

"We spend so much time on smart training, but all that hard work is jeopardized if infection invades your team."

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USA Wrestling MRSA and other Infection Facts

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Making Wrestling Safer Guide to Recognition of Skin Infections

The Sport of Wrestling faces many challenges and with each one its community has responded in a positive way. In the late 1990's, three fatalities prompted necessary changes in weight cutting. In many ways this improved the sport and the training programs of our wrestlers. Identification and management of infectious skin diseases have always been an issue, but we are now facing a more insidious outbreak of infections that could mean the loss of life and limb. The Center of Disease Control has issued a warning about a "cluster" of Staphylococcus <u>aureus</u> bacteria that is resistant to many of the more common oral antibiotics. We have clinical identification of this bacteria in wrestlers in IN, football players in FL, CA, CO and WI. Most have resulted in significant loss of competition, hospitalization and surgical skin grafting. Additional information about the Warning at <u>www.cdc.gov</u>. or at **thematdoc.com** ("*Am I Disqualified*" DVD)

As result of this new challenge, it is critical that every parent, coach and physician that works with the sport of wrestling must be aware of what to look for and the appropriate action to take. There are basically three types of skin infections that plague this sport:

- Bacterial-Small organisms that are found everywhere in the air, water, ground, mats and on skin. These organisms only become a problem if they get into and under the skin and "colonize". The two major strains (types) are <u>Staphylococcal</u> and <u>Streptococcal</u> that produce infectious lesions within the sport. Early identification and management of bacterial infection is critical in minimizing the impact on the athlete.
- Viral-Microscopic "parasitic" structures that require a host cell to survive. Viruses are constantly changing and mutating but cannot survive without a "host". Within the Sport of Wrestling the primary agent being Herpes Simplex Type-I. The major concern with Herpes is once an athlete has contracted the virus, they are infected for life and can have a breakout at any time. They become carriers and can develop a breakout lesion at any time. If a breakout infection occurs the athlete can "share" the virus with any wrestler they have direct contact with.
- Fungal-Small Parasitic Plant Organisms that are found throughout daily living. They spread through the dispersal of spores and can be very contagious. These organisms love moist conditions and in some cases prefer to be anaerobic. Common types seen in athletics are "Athlete's Foot", "Jock Itch" and Ringworm.

There are specific guidelines that should be followed in recognition of a skin lesion that should be seen by physician for identification and management:

- 1. Lesions with a red, flaky border.
- 2. Weepy lesions, especially with "pus" or yellowish fluid.
- 3. Facial lesions associated with fever, redness and swollen lymph nodes.
- 4. Any skin lesion that is around the mouth, crosses the face into the scalp or redevelops in the same area.
- 5. Lesions that produce "Pins and Needles" sensation.

PREVENTION

"The best cure for skin infections is prevention"

The best way to treat contagious skin infections is prevention. The following rules are critical to the success of preventing wrestlers from becoming infected:

- 1. GOOD Hygiene: Shower immediately and no longer than 30 minutes after practice, change workout clothes and socks daily, consistently washing your hands during the day, DO NOT share equipment.
- 2. If you notice an open lesion, keep it clean, cover it with a dressing and show it to the Athletic Trainer or coach immediately.
- 3. Do not reuse razors, towels, or lotions that have had contact with an infected lesion.
- 4. Self "skin checks" and workout partner "skin checks" daily.
- 5. Report any redness of a lesion to coach or Athletic Trainer.
- 6. If you have a sudden area that "itches", show it to the Athletic Trainer or coach.
- 7. If you come in contact with an opponent or workout partner with an open lesion clean the area with appropriate cleanser that contains Triclosan 1%; Nonoxynol 9;
- 8. Clean all practice mats and equipment daily with a 10% bleach or appropriate cleaner.
- If it appears to be infected get to the physician quickly and have the lesion tested to determine the specific organism. Certain lesions may be covered with a bioocclusive agent (i.e. Tegaderm), but not herpes to protect teammates, opponents or family members.

Additional information is available at the following websites:

• www.physsportsmed.com/issues/2003/0203/howe.htm

BACTERIAL CONDITIONS

Bacteria is always present on human skin and on mucous membranes (coating of mouth, nose, throat) but only when the bacteria enters into the skin or membrane and "colonizes" does it become infectious. Regardless of the specific strain of bacteria (Streptococcal of Staphylococcus) the "colonization" is classified as:

- a. localized (mild superficial)
- b. to a specific area (such as a boil)
- c. regional (such as impetigo)
- d. systemic (severe/invasive) such as MRSA-CA (Methacillin-Resistant Staph aureus) or Necrotizing fascitis ('flesh eating bacteria'').

Bacterial infections that cause skin infections are spread from one person to another person by direct contact (skin to skin) or indirect contact with inanimate objects such as towels, clothes, mat surfaces, headgear and workout areas. If several individuals become infected in a small group such as a team or individuals in the same tournament this is classified as a "cluster".

Treatment: A Bacterial infections needs to be treated by appropriate medical professional. Any infected wound needs to be "cultured" to identify the specific strain of Bacteria before appropriate action is taken, Simply placing the infected wrestler on an antibiotic is not enough. Using the wrong antibiotic can actually worsen the infection especially with MRSA-CA.

The types of Bacterial Infections that have been identified within the sport are:

Mild:

- **Folliculitis**: Mild superficial bacterial infection of the hair follicles. Presents with "pus" filled lesions around the base of the hair. In normal healthy individuals, the immune system will neutralize the bacteria. If no "pus" filled blisters present not considered infectious.
- **Boil** (Furuncle): Bacterial Infection that is the result of a Staphylococcus Strain that "colonizes" in a specific location within the skin. Lesion will be hard to the touch, raised red or purplish border; "pus" contained blister and is warm to the touch (feverish). Infectious lesion that should be seen by a physician and a specific diagnosis of bacterial strain determined

prior to treatment. In some cases the lesion must be opened by physician and allowed to drain.

- Impetigo: Bacterial Infection that is the result of an open lesion (scratch or abrasion) that becomes infected by either a Streptococcal or Staphylococcus Strain. The lesions will have a raised red or purple outside border, yellowish blisters develop with either "pus" or honey colored drainage. Very infectious by both direct and indirect contact. If infection remains localized can be treated with topical antibiotic but if infection "colonizes" and spreads the lesion needs to be treated by a physician and an accurate diagnosis of the Bacterial Strain obtained and treatment based on appropriate antibiotic.
- Secondary Bacterial Infections: Athletes can develop a "secondary" bacterial infection of a lesion such as a bug bite, fungal infection such as athlete's foot, acne or poison ivy. These bacterial infections must be treated as any bacterial infection if they present with "pus" or honey colored drainage. A definitive diagnosis of the Bacterial Strain is critical and appropriate medical care plan initiated.

Regional:

• Subcutaneous Infectious cyst: Bacterial infection that colonizes within the tissue below the skin often forming into a cyst. Generally, the infected athlete will not feel well, present with "red streaks" spreading toward the heart from the lesion. A fever will be present at the regional site. Any athlete with any such presentation is highly infectious and needs to be treated aggressively to prevent the bacterial infection from becoming systemic.

Systemic:

- Septic Shock: Very severe illness that can result in loss of limb or life. Signs and symptoms include high fever, malaise, radiating redness along lymphatic tissue. Generally requires hospitalization. Bacteria can spread from skin to bone, blood, muscle and lymphatic tissue. May require surgery, Intravenous antibiotic treatment, and skin grafts.
- Methicillian-Resistant Staphylococcus aureus: A strain of Staphylococcus bacteria that is
 resistant to the majority of antibiotics that are used to treat any bacterial skin infection. Almost
 always spread by direct physical contact or indirectly by contact with towels, dressings,
 shared clothing or workout surfaces contaminated by an infected individual. Infection usually
 occurs through an open wound or abrasion. Early detection is the key, but usually missed
 due to culturing not performed on a routine basis.
- Usually the physician prescribes an antibiotic course of treatment for the most common organisms causing this type of infection. Since culturing will take several days to get a result, it isn't common to perform on everyone who seeks treatment for a staph infection.
- Necrotizing fascitis: "Skin eating disease" is an infection of skin, fascia, and bone caused by a Group A Streptococcal Strain. Symptoms and signs are the same for any bacterial infection. Redness around the lesion, fever, oozing of pus and "honey colored" fluid in the initial phase but rapidly moves into the tissue beneath the skin.

VIRAL CONDITIONS

A parasitic structure comprised of a sheath of protein and nucleic acids. Requires a host cell to survive, with the most infamous viruses of our time being HIV and hepatitis (bloodborne viruses). For all practical purposes viruses require a living human cell to infect to survive and reproduce. Therefore they must be transmitted via direct contact with skin or bodily fluids. Rarely can transmission be from indirect contact. Besides the Blood borne viral conditions, the two significant viral conditions found in athletics are:

• Herpes Gladiatorum (Herpes Simplex Type-1): Viral condition that is generally found on the face, scalp, arms, neck and upper chest. The infection presents as small clusters of "purplish" round blisters that when broken can secrete a clear or yellowish fluid. The outbreak is generally preceded by a "pins and needles" sensation and extreme itching sensation. Generally the lymph nodes near the infected tissue will be swollen and sore. Initial outbreaks

also present with a low-grade fever, sore throat and malaise (general fatigue/"does not fell well"). This virus is extremely contagious the 24 hours prior to outbreak and during the formation of the blisters. Once an individual has contracted the virus, the virus remains dormant in the tissue and can reoccur when the individual experiences any type of stress such as physical stress, emotional stress or "making weight for a big tournament". Once the tissue is infected cleaning with any topical cleaner including Bleach will not kill the virus. Cleansers are designed to kill organisms and may kill some of he infected cells and cause tissue damage but the virus will survive. The acceptable medical course is to place the infected individual on oral famicilovir or valcyclovir. A physician can test presence of the virus by testing for the antibody to the virus, or by culturing an open vesicle, to determine if the individual should be placed on suppressive therapy.

 Molluscum contagiosum: A viral condition that is characterized by small perfectly round, waxy lesions generally appearing on body and shoulders. Minor infection but is contagious and should be screened for and referred to physician for management.

Fungal Conditions

A plant organism that is probably from the class of Fungi Imperfecti that infests human tissue. The fungi organism actually lives in the tissue. It is spread by minute plant spores and can be transmitted by both direct and indirect contact. Many fungi are actually anaerobic but all require a moist environment to survive. There are numerous manifestations of fungi infections in human tissue but the most contagious and greatest challenge to athletics is "ringworm". Please remember "Athletes Foot" and "Jock Itch" are fungi.

