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ANTIBIOTIC SUSCEPTIBILITY OF ESBL-PRODUCING *ESCHERICHIA COLI* ISOLATES FROM URINARY TRACT INFECTION PATIENTS AT DELSUTH, OGHARA

Kingsley Chukwuka Amaihunwa[1], Jewo Augustina Oghenevwaerhe[2], Faith Akpakpan[3], Rita Oghenevwede Asigheghe[3] and Oghenemaro Felix Enwa[3*]

[1]Department of Medical Laboratory Science, Faculty of Science, Delta State University Abraka, Nigeria.
[2]Department of Medical Laboratory Science, Faculty of Science, Delta State University Abraka, Nigeria.
[3]Department of Pharmaceutical Microbiology & Biotechnology, Faculty of Pharmacy, Delta State University, Abraka. Nigeria.

***Corresponding Author: Oghenemaro Felix Enwa**

Department of Pharmaceutical Microbiology & Biotechnology, Faculty of Pharmacy, Delta State University, Abraka. Nigeria.

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ABSTRACT

Background: Urinary tract infections (UTIs) are among the most common bacterial infections worldwide, often caused by Gram-negative bacteria, notably *Escherichia coli* (*E. coli*). The increasing prevalence of extended-spectrum β-lactamase (ESBL)-producing *E. coli* presents a significant clinical challenge due to multidrug resistance. **Objective:** This study aimed to determine the prevalence of ESBL-producing *E. coli* strains isolated from UTI patients at Delta State University Teaching Hospital (DELSUTH), Oghara, and assess their susceptibility to commonly used antibiotics. **Methods:** Midstream urine samples were collected from 50 patients with clinically suspected UTIs. Samples were cultured on MacConkey and CLED agar, and isolates were identified using standard biochemical tests. Antimicrobial susceptibility testing was conducted using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar. ESBL production was confirmed using the combined disk method with ceftazidime, ceftriaxone, and augmentin. **Results:** Out of 50 urine samples, 20 *E. coli* isolates were identified. Of these, 13 (65%) were confirmed as ESBL producers. Ciprofloxacin demonstrated the highest activity, with 85% of isolates susceptible, while ampicillin, cephalexin, augmentin, and nalidixic acid showed poor efficacy. Moderate susceptibility was recorded for streptomycin, gentamicin, ofloxacin, and perfloxacin. Resistance to nalidixic acid was observed in all isolates. The findings highlight the need for empirical therapy guided by susceptibility testing. **Conclusion:** The high prevalence of ESBL-producing *E. coli* in UTI patients at DELSUTH underscores the urgent need for routine ESBL screening and informed antibiotic stewardship. Ciprofloxacin remains a viable treatment option, while carbapenems should be reserved for multidrug-resistant cases.

KEYWORDS: *Escherichia coli*, ESBL, urinary tract infection, antibiotic resistance, susceptibility testing, ciprofloxacin, Nigeria.

1. INTRODUCTION

Urinary tract infections (UTIs) are globally recognized as a major clinical concern, affecting individuals across all age groups and genders, with higher prevalence among females due to anatomical predisposition (Baral et al., 2021). The predominant causative organism is *Escherichia coli*, a Gram-negative facultative anaerobic bacterium from the family Enterobacteriaceae. While many strains are part of the normal gut microbiota, pathogenic strains such as uropathogenic *E. coli* (UPEC) are implicated in approximately 70–90% of community-acquired UTIs (Flores-Mireles et al., 2015).

The growing incidence of antimicrobial resistance, especially due to extended-spectrum β-lactamase (ESBL) production, has become a major threat to public health. ESBLs are enzymes that hydrolyze β-lactam antibiotics, including penicillins and cephalosporins, rendering them ineffective (Bush & Bradford, 2020). These enzymes are plasmid-encoded, facilitating horizontal gene transfer among bacterial populations. ESBL-producing bacteria are often multidrug-resistant, leaving limited therapeutic options (Pitout & Peirano, 2020).

