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Original Research Paper

AN EXPLANATORY STUDY OF INFECTION CONTROL MEASURES TO MRSA PRODUCING BACTERIA WITH FOCUS TO PATIENT- PROFESSIONAL INTERACTIONS

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ABSTRACT

Background: The effectiveness of treatment and patient safety in healthcare depend heavily on interactions between patients and professionals as well as adherence to infection control procedures. With an emphasis on the interactions between patients and professionals, this research sought to assess infection control strategies for MRSA-producing bacteria. **Methods:** The study was conducted to detect nasal carriage of MRSA among ICU staff and non-ICU staff in Synergy Multispecialty Hospital, Vasna Road, Vadodara. Nasal swabs were taken from 30 health care workers who enlisted, 11 of whom worked in the ICU and 19 of whom did not. **Results:** *Staphylococcus aureus* was found in 8 of the samples, of which 6 were MSSA and 2 were MRSA. In this investigation, it was observed that *S. aureus* isolation was more common among ICU staff rather than non ICU staffs. It was also observed that *S. aureus* strain was common and most virulent among the ICU patients (75%) as compared to non ICU patient (25%). The current finding revealed MRSA, as an irrational danger. **Conclusion:** MRSA is often spread by either direct or indirect contact with a reservoir. Regularly practice excellent hygiene to lower your chances of contracting MRSA. To reduce the spread of MRSA and infection control failures, more emphasis should be put on individualresponsibility for patient-professional interactions.

Keywords: *Staphylococcus aureus*, MRSA, ICU staff, Disinfection/Cleaning

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Introduction

Asymptomatically nasal carriage colonized health care workers are the major sources of methicillin-resistant *Staphylococcus aureus* (MRSA) in the hospital, which could be the link to transmission of MRSA. When these microorganisms produce life-threatening conditions like sepsis, osteomyelitis, or endocarditis, the infection is deemed more dangerous.[1]

The majority of Staphylococci were sensitive to penicillin G; but, owing to penicillin abuse, many isolates developed resistance to the medication by producing *β*-lactamases (penicillinases), which break down the antibiotic's *β*-lactam ring and render it harmless to microorganisms.[2] A brief reprieve was brought about by the discovery of β-lactamase-resistant penicillins, such as nafcillin, oxacillin, cefoxitin, and methicillin.[3] Later methicillin-resistant strains, on the other hand, developed the mecA gene, which codes for refractory penicillin binding proteins (PBP2a), which are enzymes that produce cell walls but have a decreased affinity for penicillins.[4] Nowadays, MRSA is the most often found antibiotic-resistant infection in both healthcare facilities and the general public in many regions of the globe.[5]

Since infections brought on by this infectious agent are difficult to treat with first-choice antibiotics and progress slowly when treated with the proper medications, the development of methicillin resistance in *S. aureus* (MRSA) presents a severe therapeutic dilemma to humanity [6]. The risk of developing and spreading MRSA infections is increased by predisposing factors like choosing broad spectrum antibiotics, using multiple antibiotics without consideration, staying in the hospital for an extended period of time, abusing intravenous drugs, using prosthetic devices, and not practicing good asepsis like hand washing.[7] Physicians who follow practice guidelines must first become aware of them, then cognitively agree with them, choose to incorporate them into the treatment they offer, and finally consistently adhere to them at the proper times, according to Pathman *et al.* four-step's method .[8] Among the study's goals was to test health care workers for MRSA infection It is a pathogen, *Staphylococcus aureus*, that lives in healthy individuals as normal flora and does not cause any symptoms in those who have it.

Methodology

Data collection

In conjunction with the Medicare Synergy Hospital in Vadodara, the current research was a cross-sectional observational study conducted in the microbiology laboratory of the Synergy Multispecialty Hospital on Vasna Road. The Institute's Scientific Review Committee and Institutional Ethics Committee approved the study, and ethical clearance was sought before it could be carried out.

There were a total of 30 participants in the research. Subjects gave their informed permission to take part in the research and have a nose swab taken. There were 30 healthcare professionals in all, 11 in the intensive care unit and 19 elsewhere. Samples were taken using sterile cotton swabs. The sample was obtained by rotating the swabs gently on both nares of the study participants so that the tip is entirely at the nasal osteum level and then it was transported to the laboratory.

