Original Article

Antibiotic Resistant Patterns of Enterococcus Species Isolated from Clinical Samples in a Nigerian Private Tertiary Medical Centre

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ABSTRACT

Enterococci cause serious nosocomial infections which are characteristically associated with high mortality rates and treatment challenges because the bacteria are not only innately resistant to some antibiotics but also possess the ability to develop acquired resistance to virtually all clinically beneficial antimicrobial agents. This study was carried out to determine the antibiotics resistant patterns among isolates of *Enterococci* from clinical samples so as to provide knowledge that will inform the appropriate antimicrobial choice for its infections in this setting. It was a descriptive, cross-sectional retrospective study conducted over a period of 18 months (February 2024 – August 2025) at the medical microbiology laboratory of Nisa Premiers Hospital. Laboratory records of all *Enterococci* isolated from various clinical specimens submitted for culture as well as their susceptibility rates to variously tested antibiotics were extracted, reviewed and analyzed., Specimen culture and antimicrobial sensitivity testing of isolates were performed following standard microbiological methods. Forty-one (41) isolates of Enterococci were recovered from the various clinical samples processed. Thirty-five (85.4%) of all the isolates were *Enterococcus* faecalis, while 6 (14.6%) were Enterococcus faecium. *Enterococc*i were most frequently isolated from urine 36 (87.8%). The prevalence rate of vancomycin-resistant *Enterococcus* (VRE) was 27.5%. *Enterococc*us was highly resistant to ciprofloxacin (85.7%) and doxycycline (57.9%), relatively highly resistant to linezolid (25%), but displayed the least resistance to nitrofurantoin (18.7%). In conclusion, the most frequent enterococcal infection was UTI, and *Enterococcus* faecalis was the most frequent species causing infections in this study. There were relatively high prevalence rates of both VRE and Linezolid-resistant *Enterococcus*. There is, therefore, a need for strengthening of antimicrobial stewardship program, implementation of infection control measures and routine surveillance in order to reduce the emergence of resistant strain and control its spread.

Keywords: Clinical Samples, *Enterococc*i, Resistant Patterns.

INTRODUCTION

Enterococci are gram-positive, non-sporing cocci, usually arranged as short chains, diplococci, or single ovoid cells. They are facultative anaerobic bacteria that grow on culture media, withstanding a high 6.5% salt concentration and a wide range of temperatures. They are mostly non-hemolytic, even though some enterococc*i* show alpha and beta hemolysis.[1] They are bench diagnosed as catalase-negative, urease-negative, Lancefield group D antigen-positive, esculin hydrolyzing in 40% bile salts, and PYR hydrolyzing.

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Intra-species differentiation is based on the fermentation of carbohydrates, hydrolysis of arginine, tolerance to tellurite, motility, and pigmentation.[2] They live as normal flora in the intestinal tract, mouth and vagina of humans.[3] Despite existing as normal flora, *Enterococci* have emerged as a serious pathogen in the healthcare environment. They are one of the ESKAPE group of pathogens that cause various kinds of serious and difficult-to-treat nosocomial infections.[4] *Enterococcus faecium and Enterococcus faecalis* are the main enterococcal species isolated from clinical specimens, accounting respectively for approximately 80 and 20% of enterococcal infections.[5] These wide variety of serious infections include bacteremia, urinary tract infection, intra-abdominal infections, endocarditis, meningitis, skin and soft tissue infection, among others. *Enterococcal infections, including vancomycin-resistant enterococci (VRE), are characteristically associated with high mortality rates (25–50%) as they usually occur in immunocompromised hosts.*[6] Enterococcal infections pose serious treatment challenges because the bacteria possess the ability to develop resistance to almost all clinically beneficial antibiotics. Aside being intrinsically resistant to many antibiotics such as cephalosporins, trimethoprim-sulfamethoxazole, clindamycin,[1] *Enterococci* have the ability to develop acquired resistant to different antimicrobial agents like β lactams, aminoglycosides, and glycopeptides such as vancomycin.[7,8] More worrisome is that infections due to multidrug resistant Gram-positive pathogens including Vancomycin resistant *enterococci* (VRE) whose mainstay of treatment is linezolid have been reported to develop an increasing resistance to this antibiotic.[9]

The prevalence and antimicrobial resistant rates of clinical *Enterococcus* isolates in the healthcare setting vary markedly from one geographical area to another due to local antibiotic prescribing practices, choice of antibiotics for empirical treatment, and the specific resistant *Enterococcus species* circulating in a given geographical area.[10,11] Even within a given geographical location, the trend of the prevalence of clinical isolates of *Enterococcus*, the predominating species and their susceptibility to various antibiotics might have changed with the passage of time. Knowledge of antimicrobial susceptibility pattern of *Enterococcus* in any environment is important in informing the choice of appropriate alternative treatment options for infections caused by multidrug strain such as VRE. This study was, therefore, aimed at determining the antibiotic resistant pattern of clinical isolates of Enterococcus spp with a view to providing knowledge on the prevalence of Vancomycin-resistant *Enterococci* (VRE) and the empirical treatment options available for Enterococcal infections in this hospital.

