International Journal of Microbiology and Applied Sciences
ISSN 1115-4004 Volume 4 issue 2 May, 2025 Research Article

Efficacy of Common Antibiotics against Uropathogenic Bacteria Isolated from Urine Samples of Male Students in a Tertiary Institution

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ABSTRACT

Urinary tract infections (UTIs) are widespread globally, and comprehending the distribution of uropathogens and their susceptibility to antibiotics is vital for effective treatment. Addressing antibiotic resistance is crucial due to its substantial impact on public health and the economy. This research aims to investigate the efficacy of commonly used antibiotics on isolates from urine samples of males in hostels of a tertiary institution. A total of fifteen (15) samples were collected and analyzed using standard microbiological procedures. The bacterial isolates were identified through morphological and biochemical tests. Findings revealed that the total bacteria count ranged from 2.08 x 10^3CFU/ml to 2.98 x 10^3CFU/ml. Bacterial identified and their frequency were; *Proteus mirabilis* (10.7%), *Staphylococcus aureus* (14.6%), *Enterobacter cloacae* (10.0%), *Streptococcus* sp (4.3%), *Escherichia coli* (16.1%), *Pseudomonas* sp (9.3%), *Klebsiella pneumoniae* (13.6%), *Acinetobacter* sp (3.2%), *Enterococcus faecalis* (6.4%), *Staphylococcus saprophyticus* (3.9%), and *Serratia marcescens* (7.9%) which underscores the prevalence of uropathogens. Antibiotic sensitivity testing unveiled varying susceptibility levels to different antibiotics with certain antibiotics exhibiting higher efficacy than others. For instance, Streptomycin showed higher effectiveness on *E. coli* and *Acinetobacter* sp., Septrin and Ciprofloxacin were very effective on *Proteus mirabilis* and *Klebsiella pneumoniae*. Conversely, Trivia was not effective on *K. pneumoniae* and *Acinetobacter* sp. *Staphylococcus aureus* was resistant to Gentamicin and Amoxicillin. The study identified the most effective antibiotics against different bacterial types and shed light on the issue of antibiotic resistance in specific bacteria. Utilizing antimicrobial stewardship programs, education, and hygiene practices are imperative in mitigating antibiotic resistance and preserving the efficacy of antibiotics.

Keywords: Tertiary Institution, Male Students, Urine, Uropathogens, Antibiotic Resistance, Hygiene Practices.

Introduction

Urinary tract infections (UTI) are the second most common infections after the infections of the respiratory tract (Yang *et al*., 2023). The distribution of uropathogens and their susceptibility pattern to antibiotics (common antibiotics), vary regionally and even in the same region, they change over time. Therefore, the knowledge on the frequency of the causative microorganisms and their susceptibility to various antibiotics are necessary for a better therapeutic outcome (Saligrama *et al.,* 2018).

In Europe, annually more than 35,000 people die from infections caused by antimicrobial-resistant microbes which are an alarmingly high number. Especially in human medicine but also in the treatment of animals, a large amount of antibiotics is used (Van Boeckel *et al.,* 2014; Monahan *et al.,* 2022).

Urinary tract infections (UTIs) have represented, over time, a reason for consultation in all private and public health institutions worldwide. Due to its high prevalence and frequent inadequate use of antibiotics especially the most common ones, it is necessary to determine the most common causal agents, populations most affected and patterns of local sensitivity and resistance, to achieve better clinical results and to establish a better use of antibiotics (Julio *et al.,* 2018).

Resistance to an antibiotic occurs when a microorganism is able to grow or survive in the presence of a concentration of antibiotic that is usually sufficient to inhibit or kill organisms of the same species. The terms 'susceptible' and 'resistant' relating to antibiotics are usually used in clinical practice to infer the likely success or failure of treatment. Resistance is more likely when the concentration required to inhibit or kill microorganisms is not potent on the organism.

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Antibiotics are the most significant class of pharmaceuticals and are one of the most influential medical inventions of the twentieth century. Antibiotics have undeniably been a boon to human society in the fight against bacteria, saving millions of lives (Bernardo *et al.,* 2019). The optimization of antibiotic utilization especially the ones that are readily available, at its most basic level, is the appropriate use of antibiotics and the limiting of unnecessary antibiotic administration/exposure, which consist of appropriate diagnosis, acquiring the appropriate culture and susceptibility data, implementing the most appropriate treatment, selecting the most effective antibiotics and dosing the antibiotics appropriately (Ayukekbong *et al.,* 2017).