Within an hour of collection, swabs were inoculated into Nutrient Agar (NA), which was then incubated for 24-48 hours at 37°C. Colonies of creamy golden yellow color on nutrient agar.

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Coagulation positive was considered to be *S. aureus* after the plates were allowed to remain at ambient temperature as well as the coagulase test was run using the slide and tube test technique.

Laboratory antimicrobial susceptibility testing was performed using modified Kirby- Bauer disc diffusion method which is recommended by the Clinical and Laboratory Standards Institute (CLSI). *S. aureus* colonies were identified and suspended in tryptone broth until they matched specified turbidity (0.5 MacFarland). Mueller-Hinton agar (MHA) plates were incubated for 24 hours at 35°C after being inoculated with the suspension and the medication Cefoxitin (1µg). It was determined that colonies having inhibition zones smaller than 11 mm were methicillin-resistant.

Data analysis

An Excel 2010 spreadsheet was used to store the quantitative data. All continuous variables were described using the mean and standard deviation, whilst categorical data were represented using numbers and percentages. These elementary statistical analyses were performed using SPSS Version 25.

Results

The participants in the current study ranged in age from 20 to 30 years old, with 22 men and 8 women. Table 1 shows the precise distribution of age and gender.

Table 1: Comparison of result between gender.

Result	**Female (n=22)**	**Male (n=8)**	**Total (n=30)**	**P value**
MRSA	1(4.55%)	1(12.50%)	2(6.67%)	0.256
MSSA	6(27.27%)	0(0%)	6(20%)	
No Growth	15(68.18%)	7(87.50%)	22(73.33%)	
Total	22(100%)	8(100%)	30(100%)	

Table 1 shows that the isolation of MRSA, MSSA, and no-growth bacteria from male and female staff members showed a greater frequency of MRSA in male staff (12.5%) than female staff (4.55%). MSSA affected 27.27 percent of female workers, whereas 87.50 percent of male employees were immune to any bacterial growth (fig. 1). The p value was determined to be non-statistically significant using Chi-square without Yates correction (one-tailed p value is 0.256).

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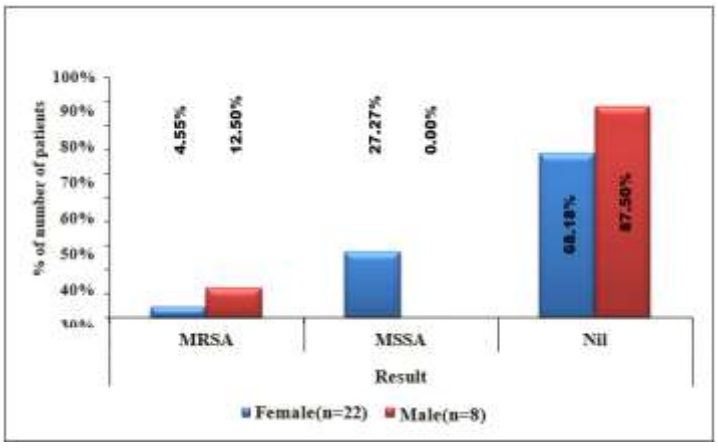

Figure 1: Comparison of result between gender.

Table 2: Comparison of result between age.

Result	20-23 (n=13)	24-27 (n=14)	28-30 (n=3)	Total (n=30)	P value
MRSA	0(0%)	1(7.14%)	1(33.33%)	2(6.67%)	0.254
MSSA	2(15.38%)	3(21.43%)	1(33.33%)	6(20%)	
No Growth	11(84.62%)	10(71.43%)	1(33.33%)	22(73.33%)	
Total	13(100%)	14(100%)	3(100%)	30(100%)	

The findings indicated that the isolation of MRSA, MSSA, and no-growth bacteria among age wise staff members revealed a higher prevalence of MRSA in 28-30 age group (33.33%) than in the 24-27 (7.14%), as shown in Table 2. With 21.43% percent of 24-27 age group vulnerable more than 15.38% 20-23 age group to MSSA and 84.62 percent of 20-23 age group resistant to any bacterial development (fig. 2). Using Chi-square without Yates correction, it was determined that the p value was not statistically significant (one-tailed p value is 0.254).

