Prevalence and Risk Factors for *Staphylococcus aureus* in Health Care Workers at a University Hospital of Recife-PE

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Staphylococcus aureus is the main human pathogen that colonizes individuals in general population. The objective of the study was evaluate the epidemiological and sensitivity profile of *S. aureus* lineage, isolated in health care workers (HCW) of a University Hospital in Pernambuco state, Brazil. Biological samples of hands and nasal cavities were sown in agar sheep blood. Colonies under suspicion of being *S. aureus* were identified using Gram staining, catalase test and coagulase, mannitol-salty agar fermentation and DNAse agar. The resistance to mupirocin was analyzed through the Kirby Bauer technique. In relation to methicillin and vancomycin the determination was by the minimum inhibitory concentration method (E-test). From the 202 HCW evaluated, 52 were colonized by *S. aureus* (25,7%). The factors associated to the colonization by *S. aureus* were: age-group, professional category, use of individual protection equipments (frequency and numbers). All *S. aureus* isolate lineages were sensitive to mupirocin and vancomycin, and three of them were identified as methicillin-resistant. The prevalence of MSSA and MRSA among HCW was considered low and was below the results described in the literature. The isolate *S. aureus* lineages have shown low resistance profile.
Key-Words: *Staphylococcus aureus*, colonization, health staff.

Nosocomial infections represent an important public health problem and they possess multifactor etiology [1]. In relation to the microorganisms that cause these infections, one can say that this profile has changed over the years. From the decade of the 80s, the Gram-positive microorganisms, especially the *Staphylococcus aureus*, have emerged as main causes of hospital infections. This Gram-positive group (*S. aureus*, the coagulase-negative *staphylococcus*, *Enterococcus* ssp), in the decade of the 90, was already responsible for 34% of hospital infections [2].

Another important factor in the context of nosocomial infections is the transmission chain in the hospital environment [2]. Studies points out that the transference of microorganisms among individuals who circulate in hospital environments (patients and professionals) represents a risk factor for the development of these infections by the patient. In a study performed with 292 nurses aides and nurse technicians, it was found a prevalence of approximately 42% individuals colonized by *S. aureus* lineages [3].

Because of this, considering the relevance of *S. aureus* as an important pathogen associated to nosocomial infections, and studies that provide data about the colonization of health staff is scarce, especially related with diverse category of health care workers, the present paper intended to evaluate the prevalence of colonization by *S. aureus* Methicillin-Resistant (MRSA) among health staff of an University Hospital in Pernambuco state, Brazil.

Material and Methods

Study Design and Population

It was a transversal, in which, health care workers (HCW) from surgical wards, intensive care unit (ICU), hemodyalisis and nephrology units, of the University Hospital of Pernambuco were evaluated in the period of March to July 2007. This study was approved by the Ethics Committee on Research from the Federal University of Pernambuco – CAAE Nº 0275.0.172.000-06. All participants were informed about the objectives of the work and, after signing the Free and Informed Consent Term, biological samples were colleted and a specific questionnaire was applied. The questionnaire evaluated the following variables: age-group, gender, professional activity, working sector, working shift, length of time in the profession, use of individual protection equipment (IPEs), number of IPEs and number of hospitals in which they work.

Collect of Samples and Laboratorial Methods

The biological samples of hands and nasal cavity were obtained using sterile swabs. They were taken to the laboratory in tubes containing Brain Heart Infusion (BHI), and cultivated in agar sheep blood at 5% and incubated at 35°C for 24 hours. After this period, colonies were characterized as *S. aureus* were identified using the Gram stain, catalase test and coagulase proof in tube, being the reading of this latter performed after 4 and 24 hours. It also, the identification was performed by mannitol-salty agar fermentation and DNAse agar. The susceptibility/resistance to mupirocin was determined by the technique of disc diffusion in agar Mueller-Hinton (Kirby Bauer) using discs with concentration of 5ìg of the substance (Oxoid Brasil®). In relation to methicillin and vancomycin, the determination of the sensitivity was performed by the minimum inhibitory concentration method (E-test – Probac do Brasil®).