Although without substantive evidence that requires further proof, non-adherence to prescribed antibiotics may potentially also play an important role in the increase in resistance of bacteria to antibiotics and decrease in susceptibility, thus understanding the determinants of patient adherence could have profound implications for formulating effective public health interventions and policy making. It is hypothesize that general knowledge of the appropriate use of antibiotics is important for patients in the community to ensure adherence to antibiotic prescriptions, and their lack of this knowledge could negatively impact on adherence (Yap *et al.,* 2012).

In light of recent predictions, that by 2050, antimicrobial resistance will cause almost 10 million deaths annually, and also resulting to economic crisis, costing the global economy 100 trillion U.S. dollars if not more than, the examination of antibiotic resistance on both local and global scales has become essential, waste water treatment should be taken into consideration as it's a major means through which the environmental organisms gain resistance to these antibiotics (Antti *et al.,* 2018).

WHO (2017) published list of bacteria that have gained resistance to common antibiotics (in brackets) are; *Acinetobacter baumannii,* (carbapenem-resistant); *Pseudomonas aeruginosa,* carbapenem-resistant; *Enterobacteriaceae,*(carbapenem-resistant); ESBL-producing *Enterococcus faecium,* (vancomycin-resistant); *Staphylococcus aureus* (methicillin-resistant, vancomycin-intermediate and resistant); *Helicobacter pylori* (clarithromycin-resistant); *Campylobacter* spp., (fluoroquinolone-resistant); *Salmonellae* (fluoroquinolone-resistant); *Neisseria gonorrhoeae,* (cephalosporin-resistant, fluoroquinolone-resistant); others are *Streptococcus pneumoniae* (penicillin-non-susceptible); *Haemophilus influenzae* (ampicillin-resistant); *Shigella* spp., fluoroquinolone-resistant (WHO, 2017).

The aim of this study was to ascertain the efficacy of commonly used antibiotics against uropathogenic bacteria isolated from urine samples of male students from a tertiary institution in Nigeria.

The objectives were to identify common bacteria pathogens present in urine samples, evaluate the effectiveness of commonly used antibiotics against urine sample isolates and compare the efficiency of different antibiotics on these isolates.

Materials and Methods

Study location

The study was carried out in Rivers State University Male hostels in Port Harcourt, with GPS coordinates of latitude 4^0 48'18.50"N and longitude 6^0 58' 39.12"E. The institution is situated in Port Harcourt, adjacent to Agip Oil Company in Port Harcourt City local Government Area in Rivers State, Nigeria.

Study subjects

Urine specimens were collected randomly from consented male students living in the hostels at Rivers State University, without specifying whether they had urinary tract infections. This was done after ethical considerations and permits were concluded.

Specimen collection and preparation

Mid-stream urine specimens were collected by the subjects into wide mouthed capped sterile urine bottles which were labelled with code, date, and time of urine collection. Study participants were well advised to sanitize their hands and their genital area with water before collection of 5–10ml of clean catch midstream urine samples.

Urine specimens were transported in a sterile ice-packed container to the Laboratory of the Department of microbiology, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt.

Urine specimens were processed, not longer than 2 hours after collection, if there was a delay to process within 2 hours, they were stored in the laboratory refrigerator (Senkomagol *et al.,* 2016).

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Sterilization of materials

Materials used for this study were sterilized using standard microbiological techniques, materials such as beakers, test tubes and measuring cylinders were washed using laboratory standard detergent in a running tap thereafter rinsed using distilled water and allowed to dry after which they were sterilized using hot air oven, with test tubes wrapped in an aluminum foil before sterilizing at 160^0C for an hour. Sterilization of culture media were done using the autoclave at 121^0C at 15psi for 15 minutes, work bench were sterilized using ethanol before any analysis were carried out (William and David, 2013). Disposable gloves were worn and changed in each procedure to ensure microbiological quality standards.

Preparation of Culture Media

All growth media in this analysis were prepared in line with the manufacturers' instructions, by weighing appropriate amount of the media powder and dissolved in 1000ml of distilled water in a Erlenmeyer flask, were properly mixed to ensure a homogenized solution, followed by boiling and sterilizing in an autoclave at 121^0C for 15 minutes at 15psi and allowed to cool at 45^0C before pouring it into sterile Petri dishes and allowed to solidify.

