



Original Research Article

Nasal carriage of methicillin resistant staphylococcus aureus among health care workers in rural Kerala



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ABSTRACT

Introduction: *Staphylococcus aureus* is an important pathogen causing infection among patients in hospital settings and people in the community. Health care workers (HCW's) being the common source and reservoir for transmission of Methicillin Resistant *Staphylococcus aureus* (MRSA). Active surveillance of HCW's for detection of MRSA carriage is important to prevent MRSA infections in the hospital and simultaneous spill of infections into the community.

Materials and Methods: This hospital based cross sectional study was conducted at a tertiary care hospital in rural Kerala. Nasal swabbing was done for 550 HCW's. Samples were inoculated into Sheep blood agar & selective medium like mannitol salt agar. *Staphylococcus aureus* was identified by colony morphology, Gram stain and catalase test. It was confirmed by tube coagulase test. Methicillin resistance was detected using Cefoxitin disc and interpreted as per CLSI guidelines. MRSA carriers identified were decolonized with Mupirocin ointment.

Results: Screening among HCW's revealed 22.54% were positive for *Staphylococcus aureus* of which 10.73% harboured MRSA in their nasal cavity.

Conclusion: Active surveillance for MRSA nasal carriage among HCW's and decolonization of carriers is important. Strict adherence to hand washing and infection control practices are also equally important.

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1. Introduction

Staphylococcus aureus is an important commensal in the humans and also the leading cause of infections.¹ *Staphylococcus aureus* is an important pathogen in human disease.² For centuries *Staphylococcus aureus* has been a cause of infection not just in the hospital but also in the community.^{3–8} *S. aureus* is known to cause mild to severe infections.⁴

Methicillin Resistant *Staphylococcus aureus* (MRSA) is the most common antibiotic resistant pathogen in the world.^{2,3} Methicillin resistance is mediated by *mecA* gene that codes for Penicillin Binding Protein 2 A (PBP2A) protein.⁹ In 1962 Methicillin resistance was first detected.⁴ Currently Multidrug resistance is a challenge worldwide having negative consequences in patient management.¹⁰

High level of resistance is reported among MRSA isolated from carriers to erythromycin, clindamycin,⁵ fluoroquinolones, and macrolides.⁴ Another study reported high resistance to Gentamicin, kanamycin, Ciprofloxacin and Trimethoprim-Sulphamethoxazole.^{8,10,11} Vancomycin resistance is reported in 6.6% to 9.3%, Rifampicin resistance in 1.3% and 3% resistance to Linezolid of all isolated.^{4,5} Methicillin Resistant *Staphylococcus aureus* (MRSA) from the carriers. Even mupirocin resistant *S. aureus* (MupRSA) have emerged.¹²

Prolonged stay in the hospital, prolonged period of antibiotic administration, inappropriate, over use and indiscriminate use of antibiotics leads to development of methicillin resistance.^{6,8,9,13}

MRSA carriage is high among HCWs.¹⁰ MRSA carriers are reportedly the most important sources and reservoir of infection to patients in the hospital.^{3,8,10} MRSA carriage is also a recognized risk factor for subsequent endogenous infection also.² MRSA carriage is reported in about 6.3%

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to 17.8% of general population and about 18.2% to 43.8% among HCWs.⁵ There are three pattern of MRSA carriage i.e. persistent carriers (20%), intermittent carriers (60%) non-carriers (20%).^{2,8,14} The microorganisms may be resident or transient flora in the HCWs.² HCWs can acquire the organism from colonized or diseased patients.¹³ But most of the colonized HCWs are generally asymptomatic.¹⁰ The most common nidus for MRSA carriage is anterior nares.^{2,6,11,14} Nasal carriage of *Staphylococcus aureus* may be of importance in the pathogenesis of staphylococcal infection among hospitalized patients.² Nasal colonization by MRSA may be an important risk factor for acquiring MRSA infections in the hospital settings.¹³

Other sites of colonization are axilla, umbilicus, mammary folds and perineum.^{2,10,13} The mechanisms leading to MRSA nasal carriage is multifactorial and not properly understood.⁸

Around 20% of those who undergo surgery in a hospital, acquire *Staphylococcus aureus* infection leading to increased morbidity, prolonged hospital stay, increased cost in patient care and sometimes mortality also.^{2–4,10,12,13,15} The medications that can be used for treating MRSA infection are Vancomycin, teicoplanin & Linezolid.¹³ Unfortunately this microorganism is developing resistance to these drugs too.¹³

Transmission from person to person and from HCW to the patients is a concern in primary health care.^{5,13,15} In the hospital settings, transmission of MRSA from one patient to another patient may be through the contaminated hands of the Health Care Workers (HCW).^{2,4} during routine patient care.^{2,16} Among the health care workers nursing staff are always in close vicinity with patients for long period of time and frequently and sometimes in poor working facilities.¹⁴ They may acquire MRSA during patient care and may be responsible for cross contamination.¹³