Statistical Analysis

The data collected were stored and analysed using version 6.04d of the Epi Info software package (Center for Disease Control and Prevention, Atlanta, GA). Statistical comparisons were made using odds ratios, whenever appropriate. A p value of <0.05 was considered indicative of a statistically significant difference.

Results

In this study, it was evaluated 404 biological samples obtained from the hands and anterior nasal region of 202 health care workers. *S. aureus* was isolated in 59 samples, showing a prevalence of 25.7% (52/202) of colonized health staff. From the 52 HCW, 3.5% presented exclusive colonization on the hands, 18.7% presented exclusive colonization in the nasal cavity, and 3.5% of the individuals presented colonization in both sites. In relation to the evaluated anatomic sites, a greater colonization rate was observed in the nasal cavity (18.7%). On the hands, the prevalence decreases to three HCW (5%).

The factors associated with *S. aureus* colonization among HCW are: age, professional category, frequency of use and number of IPEs used (Table 1).

From the HCW studied, three were colonized by *S. aureus* methicillin-resistant. From these individuals, two were from neonatal ICU and one from the surgical ward. All of them were nurse technicians, over 28 years old, work in more than two hospitals, and had been in the sector for over three years. In relation to the use of IPEs, they use them, sporadically.

All *S. aureus* lineages found were sensitive to mupirocin and vancomycin.

Discussion

There is evidence that MRSA carriers contribute for the development of infections by such microorganism and that active surveillance leads to a significant and sustained reduction in MRSA acquisition [4].

Routine screening of HCWs with the objective to detect MRSA colonization or infection is associated with high cost, possible stigmatization of carriers and there is no consensus related the screening best time. The Centers for Disease Control and Prevention has recommended culturing personnel who are implicated as the source of MRSA transmission based on epidemiological data [5].

The prevalence of colonization of *S.aureus* found in this study was low, although, agree with Santos' findings [6], who evaluating nursing students, has found a prevalence of colonization in the nasal cavity and hands of 45.7% and 27%, respectively, demonstrating that the nasal cavity, between the evaluated anatomic sites, is the area that presents a higher colonization. Such finding is probably due to the fact that as hands are washed more frequently, it hinders the microorganism installation.

Taking into account just the MRSA lineages, the prevalence of colonization decreases from 25, (7%) to 1.5%, once, from the 202 evaluated individuals, only three were MRSA. This rate is considered low, once in the evaluated hospital, previous studies performed with patients have demonstrated a prevalence of individuals infected by *S. aureus* methicillin resistant of 32.8% [7]. Recent studies showed that the prevalence of MRSA colonization among health staff changes according to the location and with the characteristics of each institution. For instance, in a Slovenia institution, the prevalence was of 2.6% [8]. As to Eveillard et al. [9] findings, the percentage found was of 6,2% and the Wang et al. [10] studies verified a rate of 8.3%. In Brazil, a research performed by Prado-Palos, in 2006, has made evident, in a health institution of Goiânia, a prevalence of colonization of 9.7% [11]. These results contrast with other studies that observed higher colonization, varying from 17% to 40% [12].

All health staff colonized by MRSA were nurse technicians and the characteristics presented by them contribute to the installation of microorganisms; they worked in more than one hospital, spent more time in contact with patients potentially infected or colonized, as well as, used IPEs sporadically. This result corroborates the study previously mentioned, which has shown that among health staff colonized by MRSA, the nursing technicians are the most taken ones, with a prevalence of 61.5% [11] and also, studies performed in a university hospital, which have demonstrated a colonization rate of 38.2% of nursing technicians colonized [13]. It is important to highlight that such results place these professionals in a critical situation, demanding more adhesion from them to the standard-precautious as, for instance, the sanitation of the hands being done with more frequency, and the constant use of EIPs during clinical procedures.

In this study, female individuals were more colonized when compared to male ones. Nevertheless, this difference was not statistically significant, indicating that in this situation, gender has not presented any association with the colonization by *S. aureus* (p>0.05). In relation to age-group, one can observe that individuals that belonged to the age-group of 20 to 28 years old, group with a higher prevalence of colonization (33.9%), presented, approximately, 3.5 times greater probability of being colonized (CI 95% 1.25-10.20) when compared to the age-group that presented lower prevalence, individuals with 33 to 44 years old (12.7%). This difference was not significant (p = 0.01).

