

## Nasal Carriage Rate of Methicillin Resistant *Staphylococcus Aureus* among Theatre Staff of Upth, Rivers State, Nigeria

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### Abstract:

**Background:** Theatre staff who are asymptomatic carriers of MRSA play a vital role in the acquisition of surgical site infections caused by MRSA in post-surgical patients. Screening and eradication of MRSA from the colonized HCWs has been identified and recommended as an important tool in infection control policy for this organism. The study aimed to determine the nasal carriage rate of MRSA and associated risk factors among theatre staff.

**Materials and methods:** Nasal swabs were obtained from 109 healthy staff working in the operating theatre and inoculated on Manitol salt agar and subcultured on blood agar. Each isolated *Staphylococcus aureus* was screened for Methicillin resistance by the Kirby-Bauer method by using cefoxitin (30 mcg) disks (oxiod) and the zone of inhibition was measured and interpreted according to the CLSI guidelines.

**Results:** The overall carriage rate of MRSA was found to be 9.3% of the total respondents. The MRSA carriage was far higher among the doctors (88.9%) compared to nurses (11.1%) and none among other support staff

**Conclusion:** Regular screening of healthcare workers in our setting with the aim of identifying MRSA carrier and development of control measures to mitigate colonization is strongly indicated.

**Key words;** Methicillin resistant *Staphylococcus aureus*, Theatre, Infection, Port Harcourt

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### I. Background information

Methicillin resistant *Staphylococcus aureus* (MRSA) is a major nosocomial pathogen that causes severe morbidity and mortality worldwide<sup>1,3</sup>. Infections caused by MRSA strains are associated with longer hospital stay, prolonged antibiotic administration, and higher cost of treatment in contrast to infections caused by methicillin-susceptible *Staphylococcus aureus* (MSSA) strains<sup>2</sup>. MRSA is a strain of *Staphylococcus aureus* which is resistant to methicillin and other antibiotics<sup>4,5</sup>.

*Staphylococcus aureus* is a potentially pathogenic organism which can be found on a lot of healthy humans<sup>6,7</sup>. Colonization may be either transient or persistent and may be at single or multiple body sites. The most common site of carriage of this organism is the nose<sup>7,10</sup>. Other sites this organism could be found on the human body includes; skin folds, hairline, perineum and navel<sup>8,9</sup>.

Asymptomatically colonized healthcare workers are believed to be a major source of MRSA in the hospital environment, being especially identified as a useful link in the transmission of MRSA between the patients<sup>11,12</sup>. Several studies have indicated a high nasal carriage rate of MRSA among health workers<sup>14,16,17</sup>. According to studies carried out by Shibabaw et al<sup>15</sup> and Lakshmi et al<sup>18</sup>, the rate of MRSA carriage among hospital care workers was 12.7% and 12% respectively.

A significant proportion of the health care workers have their nares colonized by MRSA and this has been identified as a major risk factor for the transmission of hospital acquired methicillin resistant *Staphylococcus aureus* infections<sup>13,19</sup>. This is particularly true for surgical site infections (SSI) as many studies have shown MRSA as the most common pathogen isolated from serious SSIs<sup>21,22</sup>. The impact of MRSA on SSI is enormous. These include an increase in mortality rates, longer hospitalization, and increase hospital cost, according to the study of Anderson et al who compared elderly patients with SSI and those without, it was shown that the presence of SSI doubles the risk of death while the presence of an MRSA SSI increases the risk of death 11-fold after surgery. When SSI is caused by MRSA the hospital stay can increase by as much as 2 weeks<sup>2,23</sup>

*Staphylococcus aureus* is a Gram positive, catalase positive, coagulase positive coccus in the family *Staphylococcaceae*<sup>5</sup>. Several decades ago, certain *S. aureus* strains were discovered to have acquired resistance to methicillin and other beta lactam antibiotics, this strain was called the Methicillin resistant *Staphylococcus aureus* (MRSA). The spectrum of infections due to this group of organisms are manifold and are associated with worse outcome in patient care<sup>2,23</sup>.

Resistance to methicillin is encoded and regulated by a sequence of genes found in a region of the chromosome called the staphylococcal cassette chromosome *mec(SCCmec)*, specifically the *mecA* and newly described *mecC* genes, on this locus encode a low-affinity penicillin-binding protein (PBP2a) that is responsible for the resistance<sup>5</sup>. MRSA are usually transmitted by direct contact, often via the hands<sup>24</sup> but can also be disseminated on fomites and in aerosols<sup>11,25</sup>. Hospitalization, residence in long-term care facilities, long term antibiotics usage, surgery, hemodialysis, and contact with a person who has an MRSA infection, are all known risk factors for exposure to MRSA<sup>26</sup>.

