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Surveillance of methicillin-resistant *Staphylococcus aureus* (MRSA) in acute care hospitals. Results of the VINCat Program (2008-2010)

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A B S T R A C T

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a common cause of healthcare-related infection. Surveillance and prevention of MRSA is a priority in infection control programs. The aim of this study was to describe rates and trends of MRSA colonization or infection in 40 hospitals participating in the VINCat Program from 2008 to 2010.

The study included all patients treated in acute care areas of participating hospitals. Hospitals were stratified into 3 groups based on size. The following annual indicators were reported: Methicillin-resistance rate, incidence density of new cases of MRSA and incidence density of MRSA bacteremia.

Between 2008 and 2010, the yearly mean rate of resistance to methicillin remained stable for the study period (24%-25%), while the mean incidence of new cases of MRSA decreased from 0.65 to 0.54 cases per 1000 patient-days (p=NS) and the mean incidence of MRSA bacteremia decreased from 0.06 to 0.05 cases per 1,000 patient-days (p=NS).

The implementation of a MRSA surveillance system in hospitals that participated in the VINCat Program provides information on the situation of each institution and facilitated interhospital comparisons in order to establish appropriate preventive measures.

Vigilancia de *Staphylococcus aureus* resistente a la meticilina en los hospitales de agudos. Resultados del Programa VINCat (2008-2010)

Palabras clave:
Staphylococcus aureus
Resistencia a la meticilina
Vigilancia
Infección nosocomial
Infecciones relacionadas con el sistema sanitario
Bacteriemia

R E S U M E N

Staphylococcus aureus resistente a la meticilina (SARM) es una etiología frecuente de las infecciones relacionadas con el sistema sanitario. La vigilancia y prevención de SARM es una prioridad en los programas de control de infección. La finalidad de este estudio es describir las tasas de resistencia y la tendencia en casos de colonización/infección por SARM en los 40 hospitales participantes del programa de vigilancia VINCat durante el periodo 2008-2010.

Se incluyeron los pacientes ingresados en las unidades de agudos de los hospitales participantes. Dichos hospitales fueron estratificados en 3 grupos según el número de camas. Se estudiaron los siguientes indicadores anuales: tasa de resistencia a la meticilina, tasa de incidencia de casos nuevos de SARM y tasa de incidencia de bacteriemia por SARM.

Durante el período de estudio, la tasa de resistencia a la meticilina se mantuvo estable (24-25%), mientras que la incidencia de casos nuevos de SARM descendió de 0,65 a 0,54 casos por 1.000 pacientes-día y la de bacteriemia por SARM de 0,06 a 0,05 casos por 1.000 pacientes-día, ambas diferencias no significativas.

La implementación de un sistema de vigilancia de SARM en los hospitales participantes en el Programa VINCat ha proporcionado información relevante a cada institución, facilitando la comparación interhospitalaria y el establecimiento de medidas preventivas.

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☆A detailed list of the members is available at additional data of the electronic version of the supplement.

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Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a common cause of healthcare-related infections. In recent years, an increase has been reported in the number of cases believed to originate in the community.[1] The prevalence of MRSA in Europe is unevenly distributed, from countries such as Holland, Norway and Denmark, where the prevalence is lower than 5%, to countries in Southern Europe such as Greece, France and Spain, where the rates are greater than 25%.[2-4]

The prevalence of MRSA in Spanish hospitals was established by studies performed by the Spanish Group for the Study of Staphylococci. The resistance of *S. aureus* to methicillin went from 1.5% in 1989 to 29.2% in 2006. MRSA spread from large to small hospitals, with a 28.6% MRSA rate in 2006 for hospitals with <500 beds and a 29.8% rate for larger hospitals.[5] Moreover, a study performed in 2000 on patients with bacteremia in 31 Spanish hospitals showed an oxacillin resistance percentage of 28%.[6]

Surveillance and prevention of MRSA infection is a priority in nosocomial infection control programs.[1,7,8] The implementation of an MRSA infection surveillance system in hospitals provides information on the situation in each institution, helps to establish appropriate control measures and assists in analyzing the results of their implementation. In addition, the determination of the incidence of MRSA helps to assess the effectiveness of various infection control programs, such as hand hygiene.[9]

Various methods have been used to calculate the incidence of MRSA infection and colonization, although most have certain drawbacks. The most common are the percentage of MRSA isolates in relation to total *S. aureus* cases and the incidence of MRSA in relation to stays in the institution. The first is inexpensive but does not provide information on the burden of MRSA on the hospital or of its origin, and it depends on the number and type of samples studied in each institution. The second method helps record new cases of MRSA, including nosocomial ones.

The aim of this study was to describe the evolution of MRSA infection rates recorded in hospitals that participated in the VINCat Program during the period 2008-2010.

Material and Methods

Longitudinal descriptive study performed over 3 years, for the period 2008-2010.

Participating institutions

The study was performed in hospitals in the VINCat Program that have an infection control team (ICT) and that are structured according to the size of the hospital. The hospitals were stratified according to size into three groups: group 1 (G1), with more than 500 beds; group 2 (G2), between 200 and 500 beds; and group 3 (G3), with less than 200 beds.