In relation to the professional category, one can observe that to develop activities like respiratory therapists or laboratory technicians represent a risk factor for the colonization by *S. aureus*. These individual possesses 4.57 times greater probability of being colonized when compared to doctors, reference group (p = 0.05). Physicians have presented the lowest prevalence of colonization (17.9%), followed by the nursing staff, which, include registered nurses and nurse technicians with, approximately, 26%. In general, researches that report to this theme, do not include in their study group, professionals who are not doctors, nurses or nurse technicians, making it difficult to evaluate,

Table 1. Factors associated to colonization by *Staphylococcus aureus*, in health care workers of the University Hospital of Pernambuco state, Brazil, from March to July of 2007.

Variables	N	%	Colonized		Non colonized		OR (CI95%)	p
			N	%	N	%		
Gender								
Male[1]	36	17.8	8	22.2	28	77.8	1	
Female	166	82.2	44	26.5	122	73.5	1.26 (0.50-3.29)	0.75
Age (years)								
20 |- 28	62	30.7	21	33.9	41	66.1	3.51 (1.25-10.20)	0.01*
28 |- 33	41	20.3	12	29.3	29	70.7	2.84 (0.90-9.13)	0.08
33 |- 44[1]	55	27.2	7	12.7	48	87.3	1	
> 44	44	21.8	12	27.3	32	72.7	2.57 (0.82-8.21)	0.11
Professional Activity								
Doctors[1]	39	19.3	7	17.9	32	82.1	1	
Nurses	49	24.3	13	26.5	36	73.5	1.65 (0.53-5.28)	0.48
Nurse Technicians	102	50.5	26	25.5	76	74.5	1.56 (0.57-4.43)	0.46
Others (respiratory therapists and lab technician)	12	5.9	6	50.0	6	50.0	4.57 (0.93-23.49)	0.05*
Sector								
ICUs[1]	86	42.6	21	24.4	65	75.6	1	
Surgical wards	84	41.6	22	26.2	62	73.8	1.10 (0.52-2.32)	0.92
Nephrology/ Hemodialysis Unit	32	15.8	9	28.1	23	71.9	1.21 (0.44-3.30)	0.86
Shift								
Night[1]	44	21.8	9	20.5	35	79.5	1	
Day	158	78.2	43	27.2	115	72.8	1.45 (0.60-3.59)	0.47
Length of time in the profession (years)								
0 |- 7	83	41.1	25	30.1	58	69.9	1.75 (0.78-3.98)	0.19
7 |- 14	48	23.8	13	27.1	35	72.9	1.51 (0.59-3.91)	0.47
> 14[1]	71	35.1	14	19.7	57	80.3	1	
Length of time in the sector (years)								
0 |- 2	71	35.1	24	33.8	47	66.2	2.27 (0.88-5.98)	0.09
2 |- 5	48	23.8	12	25.0	36	75.0	1.48 (0.51-4.38)	0.58
5 |- 15[1]	49	24.3	9	18.4	40	81.6	1	
> 15	34	16.8	7	20.6	27	79.4	1.15 (0.33-3.93)	0.97
Use of IPEs								
Always[1]	114	56.4	22	19.3	92	80.7	1	
Sometimes	88	43.6	30	34.1	58	65.9	2.16 (1.09-4.32)	0.02*
Number of IPEs								
1 IPE	16	7.9	8	50	8	50	4.33 (1.26-15.02)	0.01*
2 IPEs	90	44.6	26	28.9	64	71.1	1.76 (0.84-3.70)	0.15
3 or more IPEs[1]	96	47.5	18	18.8	78	81.3	1	
Number of Hospitals Worked In								
1 Hospital[1]	104	51.1	26	25.0	78	75.0	1	
2 Hospitals	75	37.1	20	26.7	55	73.3	1.09 (0.52-2.27)	0.94
3 or more Hospitals	23	11.4	6	26.1	17	73.9	1.06 (0.33-3.26)	0.87

OR: odds ratio, CI: confidence interval; [1]Reference group, *p < 0.05 – statistically significant.

comparatively, the prevalence found between respiratory therapists and laboratory technicians. However, we consider this prevalence high, and we believe that such finding probably occurs because these professionals are less provided with information related to risks, for the team and for the patients, caused by health staff, colonized by pathogenic microorganisms.

