

NASAL CARRIAGE OF STAPHYLOCOCCUS AUREUS AND THE QUANTUM OF THEIR METHICILLIN RESISTANCE AMONGST THE HEALTH CARE WORKERS IN A PERIPHERAL TERTIARY CARE CENTRE OF EASTERN INDIA

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ABSTRACT: OBJECTIVE: Staphylococcus aureus is an important pathogen causing hospital acquired infection in patients admitted to different clinical establishments. Amongst them MRSA is most important in causing morbidity, mortality and increase in economic burden not only to the patients but also to the society at large. Nasal carriage of the organism by the health care workers always remains an important source of infection to the hospitalized patients and regular screening of colonized health care workers can prevent their transmission to the hospital and community. The present study was carried out in search of obtaining the actual level of nasal carriage in our set up and to arrange a corrective measure in this context.

METHOD: A total of 183 nasal swabs were collected from different categories of staffs of Medinipur Medical College and Hospital, Paschim Medinipur, West Bengal from March 2014 to May 2014. Staph aureus isolates were identified by catalase test, coagulase test (Slide and tube) and mannitol fermentation. Methicillin resistance was detected by using cefoxitin disc 30microgram on Mueller Hinton agar with 4% sodium chloride. Vancomycin resistance was also detected by following CLSI guidelines.

RESULTS: out of the 183 health care workers screened 39(21.7%) were identified as nasal carrier of Staphylococcus aureus of which 69.23% are nurses and doctors. Amongst the carriers 12(30.7%) are colonized by MRSA strains and 27(69.2%) by MSSA strains. Highest rate nasal colonization by MRSA (75%) were observed in nurses and doctors combined together.

CONCLUSION: Nasal colonization of Staphylococcus aureus amongst Health care workers, particularly in the most educated group in our set up is quite high and what is more alarming is that 75% of them are MRSA carriers. They will be the potential source and vehicle of transmission to hospital set up and the community at large. Treatment should be given to them and awareness about hygienic methods are to be developed amongst all categories of HCW. Continuous surveillance will minimize the cost of treatment burden on to the patients and community.

KEYWORDS: Coagulase Negative Staphylococcus Aureus (CONS), Health Care Workers (HCW), Methicillin Resistant Staphylococcus Aureus (MRSA).

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INTRODUCTION: Staphylococcus aureus (*S. aureus*), recognized as an important human pathogen is amongst the clinically most relevant nosocomial pathogen giving rise to increased morbidity, mortality, length of hospital stay and economic burden to the hospitalized patients.¹⁻⁴ In spite of vigorous antibiotic therapy *S. aureus* infections in hospitalized patients have severe consequences ranging from benign superficial skin infections to life threatening infections like Endocarditis, Pneumonia, Meningitis and Septicemia etc. Treatment has become more difficult because of antibiotic resistance as a whole particularly due to Methicillin resistant *S. aureus* (MRSA). MRSA has become endemic worldwide within the past two decades.⁵ People infected with MRSA are more likely to have longer, more

expensive hospital stay and may be more likely to die as a result of the infection. Since its isolation in 1961 MRSA has become a global health problem and a major cause of concern for the infection control management groups.

Approximately 25%-30% of healthy people carry *S. aureus* in their skin or on their nose. Colonization may be either transient or persistent and may be at single or multiple body sites. Although colonization of multiple body sites occurs, anterior nares are the most frequent carriage site. Nasal colonization can be an indicator of high risk for subsequent infection as MRSA is a well-known risk factor whenever *Staph. aureus* colonization is present.⁶ Anterior nares are the major reservoir of *S. aureus*: 20% of individuals are persistently or asymptotically colonized, 60% are intermittently and 20% are noncarriers.⁷

Health care workers are an important reservoir of *S. aureus* and several studies have observed the rate of nasal carriage amongst HCW ranging from 16.8% to 56.1%.⁸ Colonised HCW may develop infection or may remain asymptomatic, but they are a potential source to the patients and can introduce to their families.⁹⁻¹⁵ Role of health care workers who are MRSA carriers is critical in the transmission of this pathogen not only to the hospitalized patients but also to the community at large.

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Therefore colonization pattern in HCW should be clearly understood for the formulation and establishment of correct infection control strategies in hospital set up.

Prevention of nosocomial infection transmitted by HCW in different clinical establishments can be achieved by the regular screening and eradication of colonized persons. This can give rise to comprehensive infection control policy for this multidrug resistant pathogen. With this background in mind we have undertaken this study to screen the HCW at various levels in our tertiary care set up with the objective to prevent outbreak related to MRSA carriage particularly.

