

# Antimicrobial Susceptibility Pattern of Enterococci Isolated From Patients in Tehran

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Received 2015 April 26; Revised 2015 June 5; Accepted 2015 June 15

## Abstract

**Background:** Enterococci are one of the most common nosocomial pathogens and the emergence of multidrug-resistant strains has been increasing.

**Objectives:** We studied the antimicrobial susceptibility of enterococci isolated from different clinical specimens of patients in Tehran.

**Materials and Methods:** From the beginning of April 2013 to the end of June 2013, a total of 146 enterococci were isolated from the Pars General Hospital in Tehran. The antimicrobial susceptibility pattern of the isolates against ampicillin, clindamycin, ciprofloxacin, erythromycin, levofloxacin, linezolid, nitrofurantoin, tetracycline, and vancomycin was determined using the disk diffusion method according to the guidelines of clinical laboratory standards institute (CLSI).

**Results:** The rates of resistance were high to clindamycin, tetracycline, and erythromycin (97.2%, 89%, and 74.5%, respectively); moderate to ciprofloxacin and levofloxacin (40.6% and 36.4%, respectively); and low to ampicillin and nitrofurantoin (13.8% and 3.5%, respectively). All isolates were linezolid sensitive. Vancomycin-resistant enterococci (VRE) accounted for 9.6% of the isolates.

**Conclusions:** VRE and a high rate of resistance to some of antimicrobial agents were found among the enterococci isolated from patients in Tehran. These findings highlight the importance of regular supervision of antimicrobial susceptibilities.

**Keywords:** Enterococci, Susceptibility, Urinary Tract Infection

## 1. Background

Enterococci are members of the normal flora in the gut of humans and animals, but have become increasingly important as hospital-acquired pathogens. They have been associated with infections of the urinary tract, post-surgical wounds, septicemia, endocarditis, and meningitis (1, 2). They have a remarkable ability to adapt to exposure to antibacterial agents and possess intrinsic resistance to penicillins and low-level resistance to aminoglycosides. They also have a tremendous capacity to acquire resistance to other antibacterial agents, including high-level resistance to aminoglycosides and glycopeptides (1-3).

Vancomycin-resistant enterococci (VRE) are recognized as important resistant pathogens worldwide (3, 4), including in Iran (5-9). Infections caused by VRE are associated with severe adverse outcomes such as extended hospital stay, increased treatment cost, and increased mortality due to reduction in the antimicrobial agents available to treat infections (10, 11). Enterococci have gained attention

because of their important role in nosocomial infections, as well as the increasing emergence of strains resistant to antimicrobial agents. Therefore, statistical analysis of the bacteria recovered from different clinical samples from hospitals is extremely important.

## 2. Objectives

The aim of this study was to determine the antimicrobial susceptibility pattern of enterococci isolated from different clinical samples of patients in the Pars General Hospital, Tehran, Iran.

## 3. Materials and Methods

### 3.1. Setting and Study Period

The study was performed with the approval of ethics committee of Shahed University. Enterococci were isolated from different clinical samples obtained from outpa-

tients and inpatients that were referred to the Pars General hospital in Tehran from the beginning of April 2013 to the end of June 2013.

### 3.2. Bacterial Isolation and Antimicrobial Susceptibility Testing

After Gram staining, all isolates were confirmed at the genus level by biochemical tests, including catalase activity tests, esculin hydrolysis test in the presence of bile, and growth in 6.5% NaCl. Antimicrobial susceptibility pattern was determined using the disk diffusion method on Mueller-Hinton agar (Merck, Germany) according to the guidelines of clinical laboratory standards institute (CLSI) (12). Disks containing the following antimicrobial agent (Rosco, Denmark) were used: ampicillin (10 µg), clindamycin (2 µg), ciprofloxacin (5 µg), erythromycin (30 µg), levofloxacin (5 µg), linezolid (30 µg), nitrofurantoin (300 µg), tetracycline (30 µg), and vancomycin (30 µg). *Enterococcus faecalis* ATCC 29212 was used as the control strain.