• Ringworm: A rash presentation with a raised exterior border. The lesion grows in a circular pattern, but may present in ovals or rounded square pattern. Sometimes you may have more than one culture growing at the same time and will present in intersecting circles. The tissue in the middle area will be a lighter color and will develop a "scaly" appearance. Topical or oral antifungal agents must be used. Using Bleach to "kill" the fungus will only kill the skin tissue and leave a chemical burn of the skin. A major concern with any fungal infection is the possibility of a secondary bacterial infection. It is most difficult to deal with in the axillary area and in areas that contain hair follicles.

Additional information can be obtained by contacting:

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Thanks to Dr. BJ Anderson of MN for providing the pictures and his leadership is the field of Management of Skin Infections in the Sport of Wrestling.

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Fighting Wrestling's Invisible Enemy: Effective Microbial Control to Keep Your Athletes Safe

Skin infections have always been a hazard of contact sports like wrestling, but recent outbreaks of MRSA in schools and athletics throughout the country have focused our attention on effective prevention and treatment protocols against harmful micro-organisms.

As wrestlers, we live on mats, so we want to know they are clean. There is so much out there—herpes, ringworm, MRSA—if you think your mats and facilities aren't safe, it can kill all your confidence.

> What can you do to manage the risks and reduce the likelihood that one of your athletes is infected?

Know what you are fighting

Any effective campaign against an opponent, even invisible micro-organisms, must begin with a solid understanding of the enemy. Here are some of the basic facts that coaches, athletes, parents, and athletic administrators should understand about MRSA (methicillin-resistant Staphylococcus aureus):

• MRSA are a specific type of staph bacteria not affected by usual antibiotic treatment.

• MRSA can be serious and potentially lifethreatening: a recent study published in the Journal of the American Medical Association suggests it may cause an estimated 18,000 deaths per year in this country, a higher fatality rate than HIV/AIDS.

• There have been several high-profile athletes who have suffered from MRSA infections.

• Bacteria thrive in athletic settings, proliferating in the damp, dark environments of athletic gear, humid locker rooms, and on moist human skin.

Generally speaking, there are two kinds of MRSA: HA-MRSA (healthcare-acquired MRSA) and CA-MRSA (community-acquired MRSA). Fortunately, most of the MRSA affecting wrestlers is CA-MRSA, and that is still somewhat easier to treat when caught early. But, it is still a serious risk. Sadly, MRSA has been responsible for the physicial debilitation and even deaths of some athletes. In athletics, CA-MRSA is spread via sports contact in locker rooms, hard surfaces (including training equipment, wrestling mats and artificial turf), skin-to-skin, cuts, abrasions, contaminated items and surfaces, crowded conditions, and poor hygiene.



Recognize possible infections

CA-MRSA usually presents itself as a swollen pimple, boil, or pustule, looking perhaps like an infected mosquito or spider bite. It can quickly cause an area of the skin to swell up and turn red. Please consult your local doctor about ANY suspicious lesions or wounds.

Educate your athletes and their support network

In helping athletes, their parents, and others to think about good hygiene practices that can prevent MRSA and other micro-organisms from being spread, recall these "5 C's" of things that cause cross-contamination:

- 1. CROWDING
- 2. Frequent skin CONTACT
- 3. COMPROMISED skin
- 4. Sharing CONTAMINATED items
- 5. Lack of CLEANLINESS

Consider the possible costs of infection

In addition to the health and safety of the athletes, which are of paramount importance, other concerns associated with MRSA and infectious disease in athletics include insurance and liability issues. We might tally the real costs of infection as follows:

- •Loss of valuable athletes (ranging from treatable symptoms to death)
- •Risk of losing a season, due to team outbreak
- •Decrease in recruitment success
- •Public image declines
- •Decrease in revenue

•Legal costs associated with lawsuits

Clearly, any defensive plan against infection must consider all of these issues, beginning with the cleanliness of the facility and hygiene of your athletes and extending to revenue and expense-related concerns.

CA-MRSA Prevention & Management

 Wash hands thoroughly with soap and warm water or using an alcohol-based hand sanitizer.

 Shower immediately following activity.

• Avoid whirlpools or common tubs with open wounds, scrapes or scratches.

• Do not share towels, razors, and daily athletic gear.

• Wash clothing, athletic gear and towels after each use with a long lasting antimicrobial detergent.

• Report all skin lesions immediately. Administer or seek proper treatment and testing to establish a diagnosis.

 Athletes with skin infections may only participate if their infections have been diagnosed, treated, and appropriately covered.

• Clean and disinfect protective equipment such as helmets, shoulder pads, etc., with a long lasting antimicrobial solution.

• Athletic lockers should be sanitized regularly with a long lasting antimicrobial solution.

 All training equipment, including mats, benches, bars and handles, should be cleaned with a long lasting antimicrobial solution.

• Locker and dressing rooms should have tile floors that may be sanitized with a long lasting antimicrobial solution.

Choose effective and safe antimicrobial products

Here's a checklist of criteria against which you can evaluate antimicrobial agents, such as disinfectants and other formulations, for use in your training facility:

Chemical Composition

What is the active ingredient? Is it generally safe for the environment and your athletes? Surprisingly, there are some ingredients in antimicrobial products, such as triclosan (phenolbase), mercury, and heavy metals that are known to be harmful. Additionally, some ingredients could corrode or damage equipment.

Effectiveness

Is the agent effective against a broad spectrum of bacteria, fungi, and other harmful microbes? Has it been tested in labs and hospitals? Does it have credible information to back up its claims?

Durability

How long does the product's antimicrobial protection last? Alcohol-based sanitizers are usually only effective for a few minutes, which won't be enough for athletic environments. Durability will affect how much protection you get, and also your product and labor costs for reapplication.

Mobility

Will the product diffuse, leach, or become mobile? Does it rub off once it is applied to a surface, or does it have some means of affixing itself and forming a bond with the substance to which it is applied?

Toxicity

Read the label and MSDS. Does the product label have skull/crossbones on it? Or do the warnings seem like relatively standard precautions for any chemical?

Cost

When evaluating the cost of the product, consider the type of protection it offers you and how long that protection lasts. A less-expensive product that must be re-applied frequently will likely cost you more in the long run (in both product costs and labor) than one that is highly durable.

Mutation Risk

Depending on how the antimicrobial kills the micro-organisms, there could be a risk of genetic mutation. This furthers the superbug problem you are trying to prevent.

Storage

Is the product easy to store and transport? Is it flammable or volatile? (Alcohol-based disinfectants clearly pose more risks here.)

INFORMATION ON MRSA

As Obtained From The

Centers of Disease Control and Prevention

What is Staphylococcus aureus and MRSA?

Staphylococcus aureus, often called "staph", is a type of bacteria commonly found on the skin or in the nose of healthy people. Approximately 30% of people have staph in their noses and do not have any symptoms. MRSA which stands for **M**ethicillin-**R**esistant *Staphylococcus aureus* is staph that is resistant to commonly used antibiotics such as penicillins and currently available cephalosporins. In the past, MRSA was found only in healthcare facilities and caused infection in people who were sick. More recently, MRSA has emerged in the community and can cause infections in otherwise healthy people.

What types of infections does MRSA cause?

In the community, most MRSA infections are minor skin infections that may appear as sores or boils that often are red, swollen, painful, or have pus or other drainage. These skin infections commonly occur either at sites of breaks in the skin such as cuts and abrasions, and areas of the body covered by hair (for example, the back of the neck, groin, buttock, armpit, or beard area of men).

Almost all MRSA skin infections can be effectively treated by drainage of the pus by a healthcare provider with or without antibiotics. More serious infections such as pneumonia, blood or bone infections are rare in healthy people who get MRSA skin infections.

How is MRSA spread?

Like other causes of skin infections in athletes, MRSA is usually spread from person to person through direct skin contact or contact with shared items or surfaces (e.g., towels, used bandages, weight-training equipment surface) that have touched a person's infection.

MRSA might spread more easily among athletes because during participation athletes have repeated skin-to-skin contact, get breaks in the skin such as cuts and abrasions that if left uncovered allow staph and MRSA to enter and cause infection, share items and surfaces that come into direct skin contact, and have difficulty staying clean.

Which athletes are most at-risk for MRSA skin infections?

Skin infections including MRSA have been reported mostly in high-physical-contact sports such as wrestling, football, and rugby. However, MRSA infections have been reported among athletes in other sports such as soccer, basketball, field hockey, volleyball, rowing, martial arts, fencing, and baseball.

Even though little physical contact occurs in some sports during participation, skin contact or activities that may lead to spread of MRSA skin infections may take place before or after participation such as in

the locker room. Therefore, anyone participating in organized or recreational sports should be aware of the signs of possible skin infections and follow prevention measures.

Advice for Athletes and Parents

How do I protect myself from getting MRSA and other skin infections?

Practice good personal hygiene

- Keep your hands clean by washing frequently with soap and water or using an alcohol-based hand rub.
 - At a minimum, hands should be cleaned before and after playing sports and activities such as using shared weight-training equipment, when caring for wounds including changing bandages, and after using the toilet.
 - Both plain and antimicrobial soap are effective for hand washing, but liquid soap is preferred over bar soap in these settings to limit sharing.
 - If hands are not visibly dirty and sinks are not available for hand washing, for example, while on the field of play or in the weight-room, alcohol-based hand rubs and sanitizers can be used. Alcohol-based hand rubs with at least 60% alcohol content are preferred.
- Shower immediately after exercise. Do not share bar soap and towels.
- Wash your uniform and clothing after each use. Follow the clothing label's instructions for washing and drying. Drying clothes completely in a dryer is preferred.

Take care of your skin

- Wear protective clothing or gear designed to prevent skin abrasions or cuts.
- Cover skin abrasions and cuts with clean dry bandage until healed.

Do not share items that come into contact with your skin

- Avoid sharing personal items such as towels and razors that contact your bare skin.
- Do not share ointments that are applied by placing your hands into an open-container.
- Use a barrier like clothing or a towel between your skin and shared equipment like weight-training, sauna and steam-room benches.

What should I do if I think I have an MRSA infection?

