ORIGINAL ARTICLE

NASAL CARRIAGE RATE OF METHICILIN RESISTENT STAPHYLOCOCCUS AUREUS (MRSA) AMONG HEALTH CARE WORKERS OF A TERTIARY CARE HOSPITAL

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ABSTRACT

Background and Objective: Nosocomial infections are increasing worldwide. Staphylococcus aureus is an important pathogen causing nosocomial infections. Anterior nasal nares are ideal site for Methicillin Resistant Staphylococcus aureus (MRSA) to reside. Health care workers who are carrier of MRSA, can transmit Staphylococcus to the patients, which is a significant cause of increase in nosocomial infections worldwide. The objective of this study was to find out the nasal carriage rate of MRSA among health care workers of a tertiary care hospital.

Methods: It was cross sectional study conducted from July 2014 to Feb 2015 at Pathology Department, Allama Iqbal Medical College, Lahore. One hundred nasal swab samples were collected from health care workers of Jinnah Hospital, Lahore. Anterior nasal swabs were taken from health care workers. Swabs were inoculated on blood and mannitol salt agar and incubated at 37°C for 24 hours. Growth of Staphylococcus was identified on colonial morphology, Gram stain, catalase test, coagulase test, DNAse test. Antimicrobial susceptibility testing was performed by using cefoxitin disc 30 µg for MRSA screening.

Results: In our study 100 nasal swab samples were collected. S.aureus was isolated from 40 nasal swab samples of health care workers. Out of total 40 S.aureus isolates, 27 were MRSA. Out of total 41 (37%) samples of doctors, 10 (24.39%) yielded MRSA. Out of 29 (22.2%) samples of nursing staff, 6 (20.69%) yielded MRSA. Out of 30 (40.7%) samples of sanitary workers, 11 (36.66%) yielded MRSA. Staphylococcus aureus was isolated among 40% samples of health care workers, out of which 27% were MRSA.

Conclusion: The result of our study revealed an alarming rate of nasal carriage of MRSA among health care workers of Jinnah Hospital, Lahore. The nasal carriage rate of MRSA in this study is 27%, which is a serious threat to patient and important source of nosocomial infections. It should be a routine to screen all health care workers twice yearly for MRSA nasal carriage.

Key Words: MRSA, Nasal Carriage, Health Care Workers.

INTRODUCTION

Staphylococcus aureus is most significant bacterial species of Staphylococcus responsible for most of the Gram positive infections. *S.aureus* has been recognized as significant cause of disease in the world. It has also become the important pathogen associated with hospital and community acquired infection.[1]

S.aureus causes different infections in humans. It causes cellulitis, sepsis, postules, abscess formation, carbuncles, endocarditis, wound infections, urinary tract infections (UTI), pneumonia. *S.aureus* causes food poisoning and toxic shock syndrome by releasing enterotoxin in food and super-antigen in blood. *S.aureus* is important cause of nosocomial infection of surgical wounds and infection related to indwelling medical devices.[1]

S.aureus has many potential virulence factors that play an important part in spread of infections such as surface protein, hyaluronidase, protein A, hemolysins.[2]

Patients and health care workers are carriers of *Staphylococcus aureus*. They carry this bacterium as commensal at different body sites like skin creases, axilla, groin skin folds and nasal nares. Nasal nares is the most common site of *S.aureus* to resides in as commensal.[3]

The frequent and extensive use of antibiotics causes emergence of resistant strains of *Staphylococcus aureus*.[4] In 1960's, there was emergence of MRSA but problems related to MRSA started piling up in 1990's, especially in the intensive care settings where more vulnerable patients acquired this bacteria through the contact transmission and it became the leading health-

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care associated infection.

Among *Staphylococcus aureus, Mec A* gene is responsible for resistance against beta lactam drugs. *Mec-A*gene synthesizes penicillin binding protein (PBP) 2a by altering the penicillin binding protein 2 to PBP2a through a resistance mechanism.[5] PBP2a leads to resistance of *S.aureus* against all beta lactam drugs including four generations of Cephlosporins, Carbapenems, Monobactams, except specially designed beta lactam drugs which has anti-MRSA activity like Ceftaroline and Ceftibiprole. MRSA express heterogenous resistance to methicillin through penicillin binding protein 2a (PBP2a).

