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CARRIAGE OF METHICILLIN RESISTANT STAPHYLOCOCCUS AUREUS AMONG DIFFERENT PROFESSIONAL GROUPS OF HEALTHCARE WORKERS AND EFFECTIVENESS OF DECOLONIZATION THERAPY

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Abstract

Background: Infections caused by multidrug-resistant organisms (MDROs) have been increasingly reported from healthcare facilities. The spread of MDROs in hospitals further increases the financial burden on healthcare facility due to prolonged hospital stays and the need for more expensive investigations and treatment. Methicillin Resistant *Staphylococcus aureus* (MRSA) is known to be widely distributed in the healthcare facilities and accounts for a substantial proportion of the infectious disease burden. Hence, active surveillance for MRSA is carried out to identify colonized patients or Healthcare workers (HCWs) in a facility. This prospective study was conducted to study and compare the carriage of MRSA among doctors, nurses, General Duty Attendants (GDA) and Houseman/ House woman (HM/HW) working in cardiac unit of a tertiary care hospital. Screening was done by collecting swabs from hands and anterior nares. These specimens were processed by standard procedures for the isolation of *Staphylococcus aureus* and resistance to methicillin was determined using cefoxitin, 30µg disks as per Clinical and Laboratory Standards Institute (CLSI) guidelines. The carriage rate of MRSA was found to be highest among HM/HW (13%) followed by nurses (8%) and GDA (7%). Out of 11 doctors screened, none was found to carry MRSA. A higher percentage carriage in HM/HW can probably be accounted to their close and prolonged contact with infected patients and involvement in activities like emptying urinary bags, floor mopping and other activities of environmental cleaning. Management of MRSA carriers include applying stringent hand hygiene, contact precautions and core strategies including isolating and cohorting patients, increased environmental cleaning, dedicated patient equipment and decolonization. Active surveillance including screening of HCWs can help in decreased risk of spread to their close contacts and further reduction of MRSA prevalence among patients.

Key words: Methicillin Resistant *Staphylococcus aureus* (MRSA), multidrug-resistant organisms (MDROs), cefoxitin, nosocomial infections, mupirocin, hand hygiene, Healthcare worker (HCW).

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Introduction

Staphylococci are Gram-positive cocci that occur in grape-like clusters and belong to the family *Micrococcaceae*. They were first observed in human pyogenic lesions in 1871. Pasteur (1880) obtained liquid cultures of the cocci from pus and produced abscesses by inoculating them into rabbits. In the same year, Ogston, a surgeon, established conclusively the causative role of the coccus in suppurative lesions and also gave it the name Staphylococcus (*staphyle*, in Greek, meaning bunch of grapes and *kokkos* meaning a berry) due to typical occurrence of the cocci in grape-like clusters in pus and in cultures. Ogston also noticed that nonvirulent staphylococci were also often present on skin surfaces. [4]

Pathogenic staphylococci are normally parasitic and are commonly found on the skin and mucous membranes, where they either occur transiently or form part of the permanent bacterial flora. Potentially pathogenic staphylococci can be isolated from the nose of approximately 50% of all individuals and from skin of about 20%. Staphylococci are sometimes found in the environment- for example, in dust, in the air or on articles of daily use; here they are especially numerous in the vicinity of heavily infected persons.[7] Because the carrier state is common among the human population, infections are frequently acquired when the colonizing strain gains entrance to a normally sterile site as a result of trauma or abrasion to the skin or mucosal surfaces. Staphylococci are also transmitted from person to person. Upon transmission, the organism may become established as part of the recipient's normal flora and later be introduced to sterile sites by trauma or invasive procedures. Alternatively, the organism may be directly introduced into normally sterile sites, such as by a surgeon or nurse during surgery. [6]

Staphylococcus aureus (*S. aureus)* is by far the most important human pathogen among the staphylococci. It is found in the external environment and in the anterior nares of 20-40% of adults. Other sites of colonization include intertriginous skin folds, the perineum, the axillae, and the vagina. Although this organism is frequently a part of normal human microflora, it can cause significant opportunistic infections under the appropriate conditions. [5]

