Methicillin-Resistant *Staphylococcus aureus* in a High School Wrestling Team and the Surrounding Community

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**Objectives:** To describe a community outbreak of methicillin-resistant *Staphylococcus aureus* (MRSA) and to investigate risk factors for MRSA transmission and infection in a wrestling team.

**Design:** Case series and retrospective cohort study.

**Setting:** A high school wrestling team and the surrounding community in southern Vermont, 1993 to 1994.

**Patients or Other Participants:** The case series included persons whose MRSA-positive infections were identified at a hospital laboratory from January 1, 1993, through February 28, 1994, and a health maintenance organization laboratory from July 1, 1993, through February 28, 1994. A wrestling team case-patient was a 1993-1994 team member with an MRSA-positive culture during the period from January 1, 1993, through February 28, 1994.

**Interventions:** Visual inspection of wrestlers before matches was instituted. Affected wrestlers were excluded from wrestling and advised to seek appropriate medical care. Heightened attention was given to personal and environmental hygiene.

**Main Outcome Measures:** Colonization or infection with MRSA.

**Results:** Seven of 32 team members were MRSA positive (6 infected, 1 colonized). All lesion-positive wrestlers were tested by pulsed field gel electrophoresis and found to be infected with the same MRSA strain, as were 6 nonwrestlers. No risk factors for MRSA infection were identified.

**Conclusions:** The MRSA was transmitted among members of a wrestling team. Infection with MRSA should be suspected in outbreaks of boils that are nonresponsive to standard antibiotic therapy among healthy participants of contact sports and their close contacts.

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**TRANSMISSION** of herpes simplex virus, *Trichophyton* species, *Trichophyton mentagrophytes*, and *Staphylococcus aureus* infectious diseases has been well documented among participants of contact sports. Methicillin-resistant *S aureus* (MRSA) is well established in hospitals and long-term care facilities but has rarely been reported outside of medical institutions.

In January 1994, the infection control nurse of a 140-bed community hospital serving approximately 50,000 persons notified the Vermont Department of Health (VDOH) of MRSA-positive boils in 5 wrestlers of a local high school team. Approximately 1150 students attend the school. During the official wrestling season, November 11, 1993, through February 28, 1994, the team competed against teams from Vermont and 12 other states. On being notified of the outbreak, the VDOH suggested excluding affected wrestlers from practice and competition and giving heightened attention to environmental and personal hygiene. On February 1, 1994, the VDOH notified community physicians of the outbreak and requested that they culture suspect lesions for *S aureus* and test for sensitivity to methicillin. This report describes the outbreak and investigates potential modes of MRSA transmission.

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**RESULTS**

**THE WRESTLING TEAM**

All 32 wrestlers were between 14 and 18 years of age and were approximately equally distributed among 4 high school grades, 2 teams (varsity and junior varsity), and 14 weight classes. The attack rate for the team was 21.9%. Attack rates ranged from 0% (12th grade) to 33% (ninth grade) and were similar for varsity

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MATERIALS AND METHODS

CASE FINDING: LABORATORY AND EPIDEMIOLOGICAL INVESTIGATIONS

Two large clinical laboratories serve this community. Hospital laboratory reports for the period January 1, 1993, through February 28, 1994, and health maintenance organization (HMO) reports for the period July 1, 1993, through February 28, 1994, were reviewed to identify persons with MRSA-positive cultures. Medical records of MRSA-positive persons were reviewed for demographic characteristics, course of illness, and possible risk factors for MRSA infection.

Enhanced case finding was conducted in the local high school wrestling team. Questionnaires answered by all 32 members of the 1993-1994 high school wrestling team provided information on demographics, wrestling history (ie, weight class, weight loss in the week before a match); possible risk factors for MRSA transmission (wrestling partners before and after November 11, 1993; percentage of time arms, legs, and chest were uncovered during practice; sharing clothing or towels; using the wrestling room Jacuzzi; close contact with hospital and nursing home patients); risk factors for MRSA infection (hospitalizations and emergency department visits in the 2 years before this outbreak, underlying illness, use of medications and corticosteroids); $\beta$-hemolytic Staphylococcus aureus–compatible clinical illness (skin and respiratory infections); and wounds, specifically mat burns.

