Nasal Carriage Prevalence of MRSA in People Living with HIV/AIDS Undertaking Antiretroviral Therapy in a Tertiary Hospital in Port Harcourt

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ABSTRACT
Methicillin resistant Staphylococcus aureus (MRSA) is a bacterium which is known globally to cause several difficult to treat infections in humans both in the hospital and community settings. It is also referred to as Oxacillin Resistant Staphylococcus aureus (ORSA). Staphylococci are members of the family Micrococcaceae. They are Gram-positive, non motile spherical bacteria, catalase-positive, do not form spores, facultatively anaerobic and occur singly and in irregular grapelike clusters. This study was aimed at determining the prevalence of MRSA nasal colonization of HIV positive patients in a Tertiary Hospital in Rivers State. A total of 217 study participants were recruited. From each participant, specimen for Staphylococcus aureus culture was collected from the anterior nares, using sterile swabs moistened with distilled water. Moistened sterile swab sticks were inserted into the nostrils 1-2 cm inside, swabbing it in clockwise direction for 3-4 times. The swabs were immediately transported to the Medical Microbiology and Parasitology Laboratory of the University of Port Harcourt Teaching Hospital for culture on Mannitol salt agar. Biochemical tests and antimicrobial testing was carried out on isolates. Blood samples were also collected from the participants from their median cubital vein using a sterile ethylene diamine tetra acetic acid vacutainer needle and tube. The blood samples were sent to the HIV Research Laboratory, where CD4 cell counts were done using a flow cytometer. However, nasal screening in this study identified 82(37.79%) S. aureus carriers. Out of these, 82(37.79%) Staphylococcus aureus isolates, 54(24.88%) isolates were Methicillin Resistant based on Oxacillin (1µg) disc and 35 isolates were methicillin resistant based on cefoxitin (30µg) disc giving a prevalence of 16.13% in the studied population. Conclusively, it is critical to note that, Staphylococcus aureus that are MRSA continue to evolve as an important agent of infection in HIV positive subjects attending the University of Port Harcourt Teaching Hospital. This study also established that there was an equal likelihood of isolation of MRSA from people living with HIV/AIDS irrespective of their CD4+ count or the stage of their disease progression.

Keywords: MRSA, Infection, Prevalence, CD4+, HIV/AIDS,
INTRODUCTION
In the world of the microscopic, *Staphylococcus aureus* is one of the most versatile organisms. It is found worldwide and is a leading cause of many diseases. Even though it is not classified as a true pathogen (an organism that is expected to always cause disease in humans), but as an opportunistic pathogen, it has a diverse repertoire of possible infections. Normally, it is a transient colonizer of the skin and body entry portals (ears, eyes, nasal passages, etc.), and an estimated 20% of humans are carriers (asymptomatic permanent colonization), 60% are intermittent carriers and approximately 20% almost never carried *S. aureus* (Kluymans, 1997). However, any break in the skin, or colonization of individuals with compromised immune systems can provide an opportunity for this organisms to cause infection. However, the emergence of vancomycin resistant staphylococci was as a result of increase in use of vancomycin to treat infections caused by methicillin resistant staphylococci, *Clostridium difficile* and enterococcal infections (Kirst et al., 1998).

Vancomycin intermediate-resistant *Staphylococcus aureus* (VISA) also has been reported. In contrast to the chromosomally mediated resistance for VISA strains, the VISA strains acquire resistance by conjugal transfer of the Van A operon from an *Enterococcus faecalis*, raising the specter of a far more efficient means for dissemination of the resistance among strains of *Staphylococcus* (Lowy, 2003). This bug comes naturally armed with a long list of virulence factors, and becoming resistant to antimicrobial drugs is just an added bonus. *Staphylococcus aureus* has long been recognized as an important pathogen in human disease. Due to an increasing number of infections caused by methicillin-resistant *S. aureus* (MRSA) strains, therapy has become problematic. MRSA has thus established itself as a heterogeneous group of organisms with different epidemic potentials resulting in its constantly evolving epidemiology. This heterogeneity is also represented by different virulence potentials and complex interactions with susceptible hosts. HIV-infected patients are now recognized as one of these higher risk groups due to increased rates of both MRSA colonization and infections over the past decade (Wertheim et al., 2005).