MATERIAL AND METHOD: The study was carried out at Medinipur Medical College and Hospital, Paschim Medinipur for a period of three months from March to May, 2014. Approval from the Institutional Ethical committee and consent from all the staffs were taken to include the in the study. A total of 183 HCWs were included in the screening which comprised of Doctors, Nurse, Attendants and Lab technicians. Variables like age, sex, category, placements in wards, self-reported health status and use of antibiotic in past 30 days were enquired about the participants.

Exclusion criteria were H/O URTI, fever, nasal surgery, smoking, using snuffs, Diabetes, Immunocompromised condition, use of nasal medications and antimicrobial therapy. Nasal swabs were obtained by using sterile cotton swabs moistened with nutrient broth. The swabs were inserted deep into both anterior nares and rotated for five times and immediately transported to the laboratory.

It was inoculated in 5% sheep blood agar and incubated at 37°C for 24 hrs. Staph aureus was identified by colony morphology, Gram stain, Catalase test, Coagulase test (both slide and tube) and Mannitol salt fermentation test. Each isolate was then screened for MRSA by showing their susceptibility to Cefoxitin (30microgram) and Oxacillin (1microgram) discs in accordance with the CLSI guidelines.¹⁶

The susceptibility of the MRSA strains against other antibiotics e.g., Ciprofloxacin, Levofloxacin, Gentamicin, Cefotaxim, Amoxycillin, Azithromycin and Vancomycin was also determined using CLSI guidelines. Statistical analysis was done by using open epi, version 0.03 a and p value of 0.05 was taken as statistically significant.

RESULTS: In this study a total of 183 Health Care Workers were screened for the nasal carriage of *S aureus* in their anterior nares. Out of these, 39 (21.47%) HCWs were detected as nasal carriers of *S aureus* and 56 were carrying coagulase negative *Staphylococcus* whereas 88 samples were negative. Carriage rate in females was 51.28% whereas in males it was 48.71% which was statistically significant (table-I). The mean age of the participants in this study was 42 years (age ranges 18-60 years).

The prevalence of nasal carriage of *S aureus* in different age groups is 53.84% in 18-31 year age group, 30.76% in 32-45 yr age group and 15.38% in 46-60 yr age group. The carriage rates in different categories of staffs of the hospital are 43.59% in Nurses, 25.64% in both Doctors and Laboratory technicians and 5.12% in the attendants. In ward wise prevalence Medicine tops the list (25.64%) followed by Orthopedics (23.07%), Surgery (20.51%), Pediatrics (17.95%), G&O (7.7%) and ICU (5.12%)-(table-I).

Out of the total nasal carriers in our study twelve (30.7%) are MRSA carriers and 27(69.2%) are MSSA carriers.

In category wise distribution most important MRSA carriers are the Doctors (50%) followed by Nurses (25%), Laboratory Technicians (16.66%) and attendants 8.33%). Ward wise Medicine and G&O have 25% each along with Pediatrics, Orthopedics and Surgery has 16.66% each. No ICU personnel were identified as MRSA carriers (table-II).

Antibiotic resistance of MRSA strains of *Staphylococcus aureus* showed 100% resistance to Cefotaxim and Amoxycillin whereas Ciprofloxacin, Azithromycin, Gentamycin and Levofloxacin showed 91.6%, 75% and 66% and 58.3% resistance respectively. Only one strain in our case is observed to be Vancomycin resistant (8.3%) - (Table-III).

DISCUSSION: *Staphylococcus aureus* is a frequent cause of nosocomial infections, including bacteremia and wound infections. Approximately 25% of all nosocomial infections are caused by *Staph aureus* affecting the patients of both the surgical and nonsurgical wards of different hospitals which leads to increased hospital stay, increased antibiotic use and in this way put an extra economic burden and chance of mortality particularly in underdeveloped or developing countries.¹⁷

In a developing country such economic burden slows the process of growth. The primary reservoir of *Staphylococci* is thought to be the vestibulum nasi, though it can be cultured from multiple sites of the skin and mucosal surfaces of carriers. This part of the nose is lined by a fully keratinized epidermis with hairs, sebaceous glands and sweat glands.

The staphylococcal cells can flourish here in the relative absence of human defenses and/or are capable of withstanding the local antibacterial defenses. The bacterial cells need to adhere firmly to prevent their elimination by physicochemical mechanisms.¹⁸

Out of a total of 183 healthy hospital personnel studied in our case, we have isolated 39 (21.31%) *S aureus* and 56(30.6%) coagulase negative *Staphylococcus* but 88 of our samples gave negative result. The nasal carriage rate amongst the HCWs in our hospital is 21.31% which is nearly similar to the studies showed by Citak et al from Turkey (24.2%).⁶ Golia et al from India.¹⁹ (24.84%) and Nasir et al from Iran.²⁰ (26.5%). Studies by Ahmed et al from Saudi Arabia.²¹ showed a bit higher rate (30.6%) along with Zermine Rashid et al from Pakistan.²² (48%) whereas a very lower rate of nasal carriage was detected by Khalili et al (12.67%) from Iran.¹⁷ and Shakya et al from Nepal.²³ (12.5%).

