Feature Article

Preventing Community-Associated Methicillin-Resistant *Staphylococcus aureus* Among Student Athletes

Patricia S. Many, RN, MS

Methicillin-resistant *Staphylococcus aureus* (MRSA) was once thought to be a bacterium causing infections in only hospitalized patients. However, a new strain of MRSA has emerged among healthy individuals who have not had any recent exposure to a hospital or to medical procedures. This new strain is known as *community-associated MRSA*. Studies have shown the rates of MRSA infection are increasing throughout the United States and that some populations are at greater risk of acquiring these infections. One population at greater risk is athletes. Educating student athletes, parents, coaches, and administrators about the seriousness of this infection and how to prevent and manage it in the school setting is an important role of the school nurse. The goal of this education is to prevent the spread of MRSA organisms, thereby reducing student absenteeism and the related costs of treating MRSA infections.

Keywords: MRSA; student athletes; hand washing; school nurses; health education; disease prevention

There is growing concern about methicillin-resistant *Staphylococcus aureus* (MRSA) infections among healthy children, prompting schools and parents to look for ways to protect children. The true prevalence of community-associated MRSA infections is unknown, but studies have demonstrated that the number of MRSA infections is increasing throughout the United States in various settings. Athletes are among the groups identified as being at increased risk of contracting community-associated MRSA (Centers for Disease Control and Prevention [CDC], 2005a). Infections among high school, college, and professional athletes have been documented, illustrating the growing problem among this population. School nurses play an important role in educating the school community about disease prevention and control measures to protect students from MRSA. The purpose of this article is to provide background information about MRSA, identify groups at risk, and discuss strategies the school nurse can implement to prevent and manage this infection in the school setting and among student athletes.

BACKGROUND

Staphylococcus aureus (staph) is a bacterium that is often carried on the skin and in the nares

Patricia S. Many, RN, MS

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of healthy people. At any given time, 25% to 30% of the population can be carriers (CDC, 2005b). Typically, this carrier stage, known as colonization, does not cause an infection. In fact, people can go unrecognized as being colonized with staph bacterium and pass it to susceptible contacts (Muto et al., 2003). At other times, this bacterium can lead to acute infections. According to the CDC (2005b), staph bacterium is one of the most common causes of skin infections in the United States. Most of these are minor infections resulting in boils and pimples that can be treated without antibiotics. In settings such as hospitals, more severe infections can occur when staph bacterium is introduced into the bloodstream through intravenous catheters, surgical sites, and the respiratory tract.

Over time, staph bacterium has become resistant to some categories of antibiotics, for a variety of reasons. First, antibiotics have been overprescribed or inappropriately prescribed to treat viruses. Second, many times people prematurely stop taking a prescribed antibiotic as soon as they start feeling better. This results in the bacterium not being totally eradicated, and thus, it grows back stronger and eventually resistant to the antibiotic. When staph bacterium becomes resistant to antibiotics such as amoxicillin, oxacillin, and penicillin, it is known as methicillin-resistant *Staphylococcus aureus,* or MRSA (CDC, 2005a).

MRSA infections occur most often among individuals who are hospitalized, who are in long-term care facilities, or who are immunocompromised. The types of MRSA infections commonly seen in these populations include infections of surgical wounds, the urinary tract, and the bloodstream, or pneumonia, due to invasive treatments and procedures performed at these facilities (CDC, 2005b).

MRSA infections can also occur outside of these facilities. Infections that develop in the community usually manifest as skin infections such as pimples and boils. MRSA infections that occur in people without a history of MRSA and those who have not been hospitalized, who have not been in a long-term care facility, or who have not had any medical procedure in the previous year are known as *community-associated MRSA* (CDC, 2005a). The strains of MRSA acquired in the community are different than the MRSA strains seen in hospitalized individuals. Community-associated MRSA has been shown to be more virulent than the hospital strain, spreading more easily and causing more soft-tissue infections (CDC, 2005a). This can be problematic if health care providers do not consider MRSA as part of the differential diagnosis when assessing a healthy young person with a skin infection. This delay in the recognition of a resistant organism prolongs its communicability and often leads to an increased severity of the infection (CDC, 2003b). Early identification by health care providers is important so that proper treatment can be implemented (CDC, 2005a).

