METHICILLIN-RESISTANT STAPHYLOCCUS AUREUS INFECTIONS

INTRODUCTION

Methicillin-resistant Staphylococcus aureus (a.k.a. MRSA) is a strain of bacterium that is resistant to many of the commonly used antibiotics such as penicillin and the cephalosporins. Methicillin-resistant Staphylococcus aureus (a.k.a MRSA) has attracted a lot of attention in the media, and the popular press has named MRSA the “superbug” and the “flesh-eating bacteria” that can cause a frightening and dangerous condition called necrotizing fasciitis.

The term superbug is somewhat sensational and although MRSA can cause necrotizing fasciitis, this is a rare condition and it can be caused by many bacterium, not just MRSA. But MRSA is a dangerous microorganism. Methicillin-resistant Staphylococcus aureus is a pathogen that is carried by a big percentage of the population, it can cause infections essentially anywhere in the body, and MRSA infections can be very difficult to treat.

But MRSA is especially serious because MRSA is one of the most common sources of infections that occur in patients after they are admitted to a hospital. These infections are called hospital-acquired MRSA infections and many of these infections happen because of poor infection control. The MRSA bacterium is spread from patients to healthcare staff and then to other patients.

Some of these hospital-acquired MRSA infections are probably impossible to prevent, but the evidence is clear that many, if not most, MRSA infections that happen to in-patients can be prevented if medical professionals follow Standard Precautions - hand washing, using protective gloves, gowns, etc., and the proper handling and disposal of body fluids. Because MRSA and MRSA infections are so common, Certified Nursing Assistants (CNAs) must understand what MRSA is, how it is transmitted, and how thye can help prevent the spread of this dangerous pathogen.

Learning Break: The term bacterium refers to a single microorganism, and bacteria is the plural term. Most people use the term bacteria to refer to both single and multiple microorganisms, but that is not correct and bacterium and bacteria will be used in this module.

OBJECTIVES

After finishing this module the learner will be able to:

1. Identify the correct definition of normal flora.
2. Identify two places on the body that Staphylococcus aureus is typically found.
3. Identify two reasons why Staphylococcus aureus is dangerous.
4. Identify the primary way that MRSA is transmitted.
5. Identify the basic causes of hospital-acquired MRSA infections.
6. Identify patients who are at risk for developing a MRSA infection.
7. Name three common types of MRSA infection.
8. Identify how the transmission of MRSA can be prevented.
THE STAPHYLOCOCCUS AUREUS BACTERIUM AND MRSA

When people think of microorganisms such as bacteria and viruses they usually think of them as foreign “invaders” that cause illnesses. That is certainly true, microorganisms can and do cause diseases and make us sick and a microorganism that causes a disease is called a pathogen. But microorganisms - especially bacteria - are often not foreign. We all have microorganisms - millions and millions of them - in our stomach, in our noses and mouths, in our bowels, and on our skin. These microorganisms are called the normal flora of the human body and Staphylococcus aureus is part of our normal flora.

Learning Break: The term flora is defined as the plant life that naturally occurs in a specified area - in this case, the human body.

Approximately 25-50% of the population has Staphylococcus aureus living inside the nose, in the armpits, in the perineal area, and in the oropharynx. People who have insulin-dependent diabetes, people who are infected with HIV, and people who need hemodialysis on a chronic basis are more likely to have Staphylococcus aureus in the nose and oropharynx or on the skin. Most of the time the Staphylococcus aureus bacterium does not cause illness or disease: many people have Staphylococcus aureus in/on their skin and they do not become sick. But Staphylococcus aureus is a dangerous pathogen for two reasons.

Number 1: Staphylococcus aureus can easily avoid the immune system. Staphylococcus aureus has strong enzymes that can break down tissues and allow the infection to spread; it produces a protein that “disguises” the bacterium from antibodies that would normally detect and destroy it, and it can survive for weeks and months outside the body on medical equipment and other surfaces in the environment.

