Int.J.Curr.Microbiol.App.Sci (2025) *14*(12): 134-139

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 14 Number 12 (2025)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2025.1412.014

Antibiotic Resistance of Pathogenic Enterobacteria strains Isolated from Stool and Urine at Al-Shifa Clinic in 2023

Mbainadji Lodoum[1*], Nan-arabe Lodoum[1], Djelassem Ferdinand[1], Ramadane Arabi Djimet[2], Mekoulnodji Lodoum[1] and Nodjioroum Ngam-ASRA[1, 2, 3]

[1]Université de N'Djamena, BP: 1117 N'Djamena, Tchad
2Université Toumai, BP: 1784 N'Djamena, Tchad
[3]Centre Hospitalier Universitaire de Référence Nationale, BP: N'Djamena, Tchad

**Corresponding author*

Keywords

Prevalence, Antimicrobial resistance, Pathogenic Enterobacteriaceae, Patients, AL-SHIFA Clinic.

Article Info

Received:
05 October 2025
Accepted:
22 November 2025
Available Online:
10 December 2025

A B S T R A C T

Antimicrobial resistance is defined as the ability of a bacterial strain that is normally susceptible to an antibiotic to acquire partial or complete resistance to it. The objective of this study was to contribute to reducing antimicrobial resistance in pathogenic Enterobacteriaceae strains isolated from stool and urine samples at the AL-SHIFA Clinic in N'Djamena. This descriptive cross-sectional study was conducted on stool and urine samples collected between November 2023 and January 2024. Samples were cultured and subjected to antimicrobial susceptibility testing at the clinic's laboratory. Of the 137 stool samples and 35 urine samples analyzed, 27 were positive for Enterobacteriaceae—representing 13.87% of stool specimens and 22.86% of urine specimens. A predominance of male patients was observed, with 62.5% in urine samples and 63.16% in stool samples, particularly in the 21–40 and 41–60 age groups. *Klebsiella* spp. was the most frequent genus, accounting for 33.33% (n=09) of isolates. Resistance levels were recorded as follows: β-lactams 37%, cephalosporins 23%, aminoglycosides 50%, tetracyclines 31%, macrolides 18%, and quinolones 16%. Enterobacteriaceae infections represent a significant public health issue. Appropriate management is essential to prevent the escalation of antibiotic resistance.

Introduction

Antimicrobial resistance is defined as the ability of bacteria normally susceptible to an antibiotic to acquire partial or complete resistance to that antimicrobial agent (WHO, 2019). Diarrheal diseases are widespread globally, particularly in developing countries, where they are the second leading cause of mortality (Aubry, 2013). Three major groups of pathogens are generally responsible for acute infectious diarrhea: parasites, bacteria, and viruses (Bonkoungou *et al.,* 2012). Strains of Enterobacteriaceae are among the bacteria exhibiting increasing resistance to antibiotics and thus represent a serious public health concern (Nascimento *et al.,* 2000). Within this family, species such as *Salmonella* spp., *Shigella* spp., *Campylobacter* spp., *Yersinia* spp., and

Escherichia coli are frequently implicated in diarrheal diseases (Sani *et al.,* 2015). This situation is especially critical in many sub-Saharan African countries where enteric diseases occur endemically and/or epidemically.

It is well established that inappropriate antibiotic use is the most important risk factor in the development of bacterial resistance, particularly within the β-lactam family (Geetha *et al.,* 2014). The emergence and rapid dissemination of antibiotic resistance pose major challenges to infection management and contribute to the spread of multidrug-resistant strains (Holt *et al.,* 2011).

Materials and Methods

This study was conducted at the AL-SHIFA Clinic in N'Djamena, located in the 8th district. It was a descriptive cross-sectional study performed on stool and urine samples from male and female patients aged 0 to 80 years who presented to the clinic's laboratory between November 2023 and January 2024, covering a duration of three months. Recruitment was consecutive and exhaustive.

Patients were excluded if they were over 80 years old, if they presented to the laboratory for other types of analyses, or if they did not consent to participate. Sample inoculation was performed on a variety of culture and enrichment media, including nutrient agar (GN), CLED agar, selective media (Chapman, Hektoen), fresh blood agar, chocolate agar, nutrient broth, and selenite broth. The laboratory protocol included sequential steps: macroscopic examination, microscopic examination, inoculation, and reading.

