Bacterial Sport-Related Skin and Soft-Tissue Infections (SSTIs): An Ongoing Problem Among a Diverse Range of Athletes

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Abstract

» Skin and soft-tissue infections have become increasingly common in the sports world. Recent reports have shown that these infections are prevalent throughout all arenas of sport, and efforts to decrease colonization of bacteria and fungi are now essential for preventing the development of SSTIs.

» Education on cleansing and hygiene are a vital part of this process, and, as such, the team physician and the team athletic trainers play an important role in the education of the athlete and all members of the athletic team.

» The impact of SSTIs on individuals and the athletic team may be severe and have the potential for notable consequences, including loss of playing time, hospitalization, and even surgery. Continued efforts to better understand and to prevent the development of SSTIs are paramount.

Skin and soft-tissue infections (SSTIs) often occur in athletes during training for competitive sports or during actual competition, and the majority of these infections are bacterial or fungal in origin. SSTIs can have an immediate impact on athletic eligibility and could threaten the ability to compete or to participate in games during the course of a single season or an entire career. The consequences resulting from restricted participation due to an SSTI may impact win-loss records as well as financial incentives such as scholarships or contracts. In addition to athletes who participate in competitive sports, millions of people regularly visit fitness centers or recreational gymnasiums in an attempt to stay fit and healthy. Studies have shown that these gymnasiums are sources of large quantities of bacteria that could cause SSTIs, which may then impact the lives and work of many people in any community.

The present review describes the mechanisms by which bacterial SSTIs occur in healthy athletes, the prevalence of SSTIs among players in various sports (including the effect of player position and the sites of the body commonly infected in each sport), the mechanisms by which SSTIs are spread, and hygiene measures that are recommended to prevent the spread of infection. Extrapolating these lessons into the general population of so-called weekend warriors or fitness enthusiasts may then help us to better understand, prevent, and treat these increasingly complicated infections.

Mechanisms by Which SSTIs Occur in Healthy Athletes

Studies of the human microbiome have shown that billions of bacteria, fungi, and other microbes inhabit the skin and that these microorganisms vary between individuals and between different sites on the skin. The Disclosure: There was no external funding source. The Disclosure of Potential Conflicts of Interest forms are provided with the online version of the article.
皮肤因素。微生物“生物膜”可能延伸数厘米远，离开皮肤表面，受到温度、湿度、风和运动的影响。这些区域的微生物群落取决于周围环境。皮肤、皮脂腺浓度、湿度、温度、宿主基因以及环境因素（包括卫生习惯）对每个社区有影响。

最近一项研究显示，皮肤接触运动参与者的皮肤微生物群落表明皮肤与皮肤的接触比非接触运动如高尔夫、交叉训练和足球更常见。结果显示，参与接触运动（如美式足球、摔跤、篮球、橄榄球和棒球）的运动员相比，153名运动员参与非接触运动。这项研究由Jiménez-Truque等人进行。11

Mechanisms by Which SSTIs Are Spread

皮肤感染是广泛存在于各种运动中，重要的是要理解传播模式和预防方法。传播的细菌组织通常结果从皮肤到皮肤的接触与一个人有 SSTI，如以往所述。因此，SSTIs 常见于运动员，参与接触运动，如那些与皮肤到皮肤的物理接触是隐性的。运动员在这些Collision 或接触运动中参与

非接触运动员的鼻窦（前鼻腔）27、上气道、消化道、皮肤和生殖道中常见的细菌和真菌被污染，可能影响 SSTI 传播，包括水壶、制服、剃须用品、漩涡池、游泳池等。在 SSTI 传播中，应特别注意对皮肤和皮肤粘膜的伤害。这可能对携带者构成立即风险；非接触性鼻窦（后鼻腔）的无症状性传播并不总是会导致感染3,4,23,24。

S. aureus Infections in the Athletic Population

S. aureus 是最常在所有运动员群体中分离的细菌病原体，并应特别注意。S. aureus 可能导致广泛的感染，包括从皮肤到皮肤的接触，使 S. aureus 可能导致更严重的侵袭性感染，甚至可能致命。最近，S. aureus 感染已证明对甲氧西林敏感的金黄色葡萄球菌（ MSSA）25,26。最常被 MRSA 感染的运动包括排球、足球、棒球和篮球。在 SSTI 感染中，应特别注意导致甲氧西林耐药金黄色葡萄球菌（ MRSA）的风险。尽管 MRSA 感染中，20% 到 30% 的人群是异源性感染，但 MSSA 感染中是异源性感染，原因可能是皮肤或皮肤粘膜的接触引起感染。当皮肤和皮肤粘膜的接触引起感染时，身体会表现出对环境的敏感性，微生物可以通过皮肤粘膜的接触导致感染。

