

SHORT PAPER

Evaluating the Trend of VRE carriage in Health Facilities: A Retrospective Study from 2019-2022

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Abstract

Background. Healthcare-associated infections (HAIs) and multidrug resistance (MDR) are a growing public health threat and pose a risk to patient safety in healthcare facilities. Vancomycin-resistant Enterococci (VRE) are responsible for nosocomial infections and have intrinsic and acquired resistance to many antibiotics, including glycopeptides. VRE carriage can remain undetected, increasing the risk of contact transmission. Identifying colonized patients is crucial for the implementation of preventive measures.

Aims. The aims of this study were to evaluate the trend of VRE carriage based on rectal swab results between 2019 and February 2022 in a large Italian trust and the percentage of patients with VRE colonization at the time of hospitalization.

Methods. This was a retrospective observational study based on results of rectal swabs performed for screening on admission between January 2019 and February 2022 in four hospitals part of a single trust in Turin, North-Western Italy. The study collected data on the date of specimen collection, type of specimen, isolated pathogen and the date of hospital admission. Descriptive analysis of data was performed, and duplicate samples were not considered.

Results. From January 2019 to February 2022 we collected 5025 rectal swabs performed in hospitals of the trust, of which 3037 were performed in 2019 (60%), 741 in 2020 (15%), 611 in 2021 (12%) and 636 in the first two months of 2022 (13%). VRE positivity was found in 162 (3%) rectal swabs, of which 2 cases in both 2019 (0.1%) and 2020 (0.3%), 95 in 2021 (15.5%) and 63 in the first two months of 2022 (9.9%). Furthermore, 52% (84/162) of positive rectal swabs were performed at admission, whereas the remaining 48% (78/162) of positive rectal swabs were performed after 48h.

Conclusions. This study found an increasing trend of VRE carriage in the study population during the SARS-CoV-2 pandemic, highlighting the importance of screening patients for VRE carriage to prevent worsening clinical conditions, environmental contamination, and prolonged hospitalization.

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Introduction

Healthcare-associated infections (HAIs) and multidrug resistance (MDR) have been recognized as increasing public health threats and represent an important risk for patient safety in health facilities. For this reason, they are considered indicators for healthcare quality (1). Vancomycin-resistant Enterococci (VRE) were first identified in 1986 and have since been associated with nosocomial infections. Enterococci are part of the normal intestinal flora and have intrinsic and acquired resistance mechanisms towards many antibiotics, including glycopeptides, which can impact the treatment of infected patients (2). Gastrointestinal VRE carriage can remain undetected for long periods of time, increasing the risk of contact transmission. Identifying colonized patients is crucial for the implementation of preventive measures (3). While enterococci are less virulent than *Staphylococcus aureus*, invasive VRE infections mainly occur in hosts with severely impaired health conditions, leading to poor outcomes (4). In recent years, methicillin-resistant *Staphylococcus aureus* (MRSA) strains with reduced susceptibility to vancomycin have been reported, making MRSA infection more complicated to treat. This is due to enterococci resistance genes that can be easily transferred to other bacterial species such as staphylococci (5). The World Health Organization (WHO) has included *VRE faecium* in its global priority list of antibiotic-resistant bacteria, emphasizing the paucity of effective treatment options. In the EU/EEA (excluding the United Kingdom), the population-weighted mean percentage of *VRE faecium* increased from 11.6% in 2016 to 16.8% in 2020. In Italy, the proportion of recorded VRE continued to grow in 2020, reaching 23.6% (6). The latest Italian national Antimicrobial-Resistance Surveillance System (AR-ISS) report shows a percentage of *VRE faecium* equal to 28.2%

in 2021 (7). This increasing trend highlights the need for close monitoring to better understand the epidemiology of VRE, both at the community and hospital levels.

The aim of this study was to assess VRE epidemiology and spread in our region through the evaluation of VRE carriage among patients of large Italian trust between 2019 and February 2022. We also evaluated the percentage of VRE carriage among rectal swabs performed on patients upon admission compared to screening results obtained after 48 hours from admission.

