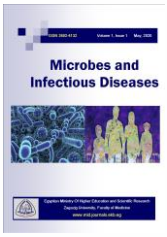
Microbes and Infectious Diseases 2023; Article-In-Press, **DOI:** 10.21608/mid.2022.167458.1395



Microbes and Infectious Diseases

Journal homepage: https://mid.journals.ekb.eg/

Original article

Detection of multidrug resistance *E. coli* isolated from patients with UTI in FMC Birnin, Kebbi

Isah Maishanu Musa* *, *Amina Muhammad, Solomon Ibrahim

Department of Microbiology, Faculty of Life Science Kebbi State University of Science and Technology Aliero.

ARTICLE INFO

Article history:
Received 6 October 2022
Received in revised form 6 November 2022
Accepted 3 December 2022

Keywords:
Detection
Multidrug
Resistance
E. coli
Urinary tract infection

ABSTRACT

Aim: This study sought to ascertain the prevalence of multidrug resistant strains among *E. coli* isolates responsible for urinary tract infections (UTIs) that were resistant to frequently used antimicrobial drugs. **Methods:** Thirty (30) urine samples were collected from Federal Medical Center (FMC) patients who may have had UTIs in Medical Center Birnin Kebbi. Regular biochemical tests were used to identify all isolates, and testing for antibiotic susceptibility were performed using disc diffusion method. **Results:** The majority of the isolates were aztreonam and cefotaxime resistant. Cefotaxime and aztreonam resistance rates overall were 81% and 82%, respectively. Almost all isolates were susceptible to ciprofloxacin and tigecycline, with respective resistance rates of 17% and 10%. One in seventeen isolates of *E. coli* were multidrug resistance (MDR). **Conclusion:** According to our findings, only a small percentage of the *E. coli* isolates included in this investigation were MDR. It is strongly advised that antibiotic prescriptions be monitored in accordance with the recommendations. Both in clinical settings and in the population at large, antibiotic use should be closely monitored. In order to reduce infections, infection prevention and control are essential in all healthcare settings.

Introduction

Escherichia coli is a Gram-negative pathogen that is rod-shaped, facultatively anaerobic, non-sporulating, motile, and has a high rate of worldwide spread. It is possible to isolate it from clinical, veterinary, and environmental sources. The majority of clinical and environmental mediated disorders are caused by certain strains of *E. coli*. *Escherichia coli* strains are widespread bacteria that live in the human gastrointestinal tract. Although they are commensals, they can cause a wide range of illnesses, including meningitis, diarrhea, septicemia, and urinary tract infections (UTIs) [1]. A number of antibiotic categories including cephalosporins, carbapenem, aminoglycosides, fluoroquinolones are used in the treatment of UTI caused by *E. coli*. The alarming increase in the rate at which these strains acquire antibiotic resistance genes has limited therapeutic options especially for UTIs for which extensive use of antibiotics has been witnessed in both community and hospital settings [1,2]. As long as they do not acquire genetic components expressing harmful proteins, their innocuous strains can continue to exist as commensals. Virulence variables could ultimately lead to these disorders [3,4]. The establishment of multidrug resistance (MDR) is a natural process, but

DOI: 10.21608/MID.2022.167458.1395
* *Corresponding author:* Isah Maishanu Musa
E-mail address: *isatactics@gmail.com*

improper antibiotic use, unsanitary settings, improper food handling, and superbug infection prevention and control procedures have all contributed to its creation and encourage its spread. Growing multidrug-resistant microorganisms pose a threat to our ability to treat these types of illnesses. These germs are particularly resistant to the widely used antimicrobials [5]. Multidrug resistance is defined as non-susceptibility to at least one agent in three or more antimicrobial categories while extensively drug resistance is non-susceptibility to at least one agent in all but two or fewer antimicrobial categories