- Tell your parent, coach, athletic trainer, school nurse, team doctor or other healthcare provider if you think you have an infection so it can be treated quickly. Finding infections early and getting care will reduce the amount of playing time lost and decrease the chance that the infection will become severe.
 - Pay attention for signs of infections such as redness, warmth, swelling, pus, and pain at sites where your skin has sores, abrasions, or cuts. Sometimes these infections can be confused as spider bites.
 - Infections can also occur at sites covered by body hair or where uniforms or equipment cause skin irritation or increased rubbing.
- Do not try to treat the infection yourself by picking or popping the sore.
- Cover possible infections with clean dry bandages until you can be seen by a healthcare provider (e.g., doctor, nurse, athletic trainer).

I have an MRSA skin infection. How do I prevent spreading it to others?

- Get medical care for your infection. Do not try to treat it yourself.
- Cover your wounds. Keep wounds covered with clean, dry bandages until healed. Follow your healthcare provider's instructions on proper care of the wound. Pus from infected wounds can contain staph and MRSA, so keeping the infection covered will help prevent the spread to others. Bandages and tape can be thrown away with the regular trash.
- Clean your hands often. You, your family, and others in close contact should wash their hands often with soap and water or use an alcohol-based hand rub, especially after changing the bandage or touching the infected wound.
- Do not share personal items. Personal items include towels, washcloths, razors, clothing, and uniforms. Wash used sheets, towels, and clothes with water and laundry detergent. Use a dryer to dry clothes completely.

Advice for schools, athletic directors, and coaches

How should athletic facilities be managed when an MRSA infection occurs?

- Athletic facilities such as locker rooms should always be kept clean whether or not MRSA infections have occurred among the athletes.
- Review cleaning procedures and schedules with the janitorial/environmental service staff.
 - Cleaning procedures should focus on commonly touched surfaces and surfaces that come into direct contact with people's bare skin each day.
 - Cleaning with detergent-based cleaners or Environmental Protection Agency (EPA) registered detergents/disinfectants will remove MRSA from surfaces.
 - Cleaners and disinfectants, including household chlorine bleach, can be irritating and exposure to these chemicals has been associated with health problems such as asthma and skin and eye irritation.
 - Take appropriate precautions described on the product's label instructions to reduce exposure. Wearing personal protective equipment such as gloves and eye protection may be indicated.
 - Follow the instruction labels on all cleaners and disinfectants, including household chlorine bleach, to make sure they are used safely and correctly.
 - Some key questions that should be answered by reading the label include:
 - How should the cleaner or disinfectant be applied?
 - Do you need to clean surface first before using the disinfectant (e.g., precleaned surfaces)?
 - Is it safe for the surface? Some cleaners and disinfectants, including household chlorine bleach, might damage some surfaces (e.g., metals, some plastics).
 - How long do you need to leave it on the surface to be effective (i.e., contact time)?
 - Do you need to rinse the surface with water after using the cleaner or disinfectant?
 - If you are using household chlorine bleach, check the label to see if the product has specific instructions for disinfection. If no disinfection instructions exist, then use 1/4 cup of regular household bleach in 1 gallon of water (a 1:100 dilution equivalent to 500-615 parts per million [ppm] of available chlorine) for disinfection of pre-cleaned surfaces.

- Environmental cleaners and disinfectants should not be put onto to skin or wounds and should never be used to treat infections.
- The EPA provides a list of registered products that work against MRSA (List H): <u>http://epa.gov/oppad001/chemregindex.htm</u>
- There is a lack of evidence that large-scale use (e.g., spraying or fogging rooms or surfaces) of disinfectants will prevent MRSA infections.
- Repair or dispose of equipment and furniture with damaged surfaces that do not allow surfaces to be adequately cleaned.
- Covering infections will greatly reduce the risks of surfaces becoming contaminated with MRSA.

How should sports equipment be cleaned?

- Equipment, such as helmets and protective gear, should be cleaned according to the equipment manufacturers' instructions to make sure the cleaner will not harm the item.
- Shared equipment should be cleaned after each use and allowed to dry.

Should athletes with MRSA skin infections be excluded from participation?

- If sport-specific rules do not exist, in general, athletes should be excluded if wounds cannot be properly covered during participation.
 - The term "properly covered" means that the skin infection is covered by a securely attached bandage that will contain all drainage and will remain intact throughout the activity. If wounds can be properly covered, good hygiene measures should be stressed to the athlete such as performing hand hygiene before and after changing bandages and throwing used bandages in the trash.
- A healthcare provider might exclude an athlete if the activity poses a risk to the health of the infected athlete (such as injury to the infected area), even though the infection can be properly covered.
- Athletes with active infections or open wounds should not use whirlpools or therapy pools not cleaned between athletes and other common-use water facilities like swimming pools until infections and wounds are healed.

What should I do if I notice an athlete with a possible infection?

- Refer athletes with possible infections to a healthcare provider such as team physician, athletic trainer, school nurse, or primary care doctor.
 - If the athlete is less than 18 years old, notify parents/guardians of the athlete with the possible infection.
- Educate athletes on ways to prevent spreading the infection.
- Using the criteria above, consider excluding the athlete from participation until evaluated by a healthcare provider.

How can I improve hygiene among my athletes?

- Make sure supplies are available to comply with prevention measures (e.g., soap in shower and at sinks, bandages for covering wounds, hand hygiene such as alcohol-based hand rubs)
- Enforce policies and encourage practices designed to prevent disease spread. o Make sure athletes:
 - keep wounds covered and contained

- o shower immediately after participation
- shower before using whirlpools
- wash and dry uniforms after each use
- report possible infections to coach, athletic trainer, school nurse, other healthcare providers, or parents.

Who should be contacted if an outbreak occurs?

• Contact local public health authorities.

Advice for team healthcare providers

- Use standard precautions, including hand hygiene before and after contact and after removing gloves when caring for nonintact skin or possible infections.
- Use barriers such as gowns, masks, and eye protection if splashing of body fluids is possible.
- If hands are not visibly dirty and no sinks are available for hand washing, for example, while on the field of play, alcohol-based hand rubs and santizers can be used to improve hand hygiene

INSTRUCTIONS FOR PREVENTING SPREAD OF MRSA-CA AND OTHER INFECTIOUS SKIN DISEASES

These instructions are based on recommendations from Center for Disease Control (<u>www.cdc.gov</u>) and numerous NCAA Athletic Departments.

Instructions to Athletes:

- Shower with hot water no later than 30 minutes after practice using liquid soap rather than bar soap
- Never re-use clothing after it has been worn once for practice
- Never Share towels, clothes or equipment
- Wipe down equipment weekly with a disinfectant spray weekly (10% Bleach solution or commercially prepared solution that is antibacterial, antiviral and antifungal)
- Show all pimples, boils, spider bites, lacerations and abrasions to Athletic Trainer/Coach immediately
- Clean Wrestling mats no more than 60 minutes before practice and immediately after practice
- Have all open wounds or draining wounds covered by Occlusive Dressing such as Tagaderm

Instructions to Administrators:

- Educate all staff, coaches, parents and athletes about CDC guidelines using the "Am I Disqualified?" DVD from www.thematdoc.com
- Increase surveillance of "spider bites" pimples and boils by Athletic Trainer or Coach and
 Document observations
- Insist that all draining wounds be referred to physician and cultured to identify bacteria
- Identify all CA-MRSA carriers with nasal cultures
- Encourage frequent hand hygiene by parents and Athletes
- Use a 3 percent hexachlorophene or 4 percent chlorhexidine in soap dispensers
- Make alcohol based hand sanitizers available in classrooms, practice fields and areas without access to soap and water
- Use disposable towels on the field during practice and tournaments.
- Inspect cleaning procedures for all equipment and facilities before and after issuing
- Wrestling Mats should be cleaned no more than 30 minutes before practice and immediately after practice
- Exercise equipment should be cleaned after each practice.
- Never issue any equipment until it has been thoroughly cleaned and disinfected
- Ensure that water used for laundry and showers is at least 140 degrees
- Isolate an athlete with identified Infectious skin disease from contact with other players until wound is healed and dry.
- Educate players about possible consequence of these infections and showing them pictures of wounds that have gone untreated
- •

National Federation of State High School Associations



MRSA in Sports Participation Position Statement and Guidelines

National Federation of State High School Associations (NFHS) Sports Medicine Advisory Committee

Skin infections occasionally become a problem in all sports. Some activities are more prone to them than others. Recent outbreaks of MRSA (Methicillin-Resistant <u>Staphylococcal aureus</u>) have occurred prompting the development of

new guidelines from the NFHS Sports Medicine Advisory Committee to: help identify an outbreak, means to minimize it's spread and preventative measures to reduce its occurrence. First and foremost, simple hygienic measures must be used to prevent any form of infection from developing. All athletes should shower after each practice or competing event. Workout gear or clothing needs to be washed at the end of each day or practice. Be sure to properly clean and disinfect all equipment that is in direct contact with an athlete's skin, i.e. mats, on a daily basis. Notify your parent and coach about any suspicious skin lesion and seek medical attention before practice or competing.

MRSA

<u>Staphylococcal aureus</u> is a common bacterium that can exist on the body and under special circumstances in the nose. Rarely does it invade the skin and cause infections. When it does, it's usually in the form of impetigo or folliculitis. Methicillin-resistant <u>staphylococcal aureus</u> is a form of this bacterium that has developed resistance to certain antibiotics. One reason for concern is that this organism, previously only thought to exist in hospitals or nursing homes, has now spread into the community. Antibiotics, such as

Simple Measures to Prevent or Minimize the Risk of MRSA

-Shower after all competition -Wash all work-out gear after practice or competition -Certain sports require cleaning equipment (Mats) before each practice or event -Use liquid soap, not bar soap -Refrain from cosmetic (whole body) shaving -Don't share towels or hygiene products -Notify parents and coach about any skin sores and have it evaluated by health care provider before returning to competition -Shower before using whirlpools or cold tubs -Refrain from using whirlpools or cold tubs with any open sores, scratches or scrapes

Penicillin and related medicines, which were used in the past, are now ineffective causing the problem we presently have. An aggressive form(1) that can spread quickly and usually appears as a boil or abscess (59%). Other forms, cellulitis (42%) and folliculitis (7%) can occur, but less frequent. This infection can invade deeper tissues and cause significant damage to the skin and muscles. Occasionally it can spread to the lungs and cause a serious type of pneumonia.

Risk factors for MRSA

Several issues increase the risk for MRSA to develop. Male-to-male sexual contact, history of intravenous drug usage and known contact with individuals with this bacterium serve as the greatest risk. Children and adolescents have a greater preponderance than adults(2). Other factors are: contact sports, i.e. football, wrestling, rugby and soccer, and history of recurrent boils(3-7).

