



Prevalence of MRSA among Health Care Staff in a Tertiary Care Hospital

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Abstract

Background: Infections are among the most important occupational risks for health care workers. Precautions related to transmission route and contact isolation or respiratory isolation is very important to protect healthcare workers and other patients. The study aimed to describe the prevalence of MRSA among health care staff.

Methods: This cross-sectional study was conducted to investigate the prevalence of MRSA among health care employee, as well as the potential risk factors for MRSA colonization. For screening, nasal swabs & hand swabs from the dorsum of the hands were taken. When an individual was tested positive, a control swab was taken; if this confirmed a positive result, decolonization measures were offered. The responsible general practitioners were notified of positive MRSA findings among residents.

Results: Analysis was carried out in a tertiary care hospital from Nov 2017 to Nov 2018. A total of n=227 health care employees from all patient care areas were screened. Out of these n=227 employees n=23(10.1%) doctors, employees from administration n=2 (0.88%), technician n=9 (3.96%), dialysis technicians n=6(2.6%), kitchen staff n=20 (8.81%), housekeeping staff n=26 (11.45%) & nurses n=141(62.1%). N=11 employees tested positive, putting the MRSA prevalence at 4.8 %. Of these n=11 cases, 9 (81.8%) were from anterior nares & n=2 (18.2%) from hands. Prevalence was more from the employees working in the critical areas such as CCU / MICU, AMC & one from the medical ward.

Conclusion: This study is the first to make data on the MRSA risk of employees at our center. The prevalence data are low in all areas and indicate a somewhat low risk of infection. Good infection control at the facilities is a continual improvement process and the employees are trained in-depth knowledge of infection prevention to improve compliance with personal protective measures.

Keywords: Health Care Employees, MRSA, Colonization, Infection Control.

Introduction

Healthcare workers frequently come into contact with infected individuals and are at a greater risk of infection than the general population due to their occupational activities. Methicillin-resistant *S. aureus* (MRSA: MIC to Oxacillin/Methicillin of $\geq 4 \mu\text{g/mL}$) arose from methicillin-sensitive *S. aureus* (MSSA: MIC to Oxacillin/Methicillin of $\leq 2 \mu\text{g/mL}$) by the acquisition of the mec A gene which is located on a genetically mobile

chromosomal determinant termed *staphylococcal* cassette chromosome mec (SCCmec)^[1]. Mec A gene encodes an additional penicillin-binding protein (PBP2a) which has low affinity for isoxazoly-phenicillins, such as methicillin^[2]. They are resistant to all of the beta-lactam classes of antibiotics (such as penicillins), penicillinase-resistant penicillins (e.g. Flucloxacillin, cloxacillin), and cephalosporins. Besides, Vancomycin /glycopeptide-intermediate *S. aureus*

(VISA/GISA) has been detected in some countries. In June 2002, the first clinical isolate of Vancomycin-resistant *S. aureus* (VRSA: MIC to Vancomycin of $\geq 16 \mu\text{g/mL}$) that contains the resistance genes Van-A or Van-B was isolated from the USA^[3]. It has been postulated that the transfer of the resistance occurred from a patient who was colonized with VRE. This pathogen also poses a significant challenge for employees in various medical settings despite vigorous attempts; eradication of MRSA over the last 30 years has not been very successful for the following reasons: Continued use of inappropriate/excessive use of broad-spectrum agents, especially Quinolones (e.g. Ciprofloxacin, Levofloxacin) and Cephalosporins. Continued failure to adhere to standard infection control practices such as hand hygiene, use of aseptic non-touch technique, inadequate decontamination of items/equipment, and clinical environment. MRSA is usually associated with high morbidity and mortality in patients, especially in ICU and those patients who develop severe infections. When MRSA strains first occurred, they were usually confined to elderly patients admitted to healthcare facilities especially those with previous antibiotic use^[4]. However, over time MRSA strains were also isolated from apparently healthy individuals in the communities with no previous contact with healthcare facilities. These new MRSA Strains were designated community-associated MRSA or community-originated MRSA (CA-MRSA) Healthcare-associated MRSA (HA-MRSA) were isolated from patients admitted to healthcare facilities such as nursing homes and long-term care facilities^[5]. Healthcare-associated infections caused by HA-MRSA Include bloodstream infections, urinary tract infections, Respiratory tract infections, surgical-wound infections and device-associated infections.

