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# METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS NASAL CARRIAGE- ITS PREVALENCE, RISK FACTORS, ANTIBIOTIC SUSCEPTIBILITY AND DECOLONIZATION AMONG HEALTHCARE WORKERS IN A TERTIARY CARE HOSPITAL IN SOUTH INDIA.

Microbiology

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## ABSTRACT

***Aims:*** To determine the prevalence of MRSA carriage among healthcare workers, the antibiotic sensitivity pattern of the isolated strains, to attempt decolonization of the carriers and to assess effectiveness of the decolonization regimen.

***Materials and method:*** Nasal swabs collected from 150 health care workers were processed for bacterial identification and antibiotic sensitivity testing. After decolonization, repeat cultures were performed to assess the effectiveness.

***Results:*** Nasal carriage of MRSA among healthcare workers was found to be 4.7%. The MRSA carriage was found high among nurses (5.5%). A significant association with MRSA was noted among health workers who have nasal problems like sinusitis, allergic rhinitis and nasal septal deviation. Topical mupirocin and chlorhexidine bath was found to be effective in eradicating MRSA carriers.

***Conclusion:*** In hospitals, nasal carriage of MRSA must be regularly screened and give an early warning of the presence of antimicrobial resistant pathogens among HCWs.

## KEYWORDS

MRSA, Nasal Carriage, Decolonization, Mupirocin.

## INTRODUCTION:

*Staphylococcus aureus* (*S.aureus*) is one of the most common pathogen in human disease especially in hospital settings. The increasing emergence of drug-resistant strains called methicillin resistant *Staphylococcus aureus* (MRSA) has been a cause of concern. MRSA infection predominantly spreads between person to person by contact. Other risk factors include frequent use of antibiotics, overcrowding and lack of cleanliness. Duration of hospital stay is also a significant risk factor for acquisition of MRSA [1]. A major risk factor for transmission of strains, including MRSA is found to be the nasal colonization of *S.aureus*. *Staphylococcus aureus* colonizes mostly under the anterior nares (nostrils) [2, 3]. Prevalence of MRSA nasal colonization is also higher among the healthcare workers than the general population [4, 5].

Studies are few regarding the prevalence of MRSA nasal carriage in hospital settings in the State of Kerala, India. Hence the present study was undertaken to determine MRSA nasal colonization among health care workers in a tertiary care hospital in Northern Kerala. The study also attempted decolonization of the carriers and to assess effectiveness of the decolonization regimen.

## AIMS AND OBJECTIVES:

1. To determine the prevalence of MRSA carriage among healthcare workers.
2. To determine the antibiotic sensitivity pattern of the isolated MRSA strains.
3. To attempt decolonization of the carriers.
4. To assess effectiveness of the decolonization regimen.

## MATERIALS AND METHODS:

The study was carried out during a period of two months between May - July 2016 in the Department of Microbiology in a Medical College Hospital in Northern Kerala, India.

**Study Design:**
Cross sectional study.

**Study Group:**
Hospital nursing staff, house surgeons (HS) and doctors working in medical intensive care unit (ICU), surgical ICU, hemodialysis unit, post operative ward, orthopaedic ward, surgery ward, paediatric ward, dermatology ward, TB and chest ward of the hospital.

**Sample Size:**
A total of 150 health care workers randomly selected from the above mentioned wards in the hospital.

**Description of the method:**

**Nasal swab collection:** All the participants willing to enroll in the study were interviewed for relevant details in a preset proforma. Sterile cotton swabs moistened with sterile saline were used to collect nasal specimens. Samples were collected by inserting the swabs into the nostril to an approximate depth of 1 cm and rotated five times [6]. The samples were quickly sent to the microbiology lab.

**Sample Processing:** The swabs were processed within 2 hours of collection and primary plating was done on mannitol salt agar (MSA) (figure-1). *S.aureus* colonies were identified by colony morphology, gram stain, tube coagulase and mannitol fermentation test. The isolated strains of *S. aureus* were screened for methicillin susceptibility by modified Kirby-Bauer method by using cefoxitin (30 µg) discs [7]. Isolates which showed inhibition zone size of diameter ≤21 mm were considered as MRSA strains (figure-2) [8]. These isolates were then subjected to antibiotic susceptibility testing.

**Antibiotic susceptibility testing:** The antibiotic susceptibility testing was done by standard Kirby Bauer disc diffusion method. Results were interpreted according to Clinical and Laboratory Standards Institute (CLSI) 2014 guidelines.

**Decolonization of MRSA carriers:** For decolonization of the MRSA carriers, mupirocin ointment was applied twice daily for five days. Daily shower with a chlorhexidine-based soap for 5-7 days was also advised [9]. Repeat cultures were performed two days after stopping the treatment.

