

## Prevalence of methicillin-resistant *Staphylococcus aureus* in a University Hospital in the South of Brazil

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Methicillin-resistant *Staphylococcus aureus* (MRSA) stand out as one of the main agents causing nosocomial and community infections. This retrospective study aimed to analyze the MRSA predominance in a university hospital in the south of Brazil and it was carried out for five years (from 2007 to 2011). 616 MRSA (33,3% of the total) were isolated and an important reduction in the MRSA predominance was observed along the study. Although it was registered a reduction in the MRSA predominance, male adult patients (41-70 years old), who were in the Medical Clinic and Adult ICU, had the highest infection rates and concerning MRSA isolates rates, these were higher in blood and tracheal aspirates. In conclusion, studies of this type are becoming relevant to recognize pathogens like MRSA and to determine its predominance.

**Uniterms:** *Staphylococcus aureus*/methicillin-resistant. Resistant pathogens. Methicillin. University hospitals/infection.

*Staphylococcus aureus* resistentes à meticilina (MRSA) destacam-se mundialmente como um dos mais frequentes patógenos nosocomiais e comunitários. Este estudo retrospectivo teve por objetivo analisar a prevalência de MRSA em um hospital universitário no sul do Brasil. Durante cinco anos (2007 a 2011), 616 MRSA (33,3% do total de *S. aureus*) foram isolados, sendo que sua frequência de isolamento apresentou considerável redução no decorrer do estudo. Nossos resultados demonstraram que as maiores taxas de isolamento dos MRSA ocorreram em amostras de sangue e secreção traqueal. As infecções prevaleceram em pacientes adultos (41 a 70 anos), do sexo masculino, internados na Clínica Médica e UTI adulto. Estudos como este se tornam importantes para o reconhecimento de patógenos resistentes, como o MRSA, e para a determinação da sua prevalência.

**Unitermos:** *Staphylococcus aureus*/resistentes à meticilina. Patógenos resistentes. Meticilina. Hospital universitário/infecções.

### INTRODUCTION

*Staphylococcus aureus* is worldly known as one of main responsible agents, which cause a wide number of infections including septicemia, pneumonia, skin and

soft tissues infections (Dong *et al.*, 2013). It is considered an important etiological agent in nosocomial infections as well as in ones acquired in the community (François *et al.*, 2007). The occurrence of methicillin-resistant *Staphylococcus aureus* strains has become a great challenge due to its prevalence in hospital environment infections as well as in community infections (Boucher, Corey, 2008).

MRSA was firstly reported in hospitals (healthcare-associated MRSA - HA-MRSA) in the United Kingdom

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in 1961 and after that, it spread to many other health institutions all over the world (Jevons, 1961; Deurenberg *et al.*, 2007). Regarding hospital environment, the MRSA colonization or infection was associated to risk factors like recent surgery, in hospital patients, chronic diseases and presence of a catheter among others.

After two decades, the first MRSA cases acquired in the community were reported (CA-MRSA) (Saravolatz *et al.*, 1982; Saravolatz, Pohlod, Arking, 1982) and since 1990 an increase in the infection occurrence caused by CA-MRSA has been reported in many countries (Deurenberg *et al.*, 2007; Skov *et al.*, 2012). The emergence of infections caused by this microorganism, when risk factors are absent, marked the beginning of a public health problem (Sdougkos *et al.*, 2008).

In Europe, the MRSA are well known among the multiresistant bacteria, which are the most involved in infections related to health assistance (European Centre for Disease Prevention and Control, European Medicines Agency, 2009). Considering United States and Latin America, this microorganism constitutes the main bacterial agent involved in nosocomial infections also presenting a growing involvement in the prevalence of infections in the community (Wallin, Hern, Frazee, 2008; Guzmán-Blanco *et al.*, 2009).

This study aims to determine the MRSA prevalence in different clinical samples making use of a retrospective analysis of bacteriological tests carried out in a tertiary university hospital.

## MATERIAL AND METHODS

This retrospective study was carried out through a research in the Microbiology Laboratory database of the University Hospital of Santa Maria (HUSM), which has 37 beds for intensive care and 291 beds for admission, in the city of Santa Maria, south of Brazil. This hospital is a tertiary one, which provides medical assistance for 30 cities from the central region of Rio Grande do Sul (RS) state.

The data of all cultures where *S. aureus* growing was observed from January 1<sup>st</sup>, 2007 to December 31<sup>st</sup>, 2011 were analyzed.

