque	Convex	Granular
17	U17	Cream	2.5mm	Circular	Entire	Opaque	Raised	Shiny
18	U18	Pink	0.5mm	Circular	Entire	Opaque	Raised	Shiny
19	U19	Pink	1.5mm	Circular	Entire	Opaque	Raised	Mucoid
20	U20	Pink	2mm	Circular	Entire	Opaque	Raised	Shiny

Keys: U: UPTH

During the Gram staining process, both groups of bacterial culture initially take up dye known as crystal violet. After which a reagent known as Grams iodine is poured on the slide. The dehydrating effect of the alcohol a decolourizer causes the peptidoglycan cell wall to shrink and the alcohol dissolves the lipid (lipopolysaccharide) in the Gram negative cell wall. When Safranin is added, the Gram negative cells will take up the dye, making it appear red/pink (when viewed under the microscope) whereas Gram positive cells will retain their purple coloration from the crystal violet due to their thick peptidoglycan layer (Table 5).

The isolates were subjected to morphological, cultural and physiological and biochemical characterization and compared with the characteristics described in Bergey's Manual of Determinative Bacteriology (1994).

Results

The findings are summarized thus:

1. The bacteria isolates identified during this study include Escherichia *coli, Klebsiella sp., Staphylococcus aureus*, *Streptococcus sp., Proteus sp.* and *Pseudomonas aeruginosa* respectively. The number and percentage frequency of occurrence of bacteria isolated from the urine samples that had growth are *Escherichia coli* 17 (40.4%), *Klebsiella sp.* 6 (14%), *Staphylococcus aureus* 9 (21.4%), *Streptococcus sp.* 3 (7.14%), *Proteus sp.* 4 (9.5%), and *Pseudomonas aeruginosa* 4 (7.14%).

2. For samples collected at Lulu Briggs Health Centre, the bacterial isolates obtained are *Escherichia coli* 7 (38.8%), *Klebsiella sp.* 2 (11%), *Staphylococcus aureus* 5 (27.7%), *Streptococcus sp.* 2 (11.1%), *Proteus sp.* 1 (5.5%), and *Pseudomonas aeruginosa* 1 (5.5%).

3. For samples collected at University of Port Harcourt Teaching Hospital (UPTH), the bacterial isolates obtained are *Escherichia coli* 10 (41.7%), *Klebsiella sp.* 4 (16.6%), *Staphylococcus aureus* 4 (16.6%), *Streptococcus sp.* 1 (4.1%), *Proteus sp.* 3 (12.5%), and *Pseudomonas aeruginosa* 2 (8.3%).

Table 1 above shows that normal urine color ranges from pale yellow to deep amber which is the result of a pigment called urochrome and how diluted or concentrated the urine is (www.mayoclinic.org). Pale clear generally means excess fluid intake, intake of a diuretic drug that forces the body to get rid of excess water while yellow color urine can be a sign of vitamin B in the body which is harmless (www.disabledworld.com). A dark cloudy is simply a sign and infection and diagnosis must be carried out immediately.

Discussion

Urinary tract infection is a very common disease and its diagnosis and treatment have important implications not only for the patients' health but also for development of antibiotic [31]. Therefore, knowledge of local UTI etiology as well as individual risk factor and the antibiotic susceptibility pattern is a useful guide to empirical therapy as prevalence of uropathogens varies with time and geographical location [32].

In this study, the prevalence and trend of UTI was carried out in sexually active men and women from ages 18 to 45 years, and the result from this study revealed that bacteria isolates were found in the urine of patients attending the University of Port Harcourt Teaching Hospital (UPTH) and O.B. Lulu-Briggs Health Centre (Tables 6-8). From a total of sixty (60) samples examined, 42 urine samples had growth and 18 samples no growth. Which gives 70% and 30% frequency respectively from both populations? Hence bacterial count of 30% of the patients was insignificant i.e. the patients were not infected while 70% of the patients were significant i.e. the patients had urinary tract infection.

Samples (30) obtained from the University of Port Harcourt Teaching Hospital (UPTH) had 20 females and 3 males with significant growth of Bacteria in their urine and samples (30) obtained from O.B. Lulu-Briggs Health Centre had 16 females and 3 males with growth of Bacteria in their urine (Tables 6-8). This shows that prevalence of UTI occurring in women attending (UPTH) is higher than that of O.B. Lulu-Briggs Health Centre (Table 8) which is in line with works by (Table 9) [33].

