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Antibiotic Susceptibility Patterns in Patients with Chronic Kidney Disease in Bangladesh: A Comprehensive Analysis of Clinical Isolates

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ABSTRACT

Chronic kidney disease (CKD) is a significant health concern in Bangladesh, with patients frequently experiencing infectious complications due to immunocompromised status. The study aimed to investigate the antibiotic susceptibility patterns among patients with chronic kidney disease (CKD) in Bangladesh. This cross-sectional study was conducted at Jalalabad Ragib-Rabeya Medical College in Sylhet, Bangladesh, from June 2022 to May 2023. Through a comprehensive analysis of clinical isolates from 205 CKD patients, the study reveals varying susceptibility profiles across multiple antibiotics. Among the antibiotics tested, carbapenems, specifically, meropenem and imipenem, exhibit high sensitivity rates exceeding 88% against diverse microbial isolates. This highlights their efficacy as broad-spectrum agents. Amikacin, on the other hand, emerges as a reliable treatment option, showing substantial sensitivity ranging from 50% to 100% against most isolates. Other antibiotics, such as ciprofloxacin and levofloxacin, demonstrate moderate to high sensitivity. They are particularly effective against prevalent pathogens like Escherichia coli and Pseudomonas. However, some antibiotics, including ceftazidime and cefuroxime, show limited efficacy against specific isolates. These findings underscore the importance of judicious antibiotic selection and surveillance in CKD patients. Such measures are crucial for optimising treatment outcomes and minimising antibiotic resistance. The study also highlights the need for ongoing antibiotic stewardship efforts. It emphasises the significance of tailored therapy based on local susceptibility patterns to effectively combat infectious complications in CKD patients.

Keywords: *Chronic kidney disease, Antibiotic susceptibility, Clinical isolates, Treatment efficacy.*

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INTRODUCTION

Chronic kidney disease (CKD) represents a significant health challenge worldwide, with escalating prevalence rates observed, particularly in low and middle-income nations such as Bangladesh.

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In 2017, an estimated 1.2 million people died from CKD worldwide, with a 41.5% increase in the all-age mortality rate between 1990 and 2017. Despite this increase, there was no significant change in the age-standardised mortality rate during the same period. The global prevalence of all-stage CKD was recorded at 697.5 million cases, corresponding to a prevalence of 9.1%[1]. According to the Global Burden of Disease study, there were approximately 1.4 million deaths worldwide due to CKD in 2019. This represents a 20% increase from 2010 and is one of

the highest increases among the leading causes of death[2]. The prevalence of CKD in South Asia is reported to be 13.6% in Thailand[3], 10.8% in China[4], and 15.0% in India[5]. CKD commonly results in progressive end-stage renal disease (ESRD), leading to higher rates of hospitalisation and premature deaths[6].

Chronic kidney disease (CKD) poses a significant burden on public health in Bangladesh, with a growing number of individuals affected by this condition. A meta-analysis of 225,206 participants found that the prevalence of chronic kidney disease (CKD) among individuals in Bangladesh was 22.48%. This rate is significantly higher than the global prevalence of CKD. Moreover, the analysis revealed that the prevalence of CKD was higher in females (25.32%) compared to males (20.31%)[7]. CKD is characterised by a progressive decline in kidney function over time, leading to various complications, including electrolyte imbalances, fluid retention, and cardiovascular diseases[8,9]. In Bangladesh, factors such as inadequate access to healthcare services, limited awareness about kidney health, and high prevalence of risk factors like diabetes and hypertension contribute to the escalating burden of CKD[10,11]. Moreover, the management of CKD is complicated by the frequent occurrence of infectious complications, such as urinary tract infections (UTIs) and bloodstream infections, which are often exacerbated by the immunocompromised state associated with kidney dysfunction[12,13].