### Inclusion criteria of MRSA samples

It was considered as MRSA all *S. aureus* isolates, which presented resistance to oxacillin and/or ceftazidime. Such consideration was carried out through conventional phenotypic methodology, through disk diffusion technique (Kirby-Bauer), and the isolates were confirmed through

automated phenotypic methodology (MicroScan® – Siemens), according to the standards established by the Clinical and Laboratory Standards Institute (CLSI) prevailing in each year.

In this study, only the first bacterial sample of *S. aureus* isolates from each patient was used.

### Ethics Committee

This study was submitted to the Research Ethics Committee (CEP) of the Federal University of Santa Maria and it was approved under the number 0117.0.243.000-08.

### Statistical Analysis

The experimental data were evaluated through Chi-Square test where a value of  $p < 0,05$  was considered statistically significant.

## RESULTS

This study was carried out for five years (2007 to 2011). During this time 1.852 samples of *S. aureus* were isolated and 616 (33.3%) were oxacillin-resistant (MRSA). The MRSA prevalence as well as the oxacillin-sensitive *S. aureus* (MSSA) according to each year can be observed on Table I. The annual MRSA prevalence is shown on Figure 1.

The distribution of MRSA isolates was predominantly in male patients (Figure 2).

Regarding age groups during all study period, it was registered a bigger predominance among patients with ages between 41-70 years (258/594) (Table II). The age of the patient was not registered in 22 cases.

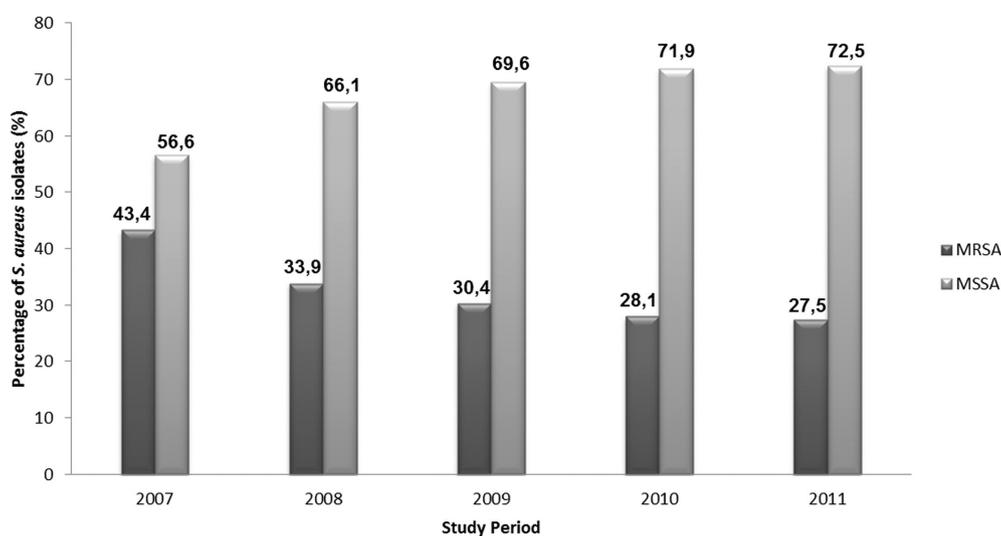
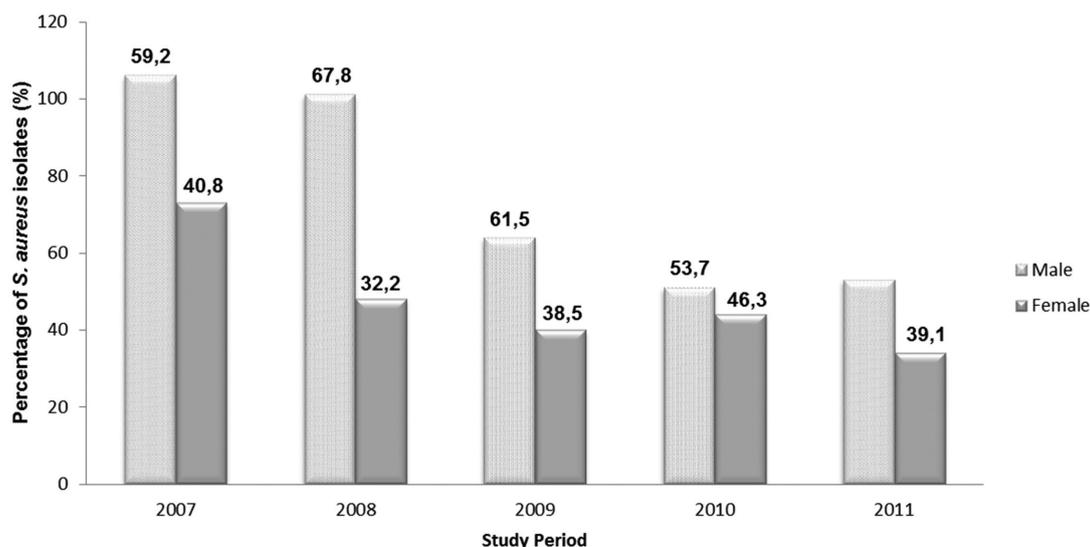
The hospital units, which registered bigger predominance of MRSA isolates, were arranged in a descending order, as it can be seen on Table III. The order is: Medical Clinic (99/608), Adult Intensive Care (ICU) (92/608), Ambulatory (79/608), Adult Emergency (77/608) and Clinical Surgery (76/608). It was found 8 clinical records without the register concerning which hospital unit the patient was.

