Methicillin-resistant Staphylococcus aureus (MRSA) Prevalence at Xavier University: Clinical-attending Students are 2x More Likely to Colonize MRSA

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Methicillin-resistant *Staphylococcus aureus* (MRSA) prevalence at Xavier University: clinical-attending students are 2x more likely to colonize MRSA

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**Abstract.** There is currently little research concerning the prevalence of MRSA colonization among students that attend clinical rotations weekly. Iyer *et al.* reports that as many as 76% of hospital workers may colonize MRSA (2014), and the workers with the highest percentage of colonization have shown to be nurses (Marie-Carmelle *et al.*, 2010). In this study, we analyze the prevalence of MRSA among clinical and non-clinical attending students at Xavier University, in order to determine if clinical-attending students colonize MRSA more frequently than non-clinical students. After providing a consent form and a questionnaire, we tested the hands and nose of 86 students at Xavier University for MRSA colonization, 39 of which were clinical-attending. After incubating mannitol salt agar plates and transferring *Staphylococcus aureus* bacteria onto CHROMagar™ plates, we found that 35% of clinical-attending students and 18% of non-clinical students colonized MRSA. In fact, by an odds ratio, we determined that clinical students were 2 times more likely to colonize MRSA than non-clinical students. From the data we collected, we are able to indicate that nursing students colonize MRSA two times more often than non-nursing students. Our results are specific to Xavier University and they allow us to reiterate the need for nursing students to be knowledgeable about MRSA transmission not only in the hospital among patients, but also on campus among students and faculty.

**Introduction.**  
Methicillin-resistant *Staphylococcus aureus* (MRSA) is a type of staphylococcal bacteria that is multi-drug resistant. Particularly, MRSA is resistant to most β-lactam drugs – penicillin and cephalosporin antibiotics (rev. in. Tenover and Pearson, 2004). Antibiotic resistant genes present in this staphylococcal bacteria, make treating bacterial infections difficult (rev. in. Tenover and Pearson, 2004). Minor MRSA infections can result in pimples or skin boils, but if MRSA progresses, it can lead to large skin lesions, pneumonia, or potentially fatal systemic infections (rev. in. Tenover and Pearson, 2004).

The CDC reports that an average of 1.5% of individuals colonize MRSA on the skin (Gorwitz *et al.*, 2008). It is important to understand that colonizing the bacteria simply means that an individual has the bacteria present on his or her skin. This individuas does not have an active MRSA infection, the colonization state is asymptomatic, but could potentially give themselves an infection or transmit the bacteria to someone else. While most areas of the body can colonize MRSA, there are certain hotspots for bacterial colonization, such as the nose, throat, groin and hands (rev. in Yang *et. al.*, 2010). The primary means of bacterial transmission among healthcare workers is contact transmission (rev. in Rutala and Weber, 2004). Interestingly, despite a high prevalence for contact transmission of bacteria, most studies examining MRSA colonization do not analyze colonization on the hands of individuals, rather focusing on hotspots, such as the nose, throat or groin. It is important for these hotspots to be recognized by healthcare workers in order to understand the role healthcare professionals have in MRSA transmission (Chamchod *et al.*, 2012, Baldwin *et al.* 2009).
Due to the large prevalence of disease and bacteria in clinical settings, it is important for healthcare workers, patients, and students learning in healthcare settings to understand MRSA colonization, transmission, and infection. Primarily a nosocomial bacteria (rev. in Tenover and Pearson, 2004), as many as 76% of healthcare workers may colonize with MRSA in the hospital (Iyer et al., 2014). A hospital study by Marie-Carmelle et al. in 2010 indicates that 11% of nurses and 4% of physicians test positive for MRSA colonization. Similarly, Gruber et al., concludes that 6.2% of nursing home staff colonize MRSA, along with 20.1% of patients (2013). While many studies examine the prevalence of MRSA among healthcare workers, not many examine the potential for MRSA colonization on students learning in healthcare facilities (Berthelot et al., 2004). Students working in clinical settings are typically not at risk for MRSA infection; however, according to Iyer et al., these students are susceptible to colonization of bacteria while learning in clinical settings (2014). Clinical-attending students also may contribute to the transmission of this multi-drug resistant bacterium during their weekly in-class rotations.

