



**Testimony
Before the House Oversight and
Government Reform Committee
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**“Methicillin-Resistant *Staphylococcus aureus* Infections in the Community:
Consequences for Public Health”**

Statement of

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Good morning Chairman Waxman, Ranking Member Davis, and other distinguished Members of the Committee. I am Dr. Julie Louise Gerberding, and it is my pleasure to be here today in my capacity as Director of the Centers for Disease Control and Prevention (CDC) to discuss with you the issues of infections caused by methicillin-resistant *Staphylococcus aureus* (MRSA), the occurrence of these infections among persons not exposed in healthcare settings (termed community-associated methicillin resistant *Staphylococcus aureus*, or CA-MRSA), as well as CDC's work in tracking trends in these infections and preventing their spread.

As you know, CDC recently released a report in the Journal of the American Medical Association (JAMA) that provided new information on the scope and nature of MRSA infections in the United States. Coincidentally, we learned of the tragic deaths of two young men in Virginia and New York due to MRSA. For the past few weeks, MRSA infections have received much media attention, which has in some cases provided useful information for parents and individuals and in others compounded confusion.

Today, I would like to discuss with you the growing problem of antimicrobial-resistant infections, provide some insights regarding MRSA, and update you on CDC's current and planned activities to address MRSA.

ANTIMICROBIAL RESISTANCE

Bacteria that are resistant to antimicrobial agents have been developing and spreading in both humans and animals for decades. As early as the 1950s, scientists had recognized strains of bacteria that were resistant to multiple antimicrobial agents, although these strains primarily caused community-associated infections such as *Shigella* dysentery. More recently, organisms resistant to multiple drugs, including strains of *Pseudomonas aeruginosa* and *Acinetobacter* species resistant to all available antimicrobial agents, have been recognized as sources of infection in U.S. hospitals and other healthcare settings around the world.

STAPHYLOCOCCUS AUREUS

Staphylococcus aureus is a bacterial species, first named in 1882, that is commonly carried on the skin or in the nasal passages of 25% to 30% of healthy people in the United States. Colonization by *Staphylococcus aureus* bacteria at these sites is often, but not always, a precursor to staphylococcal infections.

While *S. aureus* has been one of the most common causes of skin infections in the United States, most of these infections are minor (such as boils and simple abscesses). Many can be treated by lancing the wound and draining the infection without the need for antimicrobial agents; others may require antibiotic therapy, most often administered orally as outpatient therapy using one of several very commonly used and very effective antibiotic agents. However, *S.*

aureus also can cause serious infections including surgical wound infections, bloodstream infections, endocarditis, toxic shock syndrome, and pneumonia.

ANTIMICROBIAL RESISTANCE AND *S. AUREUS*

The first strain of *S. aureus* found to be resistant to penicillin was identified in 1944. Today, >90% of *S. aureus* isolates are resistant to penicillin and a large percentage are resistant to other antimicrobials including macrolides (e.g., erythromycin), lincosamides (e.g., clindamycin), tetracyclines, or other anti-staphylococcal agents. Methicillin and other semi-synthetic beta-lactam drugs were developed in the late 1950s to treat penicillin-resistant strains of *S. aureus*, yet strains resistant to these drugs emerged very quickly, becoming recognized by 1961. Such strains are called methicillin-resistant *S. aureus* or more simply MRSA. In the 1980s, MRSA strains were identified in hospitals with increasing frequency, often becoming resistant to multiple antimicrobial agents. Treatment of invasive disease caused by multidrug-resistant MRSA is limited to relatively few antimicrobial agents.