What to do with an outbreak in an athlete

As with any skin infection, treat the individual and remove them from competition and practice. All players should be screened for similar infections on a daily basis. If possible, work with one health care provider in your community. Continuity of medical care is of the utmost importance in managing these infections. If suspicious, culturing these infections will be necessary to ensure the proper antibiotics are being used. If multiple outbreaks develop on a team, i.e. clusters, contact your Public Health Department for assistance. Multiple outbreaks could indicate there are carriers for the bacteria on the team. If present, consider having nasal cultures obtained on all team members, including coaches, to determine who these carriers are. With a contact sport, consider treating all infected and carrier individuals with antibiotics. For those with an active infection, treat with an appropriate oral antibiotic. Nasal carriers should receive intranasal mupirocin 2% cream twice a day for 5 days. Once being treated, perform chlorhexidine gluconate 4% solution body washes daily for five days will also help to remove or 'decolonize' the bacterium from the body(8).

What to do to prevent an outbreak

All clothing for practice and competition needs to be cleaned daily. Equipment intense sports, i.e. football, hockey, need to address means to properly clean theses items on a routine basis*. Wrestling mats and gymnastic horse need to be disinfected (1:100 solution of household bleach and water) before each practice and several times a day throughout a tournament. Don't share any personal sporting equipment, i.e., gloves, knee pads. Don't use a whirlpool or cold tub with any open wounds, scrapes or scratches.

Individuals need to shower immediately after practice and competition, consider showering multiple times during tournaments when several events occur each day and before using whirlpools or common tubs. Use soap from

liquid dispensers, not shared bar soap(8). Require the use of personal towels and hygiene products. Sharing of these is felt to be a major source of spreading the bacterium to others(8). Refrain from cosmetic shaving of the skin, i.e. chest, back and pubic regions.

Provided there aren't any outbreaks, carriers of MRSA can continue to compete in sporting events. Proper care of all skin abrasions or cuts will minimize the risk of an infection and its spread.

*Cleaning of these equipment-intense sports can be difficult and costly. Manual disinfecting with 1:100 solution of household bleach and water is recommended. If not feasible, there are several companies that can clean larger pieces of equipment using various modalities (i.e., detergents, ozone). Consider seeking help from these companies or contact your local drycleaners for assistance.

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<u>Sports Hygiene – Guidelines to Minimize Infectious Diseases</u> <u>Position Statement and Guidelines</u>

National Federation of State High School Associations (NFHS) Sports Medicine Advisory Committee

Preparation for competition in any sport requires proper training and practice. Whether it means preparing your body or maintaining your equipment, proper preparation is necessary. Keeping your body and equipment clean is part of that process. Infectious diseases do propagate and are easily transmitted in the sports environment. Contact sports and those with heavy amounts of equipment are more prone than others, but needless to say, proper hygiene is necessary in all sports to reduce the potential of transmitting these agents. The NFHS Sports Medicine Advisory Committee realizes these issues and has helped establish guidelines to educate the sporting and medical community about their presence and means to reduce transmission of sports related infectious diseases.

Proper Hygienic Practices

- 1. Shower immediately after each practice or competition. Use your own bottled soap and towel and don't share them with others, let alone other toiletries. Studies have shown that transmission of infectious diseases can occur when these items are shared with other athletes.
- 2. Don't share water bottles. Viruses and bacterial infections can be easily transmitted via a shared bottle.
- 3. Don't perform cosmetic shaving. Needless shaving of the chest or legs or genital areas have been associated with increased outbreaks of Methicillin-Resistant Staphylococcal aureus (MRSA). Consider cropping or closely trimming the areas if necessary.
- 4. Wash equipment on a routine basis. Work-out clothing after each practice. Consider washing smaller pads (for knees or elbows) on a weekly basis or if soiled with contaminated material, each day. Larger pads, such as those in Hockey or Football, should be disinfected (1:100 solution of household bleach and water) on a routine basis. More frequently if soiled with blood or

bodily fluids. Commercial equipment utilizing detergents or ozone for decontamination could also be considered.

- 5. Don't let abrasions or open sores go without evaluation by your coach or Certified Athletic Trainer (ATC). Be sure to keep them clean and covered with proper dressings.
- 6. Inform your coach or ATC about any suspicious lesion at the beginning of practice. Consider withdrawal from practice or competition until the lesion is evaluated by your Health Care Provider (HCP). If it is considered infectious, wait to return to competition until it has cleared by your HCP. Also have other team mates evaluated for such lesions and cared for in the same manner.
- 7. Don't use a whirlpool or cold tub with any open wounds, scrapes or scratches.
- 8. Shower before using whirlpools or common tubs.

<u>Sports Hygiene</u>
Hygienic guidelines that will help reduce being sidelined: -Shower after practice/competition -Don't share water bottles -Don't perform cosmetic shaving -Wash workout clothing daily and equipment routinely -Properly cover all abrasions and open sores -Have all suspicious lesions evaluated before practice or competition -Shower before using whirlpools or cold tubs -Refrain from using whirlpools or cold tubs with any open sores, scratches or scrapes
with any open sores, scratches of scrapes

Following these guidelines will help reduce the occurrences and outbreaks of infectious diseases. This will take an active participation of the coach, parent and athlete. Together this will create a healthy environment that will allow the athlete compete and reduce the risk of being sidelined.

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National Federation of State High School Associations



Herpes Gladiatorum Position Statement and Guidelines

National Federation of State High School Associations (NFHS) Sports Medicine Advisory Committee

In the recent years, control of skin infections has become a crucial part of high school wrestling. Herpes Gladiatorum (HG), caused by Herpes Simplex Type-1 virus (HSV-1), has received the most attention due to the speed of which it can spread and the long term consequences an athlete may have, even after finishing his/her career. The NFHS Sports Medicine Advisory Committee realizes these issues and has helped establish guidelines to educate the sporting and medical community about their presence, means to treat and reduce transmission of this virus.

Guidelines for Herpes Gladiatorum – Treatment and Prevention

First time Outbreak:

- 1. Seek medical attention and oral antiviral treatment to expedite its clearance.
- 2. Regardless if treated, no wrestling until all lesions are healed with well-adhered scabs. No new vesicle formation and no swollen lymph nodes near area involved.
- 3. Consider being placed on prophylactic oral antiviral medication for remainder of season and each subsequent season.

Recurrent Outbreaks:

- 1. Seek medical attention and oral antiviral treatment to expedite its clearance.
- 2. No wrestling until after 120 hours of oral antiviral medication and no swollen lymph nodes near area involved.
- 3. If not treated with antiviral medication, no wrestling until all lesions are healed with well-adhered scabs. No new vesicle formation and no swollen lymph nodes near area involved.
- 4. Consider being placed on prophylactic oral antiviral medication for remainder of the season and each subsequent season.

Any individual exposed to the outbreak 3 days prior to its development, should be isolated from direct contact with other athletes for 8 days. Examine them daily for potential Herpes Gladiatorum.

Use of antiviral medication for prevention is only at the discretion of your Health Care Provider (HCP), who can then explain the potential risks and benefits.

The spreading of this virus is strictly skin-to-skin with the preponderance of the outbreaks developing on the head, face and neck. This reflects the typical lock-up position a wrestler has facing his/her opponent. Usually a primary outbreak is seen as a raised, rash coalesced into groupings of 6-10 vesicles. Sore throat, fever, swollen, cervical lymph nodes and malaise are typical signs with a first time outbreak. Reoccurrence usually involves a smaller area with less systemic signs and for a shorter duration.

Young athletes who contract Herpes Gladiatorum are destined to have a battle with lifelong reoccurrences and potential spread to less suspecting individuals, such as partners or children. Differing from recurrent herpes labialis, or 'cold sores', recurrent Herpes Gladiatorum can develop around the eye. This location has potential for rare but serious consequences with reoccurrences possibly affecting the visual acuity of the afflicted eye.

Previously thought to exist in 2.6% of high school age wrestlers, recent data suggests it may exist in 29.8% of these individuals. Even though this is no different than non-wrestlers in this age group, the location of the outbreaks is of concern. Since only 2-3% of these athletes are aware they have Herpes Gladiatorum, a larger number are competing with the virus and unknowingly exposing it to others. Means of infection control should focus on coaches or Certified Athletic Trainers, performing daily skin checks. An athlete with a suspicious lesion must be withdrawn from practice or competition, only to return after evaluated and cleared by his/her Health Care Provider.

Once an outbreak occurs on a team, removing the athlete from competition or play is mandatory to minimize its spread. After being on antiviral medication, and provided no further signs of infection, he/she can return to play. Since the virus can spread before vesicles are present, it's recommended to examine all athletes in contact with this individual from the previous 3 days. Monitor them for any suspicious lesions, which may take 8 days to develop. Due to the risk of viral spread before vesicle formation, consider isolating these individuals from sparring with others during that time.

The usage of oral antiviral medication is beneficial in expediting the clearance of an outbreak. One paper showed that when used for a recurrent outbreak, these medications showed a 2 day reduction in the length of time it takes to clear the virus. Although controversial, the use of prophylactic dosing can help in reducing the reoccurrence of outbreaks. Data exists showing infected individuals to have a greater preponderance to outbreaks when not on the medication. These medications won't prevent 100% of the outbreaks, but can reduce their occurrence. Amongst health professionals, the concerns about using these medications in this venue center around potential risks, inconsistent benefit and possible resistance development.

Documentation exists stating these issues are minimal, yet plausible and need to be mentioned. Therefore, this determination should be done at the discretion of the parents/guardian, Health Care Provider and the athlete.

The NFHS Sports Medicine Advisory Committee will continue to promote control of Herpes Gladiatorum by education and raising public awareness about the virus. Affected athletes should work closely with their Health Care Providers to determine the best way to treat an outbreak and how to reduce its spread to other wrestlers. The coaching staff and Certified Athletic Trainers shall focus on: daily skin checks, proper hygienic practices, and withdrawal and treatment of individuals with an active outbreak. Addendum: Other considerations could be given to perform blood testing to determine antibodies for HSV-1 at the beginning of each season. Anyone who is positive should be considered for daily antiviral prophylaxis throughout the season, even if they have never had a documented outbreak of Herpes Gladiatorum or cold sores. A belief held by few and supported by recent research in high school wrestlers. There is also data to support that shedding of the virus can occur before actual vesicle formation. This would be of importance since present guidelines focus on the presence of vesicles for withdrawal of competition. Prophylaxis would help prevent vesicle formation and possibly reduce viral shedding as these are very important factors in controlling Herpes Gladiatorum transmission.