In clinical settings, hand sanitizer use has increased significantly in the past decade (rev. in Widmer, 2000). Due to the ease of hand sanitizer use compared to washing hands, hand sanitizer application is often a highly recommended step in healthcare settings (Trampuz and Widmer, 2004). While the use of hand sanitizer may be beneficial for protecting healthcare workers and patients from colonizing and transmitting bacteria, few studies have examined the possible effects of hand sanitizer on clearing the skin of all bacteria, including protective bacteria (rev. in Bloomfield et al., 2006). Similarly, there is little to no literature concerning possible links between MRSA and hand sanitizer use. This is an area of study that we intended to explore only briefly. According to the hygiene hypothesis, an increase in sanitation practices in modern societies may correlate with the increase in allergies shown over the past couple of decades (rev. in Yazdanbakhsh and van Ree, 2002). These studies allowed us to formulate the hypothesis that individuals using hand sanitizer are more likely to have allergies, and, similarly, will colonize bacteria at a higher prevalence.

Finally, another facet our study attempted to examine, was the possible prevalence of MRSA due to the use of athletic facilities. A study done by Ryan et al. indicates that, after 3 separate swabs in various gym locations, none of the gym equipment tested by researchers was positive for staphylococcal colonization (2011). In conclusion to their study, Ryan et al. indicates that transmission of staphylococcal bacteria from gym equipment is not likely. Similarly, a study by Buss et al., concludes that athletes are not typically at a higher risk for MRSA colonization (2009). These studies allowed us to hypothesize that students utilizing Xavier University’s athletic facilities will not have a higher prevalence of MRSA than individuals that do not use these facilities.

In this study, we examined the asymptomatic prevalence of MRSA in the nasal cavity and on the hands of Xavier University students learning in healthcare settings. We hypothesized that students learning in clinical settings would have a higher incidence of both hand and nasal MRSA colonization, while students learning in non-clinical settings would show little incidence of colonization. Despite the CDC’s report that 1.5% of individuals colonize MRSA, we hypothesize that the Xavier student population will colonize MRSA more frequently than this, due to frequent interactions between students studying in non-clinical settings and those frequently studying in clinical locations. The small and unique population on university campuses may contribute to a larger incidence of MRSA colonization.

Understanding the role MRSA colonization has among students on campus can help universities better educate students and faculty about the bacteria’s transmission, and can aid in
the development of preventative strategies concerning the spread of MRSA colonization and infection to both students and patients.

**Materials and Methods.**

*Approval and Consent*

Xavier University’s Institutional Review Board approved of this study. After administering a consent form, hand and nasal bacterial samples were obtained from Xavier University students and a questionnaire was administered, in order to obtain additional data. Each student was kept anonymous through the use of a 4-digit numerical code, which was paired with the questionnaire and collected sample.

*Study Duration and Sample Population*

We collected data from students during the months of October and November. Students were asked to participate voluntarily and the samples we obtained were samples of convenience. We only sampled individuals that were willing to participate, and individuals that were walking through the area we were sampling, during a particular time and day. In order to spread the word about the need for clinical students in our sample, Xavier University nursing students were notified of the day and time that we samples would be collected and were asked to participate. A total of 86 students were sampled, 37 clinical-attending students and 49 non-clinical attending. Approximately one-half of the sampled clinical students were attending rotations in nursing homes, while the remaining were attending rotations in hospitals. Samples were taken from individuals learning in clinical settings within 24 hours of their clinical rotation.

*Questionnaire*

Before sampling each student, a questionnaire was given to collect additional data. The questions applied to both clinical and non-clinical attending students. The questions included: if the student had been to a hospital in the last 72 hours; where the student was attending clinical rotations (nursing home or hospital), and for how many hours per week; how long it had been since the student had entered a clinical setting; if the student used hand sanitizer daily, and at what frequency; and if the student worked out at Xavier University’s O’Conner Sports Center, and how often per week. The results of the questionnaire were filed appropriately and anonymously, according to the predefined 4-digit code.

*Screening for MRSA Colonization*

Hand and nasal samples were taken on mannitol salt agar, prepared by Xavier University’s Biology prep lab, to isolate *Staphylococcus aureus, Micrococcus luteus, and Staphylococcus epidermidis*. Similar MSA could be purchased from Thermofisher (Florence, KY). Nasal and hand samples were taken in order to obtain a suitable sample of *S. aureus*. Samples were taken by having students press each of their fingertips onto a mannitol salt selective agar plate for approximately five seconds (Roy, 2014). Following the fingerprint sample, each student performed a nasal swab by inserting a sterile swab approximately half an inch into each nare and swabbing the inner surface of the nares. The swab was then smeared onto the mannitol salt agar in a predefined area, separate from where the fingerprints were pressed.

