

NASAL CARRIAGE OF METHICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS* AMONG TERTIARY CARE HOSPITAL EMPLOYEES IN A NON-OUTBREAK SETTING

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ABSTRACT

Objective: To estimate the frequency of methicillin resistant *Staphylococcus aureus* (MRSA) nasal carriage in employees of a tertiary care hospital.

Study design: Descriptive cross-sectional study

Place and Duration of Study: This descriptive cross-sectional study was carried out in Lahore General Hospital, Lahore during October, 2015 – January 2016. The samples were processed according to standard operating procedures at Microbiological laboratory of Post Graduate Medical Institute, Lahore.

Materials and Methods: Nasal swabs were collected from three hundred and eighty healthcare personnel working in various clinical wards of Lahore General Hospital, Lahore. Preliminary identification of *Staphylococcus aureus* was done by observing colony morphology and mannitol fermentation on mannitol salt agar, Gram stain and catalase test. Further biochemical test, DNase, was applied for the confirmation of the organism. The phenotypic resistance to methicillin was determined using Cefoxitin disk 30 µg according to CLSI guidelines.

Results: Out of 380 nasal samples, 89 (23.42%) cultures yielded the growth of *S. aureus* out of which 31 (34.83%) were MRSA. The overall frequency of MRSA among all the HCWs was 8.15%. The MRSA carriage was more in males (9.7%). Age group of 50 years and above had the highest number of carriers (12.34%). The working category most affected was the paramedic staff (12.50%). The highest number of MRSA carrier HCWs were working in the Pediatrics department (15.15%).

Conclusion: The results of our study emphasize the need for the formulation of effective infection control policies within the healthcare setups

Keywords: *Staphylococcus aureus*, MRSA, Nasal carriage, Hospital employees/ healthcare workers.

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INTRODUCTION

Hospital-acquired infection (HAI) has negative influence on patient outcomes causing increased morbidity and mortality [1]. It has become a major problem all over the world, therefore the reduction and prevention of HAI are a leading priority to improve quality of care and safety of the patient [2]. For the last two decades, methicillin-resistant *Staphylococcus aureus* (MRSA) has come to the forefront of the scene. It has become endemic in many hospitals and is one of the most common pathogens associated with the outbreaks within the healthcare facilities [3].

Colonization is an important step in the pathogenesis of methicillin-resistant *Staphylococcus aureus* (MRSA) infection. Both patients and healthcare workers (HCWs), colonized by MRSA, play a significant role in being the reservoir within

healthcare environment [4]. It is often transmissible and the carriage appears to lead to clinical infection with greater frequency. Healthcare workers who are at the interface between hospitals, nursing homes, ambulatory care and long-term healthcare facilities on one hand and community on the other, may serve as a source of MRSA cross transmission [5].

Staphylococcus aureus and MRSA nasal colonization rate among healthcare workers has been found to be much more than in the community members. [6,7]. One of the major risk factor associated with increased MRSA nasal carriage rate and its transmission is the vicious cycle comprising of transiently colonized hands of the HCW with MRSA from the patient or the hospital environment, becoming the nasal carrier of the same strain, contamination of hands with the endogenous strain and transmission again to the patients [8].

The risk of MRSA transmission via transiently colonized hands of permanent nasal MRSA carriers in HCWs to the patients or hospital environment is three to six times greater than non-carriers and low-level carriers [9]. Poor infection control practices are

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usually implicated in both acquisition and transmission of MRSA by healthcare personnel, though, good infection control practices (including masks) and hand hygiene did not prevent the transmission completely from the heavily colonized healthcare providers to the patients. [10]

The importance of screening for MRSA colonization in the HCWs has been recognized and its eradication has been recommended as the main part of a comprehensive infection control policy. The hospital infection control staff needs to limit the spread of MRSA. A guideline has been published by the U.S. Centres for Disease Control and Prevention for controlling the spread of MRSA (<https://www.cdc.gov/mrsa/healthcare/clinicians/prevention/index.html>). It has emphasized upon the use of standard precautions by healthcare workers including regular surveillance and eradication of nasal *S. aureus* and MRSA, hand wash after visiting every patient, wearing protective mask when coming in contact with the patient harbouring MRSA and some other parameters, showing that this would work [11].