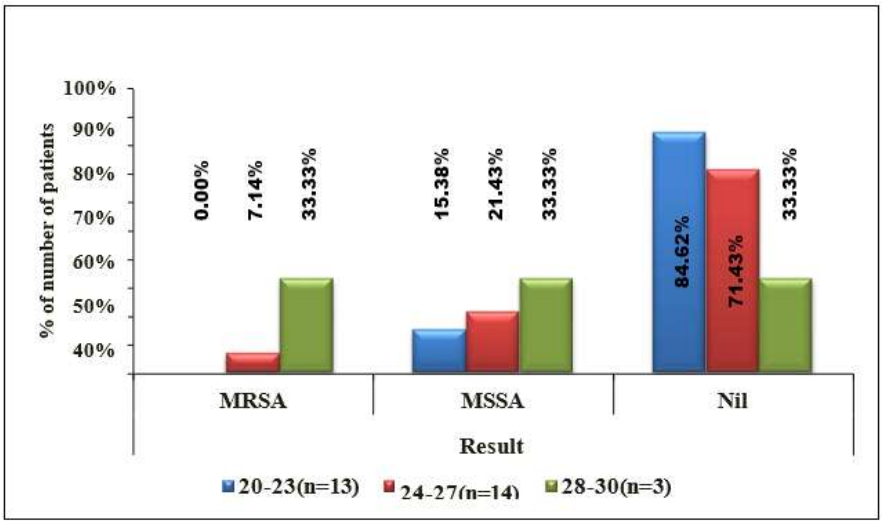

Figure 2: Comparison of result between age.

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Table 3: Comparison of result between ICU/Non ICU staff.

Result	ICU staff (n=11)	on -ICU staff(n=19)	Total	P value
MRSA	1(9.09%)	1(5.26%)	2(6.67%)	
MSSA	3(27.27%)	3(15.79%)	6(20%)	
Nil	7(63.64%)	15(78.95%)	22(73.33%)	
Total	11(100%)	19(100%)	30(100%)	0.688

The isolation of MRSA, MSSA, and no-growth bacteria among ICU and non-ICU staff showed a greater frequency of MRSA among ICU staff (9.09%) than among non-ICU staff (5.26%), as shown in Table 3. With 27.27 % of ICU staff more susceptible to MSSA than 15.79 % of non-ICU staff and 78.95 % of non-ICU staff resistant to any bacterial growth, 27.27 % of ICU staff are susceptible to MSSA (fig. 3). Using Chi-square without Yates correction, it was concluded that the p value was not statistically significant (0.688).

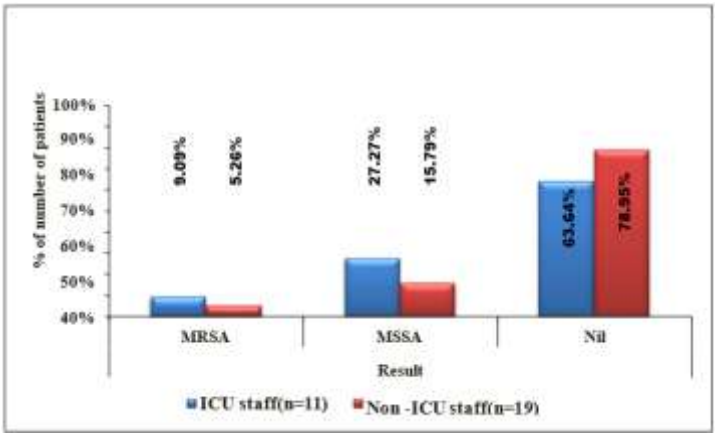

Figure 3: Comparison of result between ICU/Non ICU staff.

