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Antibiotic Resistance Profile and Risk Factors of *Enterococcus Faecalis* and *Klebsiella Pneumoniae* Isolated from UTI Patients at Okara

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Abstract

Background: Urinary Tract Infections (UTIs) are among the most common bacterial infections, with Enterococcus faecalis and Klebsiella pneumoniae being significant uropathogens associated with both chronic and recurrent cases. Rising antibiotic resistance in these pathogens poses a major public health challenge.Objective: This study aimed to determine the antibiotic resistance patterns of E. faecalis and K. pneumoniae isolated from UTI patients and to assess associated demographic, clinical, and lifestyle risk factors.Methods: Urine samples were collected from UTI patients at Jinnah Hospital, Lahore. A structured questionnaire captured data on gender, age, education, urinary habits, prior UTIs, diabetes, kidney disease, pregnancy, comorbidities, lifestyle, and antibiotic use. Bacterial isolates were subjected to antibiotic susceptibility testing using 15 discs including Doxycycline, Colistin, Cefepime, Fosfomycin, Nitrofurantoin, Ceftriaxone, Ampicillin, Co-amoxiclav, Amikacin, Tazobactam-pipracillin, Meropenem, Ciprofloxacin, Imipenem, Gentamicin, and Cotrimoxazole. Zones of inhibition were measured and interpreted per standard guidelines. Statistical analysis was performed with significance set at $p<0.05$. Results: Notable variations in sugar levels, pregnancy status, and kidney problems were observed across socioeconomic groups. K. pneumoniae showed intermediate sensitivity to Ciprofloxacin, Cotrimoxazole, Doxycycline, Fosfomycin, and Co-amoxiclav, and susceptibility to Colistin, Gentamicin, and Amikacin. Several antibiotics including Cefepime, Nitrofurantoin, Ampicillin, Tazobactam-pipracillin, Meropenem, and Imipenem showed total resistance against both E. faecalis and K. pneumoniae.Conclusion: High resistance rates to commonly used antibiotics highlight the need for rational antibiotic use and routine surveillance. Risk factor analysis underscores the role of comorbidities and socioeconomic status in UTI burden.

Introduction

Urinary tract infections (UTIs) are among the most common bacterial infections worldwide and represent a significant public health concern due to their high prevalence, recurrence, and increasing antimicrobial resistance [1]. UTIs affect individuals of all ages and both sexes; however, women are considerably more susceptible because of anatomical and physiological factors, including a shorter urethra, pregnancy-related urinary changes, absence of protective prostatic secretions, and greater risk of fecal contamination. It is estimated that nearly one-third to one-half of women experience at least one symptomatic UTI during their lifetime. Although many infections are uncomplicated and readily treated, delayed diagnosis or inappropriate management can lead to serious complications such as pyelonephritis, renal scarring, kidney failure, sepsis, and, in severe cases, death [2].

The majority of UTIs are caused by Gram-negative bacteria, particularly *Escherichia coli*, which accounts for approximately 80% of community-acquired infections. Other important uropathogens include *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Enterobacter* species, *Enterococcus faecalis*, and various Gram-positive organisms. These microorganisms generally invade the urinary tract through the ascending route from the periurethral region to the bladder and, in severe cases, to the kidneys [3]. The ability of these pathogens to adhere to the urothelial surface using fimbriae and other virulence factors enables colonization, persistence, and progression of infection despite normal urinary defense mechanisms [6].

Several host-related and environmental factors contribute to the development of UTIs. Pregnancy induces anatomical and physiological changes, including urinary stasis, hydronephrosis, glycosuria, and altered urinary pH, which increases bacterial growth and the risk of asymptomatic bacteriuria, cystitis, and pyelonephritis [4]. Similarly, diabetes mellitus predisposes individuals to recurrent and complicated UTIs because of impaired immune responses, poor glycemic control, neuropathy, and delayed bladder emptying. Children with congenital urinary tract abnormalities, vesicoureteral reflux, or neurogenic bladder are also at increased risk and may develop long-term renal complications if infections are not promptly diagnosed and treated. Elderly individuals, catheterized patients, and hospitalized populations likewise experience a higher incidence of complicated infections and adverse outcomes [5].

Socioeconomic determinants have emerged as important contributors to both the occurrence of UTIs and the growing burden of antimicrobial resistance. Low socioeconomic status is frequently associated with overcrowded living conditions, inadequate sanitation, poor nutrition, limited access to healthcare, and inappropriate antibiotic use. These factors facilitate the transmission of infectious agents while simultaneously promoting the development and spread of resistant bacterial strains. In many low-resource settings, empirical antibiotic treatment without laboratory confirmation remains common, increasing selective pressure for multidrug-resistant (MDR) organisms [7]. Consequently, socioeconomic inequalities have become an important consideration in antimicrobial stewardship strategies aimed at reducing antibiotic resistance within communities [8].

Antimicrobial resistance has become one of the greatest challenges in the management of urinary tract infections. Excessive and inappropriate antibiotic prescribing, self-medication, treatment noncompliance, and recurrent empirical therapy have accelerated the emergence of multidrug-resistant uropathogens, reducing the effectiveness of conventional antimicrobial agents. Organisms producing extended-spectrum β-lactamases (ESBLs), carbapenem-resistant Enterobacteriaceae, fluoroquinolone-resistant bacteria, and vancomycin-resistant enterococci are increasingly reported worldwide, particularly among hospitalized and diabetic patients [9]. Accurate identification of causative organisms and antimicrobial susceptibility testing, commonly performed using the Kirby–Bauer disc diffusion method, are therefore essential for selecting appropriate antimicrobial therapy and minimizing the spread of resistant pathogens [10].