One of the greatest worldwide health issues, UTI affects almost 150 million people annually and responsible for approximately 8.1 million annual visits to healthcare providers [6-8]. Untreated UTIs frequently result in major consequences that increase treatment costs and death [9,10]. Resistance has developed among different strains of bacteria as a result of the use of antimicrobial medications [11]. The most prevalent bacterial infections contracted in hospitals and the community are UTIs [12]. The majority of uropathogens originate in the gut microflora of the host and enter the bladder through the urethra, making *E. coli* the most prevalent uropathogen [13]. Urinary tract infection (UTI) treatment has increased bacterial resistance to commonly used antibiotics, which possess a significant financial and health burden on the society [14]. *Escherichia coli* could develop antibiotic resistance by efflux pumps, antibiotic-inactivating enzymes, alterations to permeability or targets, acquired plasmids encoding -lactamases, or through enzymes that modify aminoglycosides [15]. There is, however, no information on the detection of multidrug-resistant *E. coli* from UTI in FMC. Therefore, this study was carried out to investigate the multidrug resistance in *E. coli* isolated from patients with UTIs in Federal Medical Center Birnin Kebbi, Nigeria

Materials and methods

Isolation and identification of *Escherichia coli*

A total of thirty urine samples of UTI patients comprising both females and males between 18 to 60 years old were obtained at the FMC, Birnin Kebbi in Nigeria. The urine samples were inoculated into nutrient broth and incubated for 24hrs and further cultured onto MacConkey agar (Oxoid) and Eosin methylene blue (EMB). The plates were then streaked with a calibrated loop and incubated at 37°C for 18–24 hours to allow for bacterial growth. Gram staining, citrate utilization, lactose fermentation, motility, ability to generate indole, and lysine decarboxylation were among the conventional tests used to identify *E. coli* [16].

Determination of antibiotic susceptibility of *E. coli* isolates

According to the European Committee on antimicrobial susceptibility testing (EUCAST), 17 *E. coli* isolates were tested for antibiotic susceptibilities against 4 different antibiotic discs (Oxoid, UK) using the Kirby-Bauer disk diffusion test on Mueller Hinton agar [17]. The following four antibiotic classes were employed: ciprofloxacin (fluoroquinolone), cefotaxime (cephalosporins), tigecycline (tetracycline), and aztreonam (monobactams). In 5ml of sterile physiological saline, discrete colonies of isolates on nutritional agar plates were emulsified, and the turbidity was adjusted to 0.5McFarland standard (about a 0.5) 1.5 x 10^8 cells per milliliter. To ensure equal dispersion and confluent development, the standardized suspension was inoculated on Muller Hinton agar using a sterile swab. Using sterile forceps, the antibiotic disc of the different antibiotics was aseptically put on the dried, inoculated agar surface and incubated for 18 hours at 37 °C. Based on the EUCAST, 2021 criteria, inhibition zones were classified as resistant, moderate, or susceptible [18], MDR was assessed as resistance to at least three antimicrobial classes.

Statistical analysis

Statistical tools such as diagrams, Pie chart and bar chart were used for the descriptive and inferential analysis using the excel spread sheet.

Results

Isolation and identification of *E. Coli*

Out of the 30-urine samples collected, 17 were confirmed to be *E. coli* isolates. Age between 18-30 has the highest percentage of 41.1% and 51-60 has the list percentage of 5.8% as shown in **table (1)** below. The UTI's prevalence rate was high in females which were 64.7% as compared to males which were 35.3% as shown in **figure (1).**

Antimicrobial susceptibility of *E. coli* isolates

All the seventeen confirmed isolates were tested with four different antibiotics (ciprofloxacin, cefotaxime, aztreonam and tigecycline) which belongs to different classes and categories of antibiotics. From the test conducted, 82.3% of all the

isolates were resistant to aztreonam followed by cefotaxime with 81.5%. Tigecycline and ciprofloxacin showed least resistance with 10% and 17.7%. Out of the 17 isolates tested 11.7% were multidrug resistance as shown in **figure (2)** below.

