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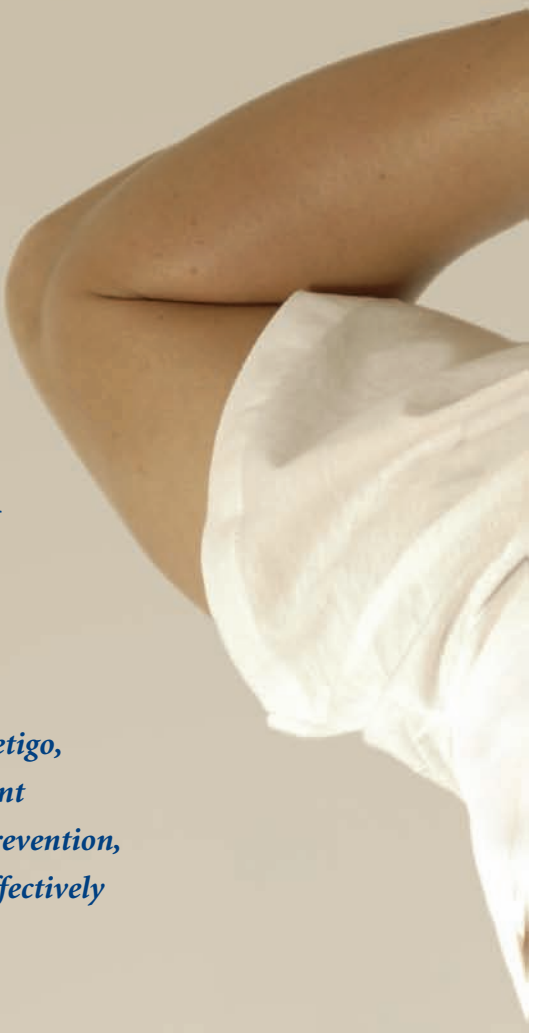

Uncovering common bacterial skin infections

Abstract: The four most common bacterial skin infections are impetigo, erysipelas, cellulitis, and folliculitis. This article summarizes current information about the etiology, clinical presentation, diagnosis, prevention, treatment, and implications for primary care practice needed to effectively diagnose and treat common bacterial skin infections.

By Daria Napierkowski, DNP, RN, ANP-BC, CNE

Bacterial skin infections are commonly seen by nurse practitioners (NPs) in primary care practice as well as in the hospital. Bacterial skin infections usually result from breakage of the skin, can be considered mild if they are superficial, and/or can result in a severe infection: necrotizing fasciitis. Necrotizing skin infections are rare–yet severe–and cause body tissue to die.[1,2] The most common skin infections seen by the NP in primary care practice are impetigo, erysipelas, cellulitis, and folliculitis.[3] The most common organisms seen in bacterial skin infections are streptococci, *Staphylococcus aureus*, and methicillin-resistant *Staphylococcus aureus* (MRSA).[2] Skin infections may have a negative impact on the patient's quality of life and warrant a discerning diagnosis and prompt treatment.

Patients with diabetes and immunodeficiencies are more susceptible to skin infections caused by gram-negative organisms.[3] Skin infections increased to the seventh most common condition among hospitalized children in 2009, whereas it was the 13th most common condition in 2000.[4] The rate of skin infection hospitalizations overall has increased 29% from 2000 to 2004, while conditions for other infectious diseases, such as infectious pneumonia, have not increased.[5] These rates are consistent with increasing hospitalizations for MRSA bacterial skin infections.[5]

Diagnosis of a bacterial skin infection needs careful consideration because other conditions such as thrombophlebitis, deep vein thrombosis, medication reactions, and gout can mimic the erythema, swelling, warmth, and tenderness of a skin infection.[2] A comprehensive patient history is essential to rule out other diagnoses. Skin infections commonly come with a complaint of a prior break in the skin: insect bite, animal bite, puncture wound, or laceration.