The media, used for this work were Nutrient Agar (N.A), MacConkey Agar, Mannitol Salt Agar (MSA), Eosin Methylene Blue Agar (EMB), and Cystine-Lactose-Electrolyte-Deficient Agar (CLED).

Preparation of Normal saline (diluents)

8.9g of (NaCl) sodium chloride was weighed and dissolved in 1000ml of distilled water and properly shaken to homogenize the mixture 9ml was pipetted into different test tubes aseptically and the mouth of the tubes were plugged with cotton wool, it was then sterilized using the autoclave at 121^0C for 15 minutes (Jin *et al.,* 2024).

Microbiological Analysis

Isolation and Characterization of Microorganisms

Microbial isolation was performed using standard microbiological methods, including streaking on solid agar media (Nutrient agar) as described by Cheesbrough (2000). This was done aseptically and in duplicates, followed by incubation at 37°C for 24 hours (Cheesbrough, 2000).

Culturing of the Urine Samples

Serial dilution was done ,1ml of each of the urine samples was introduced into test tube containing 9ml of normal saline, the homogenize was diluted serially to form 10^{-1} up to 10^{-6} dilution factor. An aliquot (0.1ml) of the dilution was inoculated into different growth media. The urine samples were cultured using standard spread plate method (0.1ml) were plated on Nutrient agar (for total heterotrophic aerobic bacteria count), MacConkey agar (for Enterobacteriacea family) and Mannitol Salt Agar (For Staphylococcus species), Eosin methylene blue agar and cystine lactose electrolyte agar, the specimen was spread evenly using a sterile bent glass rod .Inoculated plates were inverted and incubated at 37°C aerobically for 24 hrs. After incubation, the total heterotrophic aerobic bacterial counts were carried out (Obirikwurang *et al.,* 2012).

Characterization and Identification of the Isolates

The growth on the mixed culture plates were sub cultured on Nutrient agar and incubated aerobically at 37°C for 24 hrs. Growths on the culture media were identified using the colony descriptions of the isolates, morphological characteristics using Gram stain reaction and biochemical test such as oxidase test, coagulase, indole, sugar fermentation test, citrate test and motility test.

Subculture of bacteria isolates

Standard subculture technique described by Cheesebrough (2000) were used to obtain a pure culture for identification, a loop full of distinct colony were picked and tricked on a fresh growth media using a sterile inoculation loop, the plates were then inverted and incubated for 24 hours.

Identification of Bacterial Isolates

Based on microscopic examination and culture characterization, selected colonies were further identified using sugar fermentation procedures and biochemical assays. These tests include fermentation of lactose, glucose, fructose, mannitol). A reduction in pH indicates acid production, monitored by the pH indicator methyl red, which changes the fermentation medium from red to yellow.

A Durham tube is included to capture gas that is produced (Forbes and Sahm, 2014). Biochemical tests used include Methyl Red Test, Voges-Proskauer Test, Oxidase Test, and Motility Test.

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Maintenance and preservation of Isolates

Discrete and distinct bacterial isolates were maintained on nutrient agar slants and in10% glycerol solution for preservation and further identification. The isolates were stored and preserved in the refrigerator at 4ºC.

Preparation of the test organisms for sensitivity test

This was carried out using the method of (Obirikwurang *et al.,* 2012). The isolates were subcultured on nutrient broth and incubated aerobically at 37°C for 24hrs. Broth cultures of the isolates were centrifuged at 3000 rpm for 10 minutes. The sediments were diluted with sterile phosphate buffer saline (PBS) and adjusted to the 108 CFU/ml using McFarland matching standard using spectrophotometer at 540nm.

Antibiotic susceptibility/sensitivity testing

The disc diffusion method (Kirby Bauer technique) was used to carry out the antibiotic sensitivity testing, following guide lines under clinical and laboratory standard institute. Each of the bacteria colony was inoculated into a 5ml nutrient broth and incubated for 18 to 24 hours. The optical density of the standardized culture was determined to compare with the optical density of 0.5 Macfarland turbidity standard, where the bacteria cells or suspension are equivalent to 1.5 x 10^8 CFU/ ml (Akinduti *et al.,* 2019).