Various studies have been done to determine the prevalence of MRSA infection; nasal carriage rate of MRSA among hospital theatre staff (HTS), and to determine the sensitivity pattern of the MRSA isolates<sup>27,28,29</sup>.

In study done in a tertiary care hospital in Nagpur, India where nasal MRSA carriage was evaluated, a prevalence of 22.8% was reported<sup>27</sup>. However, a similar study done in civil hospital in India reported a prevalence of 3.27%<sup>28</sup>

In a multicentre study done by Gunasekara et al among anaesthetic doctors, MRSA was isolated from 22% of swabs taken from fingertips, 15% from mobile phones and 25% from wrist watches of the doctors sampled<sup>29</sup>.

In Lagos, Nigeria, a similar study was done among health workers and prevalence of 32% was reported with a positive association between the length of service and colonization by MRSA<sup>30</sup>

Theatre staff who are asymptomatic carriers of MRSA probably play a vital role in the acquisition of SSIs caused by MRSA in post-surgical patients<sup>12</sup>. This study therefore aims at determining the prevalence of MRSA colonization in the theatre staff /workers of UPTH

## II. Materials and methods

This study was carried out over a two-week period at the university of Port Harcourt teaching hospital involving one hundred and nine theatre staff; including Surgeons (consultants, senior residents and residents), Anesthetists (consultants, senior residents and residents), theatre nurses, nurse assistants (anesthetic technicians, porters and cleaners). The specimens were mostly collected during clinical meetings for doctors, and during change of shifts for the other theatre workers. This ensured there was no repetition in sample collection and guaranteed early transport of all the specimens to the laboratory for processing. The purpose and the procedure of specimen collection were explained to the respondents and informed consent was obtained from each respondent before a questionnaire was given and sample collection done.

The samples were self collected under close supervision by the respondents using sterile cotton swabs. The respondents were instructed to gently rotate a single sterile cotton swab three times in both nares. The swabs were immediately transported in a sterile tube to the medical microbiology laboratory of the same institution.

Swabs were inoculated on to Mannitol Salt Agar (MSA) within 30 minutes of collection and incubated aerobically at 35-35°C for 24 hrs. Colonies that fermented mannitol were stained using Grams' method and tested for presence of catalase. The colonies that appeared as gram positive cocci, and were catalase positive were sub cultured on Blood agar and tested for presence of coagulase using both the slide n tube methods. Coagulase positive colonies were identified as *Staphylococcus aureus*. Each isolated *Staphylococcus aureus* was further screened for Methicillin resistance by the Kirby-Bauer method using cefoxitin (30 mcg) disks and the zone of inhibition was measured and interpreted according to the CLSI guidelines. The strains with inhibitory zone diameter ≤ 21mm around the cefoxitin disk, were interpreted as MRSA.

## III. Results

Age (years)	Total respondents	Staph. aureus	MRSA	Chi square (p-value)
<20	1 (0.9)	1 (2.6)	0 (0.0)	0.24 (0.6228)
20-29	22 (20.2)	8 (21.1)	0 (0.0)	2.28 (0.1308)
30-39	56 (51.4)	22 (57.9)	7 (77.8)	1.21 (0.2699)
40-49	25 (22.9)	6 (15.8)	1 (11.1)	0.12 (0.7230)
>50	5 (4.6)	1 (2.6)	1 (11.1)	1.28 (0.2571)
<b>Total</b>	<b>109 (100.0)</b>	<b>38 (100.0)</b>	<b>9(100.0)</b>	