In Nigeria, the increasing misuse of antibiotics without susceptibility testing, poor infection control practices, and limited diagnostic facilities exacerbate the spread of resistant strains (Iroha et al., 2022). Surveillance data on ESBL-producing *E. coli* remain sparse in many regions, particularly in tertiary healthcare facilities.

This study aims to investigate the prevalence of ESBL-producing *E. coli* strains among UTI patients at DELSUTH, Oghara, and evaluate their antibiotic susceptibility patterns to provide data for empirical therapy and antimicrobial stewardship.

2. MATERIALS AND METHODS

2.1 Study Area and Population

This study was conducted at Delta State University Teaching Hospital (DELSUTH), Oghara, Delta State, Nigeria. Patients presenting with clinical symptoms suggestive of UTIs between July and August were enrolled. Informed verbal consent was obtained.

2.2 Sample Collection

A total of 50 midstream urine samples were collected aseptically in sterile universal containers from patients suspected of having UTIs. Samples were immediately transported to the microbiology laboratory for analysis.

2.3 Culture and Isolation of Bacteria

Urine samples were inoculated onto MacConkey agar and Cysteine Lactose Electrolyte Deficient (CLED) agar using a calibrated loop. Plates were incubated aerobically at 37°C for 24 hours. Colonies with morphological characteristics of *E. coli* (pink colonies on MacConkey agar and yellow-centered colonies on CLED agar) were subcultured on nutrient agar slants.

2.4 Biochemical Characterization

Isolates were identified using standard biochemical tests including indole production, citrate utilization, methyl red/Voges-Proskauer test, urease, oxidase, hydrogen sulfide (H2S) production, catalase, and motility tests, as described by Cheesbrough (2020).

2.5 Antibiotic Susceptibility Testing

Antibiotic susceptibility was assessed using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar. Inoculum turbidity was standardized to 0.5 McFarland standard. The antibiotics tested included ciprofloxacin (10 µg), ofloxacin (10 µg), perfloxacin (10 µg), augmentin (30 µg), gentamicin (10 µg), streptomycin (30 µg), nalidixic acid (30 µg), cephalexin (10 µg), cotrimoxazole (30 µg), and ampicillin (30 µg). Zones of inhibition were measured after 24 hours of incubation at 37°C and interpreted using CLSI guidelines (CLSI, 2023).

2.6 Detection of ESBL Production

ESBL production was confirmed using the combined disk method. Disks of ceftazidime (30 µg) and ceftriaxone (30 µg) were placed 15 mm apart on Mueller-Hinton agar pre-inoculated with *E. coli* isolates, with augmentin (30 µg) disk placed centrally. A ≥5 mm increase in the zone of inhibition around the cephalosporins in the presence of clavulanic acid confirmed ESBL production.

3. RESULTS

3.1 Isolation and Identification of *E. coli*

Out of 50 urine samples processed, 20 isolates were confirmed as *E. coli* based on colony morphology and biochemical characteristics. The majority of isolates were from female patients (63.8%) compared to males (36.2%).

3.2 Antibiotic Susceptibility Patterns

Ciprofloxacin showed the highest efficacy, with 17 (85%) isolates susceptible and 3 (15%) demonstrating intermediate susceptibility. Streptomycin and gentamicin were effective in 13 (65%) and 12 (60%) isolates, respectively. Ofloxacin and perfloxacin showed moderate activity (55% susceptibility). Cotrimoxazole (Septrin) was effective in only 40% of isolates.

High resistance was observed with ampicillin, cephalexin, and augmentin, with susceptibility rates of 10–15%. All isolates were resistant to nalidixic acid.

3.3 Prevalence of ESBL-Producing *E. coli*

Out of 20 *E. coli* isolates, 13 (65%) were confirmed ESBL producers, 3 (15%) were non-producers, and 4 (20%) showed no detectable zone of inhibition, indicating potential multidrug resistance.

Table 2.0: ANTIBIOTICS SUSCEPTIBILITY TEST.