**Statistical analysis:** Results were compiled, tabulated and all data were subjected to statistical analysis by Statistical Package for the Social Sciences (SPSS) software, version 3.0. Association was done by using Chi-square test. A p-value of $< 0.05$ was considered as significant.

**FIGURE-1:** Detection of *Staphylococcus aureus*. Mannitol salt agar showing yellow coloured *Staphylococcus aureus* and pink coloured normal flora.

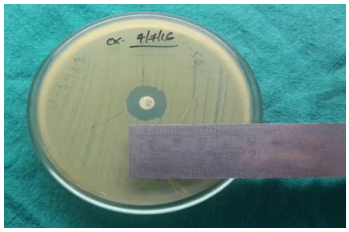


**FIGURE-2:** Detection of MRSA. Isolates showing inhibition zone size of diameter ≤21 mm.

**RESULTS:**

One hundred and fifty nasal swabs were collected from hospital staff members posted in different wards. Majority of participants were females (Table-1).

**TABLE 1:** Gender distribution among all participants'

| Gender | Number | Percentage |
|---|---|---|
| Female | 127 | 84 |
| Male | 23 | 16 |
| Total | 150 | 100 |

Study included 150 health care workers. It constitutes 73% Nurses, 24% House Surgeons and Doctors and around 3% cleaning Staff (Table-2).

**TABLE-2:** Designation of Health Care Workers (HCWs).

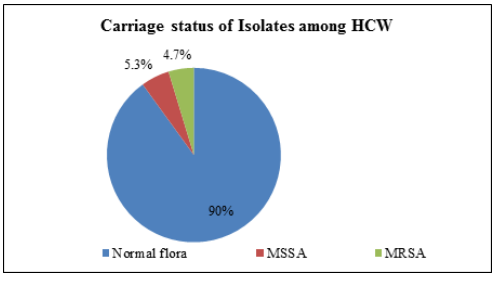
| Designation | Number of respondents | Percentage (%) |
|---|---|---|
| Nurse | 109 | 72.7 |
| HS& Doctors | 36 | 24.0 |
| Cleaning staff | 5 | 3.3 |
| **Total Sample** | **150** | **100.0** |

Various species of bacteria, including MRSA, which were isolated from the anterior nares of the participants, have been shown in Table 3/Graph-1. Out of 150 healthcare workers who were screened, 90% isolates were normal flora. MRSA nasal carriage rate was 4.7% and MSSA 5.3%.

**TABLE-3:** Nature of organisms isolated from anterior nares

| | | Number | Percentage (%) |
|---|---|---|---|
| **Identification** | **Normal flora** | 135 | 90.0 |
| | **MSSA*** | 8 | 5.3 |
| | **MRSA#** | 7 | 4.7 |
| **Total** | | **150** | |

*MSSA: Methicillin sensitive *staphylococcus aureus*
#MRSA: Methicillin resistant *staphylococcus aureus*

