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What is the Prevalence of MRSA in an Elementary School Setting Compared to a Hospital Setting?

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ABSTRACT

Staphylococcus aureus and more specifically Methicillin-Resistant *Staphylococcus aureus* (MRSA) was once known to be a hospital acquired bacteria. MRSA has now been found in community settings that can pose as a problem for controlling the bacteria. This study was done to determine the prevalence of MRSA in an Elementary school setting compared to a Hospital setting. There were 100 samples collected from the Elementary school and 91 samples collected from the Hospital all of inanimate objects. The testing of the samples were done using Mannitol Salt Agar containing oxacillin for the growth of the bacteria, and then a Gram staining procedure to confirm if the bacteria from the plates were Gram positive or negative. The plates of agar were then distributed into two different groups, yellow plates and pink plates. The yellow plates were assumed to be positive for MRSA and the pink plates were negative. Samples from one yellow plate and one pink plate were then sent to Molecular Epidemiology Inc. where the bacteria were confirmed to be MRSA and *Corynebacterium mucifaciens*. Next, a chi square analysis was done to determine the significant difference between the two different sites tested. The value 23.03 calculated, was greater than the critical value 3.84, therefore the number of positive results was not due to random chance alone. The statistical test showed that 49% out of the total Elementary samples tested positive, 74% of all positive results from both sites were from the Elementary school, and 32.6% of the 178 samples taken tested positive for MRSA. The results show that MRSA is present in communities but it does not affect everyone. The 32.6% was lower than the numbers found in similar studies done. The spread of MRSA can be prevented by simply washing hands and keeping open cuts and scrapes clean and covered.

Keywords: *Community acquired MRSA, gram negative and positive, isolation, methicillin-resistant Staphylococcus aureus, prevalence.*

INTRODUCTION

Care facilities and hospitals are a source for many different kinds of bacteria that cause infections that are spread from one person to another. Because bacteria are extremely hard to see with the naked eye, we are unaware of them lurking all around us. Hospitals have been battling Methicillin-resistant *Staphylococcus aureus* (MRSA) since it was first identified in 1960's (Capriotti, 2003). This nosocomial microbe (HA-MRSA) is a very serious problem in intensive care unit patients, due to the open wounds and contact with doctors and nurses, who may transfer the bacteria from patient to patient. Not only is this affecting healthcare facilities, it has now made its way into the community as well.

MRSA has become a community acquired (CA-MRSA) infection, meaning that it has now spread its colonies from hospitals into public facilities and also nursing homes. MRSA is defined as community acquired if the MRSA-positive specimen was obtained outside hospital settings or within two days of hospital admission, or if it was from a person who had not been hospitalized within two years before the data of MRSA isolation (Salmenlinna, 2002). MRSA is a type of staphylococcal bacteria that is resistant to methicillin and other antibiotics. The infection occurs more frequently in people who have a weakened immune system and a history of hospitalization or nursing home residence within the past year (Weber, 2008). The problem that has kept researchers and medical facilities active is how quickly MRSA has developed a resistance to antibiotics.

Currently, MRSA is resistant to amoxicillin, omacillin, penicillin, and methicillin (Jost, 2010). What makes the bacteria resistant to the current antibiotics is its ability to develop a new genetic makeup that allows the bacteria to grow and reproduce over the antibiotic. Researchers are working to eliminate the bacteria's ability to develop resistance to antibiotics by suggesting that selection and administration of antibiotics be efficient and used correctly (Weber, 2008).

There is little knowledge about community acquired MRSA (CA-MRSA). Therefore, my project goal is to test the prevalence of MRSA at McPherson College as well as Eisenhower Elementary School at different locations. Other studies, involving MRSA, have been done by fellow students. A previous student at McPherson College had designed a study that tested McPherson students, using their fingerprints, to determine if a person was positive for being a carrier of MRSA (Jost, 2010). Jost was able to calculate the number of carriers on campus and proposed ways to prevent infections to others. The study I have designed will help to provide a better

understanding to the spread of MRSA not only from organism to organism, but through affected surfaces as well, in a hope to prevent a further spread.

