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Patterns of antimicrobial resistance in Tertiary Hospitals of South-Eastern Nigeria—A three-month review

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Abstract

Background: Antimicrobial resistance (AMR) is a critical public health challenge, particularly in hospital settings where multidrug-resistant infections complicate treatment and patient outcomes. This study examines AMR patterns in tertiary hospitals in South-Eastern Nigeria over a three-month period, identifying prevalent resistant pathogens and assessing their susceptibility profiles.

Methods: A retrospective analysis of microbiological data from selected tertiary hospitals was conducted from June to September 2024. Bacterial isolates from blood and urine samples were identified using standard laboratory techniques, and antimicrobial susceptibility testing was performed following Clinical and Laboratory Standards Institute (CLSI) guidelines. Resistance patterns were analyzed across different antimicrobial classes.

Results: A total of 89 patients met the study inclusion criteria. The majority were male (58.4%), traders (42.7%), and Christians (97.8%). Prolonged hospital stays (>14 days) were observed in 61.8% of cases. Staphylococcus aureus (18.9%) was the most common blood culture isolate, with the highest resistance to Minocycline (40%). Escherichia coli (26.5%) was the predominant urinary pathogen, showing significant resistance to Cefuroxime (47.5%). Notably, antibiotic resistance was higher among patients with shorter hospital stays (45.5%) compared to those with longer stays (30.9%).

Conclusion: This study highlights concerning AMR trends in tertiary hospitals in South-Eastern Nigeria, particularly high resistance to Minocycline and Cefuroxime. The inverse relationship between hospital stay duration and resistance rates underscores the need for enhanced antimicrobial stewardship and infection control measures. Continuous surveillance and targeted interventions are crucial to mitigating the growing threat of AMR in healthcare settings.

Keywords: Antimicrobials; Antimicrobial Resistance; AMR; Microbiology

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1. Introduction

For decades, antimicrobials have played a crucial role in the treatment of infectious diseases, saving countless lives and transforming modern medicine. However, in recent times, the effectiveness of these once-reliable agents is rapidly declining. This decline has been largely attributed to a term known commonly as antimicrobial resistance (AMR) [1].

AMR is a natural evolutionary process where microorganisms develop changes in their genetic makeup, allowing them to survive exposure to antimicrobials [2]. A few factors have been implicated in the development of AMR. These include overprescription and self-medication of antimicrobials, poor infection control in health facilities and distribution of counterfeit medications. These drivers have collectively contributed to this growing global health crisis [2, 3].

In 2019 alone, AMR was directly responsible for an estimated 1.27 million deaths. A total of 5 million deaths worldwide were also associated with AMR within this period [1,4]. Its burden is particularly severe in low- and middle-income countries, including those in Sub-Saharan Africa. This is largely due to the underdevelopment of surveillance systems and antimicrobial stewardship programs in these areas [4]. According to a report by the African Center for Disease Control (CDC), AMR accounts for 27.3 deaths per 100,000 people in Africa. Consequently, Africa is currently ranked as the region with the highest mortality rate due to AMR [3]. Unfortunately, the AMR burden continues to rise. [3.4]

Within Nigeria, studies have reported a high prevalence of multidrug-resistant organisms. Amupitan et al. identified methicillin-resistant Staphylococcus aureus isolates in more than half (50.6%) of blood samples from bacteraemic patients at a tertiary hospital between May 2017 and June 2018. The authors also reported higher associated mortality rates in patients with drug-resistant pathogens [5].

Despite the growing burden, there remains a paucity of region-specific data, particularly in tertiary hospitals within South-Eastern Nigeria [3,6]. As a result, clinicians and policymakers are left to make critical decisions based on outdated or generalized resistance patterns. This study, therefore, seeks to review the resistance patterns of AMR in tertiary hospitals in South-Eastern Nigeria over a three-month period. It aims to identify the most common resistant organisms and the antibiotics most frequently affected.

2. Materials and methods

This was a retrospective analysis of microbial data obtained from five selected tertiary hospitals in South-Eastern Nigeria between June and September 2024. The study aimed to assess antimicrobial resistance patterns in Ur pathogenic and bloodstream pathogens.