The test organisms were seeded on Mueller Hinton agar using a sterile swab stick to spread the organism on the plate rotation the plate at 60^0 and allowed to dry. A sterile forceps was used to place the antibiotic sensitivity discs on the surface of the medium. The plates were inverted and incubated aerobically at 37°C for 24 hrs. The choice of antibiotics was in accordance to the clinical and laboratory standards institute (CLSI guidelines of 2019).The use of antibiotics disk were according to the bacteria type (gram-positive and gram-negative), for gram positive bacteria the following antibiotics were used: Rifampicin (20µg), Amoxil (20µg), Ceptazidime (30µg), Streptomycin (30µg), Azithromycin (10µg), Ciprofloxacin (10µg), Gentamycin (10µg), Erythromycin (30µg), Levofloxacin (20µg) and Cefuroxime (30µg). The following impregnated disk with concentration were used for gram negative isolates: Septrin (30µg), Chloramphenicol (30µg), sparfloxacin (10µg), Ciprofloxacin (30µg), Augmentin (10µg), Amoxicillin (30µg), Gentamycin (30µg), Tarivid (10µg), Pefloxacin (30µg),and Streptomycin (30µg).The clear zones of inhibition were determined by the break points of antibiotics disk were measured in millimeter with a meter rule and the zones where compared with CLSI standard chart for interpretation , the results were reported as Resistance, Intermediate or Sensitive for all strains (CLSI , 2021).

Results

Table 1 shows the results of the cultural, morphological, biochemical characteristics and probable identity of bacteria isolated from urine samples of male students. The uropathogens isolated were identified as *Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Enterobacter cloacae, Proteus mirabilis, Pseudomonas aeruginosa., Enterococcus faecalis, Acinetobacter spp., Streptococcus* spp*., Serratia marcescens,* and *Staphylococcus saprophyticus.*

Table 2 presents antibiotic susceptibility test results for isolated Gram-negative bacteria. *E. coli* showed susceptibility to Ciprofloxacin (26) and Amoxicillin (15), while *Klebsiella pneumoniae* was most susceptible to Sparfloxacin (26). *Acinetobacter* spp. had resistance to Ciprofloxacin (0) but was susceptible to Streptomycin (26). *Pseudomonas aeruginosa* exhibited susceptibility to Gentamicin (22) and Amoxicillin (23). *Proteus* spp. showed high susceptibility to Ciprofloxacin (30) and Sparfloxacin (26). *Serratia marcescens* was most susceptible to Sparfloxacin (23) and Trivia (26), while *Enterobacter cloacae* had moderate susceptibility across several antibiotics. The sensitivity criteria classified results as sensitive (≥17), intermediate (14-16), or resistant (≤13).

Table 3 summarizes the antibiotic susceptibility test results for isolated Gram-positive bacteria. *Staphylococcus aureus* and *Streptococcus* spp. exhibited varying levels of susceptibility across different antibiotics. Notably, Levofloxacin showed high efficacy against all strains, with *S. saprophyticus* demonstrating the highest susceptibility (26). In contrast, Amoxicillin was the least effective, particularly against *S. aureus*, which had a low susceptibility score of 7. *Enterococcus faecalis* displayed moderate susceptibility levels, with Streptomycin (21) and Ciprofloxacin (11) being relatively more effective compared to others.

