

Prevalence of Nasal Carriage of Methicillin Resistant Staphylococcus Aureus (MRSA) in Hospital Personnel

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SUMMARY

Nasal Carriage of Staphylococcus aureus (SA) appears to have an important implication in the epidemiology and pathogenesis of infection. Recent international reports suggest that Methicillin Resistant Staphylococcus aureus (MRSA) may be emerging as an important pathogen in the community. A prevalence survey of nasal carriage of MRSA in 308 hospital personnel was conducted during 1998 at Shaikh Zayed Hospital, Lahore. Microbiological samples in the form of swabs were taken from anterior nares. Information about various concomitant diseases, recent use of antibiotics or systemic steroids was also obtained. Standard techniques were applied for the isolation and identification of SA and MRSA in the laboratory. Out of 308 hospital personnel, including doctors and paramedics, 20.8% were found to have SA and prevalence of nasal colonization of MRSA was 10.7%. There was no difference in prevalence across various occupations. This is in accordance with reports published internationally.

Key words: MRSA, staphylococcus, community, prevalence, hospital personnel.

INTRODUCTION

Mortality and morbidity associated with infectious diseases continues to rise despite the availability of newer and more potent antibiotics¹. According to data of Centers for Disease Control, USA, infectious diseases are now the third most common cause of death in the United States². An approximate 5-10% of all infections are hospital-acquired infections³.

Staphylococcus aureus, the most common cause of more than a dozen infections in both hospitals and communities, can be considered the "ultimate pathogen". S. aureus often colonizes without any signs of infection, and then from this reservoir gains access to skin and deeper tissues, where it subverts the immune system⁴. Methicillin-resistant S. aureus (MRSA) first emerged in the United Kingdom in the early 1960s. Since then, researchers have observed that several strains of S. aureus can outmaneuver a wide variety of currently available antibiotics^{5,6}.

The most common sites of MRSA colonization

are wounds, nasopharynx, and perineum. In the hospital setting, about a third of colonized patients develop an actual infection, often pneumonia and/or septicemia⁷. In long-term facilities, more patients are colonized with MRSA, but a lower percentage develops invasive infections⁸.

MRSA is very difficult to eradicate when it becomes endemic, and prolonged antibiotic use actually tends to promote the emergence of resistance.

In hospitals, the most important reservoirs of MRSA are infected or colonized patients⁹. Although hospital personnel can serve as reservoirs for MRSA and may harbor the organism for many months, they have been more commonly identified as a link for transmission between colonized or infected patients¹⁰.

The main mode of transmission of MRSA is through hands, especially in case of hospital personnel, who may become contaminated by contact with: a) colonized or infected patients, b) colonized or infected body sites of the personnel themselves, or c) devices, items, or environmental

surfaces contaminated with body fluids containing MRSA^{11,12}.

In Greece, MRSA was 11% in 1986 and increased to 51% in 1994, in Belgium 21% of the *Staph aureus* in the period of '94-'95 were MRSA, and in analysis about 8 years ago of 7,000 isolates from Japan, 60% of them were methicillin-resistant⁹. A recent report addressing the issue of MRSA epidemiology in the US hospitals provided a rise from 20% in 1987 to 50% in 1999 (Fig. 1)¹². There are no epidemiological data addressing the issue of MRSA in Pakistan.

Aims and objectives

The specific aims of this prospective study were:

- To determine the prevalence of nasal carriage of MRSA in health care workers.
- To identify, if any, differences in nasal carriage rates of workers in different hospital departments.

PATIENTS AND METHODS

A total of 308 volunteers were enrolled in this prospective study, which was conducted in 1998 after obtaining informed consent. Subjects were enrolled from in-patient and out-patient departments, operation theaters, pathology laboratories and Accident & Emergency departments.

Method of Specimen Collection and Identification

Culture specimens were obtained by the standard methods. Commercially prepared sterile Dacron tipped swabs (Cultiplast) were used to sample anterior nares of volunteer health care workers. One swab was rotated in both nares of each worker.