Key words: bacterial skin infections, cellulitis, erysipelas, folliculitis, impetigo

Photo by Chris Fertnig/istockphoto.com ©

Questions concerning the patient's comorbid conditions should be carefully explored. The wound should be examined for areas of erythema, swelling, exudate, necrosis, crepitus, and color changes of the skin. Associated symptoms include fever, increased heart rate, decreased BP, or enlarged lymph nodes close to the site of the wound (which should be carefully monitored). Most common bacterial skin infections do not require lab assessment except if the patient has a comorbid disease or severe infection. A baseline complete blood count, chemistry, and C-reactive protein can be obtained with widespread infections.[2] Cultures, including blood cultures, are cost-effective in patients who are immunocompromised, especially if the infection becomes severe and guides antibiotic therapy.[2] Patients should be hospitalized if the infection does not have declining symptoms in 72 hours or if the patient develops a fever, has increasing pain at the site, tissue necrosis, or has an immunocompromised state.[2]

Bullous impetigo with crust formation

Source: Goodheart HP. *Goodheart's Photoguide of Common Skin Disorders.* 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.

Impetigo contagiosa

The photo shows a child with impetigo in the nasal area with the characteristic honey-colored crusts.

Source: Rubin R., Strayer D, Eds. *Rubin's Pathology: Clinicopathologic Foundations of Medicine.* 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2008:1037.

Impetigo

Etiology: The organisms responsible for impetigo are *S. aureus* (which lives on the skin and mucous membranes) and *Streptococcus pyogenes* commonly found in the gastrointestinal system, genitourinary system, and respiratory system. Both organisms are classified as gram-positive cocci and are facultative anaerobes that can survive at low levels of oxygenation. *S. aureus* causes an infection when skin is broken, whereas *S. pyogenes* produces enzymes that facilitate an infection. *S. pyogenes* can be found in asymptomatic carriers in the general population. The nares can also be colonized with *S. aureus*, and colonization with MRSA should be considered.[6] Impetigo is a bacterial skin infection commonly seen in children–especially preschool children. Children and adults who play contact sports (wrestling, football, rugby, and basketball) are more susceptible to impetigo, although impetigo is not as common in adults.[7] Factors that can lead to an outbreak of impetigo in communities or institutions include a warm, humid climate, overcrowded conditions, and patients with poor hygiene or nonintact skin.

Clinical presentation: There are two classifications of impetigo: bullous and nonbullous. Bullous impetigo presents as fluid-filled bulla containing a serous yellow fluid, and when it ruptures, it leaves a partially-denuded area with a ring of bulla remaining (see *Bullous impetigo with crust formation*). Bullous impetigo is less common, more severe, and has significant mortality in infants. Nonbullous impetigo, also referred to as impetigo contagiosa, initially presents as small vesicles or pustules with the characteristic areas of honey-colored crust (see *Impetigo contagiosa*).[3] Impetigo is commonly seen in intertriginous areas, the face, and extremities where there is a break in the skin. Impetigo can occur in more than one area, and a mixture of the two (bullous and nonbullous) can occur. Both forms are caused by *S. aureus*; however, in the nonbullous form, streptococcus is usually involved. Lymphadenopathy and an elevated white blood cell count are often seen in the acute stages of impetigo.[8] Impetigo does not commonly cause scarring because it does not ulcerate and is usually confined to the epidermis; however, lesions can leave areas of depigmentation. Ecthyma is an ulcerative form of impetigo that extends deeper into the skin and is typically found on the legs and forearms.[9]

Diagnosis: Diagnosis of impetigo can be made by a culture of the infected site or is based on the following

presenting infection characteristics: serous yellow-filled bulla or small vesicles with honey-colored crusting. Other skin infections should be considered in the differential diagnosis, such as herpes, chicken pox, contact dermatitis with secondary infection, tinea corporis, or an allergic reaction.[7] A thorough patient history can rule out other skin infections or conditions.

Prevention: Impetigo is very contagious, can spread to other areas of the body, and is easily passed by direct contact. Children in day-care often pass the bacteria to other children and the adults caring for them. Heat and humidity, as well as areas of cracked skin, can increase the chances of contracting impetigo. A viral infection with exudate from the nose can impair skin integrity under the nose and is a common site of impetigo. Children and adult caregivers should wash their hands often, especially after touching infected skin. Children should not be in contact with other children until 48 hours after initial treatment. Items such as towels and blankets should not be shared among children, and all toys need to be thoroughly washed on a daily basis.

