

Practical Management: Community-Associated Methicillin-Resistant *Staphylococcus Aureus* (CA-MRSA): The Latest Sports Epidemic

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Abstract: Community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA) has gained international recognition as a superbug that causes serious infectious outbreaks in high-risk populations such as athletes. Clusters of cases in various athletic teams, particularly contact sports, have been reported since 1993 in the United States and more recently in Canada. CA-MRSA infections are not limited to North America, and all athletes are considered high risk. Skin-to-skin contact appears to be the primary mode of transmission. While typical infections are local skin and soft-tissue abscesses, CA-MRSA infections can spread systemically and lead to significant morbidity and mortality if not promptly identified and treated. The gold standard of treatment for all abscesses is incision and drainage with wound culture for bacterial identification and antibiotic sensitivity testing. A limited number of antibiotics are currently useful in the treatment of CA-MRSA and are reviewed. Geographical variation in patterns of antibiotic resistance further complicates the treatment. Meticulous, consistent use of infection prevention strategies is critical to control outbreaks in the athletic population. Good hygiene, prompt identification of infection, limited exposure to infected persons and contaminated objects, and proper treatment combined with close follow-up of infected athletes will help contain CA-MRSA outbreaks. Future research is needed to explore person-to-person and fomite transmission risks, to define the significance of nasal carriage and skin colonization in relation to CA-MRSA infections, and to further investigate antibiotic resistance patterns. Universal education is needed for all athletes and personnel who provide care in the athletic setting to help control this widespread epidemic.

Key Words: MRSA, methicillin-resistant *Staphylococcus aureus*, athlete infections

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INTRODUCTION

Staphylococcus aureus infections are often associated with high morbidity and mortality. They commonly cause soft tissue and systemic infections. Higher-risk groups for acquisition include athletes, correctional facility inmates, military personnel, and urban children.^{1–6} Some strains of this bacterium methicillin-resistant *Staphylococcus aureus* (MRSA), have developed resistance to some common antibiotics. Community-associated MRSA (CA-MRSA) is caused by different strains than healthcare-associated (HA-MRSA) infections and exhibit different epidemiology. CA-MRSA infectious and carrier states are endemic within the United States. The Centers for Disease Control and Prevention (CDC) states that CA-MRSA has disproportionately attacked the athletic community.^{2,6} Contact sports, particularly involving skin-to-skin contact, are the primary sources for CA-MRSA outbreaks, namely American football, wrestling, and rugby. The first documented sports related outbreak was in 1993 in the United States in Vermont. Six high school wrestlers developed CA-MRSA abscesses.⁷ Since then, several case reports have documented CA-MRSA among athletes.^{2,8,9} In January, 2007, the Canadian Department of Infectious Diseases called CA-MRSA “the superbug at our doorstep.”¹⁰ This latest epidemic in athletes necessitates infection control measures in the sports setting. This article will identify the major risks to athletes and provide an up-to-date discussion of current recommendations for the evaluation and management of CA-MRSA.

DIAGNOSIS

The typical clinical presentation is an athlete with pain, redness, swelling, and/or an area of drainage on the skin (Figure 1). The onset of symptoms, a history of skin trauma, breaks or lesions, and any exposure to other symptomatic athletes should be noted. The presence of concurrent skin conditions such as eczema or herpes is a risk factor for CA-MRSA. A history of *S. aureus* infections in the athlete or his/her family or household members is also relevant. Physical examination includes a thorough skin inspection because multiple lesions are often present. MRSA infections can spread rapidly. The presence of systemic symptoms such as fever, malaise, chest pain, shortness of breath, and/or mental status changes should be noted and merit an emergent referral for further evaluation, additional testing, and consideration of intravenous antibiotics.



FIGURE 1. Umbilicus determined later to be infected with CA-MRSA.

