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Practices and Procedures to Prevent the Transmission of Skin and Soft Tissue Infections in High School Athletes

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Abstract

Skin and soft tissue infections (SSTI) are frequent in student athletes and are often caused by community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA). We evaluated the awareness of CA-MRSA among high school coaches and athletic directors in Missouri (n = 4,408) and evaluated hygiene practices affecting SSTI transmission. Of 1,642 (37%) respondents, 61% received MRSA educational information during the past year and 32% indicated their school had written guidelines for managing SSTI in athletes. Coaches and athletic directors aware of written guidelines reported a lower incidence of SSTI in student athletes (26%) compared to those without written policies (34%, p=0.03). When confronted with SSTI, 49% of respondents referred student athletes to the school nurse or a physician. A relationship exists between school policies for SSTI management and lower incidence of SSTI. Educational initiatives by school nurses in conjunction with athletic staff may lead to practices that limit SSTI in this at-risk population.

INTRODUCTION

Outbreaks of skin and soft tissue infections (SSTI), including abscesses, boils, and cellulitis, have been reported with increasing frequency among high school, college, and professional athletic teams (Bowers, Huffman, & Sennett, 2008; Kazakova et al., 2005; Lindenmayer, Schoenfeld, O'Grady, & Carney, 1998; Nguyen, Mascola, & Brancoft, 2005). Many of these infections are caused by a "superbug" which has emerged over the past decade, designated community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA) (Fridkin et al., 2005; Okuma et al., 2002). Prior to the last decade, MRSA was historically limited to individuals with exposure to healthcare settings, including hospital intensive care units and nursing homes (Klevens et al., 2007; Naimi et al., 2003). However, these new CA-MRSA strains affect otherwise healthy individuals. Novel CA-MRSA strains spread rapidly and

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produce toxins which result in more severe infections (Diep, Sensabaugh, Somboona, Carleton, & Perdreau-Remington, 2004; Kaplan, 2006). Many patients require painful drainage procedures to treat these infections, which result in subsequent scarring as well as lost time from school and work. While CA-MRSA most frequently causes SSTIs, rarely this germ causes severe, invasive infections, resulting in the need for hospitalization and prolonged antibiotic therapy (Gonzalez et al., 2005; Pannaraj, Hulten, Gonzalez, Mason, & Kaplan, 2006).

Skin integrity provides the primary defense against CA-MRSA infections (Miller & Diep, 2008). Breaks in skin integrity provide a portal of entry for microbes, especially when one is in close contact with an MRSA-infected individual or with a surface that is contaminated with MRSA. Athletes frequently develop skin abrasions, have close physical contact with one another, and may share contaminated athletic equipment or personal hygiene items, and thus are at increased risk for developing CA-MRSA infections (Benjamin, Nikore, & Takagishi, 2007; Cohen, 2005; Kazakova et al., 2005; Lindenmayer et al., 1998; Nguyen et al., 2005). In response to this important public health problem, the U.S. Centers for Disease Control and Prevention (CDC) and the National Federation of State High School Associations (NFHS) Sports Medicine Advisory Committee have made recommendations to control the transmission of CA-MRSA among student athletes. Guidance includes covering all wounds, showering and washing with soap after all practices and competitions, discouraging sharing of personal items, establishing routine cleaning schedules for shared equipment, encouraging athletes to report skin lesions to coaches, and encouraging coaches to assess athletes regularly for skin lesions (Centers for Disease Control and Prevention, 2010b; National Federation of State High School Associations Sports Medicine Advisory Committee, 2007).

The numerous reports of athletes afflicted with CA-MRSA skin infections may reflect a low awareness of the risk of CA-MRSA transmission among athletes and infrequent employment of intervention strategies to prevent transmission. To date, the majority of research focusing on CA-MRSA SSTI in athletes has been conducted at the collegiate and professional level. The objectives of this study were to determine the awareness of CA-MRSA among high school coaches and administrators; determine whether recommended measures aimed at preventing CA-MRSA and SSTI transmission are performed by high school coaches and student athletes; identify barriers to implementing measures aimed at preventing CA-MRSA and SSTI transmission; and evaluate the frequency and management of SSTI among high school student athletes.