The effective management of CKD often necessitates antibiotic therapy to address associated infectious complications[13,14]. However, despite the critical role antibiotics play in patient care, there remains a notable dearth of comprehensive studies elucidating the antibiotic susceptibility patterns specific to CKD patients within the Bangladeshi context. Understanding the prevailing microbial landscape and the nuanced effectiveness of antibiotics is paramount for guiding evidence-based treatment strategies and curtailing the emergence of antimicrobial resistance a pressing concern that poses formidable threats to patient outcomes and healthcare systems alike. Thus, this study endeavours to furnish a meticulous analysis of antibiotic susceptibility patterns among CKD patients in Bangladesh, discerning the prevalence of microbial isolates and their susceptibilities to commonly prescribed antibiotics. By scrutinising clinical isolates obtained from CKD patients, this research aspires to furnish invaluable insights to inform antimicrobial stewardship practices tailored to the distinctive healthcare milieu of Bangladesh. Ultimately, the study seeks to furnish actionable evidence aimed at optimising patient care and combating the ominous tide of antimicrobial resistance, thereby fortifying the armamentarium for effectively managing infections within the purview of CKD in Bangladesh. The study aimed to unveil the pattern of microbial isolates and their susceptibility profiles to commonly prescribed antibiotics, with the overarching goal of informing evidence-based antimicrobial stewardship practices and enhancing patient care within the context of CKD management.

MATERIALS AND METHODS

Study design and site:

This study adopted a cross-sectional study design to investigate the antibiotic susceptibility patterns among individuals diagnosed with chronic kidney disease (CKD) presenting with suspected or confirmed infectious complications. The study took place at Jalalabad Ragib-Rabeya Medical College Hospital in Sylhet, eastern Bangladesh, between June 2022 and May 31, 2023. This tertiary healthcare centre provides both inpatient and outpatient services for patients with chronic kidney disease (CKD) in its nephrology department. This medical college is a prominent healthcare hub with specialised facilities and a dedicated healthcare team in the nephrology department focused on diagnosing, treating, and managing CKD patients. Its geographical location enhances accessibility for a diverse patient population, allowing for a comprehensive and representative study of CKD in the region.

Study population and recruiting strategy:

The study population consisted of patients aged 40 years and older who had been diagnosed with chronic kidney disease (CKD) and were receiving treatment at Jalalabad Ragib-Rabeya Medical College Hospital. These patients presented with suspected or confirmed infectious complications associated with their condition. Both males and females were included in the study population, with varying CKD stages between 3 and 5. These stages were confirmed through clinical evaluation, laboratory tests, and the estimated glomerular filtration rate (GFR). The population was purposefully recruited based on positive urinary tract infection (UTI) results among individuals suffering from CKD. Patients who were required to undergo antibiotic susceptibility testing and had complete demographic and clinical data available for analysis, including age, gender,

comorbidities, CKD stage, and antibiotic usage history, were considered eligible for inclusion in the study. Patients diagnosed with acute kidney injury (AKI) or other renal conditions that did not meet the criteria for CKD, those with clinical specimens deemed inadequate for microbiological analysis, and patients with severe immunocompromised conditions or undergoing immunosuppressive therapy were excluded from the study. The estimated glomerular filtration rate (eGFR) (ml/min per 1.73 m^2) was calculated according to the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) updated formula[15], and CKD stages were categorised following guidelines by the American Kidney Association[16].

Bacterial identification using urine samples:

Aseptic techniques were used to prevent contamination and ensure accurate results. The urine sample was collected in a sterile container and transported to the laboratory. Upon receipt, the sample was mixed for homogeneity, and a small amount was inoculated onto culture media. The plates were then incubated at 37° Celsius for 18-24 hours to promote bacterial growth. After incubation, the plates were examined for colony morphology, colour, size, and any features indicating bacterial growth. Further biochemical testing was conducted to characterise and confirm the isolates. Common tests, including catalase, oxidase, indole, urease, and carbohydrate fermentation tests, were performed to provide information about the metabolic properties of the bacteria. The identified bacterial species, along with antibiotic susceptibility testing results, were included in the final report. Stringent quality control measures were maintained to ensure the reliability and validity of the results, facilitating the accurate diagnosis and treatment of bacterial urinary tract infections. Bacteriuria was defined as the growth of any microorganism at a concentration of $\geq 10^5$ CFU/ml or $\geq 10^3$ CFU/ml in patients with symptoms. Asymptomatic bacteriuria (ASBU) was defined as the presence of at least 10^5 colony-forming units (CFU/ml) of bacterial species in a midstream urine sample that was collected cleanly and did not show any symptoms of a urinary tract infection (UTI)[17]. The isolated organisms were identified using the standard biochemical method, which involves assessing the appearance of the colonies, staining reactions, and biochemical properties.

