CLINICAL MANAGEMENT

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Protecting Patients from Harm: Reducing Methicillin-Resistant *Staphylococcus aureus* Infections

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PURPOSE

To provide wound care practitioners with information about interventions to prevent, reduce, or treat methicillin-resistant *Staphylococcus aureus* (MRSA) infections.

TARGET AUDIENCE

This continuing education activity is intended for physicians and nurses with an interest in wound care.

OBJECTIVES

After reading this article and taking this test, the reader should be able to:

1. Discuss the transmission of MRSA infections.
2. Identify ways to prevent MRSA infections.
3. Identify ways to treat MRSA infections.

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Methicillin-resistant *Staphylococcus aureus* (MRSA) can survive on hands, clothing, environmental surfaces, and equipment, so it is easily transmitted in health care settings. Because MRSA is easily transmitted and drug-resistant, the Institute for Healthcare Improvement (IHI) has made reducing MRSA infections 1 of 6 new initiatives in its 5 Million Lives Campaign (Table 1). As part of this initiative, which aims to prevent 5 million incidents of medical harm in a 2-year period (December 2006 to December 2008), the IHI offers hospitals educational materials, research resources, suggestions for strategic change, and tools to monitor their success.

Table 1.
THE 5 MILLION LIVES CAMPAIGN

The 5 Million Lives Campaign incorporates the 6 interventions from the 100,000 Lives Campaign plus 6 new interventions, as follows.

6 interventions from the 100,000 Lives Campaign:

- Deploy rapid response teams.
- Prevent ventilator-associated pneumonia.
- Prevent adverse drug events.
- Prevent central-line infections.
- Prevent surgical site infections.
- Deliver evidence-based care to treat acute myocardial infarction.

6 new interventions from the 5 Million Lives Campaign:

- Reduce surgical complications by reliably implementing all the changes in care recommended by the Surgical Care Improvement Project.
- Prevent harm from high-alert medications, starting with a focus on anticoagulants, sedatives, narcotics, and insulin.
- Prevent pressure ulcers by reliably using science-based guidelines for their prevention.
- Reduce methicillin-resistant *Staphylococcus aureus* infection by reliably implementing scientifically proven infection control practices.
- Deliver reliable, evidence-based care for congestive heart failure to avoid readmissions.
- Get boards on board by defining and spreading the best-known leveraged processes for hospital boards of directors, so that they can become far more effective in accelerating organizational progress toward safe care.

In this article, the authors discuss the dangers of MRSA, how to detect it, and how to keep it from spreading to vulnerable patients.

EYE ON MRSA

A major cause of complications and death, MRSA is a serious and costly problem for the health care industry. An estimated 126,000 hospitalized patients develop MRSA infections each year, and more than 5000 of them die as a result. Hospitals are also facing the challenge of coping with the very rapid emergence of community-associated MRSA (CA-MRSA) in patients who do not seem to have risk factors.[1]

The best ways to control the spread of MRSA in a health care facility are to follow these guidelines[1–3]:

1. Improve hand hygiene among health care workers.
2. Make fastidious environmental cleaning and disinfection a priority.
3. Consider performing active surveillance cultures.
4. Identify colonized patients and implement contact precautions.
5. Implement and perform all interventions specified in the central line bundle and the ventilator bundle. (A ''bundle'' is a collection of best-practice interventions that, when used together, help protect patients from infection and other complications.)

MRSA'S RESISTANCE

Staphylococcus aureus is a type of bacteria commonly carried on the skin, in the nares, and on the perineum of healthy people. It may cause superficial skin infections that can ordinarily be treated with skin care and appropriate antibiotics, such as β-lactam inhibitors. Over time, however, some strains of *S aureus* have become resistant to β-lactam inhibitors such as methicillin, once the drug of choice for this type of infection.

The first cases of MRSA infections in the United States were reported in the 1960s.[4] Today, 46 of 1000 patients have MRSA.[5] Clinicians turned to vancomycin to treat MRSA, but several new strains of MRSA are now resistant to this drug as well; they are known as vancomycin intermediate-resistant *S aureus* (VISA).[6] Patients with VISA have severely limited treatment options. Table 2 illustrates steps to help prevent antimicrobial drug resistance.