METHODS

Subjects

Coaches and athletic directors (n = 4,408) whose schools were members of the Missouri State High School Activities Association (MSHSAA) (n=590) were eligible for participation. MSHSAA is a voluntary membership organization of public and private secondary schools in Missouri with any combination of grades 7–12. Respondents were asked to choose one sport for which to complete the survey, but multiple individuals from each school could complete the survey, even for the same sport. This study was exempted by the Washington University Human Research Protection Office and was approved by the St. Louis College of Pharmacy Institutional Review Board. Completion of the survey by participants implied their consent for study involvement.

Data Collection

Surveys were administered to evaluate the knowledge of the coaches and athletic directors regarding CA-MRSA and school policies aimed at limiting the spread of SSTI. In addition, the instrument sought to assess the hygiene practices performed by coaches and athletic directors with their teams of student athletes as well as barriers to performing these measures. Specifically, respondents were asked which sport, gender, and level of competition they coach. The survey inquired about the resources provided to student athletes in locker rooms and at practice or competition (e.g., hand sanitizer, towels, and soap). Coaches were questioned about showering requirements for student athletes at the school following practice or competition, whether coaches practice hand hygiene under a variety of circumstances (e.g., contact with blood or body fluids), and the cleaning frequency of various sports equipment. We assessed the frequency which student athletes are examined for skin infections, what advice is given to those suspected of having infections, and the management of cuts and abrasions during practice and competition. Coaches reported the number of student athletes they coached, the proportion of these athletes that developed a skin infection during the most recent season, and the number referred to seek medical attention for a skin infection. Finally, the survey examined the presence at each school of written guidelines for managing skin infections in athletes, whether each coach had received any educational information about MRSA in the last year, and if applicable, the source of this information.

An Internet-based survey (Qualtrics, Provo, UT) was distributed via e-mail to coaches and athletic directors in November and December 2009. The survey, developed by the authors, consisted of 41 questions, including 2 4-point Likert-scale questions, 6 open-ended questions, 14 multiple choice questions, and 19 yes/no questions. Three contacts were made to prospective respondents: a pre-notification e-mail from MSHSAA several days before the survey was distributed which provided their endorsement of the study and ensured the confidentiality of all respondents; an e-mail from MSHSAA with a link to the survey; and a follow-up e-mail reminder from MSHSAA with another link to the web-based survey. All communication noted that the research was being conducted by investigators who were not affiliated with MSHSAA and that answers would be confidential. Participants were offered the opportunity to enter a drawing for non-cash prizes.

Data Analysis

Quantitative analysis was conducted using SPSS version 17 (SPSS, Chicago, IL). Frequencies of responses to survey questions were calculated for all study variables and are reported as percentages in the results paragraphs, tables, and figures. Percentages were tabulated out of the number of respondents answering each individual question and not the entire sample (as not all respondents answered every question). All analyses of dichotomous variables were bivariate and performed using Fisher's exact test. These comparisons included receipt of information about MRSA by the coaches and their awareness of school guidelines for SSTI management; coaches' awareness of school guidelines for SSTI management and incidence of SSTI in their student athletes; and all comparisons between coaches of wrestling and football with coaches of other sports. The dataset was then restricted to coaches of wrestling and football teams and results are reported in the sub-analysis section.

RESULTS

Study Population

Of the 4408 surveys sent electronically, 1642 (37%) coaches and athletic directors responded. Respondents represented diverse geographical locations across the state of

Missouri and a wide variety of sports (Table 1). Forty-five percent of respondents coached at small schools (Class I or Class II), 25% at medium-sized schools (Class III), and 30% at large schools (Class IV and V). Forty-two percent of respondents reported having at least one part-time or full-time athletic trainer for his or her sport.

