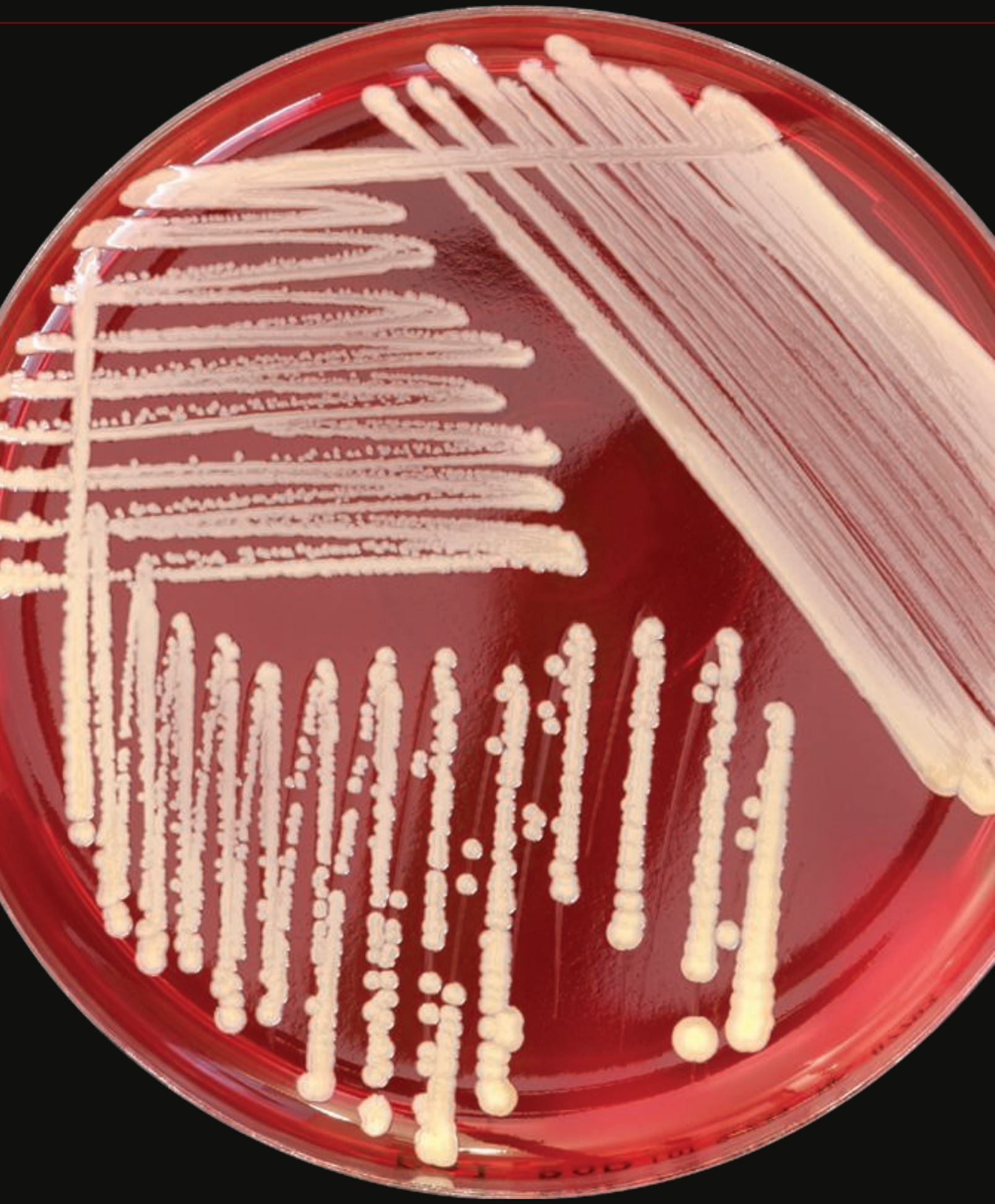


The Rise of MRSA

Jessica Cantrell, CST

In 1928, Scottish bacteriologist Alexander Fleming accidentally discovered penicillin's miraculous ability to kill *Staphylococcus* germs. Pathologist Howard Florey learned how to isolate penicillin for widespread use and created the first broad-spectrum antibiotic in 1940.[3] Penicillin-resistant strains of staph were widespread by the late 1950s. In 1961, the first case of Methicillin-resistant *Staphylococcus aureus,* or MRSA, appeared in a British hospital, just two years after Methicillin was first used to treat *Staphylococcus aureus* infections.[5] The first reported case of MRSA in the United States came in 1968.[7] Since those fledgling years in the discovery of antibiotics, bacteria have increasingly adapted and developed new strains that are able to resist a large variety of medicinal attacks, old or new, that have been created in an effort to restrain the increasing number of infectious diseases that exist today.

The term "staph infection" is a relatively common phrase that can be heard from the workplace to almost any health care facility in the country. It refers to an infection caused by *Staphylococcus aureus,* a Gram-positive, aerobic bacteria that colonizes in the nose and on the skin of 25% to 30% of the population.[6] While this colonization is typically asymptomatic, approximately 1% of *S aureus* carriers develop MRSA.[7] Methicillin-resistant *Staphylococcus aureus* typically forms as skin infections such as boils, abscesses, or pustules, but also has the potential to be much more severe and possibly fatal. It is resistant to not only Methicillin, but also more common antibiotics such as amoxicillin, penicillin and other antibiotics in the beta-lactams family.[6] MRSA can be differentiated into two different categories: Hospital-Acquired MRSA (HA-MRSA) and Community-Acquired MRSA (CA-MRSA). While MRSA is typically found most often in health

LEARNING OBJECTIVES

- Learn about the different strains of MRSA
- Identify the differences of the two strains
- Review how each type of MRSA strain can be acquired
- Examine the treatment for patients that acquire either strain of MRSA