The clinical manifestations of UTIs range from asymptomatic bacteriuria to severe upper urinary tract infections accompanied by bacteremia, septic shock, and multiple organ dysfunction. Infection severity depends on the virulence of the infecting organism, host immune status, underlying anatomical abnormalities, and the timeliness of appropriate treatment [11]. Because recurrent infections and antimicrobial resistance continue to increase globally, there is a pressing need for improved surveillance of uropathogens, identification of patient-specific risk factors, and evidence-based antibiotic selection. Strengthening preventive measures, optimizing antimicrobial stewardship programs, and promoting rational antibiotic use are essential to reduce the burden of UTIs and improve patient outcomes [12].

This study aims to evaluate the socioeconomic background of UTI-infected patients, determine the antibiotic resistance and susceptibility profiles of uropathogenic bacteria, and identify the primary risk factors contributing to urinary tract infections.

MATERIALS AND METHODS

Study Design and Study Area

A hospital-based cross-sectional study was conducted to investigate the bacterial causes of urinary tract infections (UTIs), associated risk factors, and antimicrobial susceptibility patterns among UTI patients. The study was carried out at the Urology Department of District Head Quarter (DHQ) Hospital, Okara, Kidney Care Clinic, Okara, and Jinnah Hospital, Lahore, Pakistan. Ethical approval was obtained from the affiliated university and participating hospitals before commencement of the study. Written informed consent was obtained from all participants after explaining the objectives of the study, and confidentiality of patient information was strictly maintained.

The study was conducted over a six-month period from March 2025 to September 2025. Adult males, adult females, and children diagnosed with UTIs were included. Patients with associated clinical conditions, including diabetes mellitus, kidney disorders, pregnancy-related UTIs, and benign prostatic enlargement in males, were also enrolled.

Data Collection

Patient information was collected using a structured questionnaire and face-to-face interviews. Because a considerable proportion of the participants were unable to read or write, questionnaires were completed manually by the researchers to ensure accurate and complete data collection. Demographic characteristics, clinical history, symptoms, associated diseases, and previous antibiotic use were recorded. In addition, clinical information from 998 patients diagnosed with UTIs was retrieved from hospital records, including bacterial isolates and their antibiotic susceptibility profiles, and entered into Microsoft Excel for analysis.

Sample Collection

A total of 51 midstream urine samples were collected from clinically diagnosed UTI patients using sterile, screw-capped plastic containers. Each sample was appropriately labeled with a unique identification code, patient age, sex, and collection time. Samples were transported to the microbiology laboratory in a cold box and processed immediately upon arrival. Among the cultured isolates, were identified as *Klebsiella pneumoniae* and 11 as *Enterococcus faecalis*.

Isolation and Identification of Bacteria

Urine specimens were cultured on Blood agar, MacConkey agar, and Cystine Lactose Electrolyte Deficient (CLED) agar using calibrated inoculating loops for semiquantitative culture. The inoculated plates were incubated at 37°C for 24 hours under appropriate conditions. Bacterial growth equal to or greater than 10^4 colony-forming units (CFU)/mL was considered positive for UTI, whereas growth below 10^2 CFU/mL was considered negative.

Bacterial isolates were identified using standard microbiological procedures, including colony morphology, Gram staining, growth characteristics on selective media, and the catalase test.

Biochemical Identification

Gram Staining

Gram staining was performed to differentiate Gram-positive and Gram-negative bacteria based on cell wall characteristics. Heat-fixed bacterial smears were stained sequentially with crystal violet, Gram's iodine, a decolorizing agent (acetone or ethanol), and safranin. Gram-positive bacteria retained the crystal violet stain and appeared purple, whereas Gram-negative bacteria were decolorized and appeared pink or red after counterstaining.

Catalase Test

The catalase test was used to detect the production of the catalase enzyme by bacterial isolates. Fresh bacterial colonies were mixed with 3% hydrogen peroxide on a clean glass slide. Immediate bubble formation indicated a positive catalase reaction, whereas the absence of bubbles indicated a negative result.

Antibiotic Susceptibility Testing

Antimicrobial susceptibility testing was performed using the Kirby–Bauer disc diffusion method according to the Clinical and Laboratory Standards Institute (CLSI) guidelines. Bacterial suspensions were inoculated onto CLED agar plates, and antibiotic discs were placed on the agar surface. The plates were incubated at 37°C for 24 hours. After incubation, the diameters of inhibition zones around each antibiotic disc were measured, and isolates were classified as susceptible, intermediate, or resistant based on CLSI interpretative criteria.

Fifteen antibiotics were evaluated against the bacterial isolates, including doxycycline, colistin, cefepime, fosfomycin, nitrofurantoin, ceftriaxone, ampicillin, co-amoxiclav, amikacin, piperacillin-tazobactam, meropenem, ciprofloxacin, imipenem, gentamicin, and cotrimoxazole.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 12.0.1. Descriptive statistics, including frequencies, percentages, and proportions, were used to summarize the data. Statistical significance was determined at a p-value of less than 0.05.

RESULTS

This study was conducted at Lahore and Okara district during the period from March 2025 to

September 2025. During the survey study, a total of 998 patients' data was collected through interviews. The criteria for this study include male adults, female adults, and young children . Age groups 5 to 85 years were selected for data collection.

Prevalence of UTIs by age and sex

The age- and gender-wise distribution of patients shows different trends across age groups. In 520 years, males constituted 65.52% (n=38) of the patients, whereas females constituted 34.48% (n=20), comprising 5.81% of the total study population, which was found to be statistically significant ($p = 0.002$). The gender distribution changed in that age group of 21-41 years, where there were 40.2% males (n= 176) and 59.8% females (n= 262), and constituted 43.89% of the total, which was significantly different ($p < 0.0001$). In the 42-74 years group, men again dominated at 65.77% (n=321), whereas females accounted for 34.23% (n=167), both of which accounted for 48.90% of the total, with an even stronger difference ($p<0.0001$). The males were 71.43% (n=10) and the females 28.57% (n=4) in the 74-85 years age group, which accounted for 1.40% of the females, but the difference was not significant ($p = 0.61$). In general, the sample size amounted to 998 patients, and there were significant gender differences in different age groups, which revealed substantial associations between age and gender distributions in the majority of the age groups except the oldest age group. During the study, all patients showed a first time infection in their lives. All have symptoms including fever, fatigue, headache, and some show constipation, anorexia, and hepatitis.