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COMMUNICABLE SKIN CONDITIONS (2007-08 NFHS WRESTLING RULES BOOK)

The transmission of communicable skin conditions is still a major concern in the sport of wrestling. For the third time in six years, the NFHS Wrestling Rules Committee has made communicable skin conditions a major Point of Emphasis for the 2007-08 wrestling season. Many rules changes have been implemented in an effort to reduce the spread of these conditions. If the spread of communicable skin conditions is going to be controlled, it will take more than simply rules. It will take every coach addressing the issue of prevention, everyday. Coaches must make it unacceptable for wrestlers to share common towels, to leave school without showering after practice or competition, to wear their practice clothes home, to practice or compete without having a daily skin check, to enter the practice room without wearing clean workout clothes and for mats not to be cleaned with a disinfectant cleaner at least once a day.

The following guidelines provide practical suggestions that will help reduce the incidence of communicable skin conditions among wrestlers.

1. Coaches must visit with wrestlers, and their parents, about how to recognize and prevent the most common communicable skin conditions.

2. Clean wrestling mats at least once a day with a disinfectant cleaner*, preferably within one hour of practice or competition. Allow mats to air dry before using. There is great benefit from cleaning mats before and after practice. *(Disinfectant cleaners used should state they are effective against viruses, fungi and bacteria.)

3. Don't allow any wrestler into the practice room without clean practice gear.

4. Launder all towels, practice gear and uniforms after each use. To destroy disease-causing organisms, either use detergent containing bleach or dry all articles in a dryer at the high heat setting.

5. Wrestlers should not put dirty practice clothes in the same gym bag in which they carry clean practice clothes to school. This may contaminate the bag and, therefore, the clean clothes.

6. Headgear, shoes and neoprene sleeves and supports should be wiped with a disinfectant cleaner after every use and allowed to air dry.

7. Do not allow wrestlers to share any item of practice gear or use common towels.

8. Require each wrestler to shower after each practice and contest, scrubbing vigorously with an antibacterial or deodorant soap. Consider providing liquid soap. If this is not possible, do not allow wrestlers to share bars of soap.

9. Wrestlers should keep their fingernails trimmed short to avoid scratching themselves or others, as any opening in the skin increases the risk of infection.

10. Wash wall mats with a disinfectant cleaner on a regular basis (1-2 times weekly).

11. Wipe weight benches with a disinfectant cleaner after each use and/or before the next day's use.

12. Open the doors to the wrestling room each night and use fans to lower the heat and humidity. Proper ventilation is very important to destroy disease causing organisms, especially those causing fungal conditions, such as ringworm.

13. Wrestlers, especially those who have experienced communicable skin conditions in the past, should boost their natural immunity to all diseases by eating healthy foods and getting adequate rest. They may also wish to take a multi-vitamin supplement.

14. Coaches or Certified Athletic Trainers should perform daily skin checks on all wrestlers on the team, to catch early outbreaks of a communicable skin condition before it infects fellow teammates or an opponent.

The following guidelines will help reduce the spread of communicable skin conditions, if at least one wrestler is already infected.

1. Wrestlers with any signs of a communicable skin condition must be sent to a physician immediately and MUST be withheld from practice until a medical diagnosis and clearance is obtained.

2. Wrestlers with a suspect skin condition must have current written permission from a physician before returning to practice/competition and should have such clearance before being allowed to participate in any way. After receiving physician clearance, it is wise to cover the affected area(s) with an occlusive (water resistant) dressing, or a gauze pad with water resistant covering on at least one side, until the lesion(s) is completely gone.

3. Wrestlers having lesions from a communicable skin condition on their face or neck should launder their pillow case on a daily basis.

4. Wrestlers with any signs of a communicable skin condition should wash their hands frequently to avoid contaminating themselves, or others.

5. Wrestlers with communicable skin conditions should be made aware that contact they have with others during the school day, outside the wrestling room, may spread the condition to others.

Invasive Methicillin-Resistant Staphylococcus aureus Infections in the United States

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FTER BEING INITIALLY REported among injecting drug users in Detroit in 1981¹ and then associated with the deaths of 4 children in Minnesota and North Dakota in 1997,² community-associated methicillin-resistant *Staphylococcus aureus* (MRSA) has become the most frequent cause of skin and soft tissue infections presenting to emergency departments in the United States.³ Although community outbreaks of MRSA in diverse populations, including American Indian and Alaska Natives,⁴ sports

See also p 1803 and Patient Page.

Context As the epidemiology of infections with methicillin-resistant *Staphylococcus aureus* (MRSA) changes, accurate information on the scope and magnitude of MRSA infections in the US population is needed.

Objectives To describe the incidence and distribution of invasive MRSA disease in 9 US communities and to estimate the burden of invasive MRSA infections in the United States in 2005.

Design and Setting Active, population-based surveillance for invasive MRSA in 9 sites participating in the Active Bacterial Core surveillance (ABCs)/Emerging Infections Program Network from July 2004 through December 2005. Reports of MRSA were investigated and classified as either health care–associated (either hospital-onset or community-onset) or community-associated (patients without established health care risk factors for MRSA).

Main Outcome Measures Incidence rates and estimated number of invasive MRSA infections and in-hospital deaths among patients with MRSA in the United States in 2005; interval estimates of incidence excluding 1 site that appeared to be an outlier with the highest incidence; molecular characterization of infecting strains.

Results There were 8987 observed cases of invasive MRSA reported during the surveillance period. Most MRSA infections were health care–associated: 5250 (58.4%) were community-onset infections, 2389 (26.6%) were hospital-onset infections; 1234 (13.7%) were community-associated infections, and 114 (1.3%) could not be classified. In 2005, the standardized incidence rate of invasive MRSA was 31.8 per 100 000 (interval estimate, 24.4-35.2). Incidence rates were highest among persons 65 years and older (127.7 per 100 000; interval estimate, 92.6-156.9), blacks (66.5 per 100 000; interval estimate, 43.5-63.1), and males (37.5 per 100 000; interval estimate, 26.8-39.5). There were 1598 in-hospital deaths among patients with MRSA infection during the surveillance period. In 2005, the standardized mortality rate was 6.3 per 100 000 (interval estimate, 3.3-7.5). Molecular testing identified strains historically associated with community-associated disease outbreaks recovered from cultures in both hospital-onset and community-onset health care–associated infections in all surveillance areas.

Conclusions Invasive MRSA infection affects certain populations disproportionately. It is a major public health problem primarily related to health care but no longer confined to intensive care units, acute care hospitals, or any health care institution. *JAMA. 2007;298(15):1763-1771* www.jama.com

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teams,^{5,6} prison inmates,⁷ and child care attendees,⁸ usually involved skin disease, MRSA also can cause severe, sometimes fatal invasive disease.⁹⁻¹³

Studies of the emergence of community-associated MRSA disease over the past decade determined that isolates causing community-associated and health care-associated MRSA infections were distinct.10 Isolates from the community were susceptible to most non–β-lactam antimicrobial agents,¹⁰ carried staphylococcal cassette chromosome type IV,14 and frequently encoded the dermonecrotic cytotoxin known as Panton-Valentine leukocidin.15 The strain most often isolated in community outbreaks was pulsedfield type USA300.16 Other strains of community origin include USA400, USA1000, and USA1100.17 In contrast, strains most frequently associated with MRSA infections in health care settings were USA100, USA200, and less often, USA50018; these traditionally have been multidrugresistant and have carried staphylococcal cassette chromosome type II.¹⁰

In hospitalized patients, MRSA has been a problem since the 1960s¹⁹; approximately 20% of bloodstream infections in the hospital setting have been caused by S aureus.²⁰ The proportion of hospital-onset S aureus infections that were methicillin-resistant reached 64.4% in US intensive care units in 2003.²¹ In the hospital, MRSA infections are associated with greater lengths of stay, higher mortality,²² and increased costs.23,24 Although more recently there has been increased surveillance activity for invasive MRSA infections in the community, surveillance for MRSA bloodstream infections in the United States traditionally has been limited to hospital-onset (ie, nosocomial) disease.20,21

As the epidemiology of MRSA disease changes, including both community- and health care–associated disease, accurate information on the scope and magnitude of the burden of MRSA disease in the US population is needed to set priorities for prevention and control. In this report we describe the incidence and distribution of invasive MRSA disease in 9 US communities and use these results to estimate the burden of invasive MRSA infections in the United States.

METHODS Surveillance Methodology and Definitions

The Active Bacterial Core surveillance system (ABCs) is an ongoing, population-based, active laboratory surveillance system and is a component of the Emerging Infections Program (EIP) of the US Centers for Disease Control and Prevention (CDC). From July 2004 through December 2005, 9 EIP sites conducted surveillance for invasive MRSA infections. A site number was assigned in descending order of population size: site 1, the state of Connecticut (estimated population, 3.5 million); site 2, the Atlanta, Georgia, metropolitan area (8 counties; estimated population, 3.5 million): site 3, the San Francisco, California, Bay Area (3 counties; estimated population, 3.2 million); site 4, the Denver, Colorado, metropolitan area (5 counties; estimated population, 2.3 million); site 5, the Portland, Oregon, metropolitan area (3 counties; estimated population, 1.5 million); site 6, Monroe County, New York (estimated population, 733 000); site 7, Baltimore City, Maryland (estimated population, 636 000); site 8, Davidson County, Tennessee (estimated population, 575 000); and site 9, Ramsey County (St Paul area), Minnesota (estimated population, 495 000). The total population under surveillance in 2005 was an estimated 16.5 million, or approximately 5.6% of the US population. Surveillance sites were similar to the US population in the distribution by male sex (49.2% and 49.3%, respectively); however, surveillance sites had a lower frequency of whites (72.7% and 81.0%, respectively) and of persons 65 years and older (10.8% and 12.4%, respectively).

ABCs case finding was both active and laboratory-based. Clinical microbiology laboratories in acute care hospitals and all reference laboratories processing sterile site specimens for residents of the surveillance area were contacted regularly for case identification. In hospitals without computerized microbiology data, surveillance personnel telephoned designated microbiology laboratory contacts regularly to identify new cases and request isolate submission. Where microbiology data were computerized, electronic line listings of all MRSA isolated from normally sterile sites were received on a monthly basis by surveillance staff, which investigated each potential case to confirm residency status, presence of infection, demographic characteristics, and underlying illness. The burden of disease can be estimated by this surveillance method using census data and the surveillance site-specific incidence rates and age-, race-, and sex-adjusted incidence rates pooled across all surveillance sites. This infrastructure is the same as that used for estimated incidence and disease burden for bacterial meningitis²⁵ and invasive infections with Streptococcus pneumoniae.^{26,27}

Case reporting and isolate collection were determined to be surveillance activities at the CDC; in addition, each of the 9 participating surveillance sites evaluated the protocol and either deemed it a surveillance activity (eg, that involving a reportable disease) or obtained institutional review board approval with a waiver of informed consent.