Table 4: Antibiotic resistant pattern for MSSA and MRSA

Name of the Antibiotic	MSSA resistant strains	MRSA resistant strains
Gentamycin	2 (33.3 %)	0
Ampicillin	2 (33.3 %)	1 (50%)
Erythromycin	2 (33.3 %)	1 (50%)
Azithromycin	2 (33.3 %)	1 (50%)
Amoxyclav	1 (16.6 %)	1 (50%)
Ciprofloxacin	1 (16.6 %)	2 (100 %)
Levofloxacin	0	0
Chloramphenicol	5 (83.3%)	0
Cefotaxime	2 (33.3 %)	2 (100 %)
Vancomycin	0	0
Lincomycin	0	0
Linezolid	0	0
Teicoplanin	2 (33.3 %)	1 (50%)

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Ceftriaxone	2 (33.3 %)	2 (100 %)
Cefoxitin	0	2 (100 %)

As shown in Table 4, the results of the antibiotic susceptibility tests revealed varying resistance of the MRSA and MSSA isolates to a variety of drugs. The drugs, including ceftriaxone and cefotaxime, demonstrated MRSA and MSSA sensitivity.

Discussion

The results of the current investigation showed that male staff members had a greater frequency of MRSA (12.5%) than female staff members (4.55%), and that *S. aureus* was isolated at a rate of 6.67% among MRSA, MSSA, and no-growth bacteria. With 87.50 percent of male employees immune to bacterial growth and 27.27 percent of female employees susceptible to MSSA. In another research, it was shown that 13-47 percent of *S. aureus* diseases in India[9] (in Delhi (2010), 43%) [10], Punjab (2012) 20.7%,[11] and Begaluru (2013) 23%,[12] all had methicillin resistance. Patients in an intensive care unit (ICU), particularly a surgical ICU, often have drains, wounds, and intrusive examining equipment that create skin breaches and hence raise the risk of infection.

In our investigation, when analyzing the percentage of MRSA among the *S. aureus* isolates, it was found that the incidence of MRSA was greater in the ICU staff (9.09%) than in the non-ICU staff (5.26%). Because of this, the surgical unit's employees won't be unfairly held responsible for the disease's spread, which is in line with the fact that both ICU and non-ICU staff play an equal role in the disease's spread. In our investigation, we discovered that 100% of the MRSA strains were multi-drug resistant. MRSA often exhibits multidrug resistance, which one research estimated to be 30%.[13]

Havey *et al.*,[14] also showed that *S. aureus* infection was an indication of extended period of therapy among ICU hospitalized patients with infections in blood in retrospective cohort study (n = 100). Since MRSA's virulence factors have been evolving over time, contamination control procedures, such as the selection of an empirical antibiotic, must now closely monitor clinical and microbiological characteristics. Allergies, comorbidities, antibiotic susceptibility pattern, local epidemiology, medication interactions and antibiotic safety, are among the variables influencing antibiotic choice for MRSA treatment. During the hospital stay, MRSA was acquired at a rate of 3.8%, according to Koessler *et al.*,[15]

There is still a dearth of information on the mechanics of MRSA transmission. An Indian research used mechanistic statistical models to investigate the dynamics of MRSA spread in ICU. Data on infections with methicillin-resistant *S. aureus* were gathered retrospectively over 50 months. A total of 72 MRSA diseases or an average of 1.44 incidents per month—were noted throughout the course of the research, and roughly 78% of them were nosocomial. Only 4.2% of the patient had MRSA when they were first hospitalized. Utilizing the structured unknown Markov model, the rate spreading was calculated to be 0.094 per day. ICUs in India hence often have high transmission rates.[16] The proportion of MDR strains among MRSA was found to be 73% by Arora *et al.*,[17] The prevalence of these strains varied from 23.2% to 63.6% in the several surveys from various regions of India.

All 13 of the MRSA isolates from our investigation were completely sensitive to Levofloxacin, Vancomycin, Lincomycin, Chloramphenicol, Gentamycin, and Linezolid in relation to a lack

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of effectiveness for the drugs ceftriaxone, cefoxitin, ciprofloxacin, and cefotaxime. None of the isolates in certain studies' investigations were linezolid-resistant, according to previous studies.[18] Similar findings were noted in relation to co-trimoxazole, where it was discovered that MRSA resistance to co-trimoxazole was less prevalent.[19] Imipenem (64.60%) and Vancomycin (79.83% resistant) were shown to have significant levels of resistance in a study of 827 clinical samples (containing throat, sputum, pus, blood, as well as urine) tested for MRSA in Northeast India.[20]

Antibiotic susceptibility testing was carried out by D'Souza *et al.*,[21] and SCCmec characterisation was associated with it. They discovered that 38% of the strains III SCC*mec* has been MDR, while the remaining 92% were only responsive to the antibiotics vancomycin, rifampin, chloramphenicol, and linezolid. The strains IV SCCmec has been sensitive to three antibiotic classes, none of which has been MDR, and 83% were sensitive to many antibacterial groups. The strains V SCC*mec* were sensitive to 64% of different antibacterial groups, 24% of different antimicrobial classes, and 12% of MDRs. A increasing worry is that extremely virulent population strains that harm nutritious people may become less responsive to antibiotics when community and hospital strains mix.