MRSA infections were largely confined to immunocompromised individuals or individuals with healthcare exposure till 1990s. Sooner many other Community Acquired-MRSA (CA-MRSA) cases were reported across the globe.

Methicillin-resistant *Staphylococcus aureus* is transmitted by many ways, primarily it is transmitted through direct contact. It can be transmitted from health care workers by using fomites or from a carrier of MRSA.[6] Clothing such as white coats are also contaminated with MRSA and can carry MRSA. Hands are also source of transmission of MRSA. Nasal nares of health care workers colonized with MRSA are major source of MRSA.

Infections caused by MRSA are becoming important among patients in ICU's, surgical units, immunocompromised patients and elderly patients in hospitals.[7] *S.aureus* is important cause of skin, respiratory, joint, bone and cardiovascular diseases. The choice of drug for MRSA infection is Vancomycin given intravenously. This study helped us to find out the healthcare workers colonized with MRSA in their nasal nares.

METHODOLOGY

This cross sectional observational study was carried out from July to December 2014 at Jinnah hospital Lahore (JHL) and Pathology Department, Allama Iqbal Medical College, Lahore, Pakistan. 100 nasal swab samples were collected from healthcare workers of JHL. Sample was collected with sterile cotton swabs by rotating the swabs gently for five times in both anterior nares avoiding posterior nares of the study participants so that the tip was entirely at the nasal osteum. The swab stick was transferred back to the tube and transported to the laboratory immediately. Swabs were inoculated on blood agar and mannitol salt agar within one hour of collection and incubated at 37 ^{o}C aerobically for 24 hours. After 24 and 48 hours, plates were examined for growth, white or golden color spherical colonies on blood agar plate showing hemolysis were considered as *S.aureus*. On mannitol salt agar growth of mannitol fermenter round golden or cream colour colonies were selected. Identification was confirmed by colonial morphology, Gram staining, catalase test, coagulase test, DNAse test. Antibiotic susceptibility was performed by Modified Kirby bauer disc diffusion method. Cefotixin 30µg disc was used as surrogate marker for Methicillin resistance. Zone sizes were interpreted according to CLSI guidelines 2014. Isolates having zone size ≥ 22 against 30µg cefotixin disc were considered susceptible to Methicillin. Isolates having zone size ≤ 22 against 30µg cefotixin disc were considered resistant and labeled as MRSA.[8]

RESULTS

Out of total 100 health care workers nasal swab specimens, 60 (60%) specimens yielded Staphylococcus species. Out of 60, 40 (40%) specimens yielded *Staphylococcus aureus*, 13 (13%) specimens yielded methicillin sensitive *Staphylococcus aureus*. 27 (27%) specimens yielded methicillin resistant *Staphylococcus aureus* (MRSA).

According to gender distribution, 41 specimens were taken from doctors out of which 16 (39%) were taken from male and 25(61%) were taken from female.