Materials and Methods

The present study was conducted by the Department of Microbiology, Medicity Institute of Medical Sciences, Hyderabad. Institutional

Ethical committee permission was obtained for the study. Screening for MRSA included all employees working in the patient contact areas (both critical areas and general wards). Nasal carriage of *S. aureus* was present in 20–30% of the population and is a major risk factor for multiple types of purulent endogenous infections as well as bacterial transmission both in private and nosocomial environments. As *S. aureus* predominantly colonizes the anterior part of the nasal cavity swab based screening is commonly used to identify nasal carriers.

Collection of samples

After washing hands, wear gloves peel open the Culture Swab sterile pouch twist to remove the cap from the transport tube. Remove the swab. Insert the swab approximately 2 cm (approximately $\frac{3}{4}$ inches) into the Nairs. Rotate the swab against the anterior nasal mucosa for 3 seconds, using the same swab, repeat for the other side. Using another sterile swab collect from both dorsum of hands dry swabs, these were set down into a fresh sterile 15 ml Round Bottom Tube containing 1 ml of sterile 0.85% NaCl solution. The swab-NaCl-combination was vortexed for 5 seconds. CFU was determined by plating 100 μl of 1:10 serial dilutions onto sheep blood agar, mannitol salt agar, Chromogenic agar & MHA with Oxacillin (A standard number of bacteria is inoculated onto Mueller-Hinton agar (MHA) containing 6 μg of Oxacillin per ml and 4% NaCl. Following overnight incubation, Interpretation was as follows;

1. No growth or a single colony: Oxacillin susceptible colony or a light film of growth: Oxacillin resistant the appearance of growth indicates that the *Staphylococcus aureus* isolate is resistant to Oxacillin and other penicillinase-stable penicillins (Methicillin, Nafcillin, Cloxacillin, and Dicloxacillin)

Agar plates were subsequently cultured at 37°C under ambient atmosphere for 48 h. CFU was then counted by macroscopic inspection.

Staphylococcus aureus was identified by β -hemolysis and colony color (golden yellow on sheep blood agar, golden yellow to green color on chrome agar) Inoculated on nutrient agar, Blood agar, chromogenic agar & incubated at 37° C for 24hrs

Nutrient Agar: Colonies are 1-3 mm in size, circular, smooth, convex, opaque and easily emulsifiable. Most strains produce golden-yellow non-diffusible pigments (made up of p carotene)
 Blood agar: Colonies are similar to that on nutrient agar, besides, surrounded by a narrow zone of beta hemolysis. Identification is done using Standard microbiological procedures.
 Biochemical Test for Identification - catalase Test - Catalase test-·positive Coagulase test (slide and tube), Mannitol sugar is fermented.

QC strains

1. *S. aureus* ATCC 29213—Oxacillin susceptible
2. *S. aureus* ATCC 43300—Oxacillin resistant

Disk diffusion quality control strain: *Staphylococcus aureus* ATCC 25923 sensitivity of isolates – CLSI guidelines-Kirby Bauer Disk Diffusion method