Six bacteria isolates were identified and characterized. The bacteria isolates were *Escherichia coli*, *Staphylococcus sp*, *Klebsiella sp*, *Proteus sp*, *Streptococcus sp*, and *Pseudomonas aeruginosa*. With percentage frequencies *Escherichia coli* (40.4%), *Klebsiella sp.* (14%), *Staphylococcus aureus* (21.4%), *Streptococcus sp.* (7.14%), *Proteus sp.* (9.5%), and *Pseudomonas aeruginosa* (7.14%) (Table 7). For sample collected from Lulu Briggs Health Centre, the bacterial isolates obtained and their percentage frequencies are *Escherichia coli* 7 (38.8%), *Klebsiella sp.* 2 (11%), *Staphylococcus aureus* 5 (27.7%), *Streptococcus sp.* 2 (11.1%), *Proteus sp.* 1 (5.5%), and *Pseudomonas aeruginosa* 1 (5.5%). While for samples collected at the University of Port Harcourt Teaching Hospital (UPTH), the bacterial isolates obtained and frequencies are *Escherichia coli* 10 (41.7%), *Klebsiella sp.* 4 (16.6%), *Staphylococcus aureus* 4 (16.6%), *Streptococcus sp.* 1 (4.1%), *Proteus sp.* 3 (12.5%), and *Pseudomonas aeruginosa* 2 (8.3%).

The result showed that the frequency of isolated gotten from samples obtained from UPTH had higher frequencies than those gotten from O.B. Lulu-Briggs Health Centre. *Escherichia coli* had the highest frequency and

Table 5. Biochemical characteristics of bacteria isolates.

S. No	Isolate code	Gram reaction	Cell morphology	Citrate	Catalase	Oxidase	Indole	Motility	Mr	Vp	Lactose	Glucose	Sucrose	TSIA		
														Butt	Slant Gas	H2S
1	L1	+	Cocci	-	-	-	+	-	-	-	A	A	A	-	A	+ +
2	L2	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	- +
3	L3	+	Cocci	-	+	-	-	-	+	+	A	A	A	A	A	+ +
4	L4	-	Rod	-	+	-	+	+	-	-	A	A/G	A	A	A	- +
5	L5	-	Rod	-	+	-	+	+	-	-	A	A/G	A	A	A	- +
6	L6	+	Cocci	-	-	-	+	-	-	-	A	A	A	-	A	+ +
7	L7	+	Cocci	-	+	-	-	-	+	+	A	A	A	A	A	+ +
8	L8	+	Cocci	-	+	-	-	-	+	+	A	A	A	A	A	+ +
9	L9	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	- +
10	L10	-	Rod	+	+	-	-	-	-	+	A/G	A/G	A/G	A	A	- +
11	L11	-	Rod	+	+	-	-	+	+	-	-	A/G	-	A	A	+ +
12	L12	+	Cocci	-	+	-	-	-	+	+	A	A	A	A	A	+ +
13	L13	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	- +
14	L14	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	- +
15	L15	-	Rod	+	+	-	-	-	-	+	A/G	A/G	A/G	A	A	- +
16	L16	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	- +
17	L17	-	Rod	+	+	+	-	+	-	-	A	A/G	A	A	A	- +
18	L18	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	- +
19	L19	-	Rod	+	+	-	-	-	-	+	A/G	A/G	A/G	A	A	- +

Keys: L: Lulu Briggs Health Centre, Mr: Methyl red, Vp: Voges-proskaves, A: Acid, G: Gas, +: positive, -: Negative, S. aureus: *Staphylococcus aureus*

Table 6. Biochemical characteristics of bacteria isolates.