Awareness

Of 1477 coaches and athletic directors who responded, 896 (61%) indicated that they had received educational information regarding MRSA over the past 12 months; 342 (23%) noted that they had not received any MRSA information and 239 (16%) were unsure whether they had received MRSA information. The most frequent source of MRSA information was the MSHSAA. Other sources included other coaches' organizations, state and local health departments, the CDC, and school personnel (Figure 1). Of those receiving MRSA informational materials in the past 12 months, 574 (64%) indicated that they had shared the MRSA-related information with student athletes, and 431 (48%) indicated that the information was shared with the athletes' parents.

Thirty-two percent (476/1472) of coaches and athletic directors indicated that their school had written guidelines for managing SSTI in athletes, while 25% (363) said their school had no policy, and 43% (633) did not know if their school had a policy. Coaches who reported receiving informational materials about MRSA were more likely to report having written school guidelines for managing SSTI in athletes than coaches who did not recall receiving informational materials about MRSA (62% vs. 42%, $p < 0.001$ by Fisher's exact test).

Preventive Measures

NFHS and CDC guidelines to prevent SSTI transmission among athletes recommend showering after practice and competition, using liquid soap rather than bar soap, and discouraging athletes from sharing towels and personal hygiene items. Most coaches and athletic directors indicated that their locker room facilities were equipped with showers. Liquid soap and alcohol based hand sanitizer were available in about half of all locker rooms and a minority of schools provided towels and bar soap to their student athletes (Table 2). Only 5% (80/1571) of respondents reported that athletes were required to shower with soap at the school after practice or competition; of these, 35% indicated that the student athletes actually did shower after a practice or competition (28/1571, 2% of all respondents).

Another aspect of prevention is good hand hygiene by student athletes and coaches during practices and competition. Hand sanitizer was reportedly available to 38% of student athletes during practice or competition. Most respondents (83%) reported "always" washing their hands during practice and competition after contact with blood, and many (63%) reported "always" washing their hands after contact with infected, scraped, or cut skin. Of the 549 respondents who gave reasons for not washing their hands during practice or competition after contact with blood or cut skin, the most frequent reasons were inconvenience of the sink location (84%), lack of time (57%), and unavailability of an alcohol-based hand sanitizer (49%). Other reasons provided by coaches for not washing their hands included not wanting to leave athletes unattended, always wearing protective gloves when dealing with blood, and leaving the care of injuries to athletic trainers.

SSTI Screening and Management

The CDC recommends that skin infections and wounds should be covered with clean, dry bandages until healed to prevent spread of infection to others. Nearly half of the coaches reported never examining the student athletes for SSTI, and only a small minority reported examining them on a daily basis (Figure 2). When presented with a minor cut or abrasion, most respondents required athletes to disinfect and cover the wound before returning to

practice; few held the athlete from practice for the day (Figure 3). When confronted with SSTI, 25% of coaches referred the student athlete to the school nurse and 24% suggested the athlete consult a physician (Figure 4).

Over the past season, 681 SSTIs were reported for the 31,622 student athletes (2%) by the 1136 responding coaches and athletic directors; 75% of the respondents claimed no SSTI had occurred in their athletes (Table 3 lists the prevalence by sport). Twenty-three percent (263) of those responding reported 1–5 SSTI occurring on their teams, 1% (14) reported between 6–10 SSTI, and 0.5% (6) reported between 11–15 SSTI. Coaches of football and wrestling teams reported the highest number of SSTI. Overall 301/1376 (22%) coaches and athletic directors reported referring an athlete to a physician or emergency department (ED) for SSTI management during the prior season (Figure 5). Coaches and athletic directors who were aware of written guidelines for SSTI at their school reported a lower incidence of SSTI in their student athletes (99/386, 26%) compared to those whose school did not have a written policy (92/273, 34%, $p=0.03$ by Fisher's exact test).

Sub-analysis of Wrestling and Football Teams

Twenty-nine percent of all student athletes represented in the survey participated in football or wrestling, but wrestling and football coaches reported the majority of SSTIs (398/681, 58%) (Table 3). The following data represent a sub-analysis of answers provided by coaches of wrestling and football teams. Eighty-three percent (65/78) of wrestling and 40% (70/176) of football coaches reported referring a student athlete to the ED or a physician's office for an SSTI during the prior season, compared to 15% of the coaches from all other sports (wrestling and football vs. all other sports, $p<0.0001$ by Fisher's exact test, Figure 5).