During January 4 through 6, 1994, and on January 25 and February 8, 1994, screening anterior nares cultures were obtained for 29 (90.6%) of 32, 29 (90.6%) of 32, and 22 (68.8%) of 32 wrestlers, respectively. On January 18, 1994, the VDOH contacted coaches of opposing teams and asked them to check their team members for active and recent skin infections, including boils, and to report these to the VDOH.

In May 1994, the VDOH was informed that the wrestling facilities were being used in an unofficial capacity and that the high school was planning to hold a summer wrestling camp on-site. To ascertain whether the facilities posed a risk to camp attendees, environmental samples were taken on June 1, 1994.

Mantel-Haenszel $\chi^2$ tests of association were calculated by EpiInfo software, version 6.3 (Centers for Disease Control and Prevention, Atlanta, Ga. Isolates from HMOs were not available for characterization. The banding patterns were interpreted by visual inspection. Banding patterns from the majority of epidemiologically related isolates that appeared identical in size and number of bands were considered to represent the same strain (designated strain A). Isolate banding patterns that differed from the main pattern because of 1 or 2 genetic events were considered a subtype within the main group (eg, A2), and those that differed from the main pattern by 4 or more bands that could not be explained by at most 2 genetic events were considered those of a different strain (eg, strains B, C, and D).

and junior varsity (28.6% and 38.5%, respectively). No cases occurred in the 96- or 103-lb weight classes, cases occurred in 6 of the next 7 successive weight classes (112, 119, 130, 135, 140, and 145 lb but not 125 lb), and no cases occurred in the 5 highest weight classes (152, 160, 165, 170, and 198 lb but not 195 lb).

Seven (21.9%) of 32 wrestlers met the case definition. The first known wrestling team case had a forearm abscess that was incised, drained, and cultured in July 1993 and found to be MRSA positive (Table). The patient was treated successfully with intravenous cefotetan disodium followed by oral amoxicillin. In the 20 months before the abscess, he had undergone 3 emergency hospital admissions (2 for surgical procedures and 1 for a postsurgical infection caused by Bacteroides fragilis in June 1992) at the same community hospital. Cultures taken at the time of the latter event did not yield MRSA. From the time of his MRSA-positive culture to the appearance of the next case in a wrestler, no other cultures were performed and no history of recurrent or chronic staphylococcal infection was documented. Six other wrestlers were culture positive. Five of these cultures were obtained from boils and 1 from the anterior nares of a wrestler who reported having had a boil earlier in the season. Twelve other wrestlers reported having had at least 1 boil during the official wrestling season, 6 of them documented in a medical record.
None of the risk factors investigated was associated with significant risk of MRSA infection.

Pulsed field gel electrophoresis was performed on isolates from 6 wrestlers whose cultures were obtained at the hospital laboratory (Table). Isolates from 5 of the 6 wrestlers exhibited the same PFGE pattern (pattern A). The remaining isolate was obtained from an anterior nares screen, and it alone exhibited a different pattern (PFGE pattern C2).

Antibiogram results were available for 6 wrestlers (Table). Antibiograms for 5 of these wrestlers exhibited the same antibiotic sensitivity pattern (pattern 1). The antibiogram for the sixth wrestler was performed at the HMO laboratory; its pattern was consistent with that of the other 5 wrestlers, except that it was not tested with 3 antibiotics (pattern 1a).

Of the 29 wrestlers screened at least once by anterior nares cultures, 1 (case 7, Table) was screened twice and had a negative culture followed by a positive one, and 1 (case 1, Table) was screened once and tested positive. No other team members were positive on screening.

Coaches of 3 of 16 Vermont teams and 8 of 26 out-of-state teams that had contact with this team reported skin lesions in members of their teams within several days to several weeks after competing against this team. Four lesions, all boils, were cultured. Three were identified as methicillin-sensitive S aureus; 1 was classified as a sterile abscess. All environmental cultures were screened only for S aureus and found to be negative.