S. no	Isolate code	Gram reaction	Cell morphology	Citrate	Catalase	Oxidase	Indole	Motility	Mr	Vp	Lactose	Glucose	Sucrose	TSIA			
														Butt	Slant	H2S	Gas
1	U1	-	Rod	+	+	+	-	+	-	-	A	A/G	A	A	A	-	+
2	U2	-	Rod	+	+	-	-	+	+	-	-	A/G	-	A	A	+	+
3	U3	-	Rod	+	+	-	-	+	+	-	-	A/G	-	A	A	+	+
4	U4	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	-	+
5	U5	+	Cocci	-	-	-	+	-	-	-	A	A	A	-	A	+	+
6	U6	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	-	+
7	U7	-	Rod	+	+	-	-	-	-	+	A/G	A/G	A/G	A	A	-	+
8	U8	-	Rod	-	+	-	+	+	-	-	A	A/G	A	A	A	-	+
9	U9	-	Rod	-	+	-	+	+	-	-	A	A/G	A	A	A	-	+
10	U10	-	Rod	-	+	-	+	+	-	-	A	A/G	A	A	A	-	+
11	U11	+	Cocci	-	+	-	-	-	+	+	A	A	A	A	A	+	+
12	U12	+	Cocci	-	+	-	-	-	+	+	A	A	A	A	A	+	+
13	U13	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	-	+
14	U14	-	Rod	+	+	-	-	-	-	+	A/G	A/G	A/G	A	A	-	+
15	U15	-	Rod	+	+	-	-	+	+	-	-	A/G	-	A	A	+	+
16	U16	+	Cocci	-	+	-	-	-	+	+	A	A	A	A	A	+	+
17	U17	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	-	+
18	U18	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	-	+
19	U19	-	Rod	+	+	-	-	-	-	+	A/G	A/G	A/G	A	A	-	+
20	U20	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	-	+
21	U21	-	Rod	+	+	+	-	+	-	-	A	A/G	A	A	A	-	+
22	U22	-	Rod	-	+	-	+	+	-	-	A/G	A/G	A	A	A	-	+
23	U23	-	Rod	+	+	-	-	-	-	+	A/G	A/G	A/G	A	A	-	+

Keys: U: UPTH, Mr: Methyl red, Vp: Voges-proskaves, A: Acid, G: Gas, +: positive, -: Negative, S. aureus: *Staphylococcus aureus*

Table 7. Percentage frequency and incidence of bacteria isolated from urine samples.

Bacteria isolates	Number isolated from females	Number isolated from males	Sum of no of isolate from both genders	Percentage frequency of isolates
Escherichia coli	14	3	17	40.40%
Staphylococcus aureus	8	1	9	21.40%
Klebsiella sp.	5	1	6	14%
Proteus sp.	3	1	4	9.50%
Streptococcus sp.	3	0	3	7.14%
Pseudomonas aeruginosa	3	0	3	7.14%
Total	36	6	42	100%

Table 8. Bacteria count of urine samples obtained from O.B. Lulu Briggs Health Centre.

Sample code	CLED	CLED	Mac	Mac	(Logcfu/ml) CLED	(Logcfu/ml) CLED	(Logcfu/ml) Mac	(Logcfu/ml) Mac
	Plate1	Plate2	Plate1	Plate2	Plate1	Plate2	Plate1	Plate2
L1	28	18	13	31	3.44	3.25	3.11	3.49
L2	33	24	15	11	3.51	3.38	3.17	3.04
L3	19	42	68	54	3.27	3.62	3.83	3.73
L4	25	32	53	38	3.39	3.5	3.72	3.57
L5	65	38	105	69	3.81	3.57	4.02	3.83
L6	60	90	20	10	3.77	3.95	3.3	3
L7	50	85	131	125	3.69	3.92	4.11	4.09
L8	38	64	112	90	3.57	3.8	4.04	3.95
L9	51	28	77	51	3.7	3.44	3.88	3.7
L10	18	27	50	134	3.25	3.43	3.69	4.12
L11	9	11	119	89	2.95	3.04	4.07	3.94
L12	40	29	66	60	3.6	3.46	3.81	3.77
L13	36	41	74	26	3.55	3.41	3.86	3.61
L14	43	38	79	147	3.63	3.57	3.89	4.16
L15	32	32	61	52	3.5	3.5	3.78	3.71
L16	13	23	82	71	3.11	3.38	3.91	3.78
L17	24	12	53	52	3.38	3.07	3.72	3.71
L18	69	70	17	31	3.82	3.84	3.23	3.49
L19	89	81	46	43	3.94	3.9	3.66	3.63

Keys: L: Lulu Briggs Health Centre

Table 9. Bacteria count of urine sample obtained from UPTH.

Sample code	CLED Plate 1	CLED Plate 2	Mac Plate 1	Mac Plate 2	(Logcfu/ml) CLED Plate 1	(Logcfu/ml) CLED Plate 2	(Logcfu/ml) Mac Plate 1	(Logcfu/ml) Mac Plate 2
U1	88	71	105	120	3.94	3.85	4.02	4.07
U2	15	10	99	96	3.17	3	3.99	3.98
U3	101	134	161	135	4	4.12	4.2	4.13
U4	157	169	142	123	4.19	4.22	4.15	4
U5	55	63	34	57	3.74	3.79	3.53	3.75
U6	211	228	240	251	4.32	4.25	4.38	4.39
U7	187	170	131	135	4.27	4.23	4.11	4.13
U8	144	132	201	210	4.15	4.12	4.3	4.32
U9	35	29	77	85	3.54	3.46	3.88	3.92
U10	52	44	50	45	3.71	3.64	3.69	3.65
U11	96	121	119	111	3.98	4.08	4.07	4.04
U12	138	110	152	164	4.13	4.04	4.18	4.21
U13	231	199	229	267	4.36	4.29	4.35	4.42
U14	253	275	270	281	4.4	4.43	4.43	4.44
U15	24	13	36	32	3.38	3.11	3.55	3.5
U16	132	126	82	85	4.12	4.1	3.91	3.92
U17	5	16	18	12	2.69	3.2	3.25	3.07
U18	49	63	90	99	3.69	3.79	3.95	3.99
U19	287	250	321	339	4.45	4.39	4.5	4.53
U20	162	136	104	94	4.2	4.13	4.01	3.97
U21	75	60	93	100	3.87	3.77	3.96	4
U22	98	132	225	234	3.99	4.12	4.35	4.36
U23	40	31	19	26	3.6	3.49	3.27	3.41

