ORIGINAL ARTICLE

CONTENTS

Vancomycin-resistant *Enterococci*: Local epidemiology and clinical outcomes

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ABSTRACT

Aim: To study local epidemiology, antimicrobial susceptibility patterns, and clinical outcomes of VRE infections among inpatients.

Materials and Methods: A retrospective observational study was carried out on all patients admitted with culture-confirmed Vancomycin-resistant enterococci infections between July 2025 and January 2026 in Najaf, Iraq. Data on demographic characteristics, clinical information, antimicrobial exposure, microbiological findings, and outcomes were obtained from medical records.

Results: A total of 84 patients with Vancomycin-resistant enterococci infection were included. The mean age was 56 ± 18 years, and 57.1% were male. Prior antibiotic exposure was seen in 75.0% of the patients, while 33.3% had previously received Vancomycin therapy. Enterococcus faecium was the predominant species 73.8%, followed by Enterococcus faecalis 21.4%. All isolates were resistant to Vancomycin, while resistance rates against ampicillin, ciprofloxacin, and high-level gentamicin were 70.2%, 63.1%, and 52.4% respectively. Susceptibility to linezolid and daptomycin was still high (97.6% and 98.8% respectively). Urine was the most common specimen source 40.5%, followed by blood cultures 26.2%. In terms of clinical outcomes, 36.9% were admitted to the ICU, 26.2% had a bloodstream infection, 21.4% needed mechanical ventilation, 14.3% had septic shock, and there was an overall mortality rate of 23.8%.

Conclusions: infections due to Vancomycin-resistant enterococci impose a huge healthcare burden in our setting; E. faecium is the leading species and is multidrug resistant. It was, however, associated with significant mortality despite preserved susceptibility to linezolid and daptomycin. Therefore, continuous surveillance coupled with antimicrobial stewardship and strict infection control practices is needed to contain the spread and impact of VRE infections.

KEYWORDS: Vancomycin-resistant enterococci, *Enterococcus faecium*, antimicrobial resistance, epidemiology, clinical outcomes, mortality

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INTRODUCTION

Vancomycin-resistant enterococci (VRE) have recently become identified as one of the most important pathogens in healthcare-associated infections worldwide because of their multidrug-resistant phenotypes. Over the past years, enterococci, mainly *Enterococcus faecium* and *Enterococcus faecalis*, have been considered as normal flora in the human gastrointestinal tract, but due to their increasing role as opportunistic pathogens in hospitalized and immunocompromised patients, they have gained more attention [1]. The management of enterococcal infections has been further complicated by the emergence of Vancomycin-resistance, as Vancomycin is one of the most commonly used glycopeptide antibiotics for severe Gram-positive infections. This has led to increased morbidity, mortality, and healthcare costs [2]. The epidemiology of VRE has changed dramatically over the past two decades in various healthcare settings. Increased rates of Vancomycin resistance, particularly among *E. faecium* isolates, have been documented in hospitals, long-term care facilities, and ICU wards worldwide. Other factors contributing to the spread of resistant strains include overuse of antibiotics, extended hospitalization, invasive procedures, immunosuppression, and poor infection control practices [3]. Differences in prevalence and transmission dynamics of VRE between countries and healthcare institutions are driven by regional heterogeneity in antimicrobial stewardship policies and infection-prevention strategies [2]. VRE causes a variety of infections in clinical settings such as bloodstream infections, urinary tract infections, intra-abdominal infections, surgical site infections, and infective endocarditis. Among these, VRE bacteremia is the most severe manifestation, which has been associated with prolonged hospital stay, increased treatment failure, and higher mortality rates as compared with