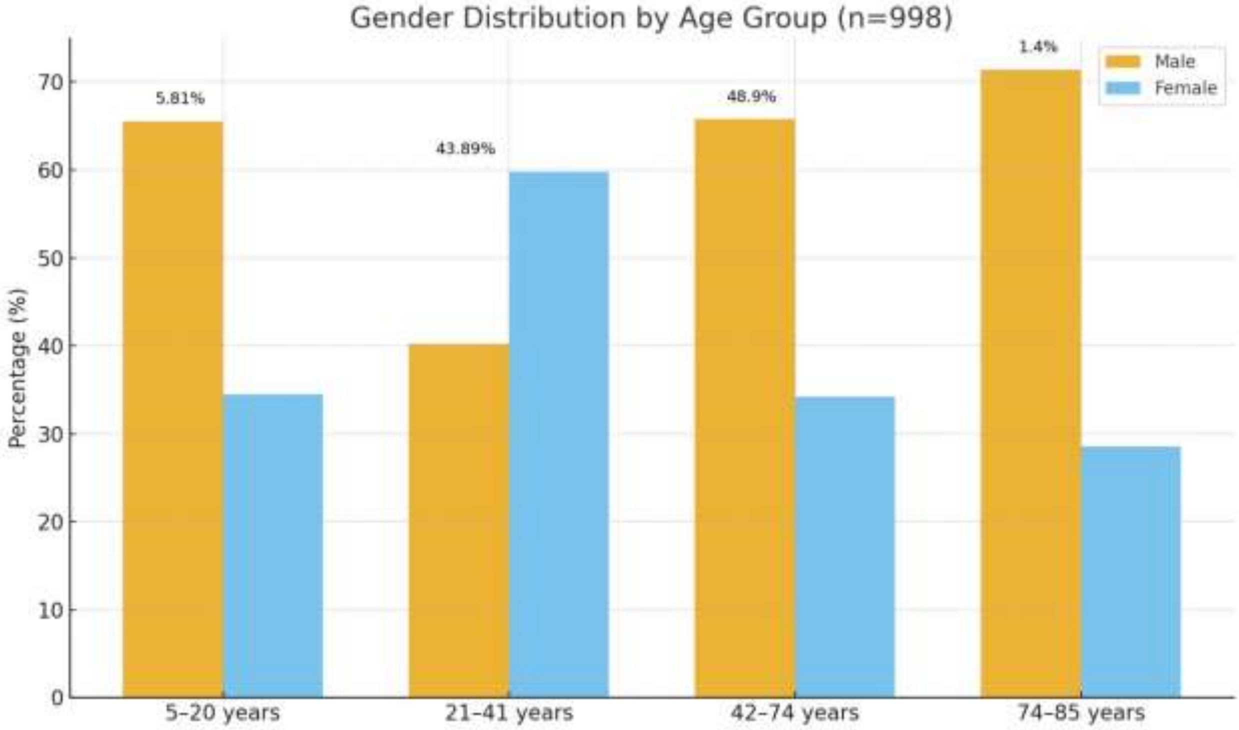

Figure 1: Shows Prevalence of UTIs by age and gender

Education status of UTIs patients

The education level of the population sampled in the study showed that there were differences in the level of literacy between males and females in various categories. Males and females had proportions of 23.35% (n=233) and 15.83% (n=158), respectively, which is 39.18% of the total illiterate population, with a a highly significant difference ($p < 0.0001$). In the primary education group, men were 1.40% (n=14) and women 0.31%, which accounted for 2.00% of the tota,, but this difference was not statistically significant ($p = 0.31$).

In the case of the middle level of education, males were 15.53 percent (n=155) and females 12.73 percent (n=127), which makes a total of 28.26, but the difference was not significant ($p = 0.62$). The proportion of males that comprised the secondary education level was 7.32% (n=73) and females 5.51% (n=55), making the total 12.83, which was also not statistically significant ($p = 0.60$). In the high-grade education group, on the other hand, the proportion of males (n=70) was 7.01 percent ,and females (n=107) were 10.72 percent of the total population, and the difference was very significant ($p=0.0001$). On the whole, among 998 people, illiteracy is the most common, and higher levels of education are much more widespread among females, which demonstrates a well-documented gender difference at the two ends of the educational spect

Caffeine and Diabeties status of patients

The Caffeine status analysis of the study population revealed that the smoking habits between genders were quite similar. In Caffeinated males comprised 78.72% (n=429), and females 79.47% (n=360), which is a summative 79.08% of the total. The statistical difference between males and females was not statistically significant ($p = 0.78$). In the non-caffeinated, the males had a percentage of 21.28 (n=116) and the females 20.53 (n=93), it is once again not showing any significant difference in the percentage between the genders. In general, the statistics indicate that the prevalence of Caffeine among males and females is nearly similar in this population.

On Diabetes status, most of the participants were not diabetic. The individuals without diabetes accounted for 88.7 percent of the population; they comprised 476 males (47.7) and 409 females (41). Conversely, diabetes patients included 70 male and 43 female patients (7 percent and 4.3 percent respectively), which constituted 11.3 percent.P-value 0.03, highly significant, is presented, and the distribution shows that the prevalence of diabetes was a little bit higher among males than among females. In general, the results indicated that the majority of the participants were nondiabetic and non-caffeinated, and no gender differences existed in smoking status.