S. aureus strains which are resistant to the penicillinase-stable β lactam antibiotics, like methicillin, cloxacillin and flucloxacillin are referred to as MRSA. MRSA strains are important because they have a remarkable ability to develop resistance to a variety of antimicrobials belonging to other classes like aminoglycosides, quinolones and macrolides. This poses a major threat to public health. Certain strains of MRSA are found to have the propensity to spread very quickly in hospitals. Concern about MRSA is related to its potential for nosocomial transmission and the limited number of antibiotics available for its treatment. [8] Various studies have documented the occurrence of multiple drug resistant MRSA in hospitals and its subsequent transmission through the hands of health care workers. [9-11] Therefore, screening for carriage of MRSA is fundamental to modern day nosocomial infection control, both for epidemiologic investigation and day-to-day decisions on barrier isolation. [12]

Healthcare-associated MRSA (HA-MRSA) are the strains that circulate and are transmitted to individuals within health care facilities and Community-associated MRSA (CA-MRSA) are the strains obtained from the individuals in the community who have not had recent exposure to health care system or from patients in health care facilities in whom the infection was present or incubating at the time of admission. [1]

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Although the incidence of nosocomial infections caused by MRSA is increasing every year especially in high risk groups, [2] it has been found to be a significant cause of community-associated infections as well. [3]

Aim And Objectives

The present study was conducted

1. to study and compare the carriage of MRSA among different professional groups of health care workers like nurses, doctors, General Duty Attendants (GDA) and Houseman/Housewoman (HM/HW) working in close contact of the patients in the cardiac unit of a tertiary care hospital.
2. To study the risk factors associated with MRSA carriage in HCWs.
3. To study the effectiveness of hand hygiene and intranasal mupirocin therapy on MRSA carriage.

Material and Methods

This prospective study was conducted on 250 health care workers including nurses, doctors, General Duty Attendants (GDA) and Houseman/Housewoman (HM/HW) who were in close contact with the admitted patients of cardiac unit.

Data collection

The following data was collected from the healthcare workers screened: name, age, sex, designation, area of service, brief history about risk factors for MRSA carriage like any history of cutaneous lesion or condition, sinusitis or rhinitis, chronic otitis externa, recent urinary tract infection, recent antibiotic intake and any history of contact with MRSA positive patients.

Specimen collection:

- Using pre-moistened sterile cotton swabs, taking aseptic precautions, the specimens were collected from the anterior nares and hands of the health care workers.
- For collecting specimen from anterior nares, a pre-moistened sterile cotton swab was inserted into the nostril, to a depth of approximately 1cm, and rotated five times.
- For collecting specimen from hands, a pre-moistened sterile cotton swab was rubbed over the palm and web spaces.

Specimen transport:

Swabs were transported to the laboratory in sterile tubes containing 7% salt broth.

Specimen processing:

Tubes containing 7% salt broth with inoculated swab specimens were incubated overnight at 37°C, subcultures were done from salt broth on blood agar plates which were again incubated overnight at 37°C.

Identification of culture isolate:

The growth obtained was identified by colony morphology and Gram's staining. The colonies on blood agar media which were about 1-3 mm in diameter, circular, low convex, densely opaque, smooth, glistening, with or without β haemolysis, with or without characteristic pigmentation (ranging from cream to buff to golden yellow) were presumed to be that of staphylococci.

Smears were made from the colony and Gram's staining was done. For further identification various biochemical tests like catalase, coagulase and mannitol fermentation tests were carried out.

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Antimicrobial susceptibility testing (AST):
AST was performed using Modified Kirby-Bauer disk diffusion method. ATCC strain *S. aureus* 25923 was used as quality control. Resistance to methicillin/oxacillin was confirmed as per CLSI guidelines, using cefoxitin 30µg disks. Zone diameters for cefoxitin for the detection of MRSA were measured and interpreted as follows:

Zone size for Cefoxitin [20]

	Resistant (mm or less)	**Intermediate (mm)**	**Sensitive (mm or more)**
S. aureus	21	--------	22
CONS	24	--------	25

Analysis
After the identification of isolates & obtaining their AST pattern, the percentage of MRSA in the health care workers was calculated. A HCW showing growth of MRSA from either the hand swab, nasal swab or both the sites was labelled as MRSA carrier. The data obtained from the study was put to statistical analysis.

Management and follow up
Nasal carriers of MRSA were advised intranasal mupirocin ointment application twice daily for a period of one week. Careful hand washing with soap and water was also promoted. Post hand wash and post treatment swabs were also collected from hand and nasal MRSA carriers respectively to check for clearance of MRSA.

