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ANTIMICROBIAL SUSCEPTIBILITY PATTERNS OF BACTERIAL ISOLATES FROM VAGINAL SWABS IN REPRODUCTIVE-AGE WOMEN IN EKITI STATE, NIGERIA

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ABSTRACT

Vaginal infections are among the most common gynaecological conditions affecting women of reproductive age. They are frequently caused by bacterial pathogens that can lead to significant reproductive tract complications if left untreated. With the increasing global burden of antimicrobial resistance (AMR), especially in low-resource settings, there is a critical need for localised surveillance to guide empirical treatment strategies. This study aimed to isolate and characterise bacterial pathogens from high vaginal swabs (HVS) collected from symptomatic reproductive-age women in Ekiti State, Nigeria, and to evaluate the antibiotic susceptibility patterns of the recovered isolates. A total of 17 vaginal swab samples were collected using sterile techniques and cultured on selective and differential media, including MacConkey, Blood, Nutrient, and Eosin Methylene Blue (EMB) agars. Standard microbiological procedures,s such as Gram staining and biochemical characterisation, were used for identification. Antimicrobial susceptibility testing was conducted using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar, with antibiotics including Ciprofloxacin, Imipenem, Amoxicillin-Clavulanate, Sulzone, and Ampicillin.

The most prevalent bacterial isolates were *Escherichia coli* (35.3%) and *Staphylococcus aureus* (23.5%), followed by *Klebsiella spp.*, *Pseudomonas spp.*, and *Proteus spp.* High sensitivity was observed to Ciprofloxacin (88.2%) and Imipenem (94.1%), while Ampicillin and Amoxicillin exhibited high resistance rates of 70.6% and 41.2%, respectively. The study

highlights the alarming resistance of vaginal pathogens to first-line antibiotics and underscores the importance of incorporating routine culture and sensitivity testing into gynaecological healthcare practices. Our findings provide regional antibiogram data essential for updating treatment guidelines and emphasise the role of surveillance in combatting antimicrobial resistance. Strengthening antimicrobial stewardship programs and public health education is necessary to prevent the escalation of resistance and to improve patient outcomes in similar endemic settings.

KEYWORDS: Vaginal infection, Antibiotic resistance, Escherichia coli, Staphylococcus aureus, Susceptibility testing, Ekiti State.

INTRODUCTION

Vaginal infections are among the most prevalent clinical conditions affecting women of reproductive age, with Bacterial Vaginosis (BV), Aerobic Vaginitis, and Vulvovaginal Candidiasis frequently encountered in primary care settings [1,2]. These infections, if undiagnosed or improperly managed, can lead to serious reproductive health issues such as pelvic inflammatory disease, infertility, adverse pregnancy outcomes, and increased risk of sexually transmitted infections (STIs) [3,4].

In healthy women, the vaginal microbiota is predominantly composed of Lactobacillus species, which maintain acidic vaginal pH and prevent overgrowth of pathogenic bacteria [5]. However, disturbances to this microbial balance—due to hormonal shifts, antibiotic misuse, douching, or unprotected sex can result in the proliferation of pathogenic organisms such as Escherichia coli, Staphylococcus aureus, Klebsiella spp., and Pseudomonas spp. [6,7]. Studies in Nigeria and other parts of sub-Saharan Africa have shown that these pathogens are commonly isolated from women presenting with abnormal vaginal discharge [8–10].

Compounding the problem is the alarming rise of antimicrobial resistance (AMR) among these isolates. Empirical use of antibiotics without culture sensitivity guidance has led to increased resistance to commonly prescribed drugs like Ampicillin and Metronidazole [11,12]. Surveillance studies in Lagos, Enugu, and Port Harcourt have reported multidrug-resistant strains of E. coli and S. aureus in vaginal swabs, emphasising the need for localised antibiograms to guide therapy [13,14].

Despite the known burden, limited recent data exist on vaginal microbiota and resistance patterns in Ekiti State. Therefore, this study was designed to fill this gap by isolating and characterising bacterial pathogens from high vaginal swabs of reproductive-age women, and

by evaluating their susceptibility to selected antibiotics using culture-based techniques. This approach provides context-specific data to inform local empirical treatment protocols and strengthen antimicrobial stewardship efforts.

