



Rapid Public Health Policy Response Project

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Methicillin-Resistant *Staphylococcus aureus* (MRSA): What Can Be Done to Control Infection?

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About this Paper

In 2005, an estimated 94,360 cases of invasive diseases caused by the methicillin-resistant *staphylococcus aureus* (MRSA) bacteria occurred in the United States, according to the *Journal of the American Medical Association* (JAMA). And 18,650 of those cases — almost 20 percent of the total — were fatal. Invasive disease can also injure the organs and cause blood, bone, and tissue infections, severe pneumonia, and other life-threatening problems.

Once confined largely to health care settings, MRSA infection is spreading. Almost 14 percent of the estimated invasive disease cases occurred in the community, with reports coming from schools, day care centers, and prisons. The MRSA strains that originate in the community are genetically distinct from those in health care environments, suggesting that new and possibly more virulent strains are emerging.

Beyond more rigorous efforts to use established infection control techniques, there is not yet a consensus on how best to combat the spread of MRSA infection. In the health care environment, mandatory reporting and more aggressive approaches to surveillance are options under debate. Strategies for gaining control in the community are only beginning to be considered.

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Rapid Health Policy Response Project

The Rapid Health Policy Response Project of the School of Public Health and Health Services at The George Washington University presents data and other background information on breaking public health stories. The goal is to educate the public, policymakers, legislators, health care providers, the media and others in order to promote informed decisionmaking. Karyn Feiden, an independent consultant who writes about public health and health care, provides editorial support for this project. Financial support comes from the Public Health and Policy Group of Pfizer Inc.

Methicillin-Resistant *Staphylococcus aureus* (MRSA): What Can Be Done to Control Infection?

The deaths of two previously healthy school children in October 2007 — one in Lynch Station, VA, the other in Brooklyn, NY — have riveted the nation’s attention on methicillin-resistant *staphylococcus aureus* (MRSA), a virulent bacterial strain that does not respond to many of the antibiotics that once cured staph infections.

The spread of MRSA to community settings, along with the life-threatening diseases it can cause, is only the latest warning from a bacterium that has been encroaching into hospitals and other health care settings with increasing frequency since it was first isolated in the 1960s.^{1,2} Many of the public health action steps that can curb the infection are already well-known, but not adequately implemented; others will have to be debated vigorously before they can become standard practice. Unfolding events suggest a clear need for action.

Growing Threat to the Public’s Health

Invasive MRSA infection has become a “major public health problem,” in recent years, according to a recent article in the *Journal of the American Medical Association (JAMA)*.³ Based on the first nationwide study to measure its frequency, researchers estimated that 94,360 invasive MRSA infections occurred in the United States in 2005, resulting in 18,650 deaths — in other words, almost 20 percent of invasive infections were fatal. Two features of the *JAMA* article, which made instant headlines, were especially compelling:

- First, the estimate was significantly higher than what had been previously reported, according to the study authors. In a *JAMA* editorial accompanying the article, Elizabeth A. Bancroft, MD, of the Los Angeles County Department of Public Health, called the incidence rate (31.8 people per 100,000) “astounding,” strong words for a medical journal.⁴
- Second, invasive, drug-resistant infections are appearing with some frequency outside hospital settings. Almost 14 percent of invasive MRSA disease cases occurred in the community among individuals with no recent encounters in health care settings.³

Given the prevalence of milder skin and soft-tissue infections linked to MRSA, Bancroft observed that invasive MRSA should be considered “only the tip of the drug-resistance iceberg ... the total burden of MRSA may be much greater than what was estimated in this study.”⁴

Also demonstrating the scope of the problem, researchers have estimated that the cost of providing direct medical care to treat MRSA infections in all forms is between \$3.2 and \$4.2 billion annually.⁵

About Drug-Resistant *Staph*

Staphylococcus aureus is a very common bacterium — the Centers for Disease Control and Prevention (CDC) estimates that 25–30 percent of the population is “colonized” in the nose with *staph*, meaning that the bacteria are present but cause no symptoms.⁶

Staph bacteria are also a frequent cause of mild skin and soft-tissue infections, which often manifest as a red or swollen wound, pimple or boil that may be filled with pus. The infection can become much more serious if it invades the body through a skin cut, a surgical incision, or some other opening. Invasive disease is diagnosed when the bacteria are identified at a site in the body normally expected to be sterile, such as the blood, cerebrospinal fluid, joint fluid, or organs. An invasive *staph* infection can damage organs or cause life-threatening blood, bone, and tissue infections.