Antimicrobial Susceptibility Test: 5 - 6 disks on a 100-mm plate discs are placed no less than 24 mm

apart, center to center. Each zone diameter is measured accurately *mecA*-Mediated Oxacillin Resistance Using Cefoxitin Direct colony suspension to obtain 0.5 McFarland turbidity. Using a 1-PL loop that was dipped in the suspension, spot an area 10–15 mm in diameter. Alternatively, using a swab dipped in the suspension and expressed, spot a similar area or streak an entire quadrant. 33–35°C; ambient air (Testing at temperatures above 35°C may not detect MRSA) for MRSA Disc diffusion test can be done by using 30 μ g Cefoxitin (surrogate test for Oxacillin) < 21 mm = *mecA* positive, >22 mm = *mecA* negative Testing for PBP2a using induced growth (growth taken from the zone margin surrounding a Cefoxitin disk on a blood agar plate after 24 hours incubation in 5% CO₂) or *mecA* should be done. Isolates that test either *mecA* negative or PBP2a negative or Cefoxitin susceptible should be reported as Oxacillin susceptible. Any discernible growth within the zone of inhibition indicates Vancomycin resistance. Isolates that test as *mecA* positive should be reported as Oxacillin (not Cefoxitin) resistant; other β -lactam agents, except those with anti-MRSA activity, should be reported as resistant or should not be reported.

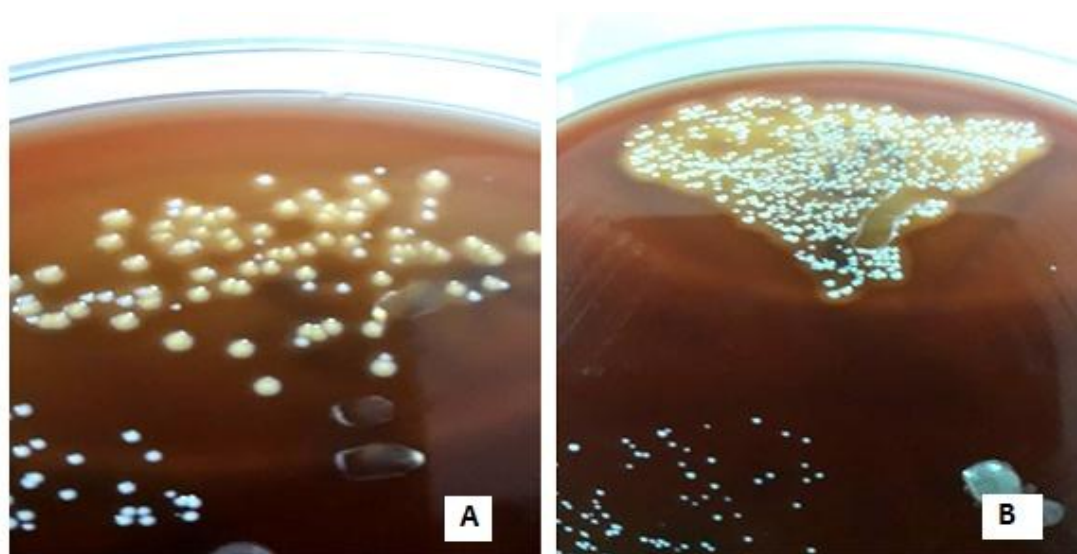


Figure A: On blood agar plate predominant growth of *Staphylococcus aureus* surrounded by zones of clear beta-hemolysis. The golden appearance of colonies;

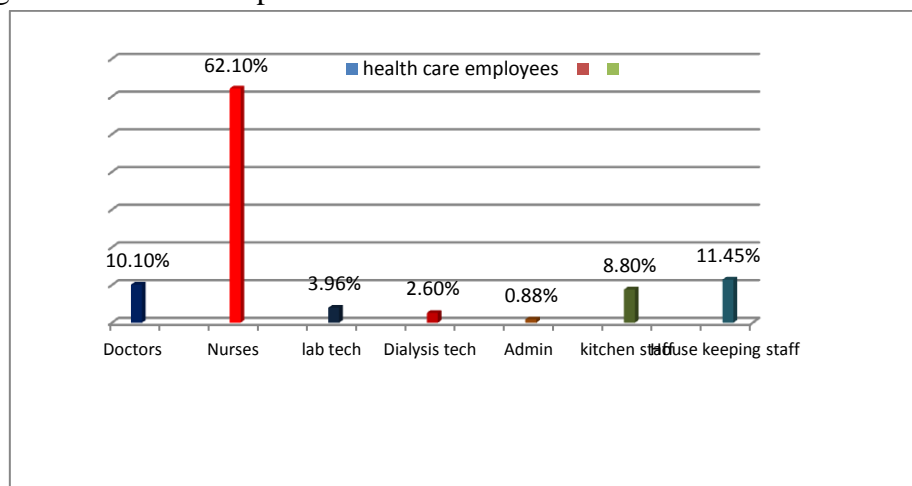
Figure B: shows mixture of both *Staphylococcus aureus* & coagulase negative *Staphylococcus spp*