**Table 1. MRSA carriage and age prevalence**

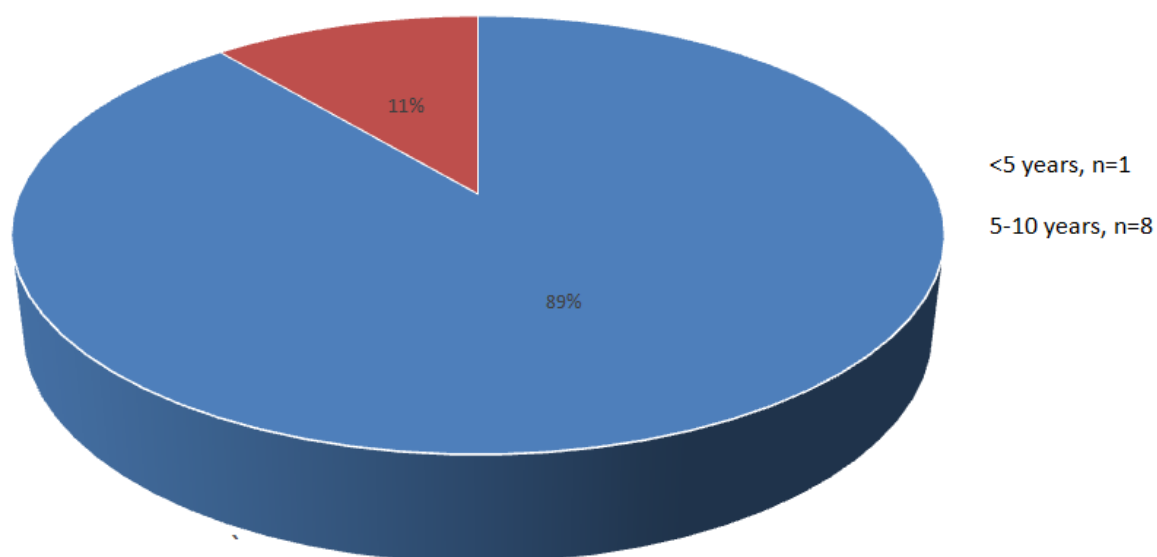
A total of 109 nasal swabs were collected of which 73.4% of it were from medical doctors (surgeon and anesthetists) while 11.4% and 9.2% were respectively from ward assistants and Nurses.

The prevalence of MRSA carriage among the study respondents was 9.3%, the prevalence was highest among the modal age group 30-39years, this age group accounted for 51.4% and 77.8% of total respondents and MRSA carriage respectively. This was however not statistically significant  $P < 0.05$ . There were no carriage among the younger age groups <20years and 20-29years while age groups 40-49years and >50years recorded 11.1% each of MRSA carriage.. **Table 1.**

Occupational	Prevalence	% MRSA
Medical doctors	80 (73.4)	8 (88.9)
Nurse	10 (9.2)	1 (11.1)
Ward maid	19 (17.4)	0 (0.0)
Total	109 (100)	9 (100)

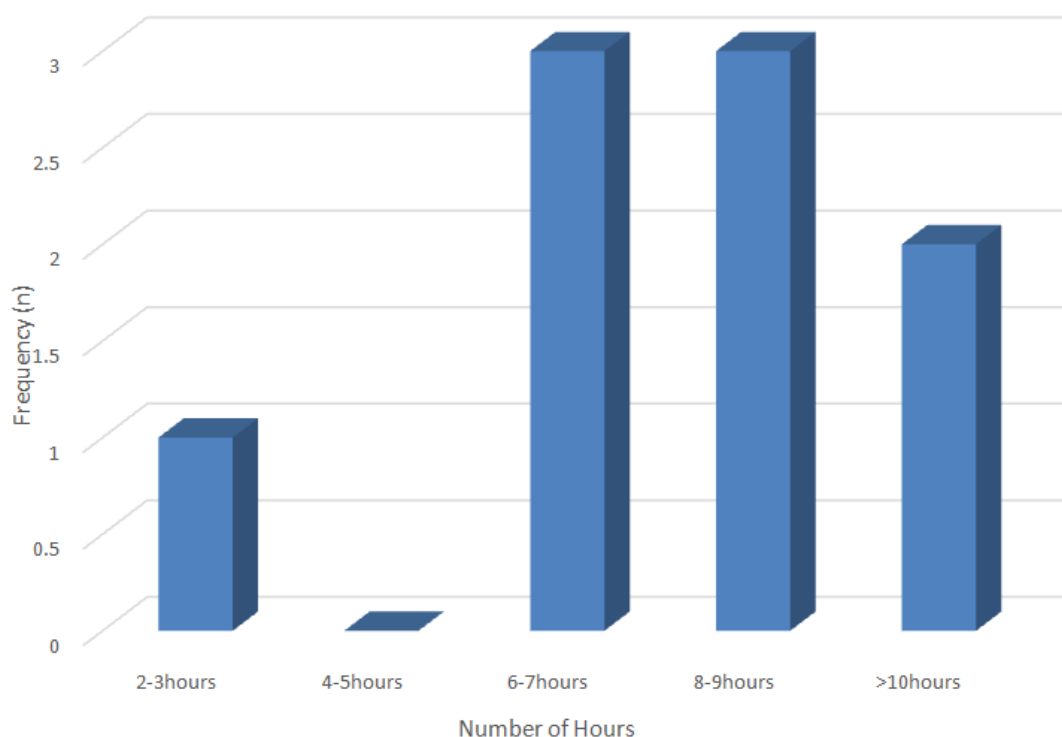
**Table 2; Occupational MRSA prevalence**