Although innumerable studies make evident that the colonization of health staff by *S. aureus* is directly associated to factors such as working place, shift, working time and length of time in the profession [11], the present study has not made evident these findings, once it was not observed a significant difference between the analyzed groups.

Innumerable are the factors that have been investigated in the attempt of better understand the dynamics of colonization by pathogenic microorganisms. Among these factors, the use of IPEs is one of the most studied [14]. In relation to this issue, we can notice that although 100% of the professionals have confirmed to use IPEs during the assistance to the patient, only 56.4% did that during all the procedures. For this reason, the sporadic use of IPEs represents a risk factor for the colonization, that is, individuals who confirmed using equipments of individual protection only in some procedures possess two times greater probability of being colonized when compared to those individuals that used IPEs continually, in all procedures (CI 95% 1.09-4.32; p = 0.02). In relation to the quantity of equipments of individual protection used, 92.1% of the evaluated professionals used two or more IPEs. The quantity of IPEs used also represents aggravate, being directly associated to colonization. We can make evident that in this studied group, individuals that reported using just one EIP, possesses, approximately, four times greater probability of being colonized than those who reported using three or more IPEs (CI 95% 1.26-15.02; p = 0,01).

The determination of the sensitivity to glycopeptides vancomycin has shown that 100% of the isolates of *S. aureus* were considered sensitive (VSSA). Vancomycin is a latest generation antibiotic, which has been used in cases of severe infections and/or in occasions in which the conventional treatments have not demonstrated a positive effect in the fighting against the disease. The first case of reduced susceptibility to vancomycin, by *S. aureus*, was reported in Japan in the year 1996 [15]. Tolerance to vancomycin in *S. aureus* is related to therapeutic failures in defined clinical circumstances, especially in septicemia, endocarditis, osteomyelitis, meningitis and in immunodepressed patients [16]. Both tolerance as well as resistance to vancomycin are considered unstable and introduced phenomena, and they appear during the treatment with the drug [17]. Researches that are meant to investigate colonization by *S. aureus* in health staff do not report lineages sensitivity to vancomycin. Studies performed by Cordeiro [7], have made evident in patients attended in the University Hospital of Pernambuco, study place that all *S. aureus* lineages found were 100%

sensitive to vancomycin agreeing with the results obtained in this work. Despite the present studies point out to the absence of *S. aureus* strains that are resistant to vancomycin in the studied unit, it is premature to say that such microorganism has not been introduced, yet, and more investigation is needed.

With the purpose of reducing the occurrence of *S. aureus* multiresistant strains in patients and health staff, control measures have been adopted, as, for instance, the use of prophylactic medications, such as the pseudomonic acid (mupirocin) in topic preparations, in cases of high frequency of colonization [18]. However, there are studies that demonstrate that some isolate bacterial of *S. aureus* already present genes resistant to mupirocin, compromising the therapeutic value of the latter [19]. Here, in Brazil, mupirocin is still less used and for this reason, it is not, customarily, included in the bacterial sensitivity tests to antibiotics. Due to this, we have decided to introduce in the study the antibiotic mentioned. This is a pioneer study in the evaluated institution and it has shown that all isolate samples of *S. aureus* were sensitive to mupirocin. A study performed in 19 European hospitals has shown prevalence of 1.6 and 2.3% of de *S. aureus* mupirocin resistant strains [20]. It is important to highlight that such substance must be used carefully because its indiscriminate use may stimulate resistance, compromising its usage even more.

According to the obtained results, we have concluded that the prevalence of MSSA and MRSA among health staff is found to be below the results described in the literature, being this one considered low and that risk factors associated to colonization by *S. aureus*, among health staff were: age-group, professional category, frequency and quantity of equipments of individual protection used.

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