*Culturing Bacteria*

Each of the agar plates were then incubated at 37°C for 48 hours. Following incubation, the plates were wrapped in 4” long Parafilm Wrap (Thermofisher, Florence, KY) and stored in the refrigerator until enough were collected for analysis. Each plate was then analyzed for the growth of *S. epidermidis, S. aureus, and M. luteus*, in both the hand and nasal sample regions. *S. epidermidis* grows as white to pink colonies and does not ferment mannitol salt agar. *M. luteus* grows as bright yellow colonies that, like *S. epidermidis*, also does not ferment mannitol salt.
agar. *S. aureus*, however, grows as cream to yellow colonies that do ferment the agar, turning it from red to yellow in the area surrounding the bacterial colony (Roy, 2014). If *S. epidermidis, M. luteus, or S. aureus* were present on the hand or in the nose, the results were recorded with the paired 4-digit code.

Samples positive for *S. aureus* were next transferred, using sterile and aseptic technique, onto BLL™ MRSA CHROMagar™ plates (Thermofisher, Cincinnati, OH). MRSA CHROMagar™ differentiates methicillin-resistant and methicillin-susceptible *S. aureus*. MRSA grows as rose to mauve-colored colonies on the agar (Roy, 2014). To transfer the bacteria, each colony of *S. aureus* grown on the mannitol salt agar was poked with an inoculating needle. The needle was then stuck into the MRSA CHROMagar™ plate in a predefined area, in order to keep track of which sample was being tested. After each stick, the inoculating needle was sterilized via the flame from a Bunsen burner. Next, the MRSA CHROMagar™ plates were incubated at 37°C for 48 hours (Roy, 2014). Following incubation, the plates were analyzed for the presence or absence of MRSA on the hand or in the nose and the results were recorded.

**Statistical Analysis**

Statistical analysis was performed on the categorical variables by means of a $\chi^2$ test. The chi-square critical value was 0.004, and a p-value less than 0.05 was considered statistically significant. Noticeable trends in the data were also reported.
**Results.** Our study surveyed 88 students at Xavier University. Each student in the study provided samples of his or her hand bacteria and a swab of each nare. Of the 88 students sampled, two results were disregarded due to an error in the growth of bacteria on each respective MSA plate. The relevant demographics of our sample population are shown in Table 1.

Of the 86 individuals sampled, 30% colonized *S. aureus*. The colonization sites were distributed on the hands (23%), in the nose (2%), and at both sites (5%). Of the 30% of individuals that tested positive for *S. aureus*, 85% of these strains were determined to be MRSA. In the nose, 100% of individuals with *S. aureus* colonized MRSA; on the hands, 80% of individuals with *S. aureus* colonized MRSA; individuals that colonized *S. aureus* at both sites colonized MRSA at 100% on the hand and in the nose. The overall colonization prevalence in our sample (n=86) was 30% for *S. aureus* and 25% for MRSA. According to an odds ratio, the odds of colonizing MRSA on the hand, if you colonized *S. aureus* on the hand, were 83%. Similarly, the odds of colonizing MRSA in the nose, if you colonized *S. aureus* in the nose, were 100%. The total prevalence on MRSA at each of the colonization sites tested is shown by figure 1. We also tested each individual for *S. epidermidis* and *M. luteus* colonization. *S. epidermidis* colonized 100% of individuals and *M. luteus* colonized 45%. Colonization of *S. epidermidis* and *M. luteus* did not show any relevant trends or significance.

In our sample, 39 of 86 individuals reported weekly clinical rotations, all but 3 of these students were nursing majors. Among the clinical population, 35% tested positive for MRSA. 92% of MRSA-positive individuals colonized MRSA on the hands and 23% colonized MRSA in the

**Table 1.** Demographic characteristics of individuals that participated in the study

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (% of sample population)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student type (n=86)</strong></td>
<td></td>
</tr>
<tr>
<td>Clinical-attending</td>
<td>37 (43%)</td>
</tr>
<tr>
<td>Nursing</td>
<td>34 (40%)</td>
</tr>
<tr>
<td>Non-nursing</td>
<td>3 (3.5%)</td>
</tr>
<tr>
<td>Non-Clinical attending</td>
<td>49 (57%)</td>
</tr>
<tr>
<td><em><em>Location of Clinical (n=39</em>)</em>*</td>
<td></td>
</tr>
<tr>
<td>Hospital</td>
<td>21 (54%)</td>
</tr>
<tr>
<td>Nursing Home</td>
<td>18 (46%)</td>
</tr>
<tr>
<td><strong>Hospital encounter in the last 72 hours (n=86)</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>44 (51%)</td>
</tr>
<tr>
<td>No</td>
<td>42 (49%)</td>
</tr>
</tbody>
</table>

*2 individuals attended clinical in both the hospital and nursing home. Under clinical location, these individuals were counted twice in the population.

