



RESEARCH ARTICLE

ANTIBIOTIC RESISTANCE PATTERNS OF *ESCHERICHIA COLI* ISOLATED FROM THE URINARY TRACT OF PATIENTS ATTENDING ENUGU STATE UNIVERSITY TEACHING HOSPITAL PARKLANE ENUGU, NIGERIA

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Abstract

Background and objectives: Antimicrobial resistance among uropathogenic *Escherichia coli* represents a growing therapeutic challenge worldwide. This study investigated the antibiotic susceptibility pattern of *E. coli* isolated from patients presenting with urinary tract infections (UTIs) at Enugu State University Teaching Hospital (ESUT-TH), Enugu, Nigeria, and examined socio-demographic factors influencing antibiotic use.

Subjects and methods: A total of 200 patients participated in this study, comprising 59 (29.5%) males and 141 (70.5%) females, predominantly aged 18 – 25 years (46.5%). *E. coli* isolated from the 200 urine samples were 45, representing a prevalence of 22.5%. Antibiotic susceptibility testing was performed using Kirby–Bauer disc diffusion method and high resistance rates were observed against ceftriaxone (84.4%), amoxicillin (84.44%), streptomycin (77.78%), chloramphenicol (75.56%), ofloxacin (71.11%), meropenem (66.67%).

Results: Moderate resistance was recorded for ciprofloxacin (55.56%) and nitrofurantoin (57.78%) while gentamicin demonstrated the highest susceptibility (77.78%). Chi-square bivariate analysis revealed that though all respondents had used antibiotics, significant associations existed between gender and knowledge of antibiotics ($p=0.028$), previous UTI ($p=0.010$), and prior antibiotic treatment ($p=0.012$).

Conclusions: The findings highlight substantial resistance to routine antibiotics and emphasize the need for periodic antimicrobial susceptibility testing, strengthened antibiotic stewardship and enhanced public health education to improve UTI management.

Keywords: Antibiotics, antimicrobial resistance, *Escherichia coli*, urinary tract infection.

INTRODUCTION

Urinary tract infections (UTIs) rank among the most prevalent bacterial infections found in both outpatient and inpatient environments globally. UTIs are infections found in the urethra, bladder, or kidneys and rank among the most prevalent infectious diseases globally, causing considerable morbidity¹. Uropathogenic *Escherichia coli* (UPEC) continues to be the primary causative organism, responsible for most uncomplicated and a notable share of complicated UTIs². The rising incidence of antimicrobial resistance in *E. coli* strains has turned into a significant worldwide public health issue, especially in low- and

middle-income nations where empirical antibiotic usage is prevalent and laboratory-directed treatment is scarce. Antibiotics are essential in treating infectious diseases, thus enhancing patients' quality of life and lifespan. Nevertheless, their inappropriate use and excessive reliance have led to the development of antimicrobial resistance (AMR), which arises when microorganisms become resistant to the impacts of antimicrobials^{2,3}. In Nigeria, inappropriate antibiotic use, self-medication, economic and geographical barriers to formal healthcare and limited antimicrobial surveillance have contributed to the rising burden of resistant uropathogens⁴. Local data on antimicrobial susceptibility patterns are therefore essential to guide

effective treatment and reduce therapeutic failure. This study assessed the antibiotic susceptibility pattern of *E. coli* isolated from patients presenting with UTIs at Enugu State University Teaching Hospital (ESUTH), Enugu, Nigeria, and evaluated associated demographic and behavioral factors.

METHODS

Study area and design

This cross-sectional study conducted in a hospital setting took place at Enugu State University Teaching Hospital (ESUTH), located in Parklane, Enugu State, Nigeria. The study included patients aged 15 to 65 years who visited the General Out-patient Department (GOPD) with symptoms indicative of UTI and provided informed consent.

Sample size, sampling technique, collection and processing

Two hundred urine samples were gathered through random sampling methods. Sterile universal containers were used to collect midstream urine samples, which were processed within two hours after collection. Specimens were grown on Blood agar and CLED agar and incubated in aerobically at 37°C for 24 hours,

Identification of *E. coli*

Isolates were recognized through colony morphology, Gram staining, and conventional biochemical assays such as indole, catalase, and triple sugar iron (TSI) agar tests.