Results

The analysis was carried out in a tertiary care hospital from Nov 2017 to Nov 2018. A total of n=227 health care employees from all patient care areas were screened of these n=227 employees n=23(10.1%) doctors, employees from administration n=2 (0.88%), lab technicians n=9

(3.96%), dialysis technicians n=6(2.6%), kitchen staff n=20 (8.81%), housekeeping staff n=26 (11.45%) & nurses n=141(62.1%). n=11 employees tested positive, putting the MRSA prevalence at 4.8% of these n=11 cases, n=9 (81.8%) were from anterior nares & n=2 (18.2%) from hands.

Graph 1: showing the number of samples taken from Health care staff



Prevalence was more from the employees working in the critical areas such as CCU / MICU, AMC & one from the medical ward. Out of the n=11 cases MRSA detected n=6(54.54%) were the samples from MICU, n=2(18.18%) each from CCU and AMC and n=1(9.09%) from Medical ward. N=6(54.54%) nurses from these areas showed MRSA positive from anterior nares samples,

followed by n=3(27.27%) housekeeping staff and n=2(18.18%) doctors were also found positive for MRSA. Staff working in MICU carried a higher risk of transmission to other individuals & patients. Kitchen staffs covered were those who are attending the wards & critical areas with the food trolleys.

Graph 2: Showing the samples collected from different areas of the hospital

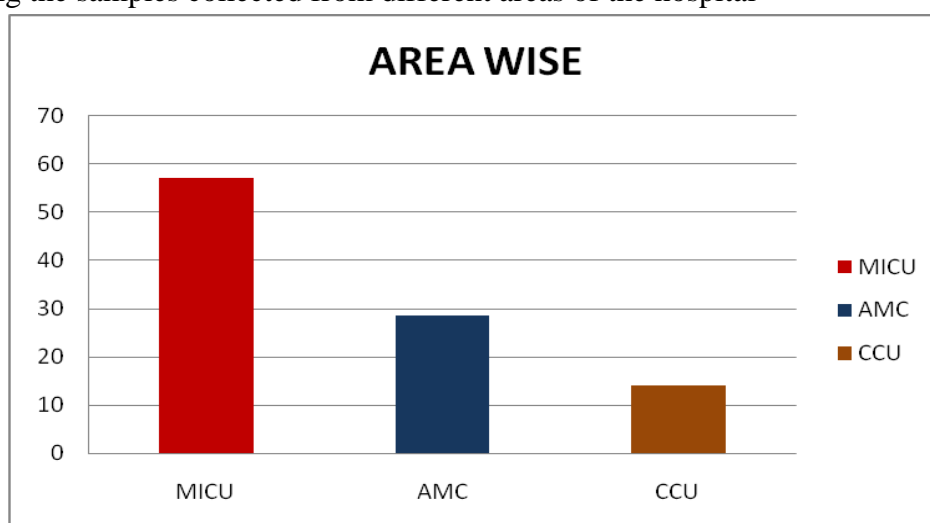


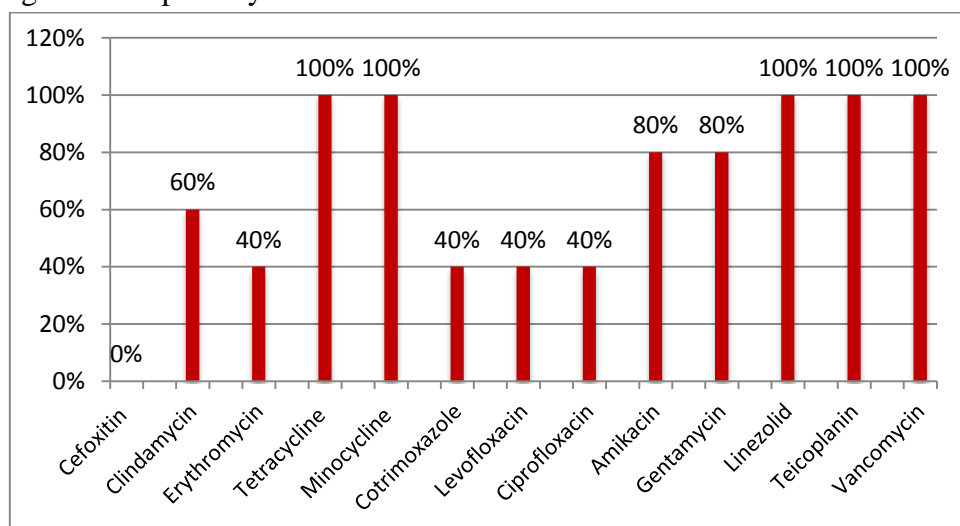
Table 1 showing the pattern of susceptibility pattern for MRSA and the samples were found to be 100% susceptible to tetracycline, Minocycline, Doxycycline, Teicoplanin, Linezolid. 80% were