**Table 2.** Distribution of MRSA-positive individuals in the sample

![Figure 1. The colonization in the sample according to %]
Of the 39 clinical students sampled, 54% attended clinical in the hospital and 46% attended clinical in the nursing home. The clinical location that reported the highest amount of colonization was the nursing home (44%), followed closely by the hospital (38%), and, finally, non-clinical locations (16%). This data is displayed by figure 2. By chi-squared test, none of the clinical locations tested were considered significant for MRSA colonization (p > 0.05). The demographics of MRSA-positive individuals in this study are shown in Table 2. Students attending clinical locations colonized MRSA more often, in both the hand and nose, than students that were not attending clinical locations weekly. Figure 3 shows this distribution. According to an odds ratio, clinical-attending students are 2x more likely to colonize MRSA than non-clinical students.
Students attending clinical were asked to report how many hours they spent at clinical locations per week. Thirty-nine students reported the hours spent at clinical locations, which ranged from 1-25 hours per week. The distribution of clinical-attending students, according to the amount of time each student reported spending in clinical settings per week, is shown in table 3. Of individuals attending clinical, 33% colonized MRSA. The distribution of MRSA-positive students, who spend 1-25 hours at clinical locations per week, is shown in figure 4. Of the MRSA-positive students, the largest percentage of colonization is seen in individuals that spend 16-20 hours per week in a clinical setting (100%). The second highest rate of colonization occurred in the percentage of individuals attending clinical settings 6-10 hours per week (36%), followed by 1-5 hours per week (27%) and, finally, 11-15 hours per week (20%). There is a positive trend in the data concerning number of clinical hours attended per week and percentage of individuals colonized with MRSA. The bin at 16-20 hours per week may display skewed data, as only one individual reported spending this amount of time in a clinical setting per week.

<table>
<thead>
<tr>
<th>Clinical hours/week</th>
<th>Number of students reporting</th>
<th>% of clinical attending students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>22</td>
<td>56%</td>
</tr>
<tr>
<td>6-10</td>
<td>11</td>
<td>28%</td>
</tr>
<tr>
<td>11-15</td>
<td>5</td>
<td>13%</td>
</tr>
<tr>
<td>16-20</td>
<td>2</td>
<td>5%</td>
</tr>
<tr>
<td>21-25</td>
<td>1</td>
<td>3%</td>
</tr>
</tbody>
</table>

Before testing, surveyed students were asked to report how many hours it had been since they had left a clinical setting. Any individuals that had been in a clinical setting, at most 72 hours before the samples were taken, were recorded. 42 students reported exposure to clinical locations at least 72 hours before testing. The distribution of the total population, according to how many hours since reported students had been in a clinical setting, is reported in table 4. The distribution of MRSA-positive students, who were exposed to a clinical setting at least 72 hours before samples were taken, is shown in figure 5. Individuals that had been in a clinical setting 1-5 and 6-10 hours prior to the sample showed the largest amount of colonization, when compared to 11-72 hours. There is an outlier of high MRSA colonization found within the 26-72 hour bin, where n=3.

Figure 4. The distribution of clinical-attending individuals that colonize MRSA, according to the amount of hours reported in clinical per week (n=39).
Students in the survey were also asked to report how often they were using hand sanitizer per day. Students reported no use (0 times per day), little use (1-2 times per day), moderate use (3-4 times per day), frequent use (5-7 times per day), and frequent use of hand sanitizer (≥8 times per day). The distribution of students reporting hand sanitizer use is shown in table 5. The highest amount of MRSA colonization was seen in individuals using hand sanitizer 1-2 times per day (32%), followed by individuals that reported using hand sanitizer 3-4 times per day (29%). The distribution continues with 5-7 uses of hand sanitizer per day falling at 17% MRSA colonization per total students, and then rebounds to 22% of students colonizing MRSA in the more than 8 uses per day bin. Of the students that reported using hand sanitizer daily (n=72), 24% tested positive for MRSA colonization on the hand, while only 8% of these students tested positive for MRSA colonization in the nose. Figure 6 shows the distribution of hand and nasal colonization. According to an odds ratio, individuals that use hand sanitizer are 30% more likely to colonize MRSA on the hand than those that do not.