Keys: U: UPTH

percentage occurrence of bacteria from both hospitals while *Streptococcus sp.* and *Pseudomonas aeruginosa* shared the lowest frequency and percentage occurrence of bacterial isolates. *E. coli* is widely documented from several studies as the commonest causative agent for both symptomatic and asymptomatic UTI [34]. The reasons may be attributed to differences in the study design and patient selection and also differing environmental conditions in various study locations.

The distribution of significant UTI in this study revealed that women had the highest prevalence with 36 females having significant growth of UTI and 6 males having significant growth of UTI as well. Number and percentage frequency of bacteria isolates obtained from males at O.B. Lulu-Briggs Health Centre are *Escherichia coli* 1 (5.2%), *Klebsiella sp.* 1 (5.2%), *Staphylococcus aureus* 0 (0%), *Streptococcus sp.* 0 (0%), *Proteus sp.* 0 (0%), and *Pseudomonas aeruginosa* 0 (0%) and those from females are *Escherichia coli* 6 (31.57%), *Klebsiella sp.* 2 (10.5%), *Staphylococcus aureus* 5 (26.3%), *Streptococcus sp.* 2 (10.5%), *Proteus sp.* 1 (5.2%), and *Pseudomonas aeruginosa* 1 (5.2%) and Number and percentage frequency of bacteria isolates obtained from males from UPTH are *Escherichia coli* 2 (8.69%), *Klebsiella sp.* 0 (0%), *Staphylococcus aureus* 1 (4.3%), *Streptococcus sp.* 0 (0%), *Proteus sp.* 1 (4.3%), and *Pseudomonas aeruginosa* 0 (0%) while from females are *Escherichia coli* 8 (34.7%), *Klebsiella sp.* 3 (13.0%), *Staphylococcus aureus* 3 (13.0%), *Streptococcus sp.* 1 (4.3%), *Proteus sp.* 2 (8.6%), and *Pseudomonas aeruginosa* 2 (8.6%). This result is in agreement with other studies [35] where UTI was higher in females (Figure 3).

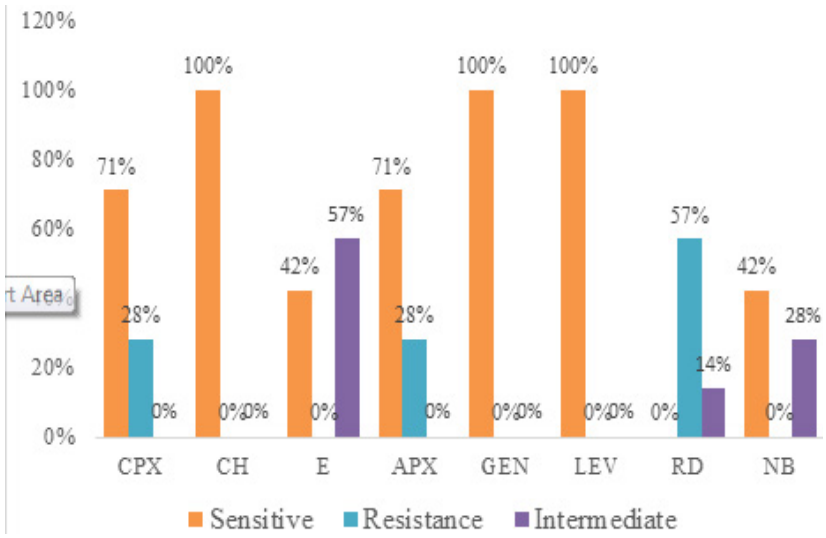
The high incidence of UTI in females could be as a result of the physiological and anatomical differences between both sexes [36]. The reason for this preponderance in this could be because of regular sexual activity and also use of one form of contraceptive or another which are positive risk factors for urinary tract infection [37]. Also, they tend to hide UTI and usually engage in self-medication and visit the hospital only when the infection is beyond their control [38]. 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 [39]. According to Stapleton (2017), alteration of the vagina microflora allows colonization of the vagina

Figure 3. Frequency distribution of bacteria isolated from urine samples obtained from female and male patients attending UPTH (University of Port Harcourt Teaching Hospital).

