

<http://dx.doi.org/10.1590/0104-07072017000400016>

STAPHYLOCOCCUS AUREUS IN NURSING PROFESSIONALS AND THE MICROORGANISM'S SUSCEPTIBILITY PROFILE TO ANTIMICROBIALS¹

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¹ Study carried out with support from the *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq), under protocol no. 476480/2012.

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ABSTRACT

Objective: to identify the carrier's state and the susceptibility profile of *Staphylococcus aureus* isolated from saliva and nasal secretion of nursing professionals to antibiotics.

Method: cross-sectional study that used saliva and nasal secretion samples of 100 nursing professionals who provide care for patients with HIV/Aids.

Results: forty-three percent of the participants presented positive saliva or nasal secretion samples for *Staphylococcus aureus*. Of the 74 nasal secretion samples with *Staphylococcus aureus*, 14.9% presented oxacillin resistance; 91.9% presented penicillin resistance; 44.6% presented erythromycin resistance, and 41.9% presented clindamycin resistance. Of the 12 positive saliva samples, 16.7% presented oxacillin resistance; 100.0% presented penicillin resistance; 33.4% presented erythromycin resistance, and 25.0% presented clindamycin resistance.

Conclusion: nursing professionals, once aware of their carrier state of multi-resistant microorganisms, will supervise their care practices and more efficiently adopt measures for prevention and control of the epidemiological chain of these bacteria in their work environment.

DESCRIPTORS: Bacteria. *Staphylococcus aureus*. Methicillin resistance. Anti-bacterial agents. Nursing. Nursing staff.

STAPHYLOCOCCUS AUREUS EM PROFISSIONAIS DE ENFERMAGEM E O PERFIL DE SUSCETIBILIDADE DO MICROORGANISMO AOS ANTIMICROBIANOS

RESUMO

Objetivo: identificar o estado de carreador e o perfil de suscetibilidade aos antibióticos dos *Staphylococcus aureus* isolados da saliva e da secreção nasal dos profissionais de enfermagem.

Método: estudo transversal, que utilizou amostras de saliva e secreção nasal, obtidas de 100 profissionais de enfermagem que assistem pessoas com HIV/aids.

Resultados: identificou-se que 43,0% dos participantes apresentaram amostras de saliva e/ou de secreção nasal positivas para *Staphylococcus aureus*. Das 74 amostras de secreção nasal com *Staphylococcus aureus*, 14,9% apresentaram resistência à oxacilina; 91,9% à penicilina; 44,6% à eritromicina e 41,9% à clindamicina. Das 12 amostras de saliva positivas, 16,7% foram resistentes à oxacilina; 100,0% à penicilina; 33,4% à eritromicina e 25,0% à clindamicina.

Conclusão: o profissional ao obter conhecimento de seu estado de carreador de microrganismos multirresistentes, passará a supervisionar suas práticas assistenciais e adotar com mais eficiência as medidas para a prevenção e o controle da cadeia epidemiológica dessas bactérias no ambiente laboral.

DESCRIPTORES: Bactérias. *Staphylococcus aureus*. Resistência a metilina. Antibacterianos. Enfermagem. Recursos humanos de enfermagem.

STAPHYLOCOCCUS AUREUS EN PROFESIONALES DE ENFERMERIA Y EL PERFIL DE SUSCEPTIBILIDAD DE LOS MICROORGANISMOS A LOS ANTIMICROBIANOS

RESUMEN

Objetivo: identificar el estado del cargador y el perfil de susceptibilidad a los antibióticos de los *Staphylococcus aureus* aislados de la saliva y de la secreción nasal de los profesionales de enfermería.

Método: estudio transversal, que utilizó muestras de saliva y secreción nasal, obtenidas de 100 profesionales de enfermería que asisten a personas con VIH/SIDA.

