

Increased incidence of *Enterococcus faecalis* infections in a tertiary care hospital in Eastern India and measures taken to combat their spread

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Abstract:

Background: *Enterococcus faecalis* is a common pathogen responsible for nosocomial infections worldwide, with rising antimicrobial resistance posing a major clinical concern. Limited data exist on its prevalence and resistance trends in Eastern India.

Aim: To assess the clinical burden and antimicrobial susceptibility profile of *E. faecalis* isolates from a tertiary care hospital in Eastern India.

Methodology: A prospective observational study was conducted on 1,095 clinical samples collected from patients with nosocomial infections. Identification and antimicrobial susceptibility testing of *E. faecalis* isolates were done using the Vitek 2 Compact system.

Results: Seventy-five (6.85%) Enterococcal isolates were obtained, predominantly from urine. All isolates were sensitive to Vancomycin, Teicoplanin and Linezolid. High resistance was noted to Erythromycin (71.05%), Ciprofloxacin (50%), High-Level Gentamicin (45.45%), and Ampicillin (22.73%). Notably, 42.86% of *E. faecalis* isolates exhibited high-level Gentamicin resistance. Resistance patterns varied by infection site. Strict infection control measures and an active Antimicrobial Stewardship Programme are essential to curb resistance spread.

Conclusion: *E. faecalis* remains a significant nosocomial pathogen in Eastern India, showing high resistance to common antibiotics but sustained susceptibility to Vancomycin, Teicoplanin and Linezolid. Continuous surveillance and judicious antibiotic use are crucial to prevent multidrug resistance.

Keywords: *Enterococcus faecalis*, nosocomial infections, antimicrobial resistance, tertiary care hospital, Eastern India.

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Introduction

The rapid development of resistance to antibiotics by common pathogens is an increasingly serious worldwide public health issue that creates serious problems for clinical treatment and public health infrastructures globally. Of these pathogens, the *Enterococcus* species has become prominent as key causative agents of nosocomial infections such as bacteremia, urinary tract infections (UTIs), and surgical site infections [1,2]. The survival of *Enterococcus* despite adverse environmental conditions coupled with its inherent and acquired resistance factors has helped its persistence within hospitals and hence its predominance as a principal cause of healthcare-related infections.

Enterococcus faecalis, specifically, has been known as an important nosocomial pathogen because of its capacity to acquire resistance against several traditionally effective antimicrobial drugs against Gram-

positive cocci. Unlike the genus *Streptococcus* that is still susceptible to several established antimicrobial agents, *Enterococcus* is resistant to many of the usual antimicrobial drugs, consequently reducing the choice of therapy [3]. Transmission of drug resistance genes, particularly Vancomycin resistance, from *Enterococcus* strains to other clinical-important organisms like *Staphylococcus aureus* adds up to the issue at hand, such that there is concern over the development of Vancomycin-resistant *Staphylococcus aureus* (VRSA). Such gene transmission potential puts an emphasis on *E. faecalis*' direct pathogen status as well as its status as a reservoir of resistance determinants that tend to spread within the healthcare facility.

Traditionally, synergistic mixtures of cell-wall active agents like β -lactams or glycopeptides with aminoglycosides were employed by utilizing synergistic

bactericidal activity. Emergence of multiple-drug resistant (MDR) strains of *Enterococcus* that are also of high-level aminoglycoside resistance (HLAR) or of lowered susceptibility to β -lactam antibiotics and Vancomycin has rendered such a strategy increasingly unsuccessful [4]. Loss of effectiveness of synergistic therapy results because HLAR inhibits penetration of aminoglycosides through the cell membrane of causative organisms, thus invalidating bactericidal activity. MDR *E. faecalis* infections consequently involve longer hospital stays, higher costs of healthcare and higher rates of morbidity and mortality.

The epidemiology of infections with *Enterococcus* differs worldwide, with variation noted between species prevalence, resistance patterns, as well as clinical outcome. While data from infections with *E. faecalis* are emerging from India, definable studies examining its clinical morbidity and antimicrobial resistance patterns are limited, specifically from the eastern part of the country. Tertiary care centers that handle complicated cases and frequently are centers of reference are ideal sites for vigilance of the nosocomially transmitted pathogens because of the enhanced probability of acquisition of MDR organisms and their transmission. Identification of local resistance patterns of *E. faecalis* provides direction for empirical treatment, designing efficacious control of infections, and prevention of the spread of resistant strains.