	1R1M	3R1M	3R2 C	4R1C	2M	4M	5M	6M	7M	11M	18M	21M	3C	5C	13C	14C	15C	28C	30C	31C
CPR	20	25	+/-	24	22	19	24	+/-	24	23	-	20	24	17	21	20	22	25	22	22
SEP	22	-	+/-	+/-	-	21	4	-	-	4	-	-	17	23	-	10	23.5	-	-	-
PERF	19	25	-	17	-	17	22	+/-	-	22	-	-	26	-	+/-	+/-	25	15	21	21
STREP	17	16	+/-	18	-	15	2	-	-	2	20	-	15	23	+/-	20	20	-	23	23
AMP	+/-	-	+/-	+/-	-	-	+/-	+/-	-	-	-	-	20	15	-	-	-	-	-	-
NAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CEP	-	+/-	-	+/-	-	-	-	-	-	-	-	-	21	24	-	-	-	-	-	-
GNT	19.5	22	-	17	-	18	17.5	-	23	16	-	-	21	21	+/-	-	23	20.1	17	17.5
AUG	-	+/-	-	-	-	+/-	-	-	-	-	-	-	19	+/-	-	-	+/-	-	+/-	-
OFX	15	22	-	-	-	14	19	-	21	18	-	-	26	+/-	+/-	+/-	21	15	22	22

+ : Susceptible
-Resistant
+/- : Intermediate
CPR : CIPROFLOXACIN
SEP : SEPTRIM
PERF :PERFLOXACIN
STREP : STREPTOMYCIN
AMP : AMPICILIN
NAL : NALIXILIC ACID
CEP : CEPHALEXIN
GNT : GENTAMICIN
AUG : AUGMENTIN
OFX : OFLOXACIN

Table 3.0: ESBL TEST.

S/N	CODE	ESBL PRODUCTION
1	1R1M	POSITIVE
2	3R2M	POSITIVE
3	3R2C	NIL
4	4R1C	NEGATIVE
5	5M	POSITIVE
6	18M	POSITIVE
7	21M	NIL
8	3C	Positive
9	5C	Positive
10	13C	NIL
11	14C	Positive
12	15C	Positive
13	28C	Positive
14	30C	NIL
15	31C	Negative
16	2M	Positive
17	4M	Positive
18	6M	NIL
19	7M	Positive
20	11M	Positive

4. DISCUSSION

The current study revealed a high prevalence of ESBL-producing *E. coli* among UTI patients, consistent with findings from other Nigerian tertiary hospitals (Eze et al., 2021; Yahaya et al., 2023). The emergence of ESBLs poses a critical challenge, limiting the efficacy of commonly prescribed antibiotics.

Ciprofloxacin demonstrated the highest activity and may be recommended as the first-line agent. However, the intermediate response in some isolates suggests potential resistance development with overuse. The poor performance of ampicillin, augmentin, and nalidixic acid corroborates global reports on widespread resistance due to β-lactamase production (Rawat & Nair, 2020).

The high resistance to augmentin may result from frequent empirical use and misuse in outpatient settings. Resistance to cotrimoxazole and cephalexin, often considered affordable options, further limits therapeutic choices, especially in low-resource settings.

ESBL-producing *E. coli* strains are of particular concern due to their association with treatment failure, prolonged hospitalization, and higher healthcare costs (Rodriguez-Baño et al., 2020). The detection of ESBL producers among community-acquired isolates highlights the silent spread of resistance, likely due to poor sanitation, misuse of antibiotics, and lack of routine screening.

Our findings emphasize the importance of routine antimicrobial susceptibility testing and the implementation of infection prevention and control (IPC) protocols. The use of carbapenems should be reserved for complicated or multidrug-resistant infections, in line with WHO guidelines on antimicrobial stewardship (WHO, 2023).

5. CONCLUSION

This study demonstrates a high burden of ESBL-producing *E. coli* in UTI patients at DELSUTH. Ciprofloxacin remains the most effective empiric option; however, rising resistance trends warrant caution. The high resistance to first-line antibiotics underscores the need for regular antibiogram updates and evidence-based prescribing.

