A better understanding of these often-serious infections that are rising in incidence and becoming more resistant to antibiotics is the first step to improved treatment.

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DURING THE PAST several years, disturbing headlines about flesh-eating bacteria have raised fear among the public, but few think they’ll actually be the next victim. That was certainly true of Cindy Martinez, who, in May 2015, somehow contracted one strain of the dangerous bacteria known to cause necrotizing fasciitis. A former Marine and mother of two small children, Cindy survived but only after her feet and right hand were amputated to halt the bacteria’s effects.\(^1\) Necrotizing fasciitis is rare. According to the Centers for Disease Control and Prevention (CDC), which tracks specific infections in the U.S. through a special system called Active Bacterial Core surveillance (ABCs), there are about 650 to 850 cases of necrotizing fasciitis caused, predominantly, by group A Streptococcal bacteria each year in the U.S. (although this is likely an underestimate because some cases are probably not reported). And, thankfully, the number of annual infections does not appear to be rising.\(^2\)

That’s not true of all bacterial skin infections. Necrotizing fasciitis is but one of a host of these infections and also one of the rarer ones. Other types of bacterial skin infections include cellulitis, erysipelas, erythrasma, folliculitis and skin abscesses, hidradenitis suppurativa, impetigo and ecthyma, lymphadenitis, lymphangitis and Staphylococcal scalded skin syndrome.\(^3,4\) All of these infections may be uncomplicated or complicated. Indeed, since all uncomplicated infections have the potential to become complicated,\(^5\) it’s important to understand the facts about them to ensure appropriate diagnosis and treatment.

Separating Myth from Fact

**Myth:** Bacterial skin infections are not common.

**Fact:** Despite the fact that skin forms an effective barrier to protect against infection when coming into contact with bacteria, bacterial skin infections are still common. This is because any break in the skin such as a cut or scrape gives opportunity for bacterial disease to establish itself.\(^6\) A study published in the *Annals of Internal Medicine* states that in 2005, there were approximately 14 million outpatient visits to doctors’ offices and emergency clinics for suspected skin and soft tissue infections (also known as skin and skin structure infections, or SSSIs) in the U.S.\(^6\) And, according to the Healthcare Cost and Utilization Project Statistical Briefs, there were 656,000 hospitalizations due to SSSIs in 2010, which was an increase of 75 percent from 1997.\(^7\)

Staphylococcus and Streptococcus are the most common types of bacteria involved in bacterial skin infections. Staphylococcal infection can result in many types of infections, but typically, it causes abscesses or boils, which are sometimes referred to as furuncles. These uncomfortable and frequently painful red lumps associated with a hair follicle may cluster together to form carbuncles.\(^8\) More seriously, Staphylococcus can result in methicillin-resistant Staphylococcus aureus (MRSA), which can be a life-threatening infection because certain antibiotics in the penicillin family cannot treat it.\(^9\) Streptococcal infection also can cause many types of infections, but it more regularly causes impetigo, which results in a rash several days after infection with small blisters that burst and leave crusty, golden patches on the skin — occurring most commonly on the face.\(^5\) Both Staphylococcus and Streptococcus also commonly cause cellulitis, which can occur anywhere on the body; however, the most common location is the lower leg.\(^5\) Cellulitis is a painful infection of the deeper layers of the skin that appears as an area of redness, warmth and swelling that gradually spreads.\(^5\)

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**Myth:** Bacteria that cause skin infections are always disease-causing.

**Fact:** Most bacteria are not harmful. In fact, many of the different types help in the digestion of food, destroy disease-causing cells and give the body needed vitamins; less than 1 percent of bacteria make people sick. However, infectious bacteria quickly reproduce in the body, giving off toxins that can damage tissue and make people ill.\(^10\)

**Myth:** Bacterial skin infections are equally opportunistic in people.

**Fact:** Individuals using medications to treat certain disorders are more susceptible to bacterial skin infections. These include individuals who have diabetes and use insulin, HIV/AIDS, kidney failure requiring dialysis, weakened immune systems (either from a disease or medications that suppress the immune system), cancer (especially those who are undergoing chemotherapy or radiation), skin damage (from conditions such as eczema, insect bites or minor trauma that opens the skin) and respiratory illness such as cystic fibrosis or emphysema.\(^11\) Some other common risk factors for bacterial skin infections are recent antibiotic use, recent hospitalization, frequent needlesticks and...
playing contact sports like wrestling and football. People who have had previous bacterial skin infections due to Staphylococcus are also more likely to develop them again. In addition, it’s possible for skin infections caused by less-common bacteria to develop in people while hospitalized or living in a nursing home, while gardening or while swimming in a pond, lake or ocean. Age can be a determinant of the type of skin infection. From adolescence to age 45 or 50, the most common type of infection is a boil, or a furuncle. Children are more susceptible to impetigo. Newborns sometimes contract Staphylococcal scalded skin syndrome caused by toxins from a staph infection in the mother during pregnancy, which causes a fever and scalp rash. And older adults typically develop cellulitis.

Only 10 percent of infections caused by Staphylococcal bacteria respond to common antibiotics such as penicillin.

Myth: Uncomplicated bacterial skin infections are not dangerous. Fact: Uncomplicated infections, also called uncomplicated SSSIs (uSSSIs), are usually not dangerous because they typically respond well to systemic antibiotics and local wound care. However, all bacterial skin infections can be dangerous because uncomplicated ones have the potential to become complicated.

