

Investigation of Nasal Colonization of Methicillin-Resistant *Staphylococcus aureus* Among Nursing Students at a University in Sri Lanka

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Abstract Methicillin-Resistant *Staphylococcus aureus* (MRSA) is one of the important pathogenic bacteria within the hospital and the community. Asymptomatic nasal carriers are potential sources for transmission and subsequent infection. Objectives of this study were to determine the MRSA nasal colonization among nursing students of the Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka and to assess associated risk factors. This was a descriptive cross-sectional study which was conducted from January 2020 to March 2020 with voluntary participation of 135 nursing students. Relevant data were collected by using a pre-tested, self-administrated questionnaire. Participants were requested to collect nasal swabs to investigate colonization of MRSA. Routine standard microbiological methods were used to isolate *Staphylococcus aureus* and cefoxitin disk diffusion method used to detect methicillin sensitivity. Collected data were statistically analyzed and the possible associations with risk factors were assessed by cross tabulations and chi-square test. Total of 135 participants constituted with 34 males and 101 females between 21-27 years. Out of them 15.56% (21/135) were identified as colonized with *Staphylococcus aureus* and 5.19% (7/135) were MRSA. History of skin infection was the only known risk factor identified as associated with MRSA nasal colonization (OR=26, CI=2.99-226.13, p=0.00). Although identified MRSA colonizers are relatively low in the present study they are potential candidates for transmission and is a

concern in healthcare facilities. As screening programs are limited in Sri Lanka due to lack of facilities and financial resources, students should be emphasized regarding simple preventive measures such as hand hygiene.

Keywords: Methicillin-Resistant *Staphylococcus aureus* (MRSA), Nasal colonization, Nursing students, Risk factors

Introduction:

Staphylococcus aureus is a human commensal bacterium, 20-30% of the healthy human population carries it on the skin and mucous membranes especially in nose and perineum (Sakr *et al.*, 2018). Although it is a human commensal it can be invasive and cause wide range of infections including skin abscess, post-operative wound infections, septicemia and pneumonia. (Guidelines for the Control of Methicillin-resistant *Staphylococcus aureus* in New Zealand, 2002). Treatment of *Staphylococcus aureus* infections has become more complicated and significantly limited due to MRSA strains (Prates *et al.*, 2010) (Altamimi *et al.*, 2018). The majority of hospital-acquired infections (HAI) are caused by MRSA strains. Worldwide largely concern about increasing prevalence of MRSA infections and controlling the spread of organisms (Thevanesam *et al.*, 2013). The primary route of MRSA transmission in the health care setting is through, direct contact with an infected person, contaminated hands of healthcare workers and, asymptomatic carriers of MRSA (Tong *et al.*, 2015). Usually, MRSA carriers are not clinically infected but MRSA organisms can be colonized on their

skin (odu NN, 2012). Most areas of the body can colonize with MRSA, but nose, throat, groin, and hands have been identified as hotspots for MRSA colonization (Brown *et al.*, 2015). It has identified nasal carriers are playing a key role in pathogenesis and subsequent MRSA infections (Prates *et al.*, 2010). Screening has facilitated the early identification of the MRSA colonized individual and promote contact precautions. It is involved performing culture and sensitivity test on a collected sample such as nasal, groin, and throat. Nursing students are encountered with more patients and involved in direct patient care during the clinical practice at the hospital. Due to prolonged contact with the patients, there is a significant risk of transmission pathogens among nursing students and patients. Hence, this study was designed to identify the nasal colonization of MRSA, and to evaluate the associated risk factors among nursing students at the Department of Nursing, Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka.

Methodology:

Study design and Setting

A descriptive cross-sectional study was conducted from January 2020 to March 2020 at the Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka. A total of 135 undergraduate nursing students from first year to the final year, who are currently engaged in hospital based clinical training were recruited according to the inclusion and exclusion criteria. Therefore Students who had contraindications for nasal sampling such as recent nasal surgery, active nasal bleeding and use of nasal medications were excluded.

Data collection and sample processing:

A pre-tested, self-administered questionnaire was administered to the participants to assess socio-demographic factors and known MRSA risk factors.

Self-collected nasal swab samples were used to investigate the colonization of MRSA in the nasal cavity. Pre-moistened (with sterile saline) swab used to collect sample along with the questionnaire. Collected samples were transferred to the Department of Microbiology, Faculty of Medicine, University of Peradeniya with minimum delay for specimen processing. Collected nasal swabs were enriched in 7% NaCl nutrient broth individually and incubated for overnight at 35° C. Enriched samples were inoculated on mannitol salt agar and incubated at 35° C for 18-24 hours. Following the incubation, observed for suspected staphylococcus colonies according to colony morphology (suspected colonies appeared yellow colour in mannitol salt agar).