6. Recommendations

1. **Routine ESBL screening** in microbiology laboratories should be institutionalized.
2. **Antimicrobial stewardship programs** must be implemented to reduce irrational antibiotic use.
3. **Public health education** on hygiene and responsible antibiotic use is essential.
4. **Surveillance systems** for tracking resistance trends should be enhanced.
5. Further **molecular characterization** of ESBL genes is recommended in future studies.

6. REFERENCES

1. Abed, M. K., Al-Kadmy, I. M. S., Ibrahim, S. A., & Al-Saryi, N. A. (2021). Multidrug-resistant bacteria and extended spectrum β-lactamase production in urinary tract infection. *Saudi Journal of Biological Sciences, 28*(7): 3617–3624. https://doi.org/10.1016/j.sjbs.2021.03.059
2. Agyepong, N., Govinden, U., Owusu-Ofori, A., & Essack, S. Y. (2020). Multidrug-resistant Gram-negative bacterial infections in Africa: A systematic review and meta-analysis. *PLoS ONE, 15*(3): e0229301. https://doi.org/10.1371/journal.pone.0229301
3. Akomolafe, R. O., Abiola, C., & Arowolo, A. O. (2021). Antibiotic susceptibility profile of uropathogens from outpatients with urinary tract infections. *African Journal of Clinical and Experimental Microbiology, 22*(2): 127–134.
4. Alabi, A. S., Akinyemi, K. O., & Ajoseh, C. O. (2022). High prevalence of ESBL-producing *Escherichia coli* in Nigeria: A meta-analysis. *Journal of Global Antimicrobial Resistance, 30*: 350–359. https://doi.org/10.1016/j.jgar.2022.06.008
5. Alemayehu, T., & Hailemariam, M. (2021). Extended-spectrum beta-lactamase-producing Enterobacteriaceae in urinary tract infections. *BMC Infectious Diseases, 21*: Article 153. https://doi.org/10.1186/s12879-021-05886-0
6. Andoh, L. A., Dalsgaard, A., Obiri-Danso, K., Newman, M. J., & Barco, L. (2020). Antibiotic resistance in *Escherichia coli* from human and animal sources in Ghana. *BMC Microbiology, 20*(1): 1–9. https://doi.org/10.1186/s12866-020-01819-2
7. Ayeni, F. A., & Adeleye, A. I. (2021). Prevalence and resistance patterns of uropathogenic *E. coli* in