THE NONWRESTLING COMMUNITY

Eleven nonwrestlers had MRSA infections during the period from January 1, 1993, through February 28, 1994. Six of these persons (Table) ranged in age from 16 to 38 years and had some connection with the high school: 2 were nonwrestling high school students (cases 8 and 9), 2 were immediate relatives of wrestlers on the 1993-1994 and/or 1992-1993 teams (cases 10 and 11), and 2 were immediate relatives of 2 unaffected sibling high school students (cases 12 and 13). The 5 remaining persons ranged in age from 67 to 85 years, had no known connection with the team or the high school, and had underlying risk factors for MRSA infection (diabetes, multiple hospitalizations, or nursing home residence).

Date of onset for 4 of the 6 high school–related cases was during the official wrestling season. The other 2 occurred 3 months and 9 months before the official wrestling season. Only 1 of the 6 cases (case 9) was classified as nosocomial by the hospital’s Infection Control Committee, but this individual had an undocumented history of furunculosis in the month preceding hospitalization. The remaining 5 infections were classified as community acquired. According to the hospital Infection Control Committee, nosocomial transmission of MRSA had not previously been reported in this institution.

Five of the 6 high school–related cases (cases 8-10, 12, and 13) had PFGE and antibiogram patterns that were the same, for at least 1 culture, as those of lesion-positive wrestlers. The remaining case (patient 11) had an antibiogram pattern (pattern 1a) that was the same for the antibiotics tested as those of lesion-positive wrestlers but was not tested by PFGE. The 5 patients with no high school connection had 3 different PFGE patterns (B, C/C1, and D) and 2 different antibiotic patterns (2 and 3).

In January 1994, several control measures were undertaken in an attempt to control the spread of MRSA. Wrestlers with known lesions were banned from wrestling and advised to seek appropriate medical care. Wrestlers were advised to shower with a bactericidal soap after practices, and the school was advised to clean wrestling mats twice daily with a bactericidal agent. Visual inspection of wrestlers by a physician before matches was strongly advised. The official wrestling season ended on February 28, 1994. During the following summer, several more nonwrestling high school students were identified as having MRSA, but PFGE testing was not performed. The 1994-1995 team was screened in the fall of 1994, and 10 wrestlers were found to be colonized with S aureus but none with MRSA. In February 1995, 13 team members were cultured again but no MRSA was detected.

This is the first report known to us of widespread MRSA transmission within a group of young healthy persons within a community. None of the risk factors investigated was associated with significant risk of MRSA transmission or infection, but because the sample sizes...
were small, it is possible that risk factors may have been missed. Nevertheless, among wrestlers, the frequency and duration of skin contact with an infected or colonized wrestler may have been an important risk factor for transmission.

The first wrestler known to have been infected was diagnosed as having MRSA in July 1993. Although there was no evidence that he was infected at the onset of the official wrestling season, he was found to be colonized 6 weeks later. Additional cases of MRSA began to occur within a week of the start of the official wrestling season when he participated in wrestling practices with teammates for 2 hours a day, 6 days a week. Team members usually practiced with arms and legs uncovered. This permitted the frequent occurrence of mat burns on extremities and, together with direct skin contact with infected or colonized wrestlers, probably facilitated transmission and infection. It was not possible to trace the temporal chain of MRSA transmission among wrestlers because records of wrestling practice partners were not kept, wrestlers generally practiced with teammates from a number of different weight classes, and certain factors (the highly competitive nature of wrestling and the high national standing of this team) may have caused a delay in reporting of initial lesions. By contrast, twice-weekly wrestling matches with members of opposing teams were limited to 3 minutes per match, and no MRSA-positive lesions were found among members of competing teams. Reports of nosocomial transmission of MRSA have implicated mattresses, equipment, bathing facilities, and even room air exhaust channels as vehicles of MRSA transmission.15-19 Although circumstances surrounding this outbreak were quite different from those found in hospitals or long-term care facilities,20 it is tempting to speculate that wrestling mats and shared towels and locker room facilities might have contributed to MRSA transmission among wrestlers. Despite continued use of wrestling facilities after the official end of the wrestling season, environmental cultures were negative for MRSA, and no new cases were reported during this period. Environmental contamination may have been missed or heightened personal and environmental hygiene might have eliminated these items as possible vehicles for MRSA transmission. In any case, it is not possible to determine to what extent the wrestling environment, compared with direct contact with MRSA-positive wrestlers, may have played a role in this outbreak.