Number 2: Staphylococcus aureus has mutated to a bacterium that cannot be treated by many of the commonly used antibiotics, the MRSA bacterium. Bacteria that can be treated with pencillins, cephalosporins, and other commonly used antibiotics have a molecule on their cell walls called the penicillin-binding protein. This protein allows the antibiotic to attach the bacteria and destroy it, but MRSA does not have the penicillin-binding protein so many antibiotics - especially the pencillins - are ineffective for treating an infection with MRSA. An infection with MRSA cannot be treated with:

- Aminoglycosides, e.g., gentamicin (a.k.a. Garamycin), streptomycin
- Cephalosporins, e.g., cephalexin (a.k.a. Keflex) cefoxitin
- Fluoroquinolones, e.g., ciprofloxacin (a.k.a. Cipro), levofloxacin
- Lincosamides, e.g., clindamycin (a.k.a. Cleocin), lincomycin
- Macrolides, e.g., azithromycin (a.k.a. Zithromax), clarithromycin
Learning Break: You may notice that methicillin is not included in the list. Methicillin is an old antibiotic that was developed in the ‘50s to treat penicillin-resistant infections. It is no longer manufactured because other antibiotics are more stable and more effective, but the term methicillin-resistant *Staphylococcus aureus* is still used.

Fortunately, the MRSA bacterium is not as common as *Staphylococcus aureus* and approximately 1-16% of the population has MRSA somewhere on the skin. However, MRSA may not be as common as *Staphylococcus aureus* but infections with MRSA can be very serious.

**HOW IS MRSA SPREAD?**

*Methicillin-resistant Staphylococcus aureus is primarily spread by skin contact.* Methicillin-resistant *Staphylococcus aureus* can also be spread by infected respiratory droplets. Transmission of MRSA by skin contact occurs commonly in healthcare facilities and in the community. Transmission of MRSA by the respiratory route is relatively common in healthcare facilities, but not common in the community. Infections with MRSA that happen in a healthcare facility are called hospital-acquired infections. Infections with MRSA that happen to people in the community are called community-acquired. For the most part - but not always - hospital-acquired and community acquired MRSA are different strains of the bacterium.

Infections with MRSA that occur in the healthcare setting occur when the MRSA bacteria are spread from an infected patient to an uninfected patient and the bacteria gain access to tissues or the bloodstream by a break in the skin, e.g., an IV catheter insertion site, a surgical incision, or a small abrasion. Hospital-acquired infections happen because of these basic causes:

- Patient contact is a constant: Most CNAs have a lot of physical contact with the patients they are caring for: depending on where you work the amount of contact will differ, but it can be quite a lot. In an average eight hour shift you will take blood pressures, help people get dressed, perform catheter care - at the end of a typical day that all adds up to many, many instances of close physical contact.

- MRSA is easily transmitted: Methicillin-resistant *Staphylococcus aureus* is very easily transmitted from patients to healthcare personnel and then to other patients, and this can happen even in situations that may seem to be safe. Every time you make physical contact with a patient there is a risk that MRSA (and other pathogens) can contaminate the gloves you wear, your clothing, or your skin, and if that happen you can transmit MRSA to another patient. One study tested the disposable gloves nurses wore when performing patient care and found that 17% of the gloves were contaminated with MRSA.

- MRSA is everywhere: This is a bit of an exaggeration, but MRSA is very common in the healthcare environment. Methicillin-resistant *Staphylococcus aureus* has been found in significant amounts on mobile phones belonging to patients, visitors, and nurses, on stethoscopes, on computer keyboards, on x-ray
cassettes, and on all kinds of surfaces such as countertops and cloth curtains. The MRSA bacterium can live on these objects and surfaces for weeks and months and can easily be picked up and transmitted. A study performed in three community hospitals found that 12% of the surfaces tested were contaminated with MRSA.

Because patient contact is so frequent, because MRSA is commonly found in health care facilities, and because MRSA is so easily transmitted, infections with MRSA are a significant risk for patients. Methicillin-resistant *Staphylococcus aureus* is the leading cause of surgical incision infections, it is the second-leading cause of bacteremia (infection of the bloodstream), and it is common cause of pneumonia is patients who are on ventilators. Patients who are elderly, patients who have a compromised immune system, patients who have received multiple antibiotics, patients who have in-dwelling catheters, and patients who have a long stay in the hospital are at risk for developing a hospital-acquired MRSA infection.

Methicillin-resistant *Staphylococcus aureus* infections that are acquired in the community are transmitted by contact with an infected person or a contaminated environment - just as hospital-acquired MRSA infections are - and there are factors that increase the risk of developing a community-acquired MRSA infection. These risk factors are called the five Cs: Crowding, Contact, lack of Cleanliness, Compromised skin, and environmental Contamination. Children, military personnel, people who are incarcerated, athletes who play team sports (especially contact sports like wrestling) people who have insulin-dependent diabetes, and people who use IV drugs are likely to have one or more of the five Cs present.