Antimicrobial susceptibility testing of Enterobacteriaceae to β-lactams and other antibiotic classes was performed using the standard disc diffusion method on Mueller–Hinton agar. Reading of inhibition zones was done using calipers or a graduated ruler. Results were interpreted by comparing inhibition diameters with standard reference tables to classify isolates as Susceptible (S), Intermediate (I), or Resistant (R).

Results and Discussion

A total of 35 patients were admitted for urine cytobacteriological examination (ECBU + AST), and 137 patients for stool culture. Among these, 27 samples were positive for Enterobacteriaceae, representing 13.87% (n = 19) of stool samples and 22.86% (n = 8) of urine samples.

The most affected age group was 41–60 years, with positivity rates of 47.37% in stool cultures and 37.5% in urine cultures, followed by the 1–20 years age group, which represented 36.84% of positive stool samples and 37.5% of positive urine samples.

Male patients were predominant, accounting for 62.5% of urine isolates and 63.16% of stool isolates, corresponding to sex ratios of 1.67 (urine) and 1.71 (stool).

The Klebsiella genus was the most frequently isolated organism, representing 33.33% (n = 9) of cases, followed by Escherichia coli with 29.63% (n = 8).

Other genera identified included Proteus, Salmonella, and Klebsiella, each accounting for 14.81%, 14.81%, and 7.41% of isolates, respectively.

Identified Pathogens

Antibiotic Susceptibility Profile of Enterobacteriaceae Isolated from Urine Samples

The table summarizes the resistance patterns of urinary Enterobacteriaceae to commonly used antibiotics. The findings reveal resistance rates of 62.5% to β-lactams, 25% to cephalosporins, 37.5% to aminoglycosides, 45.83% to tetracyclines, 25% to macrolides, and 56.25% to quinolones.

Antibiotic Susceptibility Profile of Enterobacteriaceae Isolated from Stool Samples

The table below summarizes the resistance patterns of fecal Enterobacteriaceae to commonly used antibiotics. Resistance to β-lactams (37%), cephalosporins (23%), aminoglycosides (50%), tetracyclines (31%), macrolides (18%), and quinolones (16%) was recorded.

This study included 35 patients who underwent urine cytobacteriological examination and 137 patients who had stool cultures. The prevalence of Enterobacteriaceae in urine and stool samples was 22.86% and 13.87%, respectively.

Table.1 Antibiotics Tested for Enterobacteriaceae (Lafont *et al.,* 2002)

Antibiotic	Abbreviation	Origin	Content
Amoxicillin/Clavulanic Acid	AMC	Natural or semi-synthetic	30 µg
Ciprofloxacin	CIP	Synthetic	5 µg
Cefotaxime	CTX	Synthetic	30 µg
Tetracyclines	TE	Natural or semi-synthetic	30 µg
Cotrimoxazole	SXT	Synthetic	25 µg
Gentamicin	GEN	Semi-synthetic	10 µg
Chloramphenicol	C	Semi-synthetic	30 µg
Nalidixic Acid	NA	Synthetic	30 µg
Amikacin	AN	Semi-synthetic	30 µg
Imipenem	IMP	Natural or semi-synthetic	10 µg
Doxycycline	DO	Natural or semi-synthetic	30 µg
Ofloxacin	OFX	Synthetic	5 µg