The study included 89 patients who were admitted to the hospital during the study period. Inclusion criteria were patients aged at least 18 years admitted within the three months of the study who did either of the two tests (culture and microbial sensitivity). Patients with contaminated culture samples or whose samples showed mixed growth, suggestive of poor sample collection techniques, were excluded from this study.

Microbiological data were retrospectively extracted from patients' medical records. This included their demographic details (for instance, their age, sex, marital status and occupation), clinical information (including the duration of hospital stay) and laboratory results (culture and sensitivity results). Bacterial isolates from the blood and urine samples had been identified using standard laboratory techniques. Antimicrobial testing was performed according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

No human samples were taken or used, as entire data was obtained from already existing medical databases.

Following data collection, the data were entered into Microsoft Excel and checked for completeness and accuracy. Statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS) version 25.0. Descriptive statistics, such as frequency and percentages, were used to summarize categorical variables. The results from this were represented in tables and bar charts. The chi-square test was used to assess the association between duration of hospital stay and antibiotic resistance. A p-value <0.05 was considered to be statistically significant.

Ethical approval was obtained from the Health Research Ethics Committee of the participating hospitals. To ensure confidentiality of the participants, all patients' identifiers were removed. The study was conducted in accordance with the principles of the Declaration of Helsinki.

3. Results

3.1. Sociodemographic

Table 1 Sociodemographic variables

Variable	Frequency	Percentage
Age (n = 89)		
18 – 31	18	20.2
32 – 45	21	23.6
46 – 60	18	20.2
61 – 74	19	21.3
75+	13	14.6
Sex (n = 89)		
Female	37	41.6
Male	52	58.4
Occupation		
Student	13	14.6
Unemployed	11	12.4
Farmer	20	22.5
Pastor	1	1.1
Tailor	1	1.1
Teacher	2	2.2
Trader	38	42.7
Public servant	1	1.1
Engineer	2	2.2
Religion		
Traditionalist	2	2.2
Christian	87	97.8
Marital status		
Single	16	18.0
Married	73	82.0
Duration of hospital Stay		
Short duration (1 – 7days)	22	24.7
Moderate duration (8 – 14days)	12	13.5
Long duration (> 14 days)	55	61.8

A total of 89 participants were involved in the study. Majority of the participants were aged 32-45 (23.6%) and 61-74 (21.3%). Males outnumbered females (58.4% vs 41.6%). Trading (42.7%) and farming (22.5%) were the most predominant occupations. The majority were Christian (97.8%) and were married (82%). Regarding hospital stay, 61.8% stayed longer than 14 days.