COMMUNITY-ASSOCIATED METHICILLIN RESISTANT *S. AUREUS* (CA-MRSA)

While MRSA has typically been considered a healthcare-associated infection (termed healthcare-associated MRSA, or HA-MRSA), strains of MRSA causing infections in persons with no links to healthcare systems have been occurring with increasing frequency in the United States and elsewhere around the globe. In

the United States, CA-MRSA first emerged in Detroit in the early 1980s among intravenous drug users. In 1997-1999, four children from Minnesota and North Dakota died of MRSA infections, despite being treated, seemingly appropriately, with first-generation cephalosporins for staphylococcal infections. Those infections met the epidemiologic definition of CA-MRSA infection, and were found to be caused by a new strain-type unlike MRSA strains causing infections in hospitals. Within the next few years, similar CA-MRSA strains with the same properties and antimicrobial susceptibility patterns were reported to have caused infections among Native Americans in several states and among inmates at correctional facilities. These strains had a new resistance gene complex as well as a new virulence gene, making them ideal for causing infections in community settings. These new strains colonized easily, grew more rapidly in vitro compared to HA-MRSA isolates, and were resistant to the antimicrobial agents often chosen as first-line agents for treating community *S. aureus* infections, i.e., beta-lactams and macrolides. While some indirect evidence suggests that this strain may be more likely to cause serious infections, the overwhelming majority of CA-MRSA infections continue to be uncomplicated skin and soft tissue infections (SSTIs). While the CA-MRSA strains are resistant to beta-lactams and macrolides, these strains can be treated using other commonly available antimicrobial agents, in contrast to HA-MRSA which has fewer treatment options.

In 2000, CDC began investigating outbreaks of staphylococcal infections among inmates at correctional facilities in Mississippi, Georgia, and Texas. Remarkably,

among the MRSA isolates recovered from all three correctional facilities, a new pulse-field gel electrophoresis (PFGE) pattern was found, indicating that the same strain was causing infection in all three facilities. This strain type, called USA300, was subsequently isolated from children in Tennessee and Texas, sports participants, military recruits, and men who have sex with men. This strain type was very different from the one that typically causes HA-MRSA infections: it was not multidrug-resistant and had very different virulence factors. The USA300 strain represented a shift in lineages in MRSA isolates in the United States.

Today, for descriptive purposes, these CA-MRSA infections are defined as MRSA infections occurring in persons who have no close linkages with recent healthcare delivery exposures (i.e., history of hospitalizations or surgery, permanent indwelling catheters or percutaneous medical devices, residence in a long-term care facility, or dialysis treatment within the year prior to the MRSA culture date).¹

The most common clinical manifestations of CA-MRSA infections are those that are common to *S. aureus* infections. SSTIs, specifically abscesses or “boils” and infected hair follicles, are the most frequently reported symptoms. Results from a CDC-funded study conducted in 2004 showed that the USA300 MRSA strain was the most common cause of skin infections among patients treated at 11

¹ CDC Website: http://www.cdc.gov/ncidod/dhqp/ar_mrsa_ca_clinicians.html#6

emergency departments located across the United States, suggesting that this strain had already become an important cause of skin infection in the United States. The USA300 strain has been found to cause infections in professional football players, military recruits in boot camp, children in daycare, and in crystal methamphetamine users.

CA-MRSA skin infections are known to spread in crowded settings; in situations where there is close skin-to-skin contact; during participation in activities that result in abraded or compromised skin surfaces; when potentially contaminated personal items such as towels, sporting equipment, and razors are shared; when the ability to maintain personal hygiene is compromised; and when access to healthcare is limited. Frequent antibiotic use also may facilitate acquisition of CA-MRSA. In addition to the affected populations noted above, CA-MRSA has recently emerged as a cause of pneumonia among previously healthy young adults after suffering influenza or an influenza-like-illness. While post-influenza illnesses with staphylococci have historically been well recognized, the emergence of CA-MRSA presents a new treatment challenge for these potentially fatal infections.

Population-based surveillance for CA-MRSA has been conducted through CDC's Emerging Infections Program (EIP), a network of state health departments and their collaborators at selected U.S. sites. Information from these activities has been used to define the epidemiology and microbiology of MRSA in both

healthcare and community settings. In 2001-02, surveillance was conducted at three of these sites to determine the incidence of MRSA and the proportion that was healthcare- vs. community-associated to confirm that infections identified as CA-MRSA were independent of healthcare, and to characterize the epidemiology of MRSA in the community including identifying populations at risk, the clinical disease spectrum, and outcomes. These findings were the first comprehensive data showing that most MRSA infections are healthcare-associated, that CA-MRSA was distinct from healthcare, and that most CA-MRSA infections were SSTIs. To focus on the most severe of these infections, CDC has been monitoring invasive MRSA infections since 2004 in nine U.S. sites currently participating in the EIP's Active Bacterial Core Surveillance Program (ABC) on MRSA, which represents a population of about 16.3 million persons. Findings from this surveillance, recently reported in JAMA as described above, showed that the number of people developing serious MRSA infections (i.e., invasive) in 2005 was about 94,360--only 15% of which were due to the CA-MRSA. Approximately 85% of these MRSA infections were associated with healthcare; moreover, among the more than 18,000 persons who died from invasive MRSA, 92% had HA-MRSA.