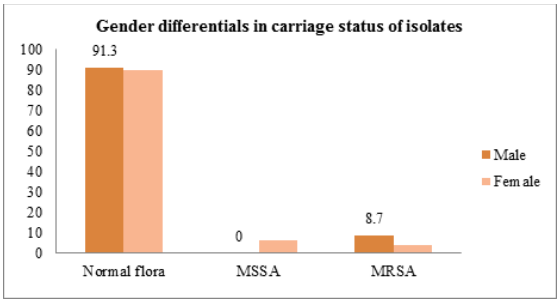



**GRAPH-1:** Carriage status of isolates among HCW

**TABLE-4:** Background characteristics of the participants and isolate carriage status

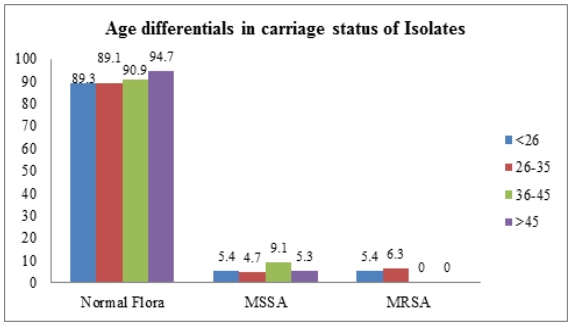
| Background characteristics | Normal Flora (%) | MSSA (%) | MRSA (%) | Number of HCW |
|---|---|---|---|---|
| **Sex** | | | | |
| Male | 91.3 | 0.0 | 8.7 | 23 |
| Female | 89.8 | 6.3 | 3.9 | 127 |
| **Age** | | | | |
| <26 | 89.3 | 5.4 | 5.4 | 56 |
| 26-35 | 89.1 | 4.7 | 6.3 | 64 |
| 36-45 | 90.9 | 9.1 | 0.0 | 11 |
| >45 | 94.7 | 5.3 | 0.0 | 19 |
| **Years of service** | | | | |
| < 5 | 85.7 | 7.1 | 7.1 | 84 |
| 6-10 Year | 93.9 | 4.1 | 2.0 | 49 |
| More than 10 years | 100.0 | 0.0 | 0.0 | 17 |
| **Designation of the staff** | | | | |
| Nurse | 89.9 | 4.6 | 5.5 | 109 |
| HS & Doctor | 91.7 | 5.6 | 2.8 | 36 |
| Cleaning staff | 80.0 | 20.0 | 0.0 | 5 |
| **Type of Units** | | | | |
| Operation Theatre/ICU/CSSD | 93.9 | 4.1 | 2.0 | 49 |
| Dialysis unit | 100.0 | 0.0 | 0.0 | 9 |
| Surgical Ward/OBG | 87.2 | 4.3 | 8.5 | 47 |
| Preventive clinic/ENT/Casualty/skin OP | 84.6 | 7.7 | 7.7 | 26 |
| Private room | 71.4 | 28.6 | 0.0 | 7 |
| **History of Hospitalization** | | | | |
| Yes | 90.9 | 4.5 | 4.5 | 22 |
| No | 89.8 | 5.5 | 4.7 | 128 |
| **History of Antibiotic therapy** | | | | |
| Yes | 93.9 | 3.0 | 3.0 | 33 |
| No | 88.9 | 6.0 | 5.1 | 117 |
| **History of Contact with MRSA** | | | | |
| Yes | 89.2 | 8.1 | 2.7 | 37 |
| No | 90.3 | 4.4 | 5.3 | 113 |
| **History of Surgery** | | | | |
| Yes | 85.2 | 14.8 | 0.0 | 27 |
| No | 91.1 | 3.3 | 5.7 | 123 |
| **Have comorbid Illness** | | | | |
| Yes | 87.5 | 12.5 | 0.0 | 8 |
| No | 90.1 | 4.9 | 4.9 | 142 |
| **Nasal abnormality or not** | | | | |
| Nasal Problem | 83.8 | 5.4 | 10.8 | 37 |
| No abnormality | 92.0 | 5.3 | 2.7 | 113 |

There is gender differential among health care workers who were carriers of isolates. Carriage status of MRSA among males is 8.7% and among females it is 3.9%. MSSA carrier status is observed only among females (6.3%) (Table-4/Graph-2).



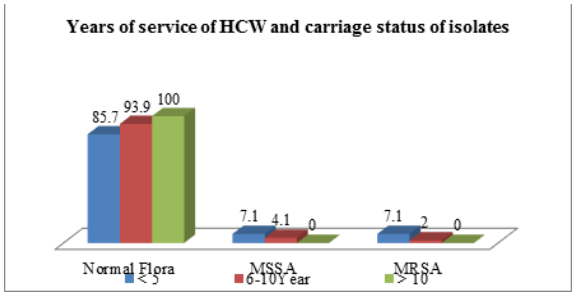

**GRAPH-2:** Gender Differentials in carriage status of Isolates

Among various age groups of the health providers, MRSA is found to be highest among 26-35 age groups (6.3%). Among less than 26yrs, it is 5.4%. Higher age groups reported no prevalence (Table-4/Graph-3). But MSSA prevalence is found high among 36-45 age group (9.1%) followed by less than 25 age group.



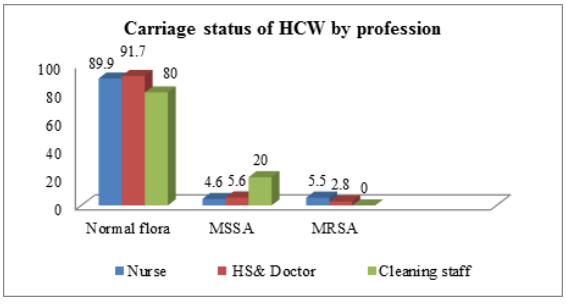

**GRAPH-3:** Age differentials in carriage status of isolates among HCWs

Years of experience shows, prevalence of MRSA to be high among those who have less years of service. Prevalence of MRSA is 7.1% among those whose years of service is less than 6 years and it is 2.0% among those whose service is 6-10 years (Table-4/Graph-4). It may be due to younger age of the HCWs which is correlated with lower years of service.