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. Biochemical test carried out on the bacterial isolates revealed gram positive and gram negative pathogens. Gram negative bacteria accounted for the most occurring bacteria which were *Escherichia coli*, *Klebsiella sp.* and *Proteus sp.* while gram positive bacteria were *Staphylococcus aureus* and *Streptococcus sp.* which is somewhat consistent with the report of (Table 6) [40].

In this study, the antibiogram showed susceptibility reactions of samples obtained from O.B. Lulu-Briggs Health Centre as 100%, 100%, 100, 83%, 83%, 71% and 71% to chloramphenicol, gentamicin, levofloxacin, septrin, streptomycin, ampiclox and ciprofloxacin (Figure 4) (Table 10a). The observed rate of resistance was 57% and 83% to Rifampicin and ampicillin. And intermediate reactions gave 80%, 57% and 33% to norfloxacin, tarivid and erythromycin respectively (Figure 5). The antibiogram showing susceptibility



Keys: CPX: Ciprofloxacin, CH: Chloramphenicol, AM: Amoxicillin, E: Erythromycin, APX: Ampiclox, GN: Gentamycin, LEV: Levofloxacin, RD: Rifampicin, NB: Norfloxacin

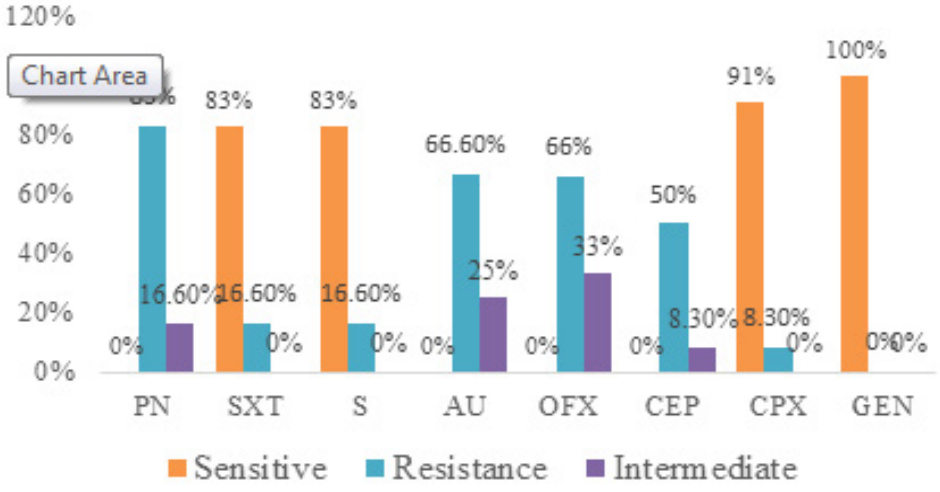
Figure 4. Percentage distribution of sensitive, resistance and intermediate pattern of antibiotics to number of bacteria isolate using gram positive disc on sample obtained from O.B Lulu Briggs Health Centre.

Table 10a. Antibiotic susceptibility pattern of isolates using gram negative disc on male and female samples attending Lulu Briggs Health Centre.

Isolate code	Ampicilin (PN)	Ciprofloxacin (CXP)	Septrin (SXT)	Streptomycin (S)	Augmentin (AU)	Tarivid (OFX)	Cephalothin (CEP)	Gentamycin (CN)	Tentative bacteria genera	MAR Index
LM2	I 15	S 37	S 34	S 24	R 10	R 05	R 14	S 23	*Escherichia coli*	0.37
LF4	R 12	S 37	S 34	S 24	R 11	R 08	R 11	S 20	*Escherichia coli*	0.5
LF5	R 14	S 36	S 34	S 24	R 12	R 05	R 9	S 23	*Escherichia coli*	0.5
LF9	R 10	S 22	S 34	S 24	R 10	R 0	I 13	S 17	*Escherichia coli*	0.3
LF11	R 05	R 12	R 7	R 11	-	I 12	-	S 25	*Proteus* sp.	0.5
LF13	I 16	S 37	S 34	S 24	R 10	R 05	R 6	S 23	*Escherichia coli*	0.37
LF14	R 8	S 24	S 34	S 24	R 10	R 05	R 11	S 15	*Escherichia coli*	0.37
LF15	R 0	S 33	S 20	S 23	I 16	I 14	-	S 27	*Klebsiella* sp.	0.1
LF16	R 10	S 37	S 34	S 24	I 17	R 09	-	S 23	*Escherichia coli*	0.2
LF17	R 0	S 30	R 0	R 08	R 0	I 15	-	S 26	*Pseudomonas* sp.	0.5
LF18	R 13	S 28	S 34	S 24	R 10	R 05	R 14	S 23	*Escherichia coli*	0.5
LM19	R 0	S 33	S 20	S 23	I 16	I 14	-	S 27	*Klebsiella* sp.	0.1

