



## HOSPITALIZED PATIENTS; METHICILIN RESISTANT STAPHYLOCOCCUS AUREUS PREVALENCE AND SUSCEPTIBILITY PATRON

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### Article received on:

28/11/2015

### Accepted for publication:

15/05/2016

### Received after proof reading:

04/07/2016

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**ABSTRACT... Objectives:** An alarming rise in Methicillin resistant *Staphylococcus aureus* (MRSA) associated hospital based infections has been reported in recent decades. Prolonged hospital stay, unhygienic health services are confined to this challenging serious problem. Anterior nares of humans are a natural reservoir for *Staphylococcus aureus* with asymptomatic colonization. This study was designed to determine the prevalence of nasal carriage rate of MRSA among hospitalized patients. **Study Design:** Cross sectional study. **Setting:** Punjab Institute of Cardiology, Lahore, Pakistan. **Period:** January 2013- 2014. **Materials & Methods:** Nasal swabs were collected from hospitalized patients. Total 2,440 patients were screened for the nasal carriage of MRSA. Microbiologically, identification of *S. aureus* was done on the basis of colony morphology, Gram staining and biochemical tests. Identified isolates of *S. aureus* were further tested for cefoxitin susceptibility testing, following the technique of modified Kirby Bauer disc diffusion using Mueller-Hinton agar as per Clinical Laboratory Standards Institute (CLSI) guidelines 2013. **Results:** Out of total 2,440 nasal swabs, 60.45% (1475/2440) were *Staphylococcus* species. Among *Staphylococcus* group, 86.10% (1270/1475) were *Staphylococcus aureus*. The frequency of MRSA and MSSA (Methicillin sensitive *Staphylococcus aureus*) was 5.20% (66/1270) and 94.8% (1204/1270) respectively. Overall nasal carriage of MRSA is 2.70% (66/2440). The coagulase negative *Staphylococcus* were found in 205 (13.90%) cases while MRSE (Methicillin resistance *Staphylococcus epidermidis*) were found in only 7 (3.41%) cases. **Conclusion:** Overall nasal carriage rate of MRSA was 2.70%.

**Key words:** MRSA, MRSE, Nasal swab

**Article Citation:** Saeed M, Rasheed F, Hussain S, Ahmad M, Arif M, Hashmi I. Hospitalized patients; methicillin resistant staphylococcus aureus prevalence and susceptibility patron. Professional Med J 2016;23(7):795-801. DOI: 10.17957/TPMJ/16.3193

## INTRODUCTION

In the recent decades an alarming increase in hospital acquired infections due to Methicillin resistance *Staphylococcus aureus* (MRSA) has been reported, which are mainly confined to prolong health care services in hospitals and are serious therapeutic challenge to the health care community.<sup>1</sup> *S. aureus* is declared as a potential causative agent for wide spectrum of hospital infections.<sup>2,3</sup> Two genes *mecA* or *mecC* are responsible for the resistance against beta lactam antibiotics in MRSA due to production low affinity penicillin binding proteins.<sup>21</sup>

After mid 1980 MRSA became a topic of common adversary.<sup>4</sup> The emergence and transmission of MRSA includes some major predisposing

elements, which are hospitalization on repeated intervals, indiscriminate exposure to medicines for prolong time, surgical procedures, intravenous (IV) drug abuse, co-morbidities related to older age and exposure to the victims of colonized MRSA.<sup>5,6,7</sup>

Colonized MRSA patients mediate the spreading of infectious strains but medical and paramedical staffs are also main source of this transmission and which results in the onset of many serious endemic and epidemic infections.<sup>13</sup>

*S. aureus* are colonized in the anterior nares of humans and this asymptomatic colonization is more common as compared to the infections. Particularly the colonization of the nasopharynx,

perineum and skin, with damaged and disrupted cutaneous barrier, may occur shortly after birth and may recur anytime thereafter.<sup>1</sup> Direct contact with colonized person is the primarily source of MRSA transmission. Different studies reported 25% to 50% nasal carriage rate from different countries. Peoples with different co-morbidities related to skin, diabetes, health care worker and IV drug addiction showed high frequency of MRSA infection in comparison to common population.<sup>2-3</sup>

Different studies have been conducted around the world and reported an alarming increase in the hospital acquired infections due to MRSA.<sup>8,9,10,11,12</sup> The incidence rate of MRSA influenced and varies between countries, different regional areas and hospitals.<sup>14</sup> The intensive care units (ICU) in hospitals with higher infection rate enhancing transmission, this might be due to exposure to large number of antibiotic and saturation of vulnerable patients. Small fraction of this infections is due to group of colonized peoples, majority of them remain undiagnosed which constitutes the primary transmission reservoir by mean of using hands, equipment and apparel of medical staff to susceptible patients.<sup>4</sup> Therefore, it has become necessary to diagnose, identify MRSA carriage for the prompt management and implementation of barrier isolation of colonized patients.<sup>15-17</sup>

