



# Antibiotic susceptibility and resistance patterns of uropathogens in female patients with symptomatic UTIs

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**Abstract :** Urinary tract infections (UTIs) remain a prevalent and bothersome health issue among women, affecting millions worldwide each year. While UTIs can affect individuals of any gender, women are more prone to developing this infection due to different factors connected to their anatomical structures. This is a retrospective study among female patients attending clinics at University College Hospital, Ibadan. A total of 961 female patients were recorded, out of which 48 (5.0%) had significant growth of  $>10^5$  cfu/ml of bacteria. The distribution of the pathogens includes *Escherichia coli* (57.1%), *Klebsiella pneumoniae* (24.5%), *Klebsiella oxytoca* (10.2%), *Pseudomonas aeruginosa* (4.1%), and *Proteus vulgaris* (4.1%). The age of the patients ranges from 1–85 years. Women at the childbearing age of 25–34 show a higher UTI incidence rate of 20.83% when compared to other age groups, followed by the 54–65 age groups (16.67%) and the 35–44 age groups (14.58%). *Escherichia coli* have been shown to be the main uropathogen of UTIs in female patients, especially women of childbearing age, with evidence of resistance to some of the usually prescribed antibiotics. Hence, there is a need to improve the choice of antibiotics in the treatment of UTIs.

**Keywords:** Urinary tract infections (UTIs), uropathogens, *Escherichia coli*, AST, antibiotics

## 1.0 INTRODUCTION

Women are more likely than men to have urinary tract infections (UTIs), which may occur at any stage of life. Because of the anatomy and structure of the female lower urinary system and its proximity to the reproductive organs, women are far more susceptible to UTIs than men. Since the female urethra is comparatively short, there is a short distance available for bacteria to ingress (Czajkowski et al., 2021).

The prevalence of urinary tract infections (UTIs) in women is significant, and it varies depending on various factors such as age, sexual activity, and overall health. Generally, UTIs are more common in women than in men due to differences in anatomy and physiology. UTI episodes will occur at least once in the lifetime of

about 50% of all females (Al-Badr et al., 2013). There is a higher prevalence of UTI in sexually active females and during pregnancy (Verstraelen et al., 2010). When it comes to pediatric patients, UTI is linked to end-stage renal disease and decreased renal function, as well as pyelonephritis, premature birth, and miscarriages in pregnant women (Foxman et al., 2002).

## 1.2 JUSTIFICATION OF THE STUDY.

Resistance to antibiotics in the treatment of UTIs has been a major concern for public health, especially in Nigeria and other developing nations. Antibiotic resistance occurs, among other things, as a result of the indiscriminate use of antibiotics without a prescription. The use of self-prescribed antibiotics, as well as the use of counterfeit and substandard medications, is widespread in developing nations (Abubakar et al., 2009; Wilson et al., 2011). There is a need to study the susceptibility and resistance patterns of each of the uropathogens, which would inform the choice of antibiotics, and also to educate the public of the dangers associated with the indiscriminate use of antibiotics, which include, among others, the development of resistant strains. This study is therefore designed to address antibiotic susceptibility and resistance patterns of uropathogens in female patients with symptomatic UTI.

## 1.3 Materials and methods

This study focused on female patients diagnosed with possible urinary tract infections attending different clinics at the University College Hospital, Ibadan. Ibadan is the capital city of Oyo State, a south-western part of Nigeria. It has an average population of over 4 million and is the third-largest state in the country after Lagos and Kano. This city has a good representation of all the tribes, religions, and ethnicities of Nigeria.

**1.3.1 Study site:** Data was retrieved from records of female patients being screened for UTI in the Laboratory Department of Medical Microbiology and Parasitology.

**1.3.2 Study population:** This study was conducted among female patients diagnosed with urinary tract infections attending clinic in University College Hospital, Ibadan.

**1.3.3 Study Design:** This is a retrospective study of female patients being diagnosed with urinary tract infections at the University College Hospital, Ibadan.