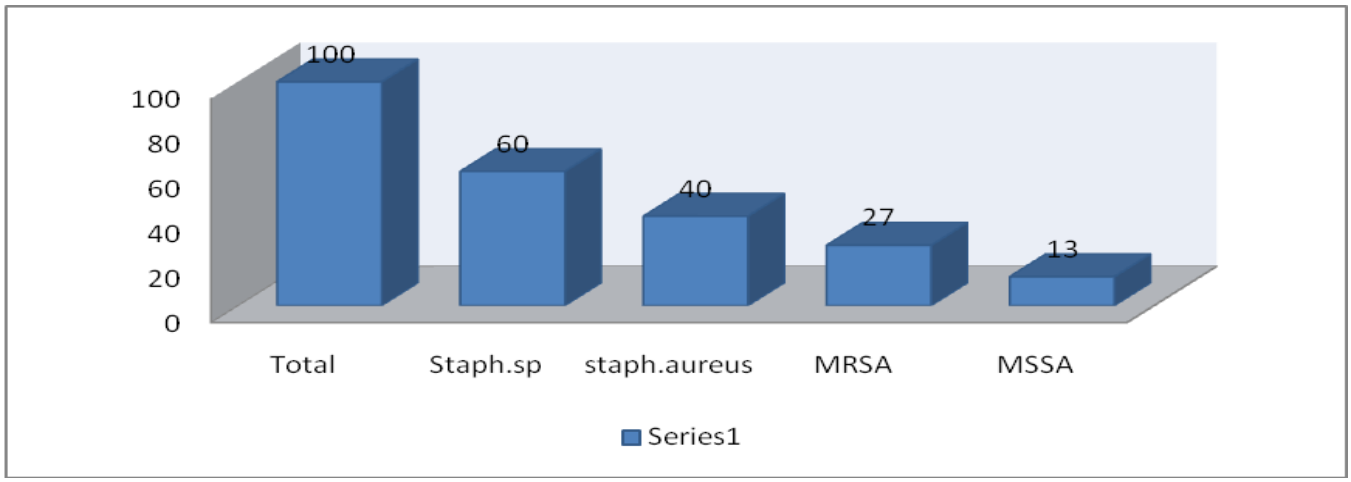

Fig. 1: *Frequency of positive isolates of staphylococcus among health care workers.*

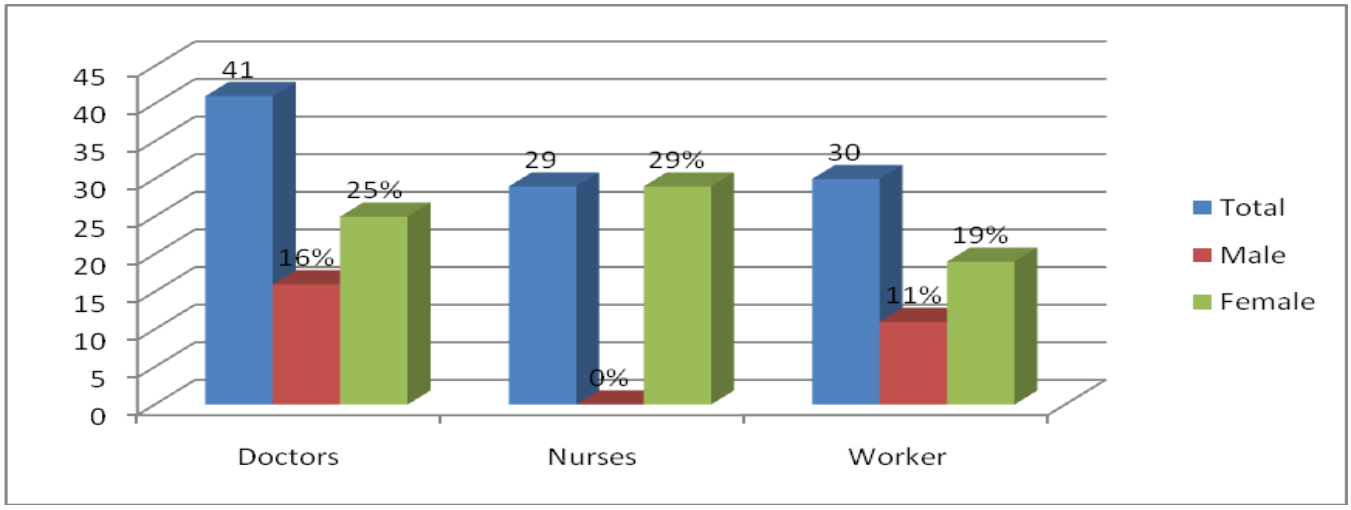

Fig. 2: *Gender distribution in health care workers screened for MRSA.*

Also 29 specimens were taken from female nurses. Among sanitary workers, a total of 30 specimens were taken including 11 from male and 19 from female sanitary workers.