Prevalence

In most states, MRSA is not a reportable disease unless there is an outbreak; therefore, the true prevalence remains unknown. However, studies have shown that the rates of MRSA infections are increasing throughout the United States. For this reason, it is difficult to identify individual cases and accurate rates of MRSA, although reports such as those noted in the following section suggest that MRSA infections are increasing among all populations and settings.

A population-based study from 1993 to 1999 at a San Francisco hospital and associated clinics indicated that community-associated MRSA rates are increasing. The inclusion criteria for this study consisted of persons who had no identified risk factors for MRSA, such as a recent medical procedure, and who had a diagnosis of MRSA confirmed with a wound culture, thereby meeting the definition of *community associated*. The study did not provide the total number of people enrolled in the study; however, findings indicate wound cultures positive for community-associated MRSA had increased from 7% in 1993 to 29% in 1999 (Shukla, 2005).

Moran, Amii, Abrahamian, and Talan (2005) found that community-associated MRSA was the most common pathogen among patients with soft-tissue infections at a Los Angeles emergency room. This emergency room sees approximately 43,000 persons annually. All outpatients enrolled in this study ($n = 96$) were 18 years or older and had draining soft-tissue infections. Patients were excluded if their wounds did not require antibiotics or if the wounds were so severe that they

required amputation. The study found MRSA in soft-tissue wounds for 14 of 49 patients (29%) from 2001 to 2002 and in 30 of 47 patients (64%) from 2003 to 2004.

Fridkin and colleagues (2005) identified the number of community-associated MRSA infections from a population-based survey. The settings for this study were hospitals in Baltimore and Atlanta and 12 laboratories in Minnesota from 2001 to 2002. The rate of infections caused by this organism varied by facility, finding that between 8% and 20% of all isolates were community-associated MRSA. However, the study concluded that community-associated MRSA is now a common and serious problem causing soft-tissue infections, especially among children.

Risk Factors

In addition to the data from large population-based studies, the CDC has investigated clusters of MRSA skin infections among various groups, including athletes. The prevalence of community-associated MRSA among athletes is unknown; however, data from the population-based studies suggest that infections caused by MRSA are on the rise, regardless of the setting. Factors that have been associated with the spread of MRSA skin infections include close skin-to-skin contact, skin cuts or abrasions, sharing personal items, contact with contaminated surfaces, crowded living conditions, and poor hygiene (Table 1; see CDC, 2005b). According to the CDC, the main mode of transmission of this bacterium is from the hands of either colonized or infected individuals. However, it is also possible to transmit MRSA via environmental surfaces contaminated with body fluids. Athletes have been identified as one group at risk of acquiring MRSA due to factors such as close contact, sharing personal items, and the potential for breaks in skin integrity.

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TABLE 1. Risk Factors for Acquiring Methicillin-Resistant Staphylococcus aureus Infections

The 5 Cs
Crowding
Frequent skin-to-skin Contact
Compromised skin (i.e., cuts or abrasions)
Contaminated items and surfaces
Lack of Cleanliness

SOURCE: Centers for Disease Control and Prevention (2007).

Risk factors associated with MRSA are found in various sports, regardless of the level of personal contact or sports equipment used. These findings are demonstrated through retrospective studies published by the CDC (2003a) of three competitive sport teams. The first study included a fencing team from Colorado in which 5 of the 70 members acquired MRSA infections. The members of the fencing team were given questionnaires that asked about possible risk behaviors such as sharing equipment and clothing. There were no showers available, and none of the fencers reported sharing clothing, masks, or weapons. However, fencers wear sensors under their clothes to record when they are touched. Interviews revealed that the sensor wires were shared and were not routinely cleaned. No other common exposures were identified.

This same CDC report (2003a) examined football players in California and Pennsylvania diagnosed with MRSA, as well as two wrestlers from Indiana who had never wrestled each other. There were 2 to 10 cases identified per team, and all affected individuals were high school or college athletes. Several possible risk factors were identified, including skin trauma from turf burns, shaving, and sharing unwashed towels. Additional risk factors included skin trauma from abrasions, lack of hand hygiene, and lack of appropriate and immediate first-aid treatment to wounds and abrasions.