The clinical materials where MRSA isolates had predominance were: blood (104/16.9%), tracheal aspirates (102/16.5%), urine (64/10.4%), sputum (54/8.7%), secretion of surgical wound (50/8.1%) and secretion of lower limb (48/7.8%). 195 isolates (31.6%) came from other clinical samples as: catheter tip, tracheal aspirates, bronchoalveolar lavage, cerebrospinal fluid, among others. Figure 3 displays the biological materials, which had more prevalence of MRSA isolates.

**TABLE I** – Prevalence of MRSA and MSSA isolates at HUSM, from 2007 to 2011

	MRSA		MSSA		Total (%)	Total of positive cultures at LAC
	n (total)	%	n (total)	%		
2007	181	43,4	236	56,6	417 (100)	3.642
2008	149	33,9	290	66,1	439 (100)	4.320
2009	104	30,4	238	69,6	342 (100)	3.993
2010	95	28,1	243	71,9	338 (100)	3.958
2011	87	27,5	229	72,5	316 (100)	4.864
Total	616		1.236		1.852	20.777

LAC = Laboratory of Clinical Analysis.

**FIGURE 1** – Prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-sensitive *Staphylococcus aureus* (MSSA) isolates at HUSM from 2007 to 2011.**FIGURE 2** – Distribution of patients with infections caused by MRSA at HUSM from 2007 to 2011 according to gender.

**TABLE II** – Age groups of MRSA isolates (2007 to 2011) at HUSM

Age	2007	2008	2009	2010	2011	Total
≤ 10 years old	21	15	14	10	14	74
11 – 40 years old	49	36	39	18	25	167
41 – 70 years old	67	70	29	48	44	258
≥ 71 years old	35	24	19	13	4	95
<b>Total</b>	<b>172</b>	<b>145</b>	<b>101</b>	<b>89</b>	<b>87</b>	<b>594</b>

**TABLE III** – MRSA isolates according to Hospital Units, in the years of 2007 to 2011

Hospital Unit	2007	2008	2009	2010	2011	Total (%)
Medical Clinic	27	32	15	15	10	<b>99 (16.28)</b>
Adult ICU*	31	23	15	14	9	<b>92 (15.13)</b>
Ambulatory	22	15	16	12	14	<b>79 (13.00)</b>
Adult Emergency	25	15	12	16	9	<b>77 (12.67)</b>
Clinical Surgery	27	19	10	11	9	<b>76 (12.50)</b>
UTI RN**	10	4	4	5	6	<b>29 (4.77)</b>
Nephrology	6	9	3	3	2	<b>23 (3.78)</b>
ICU Pediatric	6	7	3	1	3	<b>20 (3.29)</b>
Obstetric Center	4	2	4	2	4	<b>16 (2.63)</b>
Oncology Unit	4	5	4	-	3	<b>16 (2.63)</b>
Obstetric and Gynecologic Unit	1	1	7	2	3	<b>14 (2.30)</b>
Surgery Unit	4	4	1	1	3	<b>13 (2.14)</b>
CTCriaC***	2	2	1	2	4	<b>11 (1.81)</b>
Recovery Room	2	3	3	2	1	<b>11 (1.81)</b>
Pediatric Unit	1	3	-	2	3	<b>9 (1.48)</b>
Pediatric Emergency	2	2	1	1	2	<b>8 (1.31)</b>
Intensive Coronary Care Unit	2	1	-	1	-	<b>4 (0.66)</b>
CTMO <sup>+</sup>	-	1	-	1	1	<b>3 (0.50)</b>
Hemato-Oncology	1	-	-	1	1	<b>3 (0.50)</b>
SID <sup>++</sup>	1	-	1	-	-	<b>2 (0.33)</b>
Psychiatric Unit	-	-	1	1	-	<b>2 (0.33)</b>
Radiotherapy	1	-	-	-	-	<b>1 (0.16)</b>
<b>Total</b>	<b>179</b>	<b>148</b>	<b>101</b>	<b>93</b>	<b>87</b>	<b>608 (100)</b>