Vancomycin susceptible enterococcal infections [2]. Recent systemic reviews and meta-analyses have shown that patients with VRE bloodstream infections have significantly worse clinical outcomes, including increased risk of death and prolonged hospitalization especially among critically ill and hematology-oncology patients [4]. Still, the rising burden of VRE proves very challenging for clinicians and public health systems with little to offer in therapeutic options. Current treatments involve agents like linezolid and daptomycin. However, the recent development of resistance to these antibiotics has further increased the apprehension regarding the future management of VRE infections [5]. Thus, surveillance must continue to be strengthened and the timely detection of cases, together with antimicrobial stewardship and strict infection control, shall be the linchpins in reducing the spread of VRE within healthcare facilities. The local epidemiology is very important because the prevalence, resistance patterns, and clinical impact of VRE vary greatly by geographic region and institution. Data from local surveillance can help to identify the predominant species, resistance phenotypes, patient risk factors, and trends in antimicrobial susceptibility, thus allowing targeted evidence-based therapeutic decisions and infection control interventions [6]. The clinical outcomes of VRE infections at the local level provide useful information on disease burden and resource utilization [7]. Therefore, the present study was conducted with the objective of investigating the local epidemiology and clinical outcomes of Vancomycin-resistant enterococci among patients in the healthcare setting of this study.

MATERIALS AND METHODS

STUDY DESIGN AND POPULATION

This was a retrospective observational study. It included patients admitted to hospitals in Najaf between July 2025 and May 2026. Inclusion criteria were hospitalized patients with culture-confirmed Enterococcus species — that is, isolates identified as Vancomycin-resistant. Duplicate isolates from the same patient, incomplete medical records, and community-acquired isolates (no hospitalization) were the exclusion criteria.

DATA COLLECTION

Data will be collected from electronic medical records and will include patient demographic and clinical characteristics, ICU admission, comorbidities, antibiotic exposure, prior Vancomycin therapy, length of hospital stay, species distribution of VRE isolates, antimicrobial susceptibility profile, distribution of VRE isolates by clinical specimen, and clinical outcomes.

ETHICAL CONSIDERATIONS

Ethical approval will be obtained from the ethical committee/College of Pharmacy, University of Alkafeel. It was data analysis - there would be no direct patient contact or invasive methods. So, patients' consent was not applicable.

STATISTICAL ANALYSIS

Data were entered and analyzed using GraphPad Prism 10.3.1. Continuous variables were expressed as mean ± SD or median with IQR depending on data distribution; while categorical variables were presented as frequencies and percentages. Categorical variables were compared using the Chi-square test or Fisher's exact test as appropriate. Continuous variables were analyzed for differences between groups using the Student's t-test for variables that were normally distributed and the Mann–Whitney U test for non-parametric data. Mortality was the dependent variable. Univariate logistic regression analysis was carried out to identify factors that were associated with mortality in VRE infected patients. Variables with a $p<0.10$ in univariate analysis were considered for inclusion in a multivariate logistic regression model, to find out independent predictors of mortality. Results were expressed as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value of less than 0.05 was taken as statistically significant.

RESULTS

PATIENT DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

The total number of patients involved in this study was 84 with VRE infection (Table 1). The mean age was 56 ± 18 years. This could be interpreted as an indication that the majority of people who were affected were either middle-aged or elderly. There were 48 male patients 57.1% and 36 female patients 42.9% which made the male gender slightly more represented in this study. Regarding the site of care, 31(36.9%) patients were admitted to the ICU. It was noted that the study population had a high frequency of several comorbidities. Diabetes mellitus was found in 26 cases 31.0%, chronic kidney disease in 19(22.6%), and malignancy in 14(16.7%). Most of the patients had previous antimicrobial exposure before being diagnosed with VRE infection. Specifically, 63 patients 75.0% had prior antibiotic exposure before VRE isolation, while 28 patients

Table 1 Demographic and clinical characteristics of patients with VRE infection

Characteristic	Value
Number of samples	84
Mean age (years ± SD)	56 ± 18
Male, n (%)	48 (57.1)
Female, n (%)	36 (42.9)
ICU admission, n (%)	31 (36.9)
Diabetes mellitus, n (%)	26 (31.0)
Chronic kidney disease, n (%)	19 (22.6)
Malignancy, n (%)	14 (16.7)
Prior antibiotic exposure, n (%)	63 (75.0)
Prior Vancomycin therapy, n (%)	28 (33.3)
Length of hospital stay (days, mean ± SD)	17 ± 8