**1.3.4 Sample processing:** Urine samples (midstream urine) were collected in a sterile universal bottle and kept at 4°C until processing. It was first cultured on both blood agar and cystine lactose electrolyte deficiency (CLED) agar and then spun at 3000 rpm for 5 minutes using a centrifuge. It was decanted, and the sediments were resuspended by vortex and mounted on a clean glass slide for microscopy.

**1.3.5 Statistical analysis:** Data were collected and analyzed using WHONET 2022 software.

## 2.0 Results

Between October 2022 and March 2023, a total of 961 female patients with UTI with age ranges from <1 to >85 years were screened for uropathogens, of which 48 (8.2%) were positive (Table 1). Table 2 shows the distribution of the uropathogens, with *E. coli* having the highest percentage (57.1%), followed by *Klebsiella pneumoniae* (24.5%), *Klebsiella oxytoca* (10.2%), *Pseudomonas aeruginosa* (4.1%), and lastly *Proteus vulgaris* (4.1%).

Table1: Shows the distribution of urine culture results from the female patients

Growth	Number	(%)
No growth	331	34.4
No significant growth ( $<10^5$ cfu/ml)	582	60.6
Significant growth ( $>10^5$ cfu/ml)	48	5.0
<b>Total</b>	<b>961</b>	

Table 2: Shows distribution isolated uropathogens from the female patients

Organism	Number of isolates	Incidence (%)	rate
E. coli	27	56.3	
Klebsiella pneumonia	12	25	
Klebsiella oxytoca	5	10.4	
Pseudomonas aeruginosa	2	4.2	
Proteus vulgaris	2	4.2	
<b>Total</b>	<b>48</b>	100	

Figure 1 shows the distribution of the patients across different age ranges. More of the patients with UTI belong to the 25–34 age groups, followed by 55–64, 35–44, 65–74, 45–54, and so on. The unknown were the patients who did not indicate or were not sure of their exact age.

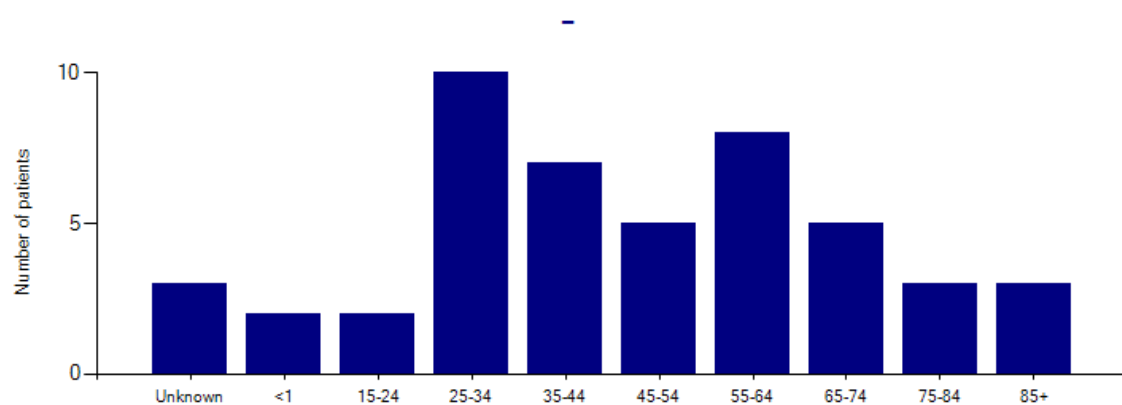


Figure 1 shows the distribution of the patients across different age groups.