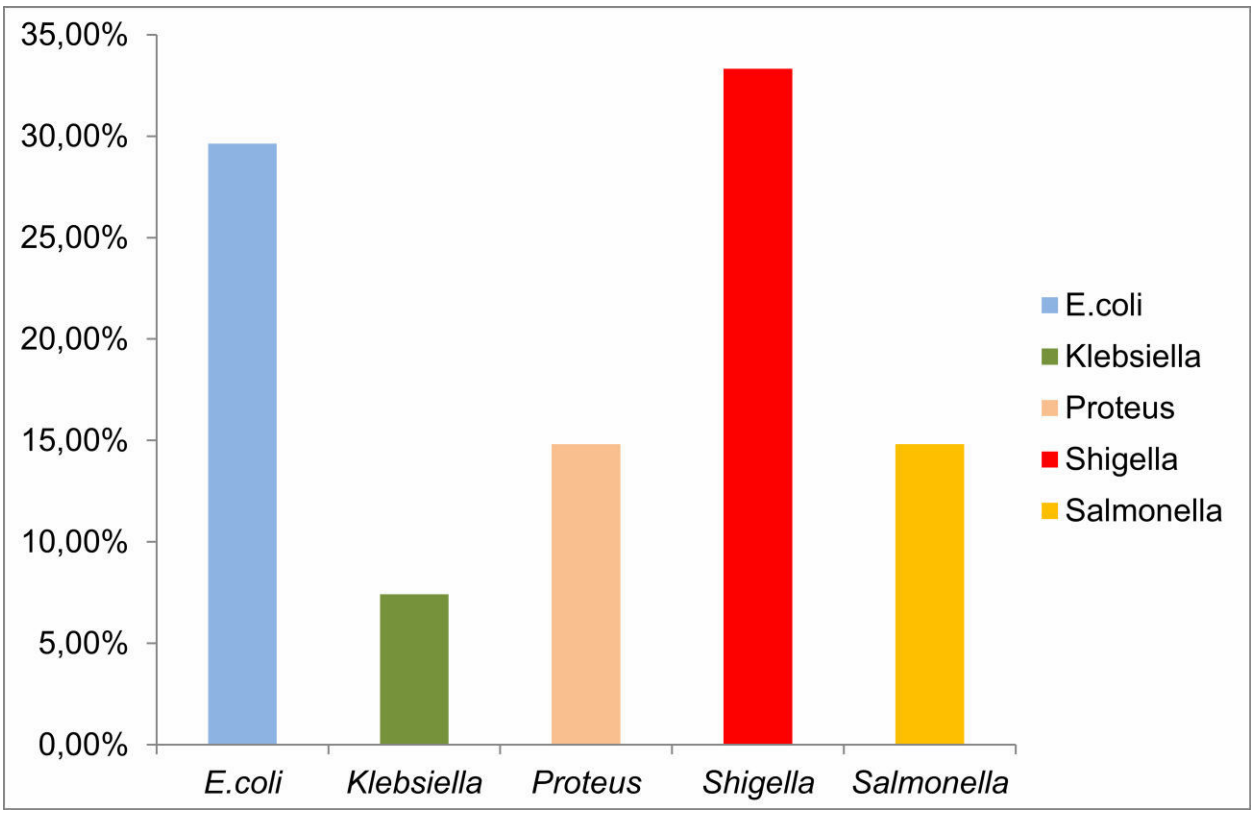
Table.2 Antibiogram of Enterobacteriaceae Isolated from Urine

Antibiotic Class	Resistant	Intermediate	Susceptible	Total
β-lactams	– (62.5%)	–	–	100%
Cephalosporins	4 (25%)	3 (18.75%)	9 (56.25%)	100%
Aminoglycosides				
– Gentamicin	4 (50%)	3 (37.5%)	1 (12.5%)	8
– Streptomycin	2 (25%)	5 (62.5%)	1 (12.5%)	8
Tetracyclines	– (45.83%)	–	–	100%
Macrolides	– (25%)	–	–	100%
Quinolones	– (56.25%)	–	–	100%
Others	–	–	–	–

Table.3 Antibiogram of Enterobacteriaceae Isolated from Stool Samples

Antibiotic Class	Resistant	Intermediate	Susceptible	Total
β-lactams	– (37%)	–	–	100%
Cephalosporins	– (33%)	– (44%)	–	100%
Aminoglycosides	– (50%)	–	–	100%
Tetracyclines	– (31%)	–	–	100%
Macrolides	– (18%)	– (59%)	–	100%
Quinolones				
– Ciprofloxacin	5 (26.32%)	8 (42.11%)	6 (31.58%)	19
– Norfloxacin	1 (5.26%)	7 (36.84%)	11 (57.89%)	19
Others				
– Nitrofurantoin	0 (0%)	6 (31.58%)	13 (68.42%)	19
– Vancomycin	17 (89.48%)	0 (0%)	2 (10.52%)	19
Total (Others)	m = 45%	m = 16%	m = 39%	100%

Figure.1 Distribution of Identified Pathogens



Lacheheub *et al.,* (2016) in Algeria reported a urinary prevalence of 13.68%, whereas Kansaye (2020) in Mali reported a stool prevalence of 43.1%. These discrepancies may be attributed to differences in population characteristics, diagnostic practices, and healthcare systems.