Mechanisms by Which SSTIs Are Spread

SSTIs 是广泛存在于各种运动中，重要的是要理解传播模式和预防方法。传播的细菌组织通常结果从皮肤到皮肤的接触与一个人有 SSTI，如以往所述。因此，SSTIs 常见于运动员，参与接触运动，如那些与皮肤到皮肤的物理接触是隐性的。运动员在这些Collision 或接触运动中参与 ERP e4 JANUARY 2017 · VOLUME 5, ISSUE 1 · e4
However, beginning in the late 20th century, epidemiologists and physicians noted a substantial increase in MRSA infections among healthy people in the general population, and especially in athletes (Fig. 2)\textsuperscript{29-33}. A recent survey of 364 members of the National Athletic Trainers Association revealed that more than half (53%) of all athletic trainers had treated MRSA infections in their athletes, with the majority (92%) being SSTIs\textsuperscript{30}. The dramatic increase in community-acquired MRSA (CA-MRSA) has necessitated a need for orthopaedic surgeons to become more familiar with the identification of the organism and to develop an awareness of treatment algorithms\textsuperscript{29}.

CA-MRSA and HA-MRSA are characterized by their genetic mechanisms of resistance and virulence. Two separate components define the CA-MRSA bacterial strains. The first component, which is similar to that seen in HA-MRSA, allows for resistance to antibiotics such as methicillin and other beta-lactam agents. The second element, atypical of HA-MRSA, is a cytotoxin that enhances tissue necrosis. The latter is of most concern and is thought to come from a virulent protein factor known as Panton-Valentine leukocidin (PVL). Several studies have shown this protein to be present in nearly all known CA-MRSA strains but in \(<5\%\) of HA-MRSA isolates\textsuperscript{31-33}. The PVL cytotoxin has the ability to lyse white blood cells and to cause necrosis of mucosa and skin. This property likely allows many CA-MRSA infections to progress to abscess formation and to transmit infection through exposed soft tissue\textsuperscript{31-33}.

Despite the preponderance of \textit{S. aureus} and CA-MRSA in athletes, other infections are also common and can present similar challenges. In the following sections, we will review common types of bacterial infections among a myriad of professional and recreational athletes.

\textbf{Prevalence of SSTIs Among Players in Various Sports}

\textbf{American Football Professional}

Bacterial infections have been widely reported among professional football players. The media have noted a large number of MRSA infections in National Football League (NFL) players, including members of the Cleveland Browns\textsuperscript{34-36}, New York Giants\textsuperscript{37}, Miami Dolphins\textsuperscript{37-39}, Tampa Bay Buccaneers\textsuperscript{37-39}, Washington Redskins\textsuperscript{40}, Indianapolis Colts\textsuperscript{41}, and New England Patriots\textsuperscript{42}. Despite this wide reporting, we found only 2 reports on MRSA SSTIs outside of the lay press\textsuperscript{43,44}.

Throughout the course of 1 season, 8 MRSA infections were found in 5 (9\%) of 58 St. Louis Rams players\textsuperscript{43}.

![](image1.png)

\textbf{Fig. 1}

Left: Clinical photograph of the left side of the face and neck of a patient presenting with impetigo caused by an \textit{S. aureus} infection. Right: Clinical photograph of the left axilla of a patient presenting with the same infection.

![](image2.png)

\textbf{Fig. 2}

Clinical photograph demonstrating the typical presentation of MRSA abscesses on the ventral surface of the abdomen of a member of a recreational gymnasium.
Infections were noted at the sites of skin lesions (turf burns) over the elbows, knees, or arms (Fig. 3) of offensive linemen, defensive linemen, and 1 linebacker. All of these infections eventually required operative treatment with incision and drainage as they failed to respond to antibiotic treatment and evolved into abscesses measuring 5 to 7 cm in diameter. While none of the players required hospital admission, 3 players missed between 1 and 12 days (total, 17 working days) of competition secondary to treatment of the infection. These findings are not necessarily unexpected as a recent cohort study revealed that players participating as linemen or linebackers demonstrated a significantly increased relative risk of infection with MRSA (10.6 [95% confidence interval (CI), 1.3 to \( \infty \)], \( p = 0.02 \)) when compared with players in skill positions such as quarterbacks or running backs\(^4\). Players with cutaneous MRSA infections demonstrated significantly higher body-mass indices (BMIs), and had more frequently used antibiotics during the prior 12 months (relative risk, 7.8; 95% CI, 0.5 to \( \infty \)) than those who completed the season without evidence of infection, although the difference was not significant\(^4\).