Out of total 100 nasal swab specimens 27 yielded MRSA. Out of 41 specimens taken from doctors, 10 (24%) yielded MRSA. Out of 29 specimens taken from nurses, 6 (21%) yielded MRSA. Out of 30 specimens

Table 1: *Frequency of MRSA among health care workers.*

			Total	
			MRSA	*Total*
Designation of health care worker	Doctor	Count	10	41
		% within result of MRSA	37%	41.0%
	Nurses	Count	6	29
		% within result of MRSA	22.2%	29.0%
	Worker	Count	11	30
		% within result of MRSA	40.7%	30.0%
Total		Count	27	100
		% within result of MRSA	100.0%	100.0%

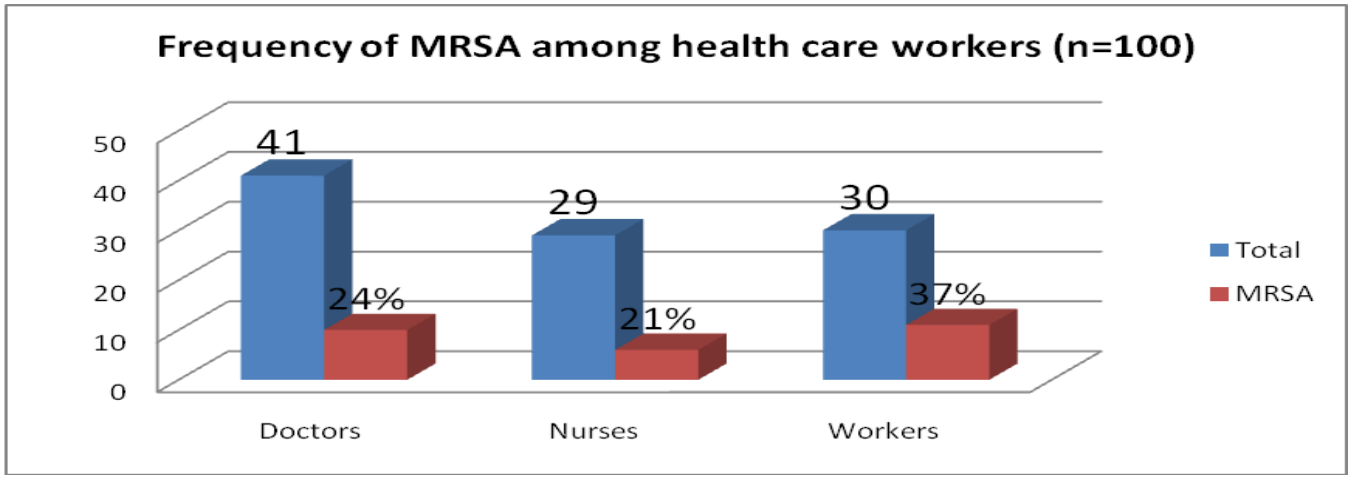

Fig. 3: *Frequency of MRSA among health care workers.*

taken from sanitary staff, 11 (37%) yielded MRSA.

DISCUSSION

One of the leading pathogen responsible for nosocomial infections worldwide is Methicillin resistant *Staphylococcus aureus*. Main source of this organism is healthy carriers including health care workers. One of the most effective methods for preventing the spread of this organism requires a detection of colonized health care workers and assessing the associated risk factors of colonization. Infected persons transmit infection to healthy persons by direct contact. MRSA healthy carriers do not show signs and symptoms but can transmit this bug to others. It can also be transmitted by used fomites in wards and operation theatres. Another important source of infection is health care workers hands.

The results of our study show 40% *Staphylococcus aureus* out of 100 samples of health care workers. Over all nasal carriage rate of MRSA among health care workers is 27% which is alarming for the hospital environment.

Whereas study conducted at Children Hospital Complex, Multan, Pakistan in 2012, the nasal carriage rate of MRSA among health care workers was found 14%. A total of 129 swabs were obtained from physician, nurses, sanitary workers and administrative staff. The prevalence of *S.aureus* and MRSA nasal carriage was significantly in physicians 51.8%, 18.5%, nurses (66.6%, 2.1%), sanitary workers (59%, 13.6%) as compared to administrative staff (27.6%, 2.1%).[9] Although sample size is near to our sample size but over all nasal carriage rate of MRSA is almost half of our nasal carriage rate of MRSA. Our sample size was 100 and in Multan hospital sample size was 129 out of which more nurses identified 66.6% whereas in our study sanitary workers had nasal carriage rate 11%. In our study, sanitary workers showed higher carriage rate than doctors.