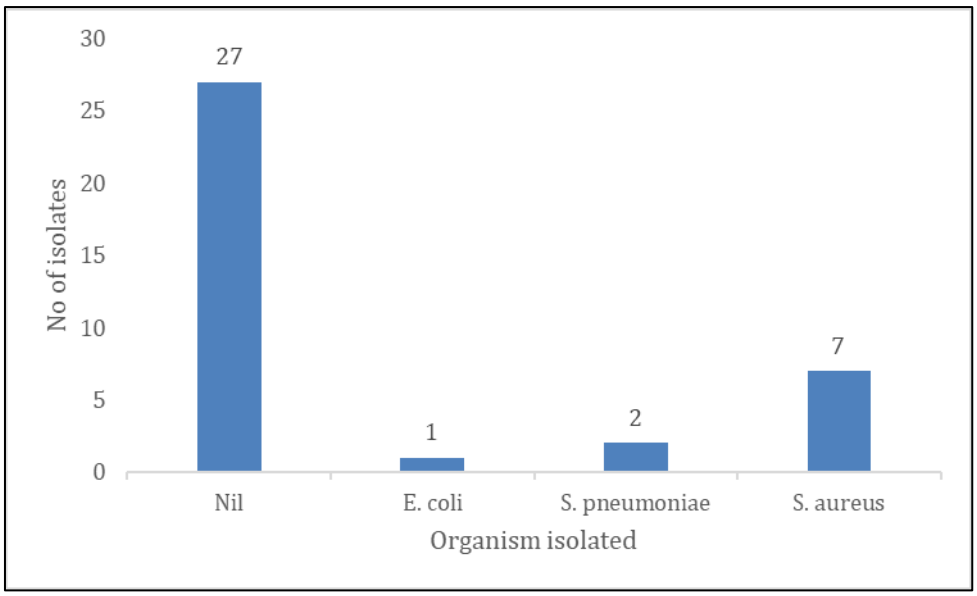

Figure 1 Organisms isolated blood cultures

A total 30 blood samples were cultured and 10 yielded bacterial isolates. Staphylococcus aureus was the most common organism (7 isolates). This was followed by Streptococcus pneumonia (2 isolates) and finally, Escherichia coli (1 isolate).

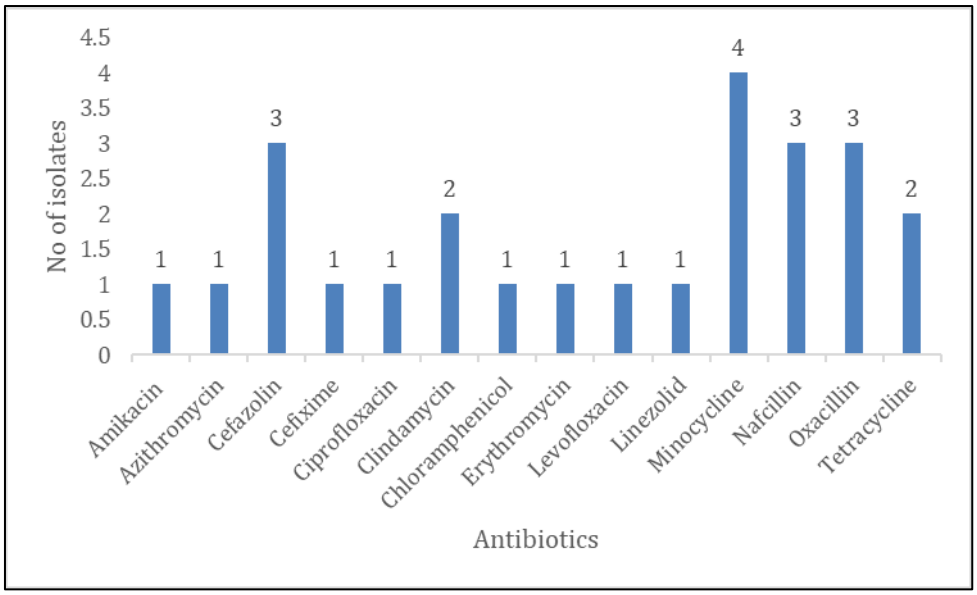

Figure 2 Antibiotics resistance of blood culture isolates

Organisms showed the highest resistance to Minocycline (4 isolates). This was followed by Nafcillin, Oxacillin and Cefazolin (with 3 isolates each). Resistance to Amikacin, Azithromycin, Cefixime, Ciprofloxacin, Chloramphenicol, Erythromycin, Levofloxacin, and Linezolid was observed in 1 isolate each.