In an attempt to avoid, treat, and prevent MRSA outbreaks during NFL competition, 108 players and associated personnel from the San Francisco 49ers underwent index nasal swabs at the start of the season and had follow-up cultures of specimens from wounds and nares in cases of suspected MRSA infections throughout the season\(^4\). Despite this careful surveillance program and aggressive preventative measures to limit the spread of bacteria, 5 (4.6%) of the 108 individuals were found to have new-onset culture-confirmed MRSA skin infections throughout the season. None of these 5 team members had MRSA-positive nasal cultures during index testing, suggesting the difficulty of controlling spread in such high-contact environments.

**College**

MRSA outbreaks among college football teams also have been well documented in the literature\(^1\)\(^\text{-}\)\(^5\)\(^3\). In 2000, a MRSA SSTI outbreak occurred in 10 members of a collegiate football program in Pennsylvania\(^5\). Seven (70%) of the affected patients required hospitalization and intravenous antibiotics to treat the infection. These MRSA infections were thought to be associated with minor skin trauma resulting from turf abrasions or shaving and the sharing of un laundered shower towels. Similarly, 2 players from a collegiate team in Los Angeles were hospitalized for the treatment of MRSA skin infections within the same week during the 2002 season\(^5\). One of these players did not respond to antibiotic therapy and required extensive surgical debridement, leading to a subsequent skin-grafting procedure for cutaneous coverage. Players from that team reported infrequent treatment or coverage of cutaneous wounds (occurring only 50% of the time), despite frequent and recurrent trauma to the skin. Staff from the team further suggested that the sharing of skin balms and lubricants contributed to the spread of infection.

Between 2000 and 2010, multiple cases of MRSA infections were reported throughout an array of collegiate teams. While many were simple skin infections that were treated with oral antibiotics, there were several reports of small abscesses requiring surgical decompression as well as 1 case of necrotizing fasciitis leading to multiple surgical interventions and prolonged hospitalization\(^1\)\(^\text{-}\)\(^4\). The majority of infections occurred in areas of exposed skin, and common sites of infection included the elbow, knee, leg, and forearm. In situations in which infections occurred in areas typically covered by clothing (e.g., thigh or torso), transmission was attributed to at least biweekly
sharing of a cold tub or whirlpool. The prevalence of infection was higher in linemen and linebackers, which was postulated to be consistent with substantial skin-to-skin contact relating to play at these positions. Other risk factors found to be associated with MRSA transmission included abrasions from turf or artificial playing surfaces (turf burns) and shaving of body hair. An overview of these groups is shown in Table I.

Despite the known risk factors, there have been reports of the ability to reduce and control infections in these collegiate settings. Studies have demonstrated that, following the institution of a campaign to promote education, the use of hexachlorophene-containing soap, increased presence of handsanitizing agents, disposable towels, cleansing and decontamination of training and weight-room equipment, and bathing or showering prior to the use of athletic training facilities, a substantial reduction in the rate of infection transmission is possible.

**High School**

There are fewer reports of SSTI outbreaks in high school football players. Over a 5-year span, 3 reports demonstrated that between 10% and 14% of players on evaluated teams were affected by skin infections (Table II). The majority of the cases were either culture-proven MRSA or suspected MRSA, and linemen carried a 4 times greater likelihood of infection than those playing other positions. Furthermore, in 1 report, the risk of MRSA infection was 8 times higher among athletes who shared towels or washcloths with others than among those who used only their own items. The subset of athletes who were infected with MRSA were found to have an increased BMI when compared with those without infection, and athletes who were found to have proven cases of *S. aureus* infection also admitted to dressing in the same game uniform or practice apparel as many as 11 times without washing between uses.