susceptible to Amikacin and Gentamycin, 30% to Levofloxacin and Ciprofloxacin and 40% to Cotrimoxazole.

Table 1: Susceptibility pattern for MRSA

Sl. No.	Antibiotic	Number of susceptibility / Number of samples	percentage
1.	Cotrimoxazole	4 / 10	40
2.	Tetracycline	10 / 10	100
3.	Minocycline	10 / 10	100
4.	Doxycycline	10 / 10	100
5.	Teicoplanin	10 / 10	100
6.	Linezolid	10 / 10	100
7.	Amikacin	8 / 10	80
8.	Vancomycin	10/10	100
9.	Gentamycin	8 / 10	80
10.	Levofloxacin	3 / 10	30
11.	Ciprofloxacin	3 / 10	30

Graph 3: Showing the susceptibility of MRSA



Other organisms most commonly isolated were *Staphylococcus epidermidis*, ESBL *Klebsiella pneumoniae*, and *Staphylococcus hemolyticus*. It is part of the skin flora of humans, and its largest populations are usually found at axillae, perineum, and inguinal areas. It is a well-known opportunistic pathogen, and is the second-most frequently isolated *S. epidermidis*. Human infections include native valve endocarditis, septicemia, peritonitis, and urinary tract, wound, bone, and joint infections often associated with the insertion of foreign bodies, such as prosthetic valves, cerebrospinal fluid shunts, orthopedic

prostheses, and intravascular, urinary, and dialysis catheters. *S. haemolyticus* is a multi-drug resistant and able to form biofilms, which makes infections especially difficult to treat.

Discussion

A total of n=227 health care employees from all patient care areas were screened Prevalence of MRSA was more from the employees working in the critical areas such as CCU / MICU, AMC & one from medical ward. Swabs were collected from hands after proper hand wash & hand rub. In spite of the hand wash, swabs collected from

