Journal of Athletic Training 2006;41(3):337–340

www.journalofathletictraining.org

Community-Acquired Methicillin-Resistant *Staphylococcus aureus*: Prevalence and Risk Factors

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Reference/Citation: Salgado CD, Farr BM, Calfee DP. Community-acquired methicillin-resistant *Staphylococcus aureus*: a meta-analysis of prevalence and risk factors. *Clin Infect Dis.* 2003;36:131–139.

Clinical Question: What are the prevalence rates and risk factors associated with community-acquired methicillin-resistant *Staphylococcus aureus* (MRSA)?

Data Sources: Studies were identified by searching MEDLINE (January 1966–February 2002) and abstracts from scientific meetings (1996–2001). Reviews of citations and reference lists were performed to identify additional eligible studies. The search terms included *Staphylococcus aureus, infection, colonization, methicillin resistance, community-acquired, community-onset, prevalence, frequency,* and *risk factors*.

Study Selection: The search was limited to English-language investigations identified from the electronic and manual searches. Studies were divided into 2 groups, as follows: group 1, retrospective or prospective studies that reported the prevalence of community-acquired MRSA (CA-MRSA) among hospital patients who were colonized (presence of bacteria without infection) or infected with MRSA; and group 2, studies that reported the prevalence of MRSA colonization in the community. The studies were evaluated independently by 2 authors, and case reports were excluded.

Data Extraction: Data extraction and study quality assessment procedures were not fully explained. The outcome measures for hospital patients were definitions of CA-MRSA used in the study, prevalence of CA-MRSA, sample size, number and type of risk factors assessed, and number of patients with ≥1 health care–associated risk factor. The studies were grouped based on type, retrospective or prospective. The pooled prevalence of CA-MRSA was calculated for each group (retrospective or prospective) and was limited to the prevalence among patients with MRSA. The proportion of patients who reported ≥1 health care–associated risk factor was also calculated. The outcome measures among community members were prevalence of MRSA, sample size, number and type of risk factors assessed, number of members with ≥1 risk factor, and MRSA strain type, when available. The studies were grouped based on the population surveyed (surveillance cultures, contacts with MRSA-colonized individuals, or sport team members or day care contacts). The pooled prevalence of MRSA colonization and the proportion of members with ≥1 reported risk factor were calculated for each of the study populations listed above. The proportion of CA-MRSA strains that represented typical nosocomial (infection that develops in the hospital) strains was also determined. Chi-square analysis was performed to compare proportions and to determine heterogeneity among the studies.

Main Results: Specific search criteria identified 104 studies for review, of which 57 met inclusion and exclusion criteria. Thirty-nine studies focused on CA-MRSA among hospital patients who were colonized or infected with MRSA. Of these, 32 groups (27 retrospective, 5 prospective) reported the prevalence of CA-MRSA using clinical specimens. Seven groups identified risk factors of CA-MRSA among patients previously diagnosed with MRSA. Thirteen different definitions of CA-MRSA were used in 31 of these studies, and 8 groups did not report the definitions used. The isolation of MRSA within 48 hours of hospital admission, with or without recent admission to a hospital or long-term care facility, or previous history of MRSA colonization were the most common definitions in the studies.

The risk factors included recent hospitalization (range, 1–24 months before identification of MRSA infection or colonization), recent outpatient visit (usually within 12 months), recent nursing home admission (usually within 12 months), recent antibiotic exposure (range, 1–12 months), chronic illness (eg, end-stage renal disease, diabetes, or malignancy), injection drug use, and close contact with a person who had risk factor(s) for MRSA acquisition. The presence of health care–associated risk factors was examined in 17 of the retrospective studies, and the median number of factors studied was 2 (range, 1–6). Among 4121 patients in these studies, 86.1% were found to have ≥1 health care–associated risk factor. All authors of prospective studies (5) examined health care–associated risk factors, and the median number of factors studied was 4 (range, 2–4). Among the 636 patients, 86.9% had ≥1 health care–associated risk factor. In the 7 studies with 515 patients previously diagnosed with MRSA, 84.7% had ≥1 health care–associated risk factor. The most common risk factors assessed in the 17 retrospective studies were recent hospitalization and chronic illness requiring health care visits.