A case of invasive MRSA infection was defined by the isolation of MRSA from a normally sterile body site in a resident of the surveillance area, including residents institutionalized in long-term care facilities, prisons, etc. Normally sterile sites included blood, cerebrospinal fluid, pleural fluid, pericardial fluid, peritoneal fluid, joint/ synovial fluid, bone, internal body site (lymph node, brain, heart, liver, spleen, vitreous fluid, kidney, pancreas, or ovary), or other normally sterile sites. Cultures designated as "fluid" were investigated as potentially sterile culture sites; cultures designated as "tissue" with no specification of original source were not investigated.

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Personnel in each EIP site abstracted data from medical records from hospital and clinic visits using a standard case report form. Information on the following health care risk factors for MRSA was collected: culture obtained more than 48 hours after admission; presence of an invasive device (eg, vascular catheter, gastric feeding tube) at time of admission or evaluation; and a history of MRSA infection or colonization, surgery, hospitalization, dialysis, or residence in a longterm care facility in the 12 months preceding the culture. Cases could have more than 1 health care risk factor. For this analysis, we used health care risk factor information to classify cases into mutually exclusive groups (those with health care-associated and communityassociated infections) justified previously²⁸ and consistent with other studies (TABLE 1).29,30 Health careassociated infections, in turn, were classified as either community-onset (cases with a health care risk factor but with a culture obtained ≤ 48 hours after hospital admission) and hospitalonset (cases with culture obtained >48 hours after admission, regardless of whether they also had other health care risk factors). Community-associated cases were those without documented health care risk factors.

Surveillance personnel also collected demographic (including race), clinical, and outcome (hospital death or discharge) information on each case from the initial hospitalization. Mortality was collected from the patient record and represented crude, in-hospital deaths only. Race was collected from information available in the medical record. Cases were considered to have a diagnosis of bacteremia, pneumonia, cellulitis, osteomyelitis, endocarditis, septic shock, or other infection, if there was documentation of such a diagnosis in the medical record, regardless of the source of the isolate. Cases could have more than 1 clinical diagnosis. Bacteremias included those classified as primary, secondary, and not specified. Use of up to 4 antimicrobial agents was recorded, but all such agents reflected only initial empirical therapy and did not in**Table 1.** Definitions Used for Epidemiologic Classification of Invasive Methicillin-Resistant

 Staphylococcus aureus (MRSA) Infections

Classification	Definition			
Health care–associated Community-onset	Cases with at least 1 of the following health care risk factors: (1) presence of an invasive device at time of admission; (2) history of MRSA infection or colonization; (3) history of surgery, hospitalization, dialysis, or residence in a long-term care facility in previous 12 mo preceding culture date			
Hospital-onset	Cases with positive culture result from a normally sterile site obtained >48 h after hospital admission. These cases might also have ≥1 of the community-onset risk factors.			
Community-associated	Cases with no documented community-onset health care risk factor			

clude dose, duration, therapeutic changes, or procedures (eg, draining, surgical therapy). Concordant empirical therapy was defined as receipt of any antimicrobial agent to which the isolate was susceptible by laboratory testing and that was documented in the medical record. Recurrent invasive MRSA was defined as a positive culture result obtained from the same case 30 days or more after the initial culture.

Isolate Collection and Testing

Laboratories identified by the EIP site were asked to submit isolates from invasive MRSA infections. Of 123 laboratories serving residents of the surveillance areas, 48 (39%) contributed isolates. All isolates were sent to the CDC for identification, selected testing, and storage. In situations in which more than 1 isolate was available from a single case, the protocol selected 1 isolate, preferably from a nonblood sterile site. Isolates were prioritized for testing as follows: within each geographic site, all nonblood isolates and the subsequent submitted blood isolate were selected; then, among blood isolates, those from cases with a diagnosis other than uncomplicated bacteremia were selected. Testing included confirmation of S aureus identification using catalase and Staphaurex (Remel Europe Ltd, Dartford, United Kingdom) agglutination tests and tube coagulase if necessary, as well as description of morphology on nonselective blood agar, confirmation of oxacillin resistance by the broth microdilution method,¹⁸ and pulsed-field gel electrophoresis (PFGE) using the restriction endonuclease

*Sma*I. PFGE patterns were analyzed using BioNumerics version 4.01 (Applied Maths, Austin, Texas) and grouped into pulsed-field types using Dice coefficients and 80% relatedness, as previously described.¹⁸ PFGE testing was conducted at the CDC and at the reference centers in Colorado, Connecticut, Georgia, Minnesota, and Oregon. All PFGE patterns were entered into a single database for analysis.

Statistical Analysis

We selected cases reported from July 2004 through December 2005 to describe epidemiologic, clinical, and microbiological characteristics. We included only cases reported from January through December 2005 for the annual 2005 incidence rate calculations. Recurrent cases were excluded from incidence calculations. We used US Census Bureau bridged-race vintage postcensus population estimates for 2005, provided by the National Center for Health Statistics for surveillance area and national denominator values.

Because the surveillance sites varied in the distribution by age and race, for national estimates of burden of disease we multiplied the aggregate age-, race-, and sex-specific rates of disease in the surveillance areas by the age, race, and sex distribution of the US population for 2005. Because 1 site (site 7, Baltimore City) reported an excessively high incidence of infection, we calculated interval estimates for the age-, race-, and sex-adjusted incidence rates and estimated burden as well. This was performed by creating a lower bound by pooling data from the 3 EIP sites

Table 2. Observed Incidence Rates of Invasive Methicillin-Resistant *Staphylococcus aureus* (MRSA) by Active Bacterial Core Surveillance Site and Epidemiologic Classification, United States, 2005^a

		Incidence per 100 000					
			Health Care-				
Surveillance Site No. (Location) ^b	No. of Cases	Community-Associated	Community-Onset	Hospital-Onset	Total		
1 (Connecticut)	952	2.7	15.6	8.4	27.1		
2 (Atlanta, GA, metropolitan area)	1165	5.1	16.7	10.3	33.0		
3 (San Francisco, CA, Bay Area)	936	4.5	15.9	7.7	29.2		
4 (Denver, CO, metropolitan area)	480	2.8	12.3	6.0	21.2		
5 (Portland, OR, metropolitan area)	305	4.7	11.4	3.6	19.8		
6 (Monroe County, NY)	307	2.7	22.2	16.8	41.9		
7 (Baltimore City, MD)	742	29.7	62.9	19.7	116.7		
8 (Davidson County, TN)	305	6.8	30.4	13.9	53.0		
9 (Ramsey County, MN)	95	1.6	11.5	6.1	19.2		

^a Epidemiologic classification of disease consisted of health care-associated (either hospital-onset cases with a culture collected >48 h after hospital admission or communityonset cases with health care risk factors but a culture collected ≤48 h after hospital admission) and community-associated cases (no health care risk factors).

^b Site numbers were assigned in descending order of population size.

Table 3. Estimated Incidence Rates of Invasive Methicillin-Resistant Staphylococcus aureus

 Infections by Race, Active Bacterial Core Surveillance, United States, 2005

		Incidence per 100 000				
Age, y	No. of Cases	White	Black	Other		
<1	60	14.9	65.9	14.2		
1	9	3.7	5.9	0		
2-4	18	1.9	6.0	0		
5-17	47	0.7	4.8	0.4		
18-34	434	7.3	29.1	3.2		
35-49	1082	16.1	84.9	6.3		
50-64	1327	35.1	127.5	15.8		
≥65	2308	118.0	253.8	67.0		
Total (interval estimates) ^a	5287	27.7 (21.9-32.4)	66.5 (43.5-63.1)	10.4 (10.7-16.4)		

^a Interval estimates for the overall incidence by race were calculated for the lower bound by pooling data from the 3 surveillance sites reporting the lowest incidence rates; for the upper bound, by pooling data from the 3 sites reporting the highest rates, excluding data from site 7 (Baltimore City), which reported excessively high rates. These race-specific interval estimates are adjusted by age and sex.

with lowest overall incidence (sites 4, 5, and 9) and an upper bound by pooling data from the 3 EIP sites with highest overall incidence (sites 2, 6, and 8), excluding site 7. Because data from site 7 were excluded from the interval estimates, there are occasions when the intervals do not include the overall rate. Confidence intervals are based on the properties of a sampling distribution and cannot be calculated with our data because our surveillance areas captured all cases, not a sample. We tested differences in proportions of descriptive characteristics using χ^2 . Analyses were performed using SAS version 9.1.3 (SAS Institute Inc, Cary, North Carolina).

RESULTS Incidence of Invasive MRSA

There were 8987 observed cases of invasive MRSA reported from July 2004 through December 2005. Most were health care–associated, with 5250 (58.4%) community-onset infections, 2389 (26.6%) hospital-onset infections, 1234 (13.7%) communityassociated infections, and 114 (1.3%) that could not be classified.

Unadjusted incidence rates of all types of invasive MRSA ranged between approximately 20 to 50 per 100 000 in most ABCs sites but were noticeably higher in 1 site (site 7, Baltimore City) (TABLE 2). The rate of invasive communityassociated MRSA was less than 3 per 100 000 in 4 sites and approximately 5 per 100 000 in 3 sites. Incidence rates were consistently higher among blacks compared with whites in the various age groups (TABLE 3). Adjusting for age, race, and sex, the standardized incidence rate of invasive MRSA for calendar year 2005 was 31.8 per 100 000 persons (TABLE 4). The overall interval estimate after exclusion of the outlier site (site 7) was 24.4 to 35.2 per 100 000.

The rate of health care-associated, community-onset infections (17.6 per 100 000; interval estimate, 14.7-18.2) was greater than either health careassociated, hospital-onset infections (8.9 per 100000; interval estimate, 6.1-11.8) or community-associated infections (4.6 per 100 000; interval estimate, 3.6-4.4). Standardized incidence rates overall were highest among persons 65 years and older (127.7 per 100 000; interval estimate, 92.6-156.9), blacks (66.5 per 100 000; interval estimate, 43.5-63.1), and males (37.5 per 100 000; interval estimate, 26.8-39.5) (Table 4). Rates were lowest among persons aged 5 to 17 years (1.4 per 100 000; interval estimate, 0.8-1.7).