Antimicrobial susceptibility testing

Antibiotic susceptibility testing was conducted on Mueller–Hinton agar utilizing the Kirby–Bauer disk diffusion technique following Clinical Laboratory Standards Institute (CLSI) guidelines⁵. The antibiotics evaluated comprised ciprofloxacin, ofloxacin, pefloxacin, gentamicin, nitrofurantoin, streptomycin, ceftriaxone, amoxicillin, chloramphenicol, and meropenem.

Data analysis

Data were analyzed using SPSS version 27. Descriptive statistics were used to summarize demographic variables and susceptibility patterns. Chi-square test was applied to assess associations, with $p < 0.05$ considered statistically significant.

Ethical consideration

Ethical approval was obtained from the ESUT-TH Institutional Ethics Committee. Written informed consent was obtained from all participants.

RESULTS

Among the 200 patients assessed, 45 tested positive for *E. coli*, indicating a prevalence rate of 22.5%, whereas 155 patients (77.5%) had UTIs resulting from different pathogens. This result shows that *E. coli* is a crucial causative factor of UTI within the study group, highlighting its recognized position as a primary uropathogen.

Table 1: Antibiotic susceptibility pattern of the *E. coli* isolates.

Antibiotic	Sensitive (%)	Resistant (%)
Ofloxacin	13 (28.89)	32 (71.11)
Meropenem	15 (33.33)	30 (66.67)
Pefloxacin	17 (37.78)	28 (62.22)
Ceftriaxone	7 (15.56)	38 (84.44)
Amoxicillin	7 (15.56)	38 (84.44)
Streptomycin	10 (22.22)	35 (77.78)
Nitrofurantoin	19 (42.22)	26 (57.78)
Gentamicin	35 (77.78)	10 (22.22)
Ciprofloxacin	20 (44.44)	25 (55.56)
Chloramphenicol	11 (24.44)	34 (75.56)

The *E. coli* isolates displayed significant resistance to several antibiotics, especially ceftriaxone and amoxicillin (84.44% each), followed by Streptomycin (77.78%) and chloramphenicol (75.56%). moderate resistance was noted with ciprofloxacin (55.56%) and nitrofurantoin (57.78%). Gentamicin showed the greatest sensitivity (77.78%) and the least resistance (22.22%), proving to be the most potent antibiotic of those evaluated. Two hundred (200) patients participated in this study, of which 141 (70.5%) were females and 59 (29.5%) were males. The majority of participants were aged 18–25 years (46.5%) and most respondents had secondary education (64%).

Chi-square bivariate analysis of the surveys revealed a statistically significant correlation between socio-demographic factors and knowledge and practices related to antibiotics. Gender showed a significant relationship with awareness of UTI treatment, past UTI infections, and earlier antibiotic usage ($p < 0.05$). Age demonstrated notable associations with the length

of antibiotic treatment and awareness of the antibiotics used ($p = 0.000$). Educational credentials showed notable correlations with understanding of UTI, methods of transmission, antibiotic impacts, prescribing habits, length of treatment, perceived efficacy, and awareness of taken antibiotics ($p \leq 0.037$). In general, educational attainment was identified as the most significant predictor of proper antibiotic awareness and usage.

DISCUSSION

Resistance to antimicrobial agents is a worldwide issue that is progressively hindering efforts to manage infectious diseases³. This has been linked to the use of antimicrobials in human and agricultural practices. This study examined the antibiotic resistance trends of *E. coli* obtained from patients with urinary tract infections visiting ESUT-TH and evaluated socio-demographic factors related to antibiotic usage and

awareness. Out of the 200 patients randomly chosen based on clinical presentation, females made up a larger share (70.5%) than males (29.5%). This distribution corresponds with known epidemiological trends of UTIs, since females are anatomically more susceptible to UTIs because of a shorter urethra and the closer location of the urethral opening to the perianal

area, which aids bacterial colonization and movement into the urinary tract⁶. Most participants were between the ages of 18 and 25 (46.5%). This demographic is frequently linked to heightened sexual activity, acknowledged as a risk factor for UTIs, and also shows greater healthcare utilization, potentially clarifying their larger presence in this study^{7,8}.

Table 2: Sociodemographic variables of respondents.