Methods

We conducted a retrospective observational study on VRE carriage in patients admitted to four hospitals part of a single trust that covers the entire territory of Turin, a city of around 900.000 inhabitants in North-Western Italy. During the study period, 30233 patients were admitted to hospitals of the trust in 2019, 25698 patients were admitted in 2020, 26296 patients were admitted in 2021 and 4202 patients were admitted until February 2022.

Data were collected on March 2022, concerning all rectal swabs performed from January 2019 to February 2022 for screening on admission in 2019, 2020, 2021 and the first two months of 2022. In the absence of national or regional guidelines for VRE screening, the criteria for the surveillance of carbapenem-resistant Enterobacteriaceae (CRE) were followed in this study.

The criteria for performing screening with rectal swabs at admission were:

- patients identified as infected/positive for carriage in the previous 12 months;
- transfers from other wards or from elderly assisted living, long-term care or neurological rehabilitation facilities;
- immunocompromised patients;
- patients admitted to other healthcare facilities in the previous 6 months (patients

in dialysis or with cancer);

- or patients from foreign countries endemic for VRE. Screening with rectal swabs were performed within 48 hours of hospital admission and sent to the laboratory to be analyzed. In case of negative results, no further testing was performed. If results were positive for VRE, screening was repeated with a weekly frequency (interrupted after three consecutive swabs) and in this case screening was also performed on patients sharing a room with the index patient.

Concerning laboratory analysis, Enterococci and their differentiation in *E. faecium* and *E. faecalis* with acquired resistance to Vancomycin (VRE) were identified using a selective chromogenic medium called Agar chromID VRE: it consists of a nutritional base that associates various peptones, two chromogenic substrates and a mixture of antibiotics including Vancomycin (8 mg / l) which allows the selective growth of VRE and the direct and differentiated search for *E. faecium* and *E. faecalis* through different colors. The procedure involves not exposing the medium to light, with the exception of the sowing and reading phases, and bringing it to ambient temperature beforehand. Then, the rectal swab is sown on the agar directly or after enrichment in broth and incubated in a thermostat and in anaerobic conditions at 37 °C. The cultures are examined after 24 hours of incubation, and in case of absence of growth or coloring, the medium is incubated for another 24 hours.

A comprehensive dataset was compiled, including the following information: date of specimen collection, collected specimen, isolated microorganism, and date of hospital admission. Duplicate samples were excluded.

The primary focus of this data analysis was to ascertain the incidence rate of rectal swabs positive for VRE among all collected swabs. Subsequent analysis was performed to evaluate how many positive results were

found among specimens collected within the initial 48 hours of a patient's hospital admission. Positive results among swabs performed within 48 hours from admission were considered an indicator of community-acquired carriage.

The Cochran-Armitage test for trends was used to assess the trend of VRE isolates. Statistical analyses were performed using Microsoft Excel and IBM SPSS Statistics, Version 27.0 (Armonk, NY: IBM Corp).

Results

Our investigations included 5025 rectal swabs performed in hospitals of the trust, from January 2019 to February 2022, of which 3037 were executed in 2019 (60%), 741 in 2020 (15%), 611 in 2021 (12%) and 636 in the first two months of 2022 (13%). VRE positivity was found in 162 (3%) rectal swabs, of which 2 cases in both 2019 (0.1%) and 2020 (0.3%), 95 in 2021 (15.5%) and 63 in the first two months of 2022 (9.9%). *E. faecium* was identified in 100% of positive rectal swabs (Table 1). A significant increasing trend was identified ($p < 0.05$).

Furthermore, 52% (84/162) of positive rectal swabs were diagnosed at admission, whereas the remaining 48% (78/162) of positive rectal swabs were screened after 48h. (Table 2). The highest number of colonizations were registered in medical wards with 56/162 (35%) of positive swabs, followed by emergency department with 27/162 (17%), intensive care units with 24/162 (15%), and COVID-19 wards with 18/162 (11%).