Suspected staphylococcus colonies sub cultured on blood agar and incubated at 35° C for 18- 24 hours to obtain pure-isolates. Gram staining, catalase enzyme test, slide coagulase, tube coagulase and DNase test performed for identification of *Staphylococcus aureus*. Methicillin sensitivity test for *Staphylococcus aureus* were tested by using the standard cefoxitin disc diffusion method according to guidelines of the Clinical and Laboratory Standards Institute. The inhibition zone diameter was measured and interpreted using CLSI recommendations (resistant \leq 21 mm, sensitive \geq 22 mm)(Clinical and Laboratory Standards Institute, 2018).

Ethical consideration:

Ethical clearance was obtained from the Ethics Review Committee of Faculty of Allied health Sciences, University of Peradeniya (AHS/ERC/2019/064) on 19th December 2019.

Data analysis

Data were analyzed by statistical package for social sciences (SPSS) 25.0 version. First analyzed for frequencies and then descriptively. Cross tabulation by the chi-square test were done to explore possible association between MRSA nasal colonization and known risk factors.

Results and Discussion:

Out of 160 nursing students, 135 (84.4%) students from first year to final year, who were matched with inclusion and exclusion criteria were voluntarily recruited for the current study. The age ranged between 21 and 27 years and mean age of the participants were 23.66 years \pm 1.10. Among the participants, 25.19% (34/135) were males and females were constituted 74.81% (101/135). The distribution of students according to the year of study as follows; 32.6% (44/135) were from the first year and respectively, 32.6% (44/135), 19.3% (26/135), 15.6% (21/135) from the second year, third year and fourth year. The majority of study participants are residing in university hostels 83.7% (113/135), students from boarding houses and homes were 16.3% (22/135). Among the participants 83.7% (113/135) are living with three or more members in above said accommodation facility and 16.3% (22/135) were living with less than three members.

Staphylococcus aureus nasal colonization and methicillin resistance

Out of 135 nursing students, *Staphylococcus aureus* was identified among 21 amounting to 15.56% (21/135), out of them 7 were identified as MRSA 5.19% (7/135). Accordingly Out of all identified *Staphylococcus aureus* isolates only 33.3% (7/21) were Methicillin resistant.

MRSA nasal colonization among male participants were 8.8% (3/34) and among females were 4.0% (4/101). All the

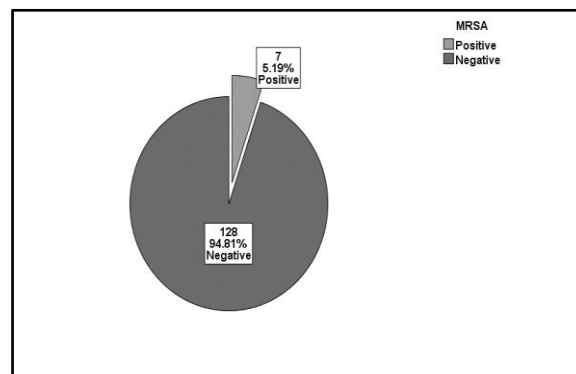


Figure: 1. Representing nasal colonization of MRSA among the participants

participants with MRSA nasal colonization were residents of the university hostels amounting to 6.2% (7/113) and crowded with three or more members in their living room 6.2% (7/113). There was a statistically significant association between history of skin infection in the past 12 months and MRSA nasal colonization 20% (6/30) (OR=26, CI=2.99-226.13, p= 0.000) but any other risk factor did not show any significant association between risk factors and MRSA nasal colonization. Although there was not statistically significant association between MRSA nasal colonization and clinical meeting with a MRSA infected or colonized patient majority of participants have met a patient with MRSA infection or colonization during their clinical training. Out of them 6.7% (7/89) were colonized MRSA while 5.6% (4/71) had nursing care experience with a MRSA infected or colonized patient. Almost, all the participants with MRSA nasal colonization 100% (7/7) practiced hand hygiene after contact with patients. Among the MRSA colonizers only one have used antibiotic in the past three months 1.8% (1/56).

Table: 1. Association of socio-demographic factors and risk factors for nasal colonization of MRSA among the participants (n=135)

Associated factor		MRSA colonization		p value
		Positive n (%)	Negative n (%)	
Demographic factors				
Gender	Male (n=34)	3(8.8)	31(91.2)	0.269
	Female (n=101)	4(4.0)	97(96.0)	