Resultados: se identificó que 43,0% de los participantes presentaron muestras de saliva y/o secreción nasal positiva por *Staphylococcus aureus*. De las 74 muestras de secreción nasal con *Staphylococcus aureus*, 14,9% presentaron resistencia a la oxacilina; 91,9% a la penicilina; 44,6% a la eritromicina y 41,9% a la clindamicina. De las 12 muestras de saliva positivas, 16,7% fueron resistentes a la oxacilina; 100% a la penicilina; 33,4% a la eritromicina y 25,0% a la clindamicina.

Conclusión: se cree que el profesional al obtener conocimiento de su estado de portador del microorganismos multi-resistentes, pasará a supervisar sus prácticas asistenciales y adoptar con mayor eficacia las medidas para la prevención y el control de la cadena epidemiológica de estas bacterias en el ambiente laboral.

DESCRIPTORES: Bacterias. *Staphylococcus aureus*. Resistencia a la meticilina. Antibacterianos. Enfermería. Personal de enfermería.

INTRODUCTION

Healthcare professionals, especially nursing professionals, are considered a population susceptible to colonization by multi-resistant microorganisms in their work environment. Work activities performed by nursing professionals involve close physical contact with patients. This, associated with the lack of adherence to standard precautions, may favor the colonization and dissemination of microorganisms, with risk to cause infection outbreaks.¹

National and international studies characterize healthcare professionals as a group vulnerable to the colonization by *Staphylococcus aureus*, in addition to potential disseminators of these microorganisms in their care activities.²⁻⁹

Asymptomatic carriers of *Staphylococcus aureus* may act as disseminators of the microorganism to a population susceptible to colonization.¹⁰ Approximately 20% of the population may be considered persistent carriers, 60% transitory carriers, and the remaining 20% do not present colonization by *Staphylococcus aureus*.¹¹ The highest rates of colonization may be found among healthcare professionals and individuals with immunological deficiency, such as those with HIV/Aids.¹²

An important characteristic of *Staphylococcus aureus* is the ability to acquire mechanisms of resistance to antibiotics. The indiscriminate use of antimicrobials, in addition to widely contributing to the maintenance and steady increase in the selection of resistant bacteria, constitutes a serious public health problem.¹³

The first report of methicillin-resistant *Staphylococcus aureus* (MRSA) occurred in 1961, one year after this semi-synthetic penicillin had been made available

in the market.¹⁴ Since then, the MRSA is endemic in several hospitals, and this problem is no longer restricted to large hospitals and developing countries.¹⁵

The adherence of healthcare institutions to hospital infection control policies will favor the reduction of bacterial resistance. However, the main basic measures for prevention and control of hospital infections¹⁶ must be adopted by healthcare professionals in their care practice.

Knowledge on the condition of MRSA carrier is a right of healthcare professionals and must be considered a result of their work practice, rather than a criticism excuse. With the knowledge on their carrier state, professionals are expected to reflect better on their attitudes and work practices, aiming at better adherence to preventive measures.⁴

Due to the relevance of the theme, combined with the lack of national studies on the prevalence of methicillin-resistant *Staphylococcus aureus*, specifically with nursing teams, the present study was considered relevant, as its objective was to identify the carrier state of nursing professionals and the susceptibility profile of *Staphylococcus aureus* to antimicrobials, isolated from saliva and nasal secretion.

METHOD

A cross-sectional study was carried out in five hospitalization units of a teaching hospital in a city in the state of São Paulo. Of these, three units were destined for medical clinics and two were specialized in providing care to patients with HIV/Aids. These units were chosen because they regularly admit patients with HIV/Aids, both high and medium complexity patients, and for extended period of hospitalization.

Guidelines and regulatory standards of research involving human beings were observed, according to resolution no. 466 of December 2012 of the Brazilian National Health Council. The research project was approved by the Research Ethics Committee of the Ribeirão Preto, College of Nursing at the *Universidade de São Paulo*, under protocol no. 603.228/2013. CAAE: 20111213.3.3001.5440.

