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What is the Prevalence of MRSA Carriers in the McPherson College Student Population?

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ABSTRACT

Methicillin-resistant *Staphylococcus aureus* (MRSA) has primarily been known as a hospital-acquired infection. However, recent studies have shown that community-acquired MRSA has begun its transmission. There is limited research regarding community-acquired MRSA, therefore, this study looks to examine its prevalence in the McPherson College population. Samples were acquired in the student union during the lunch period, where 200 full time students were randomly selected. Analysis of the samples occurred in a three step process, beginning with initial collection of fingerprints onto Mueller Hinton agar with oxacillin. Colonies were then transferred to mannitol salt agar. Positive tests were Gram stained and considered MRSA if they produced gram positive cocci. Upon sample collection, participants were asked to complete a short survey to assess the population and identify possible risk factors for transmission. The statistical significance of the correlations was assessed using chi-squared analysis. From the samples collected, 9.5% of the population were carriers of MRSA. There was a possible correlation between increasing age and an increased risk for being a carrier; however, these results were not significant. A significant difference was detected between residences, specifically for Metzler and Off-Campus residents. The remaining five categories yielded no significant data. The prevalence of MRSA carriers for the college was much higher than previous reports on community-acquired MRSA. These results suggest that transmission is on the rise, particularly in this setting. Further research on this topic could be done in different settings such as jails, sports facilities, and other colleges. Similarly, inanimate objects could also be tested in an effort to identify fomites. In addition, nasal swabs could be used as another mode of acquiring samples.

Keywords: *epidemiology, isolation & purification, Methicillin-Resistant Staphylococcus aureus, MRSA, Prevalence, Staphylococcal infections*

INTRODUCTION

In the world, microorganisms are all around us. We often underestimate their existence, as not being able to see them with the naked eye sometimes allows us to dismiss them from thought. But despite their small size, they can have significant effects on other organisms and on the environment in which we live. Antimicrobials, therefore, have proved to be one of the greatest contributions to modern medicine. However, many microbes developed antibiotic resistance very quickly, forcing researchers to create bigger and better antibiotics. *Staphylococcus aureus* is an infectious bacterium that can have catastrophic effects if not treated. This bacterium has become drug resistant and is constantly working to become resistant to the next antibiotic. Researchers are persistently working to stay ahead of the game, as this powerful bacterium spreads quickly in our health care system and has now found its way in to the community.

It is estimated that 20% of the human population are carriers of *Staphylococcus aureus* (Reygaert, 2009). Other sources indicate the number to be even larger, at 25% to 30% of the population. Although this is a startling number of people, being a carrier does not mean that infection has occurred. As a carrier, one may exhibit no signs or symptoms of infection because the MRSA strain is only colonized on the outside surfaces of the body. Consequently, carriers can spread their colonization to others that are more susceptible, and infection can occur. In order to combat *Staphylococcus aureus* infections, antibiotics were used at an alarming rate, allowing the bacterium to create resistance. In addition, not finishing the entire prescribed antibiotic can produce resistance. Methicillin-resistant *Staphylococcus aureus* now describes the antibiotics to which this bacterium has created resistance: amoxicillin, oxacillin, penicillin, and methicillin (Many, 2008).

The first cases of methicillin-resistant *Staphylococcus aureus* (MRSA) emerged in the 1960s, and rose to be a concern as we reached the 1980s and 1990s, making it the most prevalent gram-positive antibiotic resistant bacterium (Hawkey, 2008). Recent studies have shown the prevalence of MRSA in prehospital and hospital settings. Merlin, et al. (2009) chose to determine the pervasiveness of MRSA on the stethoscopes of emergency medical services providers. Of the fifty stethoscopes tested, sixteen turned out to be positive for MRSA. In the past, the majority of MRSA transmission has occurred in hospital settings. However, community-acquired MRSA has begun its transmission in the United States. Examples include jails, where inmates have assisted in transmission, and sports facilities

(Hawkey, 2008). In fact, the Leicester Royal Infirmary Trauma Unit reported that 3.2% of their unit admissions were carriers of MRSA (Shukla, et al., 2009).

Currently, the research concerning community-acquired MRSA carriers is limited, and much can be done to understand its prevalence more fully. In addition, there is very little knowledge of the risk factors associated with MRSA carrier transmission in the community. The purpose of my research, therefore, is to examine these aspects in regards to the McPherson College student population. Students will be sampled by pressing their fingers onto Mueller Hinton agar with oxacillin. At the time of sampling, a series of nine questions will be asked of the subject to identify possible risk factors. Positive results will then be tested with mannitol salt agar and Gram staining procedures to ensure that the resistant organism is indeed *Staphylococcus aureus*. Only when we understand the prevalence of methicilllin-resistant *Staphylococcus aureus* (MRSA) in our community can we begin to control its spread.