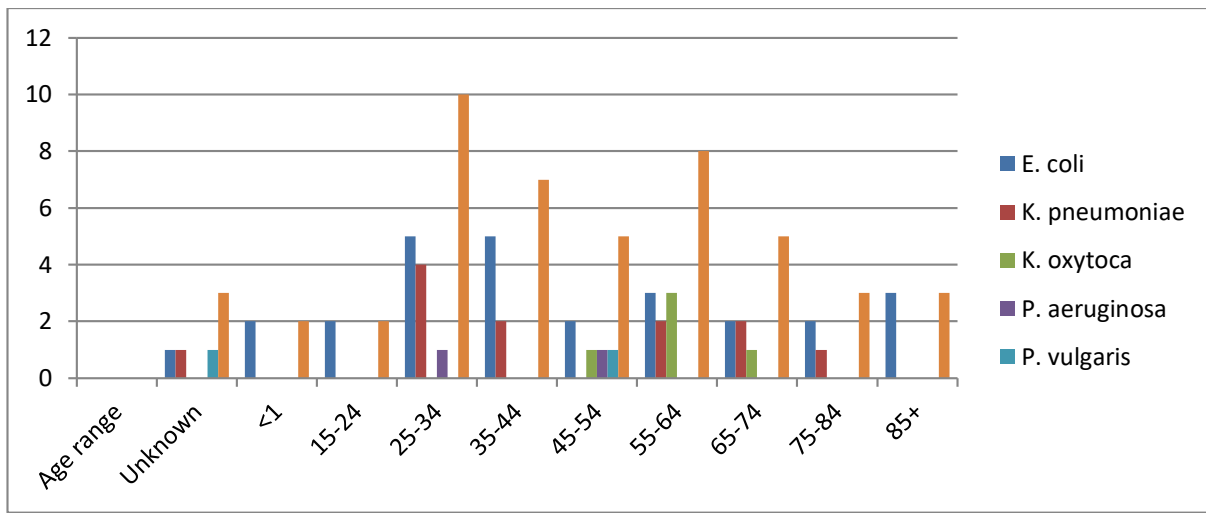


Figure 2 shows the distribution of uropathogens across different age groups.

Figure 2 shows the distribution of uropathogens across different age groups. Escherichia coli were isolated across different age groups. Female patients in the age group 25–34, followed by 55–64 and 35–44, were more infected.

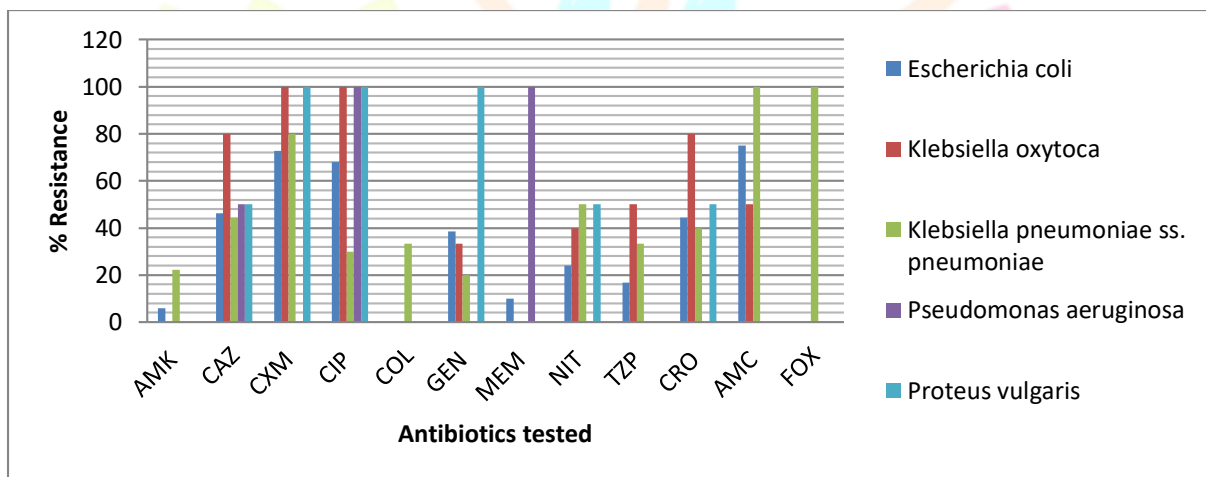


Figure 3 shows the isolate percentage resistance to each of the antibiotics tested.