MATERIALS AND METHODS

This was an 18-month (February 2024 to August 2025) descriptive, cross-sectional retrospective study conducted at the medical microbiology laboratory of Nisa Premier Hospitals Abuja. In this study, all isolates of *Enterococcus spp.* that were recovered from the various clinical specimens [urine, wound swab, blood culture, ear swab, eye swab, cerebrospinal fluid (CSF), sputum, endocervical swab (ECS), high vaginal swab (HVS), aspirates] received and processed in the laboratory were extracted and analyzed along with their susceptibility to variously tested antibiotics. Specimen culture was carried out by inoculating the specimen on various standard bacterial culture media (Blood Agar, Chocolate Agar, MaCconkey Agar and CLED Agar (urine)) and incubated in ambient air at 37°C for 24 hours.[12] Colonies of organisms from culture media with positive growth were identified following standard microbiological techniques.[13] Antibiotic susceptibility testing was carried out on Mueller Hinton Agar (MHA) in accordance with modified Kirby Bauer disc diffusion method using 0.5 Mcfarland standard turbidity of the organism. Interpretation of zone sizes of inhibition was in accordance with Clinical Laboratory Standard Institute (CLSI) Guidelines.[14]

RESULTS

A total of 41 isolates of *Enterococcus spp* were recovered from all the clinical samples processed. Thirty-five (85.4%) of the isolates were *Enterococcus faecalis*, while 6 (14.6%) were *Enterococcus faecium*. Thirty-six (87.8%) of the isolates were from urine, while the remaining 5 (12.2%) were from endocervical swab. Of the

numbers of variously tested antibiotics, 11 (27.5%) were resistant to vancomycin, 10 (25%) were to linezolid, 6 (85.7%) were to ciprofloxacin, 12 (46.2%) were to levofloxacin, 13 (32.6%) were to penicillin, 6 (18.7%) were to nitrofurantoin, and 22 (57.9%) were to doxycycline.

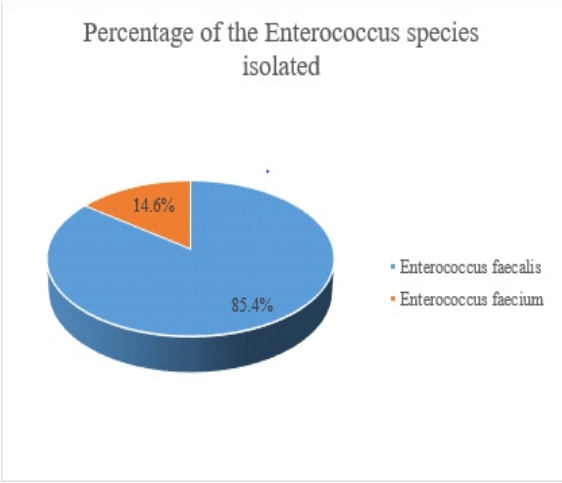

Figure 1: Enterococcal species isolated from the study population

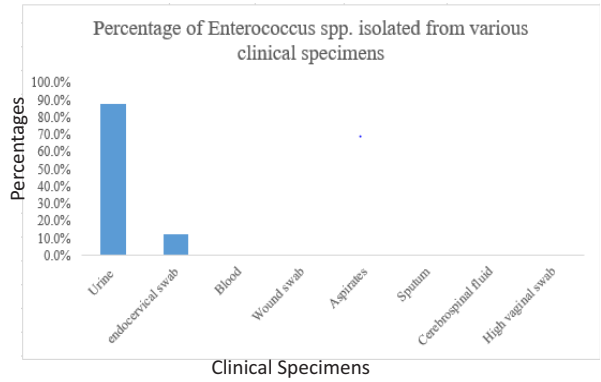

Figure 2: Patterns of Enterococcal species isolated from clinical specimens

Table 1. Antibiotic sensitivity pattern of Enterococcal isolates

Antibiotics	Sensitive n (%)	Intermediate n (%)	Resistant n (%)	Total N (%)
Vancomycin	25 (62.5)	4 (10)	11 (27.5)	40 (100)
Linezolid	30 (75)	0 (0)	10 (25)	40 (100)
Ciprofloxacin	1 (14.3)	0 (0)	6 (85.7)	7 (100)
Levofloxacin	13 (50)	1 (3.8)	12 (46.2)	26 (100)
Penicillin	27 (67.5)	0 (0)	13 (32.5)	40 (100)
Nitrofurantoin	22 (68.8)	4 (12.5)	6 (18.7)	32 (100)
Doxycycline	14 (36.8)	2 (5.3)	22 (57.9)	38 (100)

