

Low prevalence of *Staphylococcus aureus* colonization among dental students in a teaching hospital in Malaysia

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Abstract. *Staphylococcus aureus* is an important microorganism which is associated with infections in the hospital setting. It is spread mainly through contaminated hands of the healthcare worker or through the underlying colonization of this microorganism in the nasal cavity of the healthcare worker. Apart from the healthcare worker, medical and dental students also can be source of the transmission because they are also engaged with the patients during their training period. The objective of this study was to determine the prevalence and risk of *S. aureus* colonization among dental students. Cross sectional study was conducted in the month of May 2014 involving a total of 205 dental students (104 pre-clinical years and 101 clinical years) from School of Dental Sciences, Universiti Sains Malaysia. The questionnaires were distributed and nasal swabs were collected. A total of 205 dental students participated in this study which comprises 50.7% pre-clinical year and 49.3% clinical year students. Their age ranged from 20 to 26 years old, with a mean (standard deviation) of 22.29 (1.73) years. The male to female ratio was 1:2.5. Eighteen percent of dental students had *S. aureus* colonized in their nasal cavity. No colonization of Methicillin resistant *S. aureus* strain was found in their nasal cavity. A carriage of *S. aureus* was significantly associated with the presence of health care worker among their family member. Healthcare worker may acquire *S. aureus* from the hospital, colonized in their nasal cavity and spread it to other family members via inhalation and close contact, however further study on this area is recommended to find out their relationship. *S. aureus* carrier among dental students worth screening to look whether they carry resistant strain i.e. MRSA to prevent spread to other patients. This is because they also involved in the clinical management during their clinical year study.

INTRODUCTION

Staphylococcus aureus is one of the Gram positive microorganisms that can cause infections in hospital settings. This microorganism commonly colonized the area around the nasal cavity, axilla and skin of healthy personnel and served as a source of infection in susceptible host under favorable condition. *S. aureus* nasal colonization in Kelantan was 28.7% (Al-Talib *et al.*, 2013). Nasal colonization is defined as

detection of *S. aureus* from the inner part of anterior nares by nasal swab (Coates *et al.*, 2009). Colonization of this microorganism on healthy healthcare worker (HCW) as well as the medical and dental student can be one of the sources of infections to the patients. This obviously may pose a great risk to patients under their care.

Several studies found that medical students had high nasal colonization of MRSA, as they have closed contact with patients during clinical years (Bellows *et al.*,

2013; Chen *et al.*, 2012). In hospital Universiti Sains Malaysia (USM), dental students were not only involved in clinical management of dental patients in dental clinic but also had to take part in management of patients in general medical wards. Therefore, theoretically dental students have equal chances to have nasal colonization of MRSA and serve as source of transmission to the patients under their management. Studies found that the prevalence of MRSA carrier among dentals student was about 20.0% to 21.0% (Martínez-Ruíz *et al.*, 2014; Roberts *et al.*, 2011). The aim of this study was to determine the prevalence of *S. aureus* and MRSA among dental students in a teaching hospital.

MATERIALS AND METHODS

This cross sectional study was conducted in the month of May 2014. A list of all dental students (pre-clinical and clinical year) was obtained from academic office of School of Dental Sciences, USM. A total of 205 dental students (101 pre-clinical years and 104 clinical years) were consented in this study. The students were excluded if they have respiratory infections or skin infections one month before the survey was conducted. The questionnaire was adapted from previous studies consisted of demographic data and medical history for assessment of potential risk factors (Syafinaz *et al.*, 2012; Treesirichod *et al.*, 2014). The questionnaires were distributed prior to the collection of nasal swabs.

Specimens were taken from the anterior nares of the subjects by using a sterile swab. A sterile swab was inserted into nostril approximately 10-15 mm depth and rotated five times clockwise, and repeated on another nostril with the same swab. Swab then inserted into Amies transport medium with charcoal (LabChem, Malaysia) and transferred to microbiology laboratory for further processing. Samples were inoculated onto mannitol salt agar (MSA) plate (Oxoid Ltd, Basingstoke, UK) and incubated at 35°C under aerobic condition for 24 hours.