These studies concluded that MRSA is emerging as a cause of skin and soft-tissue infections in athletes and that there is a need to implement disease prevention measures by players, coaches, parents, and school officials (CDC, 2003a). Outbreaks of MRSA have the potential to spread among athletes, even with little skin-to-skin

contact. The spread of MRSA infections among players who had never wrestled each other suggests that the transmission of this organism may have occurred through shared equipment, not by direct contact. Shared equipment may also include balms or lubricants and towels. For this reason, it is essential to teach disease prevention measures to student athletes, parents, coaches, and those responsible for athletic equipment management.

Direct and Indirect Costs

According to the Society for Healthcare Epidemiology of America, the cost of medical care is higher for infections caused by antibiotic-resistant organisms compared to those caused by the same antibiotic-susceptible organism (Muto et al., 2003). Research reports that infections due to MRSA result in longer lengths of stay in the hospital and increased hospital charges when compared to methicillin-sensitive *Staphylococcus aureus* infections (Kay, Engemann, Mozaffari, & Carmeli, 2004). Determining appropriate interventions to prevent MRSA infections promotes cost-effective health care.

Not only do infections from resistant organisms require longer and more intensive medical care, but MRSA infections can also result in students missing school. Student absenteeism can decrease the amount of state aid that schools receive on a daily basis. Each student misses an average of 4.5 days a year due to illness (School Network for Absenteeism Prevention [SNAP], 2003). In addition, each year teachers miss more days than students do. On average, a teacher misses 5.3 days due to illness per year. To estimate the cost of absenteeism for a teacher, determine the daily fee for a substitute teacher and then multiply that amount by 5.3 for each teacher in the school (SNAP, 2003).

Missing school is a problem, as students can easily fall behind in their studies, potentially affecting achievement (SNAP, 2003). Infections among student athletes have the potential to spread beyond one school through athletic meets, leading to increased absenteeism for a larger number of students. School nurses have an opportunity to implement disease prevention and control measures to promote health and decrease the economic burden by preventing infections related to MRSA and decreasing school absenteeism (SNAP, 2003).

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DISEASE PREVENTION

Reports by the CDC from a July 2004 meeting of experts provides guidance for clinical management of community-associated MRSA. The CDC document acknowledges that additional data are needed to fully understand the epidemiology of MRSA soft-tissue infections and to identify optimal prevention and treatment strategies (CDC, 2006). The report also describes measures that individuals who are infected can take to prevent the spread to their close contacts (Table 2). In addition, in an attempt to prevent MRSA infections, multiple state and local health departments have developed MRSA educational materials for school health professionals, parents, coaches, and student athletes (Connecticut Department of Public Health, 2007; Massachusetts Department of Health, 2008; New York State Department of Health [NYSDOH], 2007; Tacoma-Pierce County Health Department, 2007). Despite the growing body of literature regarding MRSA, there is still a need to actively engage athletes in applying this knowledge to their day-to-day routines. The following provides information and interventions for school nurses to consider.

Hand Washing

According to the CDC, the single most important intervention to prevent the spread of infectious diseases, including MRSA, is hand washing (CDC, 2006). A study of 6,000 students from five states that examined the effect of the use of hand sanitizer on elementary school absenteeism found a 19.8% reduction in absenteeism due to illness after implementing a hand hygiene program (Hammond, Ali, Fendler, Dolan, & Donovan, 2000).

Recognizing that hand washing is a crucial prevention measure, the CDC has developed an

TABLE 2. Measures to Prevent Infections Associated With *Methicillin-Resistant Staphylococcus aureus*

1. Wash hands
2. Keep draining wounds covered with clean, dry bandages
3. Maintain good general hygiene with regular bathing
4. Do not share personal items
5. Launder clothing soiled with drainage and dry thoroughly
6. If wounds cannot be covered, do not participate in activities where you have direct skin-to-skin contact until the wound is healed
7. Clean equipment and environmental surfaces that have contact with bare skin

SOURCE: Centers for Disease Control and Prevention (2006).

educational tool for schools. SNAP is a hands-on initiative developed by the CDC, the U.S. Department of Health and Human Services, and the Soap and Detergent Association to improve overall health in middle schools by promoting clean hands (SNAP, 2003).