MATERIALS AND METHODS

The purpose of this study was to determine the prevalence of MRSA (Methicillin-resistant *Staphylococcus aureus*) in communities through two different schools. The two locations chosen for this study were Eisenhower Elementary, primarily because the school was familiar to the researcher and it was similar in size to the Melhorn Science Hall, located on McPherson College's campus that was used for the second location. The principal, as well as the custodian of the elementary school were informed of the study and all details involving the sampling. There were approximately 100 samples taken from similar locations in Melhorn and Eisenhower.

The testing was done over a four month period that allowed enough time to sufficiently collect all the samples and analyze them. To collect the samples in Melhorn, the work was divided between a fellow researcher, who was also testing for MRSA in the same location. This took one month to complete. The samples taken at Eisenhower were done over two different days that allowed a separation between samples when isolating and gram staining.

The sites that were chosen within the Elementary school and College settings needed to have a great amount of contact with people daily. In this study, door knobs, hard surfaces, bathrooms, and a computer lab were used as the testing sites (Shanks, et al., 2009). In order to obtain the samples, Nutrient Broth was made the day before with swabs that were autoclaved, to ensure the broth and the swabs were sterile so other bacteria and outside factors did not contaminate the study. The Nutrient Broth was suggested instead of a saline solution to simplify the sampling process. The Nutrient Broth (13 g/ 1 L) provided an environment for any bacteria that was collected to grow. The techniques used in this study for gathering the samples were used by the Department of Biology and Health Sciences of Pace University (Shanks, 2009). Each sample was retrieved with a sterile swab soaked with nutrient broth, rotating the swab across the same size of area each time. There were three-five sites within each location that were swabbed (Montgomery, et al., 2010). The swabs were then placed back into the sterile broth and placed in the incubator at 37°C for 48 hrs. After 48 hours of incubation, the mannitol salt agar was made and put into the plates. The agar was measured out in g/ml and then placed in to a beaker of water that measured in millimeters. The beaker with the agar and water was placed on a hot plate, where the solution was mixed with a stirring rod and heated with the hot plate. Once the solution started to boil, the beaker was then taken off of the hot plate and was covered with tin foil. Next, the beaker was put into an autoclave for 50-55 min at a temperature of 250°F ~ 121°C. After the agar was autoclaved, it was left to cool in an incubator set at 45°C for 45 min and then the oxacillin was added to the agar and the plates were poured. BBL mannitol salt agar plates were made (111g/ 1L) and mixed with 6 µg/ml of oxacillin sodium salt, then the samples were transferred to the plates and incubated at 37°C for 24-48 hours.

After the plates had been incubated the bacterial colonies and changed the color of the agar from red to yellow, this proved the bacteria to be MRSA positive. The plates that were a brighter pink with bacterial growth are presumed to be negative for the MRSA bacteria. The plates were then grouped in to yellow and pink plates. From the two groups only one plate from each group was used for the isolation and gram staining procedures. The isolations were done using a Ni-chrome wire loop that was heated with a Bunsen burner to help insure that no other bacteria were transferred to the plates. A single colony was transferred from the growth plate to another plate that contained the same mannitol salt agar and oxacillin mixture. The isolations were then incubated at 37°C until growth appeared. The red color of the agar for the isolations again turned yellow for the positive MRSA and bright pink for the negative MRSA. These isolations were gram stained using crystal violet, alcohol decolorizer, iodine solution and safranin solution, to check for the purple, cocci shape bacteria. The slides were done using a four step Gram staining procedure (Jost, 2010).

Once all the data were collected and assessed for the areas that tested positive for MRSA, the statistical analysis was evaluated using the chi square goodness of fit test.

RESULTS

The Gram staining procedure provided two different results. There were Gram positive, purple colored, cocci, and Gram negative, pink colored, rod shaped. The main difference between the two Gram bacterium is due to the structure of the bacterial cell wall. Gram positive bacteria have a cell wall containing a thick layer of peptidoglycan that allows the crystal violet to penetrate the bacterium during the staining procedure but also keeps the solution from escaping or being washed out. In Gram negative bacteria, the cell walls lack the peptidoglycan which makes it impossible for the crystal violet to stain the bacterium and this is why they stain pink from the final safranin stain.