Occupational prevalence of MRSA carriage of the respondents showed that 88.9% of the total isolated MRSA was from medical doctors (surgeon and anesthesiologists) while only 11.1 % was found in nurses and none among other theatre workers. **Table 2**



**Fig 1 length of years of work and MRSA prevalence**

The distributions of MRSA by the duration of current job showed 89% MRSA carriage among staff who have worked between 5-10years in their current job as opposed to only 11% among those who have spent less than 5years **Figure 1**



**Fig 2: Frequency of MRSA by number of hours at work**

The frequency of MRSA by the number of hours at work among positive respondents revealed that staff who spent between 6-9 hours a day at work have the highest carriage rate and closely by those who spent more than 10hours. **Figure 2**

Risk factors and prevalence of MRSA		MRSA+	MRSA-	OR (95% CI)
Previous MRSA carriage	Yes	2	4	7.2 (1.1 – 46.9)*
	No	7	102	
Previous nasal surgery	Yes	0	2	0
	No	9	98	
Recent wound infection	Yes	0	6	0
	No	9	94	
Current URTI	Yes	3	15	2.8 (0.6 – 12.4)**
	No	6	84	
Chronic use of antibiotic in the last 3months	Yes	4	37	0.8 (0.2 – 3.6)**
	No	6	63	
Chronic medical condition	Yes	0	10	0
	No	9	90	

OR: Odds ratio, CI: Confidence interval. When OR > 1, likelihood of MRSA increases.

**Table 3 Risk factors and prevalence of MRSA**

The analysis of the individual risk factors and prevalence of MRSA carriage among respondents showed that 2 of the 9 staff positive for MRSA has previous history of nasal carriage, while 3 out of the positive 9 had current URTI and 4 of the 9 were on long term antimicrobial agent while none was found among those who had had previous nasal surgery, recent wound infection and chronic medical condition **Table 3.**

#### IV. Discussion

MRSA is an important nosocomial pathogen worldwide because of the increased rate of multidrug resistant among the hospital acquired strains<sup>31</sup> It is necessary to detect the MRSA carriers among the apparently healthy hospital personnel, especially those working in the critical areas such as theatres These individuals can serve as vehicle of infection to their patients, resulting in wound complications and in their overall extended hospital stay. This can be controlled by the regular screening of the healthcare workers, appropriate preventive and curative measures<sup>32</sup>. In our study, the overall carriage rate of MRSA was found to be 9.3% of the total respondents. This falls within the internationally reported range of the MRSA carriage of 5.8 to 17.8% among the healthcare staff in the hospital environment<sup>33</sup> and was similar to the finding of Malini et al who reported

MRSA carriage rate of 10% among Hospital workers<sup>33</sup> it was however much higher when compare with the finding from a similar study done by Varghese et al where a carriage rate of 2.93% was reported<sup>34</sup> and lower than the 13.6% carriage rate reported in Lagos Nigeria by Eguatu et al<sup>30</sup>. The disparity in carriage rate from similar study across the world probably due to local infection control practices, study design; sample size, study setting and methodology for analysis. In our study, the MRSA carriage was far higher among the doctors (88.9%) compare to nurses (11.1%) as opposed to the findings from similar studies by Khanal et al<sup>35</sup>, Ohoud et al<sup>36</sup> and Malini et al<sup>33</sup> where higher prevalence were reported among nurses which was attributed to the fact that nurse have more frequent contact with patient and patients relatives in the hospital setting. In the index study, only theatre nurses were recruited and they unlike the ward nurses have minimal exposure to patient as compare to the doctors. This in addition to far higher number of doctors enrolled in the study than nurses at ratio of 8:1 doctor to nurse and the general observation that doctors handle patients during ward round without washing hand in between may have accounted for the reverse in MRSA carriage among doctors and Nurses found in our study as compared with many similar studies. A meta-analysis showed a clear association between exposure to antibiotics and MRSA isolation, and risk as high as 8times of acquisition of MRSA had been reported among patients who had taken antibiotics earlier<sup>37</sup> this was in accordance with our findings were MRSA carriage was highest (4/9) among respondents who have been on long term antibiotics. The carriage rate in our study should be seen as a great challenge as doctors are among the healthcare workers who have frequent contact with the patients; more worrisome in this case is the risk of surgical site infection among post operative patients.

## V. Conclusion

The prevalence of MRSA found in our study, though within internationally reported range, but worrisome is the group of HCW most colonized; the surgeons who have frequent contact with patient both on pre operative and postoperative basis, this has a high propensity for surgical site infection, doctor to patient transfer of the organism and even to relatives There is therefore need for regular screening of healthcare workers in our setting with the aim of identifying MRSA carrier and to develop control measures to mitigate this colonization.

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