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ORIGINAL ARTICLE

The prevalence of *Staphylococcus aureus* colonization among Healthcare Workers at a Specialist Hospital in Saudi Arabia

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ABSTRACT

Objectives: The aim of this study was to determine the prevalence of the nasal carriage of *Staphylococcus aureus* among healthcare workers (HCWs) at a Specialist Hospital and to detect the antibiotic susceptibility of *S. aureus*.

Material and Methods: This cross-sectional study was conducted from January to April, 2007. Nasal swabs were taken from 352 randomly selected HCWs. The isolates were identified as *S. aureus* based on morphology, Gram stain, catalase test, coagulase test, and mannitol salt agar fermentation. The sensitivity of the isolates was carried out by the modified Kirby Bauer method.

Results: A total of 352 subjects comprising medical doctors, nurses, cleaners and the administrative staff of a Specialist Hospital, who worked in or frequently visited the nursery, maternity, paediatric, medical, surgery and intensive care wards during January to April 2007 were tested for the carriage of Staphylococci. 204 of them (58.0%) were males and 148(42%) were females. 313 (89%) subjects were doctors, nurses and cleaners and 39 (11%) were administrative personnel. Of the total 352 samples, *S. aureus* was isolated from 112 (31.8%) specimens. Of these 112 *S. aureus* isolates, 103 (92%) were found to be methicillin sensitive *S. aureus* (MSSA) *and* 9 (8%) were found to be methicillin resistant *S. aureus* (MRSA).The rate of *S. aureus* in males and females were 23.0% and 46.0%, respectively. The rate of *S. aureus* in the medical staff, nurses, cleaners and administrative personnel were 35.5% and 2.6%, respectively. The prevalence of the carriage was higher (30.1-33.4%) in young persons, i.e. less than 35 years than (6.8-15.7%) those aged 35-55 years or above. Most of the MSSA strains were susceptible to tested agents except penicillin, ampicillin, gentamicin and erythromycin. A majority of the MRSA isolates showed multiple drug resistance. All MSSA and MRSA isolates were fully sensitive to Vancomycin.

Conclusion: A high rate of the carriage of *S.aureus* in this hospital, with a large proportion of strains being resistant to penicillin and the isolation of MRSA strains from these carriers calls for periodic surveillance of nosocomial infections due to *S.aureus* and other important bacterial pathogens.

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Introduction

Staphylococcus aureus is a significant cause of human disease and is one of the most common causes of healthcare acquired infections [1]. The ecological niche of *S.aureus* strains is the anterior nares. Studies have shown that the nares is the area from which this organism can be isolated most consistently. Healthcare workers (HCWs) constitute an important reservoir of *S.aureus*. Several studies have reported that the rate of nasal carriage of *S.aureus* among HCWs ranges from 16.8% to 56.1% [2]. Methicillin resistant *S. aureus* (MRSA) has emerged as a major pathogen in US hospitals, accounting for more than 50% of *S. aureus* isolates in intensive care units [3]. In a recent study from Saudi Arabia, Shamweel et al 2009 has shown a high

prevalence of MRSA among military personnel (22.3%) [4].

National estimates from 2001 to 2002 in USA suggest that 32.4% of individuals are colonized with *S. aureus,* and 0.8% of individuals are colonized with MRSA [5]. Among the general population including most healthcare workers (HCWs), colonization rarely leads to disease. However, HCWs have been identified as the source of MRSA in numerous outbreak investigations [6]. Several studies have shown the acquisition of MRSA by HCWs, with 50% of the nurses becoming colonized with MRSA in a ward where the epidemics of MRSA infection occurred [7]. At an academic Veterans Affairs hospital where more than 30% of *S. aureus* isolates were MRSA, 56% of the ward nurses were colonized with *S. aureus,* of which 65% was MRSA [8]. Among the house staff, 41% were colonized with *S. aureus* and 9% were colonized with MRSA on arrival; these percentages had increased to 48% and 18.4% by the end of the month-long rotation.

No studies of *S. aureus* colonization in HCWs had ever been performed in our hospital. So, the present study was undertaken to investigate the carriage of *S.aureus* among the staff of our hospital and its antibiotic sensitivity pattern, with particular focus on MRSA.

Methods

Setting: Specimens were collected from different HCWs working in different wards/areas of the hospital. A total of 352 specimens were collected. The specimens were obtained from medical / surgical doctors, nurses, cleaners/helpers and administrative staff. Anterior nares samples were obtained for culture from each participant with a premoistened, cotton-tipped swab.

Microbiological methods: All swab samples were transported to the laboratory within 24 hours after collection. The specimens were processed in the bacteriology section of the microbiology laboratory. Cultures positive for *S. aureus* were identified. All specimens were processed using standard methods for the isolation of clinically significant pathogens including *S. aureus*. The specimens were inoculated on 5% sheep blood agar and Mannitol salt agar plates. The plates were incubated at 37^{o}C for 24-48 hours. The identification of the isolates was based on Gram film, colonial morphological appearance and by positive catalase, coagulase and DNase tests [9]. A total of 112 *S. aureus* strains were isolated from these clinical specimens.

All isolates were screened for oxacillin resistance as described elsewhere [10] using Oxacillin discs (1µg) obtained from DIFCO. A zone of inhibition less than 10 mm was indicative of methicillin resistance. Standard Disc diffusion tests for Penicillin G (10U), Ampicillin (10µg) Erythromycin (15µg), Tetracycline (30µg), Gentamicin (10µg), Cephalothin (30µg), Co-trimoxazole (25µg), Clindamycin (2µg) and Vancomycin (30µg) were carried out by the modified Kirby Bauer method [10]. The zone sizes were measured and interpreted according to the National Committee for Clinical Laboratory Standards (NCCLS).