Antibiotic susceptibility testing procedure:

Antibiotic susceptibility testing was conducted meticulously using standardised protocols to evaluate the effectiveness of different antibiotics against microbial isolates obtained from individuals diagnosed with chronic kidney disease (CKD). Initially, pure cultures of microbial isolates were obtained by subculturing on appropriate agar plates. The Kirby-Bauer disk diffusion method, following the guidelines set by the Clinical and Laboratory Standards Institute (CLSI)[18], was then used for susceptibility testing. This involved preparing standardised inoculum suspensions of microbial isolates, which were then evenly spread on Mueller-Hinton agar plates. Antibiotic disks, each containing specific concentrations of antibiotics relevant to CKD associated infections, were strategically placed on the agar surface. After an incubation period under optimal conditions, the diameter of the zone of inhibition surrounding each antibiotic disk was carefully measured using a calibrated ruler. The interpretation of zone sizes followed the established breakpoints outlined in the CLSI guidelines, allowing for the classification of isolates as susceptible, intermediate, or resistant to each antibiotic tested. Throughout the testing process, rigorous quality control measures were implemented to ensure the precision and reliability of susceptibility testing results. These measures included the inclusion of standard reference strains and routine performance assessments.

Statistical analysis:

Descriptive analyses are presented using different methods for continuous and categorical variables. For normally distributed continuous variables, the mean±standard deviation (SD) is reported. Skewed data is described using the median and 25% and 75% quartiles. Categorical variables are expressed as proportions (%). Before conducting the analyses, the normality of continuous variables was checked using histograms and box plots. To compare groups for normally distributed continuous variables, the student t-test was used. For skewed continuous variables, the non-parametric Kruskal-Wallis test was performed. Categorical variables were analysed using Fisher's exact test or the χ^2 test, depending on the circumstances. The data were analysed using the statistical software STATA 17.

RESULTS

Demographic and clinical characteristics of patients with CKD by gender:

The study conducted a comprehensive analysis of demographic and clinical characteristics among the

Table-I: *Demographic and clinical characteristics of patients with CKD by gender.*

Variables	Overall (N=205)	Male (n=49)	Female (n=156)	p-value
Age in year, mean (±SD)	63.22±9.07	62.47±10.59	63.46±8.56	0.508
Age range (Min-Max)	41-85	47-85	41-85	
Age distribution in years, n %				
41-50	16 (7.8)	6 (12.2)	10 (6.4)	0. 198
51-60	66 (32.2)	10 (20.4)	56 (35.9)	
61- 70	81 (39.5)	24 (48.9)	57 (36.5)	
71-80	37 (18.1)	8 (16.3)	29 (18.6)	
>80	5 (2.4)	1 (2)	4 (2.6)	
S. Creatinine, Median (QI-Q3)	2.3 (1.6-3.5)	2.2 (1.6-5.4)	2.3 (1.6-3.5)	0.3303
eGFR, Median (QI-Q3)	26 (15-36)	32 (13-47)	25.5 (15-36)	0.111
Hb (g/dl), Median (QI-Q3)	10.6 (9.3-11.6)	10.4 (9.15-11.5)	11 (10.2-11.9)	0.019
Diabetes status, n (%)				
Diabetic	147 (71.7)	29 (59.2)	118 (75.6)	0.026
Non-diabetic	58 (28.3)	20 (40.8)	38 (24.4)	
CKD Stage, n (%)				
Stage 3	83 (40.5)	28 (57.1)	55 (35.3)	<0.001
Stage 4	72 (35.1)	69 (44.2)	3 (6.1)	
Stage 5	50 (24.4)	32 (20.5)	18 (36.7)	

*eGFR denotes estimated glomerular filtration rate, Hb denotes haemoglobin, and CKD denotes chronic kidney disease

** Students t-test for continuous variables with normal distribution (e.g. age); for skewed continuous variables, the non-parametric Kruskal-Wallis (e.g. S. Creatinine, eGFR and Hb) and for categorical variables (e.g. categorical age), Chi-square test were performed.

study participants with chronic kidney diseases, categorising them by gender. A total of 205 individuals were included in the study, with 49 (23.9%) being male and 156 (76.1%) being female (Table-I).