The pooled CA-MRSA prevalence was 30.2% (range, 1.9%–96%) among 5932 patients from the 27 retrospective studies and 37.3% (range, 18.2%–51.2%) among 636 patients from the 5 prospective studies. Eighteen groups reported the prevalence of MRSA colonization in the community. Ten of these reported MRSA prevalence using surveillance cultures, 4 examined col-

onization status of household contacts with discharged hospital patients with nosocomial MRSA colonization, and 4 reported colonization status of sports team members or day care contacts of persons colonized with MRSA. In the 10 surveillance studies, the pooled MRSA colonization prevalence was 1.3% (95% confidence interval [CI], 1.04%–1.53%; range, 0.2%–7.4%) among 8350 community members. Nine of these studies were stratified based on culture samples taken before the assessment of risk factors, and among 4825 people, the pooled MRSA colonization prevalence was 2.1%. When examining health care–associated risk factors, the median number of factors studied was 5 (range, 1–10), and 47.5% with MRSA had ≥1 health care–associated risk factor. The risk factors included those previously identified. In the remaining surveillance study, the MRSA colonization prevalence was 0.20% among 3525 people without prior health care contact. Compared with subjects in the 9 stratified studies with a health care contact, subjects in this study were 90% less likely to have MRSA (relative risk, 0.10; 95% CI, 0.05–0.21). Cultures for 3898 subjects in 7 of the 10 surveillance studies were obtained at the time of a hospital admission, an outpatient clinic visit, or an emergency department visit, and the pooled prevalence of MRSA colonization was 1.8%. In 3 studies in which cultures were obtained outside of a health care facility (schools, day care centers, homeless shelters, or military bases), the pooled MRSA colonization prevalence among 4452 subjects was reported to be 0.76%. Therefore, subjects in a health care facility were 2.35 times more likely to carry MRSA than were subjects outside of a health care facility (95% CI, 1.56–3.53). In one study examining 94 subjects in a semiclosed community, the prevalence of MRSA colonization was 7.4%. These subjects were 36 times more likely to carry MRSA than were subjects who were not in a semiclosed community (95% CI, 13.7–94.7).

The studies also identified 70 MRSA isolates (pure form of an organism in a microbial culture) from subjects who reported no health care–associated risk factors. Strain typing was performed with 32 isolates, and 29 (91%) isolates were similar to strains identified in hospitals. The colonization status of 191 household contacts of 93 patients with nosocomial MRSA colonization discharged from the hospital was examined in 4 studies. The results demonstrated that 17.8% of the contact subjects were colonized with a strain of MRSA having the same antibiogram (record of the susceptibility of bacteria to antibiotics) as the index case (initial individual with the strain). The authors reported that subjects who had household contacts with MRSA-colonized patients were 14 times more likely to be colonized than were community subjects without a known MRSA contact (95% CI, 9.8–20.1). In 4 studies examining 517 sports team members or day care contacts of persons known to be colonized with MRSA, 5.4% demonstrated colonization of MRSA with the same strain as the index case.

Conclusions: Based on the available data, the prevalence of MRSA among community members without health care–associated risk factors was relatively low. However, 85% of hospital patients diagnosed with CA-MRSA and 47.5% of healthy community members colonized with MRSA were found to have ≥1 health care–associated risk factor. The risk factors identified were recent hospitalization, outpatient visit, nursing home admission, antibiotic exposure, chronic illness, injection drug use, and close contact with a person with risk factor(s). Most MRSA colonization occurred among community members who had health care–associated risk factors or contact with persons with risk factors. The evidence indicated that control of MRSA in the community may require control of MRSA in the health care setting (hospital, health care office, and nursing home). The absence of a standardized definition for CA-MRSA and questions regarding the actual site of colonization versus acquisition should be considered in the interpretation of these findings.