AMK=Amikacin; CAZ=Ceftazidime; CIP=ciprofloxacin; COL=colistin; GEN=gentamycin; MEM=meropenem; NIT=nitrofurantoin; TZP=piperracillin tazobactam; CRO=ceftriazone; AMC=augmentin; FOX=cefoxitin

Figure 3 shows that the usually prescribed antibiotics may not be suitable for the treatment of UTI, as many of the isolates were showing resistance. Klebsiella pneumoniae was resistant to cefoxitin (100%), augmentin (100%), cefuroxime (80.0%), and nitrofurantoin (50.0%), while Klebsiella oxytoca was 100% resistant to cefuroxime and ciprofloxacin, ceftriazone (80.0%), and augmentin. Escherichia coli was resistant to augmentin (75%), cefuroxime (72.7%), and ciprofloxacin (68%). Pseudomonas aeruginosa was resistant to ciprofloxacin (100%), meropenem (100%), and ceftazidime (50%).



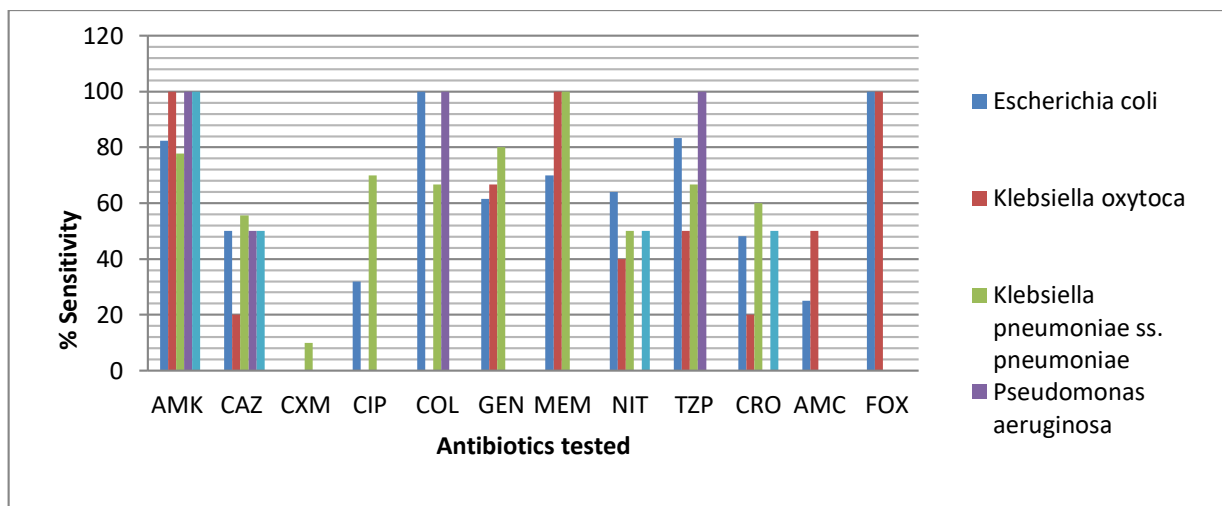


Figure 4 shows the isolate percentage sensitivity to each of the antibiotics tested.

AMK=Amikacin; CAZ=Ceftazidime; CIP=ciprofloxacin; COL=colistin; GEN=gentamycin; MEM=meropenem; NIT=nitrofurantoin; TZP=piperracillin tazobactam; CRO=ceftriazone; AMC=augmentin; FOX=cefoxitin

Figure 4 shows that *Escherichia coli* was sensitive to colistin (100%), cefoxitin (100%), piperracillin tazobactam (83.3%), amikacin (82.4%), meropenem (70%), gentamycin (61.5%), nitrofurantoin (64%), ceftazidime (50%), and ceftriaxone (48.1%). *Klebsiella pneumoniae* was sensitive to meropenem (100%), amikacin (77.8%), gentamycin (80%), ciprofloxacin (70%), piperracillin tazobactam (66.7%), colistin (66.7%), ceftriaxone (60.0%), Ceftazidime (55.6%), and nitrofurantoin (50%). *Klebsiella oxytoca* was sensitive to amikacin (100%), meropenem (100%), cefoxitin (100%), gentamycin (80.0%), piperracillin tazobactam (50%), nitrofurantoin (50%), and augmentin (50%).