The study population was made up of nurses, nursing technicians, and nursing aides who worked in one of the five studied hospitalization units and provided direct care to patients. The collection occurred in the three work shifts, and saliva and nasal secretion samples of 100 professionals were obtained in three periods (months zero, four, and eight). Professionals who did not participate in the three data collection stages were excluded.

Data collection occurred from April 2014 to February 2015 during their own shifts and workplaces, by means of application of a semi-structured instrument with average duration from 15 to 20 minutes, carried out by the researcher and four assistants in a private room. The instrument contained questions associated with demographic, professional, and individual aspects, and was previously submitted to face and content evaluation and adjustment by three specialists with experience in research on infectious diseases.

In order to obtain saliva and nasal secretion samples of the nursing professionals, they were asked to put from three to five milliliters of saliva directly in a graduated, dry, and sterile test tube. Nasal secretions were obtained with the help of a dry swab introduced in both nostrils, by means of three clockwise circular movements.

The material was seeded on blood agar and mannitol, and the collected samples were processed in the microbiology and serology laboratory of the studied hospital. Afterwards, the automated system Vitek® 2 (BioMérieux™, France) was used, by means of GP Test Kit Vitek® 2 cards for identification of gram-positive bacteria. AST P585 (BioMérieux™, France) cards were used to identify and evaluate *Staphylococcus aureus* susceptibility to antibiotics.

The data were organized in Microsoft Office Excel for Windows 2013 and analyzed through the IBM® SPSS 20 software. For data analysis, descriptive statistics with measures of central tendency (mean and median) and dispersion (standard deviation) was used.

The carrier state of nursing professionals considered in this study was consistent with that proposed by other authors.¹⁷ The numerator was the total of positive samples, and the denominator was the total number of samples collected from each individual. Therefore, professionals were considered persistent carriers when they presented two or three positive samples for *Staphylococcus aureus*, and transitory carriers when they presented a single sample. Non-carriers were those who presented three negative cultures for this microorganism.

The professionals identified as colonized were reported on the culture results and, upon agreement, they were referred to the hospital infection control committee (HICC) of the institution to proceed with the conduct required.

RESULTS

Table 1 presents demographic and professional characteristics of the 100 participants in the study.

Table 1 - Distribution of nursing professionals according to demographic and professional characteristics. Ribeirão Preto, São Paulo, Brazil, 2014-2015. (n=100)

	Variables	n	%
Professional category	Nurse	19	19.0
	Nursing technician	22	22.0
	Nursing aide	59	59.0
Gender	Female	79	79.0
	Male	21	21.0
Age (years)	20 to 39	09	9.0
	30 to 39	36	36.0
	40 to 49	39	39.0
	≥ 50	16	16.0

	Variables	n	%
Education level	Complete high school	68	68.0
	Complete higher education	22	22.0
	Complete graduate degree	10	10.0
Work shift	Day	37	37.0
	Night	28	28.0
	Rotating shift	35	35.0
Length of time in the profession (years)	< 05	15	15.0
	05 to 14	43	43.0
	≥ 15	42	42.0
Work in another institution	Yes	14	14.0
	No	86	86.0
Weekly working hours	30 to 36	43	43.0
	> 36	57	57.0

With regard to nasal secretion and saliva samples of the 100 participants, 600 samples in total were collected and processed, being three nasal secretion samples and three saliva samples from each nursing professional. The mean interval between the collections was four months.

In the present study, 57 (57.0%) professionals were classified as non-carriers of *Staphylococcus aureus* and 43 (43.0%) presented at least one positive saliva or nasal secretion culture for *Staphylococcus aureus* in the three periods of collection. Among the carriers, 36 (83.7%) presented methicillin-sensitive *Staphylococcus aureus* (MSSA) and seven (16.3%) presented methicillin-resistant *Staphylococcus aureus* (MRSA).