Results
A total of 250 healthcare workers were screened.
All the results are depicted in the tables and graphs that follow:

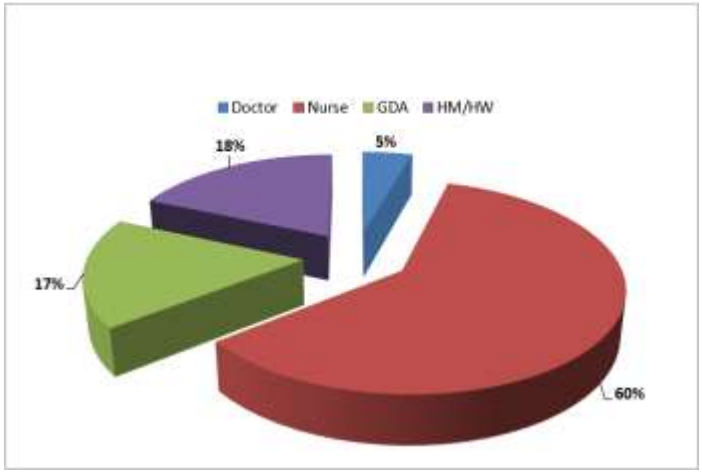

FIGURE 1: DISTRIBUTION OF HEALTHCARE WORKERS SCREENED (n=250)
The healthcare workers screened included 11 doctors, 150 nurses, 43 general duty attendants (GDA) and 46 housemen (HM)/house women (HW).

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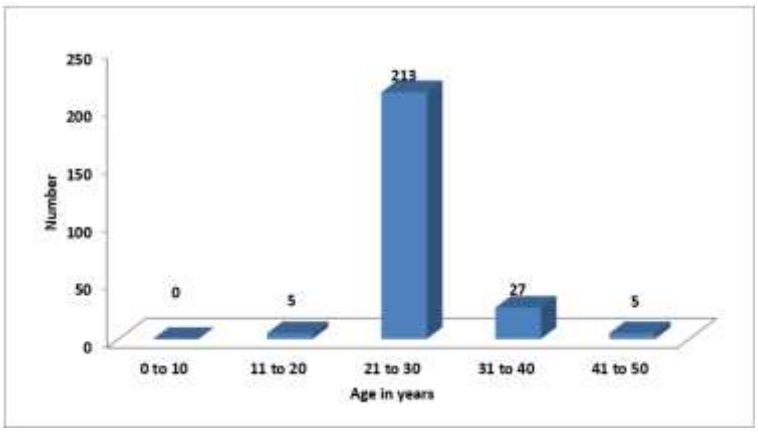

FIGURE 2: AGE-WISE DISTRIBUTION (n=250)
Maximum subjects were in the age group of 21-30 years.

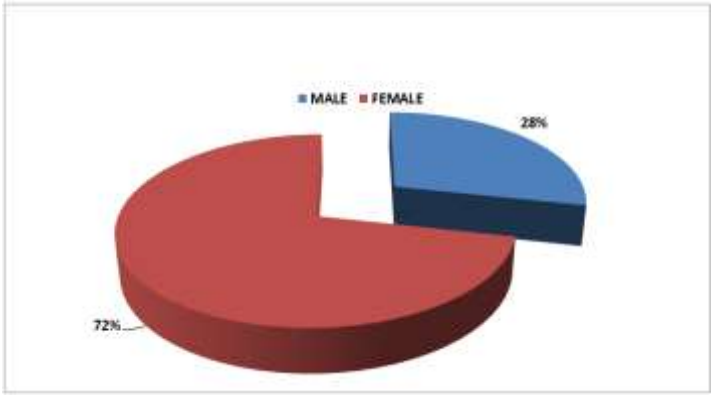

FIGURE 3: SEX-WISE DITRIBUTION(n=250)

The subjects included 179 females and 71 males.

- A total of 88 staphylococcal isolates were obtained from samples of 250 health care workers screened.
- Out of 88 staphylococcal isolates, 42 were identified as *Staphylococcus aureus* and 46 were coagulase negative staphylococci (CONS).
- Out of 42 isolates of *S. aureus*, 21 were MRSA.
- The percentage carriage of MRSA among healthcare workers was 8.4% (21/250), out of which 5.6% (14/250) were nasal carriers while 2.8% (7/250) were carrying MRSA on hands. No health care worker showed carriage of MRSA in both the sites.