Generally, localized skin CA-MRSA infections are clinically indistinguishable from MSSA (methicillin-sensitive *S. aureus*) and streptococcal skin infections; therefore, current recommendations are to culture all wounds for bacterial identification and antimicrobial sensitivity testing. Certain culture results require additional testing due to a phenomenon known as inducible resistance. Many CA-MRSA strains are resistant to erythromycin and are sensitive to clindamycin. Yet, treatment failures on clindamycin are seen. In this setting, a double-disk diffusion test (D-test) should be obtained to assess clindamycin efficaciousness. A positive D-test suggests an inducible macrolide-lincosamide-streptogramin B resistance (iMLS) due to erythromycin ribosomal methylase genes and subsequent development of clindamycin resistance. Clinically, this phenomenon results in an unexpected clindamycin treatment failure. Recently, Siberry found that 51% of adult and 43% of pediatric MRSA isolates possessed iMLS.¹¹

Athletes who present with possible CA-MRSA infections that are not easily cultured (ie, pneumonia) may benefit from surface cultures of the nares, axilla, and groin to help guide antimicrobial therapy. It has been shown that 82% of patients who develop *S. aureus* bacteremia had identical strains colonized within the nares.¹² CA-MRSA incidence has increased, yet whether this is due to increased MRSA nasal carriage has not been investigated.¹³ Skin colonization may play a role in transmission in sports, as many CA-MRSA outbreaks have occurred in athletes without detectible nasal colonization.^{9,14-17} Currently, there are no evidence-based recommendations for routine screening; however, MRSA screens may be useful during sporadic outbreaks or recurrent infections.

TREATMENT

The gold standard of treatment for CA-MRSA abscesses remains incision and drainage (I&D). Lee and Llera et al showed significant improvement following I&D regardless of antibiotic administration.^{18,19}

Topical and/or oral antimicrobials are used adjunctively with I & D for *S. aureus* infections. Topicals may treat superficial

infections and decrease transmission of MRSA.⁴ Topical mupirocin is superior to placebo for treating Staphylococcal impetigo, and most MRSA strains are susceptible to this agent.^{20,21} Mupirocin can eliminate MRSA nasal carriage; however, studies have proven this is a transient phenomenon with a 1-year recolonization rate of >50%.^{22,23} Furthermore, mupirocin resistance increased to 28% over 10 years when available over the counter in New Zealand.²⁴ Therefore, for MRSA outbreaks on teams, treatment of nasal colonization may be beneficial in decreasing infectivity and athlete transmission over a short athletic season but may have limited long-term effectiveness. Topical bacitracin is successful in treating MSSA; however, its efficacy in MRSA infections has not been demonstrated in controlled studies.²⁵

A handful of systemic antibiotics are efficacious against CA-MRSA infections (Figure 2). Studies reveal that in vitro CA-MRSA isolates are usually susceptible to trimethoprim-sulfamethoxazole (TMP-SMX), doxycycline, linezolid, clindamycin, daptomycin, gentamicin, quinupristin/dalfopristin, and vancomycin. Rifampin may be used for synergy with any one of these, but should never be used alone.^{3,25} First line empiric treatment of suspected CA-MRSA infections is either TMP-SMX, doxycycline (not approved for use under age 12 years), or clindamycin.^{26,27} The oxazolidinone antibiotic, linezolid, has recently been discovered and found to be effective against invasive CA-MRSA infections, but its regular use in the treatment of these infections should be limited.²⁸ β -lactams and first generation cephalosporins no longer have a significant role in the treatment of CA-MRSA and should not be used (Table 1).

Following initial treatment, all affected athletes should receive close follow-up by a physician. Follow-up within 48 hours includes a thorough skin inspection and evaluation for appropriate clinical response to oral antibiotics. Wound culture results and antimicrobial susceptibilities should be reviewed and treatment modified accordingly. If a β -lactam—sensitive *S. aureus* is cultured, then oral antibiotics should be promptly changed to a β -lactam. Length of treatment usually continues