However, 2.4% of *S. aureus* (linezolid-resistant) were found in 2006 in South India, according to Rajaduraipandi *et al.*,[22] Additionally, Linezolid resistance was found in 24% of orthopedic patients (12 of 50) in a study by Thool *et al.*,[23] This resistance was due to the widespread usage and overuse of this antibiotic in hospitals.

In our investigation, Ceftriaxone and Cefotaxime were 100% effective against all MRSA isolates. It was discovered that 50% of the MRSA strain was resistant to ampicillin, erythromycin, azithromycin, amoxyclav, and téicoplanin.

Conclusion

Antibiotic usage and microbial evolution are two factors that inextricably link the phenomena of antimicrobial resistance. The evolutionary progress of MRSA has been astounding in this situation. The first multiresistant nosocomial pathogen was thought to be methicillin-resistant *S. aureus*. It is connected to significant morbidity and death and is regarded as a serious public health concern globally. To determine the relevance of nasal colonization in ICU and non-ICU professionals as the possible source of infection in patients, further research in this area has to be done in patient-professional interactions. For meaningful comparison with other research, surveillance techniques and result computation must be standardized. This research raised awareness among ICU and non-ICU workers about the increasing occurrence of MRSA, the seriousness of the illnesses it might cause, and the preventative steps required to avert outbreaks even if it could not confirm a number of risk variables. The necessity of hand hygiene practices, general safety precautions, and other simple but effective preventative measures to minimize the spread and spread of MRSA contaminations were discussed in patient professional education programs.

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References

1 Singh S, Malhotra R, Grover P, Bansal R, Galhotra S, Kaur R, Jindal N. Antimicrobial resistance profile of methicillin-resistant Staphylococcus aureus colonizing the anterior nares of health-care workers and outpatients attending the remotely located tertiary care hospital of North India. Journal of Laboratory Physicians. 2017 Oct;9(04):317-21.

2 Zango UU, Ibrahim M, Shawai SA, Shamsuddin IM. A review on β-lactam antibiotic drug resistance. MOJ Drug Des. Develop. Ther. 2019;3(2):52-8.

3 Abimana JB, Kato CD, Bazira J. Methicillin-resistant Staphylococcus aureus nasal colonization among healthcare workers at Kampala international University Teaching Hospital, Southwestern Uganda. Canadian Journal of Infectious Diseases and Medical Microbiology. 2019 Mar 10;2019.

4 Kuwahara-Arai K, Kondo N, Hori S, Tateda-Suzuki E, Hiramatsu K. Suppression of methicillin resistance in a mecA-containing pre-methicillin-resistant Staphylococcus aureus strain is caused by the mecI-mediated repression of PBP 2'production. Antimicrobial agents and chemotherapy. 1996 Dec;40(12):2680-5.

5 El-Jalil HA, Jallad M, Thwaini AJ. Nasal carriage of methicillin resistant Staphylococcus aureus in individuals exposed and not exposed to hospital environments. Eur J Sci Res. 2008;22(4):570-4.

6 De Lencastre H, Oliveira D, Tomasz A. Antibiotic resistant Staphylococcus aureus: a paradigm of adaptive power. Current opinion in microbiology. 2007 Oct 1;10(5):428-35.

7 Murugan S, Mani KR, Uma Devi P. Prevalence of methicillin resistant Staphylococcus aureus among diabetes patients with foot ulcers and their antimicrobial susceptibility pattern. J Clin Diagn Res. 2008 Aug 1;2(4):979-84.

8 Pathman DE, Konrad TR, Freed GL, Freeman VA, Koch GG. The awareness-to-adherence model of the steps to clinical guideline compliance: the case of pediatric vaccine recommendations. Medical care. 1996 Sep 1:873-89.

