

## CONCISE COMMUNICATION

## Methicillin-Resistant *Staphylococcus aureus* Infection in a College Football Team: Risk Factors Outside the Locker Room and Playing Field

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We investigated a cluster of methicillin-resistant *Staphylococcus aureus* infections in college football players. Risk factors included a history of recurrent skin infections and contact with the skin lesions of persons outside college. The infections were controlled through treatment of carriers with topical mupirocin, chlorhexidine body washes, and enhancement of personal hygiene practices. Varsity and professional teams need to consider similar preventive measures.

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The incidence of methicillin-resistant *Staphylococcus aureus* (MRSA) infection is increasing among athletes who participate in contact sports; severe infections often require prolonged therapy.<sup>1-6</sup> Such events can negatively affect the careers of varsity and professional athletes. At the start of the 2005 college football season, a number of football players at the University of Florida acquired MRSA skin infections. Several key players received prolonged courses of intravenous antimicrobial therapy, resulting in loss of playing days. We conducted a retrospective case-control study, observational studies, and microbiological surveys to ascertain risk factors and determine recommendations.

### METHODS

A case patient was defined as any University of Florida football player who had at least 1 laboratory-confirmed MRSA infection, regardless of severity, diagnosed during the study period of September 1 through December 31, 2005. We ascertained cases through review of medical records and interviews with team physicians. Control subjects were randomly selected football players without any history of skin infection or MRSA infection. We collected data on each football player's demographic characteristics, field position played, frequency of play (first string vs second string), history of contact with any persons with obvious skin lesions, history of recent incarceration (ie, within 1 year), skin injuries (eg, grass or turf burns), and sharing of personal items in college and private life.

We assessed infection control practices and procedures in the training rooms and shower areas as well as during training and physiotherapy, and we attended 1 training and practice session. We interviewed players, staff, and the infectious diseases specialists who had been consulted. Nasal swab speci-

mens from athletes, trainers, and coaches were inoculated on blood and mannitol salt agar (Becton Dickinson) and incubated at 35°C for 18-24 hours in 5% CO<sub>2</sub>. MRSA and methicillin-susceptible *S. aureus* (MSSA) were identified using the MicroScan system (Dade-Behring). Cultures were performed again at the start of the 2006 football season. Data were analyzed using SAS version 6.12 statistical software (SAS Institute). Categorical variables were compared by  $\chi^2$  or Fisher exact test, where appropriate; the odds ratio (OR) and 95% confidence interval (CI) were calculated.

### RESULTS

Thirteen athletes met the case definition (Table); 28 control subjects were selected. No infections were ascertained among staff. The median age of case patients was 21 years (range, 18-22 years), and the median body mass index (BMI) was 30.1 (range, 24.4-36.5). Four case patients played offensive positions; 9 played defensive positions. Case patients and control subjects were similar with respect to age, BMI, position played, frequency of use of specific training equipment, prevalence of grass or turf burns, and habit of sharing towels or hair clippers; none of the athletes shared razors.

In contrast, case patients were significantly more likely than control subjects to have had previous skin infections (OR, 4.9 [CI, 1.13-21.0];  $P = .027$ ) or recurrent skin infections (OR, 12.0 [CI, 1.2-123];  $P = .014$ ); to have had contact with at least 1 person with skin lesions outside the college (OR, 7.8 [CI, 1.01-74];  $P < .05$ ); or to be a freshman or student who had recently transferred from another college (4 of 13 vs 2 of 28;  $P = .06$ ). Although case patients were more likely than control subjects to have a roommate or intimate partner with skin infections or boils (OR, 4.7 [CI, 0.3-150]) or to share soap bars in private life (OR, 3.8 [CI, 0.5-32]), these differences were not statistically significant. On multivariate analysis, a history of recurrent skin infections was the single independent risk factor for MRSA infection (adjusted OR, 12.0 [CI, 1.5-254]). Control subjects were more likely than case patients to share training equipment with team members (8 of 28 vs 1 of 13;  $P = .11$ ).