Kidney problem and other diseases of UTIs patients

The kidney problems analysis among the participants of the study showed that a quarter of the studied patients (25.86%) had problems with their kidneys, whereas three-quarters (74.14%) did not. Among affected people, 13.33% of males (n=133) and 12.53% of females (n=125) were affected, with no statistically significant difference between the groups ($p = 0.14$). Among persons without kidney problems, males accounted for 41.48 percent (n=414) and females for 32.67 percent (n=326). These findings reveal that there were no significant differences between males and females in developing kidney problems, suggesting that gender does not correlate with kidney disease prevalence among these people. Conversely, gender differences were more evident in the presence of other diseases. On the whole, 58.92 percent of participants indicated that they had other health conditions, and 41.08 percent did not. Among cases of other diseases, males accounted for 36.07% (n=360) and females for 22.85% (n=228), indicating a much higher prevalence among males ($p = 0.0004$). The numbers of males and females included were 198 and 212,, respectively,, among participants who did not have other diseases. These results have shown that kidney problems did not vary significantly between the genders, but other illnesses were more prevalent in males in the studied population.

Pregnancy as a Risk Factor for Urinary Tract Infection

The discussion of pregnancy as a risk factor of urinary tract infection (UTI) revealed that out of 234 females, 62 (26.5%), and 172 (73.5%), of the patients were pregnant and non-pregnant, respectively. The difference could be considered statistically significant ($p = 0.013$) and showed that pregnancy was significantly related to a higher risk of UTI. This observation implies that during pregnancy, physiological and hormonal alterations might predispose pregnant women to a greater risk of infection of the urinary tract than their counterparts who are not pregnant, such as urinary stasis and high bladder pressure.

Urinary infection and Antibiotic usage :

It indicates that antibiotic use in patients with urinary tract infection (UTI) varies by gender. Among 998 patients, 928 (92.99%) reported taking antibiotics, and 70 (7.01%) reported not taking antibiotics. The males accounted for 52.1 percent (520 patients) and the females for 40.88 percent (408 patients) of the antibiotic users. By comparison, 2.1 percent of non-users were male (21 patients), and 4.91 percent were female (49 patients). The p-value of 0 means that there was a statistically significant difference between male and female patients with regard to the use of antibiotics, indicating that the use of antibiotics was higher among UTI patients with males than with females.

Biochemical tests for Bacterial detection

Colonies showing typical morphological appearance were presumptively identified as Gram stain, catalase, and oxidase tests.

Gram staining:

Klebsiella spp. are Gram-negative, rod-shaped bacteria that appear pink in color after Gram staining, while *Enterococcus faecalis* are Gram-positive cocci that appear blue or purple. This test was performed to confirm the presence of *Klebsiella spp.* and *E. faecalis spp.* in different patient samples. Figure 1 illustrates the microscopic observation at 500× magnification, showing the Gram-negative pink rods of *Klebsiella spp.* and the Gram-positive blue cocci of *E. faecalis spp.* in the patient samples.

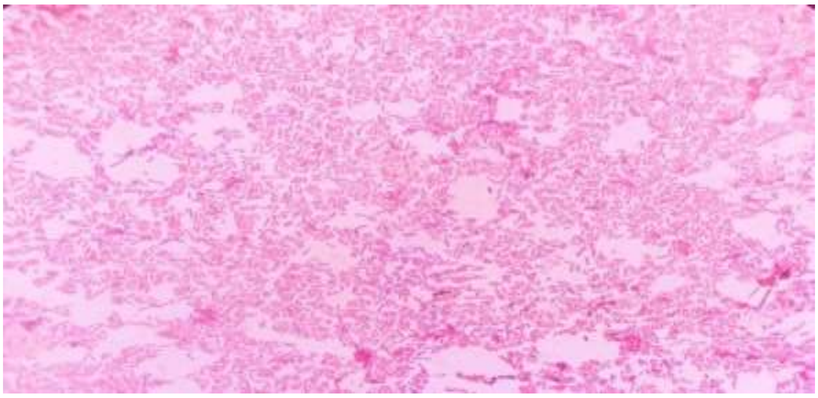

Figure 2: Shows gram positive bacteria isolate from patients

Gram-negative bacteria have a unique capsule and are frequently present in the bowel system and are usually linked to different opportunistic infections**.**

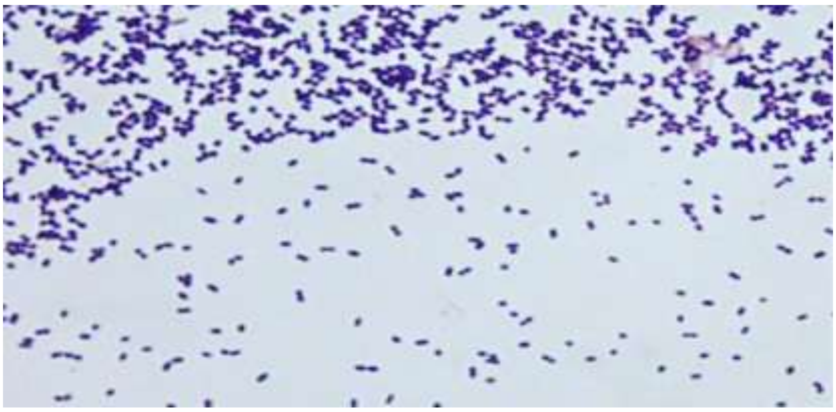

Figure 3: Shows gram negative bacteria isolate from patient

Catalase test:

To confirm bacterial infection in patients, a catalase test was performed. This was done by placing 35 percent solution of hydrogen peroxide (H 2 O 2) in a glass slide and placing a bacterial colony in petri dish in a wire loop in the solution. If the sample

contains bacteria, the solution will form bubbles indicating their presence. This is how all the samples are characterized.In the figure, the catalase test is shown.
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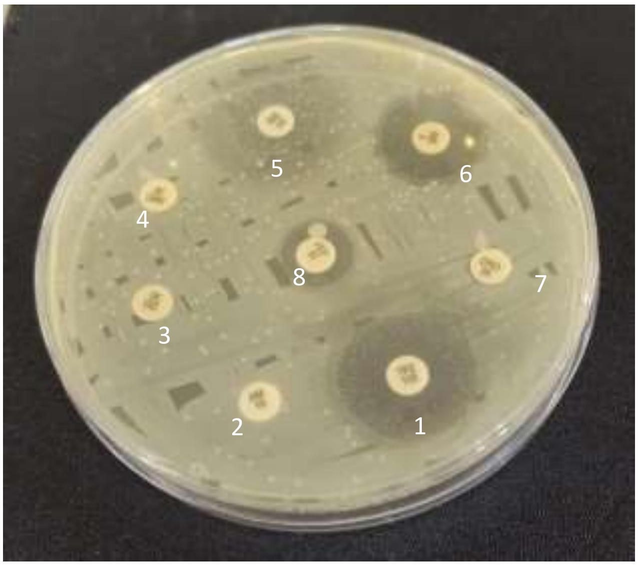
Figure 4: Shows the confirmation of gram negative bacteria by catalase test

Antibiotic resistance disc chart:

All patient samples were tested with 15 antibiotics to establish the resistance and susceptibility patterns of the bacterial isolates. These antibiotics Doxycycline DOX/DO (30 µg), Colistin CL/CT (10 µg), Cefepime CPM/FEP (30 µg), Fosfomycin FO/FF (200 µg), Nitrofurantoin NIT/F (300 µg), Ceftriaxone CRO (30 µg), Ampicillin AM/AMP (!0 µg), Co-amoxiclave AMC(30 µg) ,Amikacin AK(30 µg), Tazobactam-pipracillin TZP (110 µg), Meropenem MEM (10 µg),
Ciprofloxacin CIP(5 µg), Imipenem IPM(10 µg), Gentamicin GEN/CN (10 µg) and Cotrimoxazole Sxt (25 µg) was mainly used on all the patient samples to determine the resistance and susceptibility pattern.



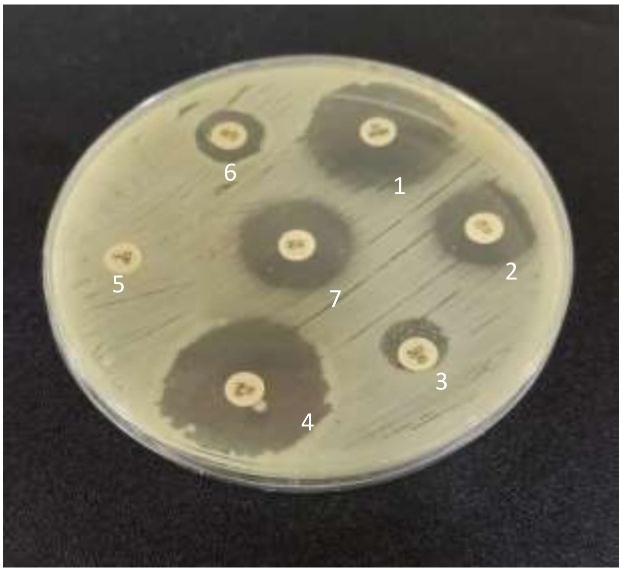


Figure 5(A): Antibiotic sensitivity test of *K. pneumonia* in plate 1. Digits indicate the different antibiotics.

Figure 5 (B): Antibiotic sensitivity test of *K. pneumonia* in plate 2 . Digits indicate the different antibiotics. The results reveal the susceptibility and resistance of the bacterial isolates to the experimental antibiotics. Antibiotics in Figure 5(A) and 5 (B) show the pattern of antibiotic susceptibility of the bacterial isolate of patient 5(A). Antibiotic discs that will be used in this test will consist of Ciprofloxacin (CIP 5 ug), Amikacin (AK 30 ug), Imipenem (IPM 10 ug), Trimethoprim-Sulfamethoxazole (SXT 25 ug), Gentamicin (CN 10 ug), and Meropenem (MEM 10 ug). The distinct, clear lines of inhibition surrounding all antibiotic disks indicate that the bacteria are sensitive to all the antibiotics used. The widest are found surrounding Imipenem and Meropenem, implying that the antibiotics are very effective against the bacterial isolate. Good sensitivity is observed with moderate levels of inhibition around Ciprofloxacin, Amikacin, Gentamicin and Trimethoprim-Sulfamethoxazole. On the whole, this tendency indicates that all antibiotics employed are susceptible to the bacterial isolate from patient 5 (B), suggesting that this isolate is not resistant.

Imipenem (IPM 10) was the drug that demonstrated the biggest zone of inhibition, which shows that the organism is very sensitive to the drug and is one of the most effective anti-infectives to address. The inhibitory zones of Amikacin (AK 30) and Gentamicin (GEN 10) were also clearly observed, so it is possible to conclude that the bacterium is also sensitive to the aminoglycoside antibiotics mentioned. On the contrary, a smaller inhibition zone was produced by Trimethoprim sulfamethoxazole (SXT 25), which is a sign of an intermediate or a resistant reaction. On the same note, Ciprofloxacin (CIP 5) and Cephalein (CN 10) showed less or no inhibition which indicated that the organism is resistant to the two agents. All in all, it can be concluded that Imipenem, Amikacin and Gentamicin would be appropriate treatment options, and Ciprofloxacin, SXT, and CN would not be the most effective in treating the bacterial isolate of Patient 5(B).