Accommodation	Home or Boarding room (n=22)	0(0.0)	22(100.0)	0.231
	Hostel (n=113)	7(6.2)	106(93.8)	
Number of room members living in one room with participant	Less than 3 (n=22)	0(0.0)	22(100.0)	0.231
	Three or more together (n=113)	7(6.2)	106(93.8)	
Risk factors				
Family history of infection and colonization	Yes (n=5)	0(0.0)	5(100)	0.739
	No (n=130)	7(5.3)	123(94.6)	
Clinical exposure to a patient with MRSA infection or colonization	Yes (n=89)	6(6.7)	83(93.3)	0.257
	No (n=46)	1(2.2)	45(97.8)	
Provided nursing care to a patient with MRSA infection or colonization	Yes (n=71)	4(5.6)	67(94.4)	0.804
	No (n=64)	3(4.7)	61(95.3)	
Hand hygiene after contact with patient	Yes (n=131)	7(5.3)	124(94.7)	0.635
	No (n=4)	0(0.0)	4(100)	
Hospitalization in the past 12 months	Yes (n=16)	0(0.0)	16(100)	0.319
	No (n=119)	7(5.9)	112(94.1)	
Undergone surgery in the past 12 months	Yes (n=4)	0(0.0)	4(100)	0.635
	No (n=131)	7(5.3)	124(94.7)	
Skin infection in the past 12 months	Yes (n=30)	6(20.0)	24(80)	0.000
	No (n=105)	1(1.0)	104(99.0)	
Use of antibiotics in the past 03 month	Yes (n=56)	1(1.8)	55(98.2)	0.134
	No (n=79)	6(7.6)	73(92.4)	
Involvement of sports	Yes (n=37)	1(2.7)	36(97.3)	0.424
	No (n=98)	6(6.1)	92(93.9)	

Prevalence of MRSA colonization among different communities is reported worldwide including hospital in patients, healthcare workers, medical students, and community (Kim, Yim and Jeon, 2015). Approximately MRSA colonization rate ranged from 5.8 - 17% among health care workers worldwide. Literature showed high prevalence rate of MRSA colonization among health care workers in developing countries (Shibabaw,

Abebe and Mihret, 2013). Results of present study is lower than MRSA colonization rates reported among healthcare workers in worldwide.

International studies reported with different rates of *Staphylococcus aureus* colonization among medical students, with the range of 14-45% while MRSA colonization rate within 0 - 14.3% (Al-tamimi *et al.*, 2018). Results of the present study are within the range MRSA colonization rate which reported among medical students. Published data regarding MRSA colonization among nursing students are limited. The MRSA nasal carriage rate of 1.4% (3/215) among nursing students at university in Chungcheongbuk-do, Korea (Kim, Yim and Jeon, 2015) is lower than the findings of the present study.

In Sri Lanka, hospital isolation rates of MRSA is relatively high. MRSA colonization rate was 15.4% (260/1684) on admission among orthopedic patients at Teaching Hospital Peadeniya and patients who negative on admission were rescreened weekly during the hospital stay. Out of 1424 rescreened patients 170/1424 acquired MRSA (Thevanesam *et al.*, 2013). MRSA nasal colonization rate was 6.2% (31/502) among patients admitted to the Karapitiya Teaching Hospital (Kurukulasooriya *et al.*, 2018). But MRSA colonization identified in the present study is (5.19%) relatively lower than MRSA colonization rates identified among hospital inpatients in above studies. Furthermore, MRSA colonization rate was 4.3% among healthy university residential students representing five different faculties at University Peradeniya. Both nasal swabs and peri-rectal swabs were collected in this study. But nasal colonization rate identified in the present study(5.19%) is higher than the rate identified by that study (Munasinghe *et al.*, 2019).

History of skin infection is the only risk factor statistically associated with MRSA

colonization (20.0%, OR=26, CI=2.99-226.13, p value=0.000) in the current study while other studies reported statistically significant association with gender, chronic illness, history of hospitalization and antibiotic usage. But in the present study, none of the MRSA colonizers have been hospitalized for the past 12 months while only one colonizer reported with antibiotic usage during the past 3 months of period. Interestingly in the present study, there was no significant association between clinical exposure and MRSA colonization whereas 6.7% (6/7) of the MRSA colonizers have met a patient with MRSA infection or colonization during hospital training while 5.6% (4/7) had an experience of providing nursing care to a patient with MRSA infection or colonization. Knowledge of basic infection management, proper hand hygiene, and use of protective equipment in nursing care may have affected the transmission of MRSA among patients and students. As most of the known risk factors have not shown to be associated with MRSA colonization in the present study, this may indicate that possible risk factors yet to be identified if any which associate with the nasal colonization of MRSA among nursing students.

Conclusion and Recommendations:

The present study provides an overview of MRSA nasal colonization of the nursing students attached to a university in Sri Lanka. Among 135 nursing students, 15.6% (21/135) which is a significant percentage, was identified as colonized with *Staphylococcus aureus* and 5.2% (7/21) of those were MRSA. As nursing students are involved with healthcare, carriage of MRSA is a concern in infection control. History of skin infection in the past 12 months was the only known risk factor identified in this study with significant association with MRSA colonization. Screening programs are limited in Sri Lanka due to lack of facilities and financial resources. But simple preventive measures such as hand hygiene which is both affordable and effective

for preventing MRSA transmission need to be strengthened in healthcare. Awareness of MRSA is vital to prevent transmission and subsequent infections, especially students' exposure to the clinical-setting. Future studies should be conducted in a large population with healthy participants to identify the extent of the carriage and the possible risk factors associated with MRSA colonization. Further molecular studies will be beneficial to characterize MRSA strains associated with healthy individuals.

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