Table 5. Distribution of sample population concerning the use of hand sanitizer (n=86).

<table>
<thead>
<tr>
<th>Frequency of Use</th>
<th>MRSA Hand</th>
<th>MRSA Nose</th>
<th>% with MRSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>7%</td>
</tr>
<tr>
<td>1-2</td>
<td>10</td>
<td>4</td>
<td>32%</td>
</tr>
<tr>
<td>3-4</td>
<td>4</td>
<td>0</td>
<td>29%</td>
</tr>
<tr>
<td>5-7</td>
<td>1</td>
<td>2</td>
<td>17%</td>
</tr>
<tr>
<td>8-10</td>
<td>2</td>
<td>0</td>
<td>22%</td>
</tr>
</tbody>
</table>

*3 students in the population tested positive for MRSA on both the hands and in the nose. 2 of these students reported using hand sanitizer 1-2 times per day and the other student reported use 5-7 times per day.
Surveyed students were asked to also report if they had any allergies, seasonal or organism-specific. 40% of individuals surveyed reported having allergies (n=86). When allergy prevalence (n=34) was compared to hand sanitizer use (n=72) per bin, the distribution shown in figure 7 revealed a positive trend. According to an odds ratio, individuals that use hand sanitizer are 2.77x more likely to have allergies than individuals that do not use hand sanitizer. According to a chi-square test, there is no significant difference between individuals using hand sanitizer and having allergies (p>0.05). A comparison of individuals colonizing MRSA to allergy prevalence is shown by figure 8. According to a chi-squared test, a significant different exists between allergy prevalence and percent of individuals colonized with MRSA on the hands (p=0.006).

Figure 7. The distribution of individuals with allergies according to their frequency of hand sanitizer use per day. 0 uses per day (n=13), 1-2 uses per day (n=38), 3-4 uses per day (n=14), 5-7 uses per day (n=12), 8-10 uses per day (n=9).

Another question students were asked was their use of O’Connor Sport Center, Xavier University’s student gym. Of the total population, 63% of individuals reported using the gym on a weekly basis. The distribution of the population comparing MRSA-positive individuals with gym frequency is shown in figure 9 (n=86). There was no evident trend shown comparing the frequency of gym use with MRSA colonization.

Figure 8. Distribution of MRSA positive individuals compared to allergy prevalence (n=86).

Figure 9. Distribution of MRSA positive individuals compared to gym use (number of times per week) (n=86).
Conclusions. According to the CDC, 1.5% of individuals test positive for MRSA colonization (Gorwitz et al., 2008). Our hypothesis did not align with Gorwitz et al. concerning the colonization of MRSA in the present population at Xavier. Our data support our hypothesis that Xavier students will colonize MRSA more often than 1.5%, due to the amount of students that attend healthcare settings weekly and then interact closely with other individuals on campus. In fact, the prevalence of MRSA in our study was 22%. In Gruber et al., 50.7% of 288 individuals test positive for S. aureus, while 20.1% test positive for MRSA (2013). Our study shows a smaller percent difference, with 30% of individuals colonizing S. aureus and 25% of individuals colonizing MRSA.

Iyer et al. reports that 76% of 100 healthcare professionals in the hospital test positive for MRSA colonization (2014). Due to frequent exposure to disease and bacteria within clinical settings, healthcare workers and clinical-attending students are at high risk for colonization (Iyer et al. 2014). Our hypothesis agreed with Iyer that around 76% of individuals participating in healthcare settings would colonize MRSA. While the prevalence of MRSA among clinical-attending students at Xavier is not 76%, our data did support the hypothesis that clinical students would colonize MRSA at a higher rate than non-clinical students. Among clinical students that participated in our study, 33% tested positive for MRSA colonization. An odds ratio revealed that students attending clinical settings weekly were 2x more likely to colonize MRSA than students not attending clinical settings. Of the 33% of clinical students that tested positive for MRSA colonization, 44% tested positive for colonization after attending clinical in the nursing home and 38% tested positive after attending clinical in the hospital. Our results are similar to Elie-Turenne et al., who reports that 41.4% of nurses colonize MRSA in the hospital (2010). In comparison to Gruber et al. and O’Sullivan et al., who found that 6.2% and 8.6%, respectively, of nursing home staff members colonize MRSA, our results show a higher rate of colonization (2013, 2000). When comparing the prevalence of MRSA in both nursing homes and hospitals, our results supported our hypothesis that students attending hospital and nursing home clinical locations would colonize MRSA at approximately the same prevalence. Lee et al. also came to a similar conclusion, suggesting that nursing home residents may contribute to the amount of MRSA prevalence in the hospital, due to frequent trips between the nursing home and hospital for immunocompromised individuals (2013).