Source: Compiled by the authors of this study

Table 2. Species distribution of VRE isolates

Species	Number (n)	Percentage (%)
Enterococcus faecium	62	73.8
Enterococcus faecalis	18	21.4
Other Enterococcus spp.	4	4.8
Total	84	100

Source: Compiled by the authors of this study

Table 3. Antimicrobial susceptibility profile of VRE isolates

Antibiotic	Resistant n (%)	Susceptible n (%)
Vancomycin	84 (100)	0 (0)
Ampicillin	59 (70.2)	25 (29.8)
High-level Gentamicin	44 (52.4)	40 (47.6)
Ciprofloxacin	53 (63.1)	31 (36.9)
Linezolid	2 (2.4)	82 (97.6)
Daptomycin	1 (1.2)	83 (98.8)

Source: Compiled by the authors of this study

33.3% had been exposed to Vancomycin. The average duration of stay in the hospital was 17 ± 8 days for the study population, which shows the substantial burden of healthcare associated with VRE infections.

SPECIES DISTRIBUTION OF VRE ISOLATES

Microbiological identification of the isolates revealed that Enterococcus faecium was the major species associated with VRE infections in this cohort. *E. faecium* was found in 62(73.8%) of the isolates. Other *Enterococcus* species were a small minority, with 4 isolates 4.8%, while *Enterococcus faecalis* accounted for 18 isolates 21.4%. These results highlight the dominance of *E. faecium* in the epidemiology of Vancomycin resistance among enterococci in the health care setting studied (Table 2).

Table 4. Distribution of VRE isolates by clinical specimen

Specimen source	Number (n)	Percentage (%)
Urine	34	40.5
Blood	22	26.2
Wound / surgical site	15	17.9
Intra-abdominal samples	7	8.3
Other	6	7.1
Total	84	100

Source: Compiled by the authors of this study

Table 5. Clinical outcomes of patients with VRE infection

Outcome	Number (n)	Percentage (%)
ICU admission	31	36.9
Bloodstream infection	22	26.2
Mechanical ventilation	18	21.4
Septic shock	12	14.3
Appropriate antimicrobial therapy	67	79.8
Mortality	20	23.8

Source: Compiled by the authors of this study

ANTIMICROBIAL SUSCEPTIBILITY PROFILE

Results of antimicrobial susceptibility testing indicated that all isolates 100% were resistant to Vancomycin, thus confirming the VRE phenotype (Table 3). High resistance was also noted against several commonly used antimicrobial agents. Specifically, 59 isolates 70.2% were resistant to ampicillin and 53 isolates 63.1% were resistant to ciprofloxacin. Moreover, 44 isolates 52.4% expressed high resistance to gentamicin, indicating limited efficacy of aminoglycoside-based combination therapies. Most isolates, however, remained susceptible to some last-line antimicrobial agents. Only 2 isolates 2.4% registered resistances to Linezolid and 1 isolate 1.2% to Daptomycin. These results indicate that Linezolid and Daptomycin remain very effective treatment options for VRE infections in the study population of this investigation.

DISTRIBUTION OF VRE ISOLATES BY CLINICAL SPECIMEN

The distribution of VRE isolates varied with the type of clinical specimen. Urine samples were the most common source — 34 isolates 40.5% — showing that urinary tract infections were the most frequent clinical presentation associated with VRE (Table 4). The second most common source was blood cultures, from which 22 isolates 26.2% were recovered, indicating cases of VRE bloodstream infections. Others were wound/sur-

gical site specimens, which accounted for 15 isolates 17.9%, and intra-abdominal samples, which represented 7 isolates 8.3%; the rest, 6 isolates 7.1%, were from miscellaneous types of specimens.