Results and Discussion

The distribution of the nasal carriers of *S.aureus* in different categories of hospital staff is shown in [Table/Fig 1]. The ecological niche of *S.aureus* is the anterior nares. Screening for the carriage of MRSA is fundamental to nosocomial infection control practices, including epidemiological surveys and day to day decisions [2]. A carriage rate of 30.6% observed in the present study is quite high as compared with that reported in a study from Saudi Arabia [11] and India [12] and lower than that reported in a study from the Al-Ahsa region of Saudi Arabia, in which an overall nasal carriage of 38.0% was observed [13]. Our findings were in agreement with those of others [14],[15]. None of the carriers showed any signs of respiratory infection at the time of investigation and none had received antibiotics during three weeks preceding investigation.

As is apparent from [Table/Fig 1], the nursing staff, cleaners and attending physicians, who were in close contact with the patients by nature

of their duties, have a much higher carriage rate (35.5%) than the other categories of staff (2.6%). Regarding the carriage rate in relation to the age group, the prevalence of the carriage was higher (30.1-33.4%) in young persons, i.e. less than 35 years than (6.8-15.7%) those aged 35-55 years or above, as also reported by others [14,[16] and a much higher prevalence rate in females than in the males compares with the findings of others [14],[16]. An analysis of the distribution of the carriers of *S.aureus* amongst the staff working in different wards showed the carriage rate to be higher in the staff working in the accident / emergency wards, as also observed by others [14],[17].

Of the 112 strains of *S. aureus* recovered in the study, 103 (92%) isolates were methicillin sensitive *S. aureus* (MSSA) and 9 (8%) were Methicillin resistant *S.aureus* (MRSA). All the MRSA isolates were recovered from attending doctors. A majority of the MRSA isolates showed multiple drug resistance and were fully sensitive to vancomycin only [Table/Fig 2]. Amongst the MSSA isolates, about 90.3% isolates were resistant to penicillin and ampicillin while 68 (66.8%) and 77 (74.7%) were resistant to Erythromycin and gentamicin respectively. A majority of the strains were sensitive to tetracycline, cephalothin, cotrimoxazole and clindamycin. All isolates were sensitive to vancomycin [Table/Fig 2]. Few strains showed multiple drug resistance. The resistance of hospital strains to penicillin and other antibiotics has been reported from some parts of Saudi Arabia [4].

This study suggests that the risk of MRSA being transmitted to HCWs is low in a hospital where MRSA is endemic, as long as standard infection control practices are followed. We examined a cohort of HCWs with significant potential exposure to MRSA and we anticipated that the rate of MRSA colonization would be approximately 10% to 50% for clinical staff, as reported elsewhere [7]. This study has several limitations. Cultures of hand samples were not performed, which could cause potential underestimation of colonization rates. The anterior nares is the reservoir for hospital-acquired MRSA, although it appears that this is not necessarily the case for CA-MRSA [18]. Selection bias could have occurred, resulting in an underestimate of MRSA colonization, if those who were at less risk of acquiring MRSA were more likely to volunteer for the study.

MRSA is a persistent and ever growing problem for healthcare institutions, and CA-MRSA adds another degree of complexity. Minimizing the emergence of this organism and containing its spread remain to be the challenges that need to be addressed. For HCWs who are routinely exposed to this organism, the personal risk appears to be minimal.

In conclusion, a high rate of the carriage of *S.aureus* in this hospital, with a large proportion of strains being resistant to penicillin and the isolation of MRSA strains from these carriers calls for the periodic surveillance of nosocomial infections due to *S.aureus* and other important bacterial pathogens. The usual hygienic methods such as hand disinfection after each contact with patients, and the use of masks when is appropriate, must be performed by all workers in hospitals to protect the patients from nosocomial infections. Alcohol hand rub must be placed at every bedside in hospitals and promotional materials must be used to remind health workers and visitors to use the hand rub.

(Table/Fig 1) Distribution of nasal carriers of *S. aureus* according to different groups and sex of subjects

No.	Group	No. Examined			No. Positive (Percentage)					
		Male	Female	Total	Male		Female		Total	
1	Doctors (physicians/surgeons)	38	26	64	16	(42.1)	18	(69.2)	34	(53.1)
2	Nurses	109	101	210	27	(24.7)	43	(42.6)	70	(33.3)
3	Cleaners/helpers	18	21	39	2	(11.1)	5	(23.8)	7	(17.9)
4	Administrative staff	39	-	39	1	(2.5)	0	(0.0)	1	(2.5)
	Total	204	148	352	46	(22.5)	66	(44.6)	112	(31.8)

(Table/Fig 2) Showing antibiotic resistance pattern of MRSA and MSSA.

No.	Antibiotic	MSSA (n=103)	MRSA (n=9)
1	Penicillin G	93 (90.3%)	9 (100%)
2	Ampicillin	93 (90.3%)	9 (100%)
3	Erythromycin	68 (66.8%)	8(89.0%)
4	Gentamicin	77 (74.7%)	9 (100%)
5	Tetracycline	19(18.4%)	8 (89.0%)
6	Cephalothin	17 (165%)	9 (100%)
7	Cotrimoxazole	15 (14.5%)	6 (66.7%)
8	Clindamycin	7 (6.8%)	6 (66.7%)
9	Vancomycin	0 (0.0%)	0 (0.0%)

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