Of the individuals attending clinical weekly, a positive trend was suggested comparing the percentage of students colonized with MRSA and the amount of hours spent in clinical per week. There seems to be an outlier at 16-20 hours of clinical participation per week, and this may be due to a small population size in this bin (n=2). It would be interesting to examine the prevalence of MRSA in individuals that spend more time in clinical settings per week than the hours reported in our study. With a greater population size in this regard, data may compare more to the likes of Iyer et al (2014).

In the investigation of MRSA colonization among healthcare professionals, Iyer et al. reports 73% colonization of the anterior nares among 100 tested healthcare professionals (2014). Similarly, in a study by Bitterman et al., 70.5% of 1,800 individuals test positive for nasal colonization of MRSA (2010). MRSA can colonize at many sites on the skin (Yang et al., 2010); however, the two most accessible sites that we tested were the hand and nose. Our initial hypothesis agreed with the studies done by Iyer and Bitterman, however, our data did not support our hypothesis that individuals would colonize MRSA more frequently in the nose than on the hand. In our study, we observed that both clinical and non-clinical individuals (n=86) colonized MRSA more often on the hands (22%) than in the nose (7%).
Our data suggest that a positive trend exists between the frequency of hand sanitizer use per day and the prevalence of MRSA colonization. This trend, however, was not indicated significant by chi-square test (p>0.05). We also may not be able to trust the validity of the positive correlation, as students in healthcare facilities are using hand sanitizer often between patients, and MRSA colonizes with the largest prevalence nosocomially (Iyer, et al., 2014). Yet, this data could possibly indicate that a more frequent clearing of the skin’s good, protective bacteria (S. epidermidis), through the use of hand sanitizer, the more likely it may be for individuals to colonize potentially infectious bacteria. Our data aligned with our hypothesis that individuals using hand sanitizer more frequently would colonize bacteria at a higher prevalence. This data has the potential to suggest a future study concerning hand sanitizer and bacterial colonization.

MRSA colonization was also compared to the percentage of students with allergies. No clear trend emerged comparing these two variables; however, by chi-square test, the p-value was considered statistically significant between MRSA colonization and students with allergies (p=0.006). While comparing individuals with allergies and hand sanitizer use, an odds ratio determined that individuals using hand sanitizer are 2.77x more likely to have allergies than individuals not using hand sanitizer. This data suggests ideas for a future study concerning allergies, bacterial colonization, and hand sanitizer use.

While analyzing the data for student use of Xavier University’s workout facility, O’Connor sports center, no trends were suggested with increased use of the facility and prevalence of MRSA. This data aligned with our hypothesis that individuals using gym facilities colonize MRSA at about the same rate as individuals who do not use these facilities. Our data agree with the conclusions suggested by Ryan et al., which indicate that gym equipment does not test positive for MRSA colonization, thus, individuals using gym facilities were not likely to acquire MRSA bacteria from the gym (2011).

Potential flaws in the execution of our study could possibly include improper use of sterile technique while conducting surveys, collecting data, and transferring S. aureus positive bacteria from MSA to CHROMagar™ plates. Many individuals taking the survey before their hand sample was taken also used the same pens to fill in the survey. We may have initiated some transmission of bacteria in this manner. In a future study, we might suggest that the researchers provide each student with his or her own pen to complete the survey.

Our study was limited by convenience sampling. We only sampled individuals that volunteered to be tested during a specific time frame. It is possible that we may have not returned results that accurately portray the total of Xavier University’s student population or clinical student population. For future studies, we might suggest that the samples acquired for analysis represent a larger population of clinical-attending and non-clinical-attending students. In other future studies, we also suggest analyzing the potential correlation between hand sanitizer use and allergy prevalence, with particular emphasis on the Hygiene Hypothesis.

From the data we collected, we are able to indicate that nursing students colonize MRSA two times more often than non-nursing students. Our results are specific to Xavier University and they allow us to reiterate the need for nursing students to be knowledgeable about MRSA transmission, not only in the hospital among patients, but also on campus among students and faculty.

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**Literature Cited.**