According to Table 2, of the 32 (32.0%) participants colonized in the nasal area, 16 (50.0%) were

persistent carriers and the others were transitory carriers. Regarding persistent carriers, 11 (11/16) had the microorganism isolated in two samples and five nursing professionals had it isolated in the three nasal secretion samples. The only professional colonized exclusively in the saliva sample was classified as a transitory carrier.

With regard to the ten colonized professionals (nasal and saliva), seven (7/10) were considered persistent carriers by the nasal secretion sample. Of these, in four (4/7), *Staphylococcus aureus* was isolated in the three samples and, in three (3/7) professionals, it was isolated in two nasal secretion samples. The only professional who was considered a saliva persistent carrier had the microorganism isolated in two samples.

Table 2 - Distribution of nursing professionals colonized by *Staphylococcus aureus*, according to colonization areas and carrier state. Ribeirão Preto, São Paulo, Brazil, 2014-2015. (n=43)

Colonization areas	*N _p	†S _p	‡N _t	§S _t	N _t S _t	¶N _p S _t	**N _t S _p	Total
Nasal	16	-	16	-	-	-	-	32
Saliva	-	-	-	01	-	-	-	01
Nasal and saliva	-	-	-	-	02	07	01	10
Total	16	0	16	01	02	07	01	43

*N_p: nasal persistent; †S_p: saliva persistent; ‡N_t: nasal transitory; §S_t: saliva transitory; ||N_tS_t: nasal transitory and saliva transitory; ¶N_pS_t: nasal persistent and saliva transitory; **N_tS_p: nasal transitory and saliva persistent

Considering the colonization by MRSA, 100.0% were nasal carriers of *Staphylococcus aureus*. Of these, 57.1% (4/7) were classified as transitory carriers, that is, they presented a single nasal secretion sample colonized by MRSA, and 42.9% (3/7)

were classified as persistent carriers, with two or three positive samples. Of the three professionals considered persistent carriers, it was observed that in one of them *Staphylococcus aureus* was detected in three nasal secretion samples. The two profession-

als colonized by MRSA in the saliva sample were considered transitory carriers; in addition to being saliva carriers, they were also nasal carriers.

Of the 43 nursing professionals considered transitory or persistent carriers of *Staphylococcus aureus* in the saliva or nasal secretion samples, 53.5% were nursing aides, 25.6% were nursing technicians, and 20.9% were nurses.

An antibiogram was carried out to identify the susceptibility profile of *Staphylococcus aureus* to antimicrobials. In the total, 74 nasal secretion samples and 12 saliva samples isolated with *Staphylococcus aureus* were identified. Of the 74 nasal secretion samples, 14.9% (11/74) presented oxacillin resistance; 91.9% (68/74) presented penicillin

resistance; 44.6% (33/74) presented erythromycin resistance; 41.9% (31/74) presented clindamycin resistance; 5.4% (4/74) presented ciprofloxacin and chloramphenicol resistance; 4.1% (3/74) presented tetracycline resistance; 2.7% (2/74) presented trimethoprim-sulfamethoxazole (TMP-SMX) resistance; and gentamicin, rifampicin, and vancomycin resistance was not found. Among the 12 isolated *Staphylococcus aureus* saliva samples of professionals, 16.7% (2/12) were oxacillin resistant; 100.0% (12/12) penicillin resistant; 33.4% (4/12) erythromycin resistant; 25.0% (3/12) clindamycin resistant, and no ciprofloxacin, chloramphenicol, gentamicin, rifampicin, TMP-SMX, tetracycline, and vancomycin resistance (Figure 1) was found.