The ability of *staph* bacteria to evade standard antibiotic treatment has been growing steadily over the past three decades. In 1972, only 2 percent of *staph* infections were drug resistant;⁷ that figure stood at 20–25 percent in the early 1990s⁸ and at 63 percent by 2004.⁷

Nonetheless, most MRSA infections are treatable if they are properly diagnosed. While they no longer respond to the beta-lactam class of antibiotics (which includes methicillin, penicillin, amoxicillin, and cephalosporins), other effective antibiotics are available. The most common alternative for invasive disease is vancomycin, administered intravenously.⁹ However, the CDC warns that “in a few cases, bacteria become so resistant that no available antibiotics are effective against them.”¹⁰

The Spread to Community Settings

A few strains of MRSA bacteria seem uniquely capable of spreading among patients in health care settings, typically through the hands of workers.⁸ The elderly population and people with weakened immune systems in hospitals, nursing homes and dialysis centers are especially vulnerable. While this is a longstanding issue, the data from the *JAMA* study suggest it has been worsening steadily and causing substantially more illness and death than had been generally recognized.

But the spread to community settings may reflect something altogether new. MRSA infections unconnected to health care exposure have been identified only over the past decade. Since then, many published reports have suggested a severe and growing problem:

- The CDC described the deaths in the late 1990s of four children without prior health problems, ages 12 months to 13 years, from community-acquired MRSA.¹¹
- In the early 2000s, the CDC reported on clusters of MRSA infections in athletes, prisoners, Alaskan natives, and Pacific Islanders, most of them involving relatively mild skin and soft tissue infections.^{12,13,14,15}
- Also in the early 2000s, a number of investigators around the country began reporting increases in severe and sometimes fatal disease among previously healthy young people in their communities.^{16,17,18} While skin infections remained the dominant MRSA-related problem, invasive infections were reported to have caused necrotizing pneumonia, a form of pneumonia that destroys lung tissue; necrotizing fasciitis, popularly known as flesh-eating disease; severe bone infections (osteomyelitis); and sepsis.

In the Fall of 2007, the media seemed to explode with reports of methicillin-resistant *Staphylococcus aureus* infections in school settings.¹⁹ Although the *JAMA* article had noted that noninvasive MRSA cases “greatly outnumber invasive MRSA infections” in the community,³ the deaths of a high school football player in Virginia and a seventh-grader in Brooklyn — young, healthy people with no recent hospitalizations or other health care system encounters — led the news. Milder infections also made headlines. School gyms, where students share sports equipment and sometimes towels and may be likely to have open cuts, received particular attention as a potential source of infection. New cases were also reported in day care centers.²⁰

Most of the bacterial strains isolated from patients who acquired MRSA in the community have been genetically distinct from those that cause disease in health care settings. That suggests a new set of *Staphylococcus aureus* strains has mutated with genes encoded for antibiotic resistance.⁸ Moreover, there is evidence that at least some strains found in community settings have especially virulent properties.²¹

As well, genetic analyses have shown that certain MRSA strains previously seen only in community settings are now establishing themselves in hospitals.^{22, 23, 24} Those reports have come from many corners of the country — for example, one study found community-acquired MRSA infection among women in New York who had recently given birth²² while another identified it among infants with sepsis in a Houston neonatal intensive care unit.²³

As community-based strains of MRSA migrate into hospitals, they create new avenues for infections to spread. That development, coupled with the overall increase of invasive MRSA infection, highlights the limitations of current infection control practices, calls into question existing distinctions between infections of community and hospital origin, and supports the widely held notion that antibiotic-resistant *Staphylococcus aureus* is growing as a public health challenge.

What Should Be Done?

Basic infection control and prevention measures in health care settings are well-characterized and widely known, if not always fully respected. The Centers for Disease Control and Prevention and the Association for Professionals in Infection Control and Epidemiology provide detailed recommendations on a set of techniques for controlling infections in health care settings.^{8, 25} Among them are strategies for hand hygiene, contact precautions, environmental decontamination, judicious use of antimicrobial agents, active surveillance for high-risk patients, and staff education.

