

# Prevalence and Antibiotic Susceptibility Patterns of *Staphylococcus aureus* Among Health Care Workers in a Tertiary Care Hospital of Western Maharashtra, India

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## Abstract

*Staphylococcus aureus* (*S. aureus*) has been important human pathogen responsible for wide spectrum of infection ranging from mild to severe life threatening infection. The present study was carried out to assess the prevalence and susceptibility patterns of *S. aureus* nasal colonization among health care workers (HCWs). This study was done at the Department of Microbiology, Bharati Vidyapeeth Deemed University Medical College and Hospital, Sangli, Maharashtra. A cross sectional study was carried out. Four hundred and fifty (n=450) HCWs were screened for *S. aureus* by nasal swabbing. *S. aureus* strains were detected by gram staining, catalase test, slide and tube coagulase test, phosphatase test and antibiotic sensitivity testing by Kirby-Bauer Method. The Z-test was also carried out to detect standard error of difference between two proportions. Of the 450 samples screened 102 (23%) strains of *S. aureus* were isolated. The overall carriage rate of *S. aureus* in our study was 23% with the highest rate being seen among the nursing staff 42(28%) and other categories of HCWs i.e. Doctors and Housekeeping staff carriage rate was same 30 (20%) but it was less as compared to the nursing staff. A high rate of resistance (>50%) was found against ampicillin, erythromycin and penicillin. The isolates of *S. aureus* were more susceptible (>80%) to gentamycin, cefoxitin, vancomycin, cephalixin and tetracyclin. Our study showed that nursing staff were the potential colonisers of *S. aureus* when compared to other clinical staff. This study documents the prevalence and colonization of *S. aureus* among HCWs at our institute.

**Keywords:** Antibiotic susceptibility patterns, Health care workers, Tertiary care hospital.

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## INTRODUCTION

*Staphylococcus aureus* (*S. aureus*) infections cause imperative morbidity and mortality in both community and hospital environment. Its treatment has become more challenging since the development of antimicrobial resistant *S. aureus*, methicillin resistant *S. aureus* (MRSA) [1]. The increased use of this antibiotic has been accompanied by colonized or infected patient or a healthcare worker (HCW) [2]. Colonisation may be either transient or persistent and may be at single or multiple body sites [3]. Carriage of *S. aureus* in the nose appears to play a key role in epidemiology and pathogenesis of infection [4]. Generally, humans are reservoir for *S. aureus* and the anterior nares are the common site of colonization for MRSA. The stains of MRSA may be introduced by colonized HCW and serve as the major reservoir of MRSA [5].

The screening and eradication of *S. aureus* especially MRSA from colonized HCWs have been

recognised and recommended as an important part of a comprehensive infection control policy for this organism [6]. Nasal colonization of *S. aureus* is well known. The rate of colonization varies from place to place and population studied. Not many studies related to HCWs are there in this regard especially from Western Maharashtra region of India. Therefore we have studied nasal colonization by *S. aureus* in HCWs of Bharati Hospital, Sangli.

## MATERIALS AND METHODS

The present study was carried out at Department of Microbiology, Bharati Vidyapeeth Deemed University Medical College and Hospital, Sangli, after approval from Institutional Ethical Committee of B.V.D.U. Medical College and Hospital, Sangli. The total number of HCWs included in the study during a period of year, from June 2012 to July 2013 was 450. The study subjects (n=450) were divided into three groups i.e. doctors, nursing staff and

housekeeping staff. Each group consisted of 150 HCWs constituted the voluntary subjects for the proposed study of nasal carrier state of *S. aureus*. HCWs had history of upper respiratory tract infection (URTI) or having taken any antibiotic during the last one week were excluded from the study. After taking written consent, a predesigned data collection form including details about age, gender, designation/post, duration of service and Wards etc. was filled for each individual.

Nasal swab were collected from HCWs which includes doctors, nurses, housekeeping staff. The sterile cotton tip swab moistened with sterile normal saline solution (0.9%) was inserted in each nostril to a depth of 1cm from anterior nares rotated 2-3 times. The nares were chosen for sampling because it was the native colonization site for *Staphylococci* and usually represented colonization rather than transient skin coverage [7]. The samples were transported

immediately to a laboratory. Inoculation was done on mannitol salt agar and blood agar obtained from Himedia. The plates were incubated at 37°C for 24 hrs.