Nasal carriage rate in females are a bit higher (51.28%) in our case in comparison to the carriage rate in the case of males (48.71%) which is similar to the report by Shakya et al.²³ (13.6% in females and 11.3% in males). In age-wise distribution of nasal carriage it was found that the young adults (18-31) are the most important reservoir (53.84%) of *s aureus* in our study followed by 32-45 year age group (30.76%) and 46-60 year age group (15.38%). The prevalence of carriage is higher in young individuals was also reported by Ahmad et al.²¹ (33.4%) as compared to the aged.

Commonest group of health care workers having nasal carriage are the Nurses (43.59%) followed by the Doctors (25.64%), Laboratory technicians (25.64%) and the attendants (5.12%). Overall the group comprising of the Doctors and Nurses (69.23%) who are supposed to remain in constant touch with the patients in a hospital set up constitutes the largest group of transmitters of infection in our study.

This figure is in agreement with other studies like Ahmad et al.²¹ reported 87.2% in Doctor and Nurses.

Zermina Rashid et al.²² reported a carriage rate of 66.6% and 51.8% respectively in Nurses and Doctors whereas Dimitrov and his coworkers²⁴ found 21% and 14% nasal carriage in Doctors and Nurses respectively. The organism may be transmitted from the nose to skin where colonization seemed to be more transient. Person to person transmission is the usual mode of spread via hands, nasal discharges and rarely by aerosols.²⁵

So maintenance of hand hygiene amongst the Doctors and Nurses is a primary change in habit to be adopted by both. This can prevent the transmission of infections not only to the hospitalized patients but also to their families and community at large. Studying the prevalence of nasal carriage by staffs of different wards it was found that staffs of Medicine are the commonest group (25.64%) followed by the Orthopedics (23.07%), Surgery (20.51%), Pediatrics (17.95%), G&O (7.7%) and ICU (5.12%).

MRSA has been recognized as an important nosocomial pathogen worldwide because of increased rate of multidrug resistant strains it may cause²⁶. MRSA is a persistent and ever growing problem for health care Institutions. Minimizing the emergence of this and containing its spreads in both hospital and community remains a great challenge to the health care set up.

This challenge needs to be addressed very seriously by the health care providers of every developing country to minimize the enormous economic burden due to this. Methicillin resistance in *S aureus* is determined by *mec A* gene which is coding for the Penicillin binding protein 2a (PBP2a). Presence of PBP2a makes a susceptible strain resistant to all beta-lactum antibiotics¹⁹. So methicillin resistance confers resistance to all beta lactum agents. Methicillin resistance may be referred to as an intrinsic means, that the mechanism is chromosomally mediated.

Amongst the nasal carriers of *S aureus* in our study 12(30.7%) were carrying MRSA in their anterior nares and 27(69.2%) were carrying MSSA. The prevalence of MRSA (31.8%) observed by Ahmed et al in Saudi Arabia.²¹ is similar to the present study whereas a higher rate (44.1%) is observed by a study in Ethiopia.²⁷ Lower rate of prevalence was observed by some other studies e.g. Citak et al⁶ showed 23.6%, Zermina Rashid et al.²² 13.95% and Laxmi et al.²⁶ 12.2%. Methicillin resistance amongst Staphylococci is present throughout India and it ranges from 27% in Bombay to 47% in Bangalore²⁸.

The present study gives a picture of peripheral tertiary care centers in Eastern India. The MRSA carriage is quite high in our centre indicating the danger of appearance of nosocomial infection in a large section of the patients and also there is a chance of spillage of these strains into the community. The health care workers of the different care facilities should put an extra emphasis on hand hygiene while dealing with the patients to diminish the transmission of MRSA not only to their patients but also to their family members.

Disinfection of hands after each contact with the patient and use of masks, sterile aprons, avoidance of touching nose during work inside hospitals must be performed by all workers in clinical set up to protect patients from nosocomial infection. What is more alarming in the present study is that the highest rate of carriage of MRSA is amongst the doctors (50%) followed by the Nurses (25%). The other groups are technicians (16.66%) and attendants (8.33%).

