Nasal carriage of methicillin-resistant *Staphylococcus aureus* in university students

**ABSTRACT**

In a study of university students, the percentage nasal carriage of *Staphylococcus aureus* was 40.8% (102/250). Of the isolates, MIC$_{50}$ of methicillin was 0.5 µg/mL and MIC$_{90}$ was 1 µg/mL. Six (5.8%) isolates were methicillin-resistant and carried the *mecA* gene. These results suggest that community-associated methicillin-resistant *S. aureus* may be spreading in Brazil.

Keywords: nasal carriage, CA-MRSA, *S. aureus*.


Methicillin-resistant *Staphylococcus aureus* (MRSA) is an important cause of health care-associated infections worldwide. In recent years, cases of MRSA infection have been reported more frequently in healthy community individuals with no traditional risk factors for MRSA infection. These infections, apparently acquired in the community, are termed community-associated MRSA infections.

Community-associated MRSA (CA-MRSA) strains differ from health care-associated (HA) MRSA strains in terms of epidemiology, microbiology, and clinical manifestations. CA-MRSA strains are generally susceptible to most antibiotics, contain staphylococcal chromosome cassette *mecA* type IV, produce the virulence factor Panton-Valentine leukocidin, and cause mainly skin and soft-tissue infections.

It is well recognized that nasal carriage of MRSA represents a major risk factor for subsequent infection and transmission of this pathogen. Although several studies have reported the prevalence of MRSA nasal carriage in patients in health care-settings, this subject has been little investigated in healthy individuals in the broader community, and is practically unstudied in Brazil.

In this study, we determined the prevalence of nasal carriage of *S. aureus* in university students. Antibiotic susceptibility patterns, minimal inhibitory concentration to methicillin, and *mecA* gene detection of the isolates were included.
assessed by disk-diffusion tests, according to the Clinical Laboratory Standards Institute guidelines.10,11 The following antimicrobial disks were used: penicillin (10 U), oxacillin (1 μg), ciprofloxacin (5 μg), gentamicin (10 μg), amikacin (30 μg), telithromycin (15 μg), linezolid (30 μg), trimethoprim-sulfamethoxazole (1.25-23.75 μg), and vancomycin (30 μg). All the disks were obtained from Oxoid (Oxoid, Basingstoke, UK). A mupirocin (5 μg) disk (Oxoid) was also tested, according to Finlay et al. (1997).12

Minimal inhibitory concentration (MIC) – MIC to oxacillin was assessed by both E-test® oxacillin strips (AB-Biodisk, Solna, Sweden) according to the manufacturer’s instructions, and the agar dilution method as recommended by the Clinical Laboratory Standards Institute.11,13

Detection of mecA by polymerase chain reaction (PCR) – One hundred and two strains of S. aureus were analyzed by PCR assay, using total DNA after boiling the bacterial cells. The mecA gene was detected using mecA sense 5’TGGCTATCGTGTCACAATCG3’ and mecA antisense 5’CTGGAACCTTGTTGACGAG3’ primers. Cycling parameters were 94°C for 5 min followed by 30 cycles of 94°C for 30 sec, annealing at 52°C for 30 sec, extension at 72°C for 30 sec, and a final 7 min incubation at 72°C. The amplification products (309 bp) were analyzed by electrophoresis in 1% agarose gel stained with ethidium bromide.

S. aureus was isolated from nasal swabs of 102 (40.8%) of the 250 volunteers, and six (2.4%) of them were CA-MRSA carriers. None of the volunteers had any identified risk factor.

Recovery of S. aureus strains from volunteers’ nostril by direct plating on MSA was 26.8% (67 of 250), and by enrichment broth was 40.8% (102 of 250). All the volunteers detected as nasal carriers of S. aureus by the MSA method, were also detected by the enrichment broth method.

All the 102 strains of S. aureus were sensitive to vancomycin, telithromycin, linezolid, gentamicin, and trimethoprim-sulfamethoxazole. Resistance to penicillin G, ciprofloxacin, oxacillin, and amikacin was found in 92.0%, 8.8%, 5.8%, and 4.0% of the strains, respectively. Mupirocin resistance was detected in 6 of 102 (5.8%) isolates, which were sensitive to oxacillin.

Of the 102 strains, the minimal inhibitory concentration to oxacillin ranged from 0.06 μg/mL to 256 μg/mL, and MIC50 and MIC90 were 0.5 μg/mL and 1.0 μg/mL, respectively. Six strains (5.88%) showed MIC ≥ 32 μg/mL and carried the mecA gene, and were therefore considered CA-MRSA. Two CA-MRSA strains were recovered only by the enrichment broth method. E-test® and agar dilution methods gave similar results.

The prevalence of S. aureus nasal carriage varies according to the quality of sampling, culture techniques, and the population studied.12 Early cross-sectional surveys on nasal carriage demonstrated a mean carriage rate of 37.2%.3 More recent studies have reported rates of approximately 27% in healthy adult populations.6,14 Two studies with pre-clinical medical students showed that 35.2% and 29% were S. aureus nasal carriers.15,16 Our results are consistent with these findings.

Although CA-MRSA emerged as a cause of infection in the community in the 1990s, the first report of infections caused by this microorganism in Brazil was published in 2005.17 Our study found the prevalence of CA-MRSA nasal carriage in our student community to be 2.4%, which is higher than the findings of similar studies by investigators outside Brazil.5,10,18

In cross-sectional studies, the choice of the microbiological method used for S. aureus carriage detection is important, because the nasal culture is done only once. The enrichment broth method has been recommended to increase the sensitivity of detection of MRSA carriage.19 In our study, two of the six CA-MRSA strains were isolated only by the enrichment broth, and the use of this method resulted in improved recovery rates of 14%.

As expected, all the S. aureus isolates, including the six CA-MRSA, were susceptible to most of the antimicrobial agents tested. Although most of these strains were sensitive to oxacillin, their MIC50 and MIC90 were near the resistance breakpoint to oxacillin (i.e., MIC ≥ 4 μg/mL), suggesting less potency and antimicrobial activity of this drug. This finding may be important for developing therapies for staphylococcal diseases.

In respect to mupirocin, the heavy growth with no visible zone of inhibition around the mupirocin disk observed in six S. aureus isolates may indicate a high level of resistance (i.e., MIC ≥ 1,024 μg/mL) to this drug.20 This fact is worrisome because mupirocin is widely used for prevention of S. aureus intranasal colonization.3

Our results showed that all strains resistant to oxacillin by phenotypic methods carried the mecA gene. This was not observed in the oxacillin-sensitive S. aureus strains.

In conclusion, the results of this study showed that S. aureus nasal colonization is common in our student community, and suggest that CA-MRSA may be spreading in Brazil.

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REFERENCES