Waterless hand gel is an effective alternative when soap and water are not available and when hands are not visibly soiled. The amount of hand gel used based on the size of an individual's hands, the concentration of alcohol (60%-95%), and the length of contact time determine the effectiveness of the product. To promote hand hygiene among athletes, school nurses and coaches can encourage the use of waterless hand gel before practice and games; before eating; and before applying balms, lotions, or face paint. Waterless hand gel could be made available in the gym area via wall dispensers and portable pump containers taken to the field. Waterless hand gel could be packed with other sports equipment and made available at player benches and before leaving buses to eat.

Wound Care

A second prevention measure is wound care. Athletes who acquire wounds during play or practice should have the area promptly cleaned and covered. Staphylococcal infections begin when the bacterium enters the body through a break in the skin. Therefore, when skin integrity is compromised, it is important to clean the area promptly and keep it covered until healed (NYSDOH, 2007). If wounds cannot be covered, students should not participate in activities where direct skin-to-skin contact is anticipated, until the wound is healed. In addition, all draining wounds should be kept covered with dry bandages (CDC, 2006).

If a staff member assists an athlete with a wound or bandage, he or she should perform hand hygiene before providing care, wear gloves, place bandages in the trash, and perform hand hygiene immediately after removing gloves (NYSDOH, 2007). First-aid kits should be available for practice and for all sporting events. To ensure that staff can perform hand hygiene, the first-aid kits should contain waterless hand gel for those times when sinks are not available to wash with soap and water.

It is important to be aware of all skin infections as soon as they occur to prevent a single case of MRSA from becoming an outbreak. Coaches, athletes, or teachers who identify students with new skin sores such as boils should report them to the school nurse so that they can be referred to their physicians for assessment (Tacoma-Pierce County Health Department, 2007). Moreover, a student with any open or draining wound, such as MRSA infections, should be excluded from swimming pools, whirlpools, or hot tubs until the wound has healed (NYSDOH, 2007).

Personal Hygiene

Student athletes should be encouraged to shower after every practice, game, or sporting event to promote good personal hygiene (CDC, 2006). Athletes should not share personal items such as sweat towels, water bottles, lotions, or balms. One recommendation is that those schools that provide sweat towels and water bottles are to have these items identified with numbers that correspond to each student's uniform number. This would allow students to identify their individual items regardless of where they set them down on the sideline and discourage sharing of these items.

If uniforms and towels are washed at school, they should be laundered in hot water (at least 71° C or 160° F) and dried in the dryer (Tacoma-Pierce County Health Department, 2007). If the water does not reach at least 160° F, add one cup of bleach to the wash water and dry cloths in the dryer (NYSDOH, 2007). Encourage parents to launder uniforms, workout clothes, and towels in hot water and dry in the dryer—not air dry.

Drying items in the dryer helps to kill bacteria. Athletes should also be encouraged to take workout clothes and uniforms home on a routine basis to be laundered. They should also be discouraged from leaving clothing and towels in school lockers for long periods of time and from continuously reusing them without being laundered.

Disinfection

Regular cleaning schedules should be established and followed for all environmental surfaces such as mats and strength training equipment (NYSDOH, 2007). Shared sports equipment such as workout benches should be disinfected after each use. In addition, personal athletic equipment should be routinely cleaned. Athletes should be encouraged to avoid bare skin on shared equipment. They need to create barriers by taking measures such as wearing clothing that covers skin that comes in contact with the equipment, placing towels on weight equipment, and wiping equipment down with an Environmental Protection Agency–approved disinfectant after each use.