The overall mean age of the participants was 63.22±9.07 years. Males had a slightly lower mean age of 62.47 years compared to females, who had a mean age of 63.46 years. However, this difference was not statistically significant (p=0.06). Similarly, there were no statistically significant differences observed between males and females across various age groups (41-50, 51-60, 61-70, 71-80, and >80) (p=0.198) (Table-I).

Median serum creatinine levels and estimated glomerular filtration rates (eGFR) showed similar values between males and females (S. creatinine: 2.2 mg/dl vs. 2.3 mg/dl, p=0.3303; eGFR: 32 ml/min/1.73m^{2}vs. 25.5 ml/min/1.73m^2, p=0.111). However, a significant difference in median haemoglobin levels was observed, with females having higher levels (10.4 g/dl vs. 11 g/dl, p=0.019). Furthermore, the proportion of diabetes was notably higher among females compared to males, and this difference was statistically significant (59.18% vs. 75.64%, p=0.026). Notably, there were significant disparities in the distribution of chronic kidney disease (CKD) stages between genders (p<0.001). Stage 4 CKD was more prevalent among males (57.14%), while Stage 5 CKD was more prevalent among females (36.73%) [Table-I].

Table-II: *Proportion of micro-organism infection among patients with CKD by gender.*

Organism	Overall (n=205)	Male (n=49)	Female (n=156)
Streptococci	2 (0.9)	0 (0)	2 (1.3)
Citrobacter	7 (3.4)	0 (0)	7 (4.5)
CoNS	12 (5.8)	7 (14.3)	5 (3.2)
E. Coli	108 (52.7)	22 (44.9)	86 (55.1)
Enterococci	10 (4.9)	3 (6.1)	7 (4.5)
Klebsiella	29 (14.2)	7 (14.3)	22 (14.1)
Proteus	11 (5.4)	2 (4.1)	9 (5.8)
Pseudomonas	20 (9.8)	5 (10.2)	15 (9.6)
Staphylococcus	6 (2.9)	3 (6.1)	3 (1.9)

Table-III: *Antibiotic susceptibility profile of tested microbial isolates among patients with CKD.*

Antibiotics	Sensitive, n (%)	Intermediate, n (%)	Resistance, n (%)
Ceftriaxone	74 (37.2)	18 (9.1)	107 (53.8)
Amoxiclav	116 (61.1)	24 (12.6)	50 (26.3)
Cefuroxime	33 (22.3)	14 (9.5)	101 (68.2)
Cefixime	18 (9.3)	22 (11.3)	154 (79.4)
Ciprofloxacin	89 (45.4)	40 (20.4)	67 (34.2)
Levofloxacin	81 (43.1)	42 (22.3)	65 (34.6)
Azithromycin	63 (31.8)	88 (44.4)	47 (23.7)
Ceftazidime	9 (32.1)	6 (21.4)	13 (46.4)
Meropenem	178 (88.6)	10 (4.9)	13 (6.5)
Imipenem	163 (88.1)	9 (4.9)	13 (7)
Cefepime	21 (23.3)	10 (11.1)	59 (65.6)
Nitrofurantoin	114 (58.5)	43 (22.1)	38 (19.5)
Doxycycline	79 (48.5)	33 (20.3)	51 (31.3)
Amikacin	140 (75.3)	26 (13.9)	20 (10.8)
Gentamycin	86 (64.7)	23 (17.3)	24 (18.1)
Co-trimoxazole (CTX)	57 (34.1)	22 (13.2)	88 (52.7)
Linezolid	2 (14.3)	2 (14.3)	10 (71.4)

The proportion of microorganism infection among patients with CKD by gender:

The study investigated the occurrence of microorganism infections in patients with CKD, categorised by gender. Among these infections, *Escherichia coli (E. coli)* was the most prevalent, accounting for 52.68% of all cases. The proportion of *E. coli* infections was slightly lower in male participants (44.90%) compared to female participants (55.13%), but it remained the predominant pathogen in both genders. *Klebsiella* infections were documented in 29 patients, representing 14.15% of all infections, with similar proportions among male (14.29%) and female (14.10%) participants. *Pseudomonas* infections were reported in 20 patients, amounting to 9.76% of all infections, with comparable rates between males and females. Coagulase-negative staphylococci (CoNS) infections were diagnosed in 12 patients, making up 5.85% of all infections. Among the participants, a