In addition to active surveillance to define the problem, data analyses have been conducted from currently available data collected by CDC and AHRQ. Data collected through CDC's ambulatory medical care surveys (NAMCS/NHMACS) demonstrated that each year from 2001 through 2003 an estimated 12 million

outpatient (i.e., physician offices, emergency and outpatient department) healthcare visits for suspected *S. aureus* SSTIs occurred in the United States. Compared to 1992-1994, rates of visits to outpatient and emergency departments for suspected SSTIs increased by 59% and 31%, respectively, possibly reflecting the emergence of CA-MRSA infections. Furthermore, data from AHRQ's Health Care Utilization Project (HCUP) have shown a 25% increase in outpatient visits for skin infections from 2001 to 2005 and a 25% increase in hospitalizations for *S. aureus* infections from 1998 to 2003. Although MRSA may be a driver of these increases, the surveys do not provide such information.

HEALTHCARE-ASSOCIATED METHICILLIN RESISTANT

***STAPHYLOCOCCUS AUREUS* (HA-MRSA)**

Despite the increase in the number of CA-MRSA cases, most serious MRSA infections continue to occur in healthcare settings. HA-MRSA commonly causes serious and potentially life threatening infections, such as bloodstream infections, surgical site infections, or pneumonia. Of the healthcare-associated infections (HAIs) reported to CDC's National Healthcare Safety Network (NHSN), 8% are caused by MRSA; however, because of its virulence and resistance characteristics, these infections may account for a disproportionate amount of illness and death among patients receiving healthcare. Patients in healthcare settings are most vulnerable to colonization and infection with the bacteria because of severe disease, compromised host defenses from underlying medical

conditions, recent surgery, or the presence of indwelling medical devices such as urinary catheters or endotracheal tubes. Hospitalized patients, especially those in intensive care units (ICU), tend to have more risk factors for these infections compared with non-hospitalized patients and have the highest infection rates. Most HA-MRSA infections are also resistant to several other categories of antimicrobials (including macrolides, fluoroquinolones, clindamycin, and trimethoprim/sulfamethoxazole), leaving limited treatment options.

There is ample epidemiologic evidence to suggest that MRSA and other multidrug-resistant organisms are carried from one person to another via the hands of healthcare personnel. Hands are easily contaminated during the process of caregiving or from contact with environmental surfaces in close proximity to the patient. Thus, strategies to increase and monitor adherence to hand hygiene and correct glove use are important components of prevention programs. Implementation of prevention strategies recommended by CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC) have led to reductions in MRSA rates in U.S. hospitals.

WHAT IS CDC DOING TO PREVENT CA-MRSA?

CDC conducts surveillance and epidemiologic and laboratory research to guide and inform prevention efforts. CDC also leads national outbreak investigations on staphylococcal disease in collaboration with state and local health departments. In recent years, CDC has assisted state and local health departments in

investigating emerging CA-MRSA infections in several populations and settings shown to be at increased risk including athletes and military personnel, correctional facilities, schools, normal newborn nurseries, and tattoo parlors. These investigations have identified risk factors for the outbreaks and measures for their control. CDC also provides assistance to state public health laboratories by performing confirmatory testing for antimicrobial susceptibility, toxin characterization, and molecular typing for antimicrobial-resistant pathogens including MRSA.

CDC also monitors national trends and patterns of emerging CA-MRSA by collaborating with external partners including both academic and public health partners. As described earlier, CDC's EIP network conducts national surveillance for the most severe (i.e., invasive) cases of MRSA infections and has provided valuable insight into populations at risk and burden of disease in the U.S., as described in the recently published JAMA article. Such a system can also assess the impact of prevention efforts and detect emerging patterns of resistance.