The use of disinfectants is not without risk (NYSDOH, 2007). Sanitizers or disinfectants can irritate the skin or eyes. Moreover, not all products are appropriate to use on all surfaces or for all organisms. For example, some products are appropriate to use only on hard nonporous surfaces and are irritating to the skin, requiring gloves when using the product. The school nurse should be aware of the products used in the school and on what equipment or surfaces they are used. To reduce the chances of adverse exposure, refer to the product label. The label should identify which surfaces are safe to apply the product to, specify contact time required to be effective, identify any special precautions, and list which organisms the product will destroy. If bleach is used on surfaces, use a freshly mixed solution of 1 part bleach to 100 parts water (1 tablespoon bleach to 1 quart of water; NYSDOH, 2007). The bleach solution should be mixed daily to ensure that concentration and potency are maintained. Bleach can be corrosive to some surfaces and should not be mixed with products containing ammonia.

Disinfection of artificial turf is not recommended (NYSDOH, 2007). MRSA has not been isolated from the turf during previous MRSA investigations (National Collegiate Athletic Association, n.d.). Artificial turf has been associated with an increased risk factor for MRSA infections because skin abrasions are more likely from falls or from sliding on this surface, not because the turf is a reservoir for MRSA. Outdoor turf is even less likely to harbor bacterium because sunlight reduces the survival rate of organisms (NYSDOH, 2007). If school personnel have questions about cleaning artificial turf, the manufacturer should be contacted to determine appropriate measures.

Exclusion Criteria

It is likely that most schools already have policies in place to address skin infections such as impetigo. Many of the policies and procedures school nurses use in dealing with other skin infections apply to MRSA infections. Unless directed by a physician, students with MRSA infections should not be excluded from school, as the risk of transmitting MRSA in the classroom is low (NYSDOH, 2007). Exclusion from school or sports activities should be reserved for students with draining wounds that cannot be covered, for students with wounds where drainage cannot be contained, or for students who cannot maintain good personal hygiene (CDC, 2007).

Athletes with open wounds do not need to be excluded if the wounds can be completely and securely covered with clean, dry bandages. Athletes with active skin infections should not participate in sports activities where skin-to-skin contact is likely until their infections are completely healed (NYSDOH, 2007). School nurses should follow their school district policies for clearing students to return to sports and physical education classes (NYSDOH, 2007).

Notification

Schools should take care to maintain the student's right to privacy and confidentiality with this or any health issue (NYSDOH, 2007). Typically, it is not necessary to inform the entire school or sports team about a single case of MRSA infection (NYSDOH, 2007). However, when two or more cases of MRSA infections are identified on a sports team or among associated contacts, the school nurse should consult the local health

department to discuss the appropriateness of interventions, such as disinfection, exclusion, and school or parent notification, based on the established school board policies (NYSDOH, 2007).

IMPLICATIONS FOR SCHOOL NURSING PRACTICE

Disease prevention and infection control measures are basic to nursing but others may not be as familiar with these principles. Therefore, incorporating these principles requires a team effort. Creating a healthy environment in schools requires buy in from administrators, coaches, custodians, teachers, parents, and students. School nurses are well positioned with the knowledge and skills to lead the collaborative efforts required to unite the school athletic community around this growing problem.

Needs assessment. Each school has its own unique health behaviors, needs, and resources. Before implementing new disease prevention and personal hygiene strategies, the school nurse should assess student athletes' current health behaviors. The school nurse could conduct an observational assessment in combination with a needs assessment (an example is presented in the appendix; see National Center for Chronic Disease Prevention and Health Promotion/Centers for Disease Control and Prevention, 2008). The data gathered from the needs assessment could be used to tailor educational interventions to the unique behaviors of the athletes and to create buy in from administrators. This survey data could also be used to determine the effectiveness of interventions, identify potential MRSA infections among this population, and monitor health behaviors during the school year.

Teaching techniques. When developing health education programs for students, a variety of strategies will increase the effectiveness of and interest in the program. In addition to the standard lecture format, interactive and hands-on strategies increase student involvement in learning. A novel hands-on strategy for student athletes would be using fluorescent powder, lotion, or gel, invisible to the naked eye but that glows under a black light, to demonstrate the transmission of germs in a game situation. The activity could be as simple as playing a mock game with a ball covered with the powder or gel. At the end of the activity, a black light will visually demonstrate how routine sport activity could transmit organisms among team members. The invisible powder or gel simulates the invisible organisms, such as MRSA, that athletes may unknowingly pass to individuals they contact. Other scenarios related to a specific sport, such as basketball or wrestling, or to other behaviors, such as using shared equipment, could be developed to demonstrate how organisms are transmitted. The fluorescent powder or gel can also be used to demonstrate the effectiveness of hand-washing techniques.

