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Prevalence and Antimicrobial Susceptibility of *Staphylococcus aureus* Isolated from Nasal Carriers

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ABSTRACT

***Background*:** *Staphylococcus aureus* (*S. aureus*) is one of the major virulence factors of hospital and community acquired infections. Healthcare workers can be the host of *S.aureus* for many months. And it is very important due to the possibility of transmission to patients. The aim of this study was to determine the prevalence of *S.aureus* nasal carriers, the antibiotic susceptibility pattern and its effective factors on Sina Hospital workers in Tehran, Iran.

***Methods*:** healthcare workers from different wards of Sina Hospital were studied in Tehran, Iran in 2010. Samples were taken from both nostrils of each individual. After 18-24hr incubation, the isolates were evaluated by gram stain, catalase, coagulase, DNase and manitol salt agar by which *staphylococci* were isolated. Disk diffusion antimicrobial susceptibility tests against oxacillin, cefoxitin and vancomycin was performed. Finally, by using PCR, the mecA gene was studied in methicillin-resistant strains (MRSA).

***Results*:** 34of the 166 workers, were nasal carriers of *S. aureus* and one of them was MRSA. The ratio of carriers in operating room workers was more than other wards, without significant relationship (p.value>0.05). *S.aureus* was found in 34.3% of operating room, 13.8% of nurses and 22.7% of licensed and other personnel. There was a significant relationship between occupations and *S.aureus* carriage (p.value:0.03).

***Conclusion*:** According to the low prevalence of *S. aureus* and MRSA carriers in Sina hospital, it can be said that the role of the hospital staff as a source of infections caused by *S. aureus* especially is very low.

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Introduction

Staphylococcus aureus is a non-motile and non-spore forming gram positive coccal bacterium (1). It is one of the most important pathogens in hospital and community infections. This organism has been identified as the second leading cause of nosocomial infections after *E.Coli* (2). Health care workers can as the host of methicillin-resistant *Staphylococcus aureus* (MRSA) for a long time. Unfortunately, due to the appearance of antibiotic resistant strains of *Staphylococcus aureus*, the effectiveness of antibiotic therapy is declining. The first synthetic penicillin resistant to *β*-lactams was named methicillin introduced in 1959 to treat these infections. But the first resistant strain of methicillin (MRSA) was reported in 1961 (3). Generally, about 2 billion *S.aureus* carriers and 53 million MRSA carriers are reported worldwide (4). Hospital-acquired *S. aureus* infection and MRSA are reported in 78.8% and 50% of Iranian hospitalized patients, respectively (5). The prevalence of nasal carriage of MRSA is about 5.3% in Iranian healthcare workers (6). Antibiotic-resistant organisms such as MRSA may increase hospital stays and mortality rates of infection. The aim of this study was to determine the prevalence of *S.aureus* nasal carriers, the antibiotic susceptibility pattern and its effective factors on Sina hospital workers in Tehran, Iran.

Materials & Methods

During the summer of 2010, 166 Sina hospital health care workers were screened for *S. aureus* carriage in Tehran, Iran. The participants included the personnel of operating rooms, Hemodialysis, ICU, surgical and orthopedic wards of the hospital due to the higher prevalence of infection in these wards. People who spent less than 2 months of employment at the hospital and those who had used antibiotics within 2 months were excluded. We have described the aim of the study and its methods to the individuals and if they consented to participate in the study, the data information of each person was entered into a previously prepared form. Then, samples were taken from each nostril of every person by a sterile wet swab dipped in saline. Samples were transported to the laboratory within 30 minutes. The swabs were inoculated on blood-agar plates which were incubated for 18- 24 h in 37 ° C. Gram-positive *cocci* were identified by Gram stain. By catalase test, *Staphylococci* were different from *Streptococci*. Catalase-positive cocci were evaluated by coagulase, DNase and manitol salt agar tests to differentiate *Staphylococcus aureus* from other Staphylococci species. Finally, disk diffusion antibiogram was performed on Muller-Hinton agar using oxacillin (1µg), vancomycin (30µg) and cefoxetin (30µg) disks of MAST British company. *Staphylococci* which were resistant to oxacillin and cefoxetin were examined by conventional PCR method for the presence of *mecA* genome. Primers designed to detect *mecA* gene were purchased from Sinagene Company. Statistical analysis was performed by SPSS software. The relationship between nasal carriers of *S.aureus* and age, gender, work department, job type, work experience, and diabetes was evaluated by statistical methods, including chi-square and logistic regression**.**

RESULTS

As shown in table 1, 112 (67.5%) of 166 subjects were women and 54 (32.5%) were men, the mean age of the studied population was 36.9±7.7 years old (range: 21-54 years), most

cases were related to operating rooms (40.4%), more than half of the participants were nurses (52.4%), the average work experience of the participants was 5 years (2 months-27 years) and Six (3.6%) of them had the history of diabetes (table 1).