Study population

The study population consisted of patients treated in any acute care area of the hospital. Patients hospitalized in palliative care and convalescence units were excluded. The rate was calculated annually (from January 1 to December 31).

Definitions

Cases of methicillin-resistant *Staphylococcus aureus* (MRSA) were determined based on antimicrobial susceptibility reports provided by the microbiology laboratory during each period. We only included unduplicated isolated strains during each period from samples obtained for clinical purposes, regardless of their clinical value (colonization or infection) and the location of acquisition. We did not include samples from active surveillance of carriers.

Surveillance indicators

The following basic (MRSA rates) and optional (incidence of new cases of MRSA and incidence of MRSA bacteremia) indicators were studied.

Methicillin-resistance rate

The calculation of the MRSA rate was obtained using the number of patients with positive MRSA culture (we counted the first MRSA isolate per patient in each period) in the numerator and the number of patients with positive *S. aureus* culture susceptible or resistant to methicillin in each period in the denominator.

Formula: No. patients with MRSA x 100 / No. patients with *S. aureus.*

Incidence density of new MRSA cases

We considered new MRSA cases to be those in which the patient was colonized or infected by the microorganism and was not a previously known case in the hospital registry.

The calculation of the incidence density of new MRSA cases was derived from the number of new MRSA cases (hospital-acquired or not) in the numerator and the number of days of hospitalization during the surveillance period, including those for adults and children, in the denominator.

Formula: No. new MRSA cases x 1000 / No. days of hospitalization during the study period.

Incidence density of MRSA bacteremia

MRSA bacteremia was considered to be any episode of clinically significant MRSA bacteremia (one episode per patient), of any focus and location of acquisition, which was detected in the microbiology laboratory of the hospital itself.

The calculation of the incidence density of MRSA bacteremia was derived from the number of MRSA bacteremia cases within each period (hospital-acquired or not) in the numerator and the number of days of hospitalization during the surveillance period, including those for adults and children, in the denominator.

Formula: No. MRSA bacteremia cases x 1000 / No. days of hospitalization during the study period.

Data collection process

Each hospital sent the data annually to the VINCat coordination center that collected, reviewed and analyzed the data. The center then sent reports to the hospitals containing the data for each institution and the aggregated data from the various hospitals.

Statistical analysis

We calculated the annual means for each indicator by hospital group and overall.

Ethical aspects

Participation in the VINCat Program is voluntary and data confidentiality is guaranteed by VINCat.

Results

There were 38 participating institutions in 2008 and 2010 and 40 in 2009. All participating institutions collected MRSA rates, as this was a mandatory indicator, while the incidence of new MRSA cases

Table 1
Evolution of the annual mean rate (2008-2010) of methicillin resistance, overall and by hospital group

	2008			2009			2010		
		Resistance rate			Resistance rate			Resistance rate	
	N	%	(Range)	N	%	(Range)	N	%	(Range)
Overall	38	24	(0-64)	40	25	(7-50)	38	24	(11-53)
Group 1	9	24	(19-28)	7	23	(20-28)	8	23	(19-28)
Group 2	14	24	(5-47)	14	22	(7-44)	9	19	(11-25)
Group 3	15	21	(0-32)	19	28	(7-50)	21	26	(12-43)

*Proportion of methicillin-resistant *S. aureus*.
N: number of participating hospitals; Group 1: hospitals with more than 500 beds; Group 2: hospitals with between 200 and 500 beds; Group 3: hospitals with less than 200 beds.

Table 2
Evolution of the annual mean incidence (2008-2010) of new MRSA* cases, overall and by hospital group

	2008			2009			2010		
		Incidence			Incidence			Incidence	
	N	ID	(Range)	N	ID	(Range)	N	ID	(Range)
Overall	35	0.65	(0.15-3.93)	36	0.58	(0.05-1.81)	32	0.54	(0.14-0.98)
Group 1	7	0.55	(0.30-0.84)	6	0.49	(0.30-0.73)	5	0.52	(0.36-0.68)
Group 2	13	0.46	(0.15-0.68)	13	0.43	(0.05-0.80)	10	0.53	(0.23-0.98)
Group 3	14	0.91	(0.16-3.77)	17	0.73	(0.27-1.81)	17	0.54	(0.14-0.83)

*New cases of MRSA per 1000 hospital stays.
N: number of participating hospitals; ID: incidence density of new cases; Group 1: hospitals with more than 500 beds; Group 2: hospitals with between 200 and 500 beds; Group 3: hospitals with less than 200 beds.