MATERIALS AND METHODS

The present study was conducted on the health care workers from Lahore General Hospital, Lahore after taking informed consent. Various clinical departments which included Intensive Care Unit, Gynecology/Obstetrics, Internal medicine/ medical allied departments (dialysis unit), General surgery/surgical allied wards (Orthopedics, Neurosurgery, Urology, Eye and Ear-Nose-Throat) and Pediatrics were visited systematically to collect the specimens. The working category of the health care workers participating in the study was categorized as doctor, nurse, paramedic staff (operation theatre assistant, anesthesia assistant, sterilizer operator, technician, physiotherapist and dispenser) office worker (clerk, peon, computer operator and receptionist) and janitorial staff (sweeper, aya, ward boy and gate keeper). HCWs' profile was recorded which includes gender, age, ward, working category and duration of work in the healthcare environment.

Each participant was provided with a sterile cotton swab, moistened with normal saline and was instructed to insert the cotton swab into both nostrils in turn, to a depth of approximately 1 cm and to rotate about four to five times, ensuring that each swab contained specimens from both nares of each subject.

The specimens were labelled with the name, laboratory number and date. All the specimens were

taken in Amies transport medium to the microbiology department of Post Graduate Medical Institute, Lahore.

The specimens were inoculated on Mannitol salt agar plates along with the positive and negative controls. MSSA ATCC 25923 was used as positive control and *Staphylococcus epidermidis* ATCC 12228 was taken as negative control. All cultured plates were incubated at 35° C for 24 hours. Mannitol fermenting, yellow colored colonies were subjected to Gram staining. After finding Gram positive cocci in clusters, further biochemical tests like Catalase and DNase were performed for the confirmation of *Staphylococcus aureus*.

According to Clinical Laboratory Standards Institute (CLSI) guidelines, resistance to Methicillin was determined by disk diffusion method using 30 µg Cefoxitin disk (Oxoid Ltd) on Mueller Hinton agar plates. For each strain, a bacterial suspension adjusted to 0.5 McFarland turbidity standards was used. The plates were incubated for 24 hours at 35°C. Interpretation was done according to CLSI criteria i.e. zone of ≤ 21 mm was considered as resistant and ≥ 22 mm was considered to be sensitive. MRSA ATCC 33591 was used as positive control while MSSA ATCC 25923 was taken as negative control.

RESULTS

Three hundred and eighty hospital employees provided nasal swab samples after consent. The demographic characteristics of the participants are listed in Table 1.

The results of 380 nasal swab cultures showed that 89 (23.42%) cultures yielded the growth of *Staphylococcus aureus*. 260 (68.42%) cultures revealed the growth of Coagulase Negative *Staphylococcus* while 31 (8.15%) cultures had no growth as shown in Figure-1.

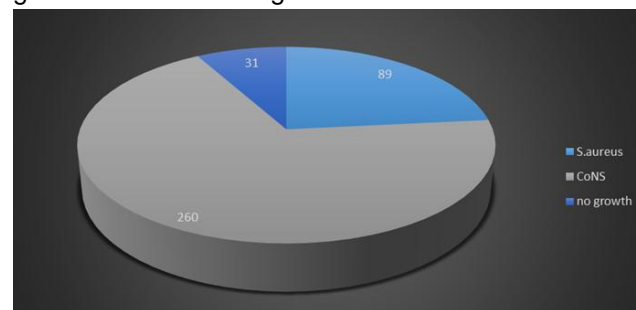


Figure-1: Culture results of nasal swabs of the HCWs in the study (n=380).

Out of 89 *S. aureus* being isolated in the present study, 34 % were MRSA. The overall

frequency of MRSA among hospital employees is shown in Table-2. The rate of nasal carriage of Staphylococcus aureus and MRSA varied among the HCWs according to their gender, age groups, working category, ward and duration of healthcare employment is shown in table 3-7.