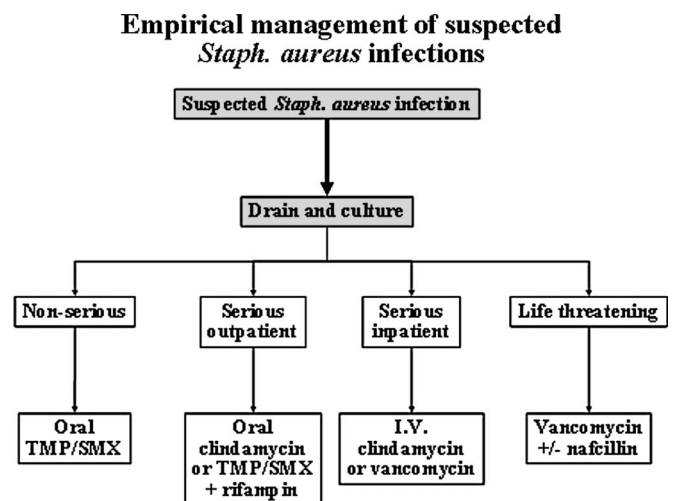


FIGURE 2. Empirical management of suspected *S. aureus* infections.

TABLE 1. Antibiotic Treatment of Community-Associated MRSA

Antibiotics	Dose	Notes
TMP-SMX	1 DS tab po bid for 7 to 14 days (2 DS bid also acceptable)	Often 1st line treatment
Doxycycline	100 mg po bid for 7 to 14 days	Not used for severe infections
Clindamycin	300 to 450 mg po Q6-Q8H or 600 to 900 IV Q8H	If resistant to erythromycin must perform D test; frequent GI symptoms
Fluoroquinilones	Generally not used	Contraindicated in children
Linezolid	600 mg po Q12H	Check for thrombocytopenia; expensive
Vancomycin	1 g IV Q12H of 15 mg/kg/dose	Gold standard IV, aim for a trough level of 10–15
Daptomycin	4 mg/kg/day IV	For serious infections; not for lung infections; can cause rhabdomyolysis
Quinupristin-dalfupristin	7.5 mg/kg IV daily	For serious infections; older medication
Chloramphenicol	50 to 100 mg/kg/day IV Q6H	Must follow CBC; rarely used
Rifampin	600 mg po QD	Never used alone, only in synergy

Dose and length of treatment depends on site and extensiveness of infection as well as response to treatment all in the context of each patient's unique history. Pediatric doses must take into account patient weight and age. Dosing should be with these parameters in mind.

for 7 to 14 days depending on the severity and response to treatment. A D-test should be performed on erythromycin-resistant strains if clindamycin is prescribed. In the United States, clindamycin resistance varies greatly. This can be exemplified in that 4% to 12% of CA-MRSA isolates in Chicago were resistant to clindamycin, as opposed to approximately 50% in Baltimore and <10% in Houston.^{11,29–31} Healthcare providers should be familiar with local geographic resistance patterns when empirically prescribing antibiotics. Resistance patterns in Canada, Australia, and the UK will likely exhibit geographic variation as well but are not well described in current international literature.

RETURN TO PLAY

Strict adherence to contact precautions should be followed.³² In mild-to-moderate skin infections, the athlete may return to play 72 hours after initiation of therapy given clinical improvement and no new skin lesions for 48 hours. This is consistent with wrestling guidelines set forth by the US-based National Collegiate Athletic Association (NCAA).³³ Before and during sports participation, the wound should be completely covered with an occlusive dressing. Multiple wound checks should be performed to assure an intact dressing that has not shifted in position during competition.^{2,34,35} If leakage of the dressing occurs, the athlete should be removed from competition until the wound can be cleansed with soap and water and a new dressing applied. The dressing may be removed when the lesion has developed a firm adherent crust and all signs of infection have resolved.^{34,35}

PREVENTION

In the United States, the CDC states, “the main transmission mode of *S. aureus*/MRSA is via hands which may become contaminated by contact with colonized or infected individuals, or devices, items, or environmental surfaces contaminated with body fluids containing the bacterium. Skin-to-skin contact, crowded conditions, and poor hygiene also contribute to transmission.”⁶