PN: S ≥17 R ≤14 I: 15-16, **CXP**: S ≥21 R ≤13 I: 14-16, **S**: S ≥15 R ≤11 I: 12-14, **AU**: S ≥18 R ≤13 I: 16-21 **CEP**: S ≥18 R ≤14 I: 13-17, **CN**: S ≥15 R ≤12 I: 13-14, **OFX**: S ≥18 R ≤13 I: 16-17, **SXT**: S ≥15 R ≤12 I: 13-14

Keys:, PN: Ampicillin, SXT: Septrin, S: Streptomycin, AU: Augmentin, OFX: Tarivid, CEP: Cepthalotin. L: Lulu Briggs Health Centre, S: Sensitive, R: Resistant, I: Intermediate, M: Male, F: Female



Keys: PN: Ampicillin, SXT: Septrin, S: Streptomycin, AU: Augmentin, OFX: Tarivid, CEP: Cepthalotin, CPX: Ciprofloxacin, GEN: Gentamycin

Figure 5. Percentage distribution of sensitive, resistance and intermediate pattern of antibiotics to number of bacteria isolate using gram negative disc on sample obtained from O.B Lulu Briggs Health Centre.

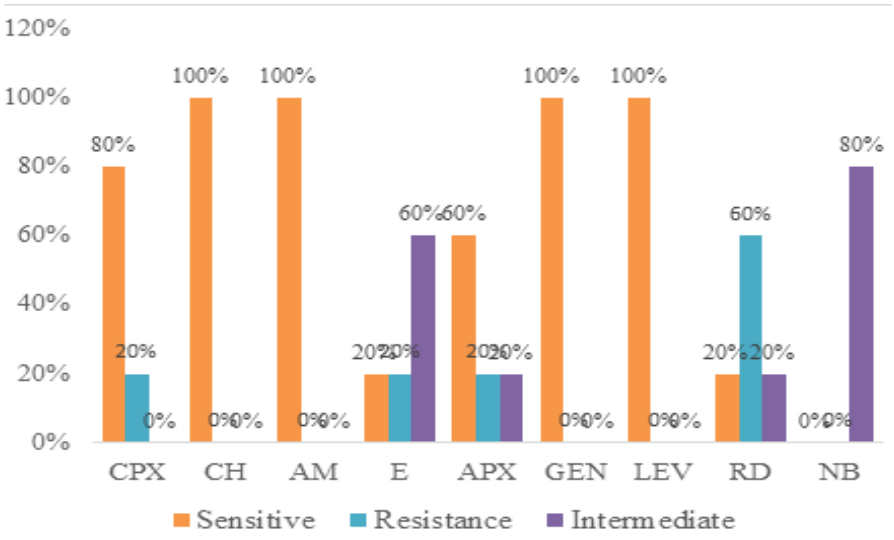
reactions of sample obtained from UPTH are 100%, 100%, 100, 100%, 83%, and 67%% to chloramphenicol, amoxicillin, gentamicin, levofloxacin, septrin, and ciprofloxacin. Observed rate of resistance was 66%, 61%, 61%, 60% and 27% to ampicillin, augmentin, cepthalothin, rifampicin and streptomycin. And intermediate reactions gave 80% and 60% to norfloxacin, and erythromycin respectively antibiotics which is consistent with reports (Figure 6).

The Multiple Antibiotic Resistance (MAR) Index was calculated and found ranging from 0.1 - 0.5 in both samples collected from O.B. Lulu-Briggs Health Centre and UPTH. O.B. Lulu-Briggs Health Centre had MAR Index of females ranging from 0.1–0.5 and that of males ranging from 0.1–1.37 while UPTH had MAR Index of females ranging from 0.1–0.5 and males from 0.3–0.5 respectively. This shows that MAR Index from males from UPTH (0.3) were higher than those from O.B. Lulu-Briggs Health Centre (0.1–0.37) (Figure 7) (Table 10b). And MAR Index of females from O.B. Lulu-Briggs Health Centre and UPTH shared the same value (0.1–0.5). MAR Index higher than 0.2 identifies microorganism from high risk source of contamination where antibiotics are often used or abused [41].