- Determine what groups are most susceptible to acquiring *Staphylococcus aureus*

Courtesy CDC *Magnified 20,000X, this colorized scanning electron micrograph (SEM) depicts a grouping of methicillin resistant* Staphylococcus aureus *(MRSA) bacteria*

care settings, it has been noted that the number of CA-MRSA incidents have increased during the past decade as well significant differences between the two strains.[1] For instance, CA-MRSA seems to be more sensitive to a wider range of drugs than HA-MRSA. HA-MRSA, however, seems to be the strain of MRSA that affects the most victims. A study conducted in 2005 by the US Centers for Disease Control and Prevention stated that the majority of the estimated 94, 360 cases of MRSA were hospital-acquired, which supports the belief that the HA-MRSA strain is potentially more resilient than the CA-MRSA strain.[2]

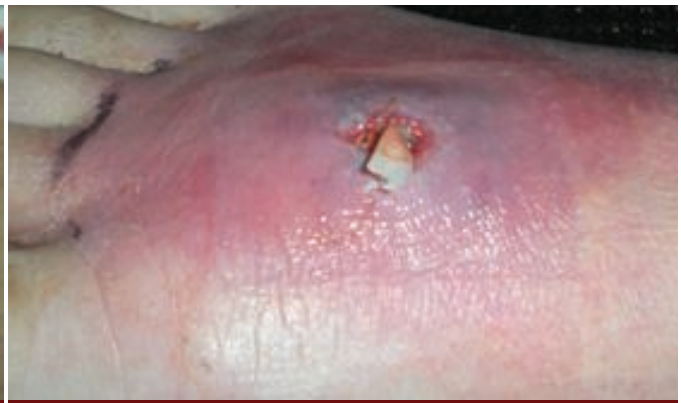
Due to the speed at which the bacteria multiply as well as its ability to adapt to its environment quickly, MRSA can occur at any location, and it can occur anywhere on a person's body and affect anybody. It is typically transmitted through an area of broken or open skin, but it has also been known to cause infections on areas of skin that lack any kind of wound.[6] With HA-MRSA, the infection is spread when a colonized individual comes into contact with a patient who has had surgery or who has a weak immune system. People at risk also include patients who have come into contact with inanimate objects or surfaces contaminated with the body fluids of someone who carries MRSA in their system, patients who have had to stay in ICU, and patients who have indwelling catheters. CA-MRSA can be transmitted much quicker; all it takes is for one colonized individual to come into contact with a crowd to start a crisis if the proper precautions are not taken. This category of MRSA is transmitted usually due to poor hygiene, overcrowded living conditions, skin-to-skin contact, and the sharing of personal items such as towels or razors. Certain groups remain at risk to CA-MRSA because of the aforementioned transmission risks, such as young children, the elderly, the homeless, athletes, prison inmates, daycare workers, tattoo recipients and drug abusers.[1]