Table-IV: *Antibiotic susceptibility profiles against multiple clinical isolates among patients with CKD.*

Antibiotics	Overall n (%)	*Strep.* n (%)	*Citrobacter* n (%)	*CoNS* n (%)	*E. Coli* n (%)	*Enterococci* n (%)	*Klebsiella* n (%)	*Proteus* n (%)	*Pseudomonas* n (%)	*Staph.* n (%)
Ceftriaxone	74	1	3	4	37	3	11	5	5	5
(n=199)	(37.2)	(50)	(42.9)	(36.4)	(35.6)	(30)	(37.9)	(45.5)	(26.3)	(83.3)
Amoxiclav	116	2	2	7	67	8	12	8	6	4
(n=190)	(61.1)	(100)	(33.3)	(58.3)	(66.3)	(88.9)	(42.9)	(72.7)	(37.5)	(80)
Cefuroxime	33	0	1	3	17	2	6	1	0	3
(n=148)	(22.3)	(0)	(20)	(42.9)	(21.3)	(22.2)	(26.1)	(12.5)	(0)	(100)
Cefixime	18	0	1	1	11	1	1	0	0	2
(n= 194)	(9.3)	(0)	(14.3)	(8.3)	(11.8)	(12.5)	(3.5)	(0)	(0)	(33.3)
Ciprofloxacin	89	1	3	10	37	5	10	4	15	4
(n= 196)	(45.4)	(50)	(42.9)	(83.3)	(36.6)	(50)	(35.7)	(40)	(75)	(66.7)
Levofloxacin	81	1	2	10	38	3	7	2	14	4
(n= 188)	(43.1)	(50)	(33.3)	(83.3)	(38.4)	(30)	(26.9)	(22.2)	(73.7)	(80)
Azithromycin	63	0	0	5	30	4	8	3	10	3
(n= 198)	(31.8)	(0)	(0)	(41.7)	(28.3)	(40)	(29.6)	(33.3)	(52.6)	(50)
Ceftazidime	9	0	-	-	4	0	1	-	4	-
(n=28)	(32.1)	(0)			(0.8)	(0)	(14.3)		(100)	
Meropenem	178	1	6	11	96	7	24	11	17	5
(n=201)	(88.6)	(50)	(85.7)	(91.7)	(90.6)	(70)	(85.7)	(100)	(89.5)	(83.3)
Imipenem	163	2	5	10	90	7	24	5	16	4
(n=185)	(88.1)	(100)	(83.3)	(90.9)	(90)	(77.8)	(92.3)	(71.4)	(88.9)	(66.7)
Cefepime	21	-	2	3	10	0	3	2	1	0
(n=90)	(23.3)		(100)	(37.5)	(20.4)	(0)	(30)	(40)	(14.3)	(0)
Nitrofurantoin	114	-	5	9	64	7	11	6	7	5
(n=195)	(58.5)		(100)	(75)	(60.9)	(70)	(40.7)	(54.6)	(36.8)	(83.3)
Doxycycline	79	1	3	7	40	4	10	6	6	2
(n=163)	(48.5)	(50)	(75)	(58.3)	(50.6)	(40)	(41.7)	(54.6)	(37.5)	(40)
Amikacin	140	1	3	7	71	5	21	10	19	3
(n=186)	(75.3)	(50)	(42.9)	(70)	(71.7)	(83.3)	(77.8)	(100)	(95)	(60)
Gentamycin	86	1	3	9	41	4	9	1	15	3
(n=133)	(64.7)	(100)	(50)	(90)	(56.9)	(80)	(64.3)	(25)	(88.2)	(75)
CTX	57	0	3	2	34	3	6	6	1	2
(n=167)	(34.1)	(0)	(50)	(20)	(37.8)	(33.3)	(26.1)	(60)	(7.7)	(40)
Linezolid	2	-	0	1	0	1	0	0	0	-
(n=14)	(14.3)		(0)	(100)	(0)	(100)	(0)	(0)	(0)	

**Strep*. denotes *Streptococci*, *E. coli* denotes *Escherichia coli*, *CoNS* denotes coagulase-negative *Staphylococci*, *Staph*. denotes *staphylococcus*, CTX denotes Co-trimoxazole

higher proportion of male patients (14.29%) experienced these infections compared to female patients (3.21%) [Table-II].