Table 3
Evolution of the annual mean incidence (2008-2010) of MRSA* bacteremia episodes, overall and by hospital group

	2008			2009			2010		
		Incidence			Incidence			Incidence	
	N	ID	(Range)	N	ID	(Range)	N	ID	(Range)
Overall	28	0.06	(0.00-0.17)	35	0.03	(0.00-0.15)	36	0.05	(0.00-0.38)
Group 1	7	0.07	(0.05-0.10)	5	0.06	(0.03-0.09)	6	0.08	(0.05-0.13)
Group 2	9	0.06	(0.02-0.14)	13	0.03	(0.01-0.07)	10	0.02	(0.00-0.06)
Group 3	12	0.05	(0.00-0.17)	17	0.03	(0.00-0.15)	20	0.05	(0.00-0.38)

*MRSA bacteremia episodes per 1000 hospital stays.
N: number of participating hospitals; ID: incidence density of MRSA bacteremia; Group 1: hospitals with more than 500 beds; Group 2: hospitals with between 200 and 500 beds; Group 3: hospitals with less than 200 beds.

and the incidence of MRSA bacteremia was recorded in slightly lower number of hospitals. Distribution by hospital group and indicators are shown in Tables 1-3.

The evolution of the annual mean rate of methicillin resistance, overall and by hospital group, remained fairly stable during the study period and in the various groups, as shown in Table 1. The results of the annual mean incidence density of new MRSA cases and the evolution of the annual mean incidence of MRSA bacteremia per 1000 stays, overall and by hospital group, are shown in Tables 2 and 3.

Discussion

Surveillance is the cornerstone of control programs for all antibiotic-resistant microorganisms, including MRSA. The surveillance system of the VINCat Program helps to establish the baseline rates of MRSA and understand its evolution over time. It also allows each hospital to compare itself to other institutions with similar characteristics and monitor the effect of established control measures.

By analyzing range of rates of the three study indicators, significant differences were observed among hospitals within each group. The differences were less pronounced among the larger hospitals, with greater variation among the medium-sized hospitals and especially among those with less than 200 beds.

The overall rate of resistance of *S. aureus* to methicillin remained stable (24%-25%) for the study period (2008-2010), as with hospitals in G1 (23%-24%). In G2, we observed a reduction in the MRSA rate (from 24% in 2008 to 19% in 2010), while in G3 there was an increase in this rate (from 21% in 2008 to 26% in 2010). The differences may be partially explained by the characteristics of the patients treated in each institution and the various patient flows between the participating hospitals and the health centers and long-stay residences, taking into account the high rates of MRSA colonization in these institutions.[10] Furthermore, this indicator varies with the number of methicillin-susceptible *S. aureus* isolates in each institution. It is difficult to compare these data with those from the rest of Spain and Europe because they use different indicators. According to data from the Nosocomial Infection Prevalence Study in

Spain (EPINE), the percentage of MRSA cases among all cases of *S. aureus* in nosocomial infections decreased from 48% in 2008 to 43% in 2010.[11] According to the European Antibiotic Resistance Surveillance System (EARSS), the percentage of MRSA in bacteremia cases among all cases of *S. aureus* in 2010 ranged from <1% in Scandinavian countries to >50% in Portugal, with a rate of 25% in Spain.[12]

The overall mean incidence of new MRSA cases in hospitals that participate in the VINCat Program decreased slightly from 2008 to 2010 (from 0.65±0.65 to 0.54±0.20 cases per 1000 stays) and was fairly similar in the three hospital groups in 2010 (0.52-0.54). By hospital group, this incidence remained stable in G1 (0.54-0.55), increased in G2 (from 0.46 to 0.53) and decreased in G3 (from 0.91 to 0.54). However, these variations in the smaller hospitals must be interpreted with caution because minor variations in the number of cases may produce major changes in the rates. This indicator does not provide information on the relative weight of new cases originating in the institution itself (nosocomial) or those from health centers. The program intends to incorporate a new indicator, the incidence of new cases of nosocomial MRSA, which would guide and analyze the efficacy of MRSA prevention and control programs. The overall mean incidence rates of new MRSA cases recorded by the VINCat program are somewhat greater than those reported in 2007 by a French multicenter study (0.44/1000 stays). The authors observed a reduction in the incidence of MRSA recorded in 2001 (0.9 cases/1000 stays) after the promotion of the use of alcoholic solutions for hand hygiene.[13]

The mean overall incidence of MRSA bacteremia decreased slightly between 2008 and 2010 (from 0.06 to 0.05). This reduction was more pronounced in G2 hospitals (from 0.06 in 2008 to 0.02 in 2010). It is possible that this reduction in the incidence of MRSA bacteremia was partly due to the implementation of nosocomial MRSA control programs, in particular those for catheter-related bacteremia.[14]

In 2008, the European Antimicrobial Resistance Surveillance System (EARSS) reported a mean incidence of 0.048 MRSA bacteremia episodes per 1000 stays. There were large variations between Northern European countries (<0.01) and Portugal, with 0.28 episodes/1000 stays. Spain had an incidence of 0.07 episodes/1000 stays.[15] These differences may be due to the volume of cases with nosocomial origin and the MRSA prevention and control measures adopted by the various countries.

The proposed indicators provide information on the evolution over time of the volume of MRSA infection in each hospital, including cases from other hospitals, health centers and the community. This information helps adapt the preventive measures to each situation.[16]

Starting in 2012, the addition of a new indicator of the incidence of new cases of MRSA acquired in the hospital itself will allow the program to assess the impact of control and prevention measures introduced in each hospital.

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Conflicts of Interest

All authors declare that they have no conflicts of interest in this article.

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