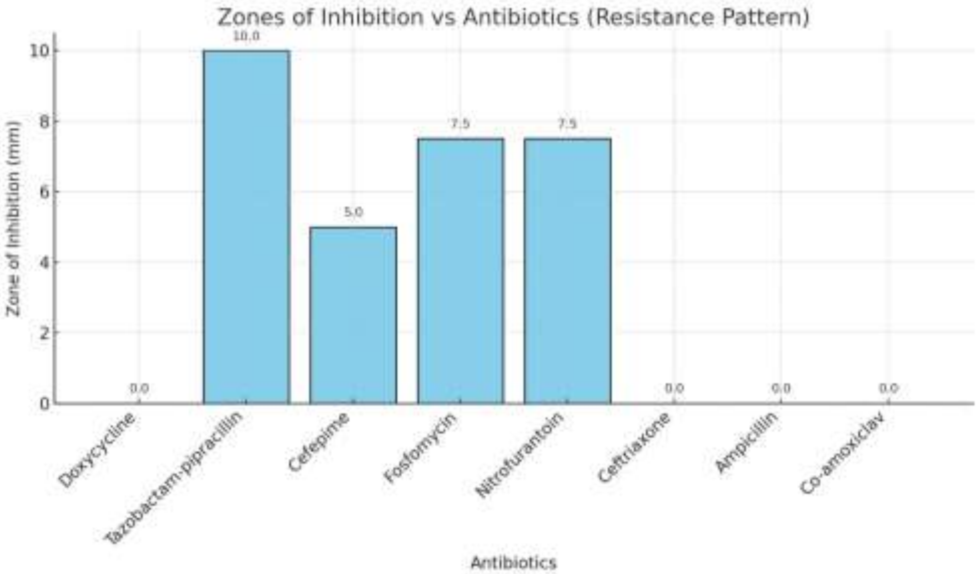


Figure 6: Shows the antibiotics and frequency

The bacterial isolate was subjected to various antibiotics such as.The zone of inhibition for each antibiotic was below the resistant cutoff, indicating that the organism was not responsive to all the drugs tested. Thus, the isolate was determined to be resistant to all antibiotics assayed, indicating that it is a multidrug-resistant (MDR) strain with limited treatment options. Figure 6 shows the antibiotics and frequency in Figure 5 (A) and 5(B).

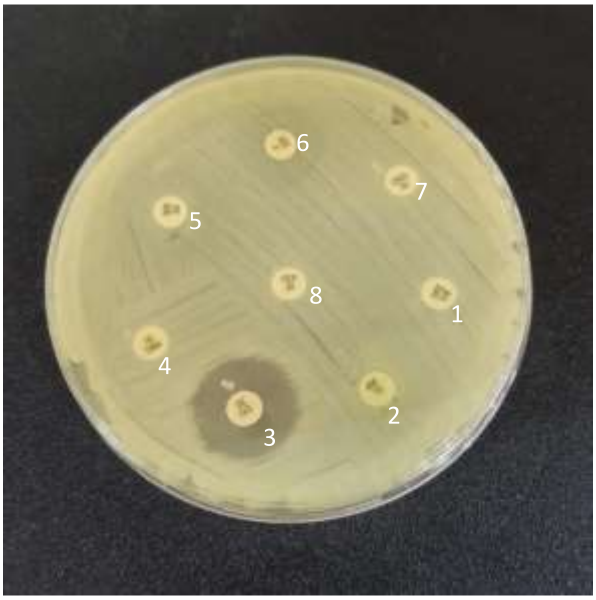


Figure 7(A): Antibiotic sensitivity test *Enterococcus faecalis* in plate 3. Digits indicate the different antibiotics.

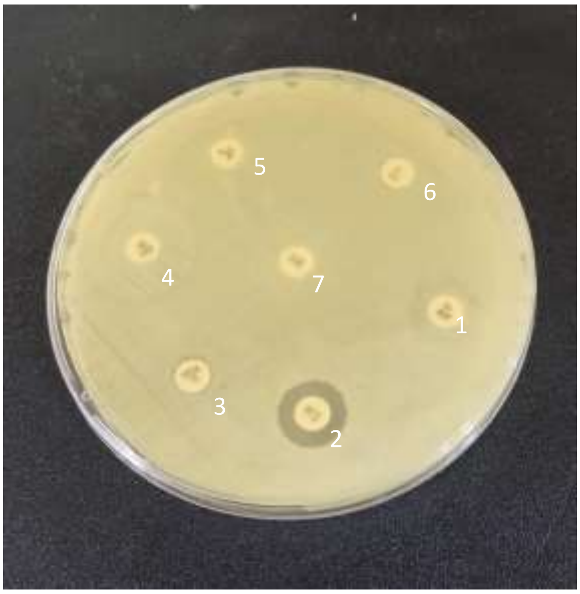


Figure 7(B): Antibiotic sensitivity test of *Enterococcus faecalis* in plate 4. Digits indicate the different antibiotics.

All the Antibiotics in Figure 7 (A) and 7(B) were inoculated at the particular concentration, and the area of the inhibition zone (in millimeters) was measured to understand whether the bacterium was susceptible, intermediate, or resistant based on standard clinical breakpoints. In this experiment, practically all antibiotics (β-lactams, including Ampicillin and Ceftriaxone), carbapenems (Imipenem and Meropenem), aminoglycosides (Amikacin and Gentamicin), and fluoroquinolones (Ciprofloxacin) did not exhibit any inhibitory zone (0 mm), which is evidence of absolute resistance. Cotrimoxazole was the only drug that had an intermediate response with the isolate, indicating partly effective behavior. In the general findings it indicates that the bacterial strain under analysis is multidrug-resistant (MDR) or, more likely, extensively drugresistant (XDR), as it is sensitive to almost all classes of antibiotics. This resistance profile poses a significant challenge to treatment, as traditional antibiotics are ineffective.