The most effective antibiotic for eliminating *E. coli* and other uropathogens from UTI cases in this study was Ciprofloxacin, 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 studie. The least effective antibiotics were augmentin and ampicillin. The less sensitivity of augmentin is low and disturbing in view of its usefulness in the treatment of UTI's and other diseases recorded less than 4% sensitivity of uropathogens to augmentin.

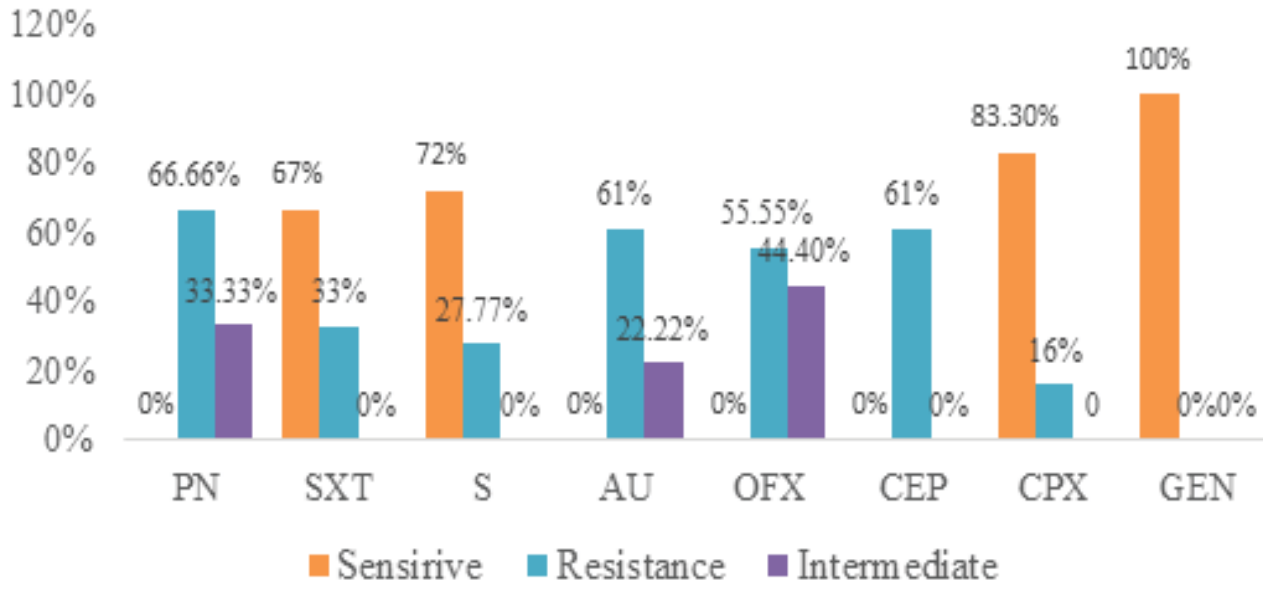
The almost total resistance of uropathogens to ampicillin and augmentin is alarming as it may have lost its potency in the treatment of UTI. There are various mechanisms by which these organisms develop resistance to antibiotics either by producing beta lactamases which destroy the antibiotics, by blocking the entry of these antibiotics or by efflux pumps which actively pump out these antibiotics.

Three (3) bacteria isolates from the total number bacteria isolated (6) were resistant to more than three antibiotics. In this study, *Proteus sp.*, *Escherichia coli* and *Pseudomonas* strains were resistant to 3-4 drugs while and *Streptococcus sp*., *Staphylococcus sp*. and *Klebsiella sp*. were resistant to 2, 2 and 1 antibiotics respectively and this correlated with works



Keys: CPX: Ciprofloxacin, CH: Chloramphenicol, AM: Amoxicillin, E: Erythromycin, APX: Ampiclox, GN: Gentamycin, LEV: Levofloxacin, RD: Rifampicin, NB: Norfloxacin

Figure 6. Percentage distribution of sensitive, resistance and intermediate pattern of antibiotics to number of bacteria isolate using gram positive disc on sample obtained from UPTH.