The standardized mortality rate was 6.3 per 100 000 (interval estimate, 3.3-7.5) overall, and was higher among persons 65 years and older (35.3 per 100 000; interval estimate, 18.4-44.7), blacks (10.0 per 100 000; interval estimate, 5.7-9.9), and males (7.4

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per 100 000; interval estimate, 3.7-8.9) (Table 4). Among persons with MRSA, mortality for health care– associated, community-onset infections was higher (3.2 per 100 000; interval estimate, 1.7-3.7) than for health care–associated, hospital-onset infections (2.5 per 100 000; interval estimate, 1.2-3.1) or for communityassociated infections (0.5 per 100 000; interval estimate, 0.3-0.6).

There were 5287 infections reported in the surveillance areas during 2005; after adjusting for age, race, and sex to the US population, we estimated that 94 360 (interval estimate, 72 850-104 000) patients had an invasive MRSA infection. There were 988 reported deaths, which we estimated were 18 650 (interval estimate, 10 030-22 070) in-hospital deaths subsequent to invasive MRSA infections in the United States (Table 4).

Pooled among all sites, we looked at the frequency of reports over the 18month period from July 2004 through December 2005. The number of cases reported per month ranged from 443 in August 2004 to 541 in September 2005. Among all cases reported in the 18-month period, the percentage with community-associated infections ranged from 4.2% in April 2005 to 6.6% in July, August, and October 2005. When limiting the evaluation to only the 172 community-associated pneumonia reports, there was no apparent clustering by season (data not shown).

Established MRSA Risk Factors and Spectrum of Disease

Apart from community-associated cases which, by definition, had no established health care risk factors for MRSA, 4105 of 5250 (78.2%) cases with health care–associated, community-onset infections and 1993 of 2389 (83.4%) cases with health care–associated, hospitalonset infections had more than 1 health care risk factor for MRSA documented in medical records. The most common health care risk factors among cases with community-onset infections and hospital-onset infections were a history of hospitalization (76.6% and 57.7%, respectively), history of surgery (37.0% and 37.6%), long-termcare residence (38.5% and 21.9%), and MRSA infection or colonization (30.3% and 17.4%).

Of the 8792 cases with complete information, the clinical syndrome associated with invasive MRSA disease included bacteremia (75.2%), pneumonia (13.3%), cellulitis (9.7%), osteomyelitis (7.5%), endocarditis (6.3%), and septic shock (4.3%). Almost all cases (8304 [92.4%]) were hospitalized, 1598 (17.8%) of all cases died during hospitalization, and 1162 (12.9%) developed recurrent invasive infections. Cases with endocarditis had a high frequency of recurrent infections (108 [19.3%]). Clinical outcome was recorded for 8849 cases (98%). Crude

Table 4. Numbers and Incidence Rates of Invasive Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infections and Deaths, by Selected Demographic Characteristics and Epidemiologic Classifications, Active Bacterial Core Surveillance, United States, 2005^a

			Invasive MRS	A Infections			Invasive MRSA Deaths					
	I			Incidence pe	r 100 000		11		In	cidence per	100 000	
			[Health (Associ						Health (Associ		
Demographic	Actual No.	Estimated No.	Community	Community- Onset	Hospital- Onset	Total	Actual No.	Estimated No.	Community	Community- Onset	Hospital- Onset	Total
Sex												
Male	3066	54 790	6.1	20.6	10.1	37.5	571	10840	0.8	3.9	2.7	7.4
Female	2220	39 360	3.2	14.7	7.9	26.3	417	7820	0.3	2.6	2.2	5.2
Age, y <1	60	950	3.5	4.7	14.7	23.1	5	80	0	0.3	1.6	2.0
<u> </u>						-						
1	9	160	2.9	0.0	1.0	3.8	0	0	0	0	0	0
2-4	18	290	0.8	1.0	0.6	2.4	1	10	0	0	0.1	0.1
5-17	47	730	0.6	0.4	0.3	1.4	3	60	0	0	0.1	0.1
18-34	434	7050	3.2	4.2	2.4	10.1	31	460	0.1	0.2	0.3	0.7
35-49	1082	16100	6.3	11.9	5.3	24.3	92	1400	0.4	0.8	0.9	2.1
50-64	1327	22 1 20	6.7	23.9	12.1	43.9	224	3640	0.9	3.2	2.9	7.2
≥65	2308	46 970	8.9	78.2	39.1	127.7	632	13 000	2.1	19.7	13.4	35.3
Race												
White	2716	66 590	3.8	15.3	8.1	27.7	596	14270	0.4	3.1	2.4	5.9
Black	1794	25 980	10.9	37.2	16.6	66.5	263	3900	0.2	4.8	3.7	10.0
Other	139	1790	1.6	5.4	3.3	10.4	38	480	0.1	1.3	1.2	2.8
Total (interval estimates)	5287	94 360 (72 850- 104 000)	4.6 (3.6- 4.4)	17.6 (14.7- 18.2)	8.9 (6.1- 11.8)	31.8 (24.4- 35.2)	988	18 650 (10 050- 22 100)	0.5 (0.3- 0.6)	3.2 (1.7- 3.7)	2.5 (1.2- 3.1)	6.3 (3.3- 7.5)

^aEpidemiologic classification of disease consisted of healthcare-associated (either hospital-onset cases with a culture collected >48 hours after hospital admission or community-onset cases with healthcare risk factors but a culture collected ≤48 hours after hospital admission) and community-associated cases (those with no healthcare risk factors). There were 638 cases and 91 deaths with unknown race.

mortality varied by MRSA-related diagnosis, with high rates observed among cases with septic shock (55.6%) and pneumonia (32.4%), low rates among those with cellulitis (6.1%), and moderate rates among those with bacteremia (10.2%) or endocarditis (19.3%). The proportion of cases presenting with each major clinical condition varied between epidemiologic classifications (TABLE 5). Compared with the distribution of syndromes among cases with communityassociated infections, bacteremia was more common, and cellulitis and endocarditis were significantly less common, among each of the cases with health care-associated infections.

Empirical therapy was documented for 5730 of the 8987 cases (63.8%). Overall, 4720 cases (82.4%) received concordant empirical therapy. Differential outcomes based on discordant therapy were not evaluated, since required data such as dose, duration, therapy changes, and adjunctive therapy were not abstracted. Receipt of concordant therapy was slightly lower among cases with communityassociated infections compared with those having health care-associated infections either of community onset (80.1% vs 82.9%, respectively; *P*=.03) or hospital onset (80.1% vs 86.0%, P < .001). Vancomycin was the antimicrobial agent most frequently used for

Table 5. Number and Percentage of Invasive Methicillin-Resistant Staphylococcus aureus Infections by Clinical Condition and Epidemiologic Classification, Active Bacterial Core Surveillance, United States, July 2004-December 2005^a

Condition ^b		Health Care- No.		
	Community- Associated (n = 1226)	Community- Onset (n = 5191)	Hospital- Onset (n = 2375)	Total, No. (N = 8792) ^c
Bacteremia	798 (65.1)	4019 (77.4) ^e	1794 (75.5) ^e	6611
Pneumonia	172 (14.0)	616 (11.9) ^d	383 (16.1)	1171
Cellulitis	278 (22.7)	456 (8.8) ^e	114 (4.8) ^e	848
Osteomyelitis	99 (8.1)	415 (8.0)	142 (6.0) ^d	656
Endocarditis	155 (12.6)	341 (6.6) ^e	60 (2.5) ^d	556
Septic shock	46 (3.8)	233 (4.5)	99 (4.2)	378
0				

^a Epidemiologic classification of disease consisted of health care-associated (either hospital-onset cases with a culture collected >48 h after hospital admission or community-onset cases with health care risk factors but a culture collected ≤48 h after hospital admission) and community-associated cases (those with no health care risk factors). ^bCases could have ≥ 1 clinical syndrome.

^cOf 8987 observed cases with invasive methicillin-resistant Staphylococcus aureus, 114 (1.3%) could not be classified and 81 had missing condition. $^{\rm d}P < .05.$

eP < .01; all comparisons use community-associated as the referent category

Table 6. Number and Percentage of Pulsed-Field Types USA100 and USA300 of Methicillin-Resistant Staphylococcus aureus Isolates, Active Bacterial Core Surveillance Sites, United States, 2005^a

		Isolates at Each Site, No. (%)					
Surveillance Site No. (Location) ^b	No. of Cases	Isolates	USA100	USA300	Other		
1 (Connecticut)	1583	142 (9.0)	109 (76.8)	5 (3.5)	28 (19.7)		
2 (Atlanta, GA, metropolitan area)	1995	134 (6.7)	36 (26.8)	64 (47.8)	34 (25.4)		
3 (San Francisco, CA, Bay Area)	1604	141 (8.8)	66 (46.8)	53 (37.6)	22 (15.6)		
4 (Denver, CO, metropolitan area)	805	85 (10.6)	68 (80.0)	14 (16.5)	3 (3.5)		
5 (Portland, OR, metropolitan area)	562	175 (31.1)	83 (47.4)	77 (44.0)	15 (8.6)		
6 (Monroe County, NY)	546	81 (14.8)	61 (75.3)	13 (16.3)	7 (8.6)		
7 (Davidson County, TN)	423	40 (9.5)	23 (57.5)	15 (37.5)	2 (5.0)		
9 (Ramsey County, MN)	130	66 (50.8)	54 (81.1)	11 (16.7)	1 (1.5)		
Total	7648	864 (11.3)	500 (6.5)	252 (3.3)	112 (1.5)		
a Isolates not available from site 7, so total does not include 1339 cases reported from that site.							

^bSite numbers were assigned in descending order of population size.

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empirical therapy (75%), followed by semisynthetic penicillins (28%) and fluoroquinolones (26%). Similar proportions of cases were prescribed monotherapy (31.3%), therapy with 2 antimicrobials (37.9%), or therapy with more than 2 antimicrobials (30.9%).

Pulsed-Field Typing

PFGE results were available for 864 of the 1201 (71.9%) isolates received from 8 of the 9 ABCs sites (isolates were not available from site 7); these results represent 11.3% of the 7648 cases reported from these 8 sites (TABLE 6). Of these results, 81.6% were from blood cultures, 4.7% from bone, 4.8% from synovial fluid, 1.9% from pleural fluid, 1.5% from peritoneal fluid, and the remaining 5.5% from other normally sterile sites; this culture site distribution is similar to the distribution of culture sites reported among all 8987 cases. Isolates tested were associated with all of the major clinical conditions previously described, including uncomplicated bacteremia (69.8%), pneumonia (19.3%), cellulitis (11.3%), osteomyelitis (10.4%), endocarditis (8.5%), and septic shock (5.0%).