Key Words: infectious diseases

COMMENTARY

Methicillin-resistant *Staphylococcus aureus* (MRSA) has recently emerged as a growing concern and challenge for allied health care providers. Historically MRSA has been linked to patients in hospital or nursing home settings, but outbreaks have been reported among previously healthy members of the community, further increasing the awareness of community-acquired MRSA (CA-MRSA). As a result, many questions exist regarding the prevalence and risk factors associated with the acquisition of MRSA among otherwise healthy community members without the traditional health care–associated risk factors. Although this review investigated the evolving epidemiology of MRSA in the community, questions remain.

Salgado et al presented a number of studies that assessed certain risk factors for MRSA acquisition; these risk factors included recent hospitalization, outpatient visit, nursing home admission, antibiotic exposure, chronic illness, injection drug use, and close contact with a person with risk factor(s). The most common risk factors assessed were recent hospitalization and chronic illness requiring health care visits. Prevalence rates of CA-MRSA were low among community members without health care–associated risk factors, but the rates increased to 85% and 47.5% among hospital patients and community members, respectively, with ≥1 health care–associated risk factor. These results indicated that the presence of risk factors or contact with persons with risk factors contributed to MRSA colonization. These findings have caused concern for the athletic population and are relevant to athletic training practice.

As mentioned previously, recent outbreaks of CA-MRSA have been reported outside of the traditional hospital and nursing home settings, including outbreaks among athletic teams.[1–5] Community-acquired MRSA soft tissue and skin infections have been detected among volleyball, football, fencing, rugby, and wrestling athletes, many without documented health care–associated risk factors. In these outbreaks, environmental sources, such as sharing of clothing, sports equipment, towels, balms, lubricants, razors, and soaps; improper care of skin trauma; direct skin-to-skin contact with MRSA lesions; and crowded living conditions were identified as possible risk factors for MRSA acquisition. In the absence of proper education and preventive guidelines, these risk factors are present in many athletic training facilities, perhaps contributing to CA-MRSA colonization and soft tissue and skin infections. Additional studies are needed to characterize the role of these environmental sources in the transmission of CA-MRSA.

The risk factors for CA-MRSA acquisition reported by Salgado et al apply directly to the athletic training setting. Salgado et al suggested that most MRSA colonization and infection was the result of having health care–associated risk factor(s) or contact with others with risk factors. This may lead those who deliver health care in the athletic setting to question whether athletes are exposed to health care–associated risk factors during the delivery of athletic training services. Although most athletic injuries and/or illnesses do not require hospital-

ization, athletes are often referred to outpatient surgery; physician, rehabilitation, radiology, and laboratory offices; and centers for evaluation and treatment. In addition, those athletes who live in off-campus housing may reside with extended family members who suffer from a chronic illness or have had a recent hospitalization. Athletes may also be exposed to health care–associated risk factors if the on-campus athletic training setting is used to provide treatment and rehabilitation for outpatient orthopaedic patients through hospital and/or rehabilitation clinic personnel. Many of these patients may have had recent hospitalizations or outpatient visits ($\geq$1 risk factor) and frequently share equipment (modalities, therapeutic exercise, soaps, towels, lubricants, balms, etc) with athletes. These situations appear to have the potential to increase athletes' risk for MRSA acquisition and warrant further epidemiologic investigation. Furthermore, we need to develop prevention, detection, and treatment guidelines for facilities and outpatient and athletic populations.