Table-1: Demographic Characteristics of Health Care Workers in the study (n=380)

Characteristics	No. (%)
Gender	
Male	206(54.21)
Female	174(45.78)
Age group (years)	
<20	5 (1.31)
20-29	139(36.57)
30-39	110(28.94)
40-49	68(17.89)
≥ 50	58(15.26)
Clinical ward	
Intensive Care Unit	
Gynaecology/Obstetrics	
Surgery /Surgical allied	
Internal Medicine/ Medical allied	
Pediatrics	
Working category	
Doctor	143(37.63)
Nurse	85(22.36)
Paramedic staff *	56(14.73)
Office worker **	19(5.00)
Janitorial staff ***	77(20.26)
Length of healthcare employment (years)	
<1	50(13.15)
1-5	145(38.15)
6-10	77(20.26)
>10	108(28.42)

*Operation theatre assistant, anesthesia assistant, sterilizer operator, technician, physiotherapist and dispenser.

** Clerk, peon, computer operator and receptionist.

***Sweeper, aya, ward boy and gate keeper.

°Surgical allied: Neurosurgery, Orthopedics, ENT, Eye and Urology.

°°Medicine allied: Dialysis unit.

Table-2: Overall Frequency of S. aureus and MRSA among HCWs in the study (n=380)

HCWs	S. aureus (%)	MRSA (%)
380	89 (23.42)	30 (8.15)

Table-3: Frequency of Nasal Colonization with S. aureus and MRSA among HCWs according to gender (n=380).

Gender	S. aureus	MRSA
Male (n=206)	47(22.81%)	20(9.70%)
Female (n=174)	42 (24.13%)	10(5.74%)

(p> 0.05)

Table-4: Frequency of Nasal Colonization with S. aureus and MRSA among HCWs according to their Age Groups (n=380).

Age Group	S. aureus	MRSA
<20 years (n=5)	1 (20.00%)	0 (0%)
20-29 years (n=139)	29 (20.86%)	9 (6.47%)
30-39 years (n=110)	27 (24.54%)	7 (6.36%)
40-49 years (n=68)	15 (22.05%)	7 (10.29 %)
≥50 years (n=58)	17 (29.32%)	7 (12.34%)

Table-5: Frequency of Nasal Colonization with MRSA among HCWs working in various clinical wards (n=380).

Ward	S. Aureus	MRSA
Intensive care unit (n=27)	6(22.22%)	4(14.81%)
Gynaecology/ obstetrics (n=36)	11(30.55%)	2(5.55%)
Surgery / surgical allied° (n=229)	52(22.7%)	18(7.86%)
Internal medicine/ medicine allied°° (n=55)	11(20.0%)	1 (1.8%)
Pediatrics (n=33)	9(27.27%)	5(15.15%)

° Surgical allied: Neurosurgery, Orthopedics, ENT, Eye and Urology.

°°Medicine allied: Dialysis unit. (p>0.05)

Table-6: Frequency of Nasal Colonization with MRSA among Various Working Categories of the HCWs (n=380)

Category	S. aureus	MRSA
Doctors(n=143)	29(20.27%)	10 (6.99%)
Nurse (n=85)	20(23.52%)	6 (7.05%)
Paramedic staff* (n=56)	21(37.50%)~	7(12.50%)~
Office worker ** (n=19)	6 (31.57%)	1(5.26%)
Janitorial staff *** (n=77)	13(16.88%)	6(7.79%)

*Operation theatre assistant, anesthesia assistant, sterilizer operator, technician, physiotherapist and dispenser.