**Rugby**

We are aware of only 2 reports on bacterial SSTIs affecting rugby players in the medical literature. In 1 report, 5 (33%) of 15 members of a rugby team in the United Kingdom (all of whom played the forward position) presented to the team physician because of a cutaneous MRSA infection, and all of them had recently played in a match against a visiting team from the South Pacific. In the subsequent 10 days, all of the infections progressed to large abscesses measuring several centimeters in width at various body locations, including the shoulder region, head, neck, and back. In the second report, 37 suspected cases of skin infection were observed in participants from 4 different Belgian rugby clubs, and cultures of specimens from 5 of these wounds were positive for *Streptococcus pyogenes* emm type 81, suggesting that many had been exposed to similar modes of infection.

**Soccer**

There have been several reports of MRSA outbreaks in soccer teams. A 26-member Slovenian soccer team was affected by an outbreak of a highly virulent and contagious MRSA SSTI. Eleven team members and the team masseuse (46%) were diagnosed with cutaneous MRSA infections. Bilateral staphylococcal furunculosis of the lower extremity was seen in 10 players, nasal colonization was found in 1 player who subsequently developed a MRSA-positive perianal abscess, and eczematous dermatitis of the hands developed in the masseuse. During the 2005-2006 season, members of a Dutch soccer club along with close team associates experienced an outbreak of MRSA infections. Several players had skin infections, and 1 member of the team was hospitalized because of an abscess that was attributed to MRSA. Forty-two members of the soccer club (all of whom utilized the same shower facilities, locker rooms, and training equipment) along with 14 of their roommates were screened for the organism. Of the 56 individuals who were screened, 11 were found to have a MRSA infection, including 9 (21%) of 42 soccer players and 2 (14%) of 14 roommates. The genesis of this outbreak was later attributed to contact with a member from a visiting team with an exposed boil that tested positive for MRSA following completion of the match.

**Wrestling**

With extensive and continuous skin-to-skin collision during grappling and maneuvering, a large number of bacterial SSTIs are plausible in wrestlers. However, a majority of reported infections are fungal in nature, and we are aware of only 2 reports of MRSA SSTIs among wrestlers. In 1 report, 7 (22%) of 32 members of a high school wrestling team in Vermont, as well as 6 individuals who were closely related to the athletes, were found to be infected with MRSA during an outbreak between January 1993 and February 1994. Of those infected, 6 wrestlers sought medical attention and were found to have boils on the arms or legs that were positive for MRSA on culture. Another patient was found to have positive results on culture of specimens from the anterior nares. One infected team member had progressive cellulitis that required admission to the local hospital and was found to have lymphangitis and septicemia associated with the cutaneous infection. Although the cause of this outbreak was indeterminate, members of the team typically practiced as a group on the same mats and wrestling floors without clothing covering the legs or arms for 6 days each week, and contact in these exposed areas was thought to play a contributing role. A second report revealed that 2 wrestlers from the same high school team in Indiana had cutaneous MRSA infections. Those teammates competed in different weight classes, and as such had not wrestled against each other, even in a practice setting. This finding suggested that in sports such as wrestling, in which skin frequently comes in contact with a common playing surface, cleansing of shared spaces and limiting
<table>
<thead>
<tr>
<th>Population</th>
<th>Year(s)</th>
<th>No. of Athletes Infected</th>
<th>Infection Site(s)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>College football players</td>
<td>2000</td>
<td>10</td>
<td>NR</td>
<td>• Shaving and turf burns resulting in trauma to the skin and sharing of unwashed bath towels were suspected as potential risk factors for transmission of MRSA infections among college football players.</td>
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<td>• Both players were hospitalized for MRSA skin infections within the same week; 1 received surgical debridement and skin grafts.</td>
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<td>• Shared items such as balms and lubricants were identified as potential risk factors for transmission of MRSA infections among college football players.</td>
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<td>2002 to 2003</td>
<td>2</td>
<td>NR</td>
<td>• 10 players developed 13 MRSA skin infections (9 abscesses and 4 cellulitis).</td>
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<td>• Hospitalization was required for 2 players who had recurrent MRSA infections. The other 8 players were managed as outpatients; all but 1 required at least 7 days of frequent visits for wound care.</td>
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<td>• 8 of the 10 infected players were cornerbacks or wide receivers. The 2 remaining infected players were a linebacker and a tight end.</td>
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<td>• Other risk factors deemed to be associated with transmission of MRSA infection included abrasions from artificial grass (turf burns), cosmetic body shaving.</td>
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<td>• In 3 of the 4 players whose infection was located at a covered site (e.g., hip or thigh), transmission was attributed to sharing the cold whirlpool at least twice each week.</td>
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<tr>
<td>College football players</td>
<td>2003</td>
<td>10 (10%) of 100</td>
<td>Elbow, thigh, hip, chin, forearm, wrist, knee, tibial plateau</td>
<td>• The spectrum of disease ranged from a small abscess requiring outpatient surgical drainage to necrotizing fasciitis requiring hospitalization and multiple procedures.</td>
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<td></td>
<td>2002 to 2004</td>
<td>2 (1.9%) of 107 in 2002; 17 (15.9%) of 107 in 2003; 1 (0.96%) of 104 in 2004</td>
<td>Elbow, shin, ankle, forearm, knee, buttock, and chin</td>
<td>• Cutaneous manifestations included abscess (70%), cellulitis (16%), folliculitis, impetigo, and necrotizing fasciitis.</td>
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<td>• 90% of the infections were treated with surgical drainage, whereas 27% were treated with intravenous antibiotics.</td>
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<td></td>
<td>• No differences were seen in occurrence by player position.</td>
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<td></td>
<td>2005</td>
<td>13</td>
<td></td>
<td>• 13 (52%) of the 25 cases occurred in offensive linemen. Other positions included defensive lineman (4), tight end (2), linebacker (2), defensive back (2), quarterback (1), and wide receiver (1)</td>
</tr>
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<td></td>
<td>2006</td>
<td>33 (6.7%) of 491</td>
<td>Elbow, knee, leg, and forearm</td>
<td>• A particularly virulent strain of MSSA with an unusual resistance profile (resistant to erythromycin and ciprofloxacin) was responsible for this outbreak.</td>
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<td></td>
<td>2006</td>
<td>25 (22.9%) of 109</td>
<td>Distal arm, distal leg, neck, chest, shoulder, axilla, foot, and groin</td>
<td>• 5 of the 9 infections were identified as MRSA, 1 was identified as MSSA, and 3 were not S. aureus abscesses.</td>
</tr>
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<td></td>
<td>2007</td>
<td>8 (7.3%) of 110</td>
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<td></td>
<td>2008 to 2010</td>
<td>9 (7.2%) of 125</td>
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</tbody>
</table>