The challenges of prevention and effective control of CA-MRSA remain until the origin and actual site of acquisition are known. Salgado et al stated that effective control of CA-MRSA appears to require effective control of MRSA in the health care setting. In the health care setting, standard precautions[6] consisting of hand washing; gloving, masking, and gowning procedures; and device and laundry handling are recommended for the control of MRSA. In the community, including athletic training settings, the Centers for Disease Control and Prevention[2] recommend the following measures to control CA-MRSA:

- Increase recognition of MRSA infection through prospective surveillance, education of athletes on signs/symptoms and reporting procedures, and coordination of referral services.
- Conduct appropriate treatment of MRSA infections by obtaining cultures, draining abscesses when necessary, and using antimicrobial medications concordant with susceptibility patterns.
- Care for and containment of wounds through education of athletes; use of clean, dry dressings to cover infected wounds; and hand washing after contact with wounds.
- Promote enhanced personal hygiene by encouraging hand washing and bathing/showering among all athletes and staff, using antimicrobial soaps (liquid if possible) and alcohol-based hand gels and limiting sharing of personal items such as razors and towels.
- Exclude athletes from routine activities if proper hand and personal hygiene and wound coverage cannot be assured, and exclude athletes from whirlpools and common-use water facilities if open wounds are present.
- Maintain a clean environment by performing cleansing duties consistent with manufacturers' recommendations and target cleaning of areas and equipment where known MRSA-infected individuals had recent contact.

This review by Salgado et al has several limitations. The search was limited to English-language investigations, which may have introduced bias by excluding non–English language studies. The authors did not comment on the potential bias. The groups examining the prevalence of CA-MRSA among hospitalized patients did not report the total number of patients for whom cultures were obtained. As a result, the calculated CA-MRSA prevalence is limited to the prevalence of hospitalized patients with MRSA. Salgado et al stated that simple pooling of the data may be a limitation because of the heterogeneity among the surveillance cultures of community members. Thus, the reported prevalence from the surveillance cultures was calculated following stratification based on the methodologic differences.

A consistent definition of CA-MRSA has yet to be established. Salgado et al reported that at least 8 different definitions were used to classify MRSA infections as community acquired, possibly contributing to the heterogeneity among the studies. Colonization of MRSA can persist for months to years, and most patients remain asymptomatic.[7,8] Salgado et al stated that acquisition of MRSA may go unrecognized unless clinical infection develops, and the infection may develop in a setting different from that in which actual acquisition occurred. Salgado et al suggested that the current use of the term *CA-MRSA* (community-acquired) implies that the true site of acquisition is known to be in the community. However, they stated that the term refers to the detection of colonization or infection in the community rather than actual acquisition in the community. Salgado et al proposed the term *community-onset MRSA* to describe the location of the patient at the time at which MRSA was identified.

The terms *community-acquired* and *community-associated* have been used to classify CA-MRSA. Currently, the Centers for Disease Control and Prevention[2,4] prefer the term *community-associated* because of the difficulty of establishing the origins of MRSA strains in the community. Most MRSA outbreaks among athletic teams[1–5] have been linked to community-associated strains. These strains are distinct from other MRSA strains with regard to molecular characteristics (type of strain), clinical spectrum (type and location of infection), epidemiology (location of outbreaks), and resistance pattern (susceptibility to antibiotics).

The results of this review indicate that the prevalence rates of CA-MRSA were low among community members without health care–associated risk factors. However, the presence of risk factors or contact with persons with risk factors may contribute to MRSA colonization. It appears that the development and use of a standard definition of CA-MRSA to classify MRSA infections is warranted. Investigations that include molecular typing techniques to identify isolates of CA-MRSA strains could assist in the development of a standard definition. Community-based surveillance studies among randomly selected healthy members to examine risk factors are required to understand how MRSA is transmitted in the community. Additionally, studies determining the prevalence and risk factors of MRSA in the athletic setting are needed to further educate athletic trainers. The development of an epidemiologic surveillance system or the addition to an existing system among high school, collegiate, and professional sports would identify CA-MRSA prevalence and risk factors in the athletic setting. From these findings, appropriate prevention, referral, and control guidelines could be developed.

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