Public participation in sports is popular in many countries, particularly the United States. Athletes often acquire dermatologic infectious diseases during their sporting activities. Direct and indirect transmission of infectious agents occurs readily by the sheer nature of contact competition in the sports environment. Athletes commonly present to primary care physicians, sports medicine specialists, and dermatologists, but they may also present to any specialty provider. Preventing disruption of sports participation and achieving an appropriately timed return to play is challenging for both provider and patient. Poorly managed infectious disease may result in detrimental consequences to the patient’s health and sports success. Furthermore, inaccurate diagnosis may lead to regional epidemics and other medical consequences, as well as substantial amounts of missed time from sports. Unnecessary missed time can result in increased morbidity as well as decreased athletic opportunities for the patient.1

The purpose of the present article is to describe the diagnosis, management, and return-to-play guidelines of common skin-related infectious diseases in high school and college athletes, with the goal of optimizing patient care, enhancing public health, and reducing morbidity and mortality.

Epidemiologic Characteristics
The incidence of skin-related infectious diseases has been estimated at 8.5% of health conditions and injuries related to high school sports and 21% of health conditions and injuries related to college sports involve infectious diseases of the skin. In about half of these cases, the head, face, or neck is affected. The infectious agents are common microorganisms, including methicillin-resistant and methicillin-sensitive *Staphylococcus* and *Streptococcus* bacteria, herpes viruses, and tinea fungi. The challenge for physicians is to provide proper treatment to patients within the return-to-play guidelines of a sport’s governing body, resulting in rapid resolution of the condition, minimization of time spent out of the sport, and minimization of communicable spread of the disease.


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contact while competing against an infected athlete is 33%.5,6 Reported statistics from Minnesota State Wrestling Tournaments between 1997 and 2006 revealed an incidence of skin infections between 2.5 to 3.7 of 100 individual competitors, with the highest incidence reported in urban areas.6,7 The National Collegiate Athletic Association (NCAA) wrestling injury database statistics from 1988 through 2004 show the incidence of skin infections at an estimated 0.98 of 100 athlete exposures (with exposure defined as equivalent to 1 practice or game).8 Yard et al9 documented that 70% of athletes with skin infections miss fewer than 7 days of sports before return to play.

**Fungal Dermatologic Conditions**

Tinea infections represent most fungal infections in the athletic population, and causative agents of these conditions are commonly *Trichophyton rubrum* and *T. tonsurans*. Clinical diagnosis may be confirmed via KOH (potassium hydroxide) preparation and microscopic examination of skin scrapings.

Tinea capitis is a dermatophyte infection of the scalp that typically presents as a patchy scale with varying degree of alopecia. Treatment for patients with this condition is more stringent than for other nonscalp tinea infections and requires oral antifungal medications (Figure 1) with optional antifungal shampoo (ketoconazole or selenium sulfide).9,12 Return-to-play guidelines require the athlete to undergo a minimum of 14 days of this treatment.1,13

<table>
<thead>
<tr>
<th>Medication</th>
<th>Daily Oral Dosage, mg</th>
<th>Treatment Duration, wk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluconazole</td>
<td>100-200</td>
<td>3-6</td>
</tr>
<tr>
<td>Griseofulvin</td>
<td>375-1000</td>
<td>6-12</td>
</tr>
<tr>
<td>Itraconazole</td>
<td>200</td>
<td>2-4</td>
</tr>
<tr>
<td>Ketoconazole</td>
<td>200-400</td>
<td>2-4</td>
</tr>
</tbody>
</table>

**Figure 1. Medications recommended for treating patients with tinea capitis.**10,12,14

Tinea corporis (ringworm) presents as a circular or ring-shaped, scaly, raised plaque with irregular erythematous borders and often with central clearing. It commonly occurs in athletes secondary to direct contact transmission, and it is spread via fomites in the athletic environment. The head, neck, and upper extremities are most commonly affected. Treatment with antifungal medications may be topical or oral, and continuation of treatment has been recommended for 1 week after clinical resolution. Extensive or multiple superficial lesions respond best to oral therapy. Suppression and prophylaxis doses that have been successful include fluconazole (100-200 mg once weekly) or itraconazole (400 mg every other week) for recurrent infections.3,14-16

Monitoring serologic factors indicative of liver function during treatment for tinea corporis is controversial, with some experts recommending monthly surveillance during active management and other experts recommending no surveillance. Strategies for preventing tinea corporis infection include restricting shared towels, equipment, and clothing. Appropriate sterilization of the sports environment—including the locker room, equipment, and clothing—is recommended on a daily basis. Return-to-play guidelines for athletes with tinea corporis outline a minimum of 72 hours of topical or oral antifungal treatment, as well as appropriate occlusive covering of the affected site until resolution or until the athlete is disqualified from participation.1,13