The eradication of MRSA strain become difficult after the development of resistance against multiple drugs and leaving glycopeptides as the choice of drug for the treatment.<sup>18</sup> Different studies in which pathologist compared treatment therapy in combination of Vancomycin with group of  $\beta$ -lactam antibiotics for management of persistent MRSA infections have demonstrated clinical relapse, microbiological failure and persistent bacteremia with  $\beta$ -lactam antibiotics, recommending vancomycin as superior and choice of available drug for MRSA treatment.<sup>19,20</sup> The MRSA detection and their antimicrobial-susceptibility pattern is a must for appropriate treatment of these infections.

Therefore this present study was designed to

determine the incidence of nasal carriage rate of MRSA among hospitalized patients of Punjab Institute of Cardiology, Lahore, Pakistan.

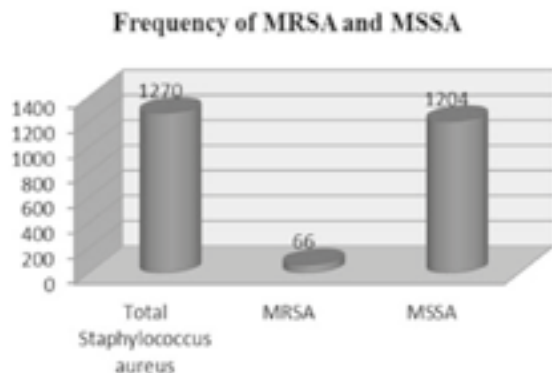
## MATERIALS & METHODS

This cross sectional study was carried out in Punjab Institute of Cardiology, Lahore, Pakistan, from January 2013 to January 2014. Nasal swabs from hospitalized patients for culture test were collected from ICU, Cardiology ward, CCU, cardiac emergency and cardiac surgery wards. Total 2,440 patients were screened for the nasal carriage of MRSA. Demographical along with clinical characteristic related to patient's age, gender, antibiotics history in past 30 days and evidence of any other disease were also investigated.

The specimens were obtained by swabbing of the anterior 1.5 cm the nasal vestibule with sterile cotton swab within 48 hours of hospitalization, and immediately (within 1 hour) transported to the Microbiology laboratory for microbiological culture and sensitivity. Nasal swabs were inoculated on 5% sheep blood agar along with mannitol salt agar and left for the incubation of 24 h at 37C. Identification of *S. aureus* were done on the basis of colony morphology, Gram staining, catalase, and coagulase test by standard protocol. Isolates of *S. aureus* were further tested for ceftioxin susceptibility testing, following the technique of modified Kirby Bauer disc diffusion method using Mueller-Hinton agar as per Clinical Laboratory Standards Institute (CLSI) recommendations 2013. The strains with ceftioxin (30  $\mu$ g) zone diameter  $\leq$  21 mm were considered as MRSA. A Group of antibiotic including ceftioxin (30  $\mu$ g), linezolid (30  $\mu$ g), penicillin (10 units), amikacin (30  $\mu$ g), erythromycin (15  $\mu$ g), cephalexin (30  $\mu$ g), norfloxacin (10  $\mu$ g), ciprofloxacin (5 $\mu$ g), vancomycin (30  $\mu$ g), nitrofurantoin (300  $\mu$ g) and gentamicin (10  $\mu$ g), were tested for their susceptibility against *S. aureus*.

## RESULTS

The results showed that out of total 2,440 nasal swab specimens, 60.45% (1475/2440) cases were labeled as staphylococcus species because

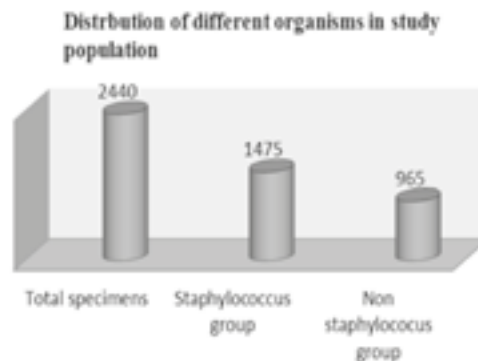


**Figure-1. Distribution of different isolates in study population**

they were Gram positive cocci and catalase test positive (Figure-1).