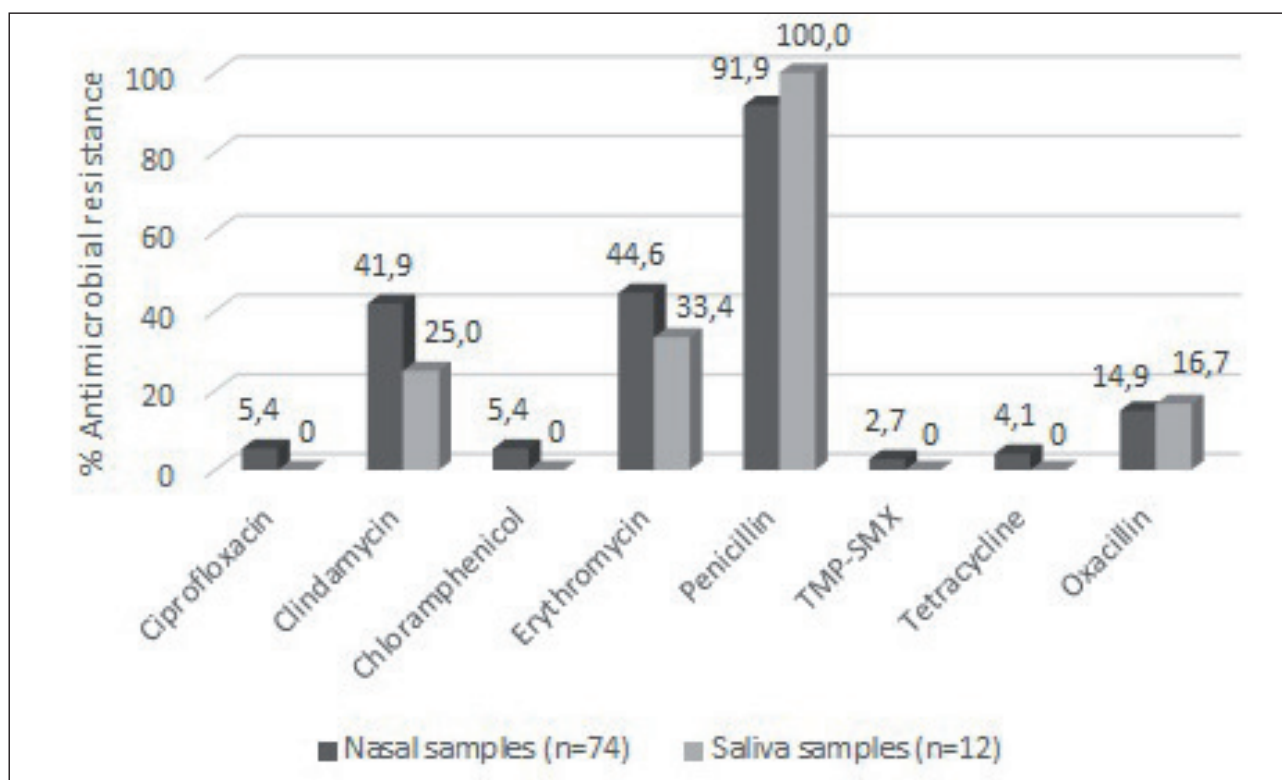


Figure 1 - Resistance profile of *Staphylococcus aureus* isolated from saliva and nasal secretion samples of nursing professionals to antimicrobials. Ribeirão Preto, São Paulo, Brazil, 2014-2015

DISCUSSION

Human beings are considered reservoirs of numerous microorganisms. Among these microorganisms, *Staphylococcus aureus* stands out as a relevant human pathogen, because it is responsible for several infections and has a high infectious potential.^{11,18}

Colonization by *Staphylococcus aureus* often occurs in the anterior nasopharynx compared to the

oropharynx.¹¹ Another study¹⁹ showed that the nostrils were the main colonization areas by MRSA. However, screening tests in different anatomic areas are recommended, since in that study, 40.3% of the individuals colonized by MRSA presented negative cultures in the nostrils and positive cultures in the oral cavity, groin, armpit, perineum, and other areas.¹⁹

Healthcare professionals, in addition to being potential carriers and disseminators of microor-

ganisms in their work environment, are also considered vehicles of transmission between patients and communities.⁴

Studies show that healthcare professionals, as well as their families and those who are in contact with them, are potentially at risk of infection by pathogen agents, including MRSA.^{2,8}