*Assessment of practices and procedures.* The staff was familiar with published infection control guidelines for athletic facilities and had implemented scrupulous infection control policies during the previous 12 months. Shower stalls had wall-mounted liquid soap dispensers. Work surfaces and tables in the training and physiotherapy rooms were cleaned regularly according to published environmental infection control guidelines.<sup>7</sup> However, catching gloves, water bottles, and towels were often shared and passed from individual to individual during training, practice, and games. Exercise equipment was not always cleaned between uses. Tackling dummies (large pads used by linemen to practice tackling

TABLE. Characteristics of Football Players With Methicillin-Resistant *Staphylococcus aureus* Infections at the University of Florida, Gainesville, September 1 through December 31, 2005

Patient	Age, years	Body mass index	Field position played	Site of lesion	Recurrence of lesions	Item(s) usually shared with teammates
1	20	29.5	Line backer	Right elbow	Yes	Hair clippers
2	21	30.5	Line backer	Left mandible	No	None
3	20	24.4	Safety	Both elbows, left forearm	Yes	Soap
4	21	27.0	Safety	Left knee	No	Towels
5	22	25.7	Free safety	Right ankle	No	None
6	21	35.0	Defensive end	Left elbow	No	Soap
7	20	36.5	Offensive line backer	Left elbow	No	Towels, deodorant
8	18	30.1	Running back	Right knee	No	Towels
9	21	32.5	Defensive end	Posterior neck	Yes	Towels, deodorant, hair clippers, soap
10	20	36.2	Defensive tackle	Right flank	Yes	Deodorant, soap
11	20	27.0	Wide receiver	Right sacroiliac region, right groin	No	Towels, deodorant
12	21	25.8	Receiver	Left elbow	No	Towels
13	21	34.1	Defensive tackle	Right knee	Yes	Towels

maneuvers) were used routinely during practice and were cleaned after each practice session but not after individual uses.

**Microbiologic survey.** Cultures of nasal specimens from 109 athletes and 38 staff yielded 31 *S. aureus* isolates. Seven isolates, which came from 4 athletes [3.7% of the athletes] and from 3 staff [7.9% of the staff], were MRSA, and 24 were MSSA. The rate of MRSA nasal carriage was similar for case patients and control subjects (1 of 13 vs 1 of 28;  $P = .54$ ). All case patients had received at least 1 course of antimicrobial therapy before the nasal swab cultures were performed.

#### RECOMMENDATIONS AND INTERVENTION

The University Athletic Association instituted our recommendations after the conclusion of the investigation, which were as follows:

1. A screening questionnaire would be administered to all new or prospective football players, trainers, coaches, and administrative personnel, which would be designed to collect data on recurrent skin infections and contact with individuals with skin lesions. Persons with a history of either of these factors would have a nares specimen obtained and cultured. Those people found to be colonized with MRSA would be considered for treatment with mupirocin 2% in paraffin-based salve (applied 3 times per day for 5 days to the inner surface of each nostril) and 4% chlorhexidine baths (daily for 5 days).<sup>8</sup>

2. Clean clothing, bedding, and towels would be provided following decolonization.

3. Scrupulous infection control practices would be maintained in college facilities and playing field (Figure).

4. Sharing of gloves, water bottles, towels, and toiletries would be discontinued.

5. Good personal hygiene would be maintained in private life.

Of the 140 nasal cultures of athletes and staff performed on follow-up in 2006, only 2 (1.4%) yielded *S. aureus* (both MRSA). The *S. aureus* colonization rate at the start of the 2006 season was significantly lower than the rate ascertained during our investigation (2 of 140 vs 31 of 147;  $P < .001$ ). Although the MRSA infection rate, too, was lower, the difference was not statistically significant (2 of 140 vs 7 of 147;  $P = .2$ ). There were no new reports of MRSA infections for the remainder of the 2006 football season.