Table 1. Isolation and identification of *E. coli* isolates from patients with suspected UTI.

No of samples collected	**Age**	**No. of *E.coli* isolated**	**% of isolates**
12	18-30	7	41.1
10	31-40	5	29.4
5	41-50	4	23.5
3	51-60	1	5.8
30	18-60	17	56.6

Figure 1. Percentage distribution of isolates based on gender.

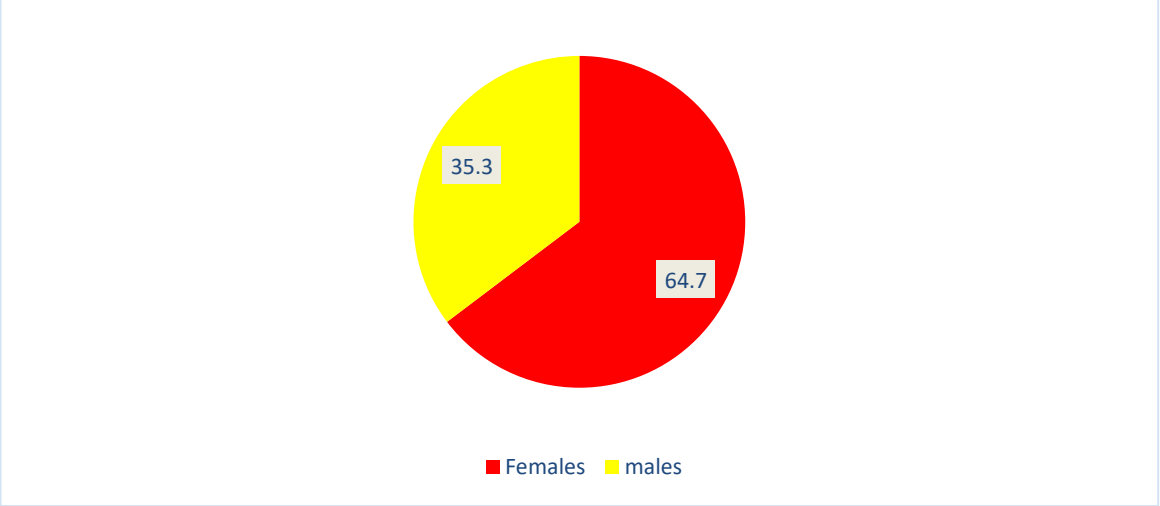
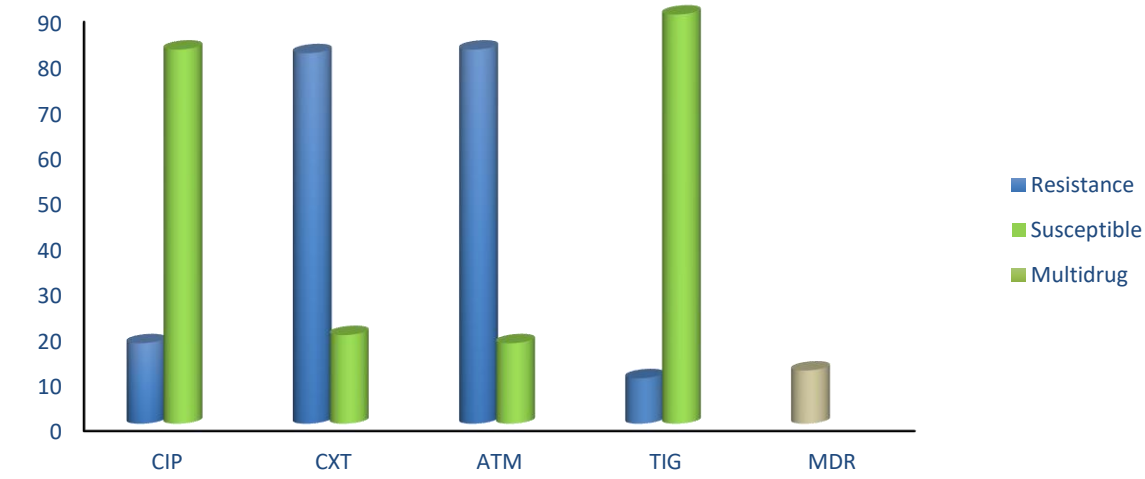


Figure 2. Antimicrobial susceptibility of *Escherichia coli* isolates.