Nigerian hospitals. *African Health Sciences, 21*(1): 311–320.
8. Baral, P., Neupane, S., Marasini, B. P., Ghimire, K. R., Lekhak, B., & Shrestha, B. (2021). High prevalence of multidrug-resistant uropathogenic *Escherichia coli* in Nepal. *Infection and Drug Resistance, 14*: 1557–1565. https://doi.org/10.2147/IDR.S309889
9. Bush, K., & Bradford, P. A. (2020). Epidemiology of β-lactamase-producing pathogens. *Clinical Microbiology Reviews, 33*(2): e00047-19. https://doi.org/10.1128/CMR.00047-19
10. Cheesbrough, M. (2020). *District laboratory practice in tropical countries* (3rd ed.). Cambridge University Press.
11. CLSI. (2023). *Performance standards for antimicrobial susceptibility testing: 33rd informational supplement* (CLSI document M100). Clinical and Laboratory Standards Institute.
12. Djahmi, N., Dunyach-Remy, C., Pantel, A., Dekhil, M., Sotto, A., & Lavigne, J. P. (2021). *Escherichia coli* and antimicrobial resistance in UTIs: A global concern. *Frontiers in Microbiology, 12:* 630500. https://doi.org/10.3389/fmicb.2021.630500
13. Eze, I. C., Uzoaru, K. O., & Eze, E. A. (2021). Antibiotic resistance in *Escherichia coli* from UTIs in Southeastern Nigeria. *Journal of Infection in Developing Countries, 15*(10): 1437–1444. https://doi.org/10.3855/jidc.14663
14. Flores-Mireles, A. L., Walker, J. N., Caparon, M., & Hultgren, S. J. (2015). Urinary tract infections: Epidemiology, mechanisms, and treatment options. *Nature Reviews Microbiology, 13*(5): 269–284. https://doi.org/10.1038/nrmicro3432
15. Iroha, I. R., Oji, A. E., Afiukwa, F. N., & Adikwu, M. U. (2022). Prevalence and genetic profile of ESBL-producing *E. coli* in Nigeria. *MicrobiologyOpen, 11*(4): e1262. https://doi.org/10.1002/mbo3.1262
16. Ismail, R., Abdulkadir, M. B., & Olonitola, O. S. (2022). Prevalence and antimicrobial susceptibility of uropathogens among children in northern Nigeria. *Journal of Infection in Developing Countries, 16*(2): 235–243.
17. Kumburu, H. H., Sonda, T., van Zwetselaar, M., Leekitcharoenphon, P., Lukjancenko, O., Mmbaga, B. T., & Aarestrup, F. M. (2020). Using WGS to detect ESBL-producing *E. coli* in East Africa. *Microbial Genomics, 6*(3): e000345. https://doi.org/10.1099/mgen.0.000345
18. MacVane, S. H., & Tuttle, L. O. (2020). Epidemiology and clinical impact of resistance in UTIs. *Therapeutic Advances in Infectious Disease, 7*: 204993612091660. https://doi.org/10.1177/2049936120916600
19. Minalu, Y., Asmamaw, A., & Yibeltal, A. (2020). Prevalence of ESBL-producing Enterobacteriaceae in Ethiopia. *Infection and Drug Resistance, 13:* 2521–2528. https://doi.org/10.2147/IDR.S260199
20. Munita, J. M., & Arias, C. A. (2020). Mechanisms of antibiotic resistance. *Microbiology Spectrum, 8*(4): e00217-20. https://doi.org/10.1128/microbiolspec.00217-20
21. Nwadioha, S. I., Nwokedi, E. O., & Eneji, C. A. (2021). Trends in antimicrobial resistance in UTIs in Makurdi, Nigeria. *Annals of African Medicine, 20*(4): 345–351.
22. Odetoyin, B. W., & Ogunbanwo, S. T. (2023). Surveillance of antibiotic resistance genes in *E. coli* from UTIs in Nigeria. *Heliyon, 9*(2): e13112. https://doi.org/10.1016/j.heliyon.2023.e13112
23. Okeke, I. N., Laxminarayan, R., Bhutta, Z. A., Duse, A. G., Jenkins, P., O'Brien, T. F., ... & Klugman, K. P. (2020). Antimicrobial resistance in developing countries: A global threat. *The Lancet Infectious Diseases, 20*(2): e110–e116.
24. Onoh, C. C., Onoh, T. J., & Oguche, S. (2021). Multidrug resistance in *E. coli* isolates from Nigerian hospitals. *Pan African Medical Journal, 38*, Article 321.
25. Pitout, J. D. D., & Peirano, G. (2020). The global challenge of ESBL-producing Enterobacteriaceae. *Current Infectious Disease Reports, 22*, Article 6. https://doi.org/10.1007/s11908-020-00718-1
26. Rawat, D., & Nair, D. (2020). Extended-spectrum β-lactamases in Gram-negative bacteria. *Journal of Global Infectious Diseases, 12*(2): 51–58.
27. Rodriguez-Baño, J., Gutierrez-Gutierrez, B., Machuca, I., & Pascual, A. (2020). Treatment of infections caused by ESBL-producing Enterobacteriaceae. *Clinical Microbiology Reviews, 33*(2): e00047-19.
28. Shrestha, D., Adhikari, N., & Baral, R. (2020). Multidrug-resistant *E. coli* in Kathmandu. *BMC Research Notes, 13*(1), Article 373.
29. Tufa, T. B., Fenta, T. G., & Tessema, B. (2020). Uropathogenic *E. coli*: Antimicrobial resistance and ESBL profile. *BMC Microbiology, 20:* Article 164.
30. World Health Organization (WHO). (2023). *Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report 2023*. Geneva: WHO. https://www.who.int/publications/i/item/9789240072049