Although other types of MRSA disease are not tracked by the EIP system, assessments are made through additional survey mechanisms, such as CDC's National Hospital Discharge Survey (NHDS) and AHRQ's HCUP, which are useful in following burden of disease for common occurrences,. CDC has also collaborated with *EMERGENCY* ID Net, a network of 12 emergency departments

across the country, to determine the prevalence of MRSA as a cause of purulent skin infections and severe community-acquired pneumonia among adult patients at emergency departments.

To specifically address CA-MRSA infections, CDC has developed and published guidance for the management and prevention of MRSA in the community based on review of available information and input from clinical and public health experts. Major prevention messages include:

- keeping hands clean by washing thoroughly with (plain) soap and water or using an alcohol-based hand sanitizer;
- cleaning cuts and scrapes and keeping them covered with a bandage until healed;
- avoiding contact with other people's wounds or bandages;
- avoiding sharing personal items such as towels or razors; and
- for persons unable to maintain routine hygiene and keep wounds covered, not participating in activities such as athletic events or childcare until their wounds are healed or can be contained to prevent transmission.

CDC has also developed targeted materials for a variety of audiences, including clinicians, the general public, athletic directors, prison officials, and school nurses, and has promoted these messages through the CDC website, responses to public inquiries, interviews, presentations at local and national meetings, and work with national and state organizations. To reach both the clinical and

general community quickly with new information that could impact prevention and treatment of these infections, CDC has published at least one report a year on CA-MRSA in the Morbidity and Mortality Weekly Report (MMWR), CDC's high profile weekly publication spotlighting the latest disease trends for clinicians, public health professionals, and the media. CDC has collaborated with state and local health departments to develop physician and patient guidance and education materials for MRSA and has performed needs and knowledge assessments with public health partners, at-risk groups, and the general public to target further development of guidance and education. In addition to collaborations with health departments, CDC has worked with professional societies such as the American Medical Association, Infectious Disease Society of America, and others to develop guidelines for prevention and treatment of infections, including management of SSTIs and community-acquired pneumonia. Other efforts have focused on prevention messages for specific at-risk groups and have involved collaborations with organizations such as the National Collegiate Athletic Association (NCAA), National Federation of High School Associations, National Athletic Trainers' Association (NATA), and others to develop informational materials and educate athletes and trainers about CA-MRSA and its prevention. CDC has also collaborated closely with other federal agencies including the Federal Bureau of Prisons to develop guidelines for correctional facilities, the Department of Defense to provide guidance for preventing MRSA infections among military recruits, and the National Institutes of

Health by providing staphylococcal isolates to the Network for Antimicrobial Resistance for *S. aureus* (NARSA).

CDC has also supported numerous extramural grants for research on CA-MRSA. Specific objectives for these collaborations included the characterization of the epidemiology and microbiology of CA-MRSA, the development of novel methods for controlling the transmission of antimicrobial-resistant pathogens including CA-MRSA, and evaluation of strategies to prevent recurrent CA-MRSA infections. By characterizing these CA-MRSA strains, we can improve our understanding of the infection and enhance national and local prevention and control efforts.

CDC ACTIVITIES FOR PREVENTION OF HA-MRSA

In addition to strategies to detect and prevent CA-MRSA infections, CDC leads several activities to monitor and prevent HA-MRSA. The [National Healthcare Safety Network \(NHSN\)](#), formerly the [Nosocomial Infection Surveillance \(NNIS\) System](#), is a surveillance tool for hospitals and state health departments to measure HAIs including those caused by MRSA. This system has many options available to hospitals and local health authorities, and provides hospitals with an accurate measure of infections attributable to a patient's hospital stay as well as information to drive infection prevention efforts at the hospital level. Additional options available to facilities and States participating in NHSN include the system's ability to measure MRSA among both inpatients and outpatients to help the facility prioritize staffing and prevention efforts. CDC's surveillance systems,

including NHSN, provide the means for building the infrastructure to capture data from electronic sources in an automated fashion, providing accurate, timely measures of MRSA at a healthcare facility to direct local prevention efforts and track the effectiveness of prevention programs.