All isolates were identified routinely by grams stain, catalase test, slide and tube coagulase test, and phosphatase test, deoxyribo nucleic acid (DNase) test and mannitol salt agar. The identification of organisms was based on cellular, cultural and biochemical characteristics depicted in Fig 1-7.

Antibiotic Susceptibility was assessed to check out the resistance profile of *S. aureus* against different antibiotics like cefoxitin (30µg), ampicillin (10µg), ciprofloxacin (5µg), cephalexin (30µg), tetracyclin (30µg), gentamycin (10µg), erythromycin (15µg), vancomycin (30µg), and penicillin (10µg) by Kirby-Bauer disc diffusion method [8].



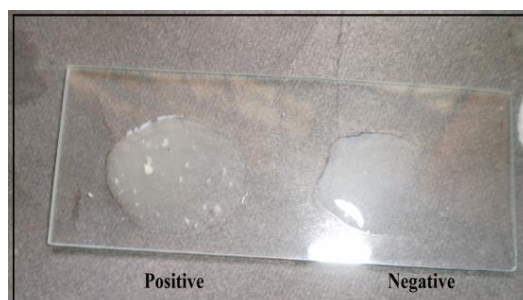
**Fig-1:  $\beta$ -hemolysis on blood agar**



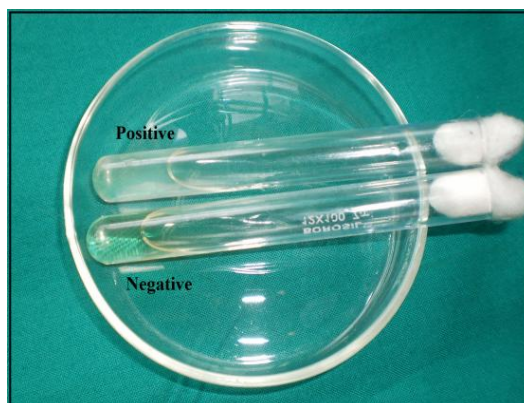
**Fig-2: Yellow colour colonies on mannitol salt agar**



**Fig-3: Catalase test**



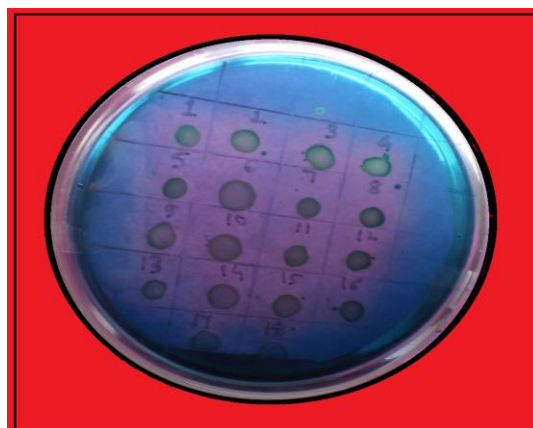
**Fig-4: Slide coagulase test**



**Fig-5: Tube coagulase test**



**Fig-6: Phosphatase test**



**Fig-7: Deoxyribonucleic acid (DNase) test**

The Z-test was also carried out to detect standard error of difference between two proportions. In this analyses, variables showing  $p < 0.05$  and  $p < 0.001$  were considered to be statistically significant and highly significant respectively.

## RESULTS

The total numbers of HCWs were 450. Out of these 150 (33.3%) were Doctors, 150 (33.3%) were Staff Nurses and remaining 150 (33.3%) were Housekeeping staff. In the present study maximum number of participants were females in all the three different categories of HCWs, female ( $n=258$ ) is higher than male ( $n=192$ ) in HCWs (Table-1).

**Table-1: Distribution of Subjects – Gender wise**

Category of HCWs	Male n (%)	Female n (%)	Total n (%)
Doctors	74 (49%)	76 (51%)	150 (33.3%)
Nurses	47 (31%)	103 (69%)	150 (33.3%)
Housekeeping staff	71 (47%)	79 (53%)	150 (33.3%)
Total	192 (43%)	258 (57%)	450 (100%)

In the present study, out of 450 subjects 102 i.e. 23% (male,  $n=49$  and female,  $n=53$ ) were detected as nasal carrier of *S. aureus*. The nasal carriage rate of *S. aureus* among male and female were 26% and 21%,

respectively. The percentages of negativity of *S. aureus* in male and female group were 74% and 79% respectively (Table-2).