9 Wattal C, Goel N, Oberoi JK, Raveendran R, Datta S, Prasad KJ. Surveillance of multidrug resistant organisms in tertiary care hospital in Delhi, India. J Assoc Physicians India. 2010 Dec 1;58(Suppl):32-6.

10 Jindal N, Malhotra R, Grover P, Singh S, Bansal R, Kaur S. Methicillin resistant Staphylococcus aureus (MRSA) in Malwa region of Punjab (North-west India). Indian Journal of Medical Research. 2016 Mar 1;143(3):371-2.

11 Eshwara VK, Munim F, Tellapragada C, Kamath A, Varma M, Lewis LE, Mukhopadhyay C. Staphylococcus aureus bacteremia in an Indian tertiary care hospital: observational study on clinical epidemiology, resistance characteristics, and carriage of the Panton–Valentine leukocidin gene. International Journal of Infectious Diseases. 2013 Nov 1;17(11):e1051-5.

12 Mehta Y, Hegde A, Pande R, Zirpe KG, Gupta V, Ahdal J, Qamra A, Motlekar S, Jain R. Methicillin-resistant Staphylococcus aureus in intensive care unit setting of India: a review of clinical burden, patterns of prevalence, preventive measures, and future strategies. Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine. 2020 Jan;24(1):55.

13 Goyal R, Das S, Mathur M. Colonisation of methicillin resistant Staphylococcus aureus among health care workers in a tertiary care hospital of Delhi. Indian journal of medical

ISSN: 0975-3583,0976-2833 VOL12, ISSUE 09, 2021

sciences. 2002 Jul 1;56(7):321-4.

14 Havey TC, Fowler RA, Pinto R, Elligsen M, Daneman N. Duration of antibiotic therapy for critically ill patients with bloodstream infections: A retrospective cohort study. Canadian Journal of Infectious Diseases and Medical Microbiology. 2013 Jan 1;24(3):129-37.

15 Koessler T, Pasricha J, Camus V, Renzi G, Harbarth S, Schrenzel J, Perrier A, Pittet D, Iten A. Prevalence and acquisition rate of methicillin resistant Staphylococcus aureus (MRSA) in internal medicine wards at the University Hospital of Geneva (HUG). InBMC Proceedings 2011 Dec (Vol. 5, No. 6, pp. 1-1). BioMed Central.

16 Ray P, Singh R. Methicillin-resistant Staphylococcus aureus carriage screening in intensive care. Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine. 2013 Jul;17(4):205.

17 Arora S, Devi P, Arora U, Devi B. Prevalence of methicillin-resistant Staphylococcus aureus (MRSA) in a tertiary care hospital in Northern India. Journal of laboratory physicians. 2010 Jul;2(02):078-81.

18 Rajaduraipandi K, Mani KR, Panneerselvam K, Mani M, Bhaskar M, Manikandan P. Prevalence and antimicrobial susceptibility pattern of methicillin resistant Staphylococcus aureus: A multicentre study. Indian journal of medical microbiology. 2006 Jan 1;24(1):34-8.

19 El-Jalil HA, Jallad M, Thwaini AJ. Nasal carriage of methicillin resistant Staphylococcus aureus in individuals exposed and not exposed to hospital environments. Eur J Sci Res. 2008;22(4):570-4.

20 http://www.ipharminc.com/brilacidin-1/, accessed 20.6.18.

21 D'Souza N, Rodrigues C, Mehta A. Molecular characterization of methicillin-resistant Staphylococcus aureus with emergence of epidemic clones of sequence type (ST) 22 and ST 772 in Mumbai, India. Journal of clinical microbiology. 2010 May;48(5):1806-11.

22 Vidhani S, Mehndiratta PL, Mathur MD. Study of methicillin resistant S. aureus (MRSA) isolates from high-risk patients. Indian journal of medical microbiology. 2001 Apr 1;19(2):13-6.

23 Thool VU, Bhoosreddy GL, Wadher BJ. Detection of resistance to linezolid in Staphylococcus aureus infecting orthopedic patients. Indian journal of pathology and microbiology. 2012 Jul 1;55(3):361.