In athletes, prevention is best achieved through good hygiene combined with avoidance of contact with wound drainage from other infected athletes. McBryde et al demonstrated that the transmission rate from MRSA-positive patients to MRSA-negative healthcare workers was 17%. Of workers who were MRSA-positive before hand washing, only 9% were positive afterwards.³⁶ Wootton et al studied the effectiveness of prevention strategies in a correctional facility known to have clustering of MRSA infections. Within this population of inmates, medical personnel implemented measures to improve skin screening, personal hygiene, wound care, and antimicrobial therapy. Results revealed a pre-intervention infection rate of 11.6% and a post-intervention infection rate of 0 ($P < 0.01$).³⁷ Therefore, the following preventive guidelines (Table 2) should be emphasized and utilized by trainers, coaches, parents, and players themselves until further data in athletes are available.

Good Hygiene

Instruct players on good hygiene. Hand hygiene is the single most effective measure to reduce transmission of MRSA.³⁸ In 2002, the CDC reported alcohol-based hand rubs are more efficacious and associated with a lower incidence of

TABLE 2. MRSA Prevention Strategies

1. Frequent hand washing with soap or alcohol-based hand sanitizers
2. Showering with soap and water before and after practice sessions and games
3. Cover all infected wounds with occlusive dressings
4. Perform frequent skin inspections
5. Educate athletes to report skin lesions to training staff
6. Use universal precautions for all wound care
7. Cleanse all wounds regularly with soap and water
8. Cleaning equipment, playing surfaces, locker facilities with 1:100 bleach and water solution or a bactericidal solution
9. Prohibit sharing of equipment, towels, water bottles, topical medications, or skin products
10. Launder uniforms and workout care after each use

dermatitis compared to soap, particularly 3% soap.³⁹ Therefore, it is recommended that adequate supplies of soap, towels, and alcohol-based hand sanitizer are provided for regular use. Athletes may benefit from showering with soap immediately after each practice and competition.^{2,34,35,38}

Limit Exposure to Infected or Colonized Individuals

MRSA transmission is primarily via exposure to MRSA infected or colonized individuals.^{2,6} Therefore, all wounds must be covered, whether they appear infected or clean, with an occlusive dressing. If suspicious wounds cannot be covered adequately, the athlete should be excluded from play.^{2,34,35,38} Regular skin inspections should be performed by coaches and trainers. Athletes should be instructed to report skin lesions or breaks immediately. One study attributed an MRSA outbreak among collegiate American football players to skin breaks such as turf burns, which resulted in a sevenfold greater risk of MRSA infection and groin/genital body shaving, which had a 6.1-fold greater risk.⁴⁰ All breaches in the skin should be washed promptly with soap and water, and a topical antibacterial lubricant should be applied and covered. Education on early signs of infection and indications for obtaining a wound culture is needed for coaches, trainers, and other healthcare providers who treat athletes regularly. Consistent use of universal precautions, particularly gloves, is necessary during wound care.

Limit Contact With Contaminated Devices, Items or Environmental Surfaces

Fomite and airborne transmission are poorly understood. There is little scientific evidence regarding the risk of acquiring CA-MRSA through fomite transmission. Precautions to avoid cross-contamination of surfaces such as examination tables, and eliminating the practice of sharing equipment and supplies is prudent pending further studies.

CONCLUSION

CA-MRSA has caused frequent, sometimes endemic outbreaks in various athletic teams throughout the world. CA-MRSA is a frequently changing pathogen, and infections need prompt care and close follow-up to monitor for complications and treatment failures. The gold standard of treatment for abscesses in athletes remains I&D with a wound culture for identification and antibiotic sensitivity. Prevention strategies as outlined above may help prevent the spread of CA-MRSA infections in the athletic population. Education is needed at all levels, including athletes, coaches, athletic trainers and various healthcare personnel regarding the unique characteristics of CA-MRSA infections. Support for future research regarding person-to-person and fomite transmission risks, as well as infection prevention measures is needed before CA-MRSA infections can be significantly reduced or eliminated in athletes.

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