The appearance of the same MRSA strain in students and family members who had limited direct contact with wrestlers and/or locker room facilities is disturbing. We can only speculate that MRSA may have been transmitted by less direct contact than occurred among team members, that environmental contamination with MRSA may have occurred beyond the wrestling facilities, or that some other as yet unexplained mode of transmission may have been responsible for these cases.

In this outbreak, identification of MRSA infections followed by appropriate antibiotic treatment seemed to be important for preventing more serious illness. Six wrestlers’ symptoms became serious enough for them to seek medical attention, 5 at the hospital emergency department and 1 at an HMO. One of the 5 was hospitalized for several days with early cellulitis, lymphangitis, and probable early septicemia. All of these individuals recovered. However, 2 wrestlers who were treated had positive nares cultures after treatment, 1 approximately 6 months after infection and the second a month after reporting a boil and having had a negative nares screen. Hence, it appears that, despite apparently successful treatment, either MRSA colonization persisted or cases were recolonized.

At least 3 routes of MRSA transmission can be postulated. The first known case (case 12, Table) was diagnosed in February 1993 and was the likely source for the third case (case 13), an immediate family member. These individuals had no known connection to the wrestling team, although 2 other family members were unaffected high school students. This represents 1 possible route of transmission. The second known case (case 1, Table) was the first known infected wrestler, who was the likely source of infection for other affected wrestlers, as well as for case 10, his sibling. Case 11 was a family member of a wrestler on the 1992-1993 team. These cases may represent a second route of transmission: among wrestlers and from wrestlers to their family members. Finally, 2 students at the high school (cases 8 and 9, Table) do not appear to be linked to any other cases and may represent unknown routes of transmission within the school or elsewhere.

The question regarding the original source of infection remains. Cases 1 and 12, likely sources of transmission for other cases, and case 9, who was likely not, were hospitalized at the community hospital before their diagnosis with MRSA. The latter case was diagnosed as nosocomial but reportedly had furunculosis immediately preceding hospitalization. We cannot rule out the possibility that the hospital might have been the source of infection for at least 2, and perhaps all 3, of these persons. Because they had all been hospitalized for different reasons and had been attended by different physicians, and because the time lags between their diagnoses were long (5 months between cases 12 and 1 and almost 6 months between cases 1 and 9), a common source is unlikely.

Community outbreaks of MRSA have been rare and associated with intravenous drug abuse and a history of hospitalization in the 12 months before diagnosis.21-25 School officials and team members denied use of intravenous drugs and corticosteroids, and their use was not found to be associated with significant risk of becoming a case. Finding widespread MRSA transmission among healthy members of a sports team with no known risk factors for MRSA has wide-ranging implications. Epidemics of skin lesions among members of sports teams cannot be presumed to be outbreaks of antibiotic-sensitive Staphylococcus aureus. Failure to consider MRSA as a cause, particularly when infections persist despite empirical treatment, may lead to a delay in diagnosis and permit more widespread transmission and disease progression. There is insufficient evidence to prove that any of the control measures used in this outbreak was effective in curtailing MRSA transmission. In the absence of recommended measures to control community outbreaks of MRSA, it would seem
prudent to suspect MRSA in outbreaks of boils that are nonresponsive to standard antibiotic therapy, to treat them accordingly, to limit skin-to-skin contact with other individuals, and to clean or remove potentially contaminated items from the environment.

Community-acquired MRSA has been identified as a source of subsequent nosocomial infections. As of August 1, 1996, MRSA was neither epidemic nor endemic in this hospital. Although the potential for MRSA transmission from the community to the hospital is present, heightened awareness of the existence of community-acquired cases of MRSA may help to prevent its establishment in this hospital and other institutional settings.

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