*NР = not reported.
the use of communal hygiene products are of utmost importance.

**Other Sports**

Skin infections also have been reported in athletes participating in college basketball, volleyball, tennis, and weightlifting. While SSTIs also have been reported in athletes participating in marathon running, swimming, and judo, we are not aware of any cases of bacterial infection in such athletes; instead, all of the reported cases involved only fungal infections. Although the majority of bacterial infections are due to cutaneous beta-hemolytic streptococci or MRSA, pitted keratolysis (a condition characterized by foul-smelling pits on the plantar or dorsal aspect of the foot) also has been seen. The latter is typically provoked by gram-positive bacterial species, such as Corynebacterium or Micrococcus, and is treated with topical antibiotics such as erythromycin or clindamycin. Another effective antimicrobial agent is topical benzoyl peroxide, which not only kills the infecting organisms but also creates a difficult environment for bacterial growth by making the skin dry. Athletes with such infections should avoid wearing cotton socks as such socks keep the foot warm and moist.

**Measures to Prevent the Spread of Infection**

Given that infections occur in association with a variety of sporting activities, a thorough knowledge of mechanisms to prevent spread is of utmost importance. The Centers for Disease Control and Prevention (CDC), the Infectious Diseases Society of America (IDSA), the National Athletic Trainers’ Association (NATA), and the National Collegiate Athletic Association (NCAA) have all provided guidelines for steps that should be taken to avoid bacterial and fungal infections and outbreaks in locker rooms, private and school gymnasiums, and fitness centers.

Because even limited contact with infected areas can lead to spread, athletes should be excluded from participation if wounds cannot be properly covered by a securely attached bandage or dressing that contains all drainage and remains intact during activity. Even in the setting of properly covered wounds, appropriate hygiene measures must be stressed to prevent spread. An athlete also may be excluded at the discretion of the physician if participation poses a health risk to the infected athlete (such as injury to the infected area), even if the infection can be properly covered.