According to Das *et al.,* (2006), the frequency of urinary tract infections (UTIs) varies across countries, influenced by clinical practices such as routine preoperative or preventive urine cultures, especially among pregnant women, diabetics, and individuals with neurological disorders. Self-medication with antibiotics prior to laboratory testing may also contribute to variability in culture results.

Regarding age distribution, the most affected groups were 21–40 years and 41–60 years (37.5% of urinary isolates). In stool samples, the 41–60 years group accounted for 47.37% of cases. This aligns with existing literature, which shows that the risk of UTIs increases with age. Durand-Gasselin and Haber (2001) reported that UTIs represent nearly 35% of infections in the elderly. Amrani and Bechiri (2018) observed a predominance in the 20–40 years age group (43.42%), whereas Maghraoui *et al.,* (2022) reported a predominance in the 18–50 years group (37.88%).

Several behavioral factors with higher prevalence among younger adults—such as dietary habits, sexual activity, and hygiene practices—may also influence infection rates (Das *et al.,* 2006).

In this study, male patients were more frequently infected, accounting for 62.5% of urinary isolates and 63.16% of fecal isolates. Similar findings were reported by Cissé (2019) in Mali (65.5%), Lacheheub and Bendagha (2016) in Algeria (69.23%), Maiwore *et al.,* (2021) in Cameroon (63%), and Koné (2022) in Mali (55.32%). Differences across studies may reflect sample size, population characteristics, or methodological variations.

Conversely, Traoré *et al.,* (2015) note that females are generally at higher risk for UTIs due to anatomical predisposition, including a shorter urethra and its close proximity to the vagina and anus.

The predominant urinary pathogen identified was E. coli (29.63%)**,** consistent with global evidence indicating E. coli as the leading cause of UTIs across all age groups. Studies by Cissé (2019) (86.2%) and Lacheheub & Bendagha (2016) (69.10%) corroborate this dominance.

According to Yombi & Marot (2015), uncomplicated UTIs are primarily caused by E. coli, whereas complicated cases may involve Klebsiella, Proteus, and other Enterobacteriaceae.

In stool samples, Shigella spp. was the most frequently identified (33.33%). Kansaye (2020) reported predominantly *E. coli* (98.7%) and *Klebsiella pneumoniae* (1.3%). Koné (2022) found *E. coli* and *Salmonella spp.* accounting for 90.43% and 9.57% of isolates, respectively. Variations between studies likely reflect differences in laboratory methodologies and epidemiological contexts.

In conclusion, this study demonstrates a high prevalence of pathogenic Enterobacteriaceae infections**,** with the 41–60 years age group being the most affected. Contributing factors include water quality, inadequate hand hygiene, and improper handling of food (especially raw vegetables). Resistance to several major antibiotic classes—β-lactams, cephalosporins, aminoglycosides, tetracyclines, macrolides, and quinolones—was clearly demonstrated. A broader investigation at the national level, including stool, urine, food, and water sampling, is essential to control the spread of Enterobacteriaceae and limit the progression of antimicrobial resistance.

Author Contributions

Mbainadji Lodoum: Conceptualized the study, coordinated field operations, and drafted the manuscript. Nan-arabé Lodoum: Contributed to data analysis and interpretation; evaluated contextual relevance of the manuscript. Ramadane Arabi Djimet: Assisted with data collection, field logistics, and laboratory analyses. Mekoulnodji Lodoum: Designed the sampling protocol; contributed to data validation and manuscript revision. Nodjioroum Ngam-Asra: Contributed to study design, critically revised the manuscript, and ensured overall supervision.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

References

Amrani AA, Bechiri R. Algeria. 2018. *Urinary tract infections.* Master's Thesis, University of Frères Mentouri Constantine, 67 p.

Aubry P. *Infectious diarrheas, updates 2013.* Available online: medecinetropicale.free.fr/cours/diarrhees_infectieuses (Accessed February 22, 2022).

Bonkoungou IJ, Lienemann T, Martikainen O, Dembelé R, Sanou I, Traoré AS, *et al.,* Burkina Faso, 2012. *Diarrhoeagenic Escherichia coli detected by 16-plex PCR in children with and without diarrhoea.* Clinical Microbiology and Infection, 18: 901–906.