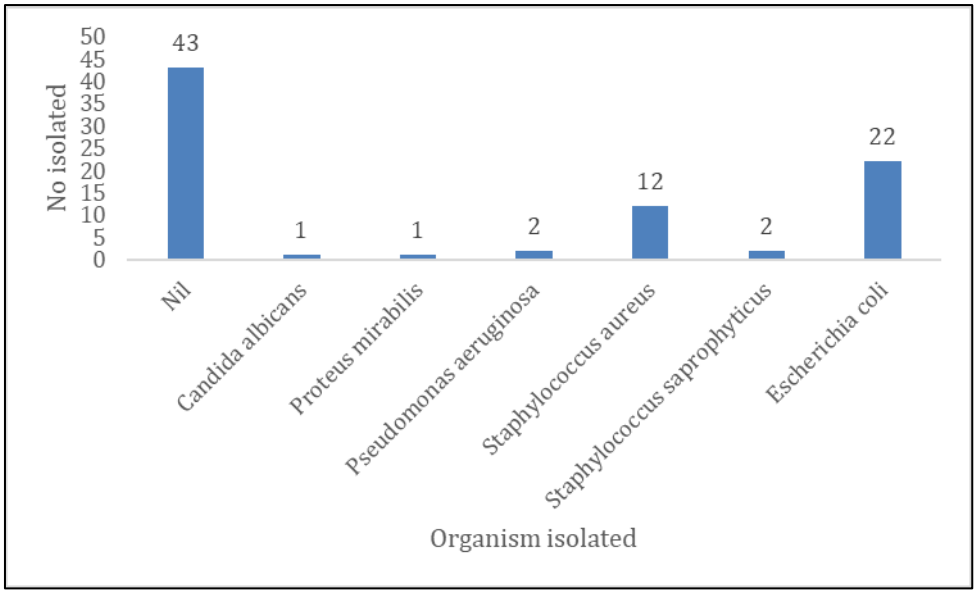

Figure 3 Organisms isolated from urine culture

A total 80 urine samples were cultured and 40 yielded bacterial isolates. Escherichia coli was the most cultured organism (22 isolate). This was followed by Staphylococcus aureus (12 isolates). Candida albicans and Proteus mirabilis were less frequently cultured with only 1 isolate each.

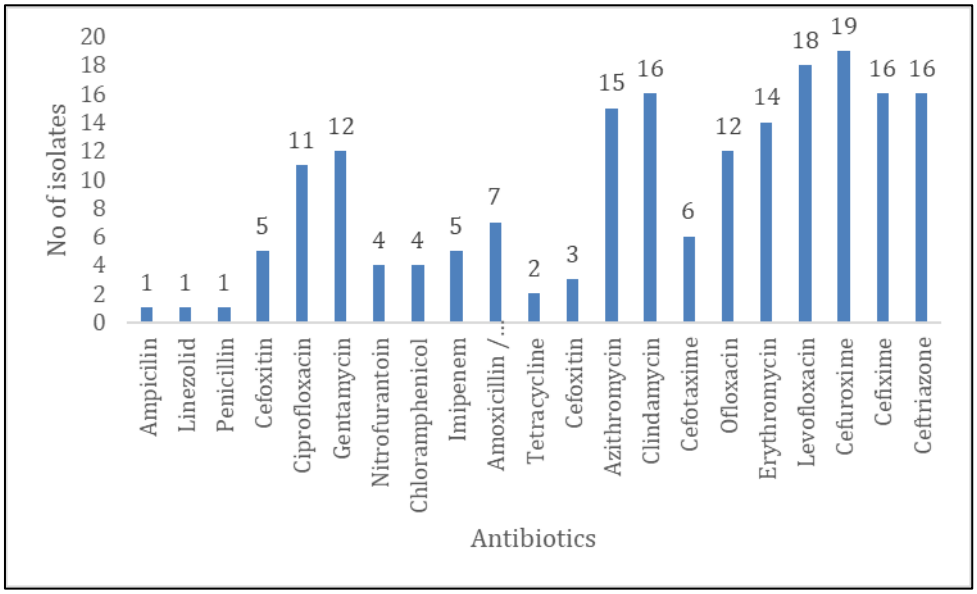

Figure 4 Antibiotics resistance of organisms isolated from urine culture

Organisms showed the highest resistance to Cefuroxime (19 isolates). This was followed by Levofloxacin (18 isolates). Resistance to Ampicillin, Linezolid and Penicillin was less common, observed in 1 isolate each.

Table 2 Relationship between hospital stay duration and antimicrobial resistance

Duration of Hospital Stay	No resistance	Antimicrobial Resistance	X 2	DF	p-value
Short duration (n=22)	12 (54.5)	10 (45.5)	1.478a	2	0.477
Medium duration (n=12)	8(66.7)	4 (33.3)			
Long duration (n=55)	38 (69.1)	17(30.9)			

There is a non-significant association between antibiotics resistance and hospital stay ($\chi 2 = 1.478a$; p-value = 0.477) with patient with the longest hospital stay having the least percentage of antibiotics resistance 17(30.9) followed by those with medium duration hospital stay 4(33.3) with patients with short hospital stay having the highest percentage of antibiotics resistance 10(45.5).