**Personal Hygiene**

Treating abrasions or cuts involving the skin is an important preventative mechanism. All cutaneous lesions should be cleaned with soap and water and covered with a clean, dry bandage before the return to sports participation is considered.

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**TABLE II Reports of MRSA SSTIs Among High School Football Players**

<table>
<thead>
<tr>
<th>Population</th>
<th>Year(s)</th>
<th>No. of Athletes Infected</th>
<th>Infection Site(s)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school football players</td>
<td>2003</td>
<td>13 (14.4%) of 90</td>
<td>Arm, elbow, forearm, knee, leg, face, neck, and abdomen</td>
<td>• Playing a linemen position carried a fourfold greater likelihood of infection than playing other positions</td>
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<tr>
<td>(Pittsburgh, Pennsylvania)</td>
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<td>• 4 cases of MSSA infection were reported in 4 football players, 1 of whom was hospitalized</td>
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<tr>
<td>High school football players</td>
<td>2004</td>
<td>4 players (team size unknown)</td>
<td>NR</td>
<td>• All 4 players reported wearing a game or practice uniform as many as 11 times without laundering the uniform between uses during the season</td>
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<tr>
<td>(Illinois)</td>
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<td>• 3 cases involved abscesses that required incision and drainage</td>
</tr>
<tr>
<td>High school football players</td>
<td>2007</td>
<td>6 (10.2%) of 59</td>
<td>NR</td>
<td>• The team had attended a preseason football training camp, where all 59 players on the team lived together in the school gymnasium</td>
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<td>(Brooklyn, New York)</td>
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<td>• The risk for MRSA infection was 8 times higher among those who reported sharing towels during the training camp than among those who did not</td>
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<td></td>
<td>• The 6 players with MRSA infections had a mean BMI that was significantly higher than that for those who were not infected</td>
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</tbody>
</table>

*NR = not reported.
athletes, are the most effective means for preventing the spread of SSTIs. All wounds, including all cuts and scrapes, should be covered adequately before participation; if the wound cannot be completely and securely protected, the athlete should be excluded from participation in practice or games until the lesions are fully healed or are small enough to be appropriately dressed. All athletes with open wounds, abrasions, or lacerations should be excluded from whirlpools or common tubs, and spaces that are jointly used should be sanitized between uses. Some studies have also revealed that, in individuals with \textit{S. aureus} SSTIs, the addition of chlorhexidine body washes or “bleach baths” (i.e., soaking in a bathtub containing a dilute solution of household bleach) to routine hygiene measures may help to decrease the colonization of organisms and prevent recurrence.

The most effective behavioral practice in preventing the spread of SSTIs such as MRSA is hand washing. All athletes, including individuals who exercise at fitness centers, should practice, or game competition. Personal items such as towels, clothing, razors, and bar soap should not be shared.

**Environmental Hygiene**

All athletes, including individuals who work out at fitness centers, should place a barrier (e.g., an item of clothing or a cloth towel) between bare skin and commonly shared surfaces, including exercise machines, massage tables, weight-training devices, and sauna and steam-room benches. All workout clothing, including team-supplied uniforms and towels used for sports and exercise, should be washed after each use in hot water with bleach or detergent to avoid moist environments that promote bacterial growth, complete drying of clothes in a dryer is recommended. Locker rooms should not provide communal jars of ointments that athletes apply by placing the hands into an open container. In gymnasiums, health clubs, and fitness centers, bar soap should be replaced with liquid soap to limit sharing. Individual or disposable, single-use products should replace commonly used communal towels during practice or competition.

Environmental interventions aimed at controlling the spread of bacterial and fungal infections in athletes focus primarily on thorough cleansing and sterilization of shared or frequently used equipment. Cleansing is the key to decreasing colonization, and a focus on surfaces that have frequent contact with skin (e.g., benches, door handles, water coolers, showers, tubs, and toilet seats) is of utmost importance. All shared equipment and athletic gear (e.g., helmets, protective gear, and wrestling mats) should be cleaned prior to, and following, each individual use, practice, or competition.

Disinfectants and detergents designed specifically for athletic equipment are commercially available. All of these agents are simple and effective solutions for routine cleansing of high-contact surfaces. Care should be exercised, however, as the overuse of prepackaged antibiotic wipes or towelettes may actually lead to an increased potential for the development of resistant organisms, so appropriate use as recommended by the manufacturers of these items and label guidelines should be followed. If prepackaged products are not available for disinfection of equipment, a dilute bleach solution made by combining 1 gallon (3.8 L) of water with 1/4 cup (60 mL) of regular household bleach (i.e., a 1:100 dilution equivalent to 500 to 615 ppm of available chlorine) can be used to produce similar results. If athletic equipment is damaged to an extent that impervious surfaces are breached and appropriate cleansing is prevented, replacement, repair, or disposal of these items is recommended.