**WHAT TYPES OF INFECTIONS ARE CAUSED BY MRSA? HOW ARE THESE INFECTIONS TREATED?**

The MRSA bacterium can cause an infection anywhere in the body. The most common sites of MRSA infections are: 1) skin and soft tissue; 2) bloodstream, and; 3) respiratory infections in patients who are on ventilators. Other infections that can be caused by MRSA include bone and joint infections, infections of the heart muscle, brain infections, ocular infections, and urinary tract infections.

**Learning Break:** Respiratory infections with MRSA are relatively common in hospitals, but pneumonia caused by community-acquired infection with MRSA is not very common.

The skin infections are the most common, and there are many different types of skin infections that can be caused by MRSA. The most dangerous is necrotizing fasciitis, the infection that is sometimes called the “flesh-eating disease.” Necrotizing fasciitis has been the focus of many sensational stories, and it is a very dangerous condition. It is difficult to diagnose and if it is not quickly detected it can, literally, destroy or “eat” soft tissue at an alarming rate. It is also very difficult to treat and the mortality rate can be as high as 80%. However, necrotizing fasciitis is quite rare and the great majority of skin
Infections caused by MRSA are conditions such as boils, cellulitis, and surgical incision infections.

Infections with MRSA are treated with antibiotics. The most commonly used antibiotic is vancomycin, but clindamycin, daptomycin, linezolid, and streptomycin can be used, as well: the specific drug that is prescribed will depend on the location of the infection. Skin infections with MRSA are often treated by a procedure called incision and drainage, or I & D. The skin over the area of infection is opened (cut with a scalpel) and the pus is drained.

PREVENTING MRSA INFECTIONS

It is unlikely that all hospital-acquired MRSA infections can be prevented. The MRSA bacterium is very common in hospitals and healthcare facilities and some patients are very susceptible to MRSA infections. But the incidence of hospital-acquired MRSA infections can be dramatically decreased with strict adherence to infection control measures and especially so if healthcare personnel conscientiously use Standard Precautions. Standard Precautions are infection control techniques and procedures that are used to prevent the transmission and spread of pathogens, and they are the most effective way of preventing the spread of MRSA and preventing hospital-acquired MRSA infections.

This module will not provide a comprehensive discussion of Standard Precautions, but the highlights will be covered. Complete information on Standard Precautions can be found on the website of the Centers for Disease Control and Prevention (CDC) at: http://www.cdc.gov/HAI/settings/outpatient/basic-infection-control-prevention-plan-2011/standard-precautions.html. Another good source is this link from the World Health Organization (WHO): http://www.who.int/csr/resources/publications/4EPR_AM2.pdf.

The basics of Standard Precautions:

- Hand hygiene: Hand washing is probably the most important way of preventing transmission of MRSA. Hand washing should be performed before and after any contact with patients, even if gloves are to be worn, and hand washing must be done if you have had any contact with body fluids or secretions or if you have had contact with any item that may be contaminated. An alcohol-based hand sanitizer is the preferred method unless your hands are visibly contaminated. If that is the case, use soap and water. The facility you work in should have protocols for hand washing with hand sanitizers or soap and water.

- Personal protective equipment: Personal protective equipment (PPE) includes gloves, gowns, shoe covers, face masks, goggles, and respirators. Personal protective equipment is designed to protect the user (you) from contamination with body fluids or secretions. What to wear and when depends on the patient care situation and how likely it is you will be exposed to infectious material. Personal protective equipment is disposable and should not be re-used or worn for more than one patient contact. The facility you work in should have protocols for when and how to use PPE.
• Handling/disposal of contaminated material: Anything that is or could be contaminated with a pathogen must be disposed of properly. The facility you work in will have protocols that provide instructions about how to properly handle and dispose of contaminated material.

• Needle sticks: Any needle stick should be immediately reported to your supervisor or a physician. Never assume that a needle stick is “no big deal.”

Remember: The most important basic principle behind Standard Precautions is that all body fluids and secretions must be considered potentially contaminated and infectious. Another basic principle of Standard Precautions is that even patient contact that seems “safe” can be a source of transmission of dangerous microorganisms to you and then to other patients. Using Standard Precautions can be time-consuming and inconvenient, but it provides invaluable protection against MRSA, both to you and to patients. Never assume patient contact is “safe.” Always use Standard Precautions.