Swabs were plated on Blood agar and MacKonkey agar, as per laboratory protocol¹³. The inoculated plates were incubated at 35-37°C aerobically. Plates were read for growth at 18-24 hours initially and discarded after 48 hours of incubation.

Identification and differentiation of staphylococci

The suspected colonies of staphylococci were gram stained to confirm gram positive cocci. Catalase test was performed according to the

method-described to differentiate streptococci from staphylococci. Coagulase test was performed by slide method to separate *Staphylococcus aureus* from other staphylococcal species. Further confirmation of the isolate being *Staphylococcus aureus* was made by the DNase test, which detects the heat stable nuclease, produced by it. A positive test produces hydrolysis of DNA. In case of discrepancy between the results of the slide coagulase test and DNase test, final confirmation was based on the result of tube coagulase test⁴.

Antibiotic Susceptibility test

Methicillin sensitivity of the organism was tested by standard disc diffusion method according to the NCCLS protocols¹⁵.

The plates were incubated at 30°C for 24 hours and the results recorded.

Statistical Analysis

Nominal variables were reported as frequencies and percentages. Numerical data was reported as Mean±S.D. Chi-square test was used to compare distribution of *Staph. aureus* positive and negative subjects across various departments. A p-value = 0.05 was considered significant for all analyses.

RESULTS

This prospective study reports the prevalence of nasal carriage of MRSA in 308 healthy hospital personnel who were enrolled after informed consent from various departments of Shaikh Zayed Hospital, Lahore.

Mean age was 30.9±6.5 years. A total of 162 males and 146 females were included in the study. Their occupations were divided into 8 groups including consultants, junior doctors, nursing sisters, staff nurses, student nurses, dressers, theater attendants and aid nurses (Table 1).

The presence of various concomitant diseases including diabetes mellitus, hypertension, ischemic heart disease, ENT and dermatological diseases were noted. 73% of all personnel did not have any associated illnesses. Amongst the remaining, 23% had ENT diseases including allergic rhinitis.

Thirty nine out of 308 (13%) had used various antibiotics within one week of nasal swab. 64 persons out of 308 had SA (20.8%) out of these 31 (10.1%) had MSSA and 33 (10.7%) had MRSA (Table 2).

Table 1: Different occupations amongst healthcare workers

Occupations	Frequency	Percentage
Consultants	38	12.3
Junior Doctors	141	45.8
Nursing Sisters	24	7.8
Staff Nurses	37	12.0
Student Nurses	13	4.2
Dressers	2	0.6
Theater Assistants	31	10.1
Aide Nurses	22	7.1
Total	308	100.0

Table 2: Frequency and percentage of MRSA/MSSA positivity in the study.

Types of Isolates	Frequency	Percentage
Number of SA Isolated	64	20.8
MSSA	31	10.1
MRSA	33	10.7

MSSA: Methicillin Sensitive SA, MRSA: Methicillin Resistant SA.

Table 3: Frequency of Nasal Carriage of Staphylococcus aureus among different occupations amongst healthcare workers.

Occupations	Present	Absent	Total
Consultants	10	28	38
Junior Doctors	31	110	141
Nursing Sisters	4	20	24
Staff Nurses	7	30	37
Student Nurses	2	11	13
Dressers	2	0	2
Theater Assistants	10	21	31
Aide Nurses	1	21	22
Total	64	244	308

There was no statistically significant difference in the occurrence of MRSA in different occupations (based on Chi-square test).

DISCUSSION

Staphylococcus aureus is ubiquitous. It grows readily on human skin and mucous membranes. Methicillin-resistant *S. aureus* is a variant of *S. aureus* which is resistant to all beta-lactam antibiotics (including penicillins, cephalosporins and cephamicins). They may also be resistant to aminoglycosides, erythromycin, quinolones and others. By definition, MRSA must be resistant to one of the semi-synthetic penicillins: methicillin, oxacillin, or nafcillin^{6,8}. MRSA is neither more infectious nor more virulent than susceptible *S. aureus*; it is just more difficult to treat¹⁶. MRSA infections are most effectively treated with intravenous vancomycin.