IDENTIFYING TYPES OF MRSA

CA-MRSA is a serious disease that tends to cause skin and soft-tissue infections, such as boils, blisters, abscesses, folliculitis, and carbuncles. These are accompanied by fever and local warmth, swelling, pain, and purulent drainage. What may look like a spider bite may actually be an early sign of a MRSA infection. According to the Centers for Disease Control and Prevention definition, a diagnosis of CA-MRSA requires that the patient have no medical history of MRSA or colonization and no risk factors associated with health care–associated MRSA.[4]

Health care–associated MRSA is even more highly drug-resistant than CA-MRSA and tends to cause more invasive infections, such as surgical site infection, endocarditis, osteomyelitis, bacteremia, or pneumonia. If infection develops in a wound or at a catheter or tube insertion site, redness, swelling, tenderness, or an abscess may be present.

At home and in the community, MRSA is transmitted person to person by sharing personal items such as clothing and towels and from close contact. In a health care facility, MRSA is transmitted largely from contaminated environmental surfaces or by staff members. Although colonized and

Table 2.
STOPPING ANTIMICROBIAL DRUG RESISTANCE

Antimicrobial drug resistance occurs when bacteria change or adapt so they can survive in the presence of antibiotics designed to kill them. When this happens, the bacteria thrive, causing more harm. Because certain bacteria have become resistant, some infections that were once easily treated are now much more difficult to cure.[7]

Using antibiotics appropriately is the best way to prevent antibiotic resistance. When antibiotics are used inappropriately or incorrectly, they lose their power to cure. Taking an antibiotic that is inappropriate for the type of infection or taking antibiotics unnecessarily (for example, taking an antibiotic for a viral infection) will kill some of the body's normal flora. The bacteria that survive have now been exposed to antibiotics and may develop resistance. Also, when prescribed antibiotics are stopped prematurely, not all of the pathogenic bacteria will be killed; the remaining pathogenic bacteria will start dividing again and cause another infection.

Clinicians can help prevent the development of drug-resistant microorganisms with these steps[9]:

- Encourage the health care provider to culture the site before antibiotics are started. If the results are received after antibiotics have been started, the provider should narrow the spectrum of antibiotics based on the cultures. For example, if the patient has been started on a broad-spectrum antibiotic and then the organism causing the infection is identified as Gram-negative, the patient should be switched to an antibiotic with Gram-negative coverage. Narrowing the spectrum of antibiotic coverage will reduce antibiotic resistance in the community.
- Review all culture reports to ensure that bacteria are sensitive to the prescribed antibiotics.
- Administer antibiotics appropriately. For example, give the antibiotics at the correct times as prescribed, and make sure the patient finishes the entire course of treatment.
- Teach the patient how to use antibiotics. Tell him to take the medication exactly as prescribed and to finish the course of treatment even if he feels better. Teach him that he does not need antibiotics for viral illnesses and not to take someone else's prescribed medication.

infected patients are the chief reservoirs of MRSA, health care workers can also act as reservoirs, harboring the microorganism for many months. When health care workers do not follow appropriate infection control measures, their hands and clothing can easily become contaminated.[1,7]

Health care–associated MRSA typically infects patients who have already been weakened by disease or injury. Table 3 identifies risk factors for MRSA infection.

Initial treatment for a MRSA skin infection is incision and drainage followed by routine wound care. Drug therapy starts with a broad-spectrum antibiotic, which is changed as indicated based on susceptibility testing. Health care providers should use local antibiograms to guide antibiotic therapy. For instance, if most MRSA in a given area is resistant to clindamycin, then this drug should not be used for empiric treatment. For more information about treating MRSA infections, see the practice guidelines cited in Reference 8.

FIVE KEY STEPS FROM THE IHI

The IHI has released 5 recommendations to significantly reduce MRSA infections in health care settings as part of the IHI's 5 Million Lives Campaign.

1. Perform hand hygiene. Health care workers' hands are the principal mode of transmission of MRSA and other health care–associated infections. A clinician's hands can become contaminated during glove removal, so perform hand hygiene after each glove change and when entering and exiting any patient's room.