Therefore, prevention of staphylococcal infections has become more important. Carriage of *S. aureus* appears to play a key role in the epidemiology and pathogenesis of infection. The ecological niches of *S. aureus* are the anterior nares. Since its first appearance in 1960, methicillin resistance in *S. aureus* strains has become widespread in hospitals and intensive care units (ICUs) (Diekema et al., 2004). For MRSA, specifically, colonization rates of 0%–17% have been reported for HIV- Positive outpatients’ and 17%–31% for inpatients. HIV has been identified as an independent risk factor for determining colonization with MRSA (Hidron et al., 2005). The reason for the higher colonization rates observed are unclear, but could include factors such as frequent contact with persons in healthcare and community related settings, and frequent exposure to antibiotics, leading to a greater likelihood of becoming colonized with resistant strains of different organisms (Aaron et al., 2017). This study was aimed at determining the prevalence of MRSA nasal colonization of HIV positive patients in a Tertiary Hospital in Rivers State.

MATERIALS AND METHODS
This study was carried out at HIV clinic at the University of Port Harcourt Teaching Hospital located at Alakahia in Obio/Akpor Local Government Area of Rivers State. Consented subjects were enrolled for this cross sectional study. This study was conducted for a duration of six months. Adult male and female HIV positive patients (18 years and above) on antiretroviral drugs for up to six months and above were enrolled for this study. However, Children (under 18 years), Adults HIV positive subjects who are not on antiretroviral drugs, patients who were on antibiotic treatment for any bacterial infection during the time of data collection were excluded from this study.
Sample Collection: Nasal Swab samples were collected from the anterior nares of consenting HIV positive patients who reported at the University of Port Harcourt Teaching Hospital, HIV Clinic. Samples were collected from Adults. Any consenting participant who visited the clinic from January 2016 through June 2016 was enrolled in the study. A total of 217 study participants were recruited. From each participant, specimen for Staphylococcus aureus culture was collected from the anterior nares, using sterile distilled water aseptically moistened sterile swab. Moistened sterile swab sticks were inserted into the nostrils 1-2 cm inside, swabbing it in clockwise direction for 3-4 times. The swabs were immediately transported to the Medical Microbiology and Parasitology Laboratory of the University of Port Harcourt Teaching Hospital for microbiological analysis. Blood samples were also collected from the participants from their median cubital vein using a sterile ethylene diamine tetra acetic acid vacutainer needle and tube. The blood samples were sent to the HIV Research Laboratory, where CD4 cell counts were done using a flow cytomter.

Sample Size Calculation
The sample size was calculated by considering a 95% confidence level d=0.05 and an expected prevalence of 17%. According to this, a minimum sample size of 217 was needed for this study. To calculate the sample size using (Daniel, 1999): $N = \frac{Z^2P(1-P)}{d^2}$

$$N = \frac{(1.96)^2 \times 0.17 \times 0.83}{(0.05)^2} = \frac{3.8416 \times 0.17 \times 0.83}{(0.05)^2} = 216.81$$

Then, $N=217$, therefore the minimum sample size for this study will be 217.

Ethical Clearance
An informed, written consent was obtained from all participants after explanation of the purpose of the study. They were given the option of not to participate in the study if they wanted. Ethical approval was also obtained from the ethics committee of the University of Port Harcourt Teaching Hospital where this study was carried out.

RESULTS

<table>
<thead>
<tr>
<th>Staphylococcus aureus Isolates</th>
<th>Ox (%)</th>
<th>Fox (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
<td>54 (24.88)</td>
<td>35 (16.13)</td>
</tr>
<tr>
<td>MSSA</td>
<td>21 (9.68)</td>
<td>47 (21.66)</td>
</tr>
<tr>
<td>Intermediate-Oxacillin-Resistant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>7 (3.23)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>82 (37.79)</td>
<td>82 (37.79)</td>
</tr>
</tbody>
</table>

P=0.49 (P<0.05, Significant, while P>0.05, Not significant)

KEY:
OX = Oxacillin     MRSA = Methicillin Resistant Staphylococcus aureus
FOX = Cefoxitin    MSSA = Methicillin Susceptible Staphylococcus aureus
Table 2: Sex Distribution of MRSA Among the Studied Population