Tinea pedis (athlete’s foot) affects the interdigital spaces of the feet and includes malodorous maceration of skin with commonly associated peeling, cracking, scaling, pruritus, or burning dysesthesia (Figure 2). A study of professional and collegiate soccer players in 2007 revealed a tinea pedis incidence of 69% in male athletes and 43% in female athletes, compared to age-matched control group incidences of 20% in men and 0% in women.17 Athletes are at increased risk of infection secondary to a warm, moist environment inside occlusive footwear, shared pools and treatment tubs, and communal showers.3,9

Treatment for patients with tinea pedis consists of topical antifungal cream unless infection is severe or extensive, in which case oral antifungal therapy is required. Terbinafine hydrochloride 1% cream applied to the affected area twice daily for 7 days has a cure rate of 84% to 88% in focal cases. Oral
use of terbinafine hydrochloride (250 mg once daily for 2 to 6 weeks) is effective for extensive or “moccasin” infections.3,16 Neither the NCAA nor the National Federation of State High School Associations (NFHS)—which have each published guidelines for return to play—restrict play for tinea pedis.1,13 Prevention of spread of tinea pedis includes appropriate barriers (eg, clothing), laundering of towels and athletic gear after each use, use of shower footwear and other shower sanitation, and prompt identification and treatment of cases. Education of all sports participants, coaches, and athletic training staff is paramount.

Tinea versicolor is an infection caused by Malassezia furfur. Because of the very low transmission rates of M furfur, athletes with tinea versicolor are not restricted from sports participation. The clinical appearance of tinea versicolor is classically hypopigmented, though hyperpigmented scaly macules and patches occasionally occur. Formal diagnosis of this condition can be made via skin scraping and microscopy with KOH preparation, revealing a “spaghetti-and-meatballs” appearance. In addition, copper-orange fluorescence is revealed with Wood’s lamp examination.11,12

Treatment for tinea versicolor may include selenium sulfide 2.5% scrub (15 minutes daily for 3 consecutive days), topical or oral antifungal medication, or observation only (because the infection may be self-limiting).11,12 Figure 3 shows general treatment recommendations for fungal skin infections, and Figure 4 shows return-to-play guidelines for specific fungal infections.

Viral Dermatologic Conditions
Herpes gladiatorum is caused by herpes simplex virus type 1 (HSV-1) and is diagnosed based on clustered vesicles with erythematous borders.19 Tzanck preparation is confirmatory, revealing large, multinucleated cells. Time lapse from virus exposure to vesicle appearance is 4 to 11 days, with viral shedding occurring before vesicle formation.10-12 Transmission occurs via direct skin-to-skin contact or fomites. The body locations affected are as follows: head and face (71% to 73% of cases), extremities (18% to 42% of cases), and trunk (11% to 28% of cases).6

Treatment and sports restriction recommendations for athletes with herpes gladiatorum are based on primary or secondary infection status and include oral antiviral medications. Valacyclovir hydrochloride provides the easiest dosing, which may improve patient compliance and help prevent spread of infection. Figure 5 presents antiviral treatment recommendations for athletes with herpes infections. In a 2007 study of Minnesota high school wrestlers after a statewide outbreak of herpes gladiatorum forced an 8-day suspension in the season, researchers emphasized consideration of viral suppression medications and prophylactic dosing.7 Secondary to pre-eruption viral shedding and contagion, the NFHS recommends that anyone in contact with an infected individual during the 3 days before an outbreak be isolated from sports activity for 8 days and reexamined daily for suspicious skin lesions.13 Evidence suggests that use of oral antiviral medications during the sports season may be beneficial for suppression in athletes and coaches who have positive results from HSV serology tests or in individuals who have recurrent lesions (Figure 5). Evidence also indicates that annual HSV serology testing should be performed to identify individuals who may need suppression-dosed antiviral medication before the start of the season.6

47% of skin infections in collegiate athletes are caused by herpes viruses.
Cases of herpetic whitlow and herpes labialis (cold sores) should be promptly identified, and patients should be treated and restricted from sports participation (as in cases of herpes gladiatorum). Triggers for herpes labialis outbreaks include stress and ultraviolet radiation—both of which are common in student athletes and other individuals participating in outdoor sports. A 2008 study of skiers provided evidence of increased risk of herpes labialis secondary to participating in this high-altitude, outdoor sport in which athletes are surrounded by a white, reflective environment. The study’s authors recommended that skiers apply sunscreen with a sun protection factor of 30.3