CLINICAL OUTCOMES

Clinical outcome analysis revealed that 31 patients 36.9% needed ICU admission during their stay. Bloodstream infection was observed in 22 patients 26.2% — a significant proportion of severe cases (Table 5). Moreover, 18 patients (21.4%) needed mechanical ventilation, which indicates severe illness in a subset of our study cohort. Twelve patients 14.3% developed septic shock, showing serious systemic infection. Proper antimicrobial therapy was given to 67 patients 79.8%; most of it included agents active against VRE. Mortality was not changed by the treatment overall (23.8%, 20 deaths in the study population) analysis revealed that 31 patients 36.9% needed ICU admission during their stay. Bloodstream infection was observed in 22 patients 26.2% — a significant proportion of severe cases.

DISCUSSION

VRE has become one of the major nosocomial pathogens across the globe, with its attendant problems of infection control and antimicrobial therapy. This study reports on local epidemiology, antimicrobial resistance patterns, and clinical outcomes of VRE infections, thereby shedding more light on the burden of these organisms in the healthcare setting under study. In the present study, *Enterococcus faecium* was the most common species of VRE 73.8% with *Enterococcus faecalis* being the less common species. This result is in agreement with several international studies that have reported the predominance of E. faecium among VRE isolates. *E. faecium* has been demonstrated to have a higher capacity of acquiring antimicrobial resistance genes [8] which likely contributes to its increased prevalence in healthcare associated infections. Antimicrobial susceptibility patterns demonstrated in this study indicated high resistance rates to several antibiotics, including ampicillin and ciprofloxacin. The results are in line with several surveillance studies and represent the multidrug-resistant nature of VRE. Most importantly, Linezolid and Daptomycin, two of the most effective therapeutic options for serious infections due to VRE at present, retained high levels of susceptibility [9]. Akin susceptibility patterns have been demonstrated in previous studies evaluating treatment outcomes of VRE bacteremia. In our study, we found that the distribution of VRE isolates among clinical specimens was highest for urinary tract infections and second for bloodstream infections. This pattern has been described in prior investigations as well, with invasive infection often following urinary tract colonization [10]. However, from a clinical perspective, bloodstream infections are the most important manifestation of VRE since they are associated with increased morbidity and mortality [11]. Our results also demonstrated several risk factors associated with VRE infection, prolonged hospitalization and ICU admission, and previous exposure to broad spectrum antibiotics. These findings are supportive of published literature that has recognized antibiotic selection pressure and healthcare exposure as factors that will promote the emergence and transmission of VRE [7]. Studies in tertiary care hospitals have consistently shown that previous exposure to Vancomycin, cephalosporins, or carbapenems is a significant risk factor for VRE colonization and infection [12-14]. In this study, the overall mortality rate was 23.8%, which is close to the mortality rates reported in other clinical studies of VRE infections [15]. Mortality was particularly high among patients with bloodstream infections and those requiring ICU care [15-16]. Previous meta-analyses have also shown that VRE bacteremia is associated with significantly higher mortality compared with infections caused by Vancomycin-susceptible enterococci. Several factors may contribute to this increased mortality, including a delay in appropriate antimicrobial therapy, severity of underlying illness, and limited availability of effective treatment options. Regardless of the findings, there are several limitations to the present study. First, the research was carried out in only one city, so the findings cannot be readily generalized to other cities or regions. Second, molecular characterization of resistance genes was not done, so it could have given more insight into the genetic epidemiology of VRE. Multicenter data and molecular analysis in future studies will add to the current knowledge of VRE transmission dynamics. The present study, however, gives important data on the local epidemiology and clinical outcomes of VRE infections and emphasizes the continued need for effective infection control practices, antimicrobial stewardship programs, and continued surveillance to limit the spread of these resistant pathogens.

CONCLUSIONS

Infections due to Vancomycin-resistant enterococci impose a huge healthcare burden in our setting; *E. faecium* is the leading species and is multidrug resistant. It was, however, associated with significant mortality despite preserved susceptibility to linezolid and daptomycin. Therefore, continuous surveillance coupled with antimicrobial stewardship and strict infection control practices is needed to contain the spread and impact of VRE infections.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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