Cissé F. Bamako/Mali. 2019. *Urinary tract infections caused by extended-spectrum β-lactamase–producing Enterobacteriaceae: symptomatology and management in the nephrology department of CHU Point G.* Doctoral Thesis, University of Sciences, Techniques and Technologies, 76 p.

Das R, Chandrashekhar T, Joshi H, Gurung M, Shrestha N, Shivananda P. 2006. *Frequency and susceptibility profile of pathogens causing urinary tract infections at a tertiary care hospital in western Nepal.* Singapore Medical Journal, 47(4): 281.

Durand-Gasselin B, Haber N. 2001. *Urinary infections in the elderly.* La Revue de Gériatrie, 26(7): A17–A21.

Geetha VK, Yugendran T, Srinivasan R, Harish BN. India. 2014. *Plasmid-mediated quinolone resistance in typhoidal Salmonella: a preliminary*

report from southern India. Journal of Medical Microbiology, 32: 31–34.

Holt KE, Phan MD, Baker S, Duy PT, Nga TVT, Nair S, Turner AK, Walsh C, Fanning S, Farrell-Ward S, Dutta S, Kariuki S, Weill FX, Parkhill J, Dougan G, Wain J. 2011. *Emergence of a globally dominant IncHI1 plasmid type associated with multidrug-resistant typhoid fever.* PLoS Neglected Tropical Diseases, 5: e1245. Available at: http://dx.doi.org/10.1371/journal.pntd.0001245 (Accessed March 25, 2022).

Kansaye HC. Bamako/Mali. 2020. *β-lactam resistance phenotypes in Enterobacteriaceae strains isolated from pus, blood cultures, and stool samples at CHU Point G.* Doctoral Thesis, University of Sciences, Techniques and Technologies, 69 p.

Lacheheub L, Bendagha Y. Algeria. 2016. *Urinary tract infections.* Master's Thesis, University of Frères Mentouri Constantine, 44 p.

Maghraoui K, Malki A, Yahiaoui AK. Algeria. 2022. *Bacteriological study of pathological specimens at Dr. Benzardjeb Hospital in Ain Témouchent.* Master's Thesis, University Belhadj Bouchaib of Ain Témouchent, 56 p.

Maïworé J, Baane M-P, Youssouf D, Bole J, Nango NFY. 2021. *Digestive carriage of extended-spectrum β-lactamase–producing Enterobacteriaceae among patients at the National Social Insurance Fund Hospital, Maroua (Cameroon).* European Scientific Journal, 17(10): 107–120.

Nascimento GG, Locatelli J, Freitas PC, Silva GL. 2000. *Antibacterial activity of plant extracts and phytochemicals on antibiotic-resistant bacteria.* Brazilian Journal of Microbiology, 31(4): 247–256.

Sani A, Onaolapo JA, Ibrahim YKE, Idris HW, Igwe JC, Nworie A. Nigeria. 2015. *Prevalence of Escherichia coli pathotypes among children with diarrhea in Zaria.* British Journal of Medical and Health Research, 7(1): 17–24.

Traoré H, Emal V, Fongoro S. 2015. *Urinary tract infections in the nephrology department.* Nephrology & Therapeutics, 11: 338–406.

WHO. 2019. *What is antimicrobial resistance?* [Internet]. Available at: http://www.who.int/features/qa/75/en/

Yombi JC, Marot JC. 2015. *Rational use of antibiotics in general medicine: Focus on respiratory and urinary infections in adults.* Louvain Médical, 134(7): 363–371.

Zomahoun CINP. Bamako. 2004. *Evaluation of antibiotic susceptibility of bacteria isolated from urinary tract infections at the bacteriology laboratory of the National University Hospital Centre – Hubert Koutoukou Maga (C.N.H.U.-H.K.M.), Cotonou.* Doctoral Thesis, University of Sciences, Techniques and Technologies, 49 p.

How to cite this article:

Mbainadji Lodoum, Nan-arabe Lodoum, Djelassem Ferdinand, Ramadane Arabi Djimet, Mekoulnodji Lodoum and Nodjioroum Ngam-ASRA. 2025. Antibiotic Resistance of Pathogenic Enterobacteria strains Isolated from Stool and Urine at Al-Shifa Clinic in 2023. *Int.J.Curr.Microbiol.App.Sci.* 14(12): 134-139.
doi: https://doi.org/10.20546/ijcmas.2025.1412.014