Among catalase positive staphylococcus group, 86.10% (1270/1475) were identified as *S. aureus* on the basis of coagulase positive test. The frequency of MRSA and MSSA (Methicillin sensitive *Staphylococcus aureus*) was 5.20% (66/1270) and 94.8% (1204/1270) respectively (Figure-2). Overall nasal carriage of MRSA was 2.70% (66/2440). The coagulase negative staphylococcus was found in 205 (13.90%) cases while MRSE (Methicillin resistance *Staphylococcus epidermidis*) were found in only 7 (3.41%) cases. Overall nasal carriage rate of MRSA was 2.70%.

In present study it was observed that highest MRSA isolation was found in CCU 7.94%,



**Figure-2. Frequency of MRSA and MSSA in Staphylococcus aureus group**

followed by cardiac surgery ward 6.64% and ICU 4.10% respectively. While least carriage rate 3.65% was identified from cardiac emergency. Antibiotic susceptibility testing data for gentamicin, co-trimoxazole, vancomycin, erythromycin, clindamycin, and linezolid was compiled. There was no resistance documented against vancomycin and linezolid. Resistance to antibiotics among the MRSA isolates was more than that in methicillin sensitive *S.aureus* (MSSA).

**DISCUSSION**

The significantly higher incidence rate of nosocomial infections due to MRSA has become epidemic threat to health care setting in recent years. These are linked with health care centers especially patients or all people exposed to clinical systems including health care staff.

	<i>Staphylococcus aureus</i> n =1270	Methicillin sensitive <i>Staphylococcus aureus</i> (MSSA) n=1204	<i>Methicillin resistant Staphylococcus aureus</i> (MRSA) n= 66
<b>ICU</b>	268	257(95.90%)	11(4.10%)
<b>CCU</b>	214	197(92.06%)	17 (7.94%)
<b>Cardiac Surgery</b>	286	267 (93.35%)	19 (6.64%)
<b>Cardiology Ward</b>	228	219 (96.05%)	09 (3.95%)
<b>Cardiac Emergency</b>	274	264 (96.35%)	10 (3.65%)

**Table-I. MRSA nasal carriage rate from different wards**

Antibiotics	Strain	Sensitive %	Resistant %
Cefoxitin (methicillin)		94.80%	5.20%
Erythromycin	MRSA	56.0	64.0
	MSSA	83.4	16.6
Clindamycin	MRSA	43.5	56.5
	MSSA	78.4	21.6
Gentamycin	MRSA	47.3	52.7
	MSSA	87.5	12.5
C0-trimaxazole	MRSA	38.4	61.6
	MSSA	75.9	24.1
Ciprofloxacin	MRSA	23.5	76.5
	MSSA	73.5	26.5
Fusidic acid	MRSA	66%	34%
	MSSA	89%	11%
Vancomycin	MRSA	100	0
	MSSA	100	0
Linezolid	MRSA	100	0
	MSSA	100	0
Pencilin	MRSA	0	100
	MSSA	0.33%	99.66%
<b>MRSA, Methicillin resistant <i>Staphylococcus aureus</i></b> <b>MSSA: Methicillin sensitive <i>Staphylococcus aureus</i></b>			
<b>Table-II. Antibiotic susceptibility results of <i>Staphylococcus aureus</i></b>			

The most effective methods which help in the reduction, prevention, management and transmission of this organism is prompt diagnosis and isolation of MRSA colonized persons.

Patients with MRSA may have asymptomatic colonization with the organism at the time of admission to a hospital and often serve as a source for successive transmission and infection. Recently discharged or transferred patients from other clinical centers are at high risk of carrying MRSA. The screening of high risk patients and HCW is main strategy to control the MRSA associated infections and transmission in hospital environment.

In our study the nasal carriage rate of *Staphylococcus* is 60.45%, this is quite similar to results reported in a similar work conducted in Turkey, where they reported the nasal carriage about 56%.<sup>32</sup> Our findings are relatively higher than nasal carriage rate reported in Saudi Arabia which is 38%.<sup>33</sup> The carriage rate for the American-Indian population was also lower than this study (27.3%).<sup>34</sup>

According to different studies on MRSA in hospital environment reported that colonization of MRSA infections are prone during the hospitalization time.<sup>35</sup> The present study has a small proportion (2.70%) of hospitalized patients with MRSA nasal carriage. While in case of colonization of *S. aureus* during hospital stay in current study was relatively higher 1475 (60.45%) as compared to study from Sudia arbaia (38.0%).<sup>32</sup> Alessandro Bartoloni et al reported 1.8% MRSA nasal carriage in hospitalized patients relatively lower to our study.<sup>21</sup>

It was observed that road dust is less hazardous as compared to hospital dust and reason behind this is possibility of presence of MRSA in these areas. These infectious bacterial strains were found to be resistant to all available beta lactam antibiotic as compared to MSSA strains. An obvious discriminating antimicrobial sensitivity pattern between strains of MSSA and MRSA were observed by Vidhani S et al.<sup>25</sup> The methicillin and co-existing resistance against different drugs was comparatively higher in MSSA.<sup>26</sup>

All strains of MRSA were found to be sensitive to vancomycin and linezolid in present study.