### 3.3. Statistical Analysis

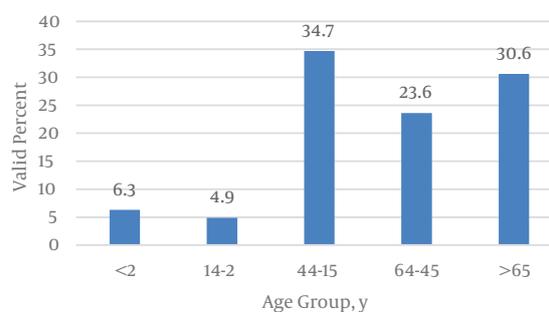
All data collected from these isolates were analyzed statistically using SPSS software (Statistical Package for the Social Sciences, version 20, SPSS Inc., Chicago, Illinois, USA).

## 4. Results

Based on the results obtained using SPSS software, of all 146 patients infected by enterococci, 99 (70.7%) were females and the remaining (47 cases, 29.3%) were males. In addition, 75.3% were outpatients and 24.7% were inpatients. The majority of the patients (88.9%) were adults ( $\geq 15$  years old), and the frequency of isolation was the highest and lowest for patients in the age groups of 15 - 44 and 2 - 14 years, respectively (Figure 1). Enterococci were isolated from different clinical samples, including body fluid (1.4%), respiratory (3.4%), urogenital (11%), skin (15.1%), and urine (69.2%). The antimicrobial susceptibility pattern of isolates is shown in Table 1. The rates of resistance were high to clindamycin, tetracycline, and erythromycin (97.2%, 89% and 74.5%, respectively); moderate to ciprofloxacin and levofloxacin (40.6% and 36.4%, respectively); and low to ampicillin and nitrofurantoin (13.8% and 3.5%, respectively). All isolates were linezolid sensitive. VRE accounted for 9.6% of the isolates. All VRE were resistant to ampicillin, erythromycin, clindamycin, ciprofloxacin, and levofloxacin, and most were resistant to tetracycline. However, most VRE were sensitive to nitrofurantoin, and all were linezolid sensitive.

Since most of the enterococci (101 cases) were isolated from urine, statistical analysis of these strains based on age, sex, and the rates of resistance is essential. Statistical analysis revealed that 78.2% and 23.8% of these isolates were recovered from females and males, respectively. In addition, 81.2% and 18.8% of these isolates were recovered from outpatients and inpatients, respectively. As shown in Figure 2, most of the urinary isolates were recovered

from older patients. The antimicrobial susceptibility pattern of urinary isolates is shown in Table 2. No statistically significant differences were noted in any of isolates recovered from the clinical samples. In total, 11 isolates from urine (11.7%) were vancomycin resistant.



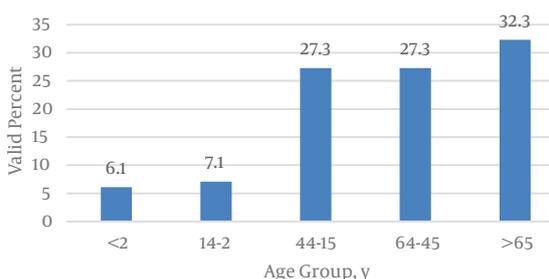
**Figure 1.** Age Distribution of 146 Patients Who Tested Positive for *Enterococcus* spp. in Different Clinical Samples

**Table 1.** Antimicrobial Susceptibility Pattern of *Enterococcus* spp. Isolated From Different Clinical Samples<sup>a,b</sup>

Antimicrobial Agents	Percent of Each Phenotype		
	Resistance	Intermediate	Sensitive
<b>Ampicillin</b>	13.8	-	86.2
<b>Clindamycin</b>	97.2	-	2.8
<b>Ciprofloxacin</b>	40.6	8.9	50.5
<b>Erythromycin</b>	74.5	5.75	19.9
<b>Levofloxacin</b>	36.4	-	63.6
<b>Linezolid</b>	-	-	100
<b>Nitrofurantoin</b>	3.5	0.9	95.6
<b>Tetracycline</b>	89	-	11
<b>Vancomycin</b>	9.6	0.7	89.7

<sup>a</sup>The values are presented as percent.