Herpes zoster (shingles) is reactivation of the varicella-zoster virus, appearing as a vesicular eruption in a dermatomal pattern. Patients with herpes zoster should be treated the same as patients with herpes gladiatorum.1

Molluscum contagiosum is caused by a poxvirus that produces dome-shaped, flesh-colored papules 1 mm to 5 mm in diameter that frequently develop central umbilication upon maturation. Acquisition of this infection occurs via direct transmission from skin-to-skin or water-to-skin contact. Medical management for molluscum contagiosum may involve lesion removal via cryotherapy, curettage, imiquimod solution, cantharidin solution, KOH 5% solution, or skin abrasion after bathing. Return to play may occur immediately (per NCAA guidelines) or at 24 hours after lesion removal (per NFHS guidelines). The site must also be covered and monitored for superinfection.1,11-13

Return-to-play guidelines for patients with herpetic viral skin infections have become more stringent in recent years (Figure 6). The NFHS guidelines require that all vesicles be crusted or matured for 48 hours without new lesions before the patient returns to play. The NFHS guidelines also require oral antiviral treatment for 10 days in primary outbreaks and 120 hours in recurrent outbreaks. If systemic symptoms are present, the minimum period of oral antiviral treatment is 14 days prior to medical clearance.13

The NCAA return-to-play guidelines generally are less restrictive than the NFHS guidelines. The NCAA requires the absence of new, noncrusted lesions or the absence of bacterial superinfection for 72 hours, as well as the absence of systemic symptoms, with a minimum of 120 hours of oral antiviral medication.1 The NCAA does not allow the covering of sites of active infections in participants.1

Verrucae (warts) must be covered to participate in sports, though neither the NFHS nor the NCAA require individuals with this condition to undergo treatment prior to returning to play.1,13

### Bacterial Dermatologic Conditions

Bacterial infections of the skin in athletes can occur as abscesses, furuncles (boils), folliculitis, and cellulitis. Infectious agents should be considered for culture to confirm species identification before initiating treatment. Empiric antibiotic coverage for community-acquired MRSA should be considered if the community’s incidence is greater than 15%.20 The NFHS recommends that all bacterial infections be managed similarly to community-acquired MRSA infections.13

Community-acquired MRSA has caused substantial morbidity and mortality in athletes since emerging in the 1960s.
Incidence of community-acquired MRSA in the United States is 21%, and colonization prevalence in the United States is approximately 30% for nonresistant Staphylococcus strains and 1% for MRSA.\textsuperscript{20,21} The athlete may mistakenly believe the lesion (Figure 7) to be a spider bite or insect bite, delaying proper identification and treatment. A study of US football players revealed that the majority of MRSA infections occur early in the sport’s season and among those players with the most direct contact (eg, lineman and linebackers).\textsuperscript{22} Besides football, high-risk sports for MRSA infection include basketball, fencing, rugby, volleyball, weight lifting, and wrestling.\textsuperscript{22}

The treatment gold standard for patients with MRSA is lesion incision and drainage. Empiric oral antibiotic treatment after abscess culture identification may include trimethoprim-sulfamethoxazole, clindamycin phosphate, doxycycline plus rifampin, or tetracycline hydrochloride, depending on resistance patterns. Prevention strategies include limiting risk factors, applying topical antibiotic ointment to abrasions, and considering eradication of colonization (which quadruples an athlete’s risk of infection).\textsuperscript{23} The recurrence rate of MRSA is 10% to 30% in the community.\textsuperscript{20}

Currently, there are no guidelines for MRSA colonization eradication in athletes. A literature search of the Cochrane Reviews database performed in March 2009 using all years to date and the keywords MRSA and eradication and decolonization revealed that insufficient data are available to recommend standard decolonization treatment. Although decolonization treatment varies, it commonly involves a 7-day course of topical ointment to the nares (bacitracin, mupirocin); skin washes (chlorhexidine gluconate 4%, silver sulfide 2%, tea tree 10%); and systemic antibiotics.\textsuperscript{24-26} Decolonization is controversial, because it has only 39% compliance and includes incision and drainage, use of warm compresses and sterile dressings, and appropriate restriction from sports. Use of antibiotics is optional in treatment unless cellulitis is also present, but antibiotics are required for return to sports participation.