Further identifications were carried on based on the standard protocol in the microbiology laboratory. Colonies that surrounded by bright yellow zones on MSA plates were tested by catalase and tube coagulase tests. Positive reaction in catalase and tube coagulase tests were identified as *S. aureus* and sub-inoculated onto Columbia horse blood agar plate (Oxoid Ltd, Basingstoke, UK) and incubated at 35°C under aerobic condition for 24 hours to obtain the pure cultures. *S. aureus* colony was then sub-inoculated on Mueller Hinton agar plate (Oxoid Ltd, Basingstoke, UK), and Cefoxitin 30mcg test discs (Oxoid Ltd, Basingstoke, UK) were placed on it and incubated at 35°C under aerobic condition for 24 hours.

Antibiotic susceptibility of the isolates was determined by using disc diffusion test according to Clinical Laboratory Standard Institutes (CLSI) guidelines. The antibiotics tested were Oxacillin, Penicillin, Erythromycin, Gentamicin, Vancomycin and Mupirocin. Zone of inhibition against Cefoxitin that equal to or less than 21mm were identified as MRSA while larger than 21mm were identified as Methicillin-susceptible *S. aureus*.

Data were entered and analyzed by using SPSS software version 22.0 (International Business Machines Corporation, USA). Chi-square test, independent t test, simple and multiple logistic tests were to analyze the data. $p < 0.05$ is considered significant.

RESULTS

A total of 205 dental students were participated in this study which comprises 50.7% (n=104) pre-clinical year and 49.3% (n=101) clinical year students. Their age ranged from 20 to 26 years old, with a mean (standard deviation) of 22.29 (1.73) years (Table 1). The male to female ratio was 1:2.5. Eighteen percent (n=37) of dental student had *S. aureus* colonization in their nasal cavity. Forty-nine percent (n=18) were from pre-clinical while 51.4% (n=19) were from clinical year. No MRSA strain was found in their nasal cavity.

Table 1. Comparisons of characteristics of dental students among positive and negative *S. aureus* nasal carriage (n=205)

Characteristics	Nasal carriage of <i>S. aureus</i>		p value
	Positive (n=37) n (%)	Negative (n=168) n (%)	
Age (years)	22.19 (1.68)*	22.32 (1.75)*	0.690**
Gender			0.850
Male	10 (17.2)	48 (82.8)	
Female	27 (18.4)	120 (81.6)	
Year Grade			
Pre-clinical			
Year 1	9 (18.8)	47 (83.9)	
Year 2	9 (16.1)	31 (77.5)	
Clinical			0.846
Year 4	9 (22.5)	29 (72.5)	
Year 5	10 (16.4)	51 (83.6)	
Year of clinical exposure			0.709
0	18 (17.3)	86 (82.7)	
1	9 (22.5)	31 (77.5)	
2	10 (16.4)	51 (83.6)	
Duration of clinical exposure (months)	35.49 (36.18)*	26.92 (30.68)*	0.187**
Currently on antibiotics treatment			0.551***
No	35 (17.9)	161 (82.1)	
Yes	1 (25.0)	3 (75.0)	
Last antibiotics used			0.889
≤6 months ago	20 (19.2)	84 (80.8)	
>6 months ago	9 (18.4)	40 (81.6)	
Underlying diseases			0.623
No	27 (17.3)	129 (82.7)	
Yes	10 (20.4)	39 (79.6)	
Fever in past two weeks			0.246
No	33 (17.8)	152 (82.2)	
Yes	4 (21.1)	15 (78.9)	
Common cold in past two weeks			0.246
No	28 (16.8)	139 (83.2)	
Yes	9 (25.0)	27 (75.0)	
Common cold in a year			0.939
≤5 times	28 (17.8)	129 (82.2)	
>5 times	5 (17.2)	24 (82.8)	
Living place			0.568
Murni hostel	14 (15.7)	75 (84.3)	
Nurani hostel	20 (18.6)	81(80.2)	
Outside	3 (27.3)	8 (72.7)	
Any family member a health care worker			0.020
No	23 (14.5)	136 (85.5)	
Yes	13 (29.5)	31 (70.5)	
History of hospitalization			0.431
No	24 (16.7)	120 (83.3)	
Yes	12 (21.4)	44 (78.6)	

*Mean (SD) **Independent t test ***Fisher Exact test.