**Table-2: Gender-wise distribution of *S. aureus* isolates**

Gender	Total Sample n	<i>S. aureus</i> Positive n (%)	<i>S. aureus</i> Negative n (%)	Z value
Male	192	49 (26%)	143 (74%)	13.93**
Female	258	53 (21%)	205 (79%)	16.00**
Total	450	102 (23%)	348 (77%)	15.00**
**p < 0.001				

In our study, among 450 HCWs screened, 102 were positive for carrier of *S. aureus* and they gives a carriage rate of 23%. From these subjects 30 (20%) Doctors, 42 (28%) Nursing staff and 30 (20%)

housekeeping staff were positive for tube coagulase. The *S. aureus* negative in Doctors, Nursing staff and Housekeeping staff were found to be 80%, 72% and 80% respectively Table-3.

**Table-3: Percentage distribution of nasal colonization in different categories of health care workers**

Professions	No. of Sample n	<i>S. aureus</i> Positive n (%)	<i>S. aureus</i> Negative n (%)	Z value
Doctors	150	30 (20%)	120 (80%)	9.98**
Nursing Staff	150	42 (28%)	108 (72%)	10.58**
Housekeeping Staff	150	30 (20%)	120 (80%)	15.99**
Total	450	102 (23%)	348 (77%)	21.01**
**p < 0.001				

A high rate of resistance (>50%) was found against penicillin, erythromycin and ampicillin. All the isolates of *S. aureus* were susceptible (>80%) to

gentamycin, cefoxitin, vancomycin, cephalixin and tetracyclin depicted in Table-4.

**Table-4: Antibiotic susceptibility pattern of *S. aureus* isolates**

Antibiotics	Antibiotics Sensitive n (%)	Antibiotics Resistance n (%)
Cefoxitin (CX)	80 (92%)	07 (8%)
Ampicillin (AMP)	38 (44%)	49 (56%)
Ciprofloxacin (CIP)	45 (52%)	42 (48%)
Cephalexin (CN)	72 (83%)	15 (17%)
Tetracycline (TE)	70 (80%)	17 (20%)
Gentamycin (GEN)	85 (98%)	02 (2%)
Erythromycin (E)	33 (38%)	54 (62%)
Vancomycin (VA)	77 (89%)	10 (11%)
Penicillin (P)	12 (14%)	75 (86%)



## DISCUSSION

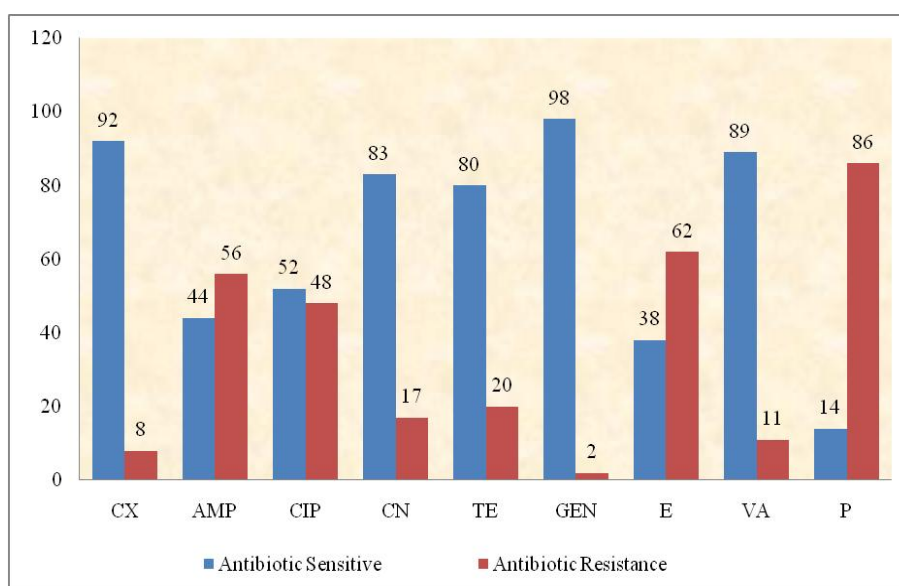
*Staphylococcus aureus* is one of the most major causes of both community and hospital acquired bacterial infection. There is strong correlation between *S. aureus* nasal carriage and disease progress [9]. Health care workers (HCWs) usually act as asymptomatic carriers of multiple drug resistance organisms, especially MRSA, and help in its transmission to patients [10].