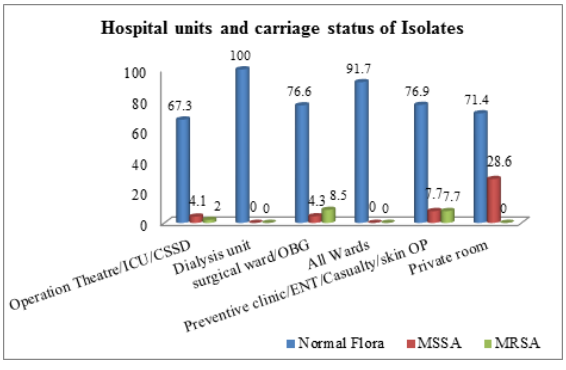

**GRAPH-4:** Years of service and carriage status of isolates

Category of the health providers shows that nurses have the highest prevalence (5.5%) of MRSA while house Surgeons and doctors have a prevalence of 2.8% (Table-4/Graph-5).



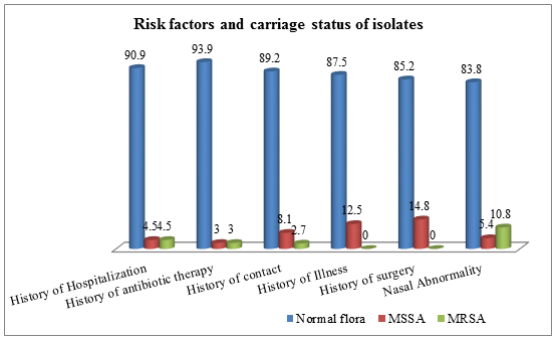

**GRAPH-5:** Profession of HCW and carriage status of isolates

Regarding hospital ward and MRSA isolates, surgical ward was found to be the most affected for MRSA carriage (8.5%) (Table-4/Graph-6). Prevalence of MRSA and MSSA were observed to be in equal percentage (7.7 each) in preventive clinic / causality. Participants from dialysis unit were free of either MRSA or MSSA carriers.




**GRAPH-6:** Hospital units and isolates

With regard to the risk factors associated, respondents with history of hospitalization (within one year) have a prevalence of MRSA of 4.5% against 4.7% who had no history of hospitalization (Table-4/Graph-7). History of antibiotic therapy (within three months) shows that those who had a history have a lower prevalence of MRSA and MSSA than those who had not taken any antibiotic therapy. History of contact with MRSA patients shows that health workers who had a contact, reported a lower prevalence (2.7% against 5.3% for MRSA) but MSSA is found to be high among those who had a history of contact (8.1% against 4.4%). History of surgical procedure shows no prevalence of MRSA among those who had underwent procedure while MSSA (14.8%) carrier status was found among those who had a history of surgery. Participants who have NCD (Non Communicable Diseases) like diabetes, hypertension or cholesterol or combination of NCD also reported no prevalence of MRSA, while MSSA carriage status was more among those who have a NCD (12.5% against 4.9%). Health Workers who have reported a nasal problem like sinusitis, allergic rhinitis, nasal septal deviation and other problems have higher prevalence of MRSA (10.8% against 2.7%). This was found to be statistically significant with p value of <0.05.

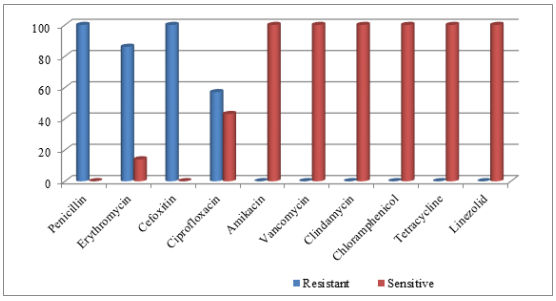



**GRAPH-7:** Risk factors and isolates

All the 7 MRSA strains isolated in the study were sensitive to vancomycin, amikacin, clindamycin, chloramphenicol, tetracycline and linezolid (Table-5/Graph-8). Four (57%) isolates were resistant to ciprofloxacin, six (86%) were resistant to erythromycin and all seven (100%) isolates were resistant to penicillin.