Citrobacter infections were found in 7 patients, representing 3.41% of all infections, and all of these cases occurred in female participants. *Staphylococcai, Enterococci*, and *Proteus* organisms showed relatively lower infection rates (2.93%, 4.88%, and 5.37%, respectively), with *Staphylococcal* infections being more prevalent among male participants (6.12%) compared to female participants (1.92%). The findings indicated that *Streptococcal* infections were only present in 2 patients, accounting for 0.98% of all infections, and both cases occurred in female patients. Therefore, the study concludes that gender may play a role in the occurrence of certain microorganism infections among patients with CKD. [Table-II].

Antibiotic susceptibility profiles against multiple clinical isolates among patients with CKD:

The antibiotic susceptibility profiles in patients with chronic kidney disease (CKD) reveal varying levels of effectiveness for different antimicrobial agents and microbial isolates, as shown in Table-IV. Carbapenems, such as Meropenem and Imipenem, demonstrate the highest overall sensitivity rates, exceeding 88%. They consistently show effectiveness against a broad

spectrum of microbial isolates, including *Streptococci*, *Citrobacter spp*, *CoNS*, *E. coli*, *Enterococci*, *Klebsiella*, *Proteus*, *Pseudomonas*, and *Staphylococcus*. Both antimicrobial agents remain predominant (over 90%) in *CoNS* organisms. Amikacin is a reliable treatment option, with substantial sensitivity ranging from 50% to 100% against most isolates. Ciprofloxacin and Levofloxacin exhibit moderate to high sensitivity, particularly against *E. coli* (approximately 37% and 38%, respectively) and *Pseudomonas* (around 74% and 75%, respectively), although there is some variability.

Nitrofurantoin stands out for its sensitivity against various isolates, while Amoxiclav demonstrates moderate to high effectiveness against *Streptococci*, *E. coli*, and *Klebsiella*. Gentamicin shows variable sensitivity across isolates, with notable effectiveness against *Staphylococci* and *E. coli*. However, some antibiotics, like Ceftazidime and Cefuroxime, exhibit limited efficacy against certain isolates [Table-IV].

DISCUSSION

The study included a total of 205 patients, with females with UTI predominant (76.1%), revealing an overall mean age of 63.22 years, with males showing a slightly lower mean age compared to females, although this disparity did not reach statistical significance. The genderbased discrepancies were consistent with a previously published article that found a higher incidence of infection in females[19,20].

Interestingly, while the age distribution across various age groups did not demonstrate statistically significant differences between males and females, there were notable trends. The highest proportion of patients fell within the 61-70 years age group, followed by the 51-60 years age group, indicating a predominance of older individuals affected by UTI with CKD. These findings align with a recently published report conducted in Bangladesh, indicating an increased prevalence of UTI in CKD with advancing age[21]. However, it's imperative to note that our study's limited sample size might have influenced the statistical power to detect significant differences.

Median serum creatinine levels and estimated glomerular filtration rates (eGFR) showed similar values between genders. However, a significant difference in median haemoglobin levels was observed, with females exhibiting higher levels, reflecting potential differences in anaemia prevalence between genders.

The prevalence of diabetes among CKD patients with UTI was notably high, with 71.71% diagnosed as diabetic. This finding underscores the strong association between diabetes and UTI in CKD, consistent with previous research highlighting diabetic complications related to poor glycaemic control and older age as a leading cause of CKD worldwide[22]. The high prevalence of diabetes in our study population emphasises the need for robust diabetes management strategies to prevent or delay the progression of CKD[23].

Furthermore, the distribution of CKD stages among UTI patients demonstrated a significant burden of advanced CKD, with stage 4 and stage 5 CKD accounting for 35.1% and 24.4% of cases, respectively. This distribution suggests a considerable proportion of patients may be at risk of complications such as end-stage renal disease (ESRD) and the need for renal replacement therapy (RRT)[24]. These findings underscore the importance of early detection and intervention strategies aimed at slowing the progression of CKD, particularly among high-risk individuals such as those with diabetes.