hands also showed MRSA. In our study we found n=11 employees tested positive, putting the MRSA prevalence at n=11(4.8%) out of n=227 samples. Maximum numbers of MRSA were n=9 (81.8%) were from anterior nares & n=2(18.2%) from hands. N=6(54.54%) nurses from these areas showed MRSA positive from anterior nares samples, followed by n=3(27.27%) housekeeping staff and n=2(18.18%) doctors were also found positive for MRSA. Malini et al; have reported a prevalence of 8% in health care workers in Bangalore^[6]. Khanal R et al; have reported a prevalence of 3.4% MRSA in health care workers of western Nepal^[7]. Askairan M et al; have reported 5.3% prevalence of MRSA in healthcare workers of Iran^[8]. MK Salman et al; in their study have found the prevalence of MRSA in 9.3% of healthcare workers of Pakistan^[9]. In the present study, the overall prevalence of *S. aureus* was found in n=25 (11.01%) samples. Similar studies in Libya showed the presence of *S. aureus* in 12.4% of samples of HCWs^[10]. Malini J et al; have reported the presence of *S. aureus* in 17.5% of samples from HCWs. MRSA are both hospitals acquired strains and community-acquired strains and infections^[6]. These organisms asymptotically colonize the patients and health care workers and are the major sources of MRSA in the hospital environment. The HCWs has been identified as an important link in the transmission of MRSA between patients^[11]. The role of MRSA carrier in the transmission of the pathogen cannot be overstated. Such carriers cause transmission of organisms between persons through colonized hands and aerosolization following sneezing. In our study the MRSA carriers were maximum by the nurses, followed by housekeeping staff and doctors. The nasal carrier rates were higher than the hand samples. Khatri S et al; have found the MRSA nasal carrier highest proportion in the lab technicians followed by nurses^[12]. El-Aila NA et al; in their study have found the highest prevalence of MRSA among nurses followed by doctors^[13]. Shibabaw A et al; have also found a high prevalence of MRSA among nurses which is

in agreement with the results of the present study^[14]. In this study, we found Tetracyclines, Linezolid, Vancomycin, and Teicoplanin were 100% sensitive for MRSA. Amikacin, Gentamycin was found to be 80% sensitive and least sensitive were Levofloxacin, Ciprofloxacin, and Cotrimoxazole were shown in table 1. Khatri S et al; and El-Aila NA et al; have also found Vancomycin to be 100% sensitive^[12,13]. An empiric treatment or prophylaxis against MRSA included Teicoplanin, Vancomycin, Linezolid in combination with Tetracyclines or Aminoglycosides. Two of the MRSA carriers – whose nasal swab constantly showed MRSA, were treated with 2% Mupirocin. Mupirocin is the most frequently used topical agent and can be used for persons aged 12 years and older and in health care workers to reduce the risk of infections and transmission. All the employees showing MRSA in anterior nares were advised for decolonization with local application 2% Mupirocin for the anterior nares 3 times a day for 5 days. A small amount of ointment (about the size of a matchstick head) is placed on a cotton bud and applied to the anterior part of the inside of each nostril. The nostrils are closed by gently pressing the sides of the nose together; this will spread the ointment throughout the nares. Mupirocin ointment is reserved for the treatment of MRSA only. Strict hand hygiene monitoring in these areas was practiced in these areas hand washing during all the 5 moments was mandatory for all the employees. Studies have shown that Mupirocin has been successfully used for the decolonization of MRSA with the success of more than 80%^[6].

Conclusion

Periodical evaluation for MRSA among healthcare workers is an important preventive measure for the hospital and institutions. Regular checkup and treatment can reduce the burden of nosocomial infections from HCWs to patients that in turn reduce the burden of treatment and patient cost. Staff working in MICU carried a higher risk of

transmission to other individuals & patients. All HCWs are given adequate education and practical training on all issues relating to IPC as part of their induction/orientation program. This is reinforced through a regular continuing education program. They are trained in the handling of blood and body fluids, chemical disinfectants, and are aware of local policies and procedures on IPC which also includes safe disposal of sharps, clinical waste, safe handling of linen, etc. Regular audits are being carried out to ensure compliance with IPC policies and procedures. The standard precautions & PPE practiced by the employees has benefitted the hospital environment and the patients, since there are no incidences related to MRSA Surgical Site Infections in the admitted cases. There is a low prevalence for MRSA among health care, there were no MRSA infections among the clean & clean contaminated kind of surgeries.

Conflict of interest: None

Source of support: Nil

Ethical Permission: Obtained

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