PATHOGENESIS

Colonization, primarily through the anterior nares of the nasal region or through other parts of the body such as the groin, rectum, or axilla, is an important factor in the development of MRSA. It has been suggested that by destroying the colonization in the nose, the colonization in other areas of the body will disappear as well. Skin-to-skin contact is another major route to infection, as well as skin-to-surface contact. With HA-MRSA, this includes contact with medical equipment and workstations, and with CA-MRSA, personal items such as soap and towels are implicated as sources of infection.[1]

Resistance to antibiotics in certain staphylococci strains seem to appear for different reasons. It has been suggested in one report that resistance is created through the transfer of the mecA gene between the different strains of the bacteria. The gene chromosomally encodes the strain with a high-level resistance to Methicillin and other beta-lactams

Gregory Moran, MD *A cutaneous abscess located on the back, caused by MRSA*



Major Kirk Waibel, MD *A cutaneous abscess on the foot post packing, which had been caused by methicillin-resistant* Staphylococcus aureus *bacteria, or MRSA*

Gregory Moran, MD *A cutaneous abscess, which had been caused by methicillin-resistant* Staphylococcus aureus *bacteria*

Gregory Moran, MD *A cutaneous abscess on the hand, caused by MRSA*

by using altered penicillin-binding proteins.[6] Another way in which resistance develops is through the overuse of antibiotics. When antibiotics are used inappropriately, such as when they are taken for a viral illness or when they are not taken as prescribed by a physician, it increases the risk of the bacteria mutating and becoming resistant to that form of antibiotic.

While there are several strains of MRSA that are virulent and significant sources of infection, one clone of the bacteria, the USA300, appears to be considered the main CA-MRSA strain. This clone contains genes and toxins that can lead to several skin and soft tissue infections.[1] If MRSA, especially this clone in particular, is left untreated, it can cause toxic shock syndrome, necrotizing pneumonia, endocarditis, scalded skin syndrome, gastroenteritis and osteomyelitis.[7]

CLINICAL/LABORATORY DIAGNOSIS

This bacteria is most commonly suspected when a skin infection is displayed in the form of abscesses, boils, or carbuncles. The patient may also complain of a painful "spider bite" which may ultimately be a MRSA infection. In order to be certain that a clinical diagnosis of MRSA is correct, a culture must be obtained from the infection site of the patient, and then sent to a microbiology lab for further testing.[6] The cultures may be obtained from different sites based on the location of the infection. Sputum would be obtained if the symptom is pneumonia, while a biopsy of skin or a sample of drainage may be obtained from a skin infection.

Different tests may be used to screen for MRSA, especially typical broth-based and agar-based tests. However, the Clinical and Laboratory Standards Institute now recommends the use of the cefoxitin disk screen test, the latex agglutination test for PBP2a (the penicillin-binding protein), or a plate containing 6 µg/ml of oxacillin in Mueller-Hinton agar supplemented with NaCl.[6] The results for these tests are positive for MRSA if the bacteria prove to be resistant to oxacillin or cefoxitin.

PREVENTION CONTROL

Once MRSA begins to spread it is notoriously difficult to control. If caught early, the localized MRSA (which usually appears as a skin infection) can be treated by lancing and draining, and keeping the area dry and covered. An oral dosage of vancomycin may be given if necessary. If the condition has been allowed to worsen and the symptoms are severe, a variety of antibiotics may be given intravenously, such as vancomycin, daptomycin, tigecycline, or linezolid.[2]