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Cultural Morphology						Microscopy		Biochemical										Sugar fermentation				Probable organism
Isolate	**Colour**	**Elevation**	**Opacity**	**Size**	**Texture**	**Gram reaction**	**Shape**	**Catalase**	**Indole**	**Coagulase**	**Motility**	**Oxidase**	**MR**	**V.P**	**Starch**	**Citrate**	**Salt tolerance**	**Maltose**	**Glucose**	**Lactose**	**Sucrose**	
1	**Colour**	Slightly raised	Tran	Small	Smooth /mucoid and shiny	GNR	Circular	+	-	-	-	+	-	-	+	+	-	N	N	A	-	*Pseudomonas aeruginosa*
2	Pink	Raised	Opq	Small -large	Mucoid and rough	GNR	Circular	+	+	-	+	-	+	-	+	+	-	AG	AG	N	-	*Proteus mirabilis*
3	Orange - golden yellow	Umbonate	Tran	Small	Mucoid and shiny	GPC	Circular	+	-	+	-	-	+	+	+	+	+	A	A	A	+	*Staphylococcus aureus*
4	Pink	Convex	Tran	Large	Mucoid and rough	GNR	Circular	+	+	-	-	-	+	-	-	-	-	N	A	AG	-	*Escherichia coli*
5	Grayish white- pink	Flat	Tran	Large	Mucoid and concentric	GNR	Irregular spreading	+	-	-	-	-	-	+	+	+	+	AG	A	A	+	*Enterobacter cloacae*
6	Cream - colorless	Umbonate	Tran	Small	Mucoid and smooth	GPR	Circular	+	-	-	-	-	-	+	-	+	-	A	AG	AG	+	*Klebsiella pneumoniae*
7	Blue green - yellowish green cream	Convex	Tran	Small	Mucoid and smooth	GPC	Circular	+	-	-	-	-	-	+	+	-	+	A	AG	A	+	*Staphylococcus saprophyticus*
8	Milky-gray/white	Convex	Opq	Large	Mucoid and smooth	GPC	Circular - irregular	-	-	-	-	-	-	+	-	-	-	AG	A	A	+	*Enterococcus faecalis*
9	Grayish white	Raised	Tran	Small	Dry and smooth	GNR	Round	+	-	-	-	-	-	-	-	+	-	A	AG	A	-	*Acinetobacter* sp.
10	White-cream	Convex	Opq	Small -large	Mucoid and smooth	GPC	Circular	-	-	-	+	-	+	-	-	+	-	AG	AG	AG	+	*Streptococcus* sp.
11	Red	Convex	Opq		Dry and smooth	GNR	Circular	+	-	-	+	-	-	+	-	+	-	AG	A	N	+	*Serratia marcescens*

Key: Tran = Translucent; Opq = Opaque; GNR = Gram negative rod; GPR = Gram positive rod; GPC = Gram positive cocci; A = Acid; AG = Acid and Gas, N = Neutral

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Table 2: Antibiotics susceptibility test results for isolated Gram negative bacteria

Antibiotics	*E. coli*	*K. pneumoniae*	*Acinetobacter* spp	*P. aeruginosa*	*Proteus* spp	*S. marcescens*	*E. cloacae*
Septrin (SXT)	18	25	19	15	25	17	13
Chloramphenicol (CH)	0	21	22	18	24	10	10
Sparfloxacin (SP)	6	26	6	21	26	23	15
Ciprofloxacin (CPX)	26	7	0	6	30	20	20
Amoxicillin (AM)	15	10	3	23	18	10	8
Azithromycin (AZM)	5	14	23	19	14	11	10
Gentamicine (CN)	16	12	15	22	10	8	14
Pefloxacin (PEF)	12	26	24	5	12	10	11
Travid (OFX)	14	0	0	8	22	26	13
Streptomycin (S)	20	2	26	19	20	24	9

Sensitive = ≥ 17mm, Intermediate =14-16mm, Resistance = ≤13mm

Table 3: Antibiotics susceptibility test results for isolated Gram positive bacteria

Antibiotics	*S. aureus*	*Streptococcus* spp	*S. saprophyticus*	*Enterococcus faecalis*
Rifampicin (RD)	19	23	24	10
Ceptazidime (CTZ)	19	15	18	20
Streptomycin (S)	16	19	20	21
Amoxicillin (AMX)	7	10	11	13
Ciprofloxacin (CPX)	15	24	19	11
Erythromycin (E)	16	16	21	17
Leufloxacin (LEV)	23	25	26	24
Gentamicin (CN)	9	17	23	9
Cefuroxime (CEF)	25	15	6	19
Azithromycin (AZM)	14	20	14	16

Sensitive = ≥ 17mm, Intermediate =14-16mm, Resistance = ≤13mm

Figure 1 presents the frequency of occurrence of various bacterial strains isolated from samples. *Escherichia coli* is the most prevalent, accounting for 16.1% of the isolates, followed closely by *Staphylococcus aureus* at 14.6% and *Klebsiella pneumoniae* at 13.6%. Other notable strains include Proteus mirabilis (10.7%) and Enterobacter cloacae (10.0%), indicating a significant presence of these bacteria in the samples analyzed.

Less frequently observed strains include *Pseudomonas* spp. (9.3%), *Serratia marcescens* (7.9%), and *Enterococcus faecalis* (6.4%). Strains with lower occurrences are *Streptococcus* spp. (4.3%), Acinetobacter spp. (3.2%), *Staphylococcus saprophyticus* (3.9%), and the total frequency of all strains sums to 280, representing a diverse bacterial population. This distribution highlights the prominence of specific pathogens in the sample, which may have implications for infection control and treatment strategies.