Another technique to use when teaching adolescents is visual examples. Visual aides can be used in PowerPoint presentations or with computer programs and Podcasts. There are many pictures and real-life stories of athletes affected by MRSA infections available on the Internet through the Infectious Disease Society of America (2007). These pictures and stories may help the athletes identify situations or activities that could put them at risk. Real-life situations and stories are more likely to motivate students to adopt positive health behaviors (University of the State of New York and the State Education Department, 2005).

Finally, consider collaborating with teachers to incorporate disease prevention principles into the curriculum. For example, science teachers can conduct a germ investigation where students culture various areas of the school, such as gym lockers and workout equipment, to see if organisms grow from these items. Social studies teachers can review disease outbreaks from the past and the impacts of the diseases. They could also highlight current events related to food safety or influenza (SNAP, 2003). In addition, math teachers could have students calculate how fast one bacterium could multiple and graph bacterial growth (SNAP, 2003).

CONCLUSION

The number of healthy individuals affected by MRSA skin infections continues to increase. Current findings suggest that MRSA infection rates are on the rise, despite the fact that there are identified measures that can be taken to

prevent or control outbreaks. Therefore, refocusing on basic concepts of disease prevention and personal hygiene can have a positive impact on the prevention of MRSA skin infections. As noted by Alex and Letizia (2007), school nurses are in an ideal position to educate the entire school community and parents about community-associated MRSA infections.

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APPENDIX
HEALTH SURVEY

This survey is about health behavior. It has been developed so you can tell us what you do that may affect your health. The information you give will be used to develop better health education for young people like yourself.

DO NOT write your name on this survey. The answers you give will be kept private. No one will know what you write. Answer the questions based on what you really do.

Completing this survey is voluntary. Whether or not you answer the questions will not affect your grade for this class. If you are not comfortable answering a question, just leave it blank.

The questions that ask about your background will be used only to describe the types of students completing this survey. The information will not be used to find out your name. No names will ever be reported.

Make sure you read every question. Fill in the ovals completely. When you are finished, follow the instructions of the person giving you the survey.

Health Survey

How old are you?
- 12 years old or younger
- 13 years old
- 14 years old
- 15 years old
- 16 years old
- 17 years old
- 18 years old or older

What is your gender?
- Female
- Male

In what grade are you?
- 9th grade
- 10th grade
- 11th grade
- 12th grade
- Ungraded or other grade

How do you describe your health in general?
- Excellent
- Very good
- Fair
- Poor

How often do you share towels with someone else?
- Never
- Rarely
- Sometimes
- Most of the time
- Always

(continued)

APPENDIX (CONTINUED)

How often do you share sports equipment with someone else?
- Never
- Rarely
- Sometimes
- Most of the time
- Always

How often do you share lotions or balms with someone else?
- Never
- Rarely
- Sometimes
- Most of the time
- Always

During the past 24 hours, how many times did you wash your hands?
- 0 times
- 1 time
- Less than 5 times
- Between 5 and 10 times
- More than 10 times

In the past 12 months how many sports teams did you play (Include any teams run by the school or community groups)?
- 0 teams
- 1 team
- 2 teams
- 3 teams or more

When you played a sport during the past 12 months, how often did you shower after a practice or game?
- I did not play sports in the past 12 months
- Never
- Rarely
- Sometimes
- Most of the time
- Always

During the past 12 months have you seen a doctor or nurse for a skin infection?
- Yes
- No
- Not sure

During the past 12 months have you noticed any sores on your body that took longer than 2 weeks to heal?
- Yes
- No
- Not sure

This is the end of the survey.

SOURCE: Adapted from the Youth Risk Behavior Surveillance System (National Center for Chronic Disease Prevention and Health Promotion/Centers for Disease Control and Prevention, 2008).