Table 1. Frequency of participants and results of nasal culture according to age, sex, ward, job, work experience and diabetes mellitus.

	Number (%)	Positive Culture (%)	P.value
Age			**0.278**
≤ 30 years	43 (25.9)	8 (18.6)	
31-40 years	73 (44)	12	
≥ 41 years	50 (30.1)	(16.4)	
		14 (28)	
Sex			**0.700**
Male	54 (32.5)	12	
Female	112	(22.2)	
	(67.5)	22	
		(19.6)	
Diabetes mellitus	6 (3.6)	1 (16.7)	**1**
Yes	160	33	
No	(96.4)	(20.6)	
Ward			**0.09**
Orthopedic	25 (15)	2 (8)	
Surgery	14 (8.4)	1 (7.1)	
Hemodialysis	9 (5.4)	1 (11.1)	
ICU	51 (30.7)	10	
Operating	67 (40.4)	(19.6)	
Rooms		20	
		(29.9)	
Job			**0.037**
Nurse	87 (52.4)	12	
Other	44 (26.4)	(13.8)	
Personnel	35 (21.1)	10	
Operating		(22.7)	
Room		12	
personnel		(34.3)	
work experience			**0.071**
	48 (28.9)	10	
≤ 1 year	64 (38.6)	(20.8)	
1-5 years	54 (32.5)	8 (12.5)	
≥ 5 years		16	
		(29.6)	

As a result, there were 34 (20.5%) nasal *S. aureus* carriers. Only one (2.95%) of these 34 participants was MRSA in which PCR for mecA gene has negative results. All specimens were also sensitive to vancomycin. There was a significant relationship between occupation and nasal *S. aureus* carriage (P.value: 0.037).

Discussion

Based on the results obtained in our study, 20.5% of the personnel of Sina Hospital were *Staphylococcus aureus* nasal carriers. Also, 0.6% of them were MRSA carriers (3% of the *S. aureus* samples). In 1997, *S. aureus* carriage in general population and healthcare workers were reported about 37.2% (19-55%) and 26.6% (16.8-56.1%), respectively (7). In another study, 4.1% of 33318 healthcare workers were MRSA carriers (8). The frequency of nasal carriers of *Staphylococcus aureus* in healthcare workers of Iran is reported from 12.7% in Yazd to 43% in Sanandaj (Table 2). In several studies, the prevalence of MRSA was between 5.3% and 13.9% in Iran (6, 9-11). In our hospital, the rate of *S. aureus* and MRSA nasal carriage among the healthcare personnel was relatively low. Overall carriage rates mentioned a wide range. The mentioned wide range of nasal carriage among different studies may be partly due to sample size, different ways of sampling and culturing methods used in these studies.

Table 2: Distribution of *Staphylococcus aureus* carriers in health care personnel of different parts of Iran

Authors	Place of study	Year	Samples	*Staphylococcus aureus* carriers	MRSA carriers
Rashidian *et al* (10)	Sanandaj	2001	118	43%	16%
Khodami *et al* (12)	Babol	2001	210	42%	No reviews
Ghasemian *et al* (13)	Ghaemshahr	2004	100	36%	30%
Askarian *et al* (6)	Shiraz	2009	600	31%	5.3%
Nasiri *et al* (14)	Tabriz	2010	113	26.5%	No reviews
Zohorinia *et al* (15)	Army Hospital	2006	253	25.3%	No reviews
Rhimi *et al* (16)	Gorgan	2011	333	24%	3%
Alavi *et al* (17)	Ahvaz	2006	240	22.5%	17%
Ziasheikhaleslami *et al* (18)	Rfsanjan	2009	220	20%	7.6%
Saderi *et al* (11)	Tehran (Shahed University)	2004	227	19.8%	5.4%
Bagher *et al* (19)	Yazd	2009	742	12.7%	7.6%

Similar to this study, all *S. aureus* strains were susceptible to vancomycin in several studies (6, 9, 16-18) while in Ghasemian *et al* study, 5.5% and in Saderi *et al* study 6.4% of the *S. aureus* strains were resistant to vancomycin (11, 13). In various studies, the association between *S. aureus* and MRSA carriers with some risk factors was measured. In some studies, job status (health services, duration of employment, place of employment, work overload) has been identified as a risk factor for the carriage (20-22). In some other studies, no risk factors for MRSA colonization were found (23-26). As noted in another study, we found a significant relationship between job (nursing) and MRSA carriers (p.value:0.037) (6). However, another study found no relationship between these two variables (9). Similar to the previous study, the highest incidence of carriers was observed in operating rooms (16).

The major limitation of this study was the reluctance of personnel to participate. Another limitation of the study was excluding physicians (professors, assistants and interns) during case selection, which can be a selection biased.

In conclusion, according to the low prevalence of *S. aureus* and MRSA carriers in Sina Hospital, it can be said that the role of hospital staff carriers as a source of infection, especially caused by *S. aureus*, is very low.

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Conflict of interest

None declared conflicts of interest.

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