Participation in NHSN has increased in the past few years and the Network is expected to continue to expand in order to accommodate local, state, and federal reporting initiatives for HAIs. CDC is currently providing support to 13 states that are using NHSN to fulfill state reporting requirements for HAIs, including MRSA infections.

CDC activities to prevent HA-MRSA include developing national infection control guidelines, conducting research activities, and working with partners to translate success with local prevention demonstration projects into national efforts to prevent MRSA infections. In 2006, CDC and HICPAC published evidence-based infection control guidelines to prevent the emergence of antimicrobial resistance and stop transmission of MRSA and other antimicrobial resistant pathogens in healthcare settings ([Healthcare Infection Control Practices Advisory Committee \(HICPAC\)](#)). The recommendations from CDC's HICPAC guidelines have been used in several successful local, regional, and national initiatives to prevent MRSA in healthcare settings.

CDC has also funded Prevention Epicenters ([Prevention Epicenter Program](#)), a network of academic centers to identify novel, or determine the effectiveness of existing, HAI prevention strategies, including the prevention of MRSA and other resistant organisms.

CDC has provided direct support, through in-kind technical assistance and extramural funds, as well as assistance to external partners involved in MRSA prevention initiatives to translate local success strategies into national efforts. These partners include the Veterans Health Administration of the Department of Veterans Affairs, Institute for Healthcare Improvement, state and regional initiatives, and other multi-center prevention collaboratives. CDC funded and collaborated with the Pittsburgh VA Medical Center to prevent MRSA infections using several CDC recommendations; these efforts led to reductions in MRSA rates of more than 60% in the hospital. Influenced by their success, other hospitals in southwestern Pennsylvania are now collaborating on a regional MRSA prevention initiative, and the Veterans Health Administration has launched a national MRSA prevention initiative involving every Veterans Health Administration hospital in the country. The prevention successes demonstrated in southwestern Pennsylvania have also served as the model for other national and regional initiatives such as Southeastern Pennsylvania, a statewide initiative coordinated by the Maryland Patient Safety Center; a group of hospitals funded by the Robert Wood Johnson Foundation to prevent MRSA infection in

participating hospitals in Pennsylvania, Maryland, Montana, and Kentucky; and a national initiative by the Voluntary Hospital Association (VHA) members.

Additionally, CDC launched a national evidence-based educational [Campaign to Prevent Antimicrobial Resistance in Healthcare Settings](#) that targets healthcare providers. The Campaign focuses on preventing antimicrobial resistance in healthcare settings by promoting four strategies targeting various patient populations including: hospitalized adults, dialysis patients, surgical patients, hospitalized children, and long-term care residents.

IN SUMMARY

Community- and healthcare-associated infections caused by antimicrobial-resistant pathogens such as MRSA are critical public health concerns, as made evident by the emergence of CA-MRSA. CDC continues to invest in the detection, control, and prevention of MRSA, working toward the goal of eliminating life-threatening infections caused by this and other healthcare-associated pathogens. The distinction between community- and healthcare-acquired infections will continue to decrease as we rely more and more on ambulatory surgical centers, home-care, infusion clinics, and other non-hospital-based types of care. To successfully prevent these infections among patients and the public, we must maximize the accurate and timely monitoring of MRSA and related infections, determine which hospitals are successfully preventing these infections and disseminate their experiences and strategies, and prevent spread in our communities by providing important information and promoting

necessary hygiene measures. Whether at home or in schools, athletic facilities, or other places similarly prone to spreading skin infections, individuals must remain alert for signs of potentially serious infections and know the importance of promptly seeking medical care if these signs occur. Basic hygiene including hand washing and wound covering can efficiently prevent the spread of these infections in community settings.

We can eliminate these infections; but only by maintaining basic hygiene in our communities, while ensuring 100% adherence to the guidelines and best-practices for prevention of infection in healthcare settings, recognizing excellence in healthcare, and informing our communities and providing data for local action.

Thank you for the opportunity to testify today; I am happy to take any questions you may have.