This study was therefore undertaken to establish the clinical relevance of infections by *Enterococcus faecalis* at a tertiary care facility in Eastern India. Further, the work endeavors to identify the antimicrobial susceptibility patterns of the *E. faecalis* strains with an emphasis on resistance towards commonly encountered drugs including β -lactams, aminoglycosides, and Vancomycin. By providing such an elaboration of susceptibility patterns, the work aspires to develop an understanding of the ongoing issue of *E. faecalis* prevailing at the local healthcare facility as well as create evidence-based guidelines towards the treatment and prevention of such infections.

Materials and Methods

Study Design: This was a prospective observational study conducted to assess the clinical burden and antimicrobial resistance of *Enterococcus faecalis* in patients with nosocomial infections at a tertiary care hospital.

Study Area: The study was carried out at the Department of Microbiology, Tertiary Care Center, West Bengal, India.

Study Duration: The study was conducted over a period of six months.

Sample Size and Study Population: The study included clinical samples from patients of all age

groups and both sexes who developed infections after 48 hours of hospital admission (nosocomial infections). Patients with infections at the time of admission, within 48 hours of hospitalization, or within 30 days post-discharge were excluded.

Sample Collection: Clinical specimens included urine, wound swab/pus, high vaginal swab and blood. Samples were collected following standard aseptic techniques and immediately transported to the microbiology laboratory for processing.

Inclusion Criteria

- Patients of all ages and both sexes with suspected nosocomial infections (infection onset more than 48 hours after admission).

Exclusion Criteria

- Patients with infection at the time of admission or within 48 hours of hospitalization.
- Patients with infection within 30 days post-discharge.

Procedure: Clinical samples like urine, wound swab/pus, high vaginal swab, and blood were collected from patients who had possible nosocomial infections. All the samples were collected by following standard aseptic practices and were immediately sent to the microbiology department for testing. The specimens were inoculated on blood agar plates and MacConkey agar plates and incubated at appropriate conditions for 24–48 hours for the growth of bacteria.

Potential colonies of *Enterococcus faecalis* were initially examined for their morphology and underwent Gram staining. Identification and Antimicrobial susceptibility testing was done by Vitek 2 Compact system.

All demographic, microbiological, and clinical data were documented in a systematic manner. Antimicrobial resistance patterns as well as MIC values were analyzed by the application of SPSS software, while resistance trends as well as clinical burden of *Enterococcus faecalis* were identified by the application of descriptive statistics.”

Statistical Analysis: Data were entered into Microsoft Excel and analyzed by SPSS 25.0. Descriptive statistics were used for summary of demographic profiles, frequency of occurrence of the isolates of *Enterococcus faecalis*, and resistance pattern of the antibiotics. The results of MIC were presented as ranges and interpreted by CLSI breakpoints.

Result

Table 1 shows the incidence and distribution of Enterococcal isolates recovered from different clinical samples. Out of a total of 1095 clinical isolates, 75 (6.85%) were identified as Enterococci. The highest proportion was obtained from urine samples, with 50 isolates (9.04%), accounting for 66.67% of all

Enterococcal isolates. This was followed by wound swabs, which yielded 15 isolates (4.90%) contributing 20%. Blood samples showed 6 isolates

(4.23%), representing 8%, while vaginal swabs had the lowest prevalence with 4 isolates (4.26%), making up 5.33% of the total Enterococcal isolates.