As there is chance of MRSA transmission from one patient to another in the hospital, routine surveillance through nasal swabbing for MRSA detection and subsequent decolonization strategies are to be considered.⁴ This is a very effective method of reducing MRSA infection in hospital settings and needs to be included in the hospital infection control policy.^{2,6,8,11} Mupirocin ointment is commonly used for decolonization.⁴ Also the prevalence of MRSA carriage among HCW's increases the occurrence of MRSA infections in the community as HCW's are the interface between community and hospital.^{2,7,9,14,17} The HCW's can transmit the infection to their family members.^{7,13}

High MRSA carriage among HCWs is attributed to poor compliance to hand washing, infection control practices and preventive measures.^{6,8} High prevalence of MRSA may be due to lack of infection control practices in the hospitals, excessive, misuse or injudicious use of antibiotics, lack of antibiotic prescription policy and availability of antibiotics

without prescription.^{1,6,8,10,18}

Surveillance of apparently healthy HCW's is necessary to detect the MRSA nasal carriage. The present study was hence undertaken to detect MRSA nasal carriage among HCW's both doctors and nurses working at our hospital. Identified nasal carriers were decolonized with mupirocin therapy & chlorhexidine bath (to decolonize nasal and skin MRSA carriage). Decolonization was confirmed by repeat nasal swab culture.

2. Materials and Methods

This is a hospital based cross sectional study conducted in the Department of Microbiology at DM Wayanad Institute of Medical Sciences, Wayanad, Kerala, India for 6 months from Jan to June 2017 among HCWs. Present study was undertaken to detect the nasal MRSA carriage among HCWs, to decolonize the carriers and confirm the same.

A total of 550 HCWs were included in the study comprising nurses and the doctors involved in direct patient care. They included staff from critical areas and the wards. HCWs with upper respiratory tract infection, recent nasal surgery, skin infections, infections of soft tissue, impetigo, diabetics, use of nasal medication and antibiotic therapy in the past 3 months were not included in the study.^{3,4,16}

HCWs were divided into groups of 20 each and were given particular date to visit the microbiology laboratory where a trained microbiologist explained to them about the study and collected the nasal swabs after their consent which were immediately processed.

Specimen were collected from both the anterior nares with a single cotton swab pre- moistened with sterile peptone water to give best results and is also cost effective.⁵ The sterile swab was inserted carefully 2–3 cms into the nasal cavity and was rotated for 4–5 times both clockwise and anticlock wise gently and same was repeated in the other nostril also.^{10,16}

The nasal swabs were inoculated on to 5% Sheep blood agar and selective medium Mannitol salt agar. These plates were then incubated at 37°C for 48hrs.^{4,5,9,11} *Staphylococcus* was identified by colony morphology, Gram stain and catalase test. *Staphylococcus aureus* was confirmed by tube and slide coagulase test and urease test.

The isolates that were coagulase test positive were further evaluated for Methicillin resistance using Cefoxitin disc (30µg/disc, Hi Media Laboratories Ltd) by Kirby Bauer disc diffusion method on Muller Hinton Agar (MHA) as per CLSI guidelines. Few *Staphylococcus aureus* colonies were inoculated into peptone water and incubated at 37° C for 2hrs. The turbidity was compared and adjusted with 0.5 McFarland standard turbidity. The MHA plate was lawn cultured with 0.5 MacFarland turbidity of this peptone water inoculation. Incubated at 37°C for 24 hrs and zone of inhibition (ZOI) measured using measuring scale and

calipers and interpreted as per CLSI guidelines. If ZOI is ≤ 21 mm the strain is reported as MRSA. Quality control of the test done by ATCC 25923 & 43300 strains.

The MRSA carriers were decolonized with mupirocin ointment application thrice a day for 5 days.⁹

2.1. Method of application

Wash the hands before and after application. Small quantity of the cream is applied on an ear bud, then applied inside the nose, the nala of the nose are pressed together gently. They are also advised to use chlorhexidine body bath. Wet the body skin, with a piece of cloth apply chlorhexidine solution from face downwards, scrub the nose, armpit and groin region. Leave for 3 minutes then wash. This is repeated for 5 consecutive days. Hair wash with the chlorhexidine solution is done on 2nd & 4th day, leave for 3 minutes and rinse.

After 7 days of mupirocin decolonization therapy, repeat nasal swab is collected and decolonization is confirmed. If again found positive for MRSA then repeat decolonization with Mupirocin ointment was advised.

Statistical analysis was done using SPSS software.

3. Results

A total of 550 HCW's consented to participate in the study. The study included active surveillance for nasal carriage of MRSA among these 550 HCWs including 505 nurses (91.81%) and 45 doctors (8.19%). Majority of the study participants are females.

Staphylococcus aureus was isolated from 124(22.54%) out of the total 550 HCWs, of these 59 were confirmed as MRSA. So 10.73% of HCW's were found to be nasal carriers of MRSA.