<table>
<thead>
<tr>
<th>Sex</th>
<th>Total Tested</th>
<th>Positive Subjects</th>
<th>MRSA(Fox)</th>
<th>MRSA(Ox)</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>65(29.95)</td>
<td>22(33.85)</td>
<td>11(16.92)</td>
<td>13(20)</td>
<td>43(66.15)</td>
</tr>
<tr>
<td>Female</td>
<td>152(70.05)</td>
<td>60(39.47)</td>
<td>24(15.79)</td>
<td>41(26.97)</td>
<td>92(60.53)</td>
</tr>
<tr>
<td>Total</td>
<td>217(100)</td>
<td>82(37.79)</td>
<td>35(42.68)</td>
<td>54(24.88)</td>
<td>135(62.21)</td>
</tr>
</tbody>
</table>

P=0.59 (P<0.05, Significant, while P>0.05, Not significant)

This current study, showed the existence of 24.88% and 16.1% MRSA prevalence out of 82 S. aureus (Plate 1) isolates using oxacillin (OX)(Plate 2) and cefoxitin (FOX)(Plate 2) respectively. Overall, there is no significant difference in the determination of MRSA using Oxacillin and Cefoxitin amongst HIV subjects from this study p = 0.49 (Table 1). Based on the 65 HIV Positive adult males enrolled in this study, 22 (33.85%) were Staphylococcus aureus carriers and 11(16.92%) were MRSA positive using cefoxitin and 13(20.0%) using oxacillin while out of the 152 HIV Positive females enrolled in this study, 60(39.47%) were Staphylococcus aureus carriers and 24(15.79%) were MRSA positive for Cefoxitin and 41(26.97%) for oxacillin (Table 2). This study showed a varying distribution in the isolation of Staphylococcus aureus and MRSA along the various age groups using oxacillin and cefoxitin. There is significant difference in the distribution of MRSA amongst HIV subjects of the various age groups p = 0.003. The isolation MRSA was highest in age group 31 – 40 years and there was no isolation of MRSA from age group 11 – 20 years (Table 3). In this study, the HIV positive patients were grouped into three stages of HIV infection based on their CD4+ count (both previous i.e. CD4+ count before they were placed on Anti-retroviral drugs) and the current CD4+ count, it was further shown that 37.79% of patients, who underwent this study, were in stage 1 of their HIV/AIDS disease progression, while 38.71% were in stage 2 and 23.5% were already in stage 3. However, there was observed 5.07% incidence of MRSA among those in stage 1, while 6.45% and 4.61% among those in stage 2 and 3 respectively (P=0.085) (Table 4).The mean of the previous CD4+ cell count of the MRSA positive population was 401cells/µl (Table 5) while that of the recent CD4+ count was 379 cells/µl (Table 6) indicating a reduction. The median of the recent CD4+ count amongst the MRSA positive HIV patients was 332cells/µl.

Table 3: Age Distribution of MRSA in the Study

<table>
<thead>
<tr>
<th>Age Group</th>
<th>No Tested</th>
<th>No Positive (%)</th>
<th>MRSA(OX)</th>
<th>MRSA(Fox)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 - 20</td>
<td>3</td>
<td>0(0)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21 - 30</td>
<td>41</td>
<td>16(7.37)</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>31 - 40</td>
<td>86</td>
<td>33(15.21)</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>41 - 50</td>
<td>65</td>
<td>25(11.52)</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>51 - 60</td>
<td>18</td>
<td>6(2.76)</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>61 - 70</td>
<td>4</td>
<td>2(0.92)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>217</td>
<td>82(37.79)</td>
<td>54</td>
<td>35</td>
</tr>
</tbody>
</table>

P=0.003
Table 4: Distribution of MRSA among Patients at Different HIV/AIDS Clinical Stages

<table>
<thead>
<tr>
<th>Stages</th>
<th>No. of Patients Based on Previous CD4 Count</th>
<th>No. of PT Based on Current CD4 Count</th>
<th>No. of MRSA Positive PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD4* ≥ 500 cells/µl</td>
<td>82(37.79%)</td>
<td>78(35.94%)</td>
<td>11(5.07%)</td>
</tr>
<tr>
<td>Stage 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD4* 200 – 499 cells/µl</td>
<td>84(38.71%)</td>
<td>90(41.47%)</td>
<td>14(6.45%)</td>
</tr>
<tr>
<td>Stage 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD4*&lt;200 cells/µl</td>
<td>51(23.50%)</td>
<td>49(22.58%)</td>
<td>10(4.61%)</td>
</tr>
<tr>
<td>Total</td>
<td>217(100%)</td>
<td>217(99.99%)</td>
<td>35(16.13%)</td>
</tr>
<tr>
<td>P=0.085</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Current Mean CD4+ Count of MRSA Positive Patients