Alcohol-based hand sanitizers are a suitable substitute for hand washing when caring for patients with MRSA as long as the clinician's hands are not visibly soiled or grossly

Table 3.
RISK FACTORS FOR MRSA

Patients with these risk factors are more likely to be infected or colonized with MRSA:

- recent hospitalization or surgery
- an invasive device, such as an intravenous catheter, urinary catheter, endotracheal or tracheostomy tube, or a gastrostomy tube
- a surgical wound or pressure ulcer
- prolonged hospitalization
- severe underlying illness
- immunocompromised status
- undergoing dialysis
- intravenous drug abuse
- diabetes
- burns
- dermatitis
- previous exposure to broad-spectrum antibiotics
- proximity to a patient colonized or infected with MRSA.

Source: Boyce JM. Update on resistant *Staphylococcus aureus* infections. Clinical Updates in Infectious Diseases. June 2003.

contaminated. Sinks and alcohol-based hand sanitizer dispensers must be easily accessible.

For effective hand hygiene, use appropriate technique. Whether using a hand sanitizer or soap and water to clean hands, focus on fingernails, nail beds, between fingers, and around thumbs. Often missed during hand hygiene, these areas can harbor pathogens. Keep jewelry on the hands to a minimum, and make sure to clean under rings and watches.

2. Make sure patient rooms are cleaned well and often. Because MRSA survives for hours or days in the environment, surfaces and equipment must be cleaned well and cleaned often, especially between patients. Patient rooms can become heavily contaminated and transmit pathogens to new patients. Medical equipment such as stethoscopes can also be a source of transmission to other patients if they are not completely disinfected.

When taking care of a patient with MRSA, make sure that every item that comes out of the room is cleaned, from bedside commodes to blood glucose meters and stethoscopes. If the patient is on contact precautions, housekeeping must clean his or her room daily. If it appears that a room has been skipped, follow up to make sure daily cleaning is done.

3. Actively look for MRSA. When patients are admitted to the hospital, they may already have a MRSA infection or be colonized with MRSA. On the other hand, they can acquire MRSA while hospitalized. Active surveillance refers to taking cultures of a group of people to determine if they are colonized with MRSA. The IHI recommends that each infection control program evaluate the benefit of active surveillance cultures for its specific facility. Some facilities obtain active surveillance cultures at admission to determine a patient's colonization status. Other facilities require admission cultures for certain patient groups, such as intensive care unit patients or those admitted from long-term-care nursing facilities.

A patient colonized with MRSA carries the bacteria as part of his or her normal flora and has no signs or symptoms. However, although MRSA is not making the patient sick, he or she can transmit it to others.

Although the anterior nares are the most common reservoir for MRSA, the bacteria may also be carried on intact skin of the axillae, the perineum, and the hands and arms. Some colonized patients, especially those who have received antibiotic therapy, develop heavy MRSA colonization in their gastrointestinal tract. Ostomy sites, pressure ulcers and other wounds, and sputum are other common colonization sites. Drug susceptibility testing, which identifies antibiotics the organism is sensitive or resistant to, differentiates MRSA from *S aureus*.

Active surveillance cultures of the anterior nares will identify 80% of colonized adult patients.[1] (Additional cases can be detected by culturing specimens from other sites, such as the perineum and axilla, but this is not usually cost-effective.) Although cultures of clinical specimens (such as sputum, wounds, urine, and blood) identify patients infected with MRSA, they will not detect up to 85% of patients colonized with MRSA. Table 4 discusses how to interpret a microbiology report.

Active surveillance is a controversial and challenging approach. Infection control professionals are divided about its usefulness, and it requires additional labor and equipment. If

Table 4.
INTERPRETING A MICROBIOLOGY REPORT

Patients with MRSA may have acquired it during this hospitalization, during a prior hospitalization, or in the community. CA-MRSA is genetically different from health care–associated MRSA and may produce different signs and symptoms. Identifying the responsible organism guides the health care provider's choice of antibiotic therapy.

The diagnosis is based on patient history, examination, and laboratory testing. Clinicians who are responsible for interpreting microbiology reports also must report the findings to the health care provider as soon as possible. To interpret microbiology results correctly, examine these 4 areas in the report:

1. *Anatomic location*. Make sure that the area from which the specimen was taken is correctly identified with the correct terminology; for instance, the right upper quadrant abdominal wound.
2. A *Gram stain report* should be performed for all wounds, internal fluids, and lower respiratory tract secretions. Look for the presence of white blood cells, which indicates infection.
3. The *antibiogram* identifies antibiotics to which the organism is susceptible or resistant.
4. *Organisms*. Clinicians need to know the epidemiology of the organism isolated, such as the source (the anatomic location where the specimen was taken), the potential for multiple-drug resistance (indicated by the antibiogram), and the mode of transmission. The source is a clue to the mode of transmission; for example, a wound could be contaminated by an organism that is spread via the contact route but not one that is spread via the droplet route.