4. Discussion

This retrospective study assessed antimicrobial resistance patterns from microbiological data collected between June and September 2024 across selected tertiary hospitals in South-Eastern Nigeria. The study found Escherichia coli and Staphylococcus aureus to be the most frequently isolated organisms in urine and blood cultures, respectively. This finding reflects similar patterns seen in other parts of the country. Haigh et al., for instance, identified that E. coli and S. aureus were the most commonly isolated organisms in urine samples in the Southern part of the country [7]. Similarly, S. aureus was the most commonly isolated organism in a study conducted in the North-Central part of the country [5]. The consistency of these findings with those of the current study suggests that pathogen distribution in the country may be relatively stable with only mild variations.

Meanwhile, the observed resistance patterns in this study raise a few clinical concerns. This study observed a high resistance of Ur pathogenic microorganisms to fluoroquinolones (e.g., levofloxacin: 45%) and cephalosporins (e.g., cefuroxime: 47.5%). Furthermore, high resistance of pathogens isolated from blood cultures was high, with 47.5% and 45% of the organisms being cefuroxime and levofloxacin resistant. The high resistance rates to these drugs may be attributable to factors including: (1) empirical prescribing, (2) easy access to these drugs over-the-counter, and (3) inadequate antimicrobial stewardship (both in the hospital and community settings). For instance, in a study involving tertiary hospitals in the Lagos and Ogun States, Lawal et al. reported that AMR was as high as 72% for ciprofloxacin and 54% for levofloxacin [8].

In contrast to high fluoroquinolone resistance, this study observed that only a few (2.5%) organisms isolated from urine cultures were resistant to ampicillin or penicillin. This stands in contrast to widespread β-lactam resistance observed by other studies. The overall resistance to penicillin is reportedly high in Nigeria. However, this finding is in fact supported by some Nigerian evidence. In a study to determine the antimicrobial susceptibility patterns of urinary quinolone-resistant E coli from selected General Hospitals in Abuja, Nigeria, Eghieye et al. observed that only 4 in 10 of these pathogens were resistant to amoxicillin/clavulanic acid [9]. This finding suggests that certain local variations in penicillin resistance may exist within the country. Interestingly, despite this, all isolated organisms in their study were resistant to ampicillin, suggesting that variations in resistance may exist between penicillin agents [3]. These discrepancies could be attributable to differences in local antimicrobial usage practices [10]. Moreover, it highlights the importance of region-specific susceptibility testing to guide the prescription of antimicrobials [11].

Although this study did not find any statistically significant association between hospital stay duration and antibiotic resistance (p = 0.477), a notable pattern was observed. The study observed that patients with shorter hospital stays had the highest proportion of resistant isolates (45.5%). This could reflect preadmission exposure to antibiotics either through outpatient prescriptions or previous self-medication [12]. Meanwhile, most studies report a positive correlation between duration of hospital stay and the risk of antibiotic resistance. This is explained by the increased risk of hospital-acquired infections in patients admitted to the hospital [13,14].

5. Conclusion

This study provides valuable insights into the antimicrobial resistance patterns of Ur pathogenic and bloodstream pathogens in South-Eastern Nigeria. It identified Escherichia coli and Staphylococcus aureus as the frequently isolated organisms. The high resistance rates observed for fluoroquinolones and cephalosporins, particularly in Ur pathogenic organisms, emphasize the growing threat of resistance in commonly prescribed antibiotics. It highlights the urgent need for antimicrobial stewardship programs to guide appropriate prescribing and reduce unnecessary use. This is particularly relevant as these antibiotics are frequently used empirically in both hospital and community settings. Furthermore, the low resistance to certain penicillin-based agents stresses the need for more localized susceptibility testing as well as considerations in the development of national or regional guidelines. Given the growing threat of AMR, further prospective studies with larger sample sizes are needed to refine these findings and enhance the understanding of regional resistance patterns.

Compliance with ethical standards

Disclosure of conflict of interest

All authors have no conflicts of interest regarding the study. All funding was paid for, out of pocket, by the authors.

Statement of informed consent

Informed consent not required as data was collected from public access hospital records.

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