Wrestling and football coaches were more likely to report receiving educational information about MRSA (77%) than coaches of other sports (57%, $p<0.0001$, Table 4). While only 2% of coaches of other sports reported that student athletes were required to shower with soap at the school after practice or competition, 18% of wrestling and football coaches required showers ($p<0.0001$); of these, 43% indicated that the athletes actually did shower after a practice or competition. Wrestling and football coaches were less likely to report “always” washing their hands after contact with blood (72%) or infected or cut skin (51%) than other coaches (86%, $p<0.0001$ and 65%, $p<0.0001$, respectively). Athletes were checked more frequently for SSTI by football and wrestling coaches than by other coaches (Figure 2). While only 6% of coaches in other sports checked their student athletes daily for SSTI, 21% of football and wrestling coaches performed daily checks ($p<0.0001$).

The NFHS recommends washing all work-out gear after practice or competition and states that some sports equipment (e.g., mats) requires cleaning before each practice or event. Almost all football and wrestling coaches indicated that their athletes used weight training equipment, helmets, and protective pads (Table 5). However, 44% of football coaches indicated that their athletes' helmets were not regularly cleaned and 40% reported that protective pads were not cleaned regularly. Head gear was reportedly not regularly cleaned by 25% of wrestling coaches, although 100% reported that mats were cleaned daily or after each use. In general, the primary responsibility for cleaning pieces of shared equipment rested with the janitor, athletic trainer, or coach, whereas the athlete was responsible for his personal protective equipment (Table 5). Many respondents were unsure about the frequency with which the equipment was cleaned. Ice packs seemed to be a special case in which disposable equipment was frequently used. Only 22% of football and wrestling coaches reported that student athletes were issued an individual water bottle. Twenty-seven percent of football and wrestling coaches stated that athletes had one or fewer personal uniforms provided by the school.

DISCUSSION

CA-MRSA SSTIs are frequently reported in student athletes, especially those participating in sports with high physical contact. Despite guidelines from the NFHS and CDC, the respondents in this study reported that many of the practices recommended to prevent the spread of CA-MRSA SSTI are not performed by coaches, administrators, and student athletes. The lack of showering requirements for athletes, the failure by some coaches to practice adequate hand hygiene, and the large percentages of protective pads and head gear that were not regularly cleaned were of particular note. Coaches and student athletes face barriers to perform preventative measures, including infrequent provision of alcohol-based hand sanitizer during practices or competition, and lack of soap, towels, and privacy in showering facilities. In addition, few coaches regularly checked athletes for the presence of skin infections.

Prior studies of collegiate athletes have demonstrated an association between the implementation of policies to prevent SSTI in athletes and a reduction in the rate of SSTI (Romano, Lu, & Holtom, 2006; Sanders, 2009). In the present study, only one-third of respondents reported having knowledge of a school policy for managing SSTI in student athletes; coaches and athletic directors at schools with written guidelines were less likely to report SSTI among their athletes than those without a written policy. This finding suggests that there is a relationship between the existence of a school policy for SSTI management and a lower incidence of SSTI. A school policy may be one component of a multilevel approach to combating the CA-MRSA epidemic in athletes, although further studies are needed to define this relationship.

Although national data are not available, a state-wide epidemiologic survey of high school officials in Nebraska identified a confirmed MRSA infection in one or more student athletes in 4.4% of schools (19 total athletes) during the 2006–2007 school year, which rose to 14.4% of schools (72 total athletes) during the 2007–2008 school year. MRSA infections occurred among football players and wrestlers with the highest frequency (Buss, Mueller, Theis, Keyser, & Safranek, 2009), which is in accordance with previous research that has noted outbreaks of CA-MRSA SSTIs among football and wrestling teams. In prior studies of CAMRSA SSTI in athletic teams, skin to skin contact, skin damage including preexisting cuts or abrasions, increased BMI, infrequent access to alcohol-based hand sanitizers, sharing contaminated equipment, and sharing personal hygiene items (e.g., bars of soap, razors, and towels) have been associated with these outbreaks (Hall, Bixler, & Haddy, 2009; Kazakova et al., 2005; Lindenmayer et al., 1998; Nguyen et al., 2005). Consistent with these studies, we also found the highest reported infection rates in student athletes participating in wrestling and football, whose sports promote skin to skin contact, facilitate the use of shared equipment, and inflict cuts, abrasions, and scratches on their participants.