TABLE 1: PREVALENCE OF MRSA AMONG DIFFERENT PROFESSIONAL GROUPS OF HEALTH CARE WORKERS

S. No.	HEALTH CARE WORKERS	NUMBER OF HCWs SCREENED	MRSA CARRIERS (%)
1.	Houseman/ House woman	46	6 (13%)
2.	Nurse	150	12 (8%)
3.	General duty attendant	43	3 (7%)
4.	Doctor	11	0 (0%)

- Highest percentage of MRSA carriage was found among the housemen/house women.

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- One or more risk factors were present in 11 (52.4%) out of 21 MRSA carriers. Most common finding was a history of contact with MRSA infected patient within the previous three months. This finding was present in 6 (28.6%) subjects. 3 (14.3%) MRSA carriers had rhinitis, 2 (9.5%) had cutaneous lesions while only one (0.4%) subject gave the history of recent antibiotic intake.
- Swabs collected after proper hand wash in case of hand carriers of MRSA and swabs collected after completion of treatment with intranasal mupirocin ointment in case of nasal carriers of MRSA turned out to be negative for MRSA.

Discussion

The major reservoirs of MRSA in health care facilities are infected or colonized patients. The anterior nares and skin are common sites of MRSA carriage. Transient carriage of MRSA on the hands of health care workers is the predominant mode of patient to patient transmission. Presence of MRSA on environmental surfaces also serves as a major reservoir. [8]

In our study, highest carriage rate for MRSA was found among the HM/HW (13%). This could probably be accounted to their close and prolonged contact with infected patients and involvement in activities like emptying urinary bags and floor mopping. Among the other health care workers, 8% of the nurses and 7% of the GDAs were found to carry MRSA, whereas out of 11 doctors who were screened, none were found to carry MRSA. Similarly, Verwer *et al*, in their study showed that, MRSA colonization was more common in patient care assistants (6.8%) and nurses (5.2%) than in allied health professionals (1.7%) and doctors (0.7%), [16] whereas, Ibarra *et al* found no significant difference in MRSA carriage among physicians, nurses and other healthcare professionals. [15]

In our study, one or more risk factors were present in 53.4% of the MRSA carriers. The most common risk factor among MRSA carriers was a history of caring for MRSA infected patients in the previous three months (28.6% carriers). Verwer *et al*, in their study, also concluded that, MRSA colonization of health care workers occurs primarily in health care workers caring for patients colonized or infected with MRSA. [16]

The epidemiology of MRSA is gradually changing since its emergence was reported. The association of multidrug resistance with MRSA has added to the problem.[13]

In our study, nasal carriers of MRSA were advised intranasal mupirocin ointment application thrice daily for 5 days. Careful hand washing with soap and water was also promoted. Post hand wash swabs and post treatment swabs in case of hand and nasal MRSA carriers respectively turned out to be negative for MRSA which shows the effectiveness of these strategies. Selective use of intranasal mupirocin and daily chlorhexidine bathing for patients colonized with MRSA, isolation and barrier precautions, improvement in adherence to hand hygiene policies reduced the incidence of MRSA colonization and infections according to various studies conducted worldwide. [17-19]

The healthcare personnel require awareness regarding the nosocomial infections as well as bacterial colonization and should know their status of carriage of MRSA and accordingly, take necessary measures to prevent possible transmission.[14] Therefore, a continuous surveillance and improvement of hygiene standards in hospitals should be adopted. Thus, the study emphasizes the need for a regular surveillance of microbial flora among hospital staff to prevent MRSA transmission in hospital setting. Vancomycin has been used as the drug of choice for treating multidrug resistant MRSA infections. However, regular monitoring of vancomycin sensitivity and routine testing of other newer glycopeptides like teicoplanin should be carried out. Further, the regular surveillance of hospital associated infections

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including monitoring antibiotic sensitivity pattern of MRSA and formulation of definite antibiotic policy may be helpful for reducing the incidence of MRSA infection. [13]

Conclusion

- Screening of HCWs for MRSA carriage may help in reduction of MRSA prevalence in patients, decreased risk of spread to close contacts, reduction of glycopeptides use and long term cost savings.
- Hand washing and decolonization of MRSA carriers are effective measures to reduce the incidence of MRSA infections in health care settings.
- Screening of HCWs for MDROs and management of carriers should be a part of hospital infection control policy.
- HCWs need awareness regarding healthcare associated infections as well as bacterial colonization and associated risk factors. They must know their status of MRSA carriage so that they can take appropriate measures to prevent further transmission to their close contacts including patients.

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