Success stories in eradicating MRSA outbreaks, or sustaining a drop in infection rates, come from:

- A neonatal intensive care unit in Dallas,²⁶ a long-term-care facility in Finland,²⁷ a cardiovascular surgical unit in Montreal,²⁸ and a burn unit in Winnipeg,²⁹ among many other locales.
- Many European nations, which have been particularly aggressive at mandating infection control measures. These include active surveillance and preemptive

contact precautions, which require health care personnel to wear a gown and disposable gloves for all interactions with a patient until the presence of MRSA has been definitively ruled out.³⁰

- The U.S. Department of Veterans Affairs, which developed an MRSA Prevention Initiative that requires all of its medical facilities to incorporate a bundle of approaches into at least one ICU or acute care unit.³¹

The growing incidence of infections suggests additional efforts are needed. Policy recommendations generally focus on requiring more comprehensive approaches to surveillance — that is, testing more patients for the presence of MRSA — and on mandatory reporting when infections occur. But the benefits of these measures are not clear-cut.

Reporting Requirements: Before 2004, Illinois and Pennsylvania were the only states with laws requiring hospitals to collect and report data on health-care associated infections.³² Now, at least 19 states have passed such laws,³³ and a handful — including Illinois, Missouri, New Jersey and Texas — have specific requirements for MRSA.³⁴ Debates on similar legislation are taking place around the country.

Two professional organizations — the Association for Professionals in Infection Control and Epidemiology and the Society for Healthcare Epidemiology of America — have emphasized the importance of science-based strategies to ensure the accuracy and usefulness of reporting systems.^{35, 32} In particular, they underscore the need to:

- Standardize systems for collecting, analyzing, comparing, and publicly reporting infection data.
- Choose appropriate measures to assess performance.
- Adjust for the nature of the care provided and the severity of patient illness.

To ensure valid data, the Healthcare Infection Control Practices Advisory Committee of the CDC issued a guidance document for those developing and implementing public reporting systems.³⁶ But the committee was unwilling to recommend mandatory reporting, given “insufficient evidence on the merits and limitations of an HAI [healthcare-associated infections] public reporting system.” With the growing trend toward reporting, the need to assess its value as a tool for reducing infections is essential.

Surveillance: The best approaches to surveillance are controversial. Many health care professionals agree that active MRSA surveillance may be appropriate for high-risk patients, such as those with a history of exposure to health care settings or close contact with someone who is infected.³⁷ But the benefits of requiring universal surveillance — testing all patients before they are admitted to a hospital or a specific patient care unit in the hospital — are not clearly established.

In 2007, two states — Illinois and New Jersey — passed legislation requiring all patients to be tested for MRSA when they are admitted to the hospital.³⁴ But the Society for Healthcare Epidemiology of America and the Association of Professionals in Infection Control and Epidemiology oppose legislative mandates for universal surveillance. In a joint position paper,

they argue that what is appropriate in one setting may not be the right strategy in another and that decisions about how to assess risk and use limited resources to maximize infection control should be left to individual facilities.³⁷

As statewide requirements continue to be considered, a smattering of hospitals around the country are developing and implementing their own screening programs. For example, the Sacred Heart Medical Center in Spokane now tests every patient in its intensive-care unit,³⁸ the VA's MRSA Prevention Initiative also requires testing.³¹ In Illinois, Evanston Northwestern Healthcare concluded that universal, hospitalwide surveillance detected more than 1,300 MRSA infections while active surveillance limited to the ICU found only 478. Passive surveillance — which tests only patients who have clinical symptoms of infection and is the approach most common in hospitals today — detected just 247 infections.”³⁹

Because these kinds of data will help to shape the debate over wider mandates, it is critical to monitor local initiatives. The VA's efforts, which are locally targeted but national in scope, may yield especially valuable information.

Community Settings: Current legislative and public health initiatives to control MRSA infection are targeted almost exclusively at health care settings, reflecting both the greater incidence of disease and the challenges of gaining control over infection in the community. Protecting the general public requires other approaches. The CDC has published fact sheets on community-associated MRSA and made safety recommendations, especially for schools and school gyms.⁴⁰ Broader initiatives to reduce unnecessary use of antibiotics, which contribute to the spread of antibiotic-resistant bacteria, may also be relevant.

But as invasive MRSA infections in community settings grow, much more will likely be needed. As they follow unfolding events, public health officials and health care experts will need to identify other infection control strategies and act with an appropriate sense of urgency.

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