MRSA is able to survive on environmental surfaces for prolonged periods of time (Huang, Mehta, Weed, & Price, 2006; Stanforth, Krause, Starkey, & Ryan, 2010). A recent prevalence study of rural high schools in Ohio detected the presence of CA-MRSA strains on 89% of wrestling mats and 78% of locker room benches (Stanforth et al., 2010). The presence of MRSA on these surfaces promotes transmission of the organism between athletes, placing them at risk for colonization and development of infection. Thus, the CDC recommends that shared equipment should be cleaned and allowed to dry after each use. In addition, cleaning procedures should focus on surfaces that commonly come into direct contact with bare skin (Centers for Disease Control and Prevention, 2010a). In the present study, the frequency of environmental cleaning was less than optimal as less than half the respondents reported that weight training equipment and whirlpools were cleaned daily or

after each use. However, reports of daily cleaning of wrestling mats by 100% of wrestling coaches is encouraging.

This study has several limitations. Although we asked coaches about the frequency of SSTI in their athletes, we did not provide a specific case definition and we were not able to verify the diagnoses. We also do not know that the infections were indeed caused by CA-MRSA, although local data suggests that MRSA is the etiology of >80% of community-onset SSTIs in our community (Orscheln et al., 2009). In addition, this was a study that required participants to remember infections and hygiene practices during the course of the most recent season. Depending on the sport, respondents may have had to remember incidents that happened several months before, and thus recall bias may have been introduced. The survey was completed by 37% of the coaches and athletic directors affiliated with MSHSAA, a response rate consistent with prior e-mail and Internet-based surveys (Cook, Heath, & Thompson, 2000). While not all respondents answered all survey questions, information was missing at random, and thus we do not believe the missing responses introduced bias. The findings of this study may be generalizable to similar settings, perhaps limited by geographic variation in prevalence of CA-MRSA colonization and by a lack of national data.

At present, we lack a comprehensive understanding of factors driving CA-MRSA transmission among athletes. Better data regarding the relationship between hygiene practices, and the presence and relative importance of CA-MRSA in the athletic environment, in relation to CA-MRSA SSTI, are needed. Future studies to identify targets playing a key role in CA-MRSA transmission are required to design interventions to ultimately block the spread of CA-MRSA and prevent disease (Liu et al., 2011). Also illuminating would be a study of whether structured education and outreach efforts would have an impact on SSTI incidence in this population.

IMPLICATIONS FOR SCHOOL NURSING PRACTICE

School nurses, administrators, coaches, and athletic trainers all play an important role in establishing a safe environment for student athletes. School nurses possess expertise which uniquely positions them to raise awareness about the threat of CA-MRSA. School nurses play an important role in providing education to student athletes, coaches, and athletic directors about measures to prevent MRSA transmission, including frequent hand hygiene, showering after participation in contact sports, avoiding the sharing of personal hygiene items, proper cleaning of personal and shared equipment, encouraging athletes with infections to seek proper medical treatment in a timely fashion, and keeping athletes out of practice or competition if they have a draining wound that cannot be contained (Benjamin et al., 2007; Many, 2008). Our survey demonstrates that school nurses are the primary contact for coaches and student athletes upon discovery of a skin infection. Thus, school nurses also have an opportunity to play a proactive role in early infection detection through routine screening of student athletes for SSTI or providing education for coaches and athletic trainers. Not only are school nurses key in individual infection assessment and management, they also play an essential role in infection control. The drainage from CA-MRSA skin infections is highly contagious, and thus, an infected student athlete may serve as a reservoir for transmission to other students. Due to the facile transmissibility of CA-MRSA and SSTI, when an infection has been detected, it is important to implement preventive efforts to halt the spread of CA-MRSA. School nurses can notify school officials to monitor student athletes for additional infections, encourage preventive hygiene efforts, and participate in the decision of when an athlete may resume athletic practice and competition.