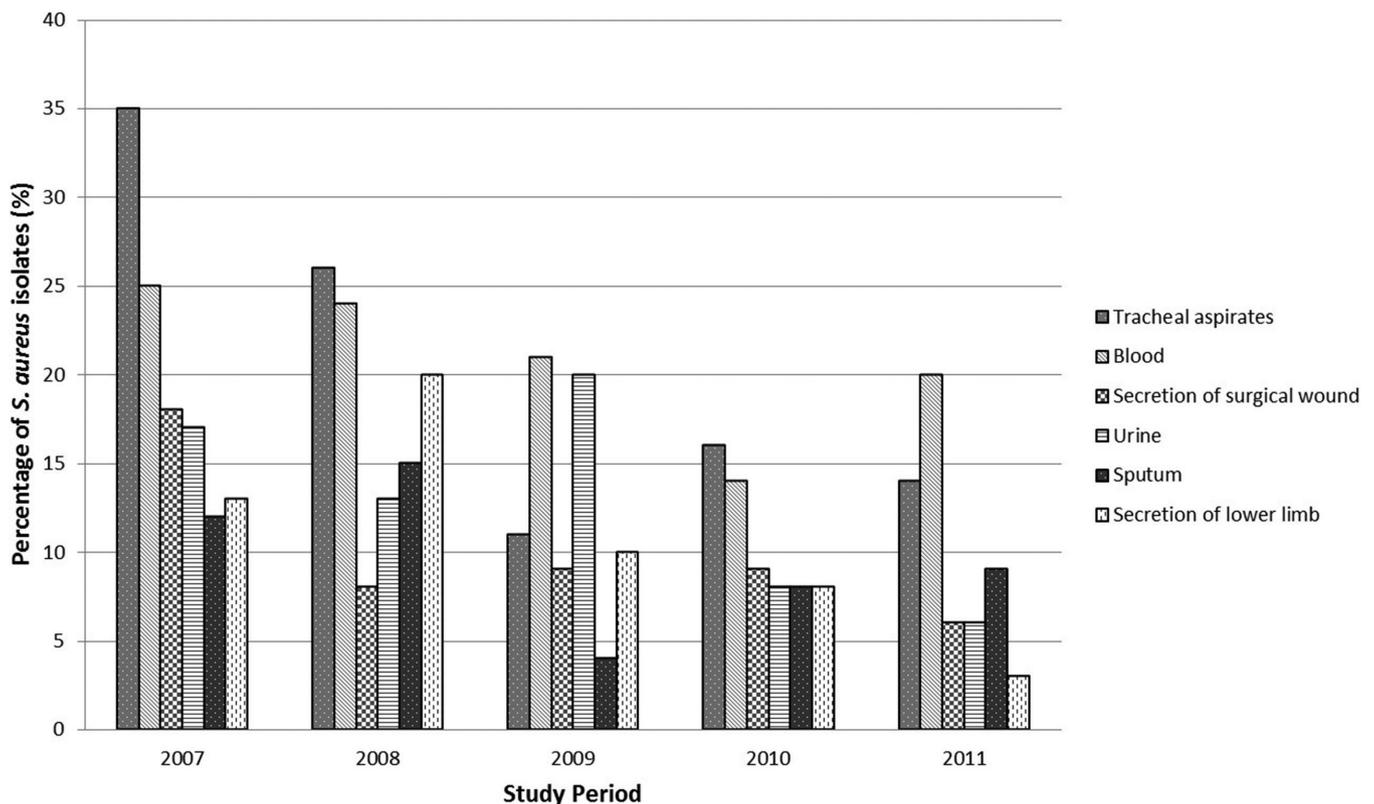
ICU\* – Intensive Care Unit; UTI RN\*\* - Intensive Care Unit for Newborns; CTCriaC\*\*\* – Center for Treatment of Infant Cancer; CTMO<sup>+</sup> – Center for Bone Marrow Transplant; SID<sup>++</sup> – Home Care Service

## DISCUSSION

MRSA are the main responsible agents, which cause nosocomial infections all over the world (Japoni *et al.*, 2010). In Brazil, the MRSA prevalence varies according to the regions and to the clinical material from which this important pathogen is isolated, presenting rates between 44% to 56% (Ferreira *et al.*,

2009; Carvalho, Mamizuka, Gontijo Filho, 2010). In the European Community, the MRSA reach different rates among its countries having less than 1% to more than 24% (Dulon *et al.*, 2011; European Centre for Disease Prevention and Control, European Medicines Agency, 2009), however, in the USA these rates can reach 38.2% (Jarvis, Jarvis, Chinn, 2012).

