ORIGINAL ARTICLE

Nasal Carriage of Methicillin Resistant Stapylococcus aureus among Healthcare Workers in University of Maiduguri Teaching Hospital

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ABSTRACT

Background: Methicillin resistant Staphylococcus aureus (MRSA) has been recognized as an important pathogen causing Nosocomial infections with severe consequences despite antibiotic therapy. Nasal carriage among healthcare workers, play an important role in the transmission of this organism within the hospital setting.

Objectives: To determine the MRSA carriage rate among health care workers' in University of Maiduguri Teaching Hospital

Materials and Methods: We conducted a cross sectional studies on healthcare workers (HCW) in University of Maiduguri Teaching Hospital Nigeria. A total of 385 healthcare workers and students on rotation in all surgical units, intensive care unit (ICU), accident and emergency, operating theatre and special care baby unit were randomly recruited and screened for nasal carriage of MRSA using nasal swab.

Results: The overall carriage rate of MRSA was 13.5%; it was higher among Nurses and in ICU/theatre. The MRSA isolates showed variable resistant to commonly used antibiotics but are highly sensitive to clindamycin and mupiricin.

Conclusion: Periodic screening of HCWs and decolonization of carriers should be considered.

Keywords: Staphylococcus aureus, methicillin resistance, nasal carriage, healthcare workers

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Introduction

Nosocomial infections occur worldwide affecting both developed and developing countries.

Staphylococcus aureus (S. aureus) was the most common organism isolated from hospital acquired infection (HAI) with methicillin resistant Staphylococcus aureus constituting 52.5% of the S. aureus isolates. The term methicillin resistant staphylococcus aureus (MRSA) refers to those strains of S. aureus that have acquired resistance to the antibiotics methicillin and other related antibiotics of the penicillin class.

The basis for the resistance is the production of an additional penicillin-binding protein PBP`or PBP2A, mediated by the mecA gene found in MRSA.

Staphylococcus aureus mainly colonizes the nasal passages, which acts as its primary reservoir. About 20%-45% of the general population is colonized by of S. aureus, with an estimated nasal MRSA colonization of 1.3%. Studies showed that average carriage rate among healthcare workers (HCWs) was 4.6% of MRSA and 23.7% of methicillin sensitive Staphylococcus aureus (MSSA), while 5.1% had clinical infections with MRSA. Several studies in Nigeria documented a prevalence rate of nasal carriage of MRSA between 13.6%-38.9%. These colonized HCWs have been linked to numerous MRSA infection outbreaks in the hospitals with increased morbidity and mortality in addition to the healthcare burden. It has been reported that one of the most important sources of staphylococci for nosocomial infections is nasal carriage among hospital personnel. Nasal carriages of S. aureus play a key role in the epidemiology and pathogenesis of S. aureus infections. Hospital staff has been reported to have significantly higher nasal carriage prevalence than inpatients.

Hands are the main vector for transmitting S. aureus from surfaces to the nasal niche e.g. through nose picking[11]. Colonized individuals may transmit the organism to another person through direct contact, usually through colonized hands and aerosolization following sneezing[8]. Colonization of the anterior nares is a recognized risk factor for subsequent S. aureus Infection[11].

The risk factors associated with MRSA colonization are prior prolonged hospitalization, preceding antimicrobial therapy, close proximity to a patient colonized or infected with MRSA, presence of skin or soft tissue infections and presence of invasive devices.

Eradication of S. aureus from the anterior nares has been proven to reduce S. aureus infections. MRSA carriage by hospital staff normally responds to treatment with mupirocin nasal ointment, antiseptic solution for washing and shampooing and hexachlorophene powder for perineal carriers.

There is dearth of study documenting the prevalence of nasal carriage of MRSA especially in North eastern part of Nigeria, hence, this study was carried out.

Materials and Methods

This is a hospital based cross-sectional study carried out among healthcare workers in University of Maiduguri Teaching Hospital. Ethical approval was obtained from the ethical committee of the hospital and informed consent was obtained from each participant.

A total of 385 healthcare workers and students on rotation in the surgical wards, operating theatre/intensive care unit (ICU), accident and emergency unit (A&E), and special care baby unit (SCBU) of the University of Maiduguri Teaching Hospital were sampled. A questionnaire was used to collect the sociodemographic and other relevant information from the participants. A sterile swab stick moistened with sterile physiologic saline was used to take specimen from the anterior nares; the swab was rotated at least 5 times in the nostrils. The specimens were then transported to the Microbiology laboratory within one hour of collection for processing. The specimens were inoculated into sheep Blood agar and Mannitol salt agar. The two agar plates were incubated at 37°C for 18-24 hours under aerobic atmosphere. Colonies that appear as yellow to cream or occasionally white, 1-2 mm in diameter, with slightly raised edges after overnight incubation are Gram stained and tested for catalase production. Coagulase test was carried out on all isolates that are Gram positive and catalase positive. All Gram positive, Catalase positive and Coagulase positive cocci were identified as S. aureus.