Discussion

Escherichia coli strains and the escalating antimicrobial resistance endanger the ability to treat UTIs effectively, which increases morbidity, lengthens hospital stays, raises treatment costs, and increases disease-related death. In our study, from 30 urine samples, we detected significant growth of *E. coli* 56.6% (n=17) of the clinical samples. In accordance with global trends, our results reveal higher prevalence of UTIs in female patients than in males [19, 20]. The prevalence rate reported by **Islam et al.** [21] was about 38.2%, the percentage rate of the isolated sample is in accordance with reports by **Farzana et al., Gad et al.** and **Thiraviam et al.** [22-24] who reported 54.6%, 67%, and 53%, respectively. Both in underdeveloped and industrialized nations, the resistance of bacteria that cause UTI to frequently administered antibiotics is rising [25]. The UTI-associated *E. coli* bacteria tested for antimicrobial susceptibility in this study had extremely high levels of resistance to cefotaxime and aztreonam. This is in contrast to a report by **Abujnah et al.** [26], which claimed that aztreonam was 58% effective, and is consistent with **Salah et al.** [27] which claimed that cefotaxime was 82.4% effective. This commonly reported observation may be the result of its widespread usage in the management of uncomplicated UTIs, however the high prevalence of bacterial resistance has now limited its effectiveness [28, 29]. The *E. coli* identified in this study may respond very well to ciprofloxacin and tigecycline, which is consistent with earlier findings [30,31]. Our findings reveal the effectiveness of ciprofloxacin against *E. coli* which is higher compare to a finding by **Nguyen et al.** [32]. Due to the rise of pathogenic isolates that are multidrug resistant, the effectiveness of treating pathogenic bacteria with antibiotics has recently declined [33]. Considerations to keep in mind while selecting an appropriate antibacterial for the treatment of UTIs. The study has a number of restrictions. Only 30 samples were used in this single-site analysis. There should be a wider representation of the population and more samples.

Conclusion

This study highlighted the existence of resistance in *E. coli* isolated from UTIs against a number of first line antibiotics. A wider population-wide survey and ongoing monitoring of antibiotic resistance and MDR should be put in place to guide local prescription recommendations. It is also extremely needful to strengthen strict compliance to antibiotic stewardship and enforcement of infection control practices in all our health institutions as a means of controlling the increasing spread of MDR bacteria.

Ethics approval and consent to participate

This study obtained approval from Medical Ethics Committee at the Federal Medical Center Birnin Kebbi. Written informed consent was provided by the patient to allow the case details to be published.

Conflict of interest

The authors declare that they have no conflict of interest

Funding

This study was self-funded.

References

1-**Röderova M, Halova D, Papousek I, Dolejska M, Masarikova M, Hanulik V, et al.** Characteristics of quinolone resistance in Escherichia coli isolates from humans, animals, and the environment in the Czech Republic. Frontiers in Microbiology 2017;7:2147.

2-**Andriole VT.** The quinolones: past, present and future. Clin Infect Dis 2005; 41 Suppl 2: S113-9.

3-**Vogt RL, Dippold L.** Escherichia coli 0157:H7 outbreak associated with consumption of ground beef, June-July 200 Public Health Reports 2005; 120(2): 174-178. PubMed | Google Scholar

4-**Onanuga A, Mahindroo J, Singh S, Taneja N.** Phenotypic and molecular characterization of antimicrobial resistant Escherichia coli from urinary tract infections in Port-Harcourt, Nigeria. The Pan African Medical Journal 2019;34.