So Doctors and Nurses (75%) are the most potential sources of nosocomial infection in the present study. In other words education level has got no impact on the carriage of MRSA in health care workers. Higher carriage rate of MRSA amongst Doctors and Nurses was observed by Zermina et al.²² (18.5% & 27.3%), Ahmed et al.²¹ (All Doctors) and Fadeyi et al.⁵ (22.7% & 16.7%). In ward wise distribution of nasal carriage of MRSA in the present study it is observed that G&O and Medicine ward contributes maximum (25% each) in comparison to others (Orthopedics 16.6%, Surgery 16.6% and Pediatrics 16.6%).

As G& O department also caters patients to the SNCU, NICU and Pediatrics wards, so they can be potential sources of infection to those areas. This in turn will cause increase in mortality, morbidity and increase in cost of treatment. Mupirocin nasal ointment is presently the treatment of choice for decolonization of nasal carriage. It is effective in temporarily eradicating *S aureus* from nose. When applied twice daily for five consecutive days it results in elimination rates of 91% after therapy.²⁹

All MRSA strains were subjected to observe the resistance pattern to other antibiotics. The MRSA strains were 100% resistant to cefotaxime and amoxicillin but 91.6% to ciprofloxacin, 75% to Azithromycin, 66% to Gentamycin, 58.3% to Levofloxacin. One of the MRSA strain in our study was observed to be resistant to Vancomycin. So the MRSA strains in the present study shows multidrug resistance to regularly used drugs in hospital set up. The reason for this could be injudicious use of regular antibiotics in the hospital and community set up which provides selective pressure favoring resistance to bacterial strains.

Inappropriate use increases the risk for selection and dissemination of antibiotic resistant bacteria. This might be the reason why commonly used inexpensive drugs lead to development of bacterial resistance in developing countries.²² Vancomycin resistance to MRSA strains in the present study gives an alarming impression of the status of resistance of even the reserved drugs used for treatment of serious infections in tertiary care centers.

So this drug should not become a regular use drug in present situation. It has to be corrected in a war footing manner to prevent its spread in both hospital and community. An important aspect of our study is that CONS were isolated from anterior nares in a large number (30.6%) and a big number of them are Methicillin resistant. They are also an important agent of infection in hospital set up and needs surveillance to check their transmission.

To conclude, health care workers in our hospital appears to be a major source of nasal carriage and to prevent nosocomial infection in our set up it needs regular screening and treatment of carriers with mupirocin ointment. There should be a proper infection control rule and regular awareness programs amongst the health care workers.

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Category	Total No. of Sample	S. aureus (n) %		P value
Age Group				
18-31	109	21	53.84%	0.167
32-45	37	12	30.76%	
46-60	37	06	15.38%	
Total	183	39	100%	
Sex				
Male	87	19	48.1%	0.009
Female	46	20	51.28%	
Total	183	39	100%	
Professionals				
Doctor	54	10	25.64%	0.503
Nurse	75	17	43.59%	
Attendants	04	02	5.12%	
Lab. Tech.	50	10	25.64%	
Total	183	39	100%	
Ward Wise				
O&G	12	03	7.7%	0.998
Paediatrics	30	07	17.95%	
Medicine	47	10	25.64%	
Orthopaedics	45	09	23.07%	
Surgery	39	08	20.5%	
ICU	10	02	5.12%	
Total	183	39	100%	

Table I: Age, gender, professional category and ward wise distribution of nasal carriage rate of S. aureus in Health Care Workers (HCW)

Group	Total	MRSA (%)	p value	MSSA (%)
Category of HCW				
Doctor	54	6 (50)	0.145	4(14.8)
Nurse	75	3 (25)		14(51.85)
Attendants	04	1 (8.33)		1(3.7)
Lab. Tech.	50	2(16.66)		8(29.63)
Total	183	12		27
Ward Wise				
O&G	12	3(25)	0.166	Nil
Pediatrics	30	2(16.66)		5(18.51)
Medicine	47	3(25)		7(25.92)
Orthopedics	45	2(16.66)		7(25.92)
Surgery	39	2(16.66)		6(22.22)
ICU	10	Nil		2(7.4)
Total	183	12		27

Table II: Category and ward wise distribution of nasal carriage rate of MSRA and MSSA in health Care Worker (HCW)

Sl. No.	Antibiotic	Resistant MRSA Strains (n=12)
1	Cefotaxime	12 (100%)
2	Amoxycillin	12 (100%)
3	Gentamycin	8 (66%)
4	Azithromycin	9 (75%)
5	Ciprofloxacin	11 (91.6%)
6	Levofloxacin	7 (58.3%)
7	Vancomycin	1 (8.3%)

Table III: Antibiotic resistance pattern of MRSA strains among Health Care Workers