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Figure 1.
Sources of MRSA Information; N=896.

Figure 2.

Frequency which student athletes are examined for skin infections by coaches. The black bars represent the percentage of the entire sample of respondents (N=1469) examining athletes at each frequency. The dark and light grey bars represent the percentage of football (N=189) and wrestling (N=82) coaches, respectively. The white bars represent the percentage of respondents coaching sports other than football and wrestling (N=1198).

Figure 3.
Coaches Actions When Confronted with a Student Athlete with a Minor Cut or Abrasion;
N=1478

Figure 4.

Advice given to student athletes by coaches when confronted with possible SSTI; N=1461.

Figure 5.
Percent of coaches reporting referral of at least one student athlete to the emergency department or to a physician for possible SSTI during the most recent season; N=1376.

Table 1

Sports Represented by Survey Respondents, N=1642

Sport	% of Respondents
Basketball	24
Football	13
Volleyball	9
Baseball	8
Softball	8
Track and field	8
Soccer	7
Wrestling	6
Cross country	5
Golf	4
Tennis	4
Swimming	3

Cheerleading, field hockey, lacrosse, dance, hockey, and water polo were each represented by <1% of respondents

Table 2

Availability of Locker Room Hygiene Resources

Resource	N (%)
Showers	1388/1561 (89)
Hand sanitizer	686/1513 (45)
Liquid soap	843/1521 (55)
Bar soap	217/1473 (15)
Towels	202/1502 (13)

Table 3

Proportion of Athletes with SSTI, by Sport

Sport [*]	Number of Athletes, N	Reported Number with SSTI, N (%)
Field hockey	112	4 (4)
Football	6990	156 (2)
Hockey	90	3 (3)
Softball	1663	43 (3)
Volleyball	2416	63 (3)
Wrestling	2252	242 (11)

^{*} Only sports with at least 2% of athletes affected are included in the table.

Table 4

Comparisons of Responses Reported by Wrestling and Football Coaches Versus All Other Coaches

	Sport Coached		p [*]
	Wrestling and Football, N (%)	All Other Sports, N (%)	
Received info about MRSA	208/270 (77)	683/1199 (57)	<0.0001
Require athletes to shower with soap at school after practice/competition	51/281 (18)	28/1143 (2)	<0.0001
“Always” wash hands after contact with blood	201/281 (72)	1062/1235 (86)	<0.0001
“Always” wash hands after contact with infected or cut skin	140/276 (51)	804/1229 (65)	<0.0001
Check athletes daily for SSTI	57/271 (21)	67/1198 (6)	<0.0001

* comparisons made using Fisher's exact test

Table 5

Use and Cleaning of Equipment by Wrestling and Football Athletes

Equipment	Wrestling					Football				
	Use, % (N)	Responsible for Cleaning, %*	Cleaning Frequency, %			Use, % (N)	Responsible for Cleaning, %*	Cleaning Frequency, %		
			Daily or every use	Weekly	Not regularly			Daily or every use	Weekly	Not regularly
Weight Training Mats	92 (79/86)	Janitor: 29 Coach: 61	42	15	8	98 (192/197)	Janitor: 37 Coach: 47	41	25	17
Helmets	100 (86/86)	Athlete: 89	100	0	0	51 (101/197)	Athlete: 66	50	12	14
Protective Pads	99 (85/86)	Athlete: 77	12	28	23	96 (189/198)	Athlete: 62	7	19	44
Whirlpools	81 (70/86)	Trainer: 50	13	31	16	96 (189/198)	Coach: 37	8	22	40
Ice Packs	23 (20/86)		50	5	5	31 (60/197)		44	19	12
	63 (54/86)		N/A - Disposable			73 (143/196)	N/A - Disposable			

* Most frequent response