#### DISCUSSION

Our investigation established that athletes on our university football team were more likely to acquire new MRSA skin infections if they already had a history of previous or recurrent skin infections before joining the team. Infected players were more likely to be freshmen who had recently arrived from high school or transferred from another college, where hygiene practices of the athletic programs might not have been as rigorous as the practices in our team's program. Sharing of soap or other toiletries at home, outside the confines of the football locker room and playing fields, likely facilitated MRSA transmission.

Our finding that control subjects were more likely than

**Education:** Education activities will be initiated for athletes, coaches, staff, and team administrators regarding the nature of bacteria, modes of transmission, and causes of infection. In addition, information sheets on the recognition and reporting of skin infections will be posted above urinals and bathroom stalls.

**Identification of carriers:** MRSA carriers will be identified by obtaining nasal specimens for culture from all athletes during preparticipation physicals. MRSA carriers will be treated with topical mupirocin ointment and chlorhexidine baths, as described in the text.

**Management of wounds/skin lesions:** All cuts, abrasions, and open skin lesions will be kept clean and covered with appropriate wound dressings until healed. Athletes with open wounds or lesions will not be allowed to use common whirlpool baths or rehabilitative pool areas.

**Hand hygiene:** Hand hygiene will be enhanced and facilitated with provision of soap and water and provision of alcohol-based hand sanitizers on the field, bench, and training and conditioning facilities. Hands will be washed after treatment of infections.

**Item sharing:** The sharing of towels, catching gloves, water bottles, protective equipment, hair clippers, soap bars and other toiletries with teammates or in private life will be eliminated.

**Showering and body washes:** Chlorhexidine 3% soap will be introduced periodically into soap dispensers in the team locker room during the preseason practice sessions. This will be repeated several times during the year in an effort to reduce the number of individuals colonized with MRSA. Athletes will be encouraged to shower immediately after all games, practices, and conditioning activities. Athletes will be required to shower before receiving any treatment in the athletic training room.

**Laundry procedures:** Hot water for laundry will be maintained at 140° F. Separate laundry bins will be provided for collection of soiled laundry and clean items.

**Maintenance of shared equipment:** All shared equipment will be cleaned with a hospital-grade bactericidal-virucidal agent routinely and after use by individual players.

FIGURE. Summary of strategies instituted by the University of Florida Football Program to prevent cases of methicillin-resistant *Staphylococcus aureus* (MRSA) infection.

case patients to share training equipment with team members suggests that training areas or equipment did not play any substantial role in MRSA transmission and that case patients likely acquired infections outside the college confines, where MRSA exposures remain unavoidable, notwithstanding meticulous infection control measures in college facilities or the playing field. Thus, our findings suggest that the infections were likely a manifestation of a problem recurring among individuals even before they joined our university football team.

The MRSA infection rate we found among athletes (3.7%) and staff (7.9%) are consistent with published carriage rates among healthy US populations (range, 0.8%-8%).<sup>2,9,10</sup> To our knowledge, there are no published data that support the effectiveness of mupirocin topical treatment *alone* in preventing person-to-person transmission of MRSA among athletes in contact sports. However, we documented an unequivocal fall in MRSA nasal colonization and infection rates following our intervention. Elimination of MRSA carriage with topical agents and body washes is necessary but not sufficient to prevent infection; it must be allied with comprehensive infection control in the training room and the locker room, on the playing field, and in private life (Figure).

Our investigation had limitations. First, we did not perform environmental cultures. Because other sports teams at our

institution regularly shared the same training facilities without having any of their team members acquire MRSA infections, we thought the training environment an unlikely source of MRSA. Second, there might have been recall bias among athletes regarding issues in private life. Third, the relatively low rate of *S. aureus* colonization among case patients might have reflected prior antimicrobial therapy.

In summary, we identified risk factors for MRSA infection in our college football players outside the training and playing arenas, particularly a history of recurrent skin infections. Screening new team members for MRSA carriage and treating affected players with topical mupirocin and skin decontamination significantly reduced the number of infections in the team and certainly played a role in preventing widespread person-to-person transmission. Finally, we wish to emphasize the importance of infection prevention in allowing athletes to compete at their highest level. The onus is now on managers in college and professional contact sports to implement similar screening and prevention programs.

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