Source: Otero RB. Methicillin-resistant *Staphylococcus aureus*—prevention and control. Available at: http://www.cinetwork.com/otero/mrsa.html. Last accessed January 31, 2007.

it is used, it must be combined with other control efforts, such as contact precautions.

Regardless of a facility's policy on active surveillance, clinicians should be aware of transmission rates in their facility and in their department. Being aware of the transmission rates will reinforce what works well to stop transmission—and what does not. For example, a facility with a staff that practices great hand hygiene is likely to have low transmission rates; conversely, a facility whose staff has poor hand hygiene will likely have high transmission rates.

4. Implement contact precautions to prevent transmission. These safeguards can help clinicians prevent MRSA transmission in their facilities.

• Always wear a gown and gloves when caring for patients infected or colonized with MRSA.

• Clinicians should always perform hand hygiene between patients and as they exit each room and after removing gloves, as outlined previously.

• Follow contact precautions for patients infected or colonized with MRSA.[1] A patient with MRSA infection or colonization (or on contact precautions for any reason) should be in a private room. A private room reduces the likelihood that a health care worker will move from one patient to another without removing his or her gloves and gown and performing hand hygiene. If a private room is not available, cohorting patients with MRSA together in a room is acceptable. However, health care workers must continue to meticulously follow hand hygiene and other infection control guidelines between patients because patients may be colonized with a different strain of MRSA or another drug-resistant organism. Some facilities cohort patients with MRSA only if they carry bacterial strains that have the same drug susceptibilities. Contact precautions are designed to interrupt important modes of MRSA transmission: health care workers' hands, the environment, and equipment. Health care professionals and nonprofessional staff must put on gloves and a gown before entering the room of a patient who is colonized or infected with MRSA. Visitors must follow the facility's policy about wearing gloves and gowns.

If a unit has an open setting with more than 2 patients per room, or if cohorting is not an option, clinicians should take extra precautions to make sure everyone maintains contact precautions for patients colonized or infected with MRSA. Use a visual cue (such as signs or a line on the floor), and keep a supply of gowns and gloves handy.

When a patient is colonized or infected with MRSA, he or she and the environment will be heavily contaminated. Studies have shown that health care workers' hands can become contaminated not only by touching patient wounds or body fluids, but also by touching intact skin and objects in the patient's immediate environment.

Whenever possible, dedicate patient-care equipment to a patient with MRSA or use disposable equipment. Items such as a stethoscope and blood pressure cuff should be used only for that patient and left in the room. If a stethoscope has been dedicated to a patient, all staff should leave their own stethoscopes outside the room to prevent them from becoming contaminated. If equipment cannot be dedicated to the patient, it must be cleaned as soon as it is removed from the room per facility policy. Keep germicidal wipes outside the room for this.

Discontinue contact precautions when appropriate (generally after at least 3 cultures have tested negative on separate days).

Remember that a patient on contact precautions requires the same level of care and attention as any other patient. Some studies have found that clinical personnel, including physicians, entered rooms of patients on precautions less often than patients of similar acuity who were not on precautions. Another study found that patients on contact precautions experienced more adverse events.[1]

5. Bundle up best practices. A patient colonized with MRSA is more likely to develop a MRSA infection because he or she already has the bacteria as a part of his or her normal flora so it can readily infect another site, such as a surgical site. Any patient with an invasive device (such as a central venous catheter) or who is undergoing an invasive treatment (such as mechanical ventilation) is especially vulnerable to MRSA or another health care–associated infection because invasive treatments bypass the natural defenses of the skin and upper airway.

Many hospitals have reduced or eliminated device-related infections by implementing ''bundles.'' The central line bundle and ventilator bundle are described in detail in how-to guides created for the 100,000 Lives Campaign (http://www.ihi.org).[2,3]

THE BUG STOPS HERE

Clinicians should ensure that their facility is doing everything possible to stop the spread of MRSA. If not, getting involved can make a difference. Encourage hospitals to institute the best practices outlined in this article to stop this deadly bug in its tracks. ●

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