USA300 was the strain type identified for 100 of 150 (66.6%) isolates from community-associated cases and also was found among 108 of 485 (22.2%) isolates from health care-associated, community-onset cases and among 34 of 216 (15.7%) health care-associated, hospitalonset cases (TABLE 7). Also, 35 of 150 (23.0%) isolates from community-associated cases were USA100. In contrast, other strains of community origin (USA400, USA1000) were rare, accounting for only 3 of 150 (2.0%) isolates from community-associated cases, perhaps reflecting that these isolates all come from normally sterile sites and not skin abscesses, where these strain types have often been reported. USA100 and USA300 were the predominant pulsed-field types in each surveillance site, with the exception of site 1 (state of Connecticut) (Table 6).

COMMENT

These data represent the first US nationwide estimates of the burden of invasive MRSA disease using populationbased, active case finding. Based on 8987 observed cases of MRSA and 1598 in-hospital deaths among patients with MRSA, we estimate that 94360 invasive MRSA infections occurred in the United States in 2005; these infections were associated with death in 18650 cases. The standardized incidence rate of invasive MRSA for calendar year 2005 was 31.8 per 100 000 persons. The incidence of other important invasive pathogens in 2005, such as invasive infections with S pneumoniae or Haemophilus influenzae, ranged from 14.0 per 100 000 to less than 1 per 100 000, largely due to the availability and success of vaccination.31-33

The estimated 94 360 infections is larger than the estimate from a recent study using hospital discharge-coded data; in 2000, the CDC estimated that there were 31 440 hospitalizations for MRSA bacteremias (ie, septicemia) in the United States.³⁴ Some of the discrepancy may relate to a more inclusive definition of invasive disease in our study and to the limitations inherent in discharge coded data. Of the estimated 94 360 infections from this study, 75.2% were bacteremias, and 26.6% were of hospital onset; thus, our estimates would vield approximately 18900 MRSA, hospital-onset bacteremias. In 2002, the CDC estimated that there were 248678 hospital-acquired bacteremias in the United States,35 of which approximately 20390 (8.2%) could be expected to be MRSA²⁰-a result consistent with our findings.

Regarding community-associated MRSA, noninvasive infections with MRSA greatly outnumber invasive MRSA infections. In fact, when 3 of the ABCs sites began surveillance in 2000 for all MRSA infections, only 7% represented invasive disease. However, findings described here further document that invasive MRSA disease does occur in persons without established health care risk factors,²⁸ is associated with strains of both community and

Table 7. Pulsed-Field Gel Electrophoresis Type of Methicillin-Resistant *Staphylococcus aureus* Isolates Cultured From Invasive Sites, by Epidemiologic Case Classification, Active Bacterial Core Surveillance, July 2004-December 2005 (n = 864)^a

			No. (%)				
	Community-Onset						
Pulsed-Field Type	Hospital- Onset	Health Care- Associated	Community- Associated	Unknown	Total		
USA100	160 (74)	303 (62)	35 (23)	2 (15)	500 (58)		
USA200	5 (2)	9 (2)	0	0	14 (2)		
USA300	34 (16)	108 (22)	100 (67)	10 (77)	252 (29)		
USA400	1 (<1)	4 (1)	1 (<1)	0	6 (<1)		
USA500	9 (4)	30 (6)	4 (3)	0	43 (5)		
USA600	1 (<1)	4 (1)	0	0	5 (<1)		
USA700	0	0	1 (<1)	0	1 (<1)		
USA800	0	6 (1)	1 (<1)	0	7 (1)		
USA1000	0	3 (1)	2 (2)	0	5 (<1)		
Iberian	4 (2)	6 (1)	3 (2)	1 (8)	14 (2)		
Not typeable ^b	2 (1)	12 (2)	3 (2)	0	17 (2)		
Total	216	485	150	13	864		
^a Enidemiologic clas	sification of diseas	e consisted of health ca	re-associated (either h	ospital-onset cases	with a culture		

^aEpidemiologic classification of disease consisted of health care-associated (either hospital-onset cases with a culture collected >48 h after hospital admission or community-onset cases with health care risk factors but a culture col-

lected ≤48 h after hospital admission) and community-associated cases (those with no health care risk factors). ^b Smal pulsed-field gel electrophoresis typing was successful in giving these isolates a pattern number, but numbers were outside of the 80% similarity range.

health care origin,³⁶ and is associated with significant mortality. Molecular analysis of isolates in our study provides evidence supporting other studies³⁶ showing that strains of community origin do now cause some hospital-onset disease but also that, overall, most invasive MRSA disease is still caused by MRSA strains of health care origin.

Compared with rates of invasive MRSA infections in 2 of our sites from 2001-2002, the incidence of invasive MRSA has increased in 2005 from 19.3 per 100 000 to 33.0 per 100 000 in Atlanta and from 40.4 per 100 000 to 116.7 per 100 000 in Baltimore.¹³ These increases were in both community- and health care–associated disease. However, in the state of Connecticut, the rate of community-onset MRSA bacteremias has been relatively stable at 2.5 per 100 000 in 1998²⁹ and 2.8 per 100 000 in 2005.

We describe striking differences in rates of invasive MRSA infections by race among all age groups. Connecticut documented a disparity for community-onset *S aureus* bacteremias in 1998.²⁹ More recently, surveillance in Atlanta reported a significantly higher rate of community-associated MRSA among blacks compared with whites¹³; however, little progress has been made in understanding why. It is likely that the prevalence of underlying conditions,³⁷ at least some of which vary by race,³⁸ may play a role. The incidence of invasive pneumococcal disease varies widely by underlying chronic illness, but racial disparities persist for all conditions evaluated.39 MRSA prevalence has been linked to socioeconomic status,⁴⁰ and this might confound the association between race and incidence of MRSA. Future analyses should focus on understanding reasons for differences in MRSA incidence rates.

The geographic variability in MRSA rates has been documented in other studies.^{3,13} In this study we found that areas with lower incidence rates of invasive MRSA overall did not always have lower rates of community-associated MRSA. For example, site 6 (Monroe County, New York) had a relatively high rate of invasive MRSA overall (41.9 per 100 000) but a low rate of community-associated MRSA (2.7 per 100 000); site 5 (the Portland, Oregon, metro area) had a relatively low rate of invasive MRSA overall (19.8 per

100 000) but a high rate of communityassociated MRSA (4.7 per 100 000). In addition to factors already mentioned such as socioeconomic status and underlying conditions, MRSA rates may be higher in urban areas.²⁹ As with differences in the incidence of invasive MRSA by race, geographic differences are probably multifactorial and complex. Improved understanding can help design and focus prevention messages as well as increase the timeliness of diagnosis and clinical management of invasive infections.

The majority of invasive MRSA cases occurred outside of the hospital (58%) but among persons with established risk factors for MRSA, such as a history of hospitalization in the past year. This observation was also made recently in a study from a single facility.³⁰ Patients with health care risk factors and community-onset disease likely acquired the pathogen from their health care contacts, such as those from a recent hospitalization or nursing home residence. Molecular analysis suggests that most of these infections were caused by MRSA strains of health care origin. If, in fact, these infections represent acquisition during transitions of care from acute care,⁴¹ it follows that strategies to prevent and control MRSA among inpatients,^{42,43} if properly applied, may have an impact on these infections as well as on the traditional hospitalonset infections. Since interventions for MRSA prevention are inconsistently implemented in US hospitals,44 correlating the impact on either inpatient or outpatient disease will be challenging. Interventions used in the community to control outbreaks consist of improving hygiene and infection control along with enhanced surveillance, diagnosis, and appropriate treatment of infections⁴⁵⁻⁴⁷; however, studies of the effectiveness of community-based prevention and control interventions are lacking.

Our estimates have certain limitations. First, we may have underestimated the incidence of invasive MRSA disease if persons in the surveillance areas sought health care from facilities using laboratories outside the surveillance area. However, any underestimate is probably minor in light of the estimates derived from discharge data on MRSA hospitalizations.³⁴

Second, we may have overestimated the incidence of community-associated MRSA if health care risk factors were not well documented in medical records. During surveillance conducted in 2000-2001, patient interviews were used to elicit undocumented health care risk factors; however, the effect on reclassification was small.¹³

Third, our surveillance sites were largely urban areas; thus, we might be overestimating the incidence of invasive MRSA.29 Although our surveillance areas comprise a diverse set of regions and are likely representative of the United States, it is not known whether the incidence rates in the observed populations are actually representative of the distribution of incidence rates in other US cities. Since the methodology of population-based surveillance produces a single point estimate without confidence intervals (ie, all cases are identified), we calculated interval estimates excluding site 7 (Baltimore City) to allow the reader to interpret a range of estimates reflecting different metropolitan areas. Regarding the high observed incidence rates reported by site 7, we conducted an evaluation to determine whether these results were valid, including a review of casefinding methods, elimination of cases to include only those with zip codes represented in the denominator, contamination in any laboratory, and other potential causes for increased rates; however, none were in error.

Fourth, our measures of deaths represented crude, in-hospital deaths, rather than attributable mortality. It is possible that MRSA infection did not cause or contribute to some deaths.

Fifth, the evaluation of isolates in this study was meant to describe strain diversity and to shed light on the potential crossover of strains from a community origin into the hospital setting. The isolate collection was a convenience sample. Furthermore, we only had test results from isolates of 864 (11.3%) of the cases reported; extrapolation of the molecular characterization to the US population should be avoided.

In conclusion, invasive MRSA disease is a major public health problem and is primarily related to health care but no longer confined to acute care. Although in 2005 the majority of invasive disease was related to health care, this may change.

Author Contributions: Dr Klevens had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Klevens, Morrison, Gershman, Lynfield, Townes, Craig, Carey, Fridkin. Acquisition of data: Klevens, Morrison, Nadle, Petit, Ray, Harrison, Lynfield, Dumyati, Townes, Craig, Fosheim.

Analysis and interpretation of data: Klevens, Morrison, Ray, Lynfield, Zell, Fosheim, McDougal, Fridkin.

Drafting of the manuscript: Klevens, Morrison, Fridkin. Critical revision of the manuscript for importan intellectual content: Klevens, Morrison, Nadle, Petit, Gershman, Ray, Harrison, Lynfield, Dumyati, Townes, Craig, Zell, Fosheim, McDougal, Carey, Fridkin. Statistical analysis: Morrison, Zell.

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