DISCUSSION

Urinary tract infections UTI are frequently caused by *Klebsiella pneumoniae*, especially in healthcare environments. Hospital-acquired infections are particularly common. All over the world, the rate of *K. pneumoniae* in UTIs varies and is influenced by various factors, including regional differences in antibiotic resistance patterns. For example, a study conducted in Burkina Faso revealed that 7.18% of UTI cases were caused by *Klebsiella spp* [9] . According to a conservative estimate based on global data from 2019, *K. pneumoniae* may have caused approximately 28.3 million UTI cases worldwide that year [10]. The most prevalent human pathogenic infections are urinary tract infections (UTIs), which can be brought on by a variety of etiological agents, including viruses, fungi, and bacteria. Most UTIs are caused by bacterial infections, and the most frequent etiological agents are S. aureus, E. coli, E. faecalis, and S. saprophyticus [11].
The treatment of urinary tract infection UTIs induced by *Klebsiella pneumoniae* with nitrofurantoin, first-generation cephalosporins, and even the combination of broad-spectrum penicillin (amoxicillin) has no more beneficial effect on patients with UTIs because of high resistance [12]. In a study that was conducted in a tropical area,*K. pneumoniae* was identified as the most common bacterium that causes urinary tract

infection UTIs after *E.coli* .The *Klebsiella* pneumonia showed a high level of resistance to ceftriaxone,gentamycin, ampicillin, doxycycline, amoxicillin/clavulanic acid [13].
The majority of *Klebsiella* strains in UTIs were shown to be amikacin-susceptible in an Indian investigation. Twelve of the fourteen strains of *K. pneumoniae* that we recovered from the urine of patients with chronic renal disease were amikacin-susceptible. The persistence of susceptibility may be explained by the limited usage of this antibiotic [14]. According to a study conducted in Jordan, every isolate of *Klebsiella* pneumonia from the patients of urinary tract infection UTI was resistant to at least one antibiotic [15]. Tazobactam with piperacillin has an admirable clinical effectiveness in various infections [16]. A promising β-lactamase inhibitor with inherent antibiotic properties is tazobactam. There was a significant correlation between amoxicillin and clavulanic acid. The relation of piperacillin with tazobactam is 50% which is found to be more efficient in percentage, and 85.71 percent for cefoperazone and sulbactam [17]. According to a recent Taiwanese study, *Klebsiella* has become less susceptible to most antibiotics over the past ten years, particularly third-generation Fluoroquinolones and cephalosporins [18]. The use of fosfomycin to treat urinary tract infections is growing due to the lack of regular testing for drug susceptibility [19].
A phosphonic acid chemical derivative called fosfomycin has antibacterial properties against a variety of gram-negative bacteria as well as some gram-positive bacteria [20]. The majority of intestinal gram-negative bacteria are included in fosfomycin's antibacterial spectrum, but with a significantly greater minimum inhibitory concentration for *Klebsiella* species [21]. Because fosfomycin is frequently used to treat simple UTIs, a comparatively high percentage of *K. pneumoniae* in our study (50%) are resistant to the antibiotic. From a pharmacodynamic perspective, treating cystitis may be necessary in patients with chronic kidney failure who have sufficiently high urine fosfomycin concentrations, even with a creatinine clearance of 20 mL/min. Fosfomicin single oral dose therapy is advised for the treatment and prevention of uncomplicated UTIs in both premenopausal and postmenopausal elderly, otherwise healthy women over 65 [22].
Fosfomycin trometamol resistance has most likely increased as a result of increased use of this antibiotic in recent years. In this study group, two chronic kidney disease CKD patients (14.28%) died due to advanced age, severe kidney failure, cardiovascular disease complications, and *Klebsiella pneumoniae* UTIs [23]. The patients with advanced age, advanced renal failure with elevated serum urea and creatinine levels, male gender, and diabetes in four cases were all associated with the multiple antibiotic resistance of the *Klebsiella pneumoniae* strains. The urinary tract infection (UTI) caused by *Klebsiella pneumoniae* was found to be resistant to ofloxacin, ciprofloxacin, and 15 other antibiotics. ceftriaxone, trimethoprim/sulfametoxazole, and nitrofurantoin; sensitive to gentamicin, amikacin, tazobactam/piperacillin, ceftibuten, imipenem, and colistin; and moderately sensitive to cefoxitin, cefazoline, fosfomycin, trometamol, and cefoperazone/sulbactam. The prevalence of resistance to every antibiotic is high in both the limited drug-resistant group and the extended multidrug-resistant group [23]. The group was compared to identify the antibiotic patients with multidrug resistance should not take. Accordingly, in the extended multidrug resistance group, Gentamicin has 66.4% of cases of resistance, while the limited resistance group has 11% [24].
Infections of the urinary tract (UTI) caused by *K. pneumoniae* seem to be rising and are now considered a serious health issue, particularly in hospital environments. This trend should be handled even more cautiously in patients with chronic kidney disease (CKD), as infections are the second leading cause of death in these patients after cardiovascular complications, and urinary infections may speed up the progression of renal failure to its final stages [25]. The most prevalent human pathogenic infections

are urinary tract infections (UTIs), which can be caused by a variety of etiological agents, including viruses, fungi, and bacteria. Most UTIs are caused by bacterial infections, and the most frequent etiological agents are S. aureus, E. coli, E. faecalis, and S. saprophyticus [26]. One notable morphological advantage of *E. faecalis* is its surface protein (Esp), which promotes its adhesion to the urinary tract's epithelial cell lines [27].