5-**Fagan M, Lindbæk M, Grude N, Reiso H, Romøren M, Skaare D, et al.** Antibiotic resistance patterns of bacteria causing urinary tract infections in the elderly living in nursing homes versus the elderly living at home: an observational study. BMC geriatrics 2015;15(1):1-7.

6-**Alam J, Juliana FM, Rahimgir M, Hossain MN, Fatema B, Asaduzzaman M.** Resistance

pattern of ciprofloxacin against common uropathogens in selected area of Dhaka city, Bangladesh. IOSR Journal of Nursing and Health Science (IOSR-JHNS) 2017;6(5):52-7.

7-**Hussain S.** Increasing Antibiotic Resistance in the Uropathogens. Asian Journal of Pharmaceutics (AJP) 2019;13(01).

8-**Bitew A, Molalign T, Chanie M.** Species distribution and antibiotic susceptibility profile of bacterial uropathogens among patients complaining urinary tract infections. BMC infectious diseases 2017;17(1):1-8.

9-**Mohammad A, Habeeb K.** Frequency and antibiotic susceptibility pattern of uro-pathogens isolated from community and hospital-acquired infections in Saudi Arabia-a prospective case study. British Journal of Medicine and Medical Research 2011;1(2):45-56.

10-**Fahim NA.** Prevalence and antimicrobial susceptibility profile of multidrug-resistant bacteria among intensive care units patients at Ain Shams University Hospitals in Egypt—a retrospective study. Journal of the Egyptian Public Health Association 2021;96(1):1-0.

11-**Tanwar J, Das S, Fatima Z, Hameed S.** Multidrug resistance: an emerging crisis. Interdisciplinary perspectives on infectious diseases 2014;2014.

12-**Ekwealor PA, Ugwu MC, Ezeobi I, Amalukwe G, Ugwu BC, Okezie U, et al.** Antimicrobial evaluation of bacterial isolates from urine specimen of patients with complaints of urinary tract infections in Awka, Nigeria. International journal of microbiology. 2016.

13-**Ugwu MC, Shariff M, Nnajide CM, Beri K, Okezie UM, Iroha IR, et al.** Phenotypic and Molecular Characterization of beta-Lactamases among Enterobacterial Uropathogens in Southeastern Nigeria. The Canadian Journal of Infectious Diseases & Medical Microbiology 2020(5843904): 1-9.

14-**Tille P.** Bailey & Scott's diagnostic microbiology-E-Book. Elsevier Health Sciences; 2015 Dec 28.

15-**Abejew AA, Denboba AA, Mekonnen AG.** Prevalence and antibiotic resistance pattern of urinary tract bacterial infections in Dessie area, North-East Ethiopia. BMC research notes 2014;7(1):1-7.

16-**Ruppé É, Woerther PL, Barbier F.** Mechanisms of antimicrobial resistance in Gram-negative bacilli. Annals of intensive care 2015;5(1):1-5.

17-**Magiorakos AP, Srinivasan A, Carey RB, Carmeli Y, Falagas ME, Giske CG, et al.** Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance. Clinical microbiology and infection 2012;18(3):268-81.

18-**Manikandan C, Amsath A.** Antibiotic susceptibility pattern of Escherichia coli isolated from urine samples in Pattukkottai, Tamilnadu. International Journal of Current Microbiology and Applied Sciences 2014;3(10):449-57.

19-**Dehbanipour R, Rastaghi S, Sedighi M, Maleki N, Faghri J.** High prevalence of multidrug-resistance uropathogenic Escherichia coli strains, Isfahan, Iran. J Nat Sci Biol Med 2016;7(1):22–6

20-**Ali I, Rafaque S, Ahmed S, Malik JI, Dasti P.** Prevalence of multi-drug resist- ant uropathogenic Escherichia coli in Potohar region of Pakistan. Asian Pac J Trop Biomed 2016;6(1):60–6

21-**Islam MS, Yusuf MA, Begum SA, Sattar AA, Hossain A, Roy S.** Extended-spectrum-beta-lactamase producing uropathogenic Escherichia coli infection in Dhaka, Bangladesh. African Journal of Bacteriology Research 2015;7(1):1-7.