MRSA is transmitted primarily by contact with a person who either has a purulent site of infection, a clinical infection of the respiratory tract or urinary tract, or is colonized with the organism. Hands of personnel appear to be the most likely mode of transmission of MRSA from patient-to-patient^{12,17}.

Studies have demonstrated that MRSA can be present on the hands of personnel after performing such activities as wound debridement, dressing changes, tracheal suctioning, and catheter care^{17,18}.

MRSA colonization may occur in the nares, axillae, chronic wounds or decubitus ulcer surface, perineum, around gastrostomy and tracheostomy sites, in the sputum or urine. One of the most common sites of colonization in both patients and employees is the nose (anterior nares)^{16,19}.

While personnel may become colonized with MRSA (as they may with susceptible *S. aureus*), they rarely develop infections.

Why should we care about antimicrobial resistance? A number of reasons: First there's the immediate costs which include both the inpatient care requirements which means longer ICU stays, more expensive antimicrobials, the protracted duration of admission of such patients, costly alternative antibiotics that we need to use to treat these patients' infections successfully.

The potential costs include the lost productivity of those infected patients and the real possibility now of untreatable infections. In the past the pharmaceutical industry has saved us by always developing antimicrobials that were better than the last but it's much more difficult to do that now. The predicted cost of antimicrobial resistance in the

United strains resistant to all clinically useful drugs, apart from the glycopeptides vancomycin and teicoplanin, have States alone has been estimated to be US dollars 4 billion^{20,21}.

Hospital strains of *S. aureus* are often resistant to many different antibiotics. Indeed been described. The term MRSA refers to methicillin resistance and most methicillin-resistant strains are also multiply resistant⁸. Plasmid-associated vancomycin resistance has been detected in some enterococci and the resistance determinant has been transferred from enterococci to *S. aureus* in the laboratory and may occur naturally. *S. epidermidis* nosocomial isolates are also often resistant to several antibiotics including methicillin. In addition, *S. aureus* expresses resistance to antiseptics and disinfectants, such as quaternary ammonium compounds, which may aid its survival in the hospital environment²².

Since the beginning of the antibiotic era *Staphylococcus aureus* has responded to the introduction of new drugs by rapidly acquiring resistance by a variety of genetic mechanisms including (1) acquisition of extrachromosomal plasmids or additional genetic information in the chromosome via transposons or other types of DNA insertion and (2) by mutations in chromosomal genes.²³

Because nasal carriage represents an important risk factor for infection in the affected individual, and serves as a source from which the organism can be spread to others, eradicating nasal carriage of *S. aureus* has been viewed as a potentially useful control measure for many years^{24,25}.

Eradicating nasal carriage of *Staphylococcus aureus* also has been used as a means of reducing the chances that the organism will spread from one individual to another. In *S. aureus* outbreaks in which there has been convincing epidemiologic evidence that a colonized healthcare worker was the source, eradicating the epidemic strain from the implicated person's nares has controlled the outbreaks²⁶.

CONCLUSION

This study is the first effort to find out the prevalence of MRSA in the Healthcare workers in Pakistan. This study has shown that a significant number of health care workers including Doctors and Nurses have positive colonization with MRSA.

Whether this has any direct relationship to the occurrence of MRSA infection in the hospital setting or do the hospital staff needs regular screening to isolate MRSA needs further evaluation. In Pakistan where the cost of medical care is mainly borne by the patient and since the medication required for the treatment of the MRSA infections are expensive, it is imperative to conduct similar studies on a larger scale so that if nasal carriage rate of MRSA is high among hospital staff, early recognition and treatment of these workers may prevent the economic losses in terms of hospital stay and cost of medicine.

The authors propose a larger prospective study to elucidate the prevalence of MRSA both in the hospitals and in community.

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