In terms of the proportion of microorganisms causing UTI among patients with chronic kidney disease (CKD), stratified by gender, *Escherichia coli* (*E. coli*) emerged as the predominant pathogen, responsible for more than half (52.68%) of all infections. While the proportion of *E. coli* infections was slightly lower among male participants compared to females, it remained the most prevalent organism in both genders, highlighting its significance as a causative agent in CKD-associated infections. The results aligned with previously conducted studies[25,26].

Similarly, *Klebsiella* infections were notably prevalent, representing 14.15% of all infections, with comparable rates between males and females[27]. Notably, coagulase-negative *Staphylococci* (*CoNS*) infections were more prevalent among male patients (14.29%) compared to females (3.21%), suggesting potential gender-specific differences in susceptibility to certain pathogens. These overall proportions and gender-based variation are consistent with various previous studies[28,29]. Conversely, *Streptococcal* and *Citrobacter* infections were less common overall, with *Streptococci* found exclusively and *Citrobacter* infections predominantly affecting females[27,30]. The relatively low prevalence of *Staphylococcal*, *Enterococci*, and *Proteus* infections[28] underscores the diverse microbial landscape associated with CKD, necessitating targeted surveillance and management strategies tailored to specific pathogens.

The examination of antibiotic susceptibility profiles among patients with chronic kidney disease (CKD) delineates a complex landscape of antimicrobial efficacy against various clinical isolates. Carbapenems,

including Meropenem and Imipenem, emerge as stalwart therapeutic options, boasting sensitivity rates exceeding 88% across multiple microbial strains[31]. Notably, both agents exhibit consistent effectiveness against a broad spectrum of pathogens, encompassing *Streptococci*, *Citrobacter spp*, Coagulase-negative *staphylococci* (*CoNS*), *Escherichia coli* (*E. coli*), *Enterococci*, *Klebsiella*, *Proteus*, *Pseudomonas*, and *Staphylococci* organisms. Particularly commendable is their robust efficacy against *CoNS*, with sensitivity rates surpassing 90%. Amikacin also stands out as a reliable treatment avenue, showcasing substantial sensitivity ranging from 50% to 100% against most isolates[32,33]. In contrast, Ciprofloxacin and Levofloxacin demonstrate moderate to high sensitivity, notably against *E. coli* and *Pseudomonas* strains; which was found to be consistent with previous research[27]. Nevertheless, some variability in effectiveness is observed across isolates, warranting careful consideration during therapeutic selection. Nitrofurantoin emerges as a noteworthy candidate, exhibiting notable sensitivity against diverse isolates, as demonstrated by previous research studies[27,34]. Similarly, Amoxiclav demonstrates moderate to high effectiveness against *Streptococci*, *E. coli*, and *Klebsiella* strains, aligned with previous studies[32,35]. Gentamicin exhibits variable sensitivity across isolates, with pronounced effectiveness against *Staph*. and *E. coli*[36]. However, certain antibiotics, such as Ceftazidime and Cefuroxime, showcase limited efficacy against specific isolates, emphasising the importance of tailored antibiotic stewardship practices[28].

This comprehensive analysis underscores the imperative of judicious antibiotic selection guided by local susceptibility patterns to optimise therapeutic outcomes and mitigate the emergence of antimicrobial resistance.

LIMITATIONS

The limitations of the study include its retrospective design, reliance on data from a single healthcare centre, small sample size, focus on urinary specimens, absence of molecular characterisation of isolates, and inability to explore temporal trends.

CONCLUSION

The study conducted in Bangladesh emphasises that patients with chronic kidney disease exhibit diverse antibiotic susceptibility patterns. The research revealed that carbapenems, specifically Meropenem and Imipenem display greater efficacy, while other antibiotics exhibit varying degrees of effectiveness. It is imperative to choose antibiotics tailored for each patient to effectively manage infections within this population. However, further studies with multicenter and molecular characterisation of isolates are required to provide valuable insights for the development of more targeted treatment strategies.

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