Discussion

This study aimed to assess the rate of VRE carriage in all patients admitted to our hospitals and screened based on

Table 1 - Incidence of VRE carriage among patients admitted to four hospitals in Turin, North-Western Italy from 2019 to 2022. The table shows the total number of rectal swabs performed each year, the proportion of rectal swabs positive for VRE, and the corresponding incidence percentage.

Year	Total rectal swabs (a)	Proportion of total rectal swabs	Vre positive rectal swabs (b)	Incidence (b/a) *100
2019	3037	3037/5025 (60%)	2	(2/3037) 0.1%
2020	741	741/5025 (15%)	2	(2/741) 0.3%
2021	611	611/5025 (12%)	95	(95/611) 15.5%
2022 (first two months)	636	636/5025 (13%)	63	(63/636) 9.9%
	5025	5025/5025 (100%)	162	(162/5025) 3%

Table 2 - Incidence of VRE carriage according to time of acquisition among patients admitted to four hospitals in Turin, North-Western Italy from 2019 to 2022. The table shows the number of cases of VRE carriage acquired either within or after 48 hours of hospital admission for each year, the total number of cases, and the corresponding percentage.

Acquisition time	2019	2020	2021	2022	Total	%
< 48h	1	0	48	35	84	52%
> 48h	1	2	47	28	78	48%
Total	2	2	95	63	162	100%

epidemiological criteria. With the onset of the COVID-19 pandemic, international health systems have implemented preventive measures to contain the spread of infections. Several of these measures, including restricted access to healthcare facilities, increased use of personal protective equipment (PPE) and hand hygiene, dedicated COVID-19 pathways, and surface disinfection, are common with infection control measures for HAIs, including VRE, which is transmitted through direct contact (8). The measures adopted in the hospitals to control VRE spread were: source-isolation of patients pending screening results, isolation and contact precautions in cases of positive swabs. Furthermore, in order to contain the spread of VRE continuous training on hand hygiene, antimicrobial stewardship and correct use of PPE were made available to healthcare personnel. On the other hand, during the pandemic there was an increase in the number of clinically severe patients undergoing invasive treatments, together

with increased workload and reduced availability of healthcare workers (9).

Our study shows that 60% of all rectal swabs were performed in 2019, prior to the pandemic. In 2020 and 2021, during the pandemic, screening activity decreased but remained almost constant in both years, in which 15 and 12% of the total number of swabs were performed, respectively. The size of the samples of the first two months of 2022 (13%) seems to show a resumption of screening activity to pre-pandemic levels. In addition, although 2019 was the year in which the highest number of rectal swabs were performed, the incidence of positive rectal swabs was 0.1%, in 2020 it rose to 0.3%, in 2021 to 15.5%, and in the first two months of 2022 to 9.9%. Despite strict adherence to prevention measures during the pandemic, our study reports an important increase in VRE carriage, in contrast to a study by Suh et al, which found a reduction in VRE acquisition in intensive care patients due to the use of 2% chlorhexidine gluconate (10).

We also evaluated how many rectal swabs were already positive at hospital admission, and which were the medical areas with the most cases of colonized patients. We found that about half (52%) of the rectal swabs performed were positive at admission, which could indicate that carriage was acquired in the community setting. Furthermore, the wards with the highest number of cases were those with the most fragile patients, i.e. medical departments (35%), emergency department (17%), intensive care (15%), and COVID wards (11%). These results are in line with findings by Karaşin et al, which previously reported that the patients most exposed to the risk of VRE infection are those with alterations of the mucosal immune system of the gastrointestinal tract, due to antibiotic therapy and respiratory diseases (11). This suggests that frail conditions can increase the risk of contagion. The COVID-19 pandemic has had a profound impact on health systems, in particular it has determined the reorganization of structural and human resources to control SARS-CoV-2 transmission, diverting resources and focus from routine activities. In addition, contingent access to hospitals, the suspension of some medical activities and the hesitation of the population to approach health care settings have reduced hospital access. For these reasons, we justify the reduced screening activity during the central years of Covid19 pandemic. It could be interesting to investigate the role of changing antibiotic prescription patterns and that of the consumption of alcohol-based hand rub, to understand if these have had an influence on the results of VRE carriage incidence. As no information on demographic and clinical characteristics of included patients were collected, the association between carrier condition and infection, as well as risk factors, were not investigated. Further, no information on the provenance of patients was collected.