**TABLE-5:** Antibiotic susceptibility of the 7 MRSA isolates

| Drugs | Resistant (%) | Sensitive (%) |
|---|---|---|
| Penicillin (10u) | 7 (100) | 0 (0) |
| Erythromycin (15µg) | 6 (86) | 1 (14) |
| Cefoxitin (30µg) | 7 (100) | 0 (0) |
| Ciprofloxacin (5µg) | 4 (57) | 3 (43) |
| Amikacin (30µg) | 0 (0) | 7 (100) |
| Vancomycin (30µg) | 0 (0) | 7 (100) |
| Tetracycline (30µg) | 0 (0) | 7 (100) |
| Clindamycin (2µg) | 0 (0) | 7 (100) |
| Chloramphenicol (30µg) | 0 (0) | 7 (100) |
| Linezolid (30µg) | 0 (0) | 7 (100) |




**GRAPH-8:** Antibiotic susceptibility of the 7 MRSA isolates

All the 7 carriers who were MRSA positive were given a decolonization regimen with mupirocin nasal ointment twice daily for 5 days and chlorhexidine bath solution for 7 days. Repeat cultures were performed two days after stopping the treatment. Table number 6 depicts the results obtained from repeat culture, which did not show any growth indicating that they were effectively decolonized.

**TABLE-6:** Post-Decolonization results

| NO. OF SWABS CULTURED | GROWTH OF MRSA | RECOLONISATION % |
|---|---|---|
| **7** | **0** | **0** |

## DISCUSSION:

*Staphylococcus aureus* is emerging as perilous pathogen for both community-acquired as well as hospital-associated infections. It is necessary to detect the MRSA carriers among health care workers (HCWs) in hospitals. These individuals act as a potential source of infection to patients, causing nosocomial infections and thereby, causing extended stays in the hospital. The best methods which can be used for controlling this are regular screening of the HCWs and taking appropriate preventive measures. The prevalence of MRSA varies between institutions and geographic areas. According to the findings of our study, nasal carriage of MRSA among healthcare workers was found to be 4.7%. MSSA was found to be 5.3%. Our findings are

comparable with the study done by Albrich and Harbarth, which revealed that 4.6% of the health care personnel were either infected or colonized with MRSA [10]. Other Indian studies also reveal similar results. MRSA carriage rate of 1.8% was reported from Pondicherry [11] and 6.6% from Delhi [12].

In our study, males (8.7%) were two-times more likely to be MRSA carriers than females (3.9%), but not statistically significant (p>0.05). Only one other study has found a marginally higher prevalence of MRSA carriage in males, although it was not statistically significant [13]. Whether this is due to better commitment with infection control and hygienic practice of females, or other factors should be looked at in future studies.

The MRSA carriage was high among nurses (5.5%), while house surgeons and doctors had a prevalence of 2.8%. Zero prevalence was found among cleaning staff for MRSA. Different distribution of MRSA carriage was noted by a Nigerian study among the professionals, with doctors and nurses being equally and highly colonized (65%) [14]. The higher MRSA carriage rate among nurses could possibly be explained by the high frequency of patient contact among these professionals.

The highest rate of MRSA carriers were noted among workers of surgical wards (8.5%). The lowest rate of MRSA/MSSA carriers was in dialysis unit (0%). This could be due to better infection control practices followed in that unit.

Statistically significant association with p value of <0.05 was noted in health workers who have nasal problems like sinusitis, allergic rhinitis, nasal septal deviation or other problems and MRSA (10.8% against 2.7%).

All of the 7 MRSA isolates were sensitive to vancomycin, amikacin, clindamycin, chloramphenicol, tetracycline and linezolid. Abbas et al (2015) used fourteen antibiotics and concluded that antibiotics such as clindamycin, amikacin, chloramphenicol and teicoplanin can be alternative for reserved drugs such as vancomycin and linezolid. The high prevalence of resistance to erythromycin (86%) and ciprofloxacin (57%) noted among the MRSA isolates observed by us is also similar to that reported from other parts of India [15, 16].

Following standard recommendations, the MRSA carriers in our study were put on a decolonization regimen comprising of topical mupirocin along with chlorhexidine bath [9]. The decolonization noticed was 100%. Although we found our subjects fully decolonized, we can by no means conclude that they have been totally rid of their colonizers because a tendency towards recolonization among the carriers has also been reported [17].

## CONCLUSION:

In our study, nasal carriage of MRSA among healthcare workers was 4.7% which is on par with the international studies of 4.6% [10]. This may be due to the effective Hospital Infection Control Committee functioning in our hospital. The MRSA carriage was found high among nurses (5.5%) and in surgical wards. Regarding risk factors and MRSA carriage, statistically significant association was noted with nasal problems like sinusitis, allergic rhinitis, nasal septal deviation with a p value of <0.05. Topical mupirocin and chlorhexidine bath was found to be effective in eradicating MRSA carriers. Measures to be taken to control the spread of MRSA infection should include: laboratory based surveillance, isolation of colonized and infected patients, use of barrier precautions, basic infection control measures, screening and treatment of MRSA-positive HCWs.

**Conflicts of interest:**
There are no conflicts of interest.

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