Kalsoom F *et* al (2008) in Holy Family Hospital, Rawalpindi, nasal carriage rate was 1.5% of MRSA. Nasal swabs from anterior nares of 468 participants, 85 (18.2%) were *Staphylococcus aureus*, 7 (1.5%) for MRSA. The highest carriage rate for *S.aureus* was in midwives (30%) followed by security guards (25%), nurses (22.7%).[10]

Nasal carriage rate in Rawalpindi, family hospital is 1.5% while in our study it is 27%, a noticeable difference in both studies. The difference was due to the environment and method used for the research and may be the sample size which was 468 in that study and 100 in our study. Sample is almost 5 times that of sample size of our study. Kalsoom *et al* also included non-health care workers like security guards. The highest rate in our study and the other study of MRSA was identified in sanitary workers was same.

Fadeyi *et al* conducted a study in Nigeria in 2010 among health care workers indicated 52.5% nasal carriage rate of methicillin resistant *Staphylococcus aureus*. Of the 198 healthcare workers screened, 104 (52.5%) were carrying MRSA in their anterior nasal nares. Doctors with 22.7% nasal carriage rate and nurses with 16.7% were the predominant carriers.[11]

Fadeyi *et al* showed almost double the nasal carriage rate of MRSA as compared to our study. Sample size is almost double as compared to our sample size. In Nigerian study the highest rate was identified among doctors while in our study the highest rate was noted in sanitary workers.

Ahmad *et al* in 2012 studied MRSA carriage rate in Libyan hospitals. A total of 569 doctors and nurses from 4 main hospitals were screened for nasal carriage of MRSA. Nasal carriage rate in this study was found to be 19%. In our study as compared to this sample size was 100 and MRSA rate was 27%.Our study is one center study but Ahmad et al is multicenter study.[12]

Omuse *et al* conducted a study to determine the prevalence of nasal carriage of MRSA at the Aga Khan University Hospital, Nairobi, in 2012. Nasal swabs were taken from 246 randomly selected HCWs. The prevalence of nasal carriage of MRSA was 0%. But 0% Nasal carriage does not exclude the nasal screening of health care workers because nasal carriage can be intermittent which can also be acquired from environment.[13]

Our study was conducted by screening 100 HCWs, where as MRSA rate was 27%. While study conducted at Nairobi hospital, MRSA rate was 0%, may be due to the healthy habits of cleanliness and strict infection control measures, implementation of MRSA protocols.

Accurate and rapid detection of MRSA is important not only for choosing appropriate antibiotic therapy for the individual patient; but also for control of the endemicity of MRSA.[13]This difference may be due, in part, to differences in geographical distribution, differences in the quality and size of samples and the culture methods used to detect *S. aureus*. The high carriage rate of MRSA in our study can be attributed to several factors e.g. high prevalence of MRSA among patient which increases the exposure potential among the participating HCWs.[14] Suboptimal infection control practices have a strong influence on the possibility of transmission between patients and HCWs.[15] These include; failure to perform active surveillance cultures to identify colonized patients, HCWs compliance with hand hygiene and incomplete use of protective barrier equipment. In our study, sanitary workers showed higher carriage rate than doctors. This can be explained by the fact that HCWs having direct patient contact have higher carriage rate than those who have lesser contact.[16]

SP Kogekar and colleagues conducted a study in a tertiary care hospital of Indore, India in 2015. Sample

size was 100 same as that of our study. The MRSA carriage rate was 16% in their study while 27% in our study with highest rate among nurses in Indian study as compared to sanitary workers in our study.

The differences observed in prevalence among countries may be due to differences in prescribing practices in antibiotics, sample size which may be more or less than present studies and culturing method. It may be due to social economic condition of that particular area where study was conducted.

It is ***concluded*** that after identification of MRSA carrier health care workers we should give proper treatment for eradication of carriage of MRSA and stop them to perform their duties in clinical environment until MRSA is being eradicated. Through this we can prevent health care workers to transmit infection to patients. It is more appropriate preventive measure. Then we should follow up the health care workers by taking anterior nasal swabs again and check the results. If their culture results are negative then they would allow working in the ward. So it is important to screen all health care workers after 6 months properly and check their record, so we can prevent spreading of infection by MRSA.

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Conflict of Interest
All authors declare that there is no conflict of interest.

Authors' Contribution
JA: Specimen collection, Specimen processing, Writing of manuscript. FR: Writing of manuscript. NWY: Review of manuscript. SI: Review of manuscript.

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