Variables	Frequency (n=200) (%)
Sex	
Male	59 (29.5)
Female	141 (70.5)
Age	
18-25	93 (46.5)
26-35	30 (15)
36-45	39 (19.5)
46-55	31 (15.5)
56-65	4 (2)
Above 65	3 (1.5)
Educational qualification	
FSLC	9 (4.5)
SSCE	128 (64)
Degree	59 (29.5)
Others	4 (2)

Table 3: Chi-Square Bivariate analysis of the questionnaires.

Relationship	p-value
Gender and knowledge of treatment of UTI with antibiotics	0.028
Gender and previous infection with UTI	0.010
Gender and previous use of antibiotics in the treatment of UTI	0.012
Age and duration of antibiotic therapy	0.000
Age and knowledge of antibiotics taken	0.000
Educational qualification and previous knowledge of UTI	0.037
Educational qualification and knowledge of transmission of UTI	0.026
Educational qualification and knowledge of effect of antibiotics against UTI	0.013
Educational qualification and prescription of antibiotics	0.001
Educational qualification and duration of antibiotic therapy	0.000
Educational qualification and antibiotic effectiveness	0.001
Educational qualification and knowledge of antibiotics taken	0.000

Antibiotic susceptibility testing of the *E. coli* isolates revealed significant resistance to frequently prescribed antibiotics such as ceftriaxone, amoxicillin, streptomycin, and chloramphenicol. These results indicate potential indiscriminate use of antibiotics via self-medication and over-the-counter availability, leading to selective pressure for resistant bacteria. Despite gentamicin demonstrating the highest sensitivity (77.78%), this is not clinically reassuring, as it is a parenteral aminoglycoside that carries risks of nephrotoxicity and ototoxicity, rendering it less appropriate for the everyday outpatient treatment of uncomplicated UTIs⁹. The observed moderate sensitivity to frequently prescribed oral antibiotics like ciprofloxacin and nitrofurantoin indicates a reduction in the effectiveness of preferred empirical treatments, potentially leading to greater dependence on injectable or broader-spectrum antibiotics, raising treatment costs, toxicity risks, and further elevating the likelihood of antimicrobial resistance. The significant resistance to meropenem (66.67%) raises alarms, considering carbapenems are crucial as last-resort treatments for multidrug-resistant infections¹⁰⁻¹³. Every participant indicated previous antibiotic usage, highlighting extensive exposure to

antimicrobials. Notable correlations between socio-demographic factors like gender, age, educational attainment, and various antibiotic-related knowledge and practice indicators emphasize the impact of these factors on treatment behaviors and the possible development of the resistance¹⁴⁻¹⁶. Educational achievement, specifically, showed extensive links to understanding and proper antibiotic usage, high-lighting the significance of health literacy in managing antimicrobial resources effectively.

CONCLUSIONS

This study highlights the complex dynamics of antibiotic resistance in *E. coli* strains responsible for UTIs. The differing resistance levels found for various antibiotics highlight the necessity for a careful strategy in choosing antibiotics and administering treatment. The elevated resistance levels to widely utilized antibiotics such as ceftriaxone and amoxicillin indicate the critical need for careful antibiotic stewardship practices to maintain the efficacy of these medications. In contrast, the comparatively reduced resistance levels to ciprofloxacin, nitrofurantoin, and gentamicin

indicate that these antibiotics may remain useful treatment alternatives for UTIs in specific situations. In summary, the results highlight the growing issue of antimicrobial resistance in uropathogenic *E. coli* and emphasize the importance of regular susceptibility testing, enhanced antibiotic stewardship initiatives, and focused public health education to improve UTI treatment.

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AUTHOR'S CONTRIBUTIONS

Chukwueze CM: formal analysis, conceptualization, writing original draft. **Ani CA:** formal analysis, critical review. **Okwunweze KT:** conceptualisation. **Okoh EG:** critical review. **Nwobodo CC:** literature survey. **Egbo DC:** data organization. **Obeagu EI:** conceptualisation. Final manuscript was checked and approved by all authors.

DATA AVAILABILITY

The associated author can provide the empirical data used to support the study's conclusions upon request.

CONFLICT OF INTEREST

There are no conflicts of interest in regard to this project.

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