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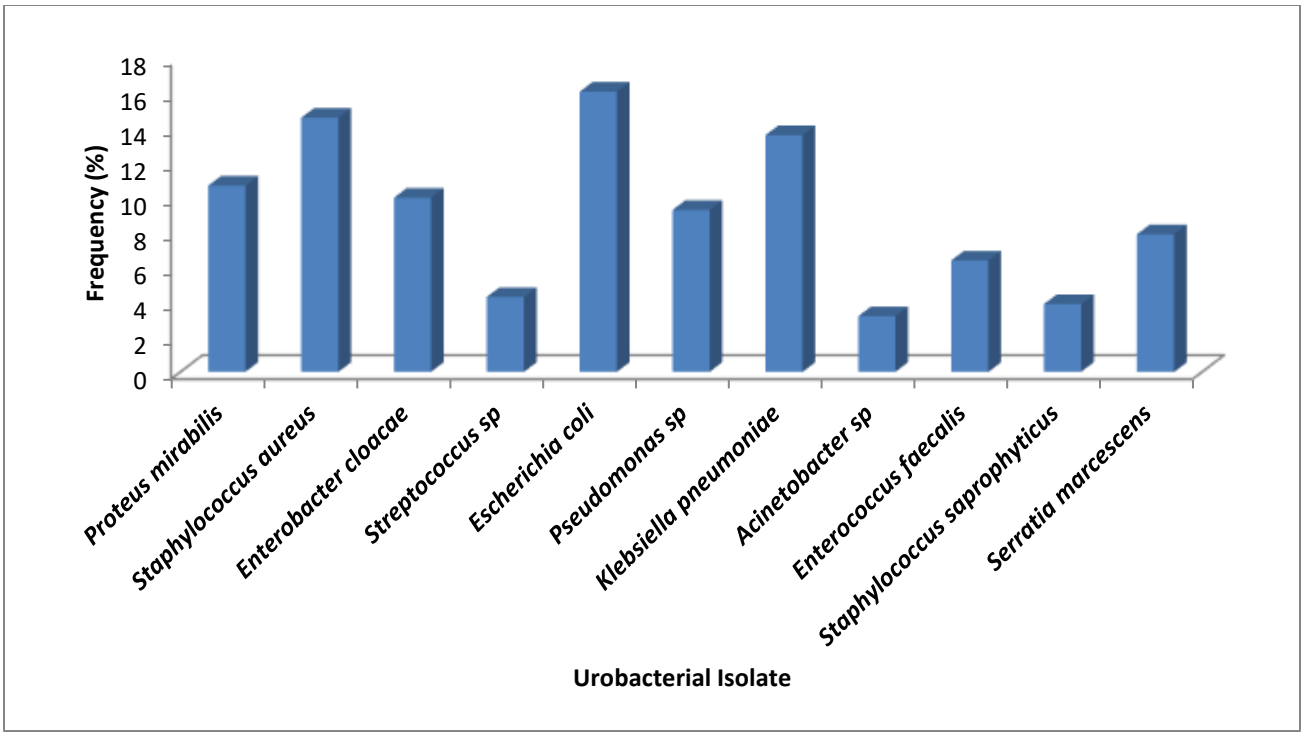

Figure 1: Frequency and percentage of occurrence of bacteria isolated from urine samples

Discussion

In this study, a total of fifteen urine samples were collected from the male hostels of Rivers State University. The samples were analyzed, and a total of eleven different bacteria species were isolated with their frequency of occurrence across the fifteen samples. These bacteria included *Proteus mirabilis* 30, *Staphylococcus aureus* 41, *Enterobacter cloacae* 28, *Streptococcus sp* 12, *Escherichia coli* 45, *Pseudomonas sp* 26, *Klebsiella pneumoniae* 38, *Acinetobacter sp* 9, *Enterococcus faecalis* 18, *Staphylococcus saprophyticus* 11, and *Serratia marcescens* 22, these organisms have being isolated from urine samples by many researchers (Poonam and Ulka, 2015; Geofery *et al.,* 2018).