Samples	Total number of isolates	Total number of Enterococcal isolates (%)	Distribution of Enterococcal isolates (n = 75) (%)
Urine	553	50 (9.04)	66.67
Wound swab	306	15 (4.90)	20
Blood	142	6 (4.23)	8
Vaginal swab	94	4 (4.26)	5.33
Total	1095	75 (6.85)	100

Table 2 presents the antimicrobial sensitivity pattern of Enterococcal isolates in nosocomial infections. All isolates were uniformly sensitive to Vancomycin, Teicoplanin and Linezolid (100%), with no resistance observed. In contrast, resistance to Ampicillin was noted in 22.73% of isolates, while 77.27% remained sensitive. A high level of resistance was observed against Erythromycin, with 71.05% resistant and only 28.95% sensitive. Ciprofloxacin

showed an equal split, with 50% of isolates being sensitive and 50% resistant. High-level Gentamicin resistance was also considerable, with 45.45% resistant isolates compared to 54.55% sensitive ones. This pattern highlights the continued effectiveness of Vancomycin, Teicoplanin and Linezolid, while significant resistance is evident against Erythromycin, Ciprofloxacin, and High-level Gentamicin.

Antibiotic	Number of sensitive isolates	Percentage of sensitive isolate	Number of resistant isolates	Percentage of resistant isolate
High-level Gentamicin	21	54.55	17	45.45
Ciprofloxacin	19	50	19	50
Erythromycin	11	28.95	27	71.05
Ampicillin	29	77.27	9	22.73
Linezolid	38	100	0	0
Teicoplanin	38	100	0	0
Vancomycin	38	100	0	0

Table 3 compares the prevalence of antibiotic resistance among Enterococcal isolates from different clinical sources. No resistance was observed to Vancomycin, Teicoplanin or Linezolid across any sample type (0%). Resistance to Ampicillin was highest in vaginal swab isolates (33.33%), followed by wound swabs (30%), urine (21.78%), and blood (7.69%), with an overall prevalence of 22.88%. Erythromycin resistance was notably high, 53.33% in wound swabs with a total prevalence of 71.24%.

Ciprofloxacin resistance was also significant, highest in urine isolates (53.47%) and lowest in vaginal swabs (33.33%), with an overall prevalence of 49.67%. High-level Gentamicin resistance varied between 42.57% in urine and 61.54% in blood isolates, contributing to an overall resistance of 45.75%. These findings indicate consistently high resistance to Erythromycin, moderate resistance to Ciprofloxacin and High-level Gentamicin, and comparatively lower resistance to Ampicillin.

Name of the antibiotic	% Resistance in urine isolates	% Resistance in wound swab isolates	% Resistance in blood isolates	% Resistance in vaginal swab isolates	% Resistance among all nosocomial isolates
High-level Gentamicin	42.57	50	61.54	44.44	45.75
Ciprofloxacin	53.47	43.33	46.15	33.33	49.67
Erythromycin	NA	53.33	61.54	66.67	71.24
Ampicillin	21.78	30	7.69	33.33	22.88
Linezolid	0	0	0	0	0
Teicoplanin	0	0	0	0	0
Vancomycin	0	0	0	0	0

Discussion

The present study highlights the clinical burden and antimicrobial resistance patterns of *Enterococcus faecalis* in a tertiary care hospital in Eastern India. A total of 75 Enterococcal isolates were recovered from 1,095 clinical samples, yielding an overall prevalence of 6.85%. Consistent with our findings, previous Indian studies have reported variable prevalence rates of Enterococcal infections, ranging from 1% to 36% across different hospital settings (Kapoor et al., 2005; Kaur et al., 2009) [5,6]. The observed distribution of isolates in our study showed a predominance in urine samples (66.67%), followed by wound swabs (20%), blood (8%), and vaginal swabs (5.33%). This confirms the urinary tract as the most common site of Enterococcal infection, particularly in catheterized patients or those with underlying genitourinary pathology, a trend similarly reported by Agarwal et al. (2009) [7] and Karmarkar et al. (2004) [8]. Wound infections were also substantial, supporting the opportunistic nature of Enterococci in nosocomial environments where breaches in skin integrity or surgical interventions predispose patients to infection. Bacteremia and vaginal infections were less frequent, echoing observations in other Indian hospitals, where Enterococcal bloodstream infections were relatively rare but carried high morbidity (Moellering, 1992; Morrison & Wenzel, 1986) [1,2].”