MATERIALS AND METHODS

2.1 Study Area

This study was conducted in Ado-Ekiti, the capital of Ekiti State, located in southwestern Nigeria. The city is characterised by a tropical climate with distinct wet and dry seasons. Healthcare delivery in Ado-Ekiti includes government general hospitals, private clinics, and diagnostic laboratories. The samples used in this study were collected from consenting female outpatients attending Bamidele Olumilua University of Education, Science and Technology, Ikere-Ekiti (BOUESTI) Health Centre, between October and December 2024. Ethical approval was obtained from the Health Centre, and verbal informed consent was received from all participants.

2.2 Study Design and Population

This was a cross-sectional microbiological study involving 17 reproductive-age women (18–45 years) presenting with symptoms such as abnormal vaginal discharge, itching, and discomfort. Women who were menstruating, on antibiotics within the past two weeks, or who declined consent were excluded from participation.

2.3 Sample Collection and Handling

High vaginal swabs (HVS) were collected aseptically using sterile cotton-tipped applicators and placed in transport medium to preserve bacterial viability. Samples were transported in ice packs and processed within 2 hours of collection.

2.4 Bacterial Isolation and Identification

Each swab was inoculated onto Nutrient Agar, Blood Agar, MacConkey Agar, and Eosin Methylene Blue (EMB) Agar (all from HiMedia Laboratories, India). The plates were incubated aerobically at 37°C for 24 hours. Isolates were evaluated based on colonial morphology, Gram staining, and standard biochemical tests including catalase, coagulase, indole, citrate utilisation, urease, triple sugar iron (TSI) agar reactions, and methyl red–Voges-Proskauer (MR-VP)[1].

Gram staining was performed using Gram stain kits. Biochemical reagents were prepared and interpreted following CLSI-recommended standards [2]. All procedures were conducted

using standard aseptic techniques.

2.5 Antimicrobial Susceptibility Testing (AST)

AST was conducted using the Kirby-Bauer disk diffusion method on Mueller-Hinton Agar, as recommended by the Clinical and Laboratory Standards Institute (CLSI) guidelines [2]. Antibiotic disks tested included:

- Ciprofloxacin (5 µg)
- Imipenem (10 µg)
- Amoxicillin-Clavulanate (20/10 µg)
- Ampicillin (10 µg)
- Sulzone (cefoperazone/sulbactam) (75/30 µg)

Disks were sourced and used within the manufacturer-stated shelf life. Plates were incubated at 37°C for 18–24 hours, and zones of inhibition were measured in millimetres.s Results were interpreted using CLSI 2021 breakpoint tables [2]. *E. coli* ATCC 25922 was used as a quality control strain. Samples were collected from reproductive-age women presenting with symptoms of vaginal infection at BOUESTI Health Centre, Ado-Ekiti, Ekiti State. A total of 17 high vaginal swabs were collected using sterile techniques. Samples were cultured on MacConkey, Blood, Nutrient, and EMB agars and incubated at 37°C for 24 hours. Colonial morphology was observed. Isolates were subjected to Gram staining and standard biochemical tests,s including catalase, oxidase, urease, indole, citrate, and methyl red tests. Using the Kirby-Bauer disk diffusion method, isolates were tested against Ciprofloxacin, Ampicillin, Amoxicillin-Clavulanic acid, Imipenem, and Sulzone. Zones of inhibition were measured and interpreted per CLSI guidelines.

RESULTS

A total of 17 high vaginal swab (HVS) samples were analysed. Five different bacterial species were successfully isolated from the samples. The most prevalent organism was *Escherichia coli*, isolated from 6 samples (35.3%), followed by *Staphylococcus aureus* in 4 samples (23.5%). Other organisms included *Klebsiella spp.* (3 isolates, 17.6%), *Pseudomonas spp.* (2 isolates, 11.8%), and *Proteus spp.* (2 isolates, 11.8%).

The table below presents the distribution of isolates.

Table 1. Frequency of Bacterial Isolates from Vaginal Swabs. (n = 17)

Bacterial Species	Frequency (n)	Percentage (%)
Escherichia coli	6	35.3
Staphylococcus aureus	4	23.5
Klebsiella spp.	3	17.6
Pseudomonas spp.	2	11.8
Proteus spp.	2	11.8
Total	**17**	**100.0**

Antimicrobial susceptibility testing showed that most isolates demonstrated a high level of sensitivity to **Ciprofloxacin** and **Imipenem**, with sensitivity rates of 88.2% and 94.1,% respectively. Conversely, **Ampicillin** exhibited the highest resistance rate among the isolates (70.6%), followed by **Amoxicillin-Clavulanate** (41.2%).