Among these isolates, *Escherichia coli* was the most abundant, with a total of 45 occurrences across the samples. This finding aligns with previous research of Larbi *et al.* (2019) and *Staphylococcus saprophyticus* being the least with a frequency of occurrence of 11 this agree with Nadia *et al.* (2014). It is noteworthy that *E. coli* is a normal flora of the gastrointestinal tract of humans and animals, and its presence in urine samples indicates urinary tract infection. *Staphylococcus aureus*, another bacterium isolated in this study with a total number of occurrences of 41, is known for causing various infections in humans, ranging from skin infections to more severe conditions like pneumonia. However the mean coliform count from these samples is 19.8 CFU/ml, indicating a moderate level of coliform bacteria in urine samples, this clinically signifies that coliform count is below the clinical threshold for urinary tract infections (UTI) (<100 CFU/ml negative, 100-10000CFU/ml suspect contamination and > 10000 is likely UTIs) suggesting that most samples have low colonization, thus further analysis may be necessary to confirm urinary tract infections (UTI).

Antibiotic sensitivity result revealed that, within the Gram negative organisms, Streptomycin, Septrin, Sparfloxacin, Ciprofloxacin and Chloramphenicol exhibited notable efficiency, with Septrin and Streptomycin demonstrating superior efficacy.

Notably *Escherichia coli*, *Klebsiella pneumoniae* *Acinetobacter* sp., *Proteus mirabilis* and *Serratia marcescens* proved susceptible to Septrin, while *Pseudomonas aeruginosa* and *Enterobacter cloacae* displayed intermediate level of susceptibility to

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Septrin, conversely to Streptomycin; *E. coli, Acinetobacter sp, Pseudomonas aeruginosa*, *Proteus mirabilis*, S*erratia marcescens*, were susceptible while *Enterobacter cloacae* and *Klebsiella pneumoniaee* were resistant. Gentamycin, Amoxicillin, Azithromycin, Pefloxacin and Travid were the least effective compared to the other antibiotics with *Pseudomonas aeruginosa* being the only susceptible organism to Gentamycin.

For the Gram positive organisms, a variety of antibiotics were tested to determine their effectiveness. Rifampicin, Ceptazidime, Streptomycin, Amoxil, Azithromycin, Ciprofloxacin, erythromycin, levofloxacin, Gentamycin, and Cefuroxime were all subjects of the study. The organisms tested included *Staphylococcus aureus, streptococcus sp, Staphylococcus saprophyticus,* and *Enterococcus faecalis*. Among the antibiotics tested, Levofloxacin stood out as the most effective, showing effectiveness across all tested organisms. Ceptazidime and Streptomycin also demonstrated notable effectiveness, although *Streptococcus sp* exhibited resistance to Ceptazidime and *Staphylococcus aureus* showed resistance to Streptomycin. On the other hand, Amoxil and Azithromycin were found to be the least effective. However, Ciprofloxacin, Erythromycin, Gentamicin, and Cefuroxime proved effective against two organisms each.

It is worth noting that according to this study Streptomycin is found to be effective against a wide range of both gram positive and negative bacteria, on the contrary this study shows the alarming rate of antibiotics resistance of these organisms with *E coli, Klebsiella*, *Enterobacter cloacae* and *Staphylococcus aureus* having highest resistance rate across the different antibiotics tested against them, the study along with the Analysis of variance (ANOVA) conducted to evaluate the difference in bacteria count between different culture media with results showing a significant difference in at least one of the mean values, this highlights the importance of understanding the specific susceptibilities of different organisms to various antibiotics in order to effectively treat infections.

In general, the results indicate a range of susceptibility among the tested antibiotics, with specific strains responding better to certain treatments, which is crucial for guiding effective therapy.

Conclusion

This study highlights the efficacy of various antibiotics against gram-positive and gram-negative organisms while revealing a concerning rate of antibiotic resistance. Continued monitoring of resistance patterns is essential for effective treatment strategies and combating bacterial infections. Understanding the prevalence of these bacteria in university hostel urine samples is critical for implementing hygiene measures to prevent infection spread. Regular cleaning of toilets and ensuring adequate handwashing facilities are recommended, alongside health education on urinary tract infection prevention. Healthcare professionals should prioritize monitoring antibiotic resistance to inform treatment strategies and strengthen hygiene measures within university hostels to protect the community's health. Ongoing research is vital for effective interventions against potential outbreaks.

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Citation: Ogbuleka *et al*. (2025). Efficacy of common antibiotics against uropathogenic bacteria isolated from urine samples of male students in a tertiary institution. *International Journal of Microbiology and Applied Sciences*. *4(2)*: 22 – 30.