MATERIALS AND METHODS

The goal of this study was to determine the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) carriers in the college community. Subjects were chosen from the McPherson College student population, all of which were considered to be current full time students. This was done to ensure that the results would be appropriate and applicable when evaluating the McPherson College student population at large. The subjects were chosen in the McPherson College student union during the lunch period. Participants were informed of the procedures both verbally and in writing prior to the start of the study. Due to a campus size of only 543 students, 200 subjects were chosen for the study to represent the McPherson College student population.

Testing was conducted in increments of forty persons, which resulted in five groups of participants. These groups were analyzed in succession of one another, allowing for adequate time to accomplish the necessary procedures. To complete the study, samples were taken through a three step process. Upon conclusion of data analysis, participants were informed of their individual results. Those that were identified as MRSA carriers were given the proper materials to increase their awareness of MRSA in the community at large.

Prior to sampling, each participant was asked to complete a short survey. The questions were designed to provide the researcher with a greater knowledge of the population. In addition, the questions were used in an attempt to find correlations between MRSA carriers and possible risk factors. The survey asked for a person's name, age, and gender, along with more specific MRSA related questions. This was in regards to involvement with an athletic team, the person's job, hospitalization within the last year, the student's residence, and whether a person has known to have had *Staphylococcus aureus* or methicillin-resistant *Staphylococcus aureus* (MRSA). A final question asked subjects whether or not they have heard of MRSA as an assessment of the population's awareness.

In order to acquire the samples, plates were prepared with the MRSA screening techniques recommended by the Centers for Disease Control and Prevention (2007). The chosen technique required Mueller-Hinton agar with 6 µg/ml of oxacillin. Difco Mueller Hinton agar was used, and the oxacillin sodium salt was purchased from the Sigma-Aldrich company. The agar was also to be supplemented with NaCl at a concentration of 4% w/v. After preparation of the plates, participants were instructed to press their fingers onto the agar. The samples were then incubated at 37°C for 72 hours (Merlin, et al., 2009).

After the initial incubation period was complete, the plates were assessed as to whether or not colonization had occurred. If there was distinct colonization, the test was considered positive. Positive tests were then taken to the second step of the procedure. In this step, the antibiotic resistant growth was transferred on to plates with Difco mannitol salt agar. These plates were incubated for 24-48 hours at 37°C. Positive tests on the mannitol salt agar were indicated by the red colored agar turning yellow. This meant that mannitol was fermented, inferring growth of *Staphylococcus aureus*. The growth on these plates was then transferred to slides by smear preparation. The four step Gram staining procedure was then used for the specimens on the slides. Samples were identified as MRSA if the slides were Gram positive clusters of cocci (Harley, 2007).

After completing the data collection, correlations were investigated between those persons that tested positive as MRSA carriers and the questions asked on the survey. The statistical significance of the correlations was assessed using chi-squared analysis.

RESULTS

From the Gram staining procedure, two different results were found. There were Gram negative rods as well as the Gram positive cocci. Of the positive samples from the mannitol salt agar, 16 were Gram negative rods. These samples were considered negative for data analysis, and only the Gram positive cocci were evaluated as positive tests.

The procedure resulted in a total of 19 positive tests. This meant that 19 out of 200 of the participants were carriers of MRSA. Therefore, the

Table 1. Proportions and percentages for risk factor categories and subcategories.

Age	**18**	**19**	**20**	**21**	**22+**
	3/34=8.82%	2/41=4.88%	5/52=9.62%	5/52=9.62%	4/21=19.05%
Dorms	**Bittinger**	**Dotzour**	**Morrison**	**Metzler**	**Off-Campus**
	1/36=2.78%	5/78=6.41%	1/18=5.56%	7/39=17.95%	5/29=17.24%
Sports	**Athletes**	**Non-Athletes**			
	8/121=6.61%	11/79=13.92%			
Gender	**Male**	**Female**			
	11/99=11.11%	8/101=7.92%			
Hospitalization	**Yes**	**No**			
	2/37=5.41%	17/163=10.43%			
Had MRSA	**Yes**	**No**			
or Staph	2/12=16.67%	17/188=9.04%			
Heard of	**Yes**	**No**			
MRSA	8/66=12.12%	11/134=8.21%			

prevalence of MRSA carriers in the McPherson College student population was 9.5%.

With the positive data collected, analysis was completed using the chi-squared test. In this case, P-values of less than 0.050 are considered significant, indicating differences due to more than random chance alone. Proportions and percentages for the categories can be found in Table 1.