As death can possibly result from exposure to MRSA, it is important to take measures to prevent and/or control the risk of outbreaks. The first and easiest step in the prevention and control of this bacteria is simply to maintain good hygiene: keep hands washed, always shower after exercising, and keep cuts, scrapes, and wounds clean and covered with bandages until completely healed. This is especially important in certain environments that involve a multitude of close contact with others, such as athletic locker rooms, schools, gyms, and health-care settings. Sharing personal items, including towels, razors, and clothing, should be avoided. Clothing and towels should be machine-washed using bleach and hot water if possible, as well as dried in a machine as opposed to air-drying.[5]

If a skin infection is suspected to be MRSA, patients should mention this to their physician in an effort to avoid contact with other patients who could potentially acquire the bacteria through contact. This also helps with the ability to track MRSA strains by healthcare providers who are attempting to control the spread of the bacteria. Patients can also help fight the spread of MRSA by monitoring their own

Taking Actions to Reduce HA-MRSA Infections

AST staff

Multiple hospitals across the US have taken steps to reduce hospital-acquired MRSA colonization and infection. Many centers have had success at decreasing the number of cases due to enacting preventative measures. From daily monitoring of clinical cultures for recovery of MRSA, surveillance of high-risk patients, ensuring all precautions for colonized or infected patients, using barrier protections for placement of central venous catheters, installing and using alcohol hand rubs and a hospital-wide dedication to hand hygiene, all these elements help reduce the exposure and spread of MRSA infections. The VA Pittsburgh Health System and the University of Pittsburgh Medical Center Presbyterian used a "bundle" of interventions and saw a 70% decrease in MRSA infections in one patient care unit over a four-year period.[1]

Due to aggressive approaches to control the spread of MRSA infections, data from the CDC's National Health Safety Network shows an "11% decrease in incidence of hospital-acquired invasive MRSA infections from 2005-2006" and a "44% decrease in central line-associated MRSA bloodstream infections from 2001 to 2007."[2]

THE ROLE OF LEADERSHIP

Initiatives work best when everyone is onboard, including hospital leadership. Leaders in the health arena need to be committed to enforcing, reviewing and implementing infection reduction policies. They also need to be willing to engage everyone on their clinical staff in acknowledging that the MRSA problem is serious and empower the front-line teams to get the job done. It is also important for leadership to understand that in order to begin a control program funds will need to be allocated to up-front resources. However, in return, by controlling MRSA infection issues, the hospital will save money in the long run. By setting up and utilizing MRSA infection precautions, hospitals can save from $20,000 to $462,000.[1]

COMPONENTS OF CARE

As a part of the 5 Million Lives Campaign, established by the Institute for Healthcare Improvement, a guide on how to reduce MRSA infections was created. In the guide, the IHI came up with five components of care that organizations should follow when adopting a MRSA-reduction initiative.

1. Hand hygiene
2. Decontamination of the environment and equipment
3. Active surveillance
4. Contact precautions for infected and colonized patients
5. Device bundles (Central Line Bundle and Ventilator Bundle)

HAND HYGIENE

Although the nose harbors the MRSA colonization, hospitalized patients often have high concentrations for MRSA on their skin and other body parts and since patients tend to contaminate their surroundings, MRSA may be lurking for days on hospital furniture. Health care workers have been shown to have MRSA on their hands when working in settings where the infection is epidemic. Transient contamination is believed to be the most frequent mode in which the infection is transferred from patient to health care worker. Cleaning hands before and after contact with MRSA patients or their immediate environment is critical in reducing transmission even when wearing gloves. Health care workers hands can be contaminated during glove removal. The IHI reports that dedicated hand hygiene remains under 50% at many hospitals derailing any effort to thwart MRSA infections.

The IHI released these components as part of the hand hygiene intervention for all health care centers to use when trying to get all staff to comply with hand washing.

- Demonstrate knowledge by training clinical staff with the key element of hand hygiene
- Demonstrate competence by training staff to use appropriate technique when cleansing their hands
- Enable staff by making alcohol-based hand gel and gloves available and easy to access
- Verify competency by monitoring correct glove usage

DECONTAMINATION

MRSA can survive for days on surfaces touched by infected patients so decontaminating their rooms or any area where an infected patient has been needs to be sterilized. Regularly cleaning and disinfection is also necessary and should be a priority for all health care settings. Leadership plays a key role in ensuring that these actions take place and providing education to all those involved in sterilizing so that everyone is well aware of the stakes in the MRSA control effort. Education for all staff, environment and clinical, needs to be available and checklists need to be used every time to verify that every area has been sterilized. The IHI recommends that those checklists be available for each cleaning and there should be areas to document any high-touch areas. Specific equipment should be dedicated for patients on isolation and leadership should use issue immediate feedback regarding cleaning and proper technique.