Colonies confirmed to be S. aureus, by the panel of test above were screened for Methicillin resistance using modified Kirby-Bauer method. This was done by streaking the inocula onto Mueller Hinton agar plates evenly and placing a Cefoxitin (30µg) disc

and incubated at 35°C for 18-24 hours. Isolates with inhibition zone diameter of ≤ 21mm around Cefoxitin disc were considered as MRSA strains.

Inocular were standardized according to clinical and laboratory standard institute (CLSI) standards, four to five colonies of 24 hour pure culture isolates were inoculated into 5mls of sterile physiologic saline in a sterile test tube and turbidity adjusted to match a McFarland 0.5 Barium sulphate standard[16]. Sterile cotton swab was dipped into the suspension and rotated several times. Excess suspension was removed by pressing the cotton swab firmly onto the inner surface of the tube. Using the modified Kirby-Bauer method, this was streaked onto Mueller Hinton agar plates and the antibiotic disc were then placed onto the inoculated plates and incubated at 35°C for 18-24 hours. The zone of inhibition around the antibiotic disc was then read according to CLSI guidelines[16].

Result

A total of 385 healthcare workers were screened for nasal carriage of MRSA. Their ages ranged from 18-56years (mean=30.2, SD=±7.3). Two hundred and eighteen (56.6%) were males and 167(43.4%) females, with a male/female ratio of 1.3:1

Table 1: Distribution by Age and Sex (n=385).

Age (years)	Male	Female	Total (%)
<20	0	7	7(1.8)
20-29	90	86	176(45.7)
30-39	94	56	150(39.0)
40-49	28	16	44(11.4)
≥50	6	2	8(2.1)
Total	218	167	385(100)

One hundred and seventy-eight (46.2%) were from surgical ward, 88(22.9%) from the theatre/ICU, 74(19.2%) from accident and emergency, and 45(11.7%) from SCBU. The carriage rate of MRSA was 18.2% in Theatre/ICU, 17.8% in SCBU, 14.9% in A&E and 9.6% in the Ward.

Table 2: Work Station Related Carriage of *S. aureus* And MRSA (n=385)

Work Station	S. aureus Carriage (%)	MRSA (%)	Non-Carriers (%)	Total Sampled n-385 (%)
Ward	**50(28.1)**	**17(9.6)**	**111(62.4)**	**178(46.2)**
Theatre/ICU	**41(46.6)**	**16(18.2)**	**31(35.2)**	**88(22.9)**
A&E	**33(44.6)**	**11(14.9)**	**30(40.5)**	**74(19.2)**
SCBU	**16(35.6)**	**8(17.8)**	**21(46.7)**	**45(11.7)**
Total	**140(36.4)**	**52(13.5)**	**193(50.1)**	**385(100)**

P-value = 0.198

One hundred and forty (36.4%) healthcare workers were nasal carriers of *S.aureus,* 52(37.1%) of the 140 harbour MRSA. The overall carriage rate of MRSA was 13.5%. It

also varied among the different cadre of health workers, being highest among Nurses (20%), Ward Attendants (17.5%), Doctors (12.2%), medical students (10.9%), student nurses (9.8%) and technicians (10.5%). Although the difference was not statistically significant (P-value = 0.483).

Table 3: Prevalence of *S. aureus* and MRSA Based on Cadre (n=385)

Cadre	*S. Aureus* Carriage (%)	MRSA (%)	Non-Carriers (%)	Total Sampled N=385 (%)
Doctors	37(45.1)	10(12.2)	35(42.7)	82(21.3)
Nurses	30(42.9)	14(20)	26(37.1)	70(18.2)
Medical student	41(32.0)	14(10.9)	73(57.0)	128(33.2)
Student nurses	11(26.8	4(9.8)	26(63.4)	41(10.6)
Ward Attendants	14(31.1)	8(17.8)	23(51.1)	45(11.7)
Technicians	7(36.8)	2(10.5)	10(52.6)	19(4.9)
Total	140(36.4)	52(13.5)	193(51.1)	385(100)

P-value = 0.483

The MRSA isolates were multi-drug resistant. Isolates were 100% resistant to penicillin G, 61.5% resistant to trimethoprim/sulfamethoxazole, 55.8% to tetracycline and 51.9% to erythromycin. Isolates were 100% sensitive to mupirocin, 96.2% to clindamycin and 90.4% to amoxyclav. Isolates showed marginal sensitivity to ciprofloxacin (Table 4).