This is consistent with the results showed from different authors about the sensitivity of vancomycin and linezolid against MRSA.<sup>27,28,29</sup> However, vancomycin-intermediate (VISA) and vancomycin-resistant *S. aureus* (VRSA) strains have been reported recently from various parts of the world.<sup>30,31</sup>

It was concluded that glycopeptides are the only choice of antimicrobial that can be used for the effective treatment for the MRSA infection. The major risk factors of VRSA are overuse of glycopeptides drugs and higher prevalence of MRSA and both are responsible for the extensive propagation of these infectious strains which is a frightening and rational possibility once it happens to appear. Therefore, it is necessary to keep glycopeptides reserved to control and manage MRSA and life-threatening damages associated with MRSA in health communities.

The most successful approach to prevent MRSA infections is that in health care centers can be possible by performing laboratory surveillance of different wards in hospitals after every 6 months on regular basis. This will help in formulating and developing more effective antibiotic policies and infection control practices. Sampling and culture of specimen from hospitalized patients who are at high risk of acquiring MRSA can facilitate screening and isolation of colonized patients. On the other hand steps of isolation of colonized and infected patients, use of barrier precautions, hand washing, and hand antisepsis can also be useful in the prevention of MRSA.

## CONCLUSION

Nasal carriage associated MRSA in hospitals is major and sensitive issue in terms of predisposing to infections, these are also responsible for spreading of infections among peoples working in health community. Eradication, prevention and monitoring of MRSA from health care workers and patients should be considered to manage alarming transmission between community and health centers. It is recommended to conduct the surveillance of health care works and wards on regular basis to monitor the hospital associated

nosocomial infections and antibiotic susceptibility to prevent the prevalence of MRSA.

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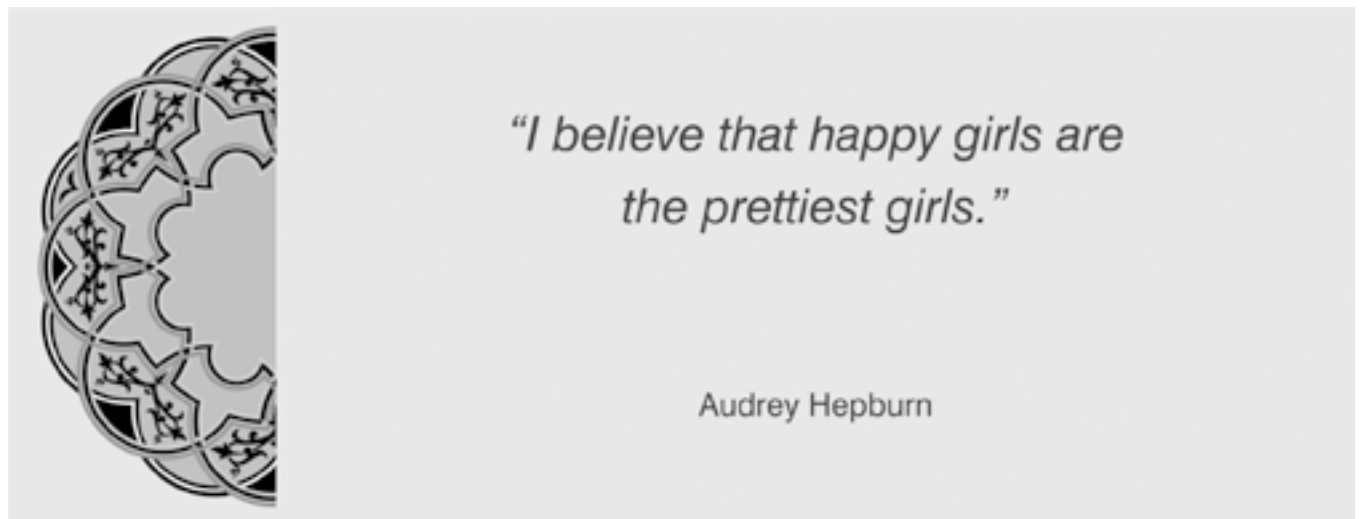
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3	Shahida Hussain	Statistical analysis	
4	Maqsood Ahmad	Review manuscript	
5	Dr. Mizna Arif	Review manuscript	
6	Dr. Ihsan ullah Hashmi	Review manuscript	