The first category of suspected correlations was age. This category was split into five groups, which are listed in the table. A chi-squared value of 3.625 was found with four degrees of freedom. This resulted in a P-value of 0.514, indicating no statistical significance. However, the proportions suggested an increase in prevalence with an increase in age. Therefore, linear regression was done to test this assumption. Although there was only an R^2 value of 0.583, the linear regression passed both the normality and constant variance tests, with values of 0.536 and 0.050, respectively. The power of the performed test, however, was 0.295, which meant that the chosen test would not necessarily detect a difference even if one existed. This was well below the desired value of 0.800. In addition, the F stat of 4.187 was not sufficient, resulting in a P-value of 0.133, demonstrating no statistical significance. To have statistically significant results from the data given, an additional 25 to 30 age groups would be needed.

For the student's residence, there were five different categories based upon the close proximity of living conditions. These categories of dorms are listed in the table, which resulted in a chi-squared value of 9.673 with four degrees of freedom. A P-value of 0.046 was statistically significant, and showed that there was a significant difference between the different subcategories.

Next, the chi-squared analysis was done concerning gender. With one degree of freedom, a chi-squared value of 0.279 was determined. A P-value of 0.597 suggested that there was no significant difference between males and females. Due to the large number of athletic teams, the results were spread out and therefore produced no statistical significance. The chi-squared value was 7.637 with 12 degrees of freedom, and had a P-value of 0.813. When comparing athletes with non-athletes, there was a chi-squared value of 2.183 with one degree of freedom. A P-value of 0.140 indicated that there was no statistical significance in this category. In regards to hospitalization for the previous year, there was a chi-squared value of 0.397 with one degree of freedom. A P-value of 0.528 showed no statistical significance. When referring to prior history of having MRSA or *Staphylococcus aureus*, a chi-squared value of 0.134 with one degree of freedom was obtained. A P-value of 0.715 showed that history of these infections was not an indicator for current conditions. Finally, whether or not the participant had heard of MRSA produced a chi-squared value of 0.398 with one degree of freedom. The P-value for this category was then 0.528.

DISCUSSION

The main objective for this study was to determine the prevalence of MRSA carriers in the McPherson College student population. A prevalence of 9.5%

seems rather high in comparison with other studies regarding community-acquired MRSA. This number was almost three times larger than the number reported by the Leicester Royal Infirmary Trauma Unit of 3.2%. Although the samples were not taken in the community, results were obtained upon admission, which meant that the MRSA strains had been colonized prior to entrance. This suggests that community-acquired MRSA is on the rise, particularly when compared to this setting.

When analyzing the specific risk factors for MRSA transmission, few categories produced significant results. However, there was a possible trend with increasing age and significant differences between residences. The results suggest that the higher a person's age, the more likely they are to be a carrier of MRSA. In addition, we can observe that Metzler and Off-Campus residents had a much higher likelihood of being carriers.

Much can be done to obtain a greater knowledge of community-acquired MRSA. Testing could be done on a larger scale, acquiring more samples in different communities. A recent study of Texas State University-San Marcos students reported a MRSA carriage rate of 7.4% (Rohde, et al., 2009). These results indicate consistency between college populations, however, further testing should be done to confirm this trend. Also, samples could be obtained from jails and sports facilities to determine the prevalence in those settings. Another mode of testing could be used instead of fingertips, such as nasal swabs. Conversely, inanimate objects could also be tested in an effort to identify fomites

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LITERATURE CITED

Harley, J.P.. 2007. Smear Preparation and Gram Staining. pp. 40-48 In Laboratory Exercises in Microbiology, 7th ed..

Hawkey, P.M.. 2008. Molecular epidemiology of clinically significant antibiotic resistance genes. British Journal of Pharmacology 153:406-413.

Centers for Disease Control and Prevention. 3 Oct. 2007. Laboratory Detection of: Oxacillin/Methicillin-resistant *Staphylococcus aureus*. http://www.cdc.gov/ncidod/dhqp/ar_lab_mrsa.html (2 Sept., 2009).

Many, P. 2008. Preventing community-associated methicillin-resistant *Staphylococcus aureus* among student athletes. The Journal of School Nursing 24:370-378.

Merlin, M.A., M.L. Wong, P.W. Pryor, K. Rynn. 2009. Prevalence of methicillin-resistant *Staphylococcus aureus* on the stethoscopes of emergency medical services providers. Prehospital Emergency Care 13:71-74.

Reygaert, W. 2009. Focus: Methicillin-resistant *Staphylococcus aureus* (MRSA): Introduction. Clinical Laboratory Science 22:109-110.

Rohde, R.E., R. Denham, A. Brannon. 2009. Methicillin Resistant Staphylococcus aureus: Carriage Rates and Characterization of Students in a Texas University. Clinical Laboratory Science 22:176-184.

Shukla, S., M. Nixon, M. Acharya, M.T. Korim, R. Pandey. 2009. Incidence of MRSA surgical-site infection in MRSA carriers in an orthopaedic trauma unit. Journal of Bone and Joint Surgery 91:225-228.