<table>
<thead>
<tr>
<th>Intervals</th>
<th>X</th>
<th>F</th>
<th>cf</th>
<th>fx</th>
<th>d = (X - A)/h</th>
<th>fd</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 100</td>
<td>50</td>
<td>7</td>
<td>0</td>
<td>350</td>
<td>-6.0</td>
<td>-42.0</td>
</tr>
<tr>
<td>100 – 200</td>
<td>150</td>
<td>3</td>
<td>10</td>
<td>450</td>
<td>-5.0</td>
<td>-15.0</td>
</tr>
<tr>
<td>200 – 300</td>
<td>250</td>
<td>4</td>
<td>14</td>
<td>1000</td>
<td>-4.0</td>
<td>-16.0</td>
</tr>
<tr>
<td>300 – 400</td>
<td>350</td>
<td>8</td>
<td>22</td>
<td>2800</td>
<td>-3.0</td>
<td>-24.0</td>
</tr>
<tr>
<td>400 – 500</td>
<td>450</td>
<td>2</td>
<td>24</td>
<td>900</td>
<td>-2.0</td>
<td>-4.0</td>
</tr>
<tr>
<td>500 – 600</td>
<td>550</td>
<td>5</td>
<td>29</td>
<td>2750</td>
<td>-1.0</td>
<td>-5.0</td>
</tr>
<tr>
<td>600 – 700</td>
<td>650</td>
<td>3</td>
<td>32</td>
<td>1950</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>700 – 800</td>
<td>750</td>
<td>1</td>
<td>33</td>
<td>750</td>
<td>1.0</td>
<td>1</td>
</tr>
<tr>
<td>800 – 900</td>
<td>850</td>
<td>0</td>
<td>33</td>
<td>0</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>900 – 1000</td>
<td>950</td>
<td>0</td>
<td>33</td>
<td>0</td>
<td>3.0</td>
<td>0</td>
</tr>
<tr>
<td>1000 – 1100</td>
<td>1050</td>
<td>1</td>
<td>34</td>
<td>1050</td>
<td>4.0</td>
<td>4</td>
</tr>
<tr>
<td>1100 – 1200</td>
<td>1150</td>
<td>0</td>
<td>34</td>
<td>0</td>
<td>5.0</td>
<td>0</td>
</tr>
<tr>
<td>1200 – 1300</td>
<td>1250</td>
<td>1</td>
<td>35</td>
<td>1250</td>
<td>6.0</td>
<td>6</td>
</tr>
</tbody>
</table>

Using \( x = a + h \left( \frac{\Sigma fd}{N} \right) \)

\[
A = 650
\]

\[
N = 35
\]

\[
h = 100
\]

\[
x = 650 + 100 ( \frac{-95}{35} )
\]

\[
= 650 - \frac{9500}{35}
\]

\[
= 650 - 271.43
\]

\[
= 378.57
\]

\[
X = 379
\]

The mean of current CD4+ count of MRSA positive patients is 379 cells/µl
Table 6: Previous CD4+ Mean Calculations of the HIV Patients