The table below summarises the antibiotic susceptibility patterns across all bacterial isolates.

Table 2. Antibiotic Susceptibility Profiles of Bacterial Isolates.

Antibiotic	Sensitive Isolates (%)	Resistant Isolates (%)
Ciprofloxacin	88.2	11.8
Imipenem	94.1	5.9
Amoxicillin-Clavulanate	58.8	41.2
Ampicillin	29.4	70.6
Sulzone	47.1	52.9

The distribution of resistance patterns was generally consistent across Gram-negative isolates, with *E. coli* showing broad resistance to Ampicillin and Amoxicillin. *S. aureus* demonstrated moderate resistance to Sulzone but remained sensitive to Imipenem and Ciprofloxacin. No case of total resistance to all tested antibiotics was observed.

DISCUSSION

The present study reveals a high prevalence of *Escherichia coli* and *Staphylococcus aureus* in symptomatic vaginal swabs from reproductive-age women in Ekiti State, Nigeria. These findings are consistent with earlier reports from different regions of Nigeria, where *E. coli* and *S. aureus* have been implicated as dominant uropathogens and causative agents of aerobic vaginitis and pelvic infections [15,16]. The predominance of *E. coli* (35.3%) in our study aligns with the study by Okonko et al. in Abeokuta, where *E. coli* was isolated in 37.5% of cases [8], suggesting its persistence across geographic zones in Nigeria. The detection of *Staphylococcus aureus* in 23.5% of the samples also supports findings by Obi et al. and Nnenna et al., who observed its high occurrence in vaginal infections and noted its

evolving resistance trends [9,10]. The presence of other opportunistic pathogens such as *Klebsiella spp.*, *Pseudomonas spp.*, and *Proteus spp.*, though less frequent, raises concerns about polymicrobial infections and the potential for horizontal gene transfer of resistance traits [17].

Notably, antimicrobial susceptibility patterns revealed an alarming resistance to Ampicillin (70.6%) and Amoxicillin-Clavulanate (41.2%), which are commonly prescribed antibiotics in many outpatient clinics across Nigeria. This corroborates findings by Olayemi et al. and Ezeonu et al., who reported similar resistance levels to β-lactam antibiotics among vaginal isolates [12,14]. The consistent inefficacy of Ampicillin emphasises the need to de-escalate its empirical use for gynaecological infections.

On the other hand, Imipenem (94.1%) and Ciprofloxacin (88.2%) retained high efficacy against the isolates, aligning with the work of Afolabi et al. in Port Harcourt, who recommended these agents as first-line therapy in multidrug-resistant (MDR) cases [13]. However, the high sensitivity of isolates to these drugs must be interpreted cautiously, as overuse could lead to the development of carbapenem-resistant strains, which would pose a greater therapeutic challenge [18].

This study's findings have clinical significance. The results offer vital region-specific antibiogram data that can support tailored empirical therapy, reducing treatment failures and resistance propagation. Furthermore, the detection of MDR organisms among vaginal flora raises concerns about antibiotic misuse, over-the-counter access, and poor diagnostic support in routine clinical care [19,20]. While the study's sample size was limited to 17, it represents a valuable insight into the resistance ecology in Ekiti State. Regular surveillance and antimicrobial stewardship strategies, including clinician education and regulation of antibiotic distribution, are essential steps toward curbing AMR in reproductive health settings.

CONCLUSION

This study highlights the predominance of *Escherichia coli* and *Staphylococcus aureus* in vaginal infections among reproductive-age women in Ekiti State, Nigeria, and underscores the growing resistance of these pathogens to commonly prescribed antibiotics such as Ampicillin and Amoxicillin-Clavulanate. The high efficacy of Ciprofloxacin and Imipenem observed in this study supports their continued use as effective therapeutic options, although their prescription should be guided by sensitivity results to prevent resistance escalation.

The findings provide critical local antibiogram data necessary for tailoring empirical treatment regimens, enhancing patient outcomes, and informing antimicrobial stewardship

strategies within the region. Routine culture and sensitivity testing should be integrated into gynaecological diagnostics, and public health interventions should focus on rational antibiotic use and improved access to laboratory services.

Further research with larger sample sizes and molecular characterisation of resistant strains is recommended to better understand resistance mechanisms and guide national policy on reproductive health and antibiotic use.

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