DISCUSSION

The most commonly isolated species of *Enterococcus* in this study was *Enterococcus faecalis* (85.4%), followed distantly by *Enterococcus faecium* (14.6%). This finding is in agreement with previous international and local studies which also reported *E. faecalis* as the most commonly isolated species from clinical samples, followed by *E. faecium*.[5,15,16,17,18,19,20] Urine sample recorded the highest prevalence (87.8%) of the isolated *Enterococcus* in this study, followed by ECS (12.2%). This finding concurs with similar discovery in several other prior studies.[21,22,23] Although the majority (69.16%, 49.6%, and 50.9%) of the *Enterococcus* isolates were respectively recovered from urine samples in these latter studies, ours was far higher (87.8%). While blood and pus samples were the next specimens that gave the highest number of isolates of *Enterococcus* in these studies, ours was ECS. However, in another similar study, the majority of *Enterococcus* isolates were obtained from stool samples[17], which wasn't included in our study. These findings support the fact that *Enterococci* cause different kind of infections such as UTI, bacteremia, wound infections, among others.[24]

The prevalence of VRE in this study was 27.5%. This finding is in agreement with the pooled VRE prevalence of 25.3% and 26.8% from systematic review and meta-analytic studies in Nigeria and Africa respectively.[25,26] Similarly, Toru et al and Razaz et al reported VRE prevalence of 22.7% and 24.6% in studies carried out in Ethiopia and Tehran respectively.[27,28] Different findings also have however been reported by other studies at Kanpur in Northern India, Osogbo, and Benin respectively. The reported prevalence of VRE in these studies were 6.5%, 42.9%, and 60% respectively.[29,30,31] Similarity or difference in hospital antibiotic policies in these places might be the reason for different prevalence of VRE in those areas.

Though the resistant rate of *Enterococcus* to Linezolid (25%) was relatively low, it is quite concerning as this antibiotic remains one of the last-resort treatment options for serious infections caused by multidrug-resistant (MDR) Gram-

positive pathogens, including VRE. This finding in this study is not surprising as much earlier study by Ndubuisi JC et al in some hospitals in Abuja revealed that 22.0% of the *Enterococcus faecalis* was resistant to linezolid, while 54.1% of *Enterococcus faecium* was resistant to the same antibiotic, both giving an overall resistant rate of 31.3% to linezolid.[17] The relatively low linezolid resistant *Enterococcus* found in this study however, contrasts with findings in India where 65% of Enterococci isolates were resistant to linezolid.[21] In Lagos and elsewhere outside Nigeria, 97 – 100% of *Enterococci* isolates were happily susceptible to linezolid.[18,28,32,33,34,35.]

Isolates of *Enterococci* demonstrated high resistance to ciprofloxacin (85.7%), doxycycline (57.9%), levofloxacin (46.2%), but gladly displayed relatively low resistance to penicillin (32.5%), linezolid (25%), and nitrofurantoin (18.7%). Therefore, these latter antibiotics could be used as empirical treatment option, particularly for UTI due *Enterococcus* in this environment. The relatively high VRE in this study calls for implementation of antimicrobial stewardship practice, infection control measures and surveillance programs so as to reduce rising enterococci resistance as well as prevent and control its spread.

CONCLUSION

Enterococci were most predominantly isolated from urine in this study. *E. faecalis* was the most significant specie isolated, followed by *E. faecium*. Prevalence rate of VRE was 27.5%, while relatively low resistance rates were recorded against linezolid, penicillin, and nitrofurantoin by the enterococci isolates, making these antibiotics good options for empirical treatment of enterococcal infections in this setting. *Enterococci* isolates exhibited high resistance to ciprofloxacin, doxycycline, and levofloxacin

RECOMMENDATIONS

Linezolid, penicillin and nitrofurantoin could be chosen for the empirical treatment of the most frequent infection (UTI) caused by this bacteria. Antimicrobial stewardship practice, infection control and surveillance programs should be strengthened in order to stem the emergence of resistance to these antibiotics and prevent spread of multidrug resistant Enterococci.

Limitation

The laboratory record used to conduct this study did not capture the patients' age, gender and wards/clinics where care was accessed. This would have enriched the study by looking at the age, gender and inpatient vs outpatient distribution of patients with Enterococcus infections as well as the antimicrobial resistance pattern. In addition, phenotypically detected VRE were not confirmed genotypically as the facility lacks molecular laboratory.

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