Keys: PN: Ampicillin, SXT: Septrin, S: Streptomycin, AU: Augmentin, OFX: Tarivid, CEP: Cepthalotin, CPX: Ciprofloxacin, GEN: Gentamycin

Figure 7. Percentage distribution of sensitive, resistance and intermediate pattern of antibiotics to number of bacteria isolate using gram negative disc on sample obtained from UPTH.

Table 10b. Antibiotic susceptibility pattern of isolates using gram negative disc on male and female samples attending UPTH.

Isolate code	Ampicilin (PN)	Ciprofloxacin (CXP)	Septrin (SXT)	Streptomycin (S)	Augmentin (AU)	Tarivid (OFX)	Cephalothin (CEP)	Gentamycin (CN)	Tentative bacteria genera	MAR Index
UF1	R 0	S 30	R 0	R 08	R 0	I 15	R 17	S 26	*Pseudomonas* sp.	0.5
UF2	R 05	R 12	R 07	R 19	-	I 12	-	S 25	*Proteus* sp.	0.5
UM3	R 06	R 10	R 09	R 17	-	I 13	-	S 28	*Proteus* sp.	0.5
UF4	R 10	S 34	S 34	S 24	R 10	R 05	R 14	S 23	*Escherichia coli*	0.5
UF6	I 16	S 37	S 34	S 24	R 10	R 05	R 12	S 23	*Escherichia coli*	0.3
UF7	R 0	S 33	S 20	S 23	I 16	I 14	-	S 27	*Klebsiella* sp.	0.12
UF8	I 15	S 37	S 30	S 24	R 10	R 05	R 15	S 23	*Escherichia coli*	0.37
UF9	R 17	S 28	S 34	S 22	R 08	R 05	R 17	S 26	*Escherichia coli*	0.3
UF10	I 18	S 32	S 34	S 23	R 10	R 05	R 16	S 23	*Escherichia coli*	0.3
UF13	R 16	S 26	S 22	S 26	I 18	R 7	R 9	S 21	*Escherichia coli*	0.37
UF15	R 05	R 13	R 7	R 17	-	I 12	-	S 25	*Proteus* sp.	0.5
UF17	I 18	S 36	S 34	S 24	R 10	R 05	R 12	S 23	*Escherichia coli*	0.37
U18	R 12	S 35	S 34	S 24	R 10	R 05	R 17	S 23	*Escherichia coli*	0.5
U19	R 0	S 33	S 20	S 23	I 16	I 14	-	S 27	*Klebsiella* sp.	0.12
UM20	I 17	S 37	S 34	S 24	R 10	R 05	R 10	S 23	*Escherichia coli*	0.37
UF21	R 0	S 30	R 0	R 08	R 0	I 15	-	S 26	*Pseudomonas* sp.	0.5
UM22	I 16	S 36	R 12	S 24	R 10	R 05	R 11	S 25	*Escherichia coli*	0.5
UF23	R 0	S 33	S 20	S 23	I 16	I 14	-	S 27	*Klebsiella* sp.	0.12

PN: $^{S}\geq 17$ $^{R}\leq 14$ I: 15-16, **CXP**: $^{S}\geq 21$ $^{R}\leq 13$ I: 14-16, **S**: $^{S}\geq 15$ $^{R}\leq 11$ I: 12-14, **AU**: $^{S}\geq 18$ $^{R}\leq 13$ I: 16-21 **CEP**: $^{S}\geq 18$ $^{R}\leq 14$ I: 13-17, **CN**: $^{S}\geq 15$ $^{R}\leq 12$ I: 13-14, **OFX**: $^{S}\geq 18$ $^{R}\leq 13$ I: 16-17, **SXT**: $^{S}\geq 15$ $^{R}\leq 12$ I: 13-14

Keys: PN: Ampicillin, SXT: Septrin, S: Streptomycin, AU: Augmentin, OFX: Tarivid, CEP: Cepthalotin U: UPTH, S: Sensitive, R: Resistant, I: Intermediate, M: Male, F: Female

by 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 [42].

Conclusion and Recommendations

The study has revealed a high prevalence of UTI in UPTH than in O.B. Lulu-Briggs Health Centre. The effect of gender on the prevalence of UTI cannot be overly emphasized which shows that the female gender is more susceptible then male and it could be due to unsafe sexual practices with multiple partners or poor hygiene and other unsafe practices. The most effective antibiotics for eliminating the*E. coli* and other uropathogens in this study were Ciprofloxacin, chloramphenicol, streptomycin 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. More so, should be an increase and sustained enlightenment and media publicity, focusing attention on the dangers of high incidence of bacterial resistance to antibacterial agents in general, and the consequences of therapeutic failures if the trend is not halted or reversed. Therefore, it is recommended 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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