Table 4: Antibiotics Sensitivity and Resistant Profile of MRSA Isolates (n=385)

Antibiotics	Sensitive (%)	Resistant (%)
Amoxyclav	47(90.4)	5(9.6)
Erythromycin	25(48.1)	27(51.9)
Tetracycline	23(44.2)	29(55.8)
TMP-SMZ	20(38.5)	32(61.5)
Ciprofloxacin	29(55.8)	23(44.2)
Clindamycin	50(96.2)	2(3.8)
Penicillin G	0(0)	52(100)
Mupirocin	52(100)	0(0)

Discussion

The nasal carriage of S. aureus among HCW of 37.1% found in this study was comparable to the nasal carriage rate of 35.6% and 37.3% reported by Egwuatu et al8 and Goyal et al respectively. This contrast to findings from southern part of Nigeria (64%)7, Ethiopia (28.8%) and India (48%). The carriage rate of MRSA of 13.5% in this study was comparable with that reported by other workers8,17, but differ from the findings from other studies in Nigeria (30% and 38.9%)7,9 and Libia (22%). The differences in the nasal carriage of S. aureus and MRSA seen above may be due to differences in study design as well as local prevalence and infection control strategy of the different hospitals from these studies are carried out.

Nasal colonization by MRSA was highest among the Nurses (20%), Attendants (17%) and Doctors (12.2%) in this study. In the same vein, Rashid et al19 reported highest incidence of MRSA nasal colonization among nurses (27.3%) followed by Doctors (18.5%), sanitary workers (13.6%) and administrative staff (2.1%). Shibabaw et al18 also reported colonization rates of 21.2%, 12.5% and 12.5% among nurses, doctors and laboratory technicians respectively. However, Akujobi et al7 documented nasal colonization rates of 50%, 34.1%, 28.8% 24% and 20% among attendants, laboratory scientist, nurses, doctors and cleaners respectively. The high colonization rate among these groups of HCWs may be due to their close contact with patients which is of great concern since they may act as reservoir for cross infection in the medical setting.

The study found the highest rate of MRSA colonization to be among HCW in ICU/theatre (18.2%), followed by SCBU (17.8%), accident and emergency unit (14.9%) and surgical wards (9.6%). A study carried out in Iran documented highest prevalence of nasal carriage of MRSA in surgery and operating room (31.2%), followed by emergency unit (21.9%), internal medicine and paediatrics (21.9%) and ICU (15.6%). However, Egwuatu et al demonstrated that up to 70% and 26.7% of MRSA nasal carriage was seen in the postnatal ward and theatre/ICU respectively. This higher rate of nasal colonization by MRSA found in these work stations may be because these places are high dependency areas, with high use of antibiotics and medical devices and usually have patients that are vulnerable and having higher tendency for infections. There could be cross transmission between such patients and the HCWs.

In this study, S. aureus isolates that were methicillin resistant also showed total resistance to penicillin G, and significant resistance to trimethoprim/sulfamethoxazole, tetracycline and erythromycin. This was in keeping with reports from other studies9. Fadeyi et al9 also reported that most of the MRSA isolate were resistant to penicillin G, trimethoprim-sulfamethoxazole and erythromycin but sensitive to ciprofloxacin and amoxicillin/clavulanic acid. In Western Australia, high resistance was observed against erythromycin (60%) and ciprofloxacin (26%) among the MRSA isolates. A study from Taiwan reported very high resistance to erythromycin (92%), while a report from Eritrea found 27% resistance of MRSA to erythromycin and 23 % to cotrimoxazole with highest resistance observed against tetracycline (88%). The high resistance of MRSA to erythromycin, cotrimoxazole and tetracycline may due to the abuse and misuse of these antibiotics because they are cheap, readily available and easily accessible over

the counter in our environment. This study found high sensitivity to clindamycin and amoxicillin/clavulanate and no resistance to mupirocin in agreement with other studies9,23. The high sensitivity to these antibiotics in this environment may be because they are not routinely used due to high cost and availability. Due to these findings the use of these drugs to treat suspected cases of MRSA infections will be appropriate in this environment.

Conclusion

The prevalence of nasal carriage of S. aureus and MRSA among HCWs in this study was 36.4% and 13.5% respectively. The carriage rate of MRSA was highest among the Nurses. Healthcare workers in ICU/theatre have the highest colonization rates.

MRSA isolates were variably resistant to trimethoprim/sulfamethoxazole, tetracycline and erythromycin with 100% resistant to penicillin G. Methicillin resistant S. aureus isolates also show high sensitivity to amoxicillin-clavulanic acid, clindamycin and are all completely sensitive to mupirocin.

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