There were a total of 91 samples taken from the McPherson College Melhorn Science Hall, and a total of 100 samples from Eisenhower Elementary School. Accounted for in the number of yellow agar plates vs.

the pink plates in the Elementary samples, there were 43 yellow plates, and 44 pink plates. Out of the 100 samples there were 13 plates that were not applicable due to no growth or the growth of a fungus that consumed the plates. Therefore, 87 plates were used for the testing. The samples from the Elementary School, both the yellow and pink plates, were sent to Molecular Epidemiology Inc. for testing along with the samples from another student who tested a Hospital for MRSA. Due to the mishap with the Melhorn samples, we were unable to have the samples taken from the College, tested due to the mistake of letting them sit for months after the isolations and Gram stain tests were completed, so they have been disregarded and the Elementary results were compared to the Hospital results done by a fellow student. There were 91 samples taken from the Hospital site.

Table 1. Shows the totals and percentages of MRSA

Locations	(+) MRSA	(-) MRSA	Total # of Samples
Elementary School	43 49%,74%	44 50%,36%	87
Hospital Setting	15 16%,25%	76 83%,63%	91
Total # of Samples	58 32.6%	120 67.4%	178

The results from Molecular Epidemiology Inc. showed the yellow plates tested positive for *Staphylococcus aureus*, and the pink plates were *Corynebacterium mucifaciens*. The results are shown in Table 1. Out of the 87 samples taken from the Elementary school, 49% of the samples were positive for MRSA and 50% were negative for MRSA. The samples from the Hospital showed that 16% of the 91 samples were positive and 83% were negative. When you look at the total positive results found, 74% of that total is from the Elementary school alone, and only 36% account for the total of negative results found between the two different locations. The percentage for the total number of surfaces testing positive out of 178 total samples was 32.6% of all surfaces, tested positive for MRSA. The chi square analysis performed had a value of 23.03, with one for the number of degrees of freedom. This value of 23.03 was much greater than the critical value of 3.84 therefore this means that the number of positive results was not due to random chance alone.

DISCUSSION

The point of this study was to determine the prevalence of CA-MRSA in both an Elementary school and Hospital setting on inanimate objects.

In a similar study, done at nine different secondary school settings, Montgomery (2010) tested surfaces in athletic health care facilities for MRSA. He found 46.7% of all surfaces tested positive for MRSA and also that 90% of facilities had two or most surfaces showing positive results (Montgomery, 2010). In comparison to the study done with the Elementary school and Hospital, 32.6% was lower but close to the percentage they found of all surfaces testing positive for MRSA. The comparison to the study performed, at the facilities sampled things such as; water coolers, treatment tables, locker room sink and shower faucet handles, moist heat units, biohazard containers, ice machine, and doorknobs in and out of the facilities. The handles to the sink faucets resulted in testing positive for 50%. There were 10 different doorknobs that were samples as well and none of them tested positive for MRSA.

This study showed that MRSA is present in communities like schools and Hospitals. However, this does not mean that everyone is at a high risk of getting the bacteria. Students with weak immune systems are more likely to acquire the bacteria as well as those with open and unattended cuts and scrapes. The bacteria are present and should be made aware to the community so the bacteria can be controlled and not allowed to spread.

Ways to prevent the spread of the CA-MRSA involve the simple task of washing hands. According to the CDC (Center for Disease Control) avoid coming into contact with others wounds and bandages, keep cuts and scrapes clean, and do not share personal items like towels and razors. They also suggest that you keep all surfaces within a high traffic area disinfected and kept clean.

This study could also be done at any facility where there is a high traffic area like cafeterias, libraries, weight rooms, gyms etc. Jost suggested that Testing for MRSA through a nasal swab is another method that could be used. In her study she also concluded that MRSA carriers are more common in older persons. Testing inanimate objects and or places were elders are found on a common bases of some sort may result in an increase of MRSA findings.

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