Conclusion

In conclusion, our study found an important increase in the incidence of VRE carriage during the pandemic. Results of this study highlight the importance of screening patients for VRE carriage to prevent worsening clinical conditions, environmental contamination, and prolonged hospitalization. To ensure continuity of care and effective surveillance, it is essential for the health system to prioritize these screening measures.

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Riassunto

Valutazione del trend delle colonizzazioni da VRE nelle strutture sanitarie: uno studio retrospettivo dal 2019 al 2022

Introduzione. Le infezioni correlate all'assistenza sanitaria (ICA) e la multi-resistenza ai farmaci (MDR) rappresentano una crescente minaccia per la salute pubblica e rappresentano un rischio per la sicurezza dei pazienti nelle strutture sanitarie. L'Enterococco resistente alla vancomicina (VRE) è un microrganismo responsabile di infezioni nosocomiali che presenta resistenza intrinseca e acquisita a molti antibiotici, compresi i glicopeptidi. La colonizzazione da VRE può rimanere asintomatica per lungo tempo, aumentando il rischio di trasmissione da contatto. Identificare i pazienti colonizzati è fondamentale per attuare misure di prevenzione.

Obiettivi. Gli obiettivi di questo studio erano di valutare l'andamento della colonizzazione da VRE sulla base degli esiti dei tamponi rettali eseguiti tra il 2019 e il Febbraio 2022 in una grande Azienda Sanitaria Locale (ASL) italiana, e la percentuale di pazienti con colonizzazione da VRE al momento del ricovero.

Metodi. Si tratta di uno studio osservazionale retrospettivo condotto sulla base degli esiti dei tamponi rettali eseguiti per lo screening al momento del ricovero tra gennaio 2019 e febbraio 2022 in quattro ospedali facenti parte della stessa ASL Torinese, nel nord-ovest dell'Italia. Lo studio ha raccolto informazioni relative alla data di

raccolta del campione, al tipo di campione, all'agente patogeno isolato e alla data del ricovero ospedaliero. Sono state eseguite analisi descrittive dei dati e non sono stati tenuti in considerazione campioni duplicati.

Risultati. Da gennaio 2019 a febbraio 2022 sono stati raccolti 5025 tamponi rettali eseguiti negli ospedali dell'ASL, di cui 3037 eseguiti nel 2019 (60%), 741 nel 2020 (15%), 611 nel 2021 (12%) e 636 nei primi due mesi del 2022 (13%). La positività al VRE è stata riscontrata in 162 (3%) tamponi rettali, di cui 2 casi sia nel 2019 (0.1%) che nel 2020 (0.3%), 95 nel 2021 (15.5%) e 63 nei primi due mesi del 2022 (9.9%). Inoltre, il 52% (84/162) dei tamponi rettali positivi è stato diagnosticato al momento del ricovero, mentre il restante 48% (78/162) dei tamponi rettali positivi è stato sottoposto a screening dopo 48 ore.

Conclusioni. Lo studio ha rilevato una tendenza all'aumento della colonizzazione da VRE nella popolazione oggetto dello studio durante la pandemia da SARS-CoV-2, evidenziando l'importanza dello screening dei pazienti per la colonizzazione da VRE per prevenire il peggioramento delle condizioni cliniche, la contaminazione ambientale e l'ospedalizzazione prolungata.

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