ACTIVE SURVEILLANCE

Since colonized patients are the main reason transmission occurs health care workers need to ensure correct and swift implementation of control measures to reduce infection rates. Active surveillance testing of the anterior nares will identify 80% of MRSA-colonized patients. By using a combination of screening specimens from the anterior nares and wounds, the percentage of identifying infected patients rises to 92%.[1] Some patients will go undetected if the infected area is not tested, such as the rectum. The IHI advises hospitals to begin collecting specimens on admission-only patients and measure compliance of the first test. If the first test is higher than 90%, call for the second test. Staff should be notified immediately when a patient tests positive for MRSA so that all precautions can be implemented.

CONTACT PRECAUTIONS FOR INFECTED AND COLONIZED PATIENTS

Although the anterior nares are the most common area for MRSA, patients can be infected in a number of body sites. Contact precautions are meant to break up the ways in which MRSA can be transmitted. Gloves, handing washing and alcohol wipes all help in reducing the spread of the infection as patients can contaminate their gowns, hospital room and the like. Each hospital needs to come up with a plan and adhere to all precautions to ensure the proper barrier techniques are used every time an infected patient is in their hospital. Adequate supplies should be easy to access and constantly restocked. Patients should be educated about hand hygiene and encouraged to comply with the hospital's protocol. When a patient cannot be placed in a private room, visual cues should be used for anything that crosses into the common area.

DEVICE BUNDLES

"Patients with invasive devices, such as central lines and ventilators, are at greater risk for developing hospital-acquired infections."1 These patients are also at a greater risk of MRSA bloodstream infections and pneumonia. Bundles have helped many hospitals reduce or eliminate device-related infections. By combining the Central Line Bundle and Ventilator Bundle, hospitals can work toward greatly reducing MRSA infections.

When reducing MRSA infections is a hospital's goal, everyone needs to be aware of the plan and leadership needs to take an active role in enforcing each of the steps. If a hospital only focuses on one of the components, they will fail to address the problem at hand. Each component requires commitment, continuing education and direction offered by leadership so that each employee may be aware and dedicated to ensure that they and their hospital are giving each patient the quality care.

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use of antibiotics. There are a few simple guidelines that can be followed to fight antibiotic-resistance:

1. Avoid asking for antibiotics without knowing the exact reason for illness.
2. If antibiotics are prescribed, take the dosage exactly as directed. This includes finishing the entire prescription instead of stopping as soon as the symptoms clear up. This prevents the resistant bacteria from multiplying and becoming more resistant.
3. Do not take someone else's antibiotic.[2]

MRSA, as well as antibiotic-resistant bacteria in general, has become a major problem not only in the US, but the world. Public awareness and good hygiene are crucial to controlling outbreaks and potentially saving lives.

ABOUT THE AUTHOR

Jessica Cantrell, CST, graduated from the surgical technology program at Ashland Community and Technical College in Ashland, Kentucky, in 2011. She immediately began working at Cabell Huntington Hospital in Huntington, West Virginia, as an anesthesia tech after graduation. Jessica was invited and participated in item writing for the National Board of Surgical Technologists and Surgical Assistants for practice exams. She is currently pursuing her Bachelor's degree in ecology/evolutionary science at Marshall University, and hopes to obtain a Master's degree in Physician Assistant Studies. She is supported by her fiancé and two daughters.

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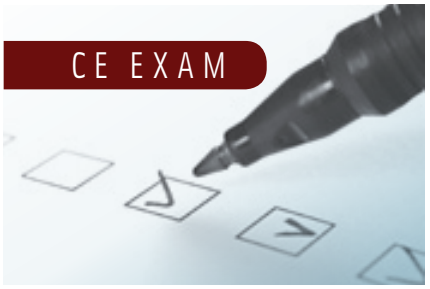

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