Worldwide, *E. faecalis* contributes to 80–90% of clinical Enterococcal strains while *E. faecium* contributes to 5–15% (Facklam & Teixeira, 1998) [9]. Of note, *E. faecium* is frequently linked with greater penicillin and aminoglycoside resistance by way of production of extra penicillin-binding proteins as well as by production of aminoglycoside-modifying enzymes (Sood et al., 2008) [10]. In the present study, high-level High-level Gentamicin resistance (HLGR) was seen by *E. faecalis* in 42.86% of the isolates reflecting results from other tertiary care hospitals of India wherein HLGR prevalence ranged from 1% to 48% (Jose et al., 2005; Padmasini et al., 2014) [11,12]. These results highlight the rise of multidrug resistance amongst Enterococci posing treatment dilemmas.

Antimicrobial susceptibility patterns here indicated full susceptibility to Vancomycin, Teicoplanin and Linezolid, confirming their ongoing use as effective drugs. Comparable findings have been noted from several Indian studies, despite varying rates of Vancomycin-resistant Enterococci (VRE) in India ranging from 0% to 30% (Sekar et al., 2008; Fernandes & Dhanashree, 2013) [13,14]. Our results showing high Erythromycin resistance (71.05%), and intermediate resistance to Ciprofloxacin (50%) and High-level Gentamicin (54.55%) indicate an alarming trend consistent with resistance patterns documented by Kaur et al. (2009) and Agarwal et al.

(2009) [6,7]. Ampicillin showed relatively good activity with 77.27% of strains being sensitive but resistance exceeded that of urine-derived strains (21.78%) amongst wound (30%) and vaginal (33.33%) strains. The difference in site-related resistance patterns indicates varying site-specific selective antibiotic forces prevailing within different clinical milieux and indicates that empirical treatment needs local antibiograms as guidelines.

The prevalence of multidrug-resistant (MDR) Enterococci was observed in 7% of the isolates, nearly exclusively from gynecology and maternity wards, which compares with other Indian reports of MDR prevalence of 5–10% (Jain et al., 2011; Padmasini et al., 2014) [15,12]. MDR strains were of highest concern because Vancomycin, Teicoplanin or Linezolid were the only drugs that were effective against them, calling for strict infection control practices. High-level aminoglycoside resistance (HLAR) also diminishes the effectiveness of combination therapy such as Ampicillin-High-level Gentamicin regimens against serious infections. Our study remarked that HLAR strains were more prevalent in urinary tract infections than in blood stream infections, also consistent with the picture at other tertiary care centers (Cetinkaya et al., 2000; Jose et al., 2005) [16,11].

In summary, our results are consistent with previous Indian and local studies on the prevalence of urinary tract infections, prevalence of *E. faecalis*, high resistance against macrolides and aminoglycosides. However, the lack of VRE in our population differs from northern and southern Indian reports wherein prevalence of VRE was noted up to 30% (Taneja et al., 2004; Fernandes & Dhanashree, 2013) [17,14]. This local variation highlights the need for local antimicrobial surveillance that will help develop effective empirical therapy. Ongoing resistance trend monitoring, judicious use of antibiotics and infection control practices continue to be essential in mitigating the clinical impact of Enterococcal infections, specifically in high-risk hospital populations.

Conclusion

The study highlights a rising clinical incidence of *Enterococcus faecalis* at a tertiary care centre in Eastern India, predominantly isolated from urine samples, followed by wound swabs, blood, and vaginal swabs. *E. faecalis* remains a major cause of nosocomial infections, especially urinary tract infections. All isolates were fully susceptible to Vancomycin, Teicoplanin and Linezolid, affirming their therapeutic efficacy. However, significant resistance was observed to Ampicillin, Erythromycin, Ciprofloxacin, and High-level Gentamicin, with Erythromycin showing the highest resistance. The detection of High-level Gentamicin resistance (HLGR) emphasizes limited treatment options and potential therapeutic failures. Overall, early and accurate

identification, continuous surveillance of Enterococcus infections with their resistance trends, rational antimicrobial use based on hospital antibiogram, infection control practices and antimicrobial stewardship programme is essential to prevent the spread of multidrug-resistant strains and ensure effective clinical management.

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