During the five years of study, the MRSA prevalence



**FIGURE 3** – Distribution of clinical samples with more prevalence of MRSA isolates at HUSM from 2007 to 2011.

average rate at HUSM was 33.3% and similar rate to the one found in this work with an index equal or higher than 25% is found in data from the European Antimicrobial Resistance Surveillance System (2009), in countries like Greece, Italy, Bulgaria, Turkey and Spain.

It was also found a significant reduction (approximately 40%) in the MRSA prevalence rates decreasing its percentage of 43.4% in 2007 to 27.5%, in 2011 ( $p < 0.05$ ). Such reduction at HUSM was due possibly to the work of the Committee on Hospital Infection Control, which since 2006 has established actions as discontinuation of antibiotic therapy and professional training and a more rigid antimicrobial distribution aiming at reducing these rates. Programs of prevention and control of the MRSA carried out in some hospitals in the European Community have become priority to public health and have reached satisfactory results due to the reduction in the MRSA infection rates in these countries (Köck *et al.*, 2010).

When genders are compared, it was observed that a small prevalence of MRSA infections happen with men. Such data was registered in all years of the study period (Figure 2) having an average rate of 60.6%. Such results are similar to the ones found by Mahmood *et al.* (2010) in Pakistan between 2005 and 2009 and by Jarvis, Jarvis,

Chinn (2012) in the USA. Both teams verified that 58% and 52.2% of patients hospitalized with MRSA were men respectively.

Although the majority of the infection cases happen with 41 to 70 year-old adults (Table II), in 2009 was registered a higher number of MRSA isolates in adolescents and young adults (11-40 year-old patients). The highest infection predominance in adults and mainly with elderly people is due to their vulnerability because they are more frequently exposed to excessive manipulation and invasive procedures (Souza, Figueiredo, 2008). Patients infected by MRSA belonging to the same age group were also reported in other studies (Mahmood *et al.*, 2010; Souza, Figueiredo, 2008).

According to the hospital unit, the Medical Clinic followed by the Adult ICU were the ones which presented the highest index, representing respectively 16.3% and 15.1% of the total MRSA isolates. The Ambulatory (13.0%), Adult Emergency (12.7%) and Clinical Surgery (12.5%) also reached relevant MRSA isolates rates at HUSM. Other authors in Brazil as well as in the USA also report higher MRSA prevalence in ICUs, as it was reported in our study (Souza, Figueiredo, 2008; Jarvis, Jarvis, Chinn, 2012). This data is justified by the fact that patients in ICUs are frequently submitted to medical

and therapeutic interventions, it is applied a big number of invasive medical devices and besides it is employed multiple therapies that can trigger the development of a MRSA infection (Verdier *et al.*, 2006). Furthermore, data from the National Nosocomial Infections Surveillance of the Center for Disease Control and Prevention (CDC) in the USA show that since 1999, the MRSA prevalence rates are beyond 50% among patients in ICUs (Moura *et al.*, 2007).

The clinical materials, which presented the biggest number of MRSA isolates were blood, tracheal aspirates, urine, sputum, secretion of surgical wound and secretion of lower limb. In the USA and in some European countries, the incidence of bacteremia caused by MRSA has increased in the last years (Shorr, Lodise, 2006). According to a study carried out in Iran, in 2007, Japoni *et al.* (2010) reported a bigger number of MRSA isolates in blood, sputum and wound samples while Mahmood *et al.* (2010) reported a bigger incidence in sputum samples. In Brazil, Souza, Figueiredo (2008) in 2008, at the Regional University Hospital of Maringá found a bigger incidence of MRSA isolates in catheter tips and tracheal secretion.

## CONCLUSION

This research found out that the MRSA prevalence rate showed substantial reduction from 2007 to 2011 and such reduction is possibly related to the collective construction of a MRSA prevention and control “bundle” guided by the practical criteria of the Committee on Hospital Infection Control at HUSM.

Infections caused by MRSA constitute an important world challenge in the public health system knowledge concerning MRSA prevalence rates at the University Hospital of Santa Maria together with the effective actions, concerning MRSA infections, registered by the Committee on Hospital Infection Control has a direct impact on the health system of our country in terms of morbidity, mortality and financial costs.

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