Asymptomatic individuals colonized by *Staphylococcus aureus* may spread the microorganism in their work environment and contribute to its colonization among susceptible individuals.¹⁰

A study carried out to determine the prevalence of asymptomatic carriers of *Staphylococcus aureus* among healthcare professionals showed a high rate of nasal colonization, since 112 of the 256 (43.8%) healthcare professionals were colonized by this microorganism. Of these, 51 (45.5%) were nurses.²⁰ Another study identified nasal colonization in nursing professionals and showed a prevalence of *Staphylococcus aureus*, representing 23.0% of the identified bacteria.²¹

In the present study, 43.0% of nursing professionals were characterized as *Staphylococcus aureus* carriers, with 83.7% (36/43) being MSSA and 16.3% (07/46) MRSA. Similar results were found in a study¹ that investigated the presence of *Staphylococcus aureus* in the nursing team's saliva in a teaching hospital in a city in the state of São Paulo. In that study, 41.0% of nursing professionals presented colonization by *Staphylococcus aureus*, with 72.2% being MSSA and 17.4% MRSA.

The knowledge of professionals on their carrier state enables the adoption of isolation measures, thus preventing the dissemination of these microorganisms in healthcare services.

Nursing aides were the professionals with the highest number of *Staphylococcus aureus* carriers (53.5%). This is expected, because in addition to being the most present category in healthcare institutions, nursing aides perform tasks that constantly require physical contact with patients, such as hygiene and comfort care. This physical contact, combined with non-adherence to standard precautions make professionals more vulnerable to colonization by microorganisms.¹

An important characteristic of *Staphylococcus aureus* is its ability to acquire resistance mechanisms to antibiotics. It has developed resistance to practically all types of antibiotics available for clinical use. The development of this resistance is directly associated with the wide and indiscriminate use of antimicrobials.¹³

The Brazilian National Health Surveillance Agency, in response to the increase in inappropriate and indiscriminate use of antimicrobials launched resolution RDC no. 44 of October 26, 2010, establishing that the dispensing and sale of antimicrobials in the country can only be carried out upon special control prescriptions in two copies.²²

It is worth mentioning that *Staphylococcus aureus* isolated from saliva and nasal secretion samples presented resistance to 8 of the 11 antimicrobials evaluated. Other studies^{3,9,23} showed a high penicillin and erythromycin resistance rate, corroborating the results in this study regarding antibiotics.

Strategies adopted by healthcare services to control the existence of resistant strains due to the indiscriminate use of antimicrobials involve the nondistribution of antimicrobials and restriction on certain drugs of broad spectrum of action, allowing their release only after previous authorization from HICC physicians.²⁴

A study carried out in the state of Paraná highlighted the importance of a deeper approach of subjects associated with the prevention and control of infections, as a strategy to promote patient safety in the training process of healthcare professionals.²⁵ The implementation of preventive strategies that seek to improve quality of care, by means of rigorous control of care procedures, epidemiological surveillance actions, identification of patients at risk, and follow-up of cases, helps reducing healthcare-associated infection rates.²⁶

This study presented limitations with regard to its population and place of study. The population was made up of a specific group of healthcare professionals and the study was carried out in a large and high complexity teaching institution, which may limit the generalization of the results to other professional categories and healthcare institutions.

CONCLUSION

The results evidenced the colonization of nursing professionals by *Staphylococcus aureus*, isolated from their saliva and nasal secretion, as well as the resistance of these bacteria to antimicrobials. Likewise, these results suggest the implementation of health policies that have an impact on the standardization and careful use of antimicrobials in clinical practices; as well as the adherence of professionals to prevention and control measures in the epidemiological chain of these microorganisms, in compliance with current guidelines. Knowledge of healthcare professionals on their

condition of carriers is important, because it may contribute to a reflection and change of attitude in professional practice.

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Received: March 07, 2016
Approved: November 23, 2016