Impetigo and cellulitis are common superficial skin infections among athletes. They are frequently caused by Staphylococcus and Streptococcus bacteria acquired via direct skin contact or fomites. Treatment for focal lesions may include the antibiotic ointment retapamulin or systemic antibiotic treatment, commonly with a β-lactam.\textsuperscript{29-33} Physicians should always consider the potential of MRSA and select antibiotics appropriately.

Folliculitis is inflammation and possible superinfection of hair follicles, predominantly by methicillin-sensitive Staphylococcus aureus.
or *Pseudomonas*.

If an infection is resistant to treatment, the patient should be evaluated for MRSA. Treatment may include observation, antibiotics (topical, washes, or—if the infection is diffuse or resistant—oral), and drying agents.

Return-to-play criteria for bacterial infections (Figure 8) include no new lesions for 48 hours, oral antibiotic treatment for 48 hours (per NCAA guidelines) or 72 hours (per NFHS guidelines), and no actively exudative lesions. Although guidelines currently do not permit sports participants to merely cover the site of an active infection, the site does need to be covered upon medical clearance and until the tissue is normalized.

Risk factors for bacterial infections include antibiotic use within the previous year, crowded conditions and close contact, compromised skin integrity, uncovered abrasions, shared fomites, suboptimal cleanliness, not showering prior to pool use, poor hygiene and inadequate hand washing by athletes and members of the sports medicine team, and insufficient laundry and environment sterilization.

### Infestations

Scabies is a pruritic infestation of the *Sarcoptes scabiei* mite, which causes tortuous erythematous burrows in the superficial skin layers. Treatment includes permethrin 5%, lindane, or ivermectin, in addition to fomite decontamination. Return-to-play guidelines (Figure 8) require restriction of activity for 24 hours after completion of treatment, in addition to negative results from a scabies mineral oil preparation under microscopy.

Pediculosis (lice) is a clinical diagnosis with identification of the organism (ie, nit) confirmed with microscopy. Treatment includes permethrin 1%, lindane, or malathion, along with fomite decontamination. Return-to-play guidelines (Figure 8) require restriction of activity for 24 hours after completion of treatment and negative results from a reexamination.

### Comment

Managing dermatologic infections in athletes is a challenging endeavor. Several actions may assist management efforts, including appropriate preactivity skin examinations and surveillance; prompt postactivity showering; education of coaches and athletes (eg, about not sharing such personal equipment as towels and skin razors); sterilization of medical equipment and dressings; optimal hygiene with liquid-based agents; and proper facility maintenance and laundering of potential fomites. Disposable applicators or tongue depressors should be used when applying medications and ointments, and they should not be reintroduced to containers after use.

Skin lesions require prompt evaluation by an appropriate member of the medical team, followed by immediate treatment initiation.

Disqualification from sports participation should include practice, competitions, and any other form of direct skin contact with members of the team—until the patient has met qualification requirements and is cleared by the appropriate medical team member.

In many cases, a diagnosis is inconclusive, or it may point to a superinfection involving multiple microorganisms. In

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**Community-acquired MRSA causes substantial morbidity and mortality in athletes.**

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<thead>
<tr>
<th>Condition</th>
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<th>NFHS Guidelines</th>
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<td></td>
<td></td>
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<td>No new lesions &gt;48 h</td>
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<td>Oral antibiotics &gt;72 h</td>
<td>Oral antibiotics &gt;72 h</td>
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<td>No draining or oozing lesions</td>
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<td>Impetigo</td>
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<tr>
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<td>All lesions must be scabbed</td>
</tr>
<tr>
<td>Folliculitis</td>
<td>Site may be covered after infection becomes inactive and patient meets criteria to participate</td>
<td>All lesions must be scabbed</td>
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<td>Reexamination shows no evidence of infestation</td>
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<tr>
<td>Scabies</td>
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<tr>
<td></td>
<td>Negative results of mineral oil preparation</td>
<td>No evidence of infestation</td>
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</tbody>
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**Figure 8.** Return-to-play guidelines for athletes with bacterial infections and infestations, as recommended by the National Collegiate Athletic Association (NCAA) and the National Federation of State High School Associations (NFHS). **Abbreviation:** MRSA, methicillin-resistant Staphylococcus aureus.
these situations, conservative treatment would include appropriate diagnostic testing, empiric treatment for any possible infectious organisms, and referring to guidelines for the longest disqualification period among possible diagnoses.

The physician should check with the governing body of the athlete’s particular sport for specific guidelines. The return-to-play guidelines of the NFHS and NCAA are meant to be minimum criteria for clearance to participate in sports and are not guidelines for adequate completion of treatment. Treatment of athletes with skin infections typically continues beyond the official return time to the sport.

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References