### 3.0 Discussion

Women are more likely than men to have urinary tract infections (UTIs), which may occur at any stage of life. It has been established that 50% of women would treat urinary tract infections during their lifetime (Fihn et al., 2003). We observed in our study that the incidence of UTI was on the high side among the middle age groups of 25–34 years and 34–35 years. This was similar to a study conducted in Nigeria by Oli et al., which showed that the incidence of UTI is high among the middle age group of 22–36 years (Oli et al., 2017). In a similar study conducted by Bankole et al. (2011), the highest prevalence of UTI was found among the 21–30 year-old age group (44.67%) among people in rural communities in Nigeria.

The overall incidence of UTI in female patients with symptomatic UTIs in this study was 5.0%. This was comparable with the UTI prevalence of 8.7% obtained among pregnant women in Iran (Azami et al., 2019). Ngong et al. obtained a prevalence of 31% of UTI among pregnant women attending antenatal clinics in Cameroon (Ngong et al., 2021). Oli et al. (2017) recorded a UTI prevalence of 89.17% among female patients attending tertiary health facilities in south-eastern Nigeria. The difference in prevalence could be a result of differences in location and study population, among which the data from the studies were obtained.

Our study shows *Escherichia coli* as the more prevalent uropathogen, with an incidence rate of 56.3%. Azami et al. obtained a 61.6% incidence rate of *Escherichia coli* among pregnant women in Iran (Azami et al., 2019). Oladeinde et al. (2011) observed an incidence rate of 42.21% among female dwellings in Okada, a rural community in Nigeria. Fatemeh et al. (2022) obtained a 35% incidence rate of *Escherichia coli* from asymptomatic pregnant women. Also, Oli et al. (2017) obtained an incidence rate of 28.5% in a study carried out among female patients attending a hospital in south-eastern Nigeria. Adeniyi et al., in a study

conducted among elderly patients, observed a 40.9% prevalence of *Escherichia coli* as the most common uropathogen (undergoing peer review). All these studies buttress the fact that *Escherichia coli* is the most prevalent uropathogen in UTIs.

This study shows that the usually prescribed antibiotics may not be suitable for the treatment of UTI, as many of the isolates were showing resistance. *Escherichia coli* was resistant to augmentin (75%), cefuroxime (72.7%), and ciprofloxacin (68%). *Klebsiella pneumoniae* was resistant to ceftazidime (100%), augmentin (100%), and cefuroxime (80.0%). *Klebsiella oxytoca* was 100% resistant to cefuroxime and ciprofloxacin, with 80.0% resistance to ceftazidime and 50% to augmentin. *Pseudomonas aeruginosa* was resistant to ciprofloxacin (100%), meropenem (100%), and ceftazidime (50%).

This study shows that *Escherichia coli* was sensitive to colistin (100%), ceftazidime (100%), piperacillin tazobactam (83.3%), amikacin (82.4%), meropenem (70%), nitrofurantoin (64%), gentamycin (61.5%), ceftazidime (50%), and ceftriaxone (48.1%). *Klebsiella pneumoniae* was sensitive to meropenem (100%), amikacin (77.8%), gentamycin (80%), ciprofloxacin (70%), piperacillin tazobactam (66.7%), colistin (66.7%), ceftriaxone (60.0%), ceftazidime (55.6%), and nitrofurantoin (50%). *Klebsiella oxytoca* was sensitive to amikacin (100%), meropenem (100%), ceftazidime (100%), gentamycin (66.7%), piperacillin tazobactam (50%), and augmentin (50%). Ali et al. obtained a similar result in research conducted among pregnant women suffering from UTIs, where he observed that *Escherichia coli* was sensitive to meropenem (96.7%), ceftazidime (83.3%), gentamycin (73.3%), and nitrofurantoin (80.0%), while resistant to augmentin (53.3%) and ciprofloxacin (73.3%) (Ali et al., 2022).

### 3.1 Conclusion

*Escherichia coli* have been shown to be the main uropathogen of UTIs in female patients, especially women of childbearing age, with evidence of resistance to some of the usually prescribed antibiotics. Hence, there is a need for early detection of UTIs and improvement in the choice of antibiotics in the treatment of UTIs.

Conflict of interest: there is no conflict of interest.

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