**Treatment of SSTIs in Athletes**

While the most important method for the avoidance of SSTIs is appropriate prevention, athletes who have contracted an infection should be managed according to the most recent guidelines put forth by the IDSA. For athletes with nonpurulent cellulitis, oral beta-lactam antibiotics providing coverage for beta-hemolytic streptococci, including penicillin and cephalosporins, are recommended as a first-line treatment. Patients who do not respond to beta-lactam agents should be managed empirically for CA-MRSA with oral clindamycin, trimethoprim-sulfamethoxazole (TMP-SMX), a tetracycline such as doxycycline or minocycline, or linezolid. The antibiotic regimen is typically continued for 5 to 10 days but should be individualized on the basis of patient symptoms and response to treatment. If concurrent treatment for both beta-hemolytic streptococci and CA-MRSA is desired, the use of isolated oral clindamycin, TMP-SMX, or linezolid is typically effective. However, a combination of a tetracycline agent and a beta-lactam also can be utilized.
Athletes presenting with purulent cellulitis are considered to be positive for CA-MRSA; in such cases, culture specimens should be obtained and empiric antibiotic treatment should be initiated. In such settings, treatment for beta-hemolytic streptococci typically is not required as such infections are unlikely to cause purulent discharge. For purulent lesions originating from a cutaneous abscess, the recommended initial treatment is incision and drainage. Isolated incision and drainage typically is adequate for the treatment of a simple abscess; however, the currently available literature does not clearly define the role of, or need for, antibiotic therapy in these settings. Nevertheless, there are clearly defined circumstances in which adjunctive treatment of an abscess with antibiotics is appropriate, including cases involving severely purulent or large abscesses; extensive involvement of multiple body locations; accelerated advancement of disease associated with cellulitis, systemic illness, an immunosuppressed state, or associated comorbid conditions; abscesses in very young or very old patients; abscesses located in areas that are difficult to treat with incision and drainage (such as the face, web space of the hand, and genitalia); concomitant septic phlebitis; or failure to completely respond to isolated incision and drainage. To ensure appropriate treatment, culture specimens should be obtained when the patient has an abscess meeting the aforementioned criteria, when the patient has an inadequate response to initial treatment, or when there is concern for an outbreak or cluster infection.

Special considerations should be observed when managing children who have SSTIs. In children and adolescents presenting with superficial cutaneous infections such as impetigo, or in the setting of secondarily infected skin lesions related to eczema, ulcers, or lacerations, topical mupirocin 2% ointment can be used effectively. Tetracycline agents are not recommended, and should be avoided, for children under 8 years of age as they may cause permanent tooth discoloration or affect growth.

If an athlete develops recurrent SSTIs despite appropriate treatment and preventative measures, referral to an infectious-disease specialist and concomitant skin and nasal decolonization may be considered. These strategies can be offered in conjunction with the ongoing recommended treatment. The best initial option for decolonization of the skin and nares is treatment with bleach baths and intranasal mupirocin, respectively; chlorhexidine and intranasal mupirocin also can be utilized as the first option can be cumbersome and has demonstrated poor compliance. Recent evidence also has suggested that the use of sodium hypochlorite body wash is associated with improved compliance and decolonization success.

Overview

SSTIs have become increasingly common in the sports world. Efforts to decrease colonization of bacteria and fungi are now essential for preventing the development of SSTIs. Education on cleansing and hygiene are a vital part of this process. The team physician and the team athletic trainers play the most important role in the education of the athlete and all members of the athletic team. The concept of the athletic team also includes anyone in contact with the athlete or athletic training facility, such as all members of the coaching and training staff, as well as the families in contact with the participant. The impact of SSTIs on individuals and the athletic team may be severe and has the potential for notable consequences, including loss of playing time, hospitalization, and even surgery. Providers should stay up to date on the information regarding the recognition, prevention, and treatment of SSTIs, and online guidelines published by the CDC can be very useful for providers in their continued efforts to better understand and to prevent the development of SSTIs.