<table>
<thead>
<tr>
<th>Intervals</th>
<th>x</th>
<th>f</th>
<th>Cf</th>
<th>Fx</th>
<th>d = ( \frac{x - A}{h} )</th>
<th>fd</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 100</td>
<td>50</td>
<td>5</td>
<td>0</td>
<td>250</td>
<td>-6.5</td>
<td>-32.5</td>
</tr>
<tr>
<td>100 – 200</td>
<td>150</td>
<td>5</td>
<td>10</td>
<td>750</td>
<td>-5.5</td>
<td>-27.5</td>
</tr>
<tr>
<td>200 – 300</td>
<td>250</td>
<td>4</td>
<td>14</td>
<td>1000</td>
<td>-4.5</td>
<td>-18</td>
</tr>
<tr>
<td>300 – 400</td>
<td>350</td>
<td>7</td>
<td>21</td>
<td>2450</td>
<td>-3.5</td>
<td>-24.5</td>
</tr>
<tr>
<td>400 – 500</td>
<td>450</td>
<td>3</td>
<td>24</td>
<td>1350</td>
<td>-2.5</td>
<td>-7.5</td>
</tr>
<tr>
<td>500 – 600</td>
<td>550</td>
<td>3</td>
<td>27</td>
<td>1650</td>
<td>-1.5</td>
<td>-4.5</td>
</tr>
<tr>
<td>600 – 700</td>
<td>650</td>
<td>4</td>
<td>31</td>
<td>2600</td>
<td>-0.5</td>
<td>-2.0</td>
</tr>
<tr>
<td>700 – 800</td>
<td>750</td>
<td>0</td>
<td>31</td>
<td>0</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>800 – 900</td>
<td>850</td>
<td>2</td>
<td>33</td>
<td>1700</td>
<td>1.5</td>
<td>3.0</td>
</tr>
<tr>
<td>900 – 1000</td>
<td>950</td>
<td>1</td>
<td>34</td>
<td>950</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>1000 – 1100</td>
<td>1050</td>
<td>0</td>
<td>34</td>
<td>0</td>
<td>3.5</td>
<td>0</td>
</tr>
<tr>
<td>1100 – 1200</td>
<td>1150</td>
<td>0</td>
<td>34</td>
<td>0</td>
<td>4.5</td>
<td>0</td>
</tr>
<tr>
<td>1200 – 1300</td>
<td>1250</td>
<td>0</td>
<td>34</td>
<td>0</td>
<td>5.5</td>
<td>0</td>
</tr>
<tr>
<td>1300 – 1400</td>
<td>1350</td>
<td>1</td>
<td>35</td>
<td>1350</td>
<td>6.5</td>
<td>6.5</td>
</tr>
</tbody>
</table>

\( \sum fd = -104.5 \)

Using \( x = a + h \left( \frac{\sum fd}{N} \right) \)

Where
- \( x \) = mean
- \( A \) = Assumed mean = 700
- \( N \) = Population size
- \( h \) = width = 100

\( x = 700 + 100 \left( \frac{-104.5}{35} \right) \)
\( = 700 - 298.57 \)
\( = 401.43 \)
\( x \approx 401 \text{cells/µl.} \)

Therefore, the mean of previous CD4+ count of MRSA positive patients was 401 cells/µl.

Plate 1: Cross Section of *Staphylococcus aureus* Isolates on Mannitol Salt Agar
DISCUSSION

The result obtained in this study was consistent with that obtained by Olakekan et al., (2016) which gave 33% prevalence of *S. aureus* among the study population. HIV has been reported as an independent factor leading to the colonization with MRSA. The reason for this high prevalence or rates of colonization is not clear but could be as a result of frequent contact with health care workers. Nevertheless, in this study, *Staphylococcus aureus* percentage colonization among HIV patients was higher than the 19.67% reported by Eiff et al., (2001) among patients undergoing dialysis in an Iranian health facility but it was similar to what Hekmat et al., (2008), Ghazvini and Hekmat, (2007) had observed from different studies at different times which summarily puts *Staphylococcus aureus* nasal carriage range to be between 36.9% to 45.8% which agreed with the study’s *Staphylococcus aureus* nasal carriage prevalence rate. Kluymans et al., (1997) reported that, 60% of healthy individuals are intermittent carriers and approximately 20% almost never carry *Staphylococcus aureus* with all prevalence of *Staphylococcus aureus* isolation being between 20-45%. Overall, the rate of MRSA identified from the nasal specimen of HIV patients in this study (16.13%) was consistent with that of Taiwo et al.,(2005) (17%), the 0-17% reported by Hidron et al.,(2010), 16% by Olakekan et al.,(2012).