In the present study maximum number of participants were females in all the three different categories of HCWs and their number was higher than male. We found 102 (23%) subjects were detected as nasal carrier of *S. aureus*. The nasal carriage rate of *S. aureus* among males were higher than females. *S. aureus* was isolated among Vinodhkumaradithyaa A *et al* have isolated 13.3% Coagulase Positive *Staphylococci* in HCWs of Institute of Microbiology, Madurai Medical College, Madurai, India [11]. *de Carvalho MJ et al.*, analyzed the prevalence of methicillin-susceptible *S. aureus* and methicillin-resistant *S. aureus* as well as the MRSA antimicrobial susceptibility profile of isolates from saliva of health

professionals at a large public education hospital. They found 47.6% coagulase positive *S. aureus* was isolated from 340 health professionals [12].

Akhtar N determined the frequency of *Staphylococcal* nasal carriage of HCWs. They reported out of the 468 HCWs, 213 (45.5%) participants were men and 255 (54.5%) were women. Eighty five (18.2%) were nasal carriers of *S. aureus*, 07 (1.5%) for MRSA, 343 (73.3%) for coagulase negative *Staphylococci* and 10 (2.1%) for methicillin-resistant coagulase negative *Staphylococci* [13].

Aswani VH *et al.*, enrolled 202 individuals for determination of the prevalence of nasal carriage of *S. aureus* and MRSA in healthcare environment workers. They found prevalence of nasal carriage of *S. aureus* and MRSA in the studied population was 24% and 1%, respectively, similar to the rate of prevalence in the United States (30%) [14]. In our study, among 450 HCWs screened, 102 were positive for carrier of *S. aureus* and they gives a carriage rate of 23%. This is in agreement with other published reports in India.



**Fig-8: Antibiotic susceptibility pattern of *S. aureus* isolates**

The most effective and sensitive antibiotics for *S. aureus* isolates were found to be gentamycin (98%) then cefoxitin (92%), vancomycin (89%), cephalexin (83%) and tetracycline (80%). The *S. aureus* isolates susceptibility to ciprofloxacin, ampicillin and erythromycin ranging between 35-55%. Penicillin showed less susceptibility against *S. aureus* isolates. High rate of resistance was found against penicillin (86%). The resistivity of *S. aureus* isolates were found against, ampicillin (56%), erythromycin (62%) and ciprofloxacin (48%) (Fig-8).

Resistance for vancomycin among *Staphylococci* has not been reported in India and in the

present study 89% the isolates were sensitive to vancomycin and remaining 11% isolates resistance to vancomycin. In the literature survey, almost all Indian studies showed all *S. aureus* including MRSA isolates were 100% sensitive to vancomycin in HCWs.

Rongpharpi SR *et al.*, reported *S. aureus* was isolated in 70 cases (22.22%). The prevalence of the *S. aureus* nasal carriage was higher among the male HCWs (54.28%) than among the female HCWs (45.71%). All the *S. aureus* isolates were sensitive to vancomycin and linezolid (100%) [15].

Farzana K *et al.*, in 2008 reported the most sensitive antibiotic for *S. aureus* was found to be vancomycin with 100% efficacy, then cephalothin 92%, ciprofloxacin 91%, amikacin 77% and erythromycin 55%, ampicillin 11% and penicillin 3%. Coagulase negative staphylococci were 100% sensitive to vancomycin and cephalothin. Oxacillin showed 78% effectiveness; while ampicillin and penicillin, demonstrated 64% and 59% respectively. Doxycycline (93%), amikacin (93%), fusidic acid (90%) and erythromycin (92%) were effective antimicrobials [16].

## CONCLUSION

In our study, among 450 health Care workers screened, 102 were found to be positive for *S. aureus* which gives a carriage rate of 23%. This study will help the scientific society especially physician to understand the extent of this condition so that further protocols and policies can be developed to support the health and wellbeing of HCWs. The generally hygienic methods are indicating for reducing of these strains significantly. Continuing medical education programmes can help to increase awareness among hospital staff.

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