All of the MRSA carriers were given mupirocin nasal ointment and chlorhexidine solution for decolonization therapy (for 5 days). After a week repeat nasal swabbing was done. One of the carriers persistent even after decolonization. She was advised repeat decolonization. Later found negative after a week of repeat nasal swab culture.

4. Discussion

Total of 550 HCWs were screened for the nasal carriage of MRSA. The study group included 91.81% nurses and 8.19% doctors. Among the participants 94.55% were females and 5.45% males. In many other studies within and outside the country majority of the participants are females.^{3-5,7-11,15}

S. aureus was isolated from 22.54% of the nasal swabs. The nasal MRSA carriage rate among HCW's in our hospital was 10.73%. Nasal carriage rate of MRSA higher and lower than our study has been reported from various parts of India.^{2,3,8,9,11-14} There are similar and contrasting studies from different region of the world.^{4-7,10,13,15-20}

Other studies from our country have reported MRSA carriage rate ranging from 6% - 8.5%, which is much lower than reported by us.^{3,8,11} Other studies from India have reported much higher rates ranging from 14% - 36%.^{2,9,12-14}

Studies from different parts of the world have reported lower isolation rates ranging from 2.9% - 9.3%.^{4,7,15,16,20} Some studies have reported very high rates of nasal carriage of MRSA among their HCW's, from 15.1% - 54%.^{5,6,10,17-19} Study also reported that isolates from HCW's were drug resistant than isolates from visitors.¹⁹ MRSA nasal carriage is much lower in rural settings than urban settings.¹⁹

Low rates of nasal carriage among HCW's are due to good infection control policy, efficiently functioning infection control committee with highlighted importance of hand hygiene.¹⁵ High number of MRSA carriers are due to inadequate infection control policies/standards.¹⁰

The difference in the nasal MRSA isolation rate in various studies may be due to local MRSA carriage rate among staff, effectiveness of infection control practices in the hospital, type of patient care and difference in sampling size, sampling quality, culturing methods and inter laboratory variability for MRSA detection.^{3,6,10,12,16,18} Different level of commitment to infection control practices may also contribute.¹⁸ They may also be due to difference in climate between the regions,⁷ variability in the geographical areas, institutions, hospital specialties and settings in the hospital where the studies are conducted.⁸ Disparity in the nasal carriage may also be due to difference in the study design and methods used in detection of MRSA.⁸

In the present study, 11.08% of nurses and 6.67% of the doctors harboured MRSA in their nasal cavity. Nurses are mainly colonized with MRSA. Most of the other studies also report high MRSA nasal carriage rate among the nurses.^{3,4,7-11,13,16,20} Only a study from Libya has reported higher MRSA carriage among their doctors.²¹ High risk of MRSA carriage among the nurses may be due to their frequent contact with patients as part of their work.^{2,10,11,16} The nurses are the most exposed HCW to the patients, bystanders and the visitors.⁹ Nurses are in prolonged close contact with patients,⁴ hence they may acquire and disseminate MRSA among patients and in the hospital settings.^{2,12}

Hence the HCW's need to follow infection control practices strictly, hand hygiene (compliance and appropriate technique is important), patient to nurse ratio to be maintained to 1:1, isolation of MRSA infected cases, use of personal protective equipment appropriately, visitors restriction, high contact area cleaning,¹⁴ terminal cleaning of isolation rooms on discharge and contact precautions.⁹ Surveillance by swab culture of critical area may also be important.⁶ Strict infection control policies, awareness & educational programs, regular training are necessary to pre-

Table 1: Sex distribution of HCW's screened for MRSA

Category	Number of HCW	Percentage
Males	30	5.45
Females	520	94.55

Table 2: MRSA carriage among the HCW's

Category	Number of samples	Number of MRSA carriage	Percentage
Nurses	505	56	11.08
Doctors	45	3	6.67

vent MRSA transmission.^{6,9,14,16,17} Thorough cleaning and decontamination of hospital environment is very important to reduce microorganisms load on the contaminated surfaces and thus reduce MRSA infections.^{6,17}

HCWs need to be educated regarding MRSA infections, and hand hygiene practices should be reassessed.¹⁰ Reducing antibiotic misuse and overuse is also very important. Screening for MRSA carriage and decolonization of the carriers are important for control and prevention of MRSA transmission among hospital settings.⁶ Urgent reporting of MRSA laboratory results is also critical.^{10,11,13} There is also need of awareness campaign in the community regarding hand washing and personal sanitation.¹⁹

Routine screening of HCW's for Methicillin Resistant *Staphylococcus aureus* carriage and eradication therapy as part of regular infection control practices is now controversial¹ also.

5. Conclusion

Regular screening for MRSA carriage among HCW's and their decolonization may be effective in reducing hospital acquired MRSA infections. Appropriate infection control practices, strict adherence to WHO five moments and steps of hand hygiene practices and appropriate use of antibiotics are also very important in controlling MRSA infections in the hospital settings.

6. Limitations

Molecular methods for identification of MRSA were not done due to financial constraints.

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8. Source of Funding

None.

9. Conflict of Interest

None.

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