The MRSA rates obtained from this study can also be compared favourably with that obtained from Austria and Germany hospitals, which were between 10% and 20% but higher than that obtained in Netherlands, Sweden, and Denmark which had prevalence below 10%. MRSA rates of 24-30% and 40% were obtained from France and Italy respectively (NIPH, 2003; Wannet et al., 2004; Nester et al., 2004). It was lower than that obtained by Adesida et al., (2016) (20%) and Lemma et al., (2015) (26%). Also, it can be noted that MRSA colonization is generally lower in resource poor countries than you could find in resource rich countries with inadequate health facilities and poor societal attitude towards medical treatment. For instance, the prevalence of MRSA in some countries like the Netherlands is still very low, as low as 1.0% (El-Jalil et al., 2008), while the prevalence of MRSA was reported to be 10% in Tunisia, Malta, and Algeria and about 15% in Kenya, as compared to the high prevalence of 21 to 30% in Cameroon and Nigeria (Emeka-Nwabnnia et al., 2015).

Similarly, the level of hygiene disposition of a populace or society, according to Pathak et al., (2010) could be a factor determining the rate of nasal carriage of MRSA among HIV patients. Perhaps, one possible explanation for the high nasal carriage of *S. aureus* in resource rich countries could be low rates of exposure to antigens due to better personal hygiene. For example, the national nosocomial infection surveillance network (USA), had shown that over 50% of *S. aureus* are MRSA among those in the United States of America, mega rich Asia, with very high

**Plate 2: A Cross Section of MRSA Plates on Muller Hilton Agar**
prevalence observed in Hong Kong (75%) and Japan (70%) and in some part of Europe like Portugal and Italy. While in some other countries, who are not as rich as the aforementioned countries but have a rich culture of hygiene and adhere seriously to infection control measures, records of extremely low prevalence of 2% in Switzerland and 1.0% in Netherlands were observed (Emeka-Nwabunnia et al., 2015).

Nevertheless, this study showed a decline in the mean CD4+ (401 cells/µl – 379 cells/µl) among the population of subjects living with HIV/AIDS, using their previous and current CD4+ count at the time of the collection of samples, indicating a slight reduction in their ability to defend themselves from systemic invaders. This Study further deduced that 37.79% of patients, who underwent this study, were in stage 1 of their HIV/AIDS disease progression, while 38.71% were in stage 2 and 23.5% were already in stage 3. Although, study subjects in stage 2 of their HIV/AIDS disease progression had the highest nasal carriage of MRSA, 6.45%, there was no identifiable explanation as to why it was that way. However, there was observed no significant difference in the number of patients in the stages of HIV infection using their previous and current CD4+ count, which showed MRSA infection. This implies that, there was an equal probability or likelihood of isolating MRSA from persons living with HIV/AIDS irrespective of the level/stage of their disease progression.

Comparatively, the above observation was in line with the position of Shet et al., (2009) that, association between HIV infected patients with MRSA colonization, might not be dependent on CD4+ T lymphocyte count. Also, this study’s mean CD4+ count, supports the findings of Kluytmans (1997), since the mean CD4+ count of the HIV patients used in this study were within the range obtainable in healthy patients. Therefore, This study’s CD4+ results explains the position of Aaron et al., (2017) and Nester et al., (2004) that, progression from asymptomatic infection to AIDS do not come suddenly but in fact occurs as a continuum of clinical stages with symptoms of active HIV infection being non-specific to include fatigue, rash, headache, nausea and night sweats. Nevertheless, the result do not contradict the position of Azuonwu et al., (2010) who suggested that, the clinical stage of AIDS, which is characterized by pronounced suppression of the immune system and development of a wide variety of severe opportunistic infections, is the most predisposed stage to suffering from underlining infections.

CONCLUSION
Staphylococcus aureus that are MRSA continue to evolve in their epidemiology which have led to an increase in colonization and infection of HIV positive population with this organism. This results obtained from this study indicate that MRSA exists in HIV positive subjects attending the University of Port Harcourt Teaching Hospital. Its prevalence is not as high as reported in other studies in this region of Africa but there is need for close monitoring to prevent its trajectory incidence. More MRSA were detected from female subjects than males which was not different from the published report of other researchers in Nigeria, Africa and other parts of the world. This study also established that there was an equal likelihood of isolation of MRSA from people living with HIV/AIDS irrespective of their CD4+ count or the stage of their disease progression.

Authors Contributions
Study design and conception (JPA, NEG and AUU): Sample collection, processing and data collation (JPA): Manuscript write up (AUU and JPA): Data Analysis (AUU): Oversight on all stages of the research (NEG and AM): All authors read and approved the final manuscript.

Conflict of Interest
All authors declared no conflict of interest.
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