Table 2. Factors influenced the presence of *S. aureus* nasal carriage among dental students by univariable and multiple logistic regression model (n=205)

Variable	Simple logistic regression			Multiple logistic regression		
	b	Crude OR (95%CI)	p	b	Adjusted OR (95%CI)	p
Duration of clinical exposure Common cold in past two weeks	0.08	1.01 (1.00, 1.02)	0.141	0.01	1.01 (1.00, 1.03)	0.058
No	0	1		0	1	
Yes	0.50	1.66 (0.70, 3.90)	0.249	0.77	2.15 (0.75, 6.17)	0.154
Any family member a health care worker						
No	0	1		0	1	
Yes	0.91	2.48 (1.13, 5.43)	0.023	1.01	2.74 (1.08, 6.95)	0.034

Carriages of *S. aureus* was significantly associated with presence of health care worker among their family member ($p = 0.020$), and this was the only variable showed significant in simple logistic regression. There was no significant association between the carriers and non-carrier of *S. aureus* with age, gender, year grade, year and duration of clinical exposure, antibiotics used, underlying diseases, history of recent common cold and fever, living places and history of hospitalization. However, they were also included in a multiple logistic regression because of their clinical importance even though did not contribute statistically significant in simple logistic regression (Table 2). Dental students with any of their family member work as a healthcare worker has 2.74 times the odds compared to dental students without any of their family member work as a health worker to have positive nasal carriage *S. aureus*.

DISCUSSION

In Malaysia, the prevalence of *S. aureus* nasal colonization was in the range of 20.0% to 30.0% in various populations studied (Choi *et al.*, 2006). A study done in one of the institution in Malaysia found the rate of *S. aureus* colonization among medical students was 26.0% out of 100 of their medical

students. Treesirichod *et al.* (2014) reported that the rate of nasal colonization among medical students in their center was within the range of 29.7% to 39.4%. However, no data was recorded as far as dental students are concern. In the current study, the rate of *S. aureus* nasal colonization was 18.0%. As mentioned earlier dentals student are also involved in direct patients contact in clinical management while they are in year 4 and 5, and they can be the source of *S. aureus* transmission to patients (Nor Shamsudin *et al.*, 2008). Mode of transmission can be through contact or through inhalation during management of the patients. If the students had *S. aureus* colonization, it could be transmitted to their patients if they did not comply with proper infection control measures. In the current study, 18.0% of dental students had nasal colonization with *S. aureus*. This finding was similar to the several studies done from 1991 to 2012 (Chang *et al.*, 1998; Corbella *et al.*, 1997; Davis *et al.*, 2004; Fishbain *et al.*, 2003; Muder *et al.*, 2006; Muder *et al.*, 1991; Pujol *et al.*, 1993; Vriens *et al.*, 2002), in which the prevalence was between 13.7% to 34.2% of dental students population colonized with *S. aureus* in their nasal cavity. In this study, there was no MRSA colonization found neither in preclinical nor clinical dental students. The current finding contradicts with a study done in Mexico that reported 20.0%

of their dental students were MRSA positive (Martínez-Ruíz *et al.*, 2014).

In the current study, dental students having a family member who is a healthcare worker tends to have higher *S. aureus* nasal carriage rate than those who had not ($p < 0.005$). The current study showed a higher percentage (29.5%) as compared to a study done by Chen *et al.* (2012) in Taiwanese university which reported 22.2% of students who have family member work as healthcare worker carried *S. aureus*. Further study on molecular characteristic should be done to investigate whether the students acquired similar *S. aureus* strain from their relatives. There was no significant association between the carriers and non-carriers of *S. aureus* with antibiotic exposure, history of cold and respiratory illness in the past, students in pre-clinical or clinical year.

In conclusion, *S. aureus* nasal carriage was low among dental students and similarly they did not carry MRSA strain in their nasal cavity. As far as infection control measures are concerned, based on the findings in the current study the screening of all the dental students for *S. aureus* and MRSA before they enter clinical posting is still not worth doing because of the low rate of colonization. Instead, they need to practice other infection control measures like hand hygiene and proper wearing of personal protective equipment while taking care of patients in the dental clinic to prevent cross contamination.

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Competing interest

No conflict of interest.

Ethical consideration

Permission to conduct the study was obtained from the Dean, School of Dental Sciences, USM. Informed consent has been taken and

study ethics was approved by Human Research Ethics Committee USM: USMKK/PPP/JEPeM [261.3.(5)].

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