Unfortunately, physicians can’t easily identify the cause of SSSIs, so they typically must all be treated empirically. And, timely treatment matters to ensure that the bacterial cause is not a drug-resistant strain. If left untreated, uSSSIs may progress to cell death in deep tissue such as necrotizing fasciitis discussed earlier.

Myth: Recognizing when a bacterial skin infection has become complicated is simple. Fact: Complicated infections, also known as complicated SSSIs (cSSSIs), are not always identifiable simply by appearance. Instead, according to the U.S. Food and Drug Administration, a skin infection is considered complicated when it meets two of the following five criteria: 1) involves a preexisting wound or ulceration of the skin, 2) involves the deeper soft tissues, 3) requires surgical intervention, 4) is caused or exacerbated by underlying comorbid disease states (e.g., diabetes, system immunosuppression) and 5) is unresponsive to conventional antibiotic therapy or is recurrent. As such, initial treatment may not recognize that an infection is complicated.

For example, a 55-year-old male who had a prior history of insulin-dependent diabetes presented to the emergency department with erythema and cellulitis in the right axilla. He was administered oral cephalixin and returned three days later with a large abscess in the right axilla. A surgical evaluation confirmed a large abscess and a large surrounding area of cellulitis, and he was taken to the operating room for incision and drainage. His abscess culture grew MRSA, at which time it was determined that he had a cSSSI due to MRSA, the leading cause of skin infections in patients presenting to the emergency department.

Myth: There are no easy ways to prevent bacterial skin infections. Fact: Most bacterial skin infections are spread through direct person-to-person contact with someone who has the infection. They can also be spread indirectly through contact with items such as athletic gear, towels, razors, cell phones, etc., that are contaminated with the bacteria.

However, it is possible in many instances to prevent these infections. Key to prevention is keeping skin undamaged and clean. Any cuts or scrapes should be washed with soap and water and covered. Petrolatum applied to open areas can help prevent bacterial invasion. Antibiotic ointments are not recommended because of the risk of developing an allergy to the antibiotic. Abscesses need to be cut open by a physician and allowed to drain, and any dead tissue should be surgically removed.

CDC has issued standard precautions to prevent the spread of MRSA in healthcare settings in its Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Health Settings 2007. Specifically, the agency recommends performing hand hygiene after touching blood, body fluids, secretions, excretions and contaminated items, whether or not gloves are worn; wearing gloves when it can be reasonably anticipated that contact with blood or other potentially infectious materials, mucous membranes, nonintact skin or potentially contaminated intact skin could occur; using personal protective equipment to protect the mucous membranes of the eyes, nose and mouth during procedures and patient-care activities that are likely to generate splashes or sprays of blood, body fluids, secretions and excretions; wearing a gown to protect skin and prevent soiling or contamination of clothing during procedures when contact with blood, body fluids, secretions or excretions is anticipated; handling used patient-care equipment soiled with blood, body fluids, secretions and excretions in a manner that prevents skin and mucous membrane exposures, contamination of clothing and transfer of microorganisms to other patients and environments; and handling, transporting and processing used
Diseases (NIAID) have discovered the genetic sequence for five strains of the group A Streptococcus bacterium. NIAID is using this information to develop a group A Streptococcus vaccine, and several candidate vaccines are in various phases of development. While some scientists are conducting animal model studies to obtain data to pursue clinical trials in humans, other scientists are evaluating group A Streptococcus vaccine candidates in Phase I clinical trials. The first group A Streptococcus vaccine clinical trial found that the vaccine was well-tolerated by patients and has led to further clinical evaluation of a similar vaccine candidate. According to NIAID, an effective vaccine will prevent not only strep throat and impetigo but also more serious invasive disease and post-infectious complications.

Similar vaccines are in development to protect against the Staphylococcus bacteria. One study is being conducted on NASA’s International Space Station (authorized by the 2005 NASA Authorization Act). The study is taking advantage of knowledge gained in previous space flight studies to identify the target genes for MRSA virulence. Each flight opportunity provides additional insight about the bacteria and the changes that are occurring as they grow in space. The knowledge is being applied to streamline and accelerate the development of vaccines and therapeutics on Earth.

Until researchers develop improved ways to prevent bacterial skin infections, perhaps in the form of vaccines, better understanding of these conditions will help to treat patients most effectively.

Dispelling the Myths Now

The human body is a natural host for many bacterial species that colonize the skin as normal flora. Unfortunately, Staphylococcus and Streptococcus account for a wide variety of bacterial skin infections. These infections are a significant public health condition in the U.S., and research is ongoing to address it.

Researchers at the National Institute of Allergy and Infectious Diseases (NIAID) have discovered the genetic sequence for five strains of the group A Streptococcus bacterium. NIAID is using this information to develop a group A Streptococcus vaccine, and several candidate vaccines are in various phases of development. While some scientists are conducting animal model studies to obtain data to pursue clinical trials in humans, other scientists are evaluating group A Streptococcus vaccine candidates in Phase I clinical trials. The first group A Streptococcus vaccine clinical trial found that the vaccine was well-tolerated by patients and has led to further clinical evaluation of a similar vaccine candidate. According to NIAID, an effective vaccine will prevent not only strep throat and impetigo but also more serious invasive disease and post-infectious complications.

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References