<sup>b</sup>n = 146.



**Figure 2.** Age Distribution of 101 Patients Who Tested Positive for *Enterococcus* spp. in the Urine

**Table 2.** Antimicrobial Susceptibility Pattern of Urinary Isolates of *Enterococcus* spp.<sup>a,b</sup>

Antimicrobial Agents	Percent of Each Phenotype		
	Resistance	Intermediate	Sensitive
Ampicillin	13	-	87
Clindamycin	96	-	4
Ciprofloxacin	40	9	51
Erythromycin	75	4	21
Levofloxacin	39.6	-	60.4
Linezolid	-	-	100
Nitrofurantoin	4	1	95
Tetracycline	89	-	11
Vancomycin	10.9	1	88.8

<sup>a</sup>The values are presented as percent.<sup>b</sup>n = 101.

## 5. Discussion

Many studies have demonstrated that urinary tract infections (UTIs) are the most common form of enterococcal infection (1-3, 5, 13). In this study, the majority of enterococcal isolates were obtained from urine samples, consistent with other reports (2, 5, 14). Moreover, it has been shown that enterococcal UTI is more common in people aged 65 years or older, which can be attributed to the increased frequency of genitourinary anomalies and obstructive uropathy in this age (3).

Results of antimicrobial susceptibility tests using the disk diffusion method showed that 10.9% of the studied enterococcal isolates were vancomycin resistant. Other studies in Iran have reported highly variable rates of VRE, from 3.6% to 20.5% (6-9, 15, 16). Prevalence of VRE in various European countries has been reported to be < 2% in Finland and Holland; > 20% in Ireland, Greece, and Portugal; < 10% in Canada; 33% in USA; 0.5% in Brazil; and 3% in Kuwait (2, 11, 14). Of note, although vancomycin is an accepted antibiotic for the treatment of Gram-positive cocci, it exerts only bacteriostatic activity against enterococci and needs to be combined with another agent, usually an aminoglycoside, to achieve bactericidal activity (17). Unfortunately, high resistance to erythromycin, clindamycin, and tetracycline (74.5%, 97.2%, and 89%, respectively) were observed in this study, which was consistent with the results of other studies in Iran and other countries (2, 5, 7, 13, 14, 16). This finding suggests that antimicrobial resistance must be considered when determining treatment of patients.

All enterococcal isolates studied here were susceptible to linezolid, consistent with a previous report from Tehran, Iran (9). Although, there are some reports about the linezolid resistance among enterococci isolated from patients in Iran (8, 16), it seems that resistance to this new antibiotic is still very low in clinical isolates of enterococci in

this region. Furthermore, only 3.5% of enterococcal isolates showed resistance to nitrofurantoin, which confirms the suitability of this drug for treatment of enterococcal UTI.

In conclusion, our results emphasize the need for a national surveillance curriculum in Iran, which constantly monitors the changes in bacterial resistance. In conclusion, our findings highlight the importance of accurate diagnosis of VRE strains in hospitals and patients.

## Acknowledgments

The authors thank the microbiology laboratory team at the Pars General Hospital, Tehran, Iran, for collaboration in this study. We are grateful to Elaheh Safkhani, Fatemeh Aghazadeh, Mahdiah Zabayehi, and Nilofar Izadi for help in data collection.

## Footnote

**Authors' Contribution:** Horieh Saderi conceptualized and designed the study, collected and analyzed data, and supervised the study. Saresadat Hosseini contributed to the search of articles and writing the manuscript. Seyedeh Marzieh Moosavi helped in data acquisition and writing the manuscript. Roxana Sahebhasagh helped in data acquisition, and Shahram Boroumandii provided laboratory data of isolates.

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