22-**Farzana R, Shamsuzzaman SM, Mamun KZ, Shears P.** antimicrobial susceptibility pattern of extended spectrum(beta-lactamase producing gram-negative bacteria isolated from wound and urine in a tertiary care hospital, dhaka city, bangladesh. Southeast Asian Journal of Tropical Medicine & Public Health 2013; 44(1):.96-103.

23-**Gad AH.** The Occurrence of Multidrug Resistant E. Coli which Produce ESBL and Cause Urinary Tract Infections. Journal of Applied Microbiology 2017;1(2):8.

24-**Thiraviam M, Yadesa D, Adugna T.** Antibiotic resistant pattern of urinary tract infection causing Escherichia coli isolated from diabetic mellitus and non-diabetic mellitus patients with special reference to Rifampicin resistance. Int J Curr Microbiol App Sci 2014;3(2014):668-74.

25-**Nobel F, Akter S, Jebin RA, Sarker TC, Mizanur M, Rahman SA, et al.** Prevalence of multidrug resistance patterns of Escherichia coli from suspected urinary tract infection in Mymensingh city, Bangladesh. J Adv Biotechnol Exp Ther 2021;4:256.

26-**Abujnah AA, Zorgani A, Sabri MA, El-Mohammady H, Khalek RA, Ghenghesh KS.** Multidrug resistance and extended-spectrum β-lactamases genes among0 Escherichia coli from patients with urinary tract infections in Northwestern Libya. Libyan Journal of Medicine 2015;10(1).

27-**Salah FD, Diagbouga S, Dabire AM, Sadji AY, Nadembega C, Moumouni A, et al.** First detection of resistance genes encoding extended spectrum beta-lactamase producing Escherichia coli at Lome, Togo. Archives of Clinical Microbiology 2016;7(6):0-.

28-**Ghandour AM, Sror SM, Sabet MA, Rashwan RS.** Detection of colistin resistant Escherichia coli in children at Pediatric Hospital of Assiut University, using phenotypic and genotypic methods 2021;2(4):748-759

29-**Moawad, A.A., Hotzel, H., Awad, O. Tomaso H, Neubauer H, Hafez HM, et al.** Occurrence of Salmonella enterica and Escherichia coli in raw chicken and beef meat in northern Egypt and dissemination of their antibiotic resistance markers. Gut Pathog 2017; 9: 57

30-**Moawad AA, Hotzel H, Awad O, Tomaso H, Neubauer H, Hafez HM, El-Adawy H.** Occurrence of Salmonella enterica and Escherichia coli in raw chicken and beef meat in northern Egypt and dissemination of their antibiotic resistance markers. Gut pathogens 2017;9(1):1-3.

31-**Assafi MS, Ibrahim NM, Hussein NR, Taha AA, Balatay AA.** Urinary bacterial profile and antibiotic susceptibility pattern among patients with urinary tract infection in duhok city, kurdistan region, Iraq. International Journal of Pure and Applied Sciences and Technology 2015;30(2):54.

32-**Nguyen SN, Thanh H, Le T, Tran TD, Vu LT, Ho TH.** Clinical Epidemiology Characteristics and Antibiotic Resistance Associated with Urinary Tract Infections Caused by E. coli. International journal of nephrology vol. 2022; 2552990.

33-**Habeeb A, Hussein NR, Assafi MS, Al-Dabbagh SA.** Methicillin resistant Staphylococcus aureus nasal colonization among secondary school students at Duhok City-Iraq. Journal of Microbiology and Infectious Diseases 2014;4(02):59-63.