** Clerk, peon, computer operator and receptionist.

*** Sweeper, Aya, ward boy and gate keeper.

~No significant difference as compared to other HCWs group. (p>0.05)

Table-7: Frequency of Nasal Colonization with S. aureus and MRSA among HCWs according to the length of their healthcare employment (n=380)

Length of healthcare employment (years)	S. aureus	MRSA
<1(n=50)	8(16.0%)	4(8.0%)
1-5(n=145)	36(24.82%)	8(5.51%)
6-10(n=77)	17(22.07%)	7(9.09%)
>10 (n=108)	28(25.92%)	11 (10.18 %)

(p>0.05)

DISCUSSION

Methicillin resistant *Staphylococcus aureus* has been recognized as one of the most common pathogen associated with nosocomial infections and continues to be a major problem for infection control [3]. The present study was designed by keeping in view the threat of MRSA cross transmission in the hospitals and other healthcare facilities through asymptomatic MRSA nasal carriage among the healthcare workers. In our study, culture results of the nasal swabs revealed growth of *S. aureus* in 89 (23.42%) cases and CoNS were seen in 260 (68.42%) cultures while 31(8.15%) swabs did not show any growth. Similar type of results was shown in other studies as well [6, 12].

The prevalence of nasal carriage of *Staphylococcus aureus* and MRSA varies between institutions and different geographic areas. In the present study the overall prevalence of staphylococcal aureus nasal carriage is 23.42% and that of MRSA is 8.15%. Similar type of study was done in a public hospital in India [11] which shows colonization rates of 23.1% for *S aureus* and 7.1% for MRSA. A meta-analysis (4) including more than twenty studies with a sample size of at least 100 HCWs in non-outbreak situation revealed that the mean *S.aureus* nasal colonization was 24% \pm 8.9%. Mean nasal MRSA colonization was 6.8% \pm 4.7% for developing countries and 3.5% \pm 2.5% for developed nations. However, some researchers report either very low [13] or very high prevalence of nasal carriage of *S.aureus* and MRSA [14].

In present study MRSA nasal colonization for males is 9.7% as compared to females which is 5.7%. Similar results are shown in Kenya [13]. Contrary to this, more percentage of MRSA nasal carriage in females was observed in Australia [15]. In our study the maximum percentage (12.34%) of MRSA nasal colonization is seen in age group of 50 years and above followed by age group of 40-49 years. Two other studies [16,17] also showed that age group above 50 years had maximum carriers for nasal MRSA. On the other hand, contrast findings were reported in a study conducted in Saudi Arabia. [18]. However, many researchers reported no association of age to nasal carriage of MRSA [13,19].

Distribution of MRSA among HCWs in various clinical wards varies in different hospitals in Pakistan as well as abroad. MRSA colonization rate was maximum in Pediatrics (15.15%), followed by ICU (14.81%), surgery (7.86%), Gynae/Obs (5.5% and internal medicine and medical allied wards (1.8%). Some similar studies also report highest MRSA colonization

rates in Pediatrics [4, 20]. Some of the researches, however, report maximum recovery of MRSA from surgical wards [5, 13].

In our study, the highest nasal carriage rate for MRSA was observed in Paramedic staff which was 12.5%. Similar results were shown in a study conducted in India. [6] Similar type of study was carried out by Rongpharpi et al (2013) in India. He also reported that paramedic staff had the highest rate of *S. aureus* and MRSA nasal colonization (51% and 13% respectively). Similarly, a study was carried out by Turenne et al in New Jersey (2010), reporting highest colonization rate among the paramedics.

In contrast to our study, Ahmed et al carried out a study in Saudi Arabia (2010). The highest MRSA nasal colonization rate was seen among the doctors in Saudi Arabia [18] while in nurses in Kenya [21]. The highest number of carriers of MRSA (10.18%) were among the group which had working experience of more than 10 years although the difference from other groups was not statistically significant. Two other studies report no difference in colonization rate with respect to healthcare employment length. [13, 21].

CONCLUSION

For healthcare associated infections, especially those caused by MRSA, health care workers (HCWs) are important in the nosocomial transmission dynamics. HCWs who become persistently colonized with MRSA, e.g., in the nose, act as a constant source for MRSA transmission. This calls out for the implementation of sound and functional infection control policies.

AUTHORS CONTRIBUTION

Amina Asif: Entire research work, sample collection, analysis, literature review and writeup.

Iffat Javed: Planning of research, literature review, help in writeup.

Sohaila Mushtaq: Literature review, help in writeup

Saeed Anwar: Overall supervision

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