In the cases of amoxicillin/clavulanic acid ($p = 0.008$), ciprofloxacin ($p = 0.0003$), trimethoprim/sulfamethoxazole ($p = 0.00009$), ceftriaxone ($p = 0.0001$), and cefuroxime axetil ($p = 0.00038$), males exhibited significantly more resistant strains of *K. pneumoniae* than females. Patients aged 50 years or older had more resistant strains of ciprofloxacin ($p = 0.0003$), trimethoprim/sulfamethoxazole ($p = 0.007$), piperacillin/tazobactam ($p = 0.003$), ceftriaxone ($p = 0.001$), and cefuroxime axetil ($p = 0.013$). More resistant strains were observed in older age groups (11 years post-tx or more) with amoxicillin/clavulanic acid,, when the number of years post-tx at the time the analyzed UTI occurred was analyzed ($p = 0.037$). Up to ten years after treatment, recipients of kidneys with UTIs had a higher prevalence of resistance to trimethoprim/sulfamethoxazole, which was subsequently counterbalanced by susceptible strains in older groups. Compared with other antibiotics or co-transplant organs, more strains of ceftriaxone-resistant bacteria were found in kidney-pancreas transplant recipients who experienced UTIs ($p = 0.014$) [28]. Compared with other end-stage kidney diseases, pre-existing diabetes was a risk factor for ceftriaxone resistance when underlying kidney disease was examined only for *K. pneumoniae* samples in past studies. For the duration of the observation period, E. faecalis's susceptibility to tigecycline stayed at 100%. Gender-wise, males had more gentamicinresistant strains than females ($p = 0.015$) [29]. When age was taken into account, the number of ampicillin-resistant strains increased among patients under 29 and those over 50 ($p = 0.012$) [30]. In a past study, patients over 50 years of age were at risk for developing resistance to ampicillin in *E. faecalis* and ciprofloxacin, trimethoprim/sulfamethoxazole, piperacillin/tazobactam, ceftriaxone, and cefuroxime axetil in K. pneumoniae. The CANWARD Surveillance Study also found that older patients had higher rates of resistance among urinary pathogens [31]

According to *E. faecalis* pattern of antimicrobial susceptibility, these strains are most resistant to gentamicin (90.06%), which is followed by quinolone antibiotics like norfloxacin (86.33%) and85.09% of levofloxacin and ciprofloxacin [32]. Compared to this study, uropathogen susceptibility revealed a relatively lower resistance profile of *E. faecalis* against gentamicin (72.4%) and ciprofloxacin (58.6%) [33]. Additionally, the study carried out in Nepal found that *E. faecalis* was 89.5% resistant to Ciprofloxacin and 91.8% resistant to Norfloxacin. According to this study, males over 65 had the highest incidence of UTI (46.34%), followed by those aged 5564 (14.63%). The lowest percentage of UTI cases (4.87 and 2.43%, respectively) is reported in the 0–4 and 5–14 age groups. A Nepali study found that males over 60 had the highest incidence of UTI (27.7%) [34] supporting these findings.

Urine samples containing 83.9% MDR *E. faecalis* isolates were found to be generally resistant to aminoglycosides and glycopeptides. Of the total isolates, 26 exhibited resistance to more than 8 different drugs, while a maximum of 55 isolates were non-susceptible to 5 different antibiotics. But according to the drug classification, the most resistance was observed to tetracyclines (Doxycycline-122), aminoglycosides (Gentamicin-145), and fluoroquinolones (Ciprofloxacin137, Levofloxacin-137, and Norfloxacin-140) [35]. The natural defense mechanisms of the male urinary system are responsible for the extremely low incidence of UTI in males. The higher incidence in elderly individuals suggests greater susceptibility to infections due to their relatively weakened defenses. It was discovered that female patients had a higher prevalence of UTIs than male patients. The situation has gotten worse due to

Pakistan's self-medication trends and excessive use of antibiotics by healthcare providers.
Compared to older men men aged between 18 and 29 have significantly higher susceptibility of *E. faecalis* to ciprofloxacin. Second, because of ciprofloxacin's side effects, it is more frequently used in younger people. Compared to older people, men aged 18 to 29 are less likely to have ciprofloxacin resistance. Ciprofloxacin is one of the empirical first-line medications recommended by German and European guidelines [36]. Overall, enterococci's resistance to ciprofloxacin is not evolving over time. This is particularly crucial because, in Germany, the number of ambulatory fluoroquinolone prescriptions decreased from 101 per 1000 insured people to 60 per 1000 insured people in 2010 [37].
In this survey, a total of 15 antibiotics, including Doxycycline DOX/DO (30 µg), Colistin CL/CT (10 µg), Cefepime CPM/FEP (30 µg), Fosfomycin FO/FF (200 µg), Nitrofurantoin NIT/F (300 µg), Ceftriaxone CRO (30 µg), Ampicillin AM/AMP (10 µg), Co-amoxiclav AMC(30 µg) ,Amikacin AK(30 µg), Tazobactam-pipracillin TZP (110 µg), Meropenem MEM (10 µg),
Ciprofloxacin CIP(5 µg), Imipenem IPM(10 µg), Gentamicin GEN/CN (10 µg), Cotrimoxazole Sxt (25 µg), were used for the determination of efficacy against bacteria. In which the antibiotics, including Ciprofloxacin, Cotrimoxazole, Doxycycline, Fosfomycin, and Co-amoxiclav, are intermediate to *Klebsiella* pneumonia. The Colistin, Gentamicin, and Amikacin are among those antibiotics that exhibit susceptibility to *Klebsiella* pneumoniae. In some cases, the antibiotic Doxycycline shows susceptibility to *Klebsiella* pneumonia. During the survey study, a total of 998 patients' data was collected through interviews. The criteria for this study include male adults, female adults, and young children. Age groups 5 to 85 years were selected for data collection.

CONCLUSIONS

The socioeconomic status of UTI patients shows notable differences in marital status and place of residence. There were more uneducated people than educated people in this survey. During this study, people with low socioeconomic status are more numerous. The antibiotics, including Ciprofloxacin, Cotrimoxazole, Doxycycline, Fosfomycin, and Co-amoxiclav, have no effect on *Klebsiella* pneumonia. Colistin, Gentamicin, Doxycycline and Amikacin are among the antibiotics that are susceptible to *Klebsiella* pneumoniae.. Antibiotics such as Cefepime CPM/FEP (30 µg), Nitrofurantoin NIT/F (300 µg), Ampicillin AM/AMP (10 µg), Tazobactam-pipracillin TZP (110 µg), Meropenem MEM (10 µg), and Imipenem IPM (10 µg) showed total resistance to both *E. faecalis and K. pneumoniae species.*

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