Treatment: The extent of the infection will guide treatment. Areas of infection should be washed with soap and water daily, and towels should also be washed daily and not shared with others. Crusted areas can be soaked two or three times a day with a solution of a half cup of vinegar in a liter of warm water (gently removing the crust).[9] Mupirocin ointment 2% can be prescribed for topical use to be applied in a thin layer to the affected site three times a day.[10] Other treatments (for instance, bacitracin and neomycin) have not been found to be as effective as mupirocin.[9] Additionally, the initial use of mupirocin can help prevent the development of MRSA.[3] The area can be covered with loose-fitting gauze if needed. Treatment should extend until all areas are free from infection and a few days following; the usual treatment is 10 days, and unused ointment should be discarded.[9] Mupirocin should be used cautiously in patients with impaired renal function and in those who are breastfeeding infants. If the infection reoccurs or is extensive (large lesions or lesions occurring in more than one area), then a course of oral antibiotics is recommended.[4]

If a culture confirms the presence of streptococcal infection, then the antibiotic of choice is the penicillin class of agents (dicloxacillin or amoxicillin/clavulanate). If the culture reveals both streptococcal and staphylococcus infection, then a first-generation cephalosporin, for example, cefadroxil or cephalexin is an effective treatment and has the least number of treatment failures.[9,11] Patients should be screened for hypersensitivity to penicillin or cephalosporins prior to treatment, and these drugs should be used cautiously in patients with renal or hepatic disease. Treatment options for patients with a penicillin allergy or MRSA infection include clindamycin.[9] Erythromycin is no longer used because of resistant strains of *S. aureus*.[9]

Erysipelas of the face

A patient with a facial rash that is salmon color and painful to touch.

Source: Barankin B. *The Barankin Dermatology Collection.* Baltimore, MD: Lippincott Williams & Wilkins; 2003.

Implications for practice: Impetigo is a common bacterial skin infection that can easily be spread from person-to-person. Strict hand washing is essential in the community, especially in areas where children congregate and play. Adult caregivers must be taught proper hand washing and care of all toys and equipment in a day-care situation or school. Personal items should be marked with the child's name and are not to be shared. Caregivers should be taught to immediately notify parents of suspicious lesions.

Erysipelas (noncomplicated cellulitis)

Etiology: The organism that causes erysipelas is beta-hemolytic *S. pyogenes* and, occasionally, *S. aureus* that enter the skin after trauma or a break in the skin. Stasis ulcers caused by venous insufficiency, insect bites, and surgical incisions can be the portal of entry.[12] The upper dermis is involved with the superficial lymphatics. Patients with lymphedema or any type of lymphatic dysfunction are at risk.

Clinical presentation: Erysipelas occurs after a break in the skin that presents as a plaque and commonly spreads with characteristic erythema and swelling—usually found on the legs or face—which are painful and warm to the touch (see *Erysipelas of the face*).[11,13] The skin, upon palpation, appears soft with areas of induration visible with a peau d'orange appearance. This occurs because the hair follicles are surrounded by edema, whereby the skin appears

dimpled.[8] The patient is often febrile and complains of fatigue. Erysipelas is differentiated from cellulitis by a raised border that is well-defined and sharply demarcates from the surrounding skin, whereas cellulitis has less-defined margins.[13] Erysipelas appears to have lesions that rise above the skin. It is more commonly seen in infants, children, older adults, and immunocompromised individuals.[3]

Erysipelas is more commonly seen in infants, children, older adults, and immunocompromised individuals.

Diagnosis: Diagnosis is made by patient history and objective signs. Risk factors include obesity, edema, lymphedema, leg ulcer, prior leg surgery, or prior history of erysipelas.[14] Patients may also complain of headache, fever, chills, and fatigue. Blood cultures should be performed for patients who present with fever.

Prevention: Instruct the patient and caregivers of children to avoid injury and breakage of the skin. Clean all injuries with mild soap and water, dry thoroughly, and apply antibiotic cream. The skin should not be scrubbed with abrasives. Risk factors for erysipelas include sharing toiletry items and close contact with infected individuals. Infections with MRSA are a concern among prisoners, I.V. drug users, homosexual men, and those in the military.

Treatment: Treatment involves an antibiotic that is effective against beta-hemolytic *S. pyogenes*. Mild cases are usually treated at home with one of the following oral antibiotics: penicillin, amoxicillin, dicloxacillin, cephalexin, or clindamycin. Severe cases require hospitalization and should be treated with penicillinase-resistant penicillin, such as dicloxacillin, nafcillin, or a first-generation cephalosporin.[14] Infections positive for MRSA can be treated with linezolid. Linezolid is contraindicated in patients who have phenylketonuria, uncontrolled hypertension, or are taking a monoamine oxidase (MAO) inhibitor due to the risk of a hypertensive response.[12] Some patients may benefit from a short course of corticosteroids.[13] Warm compresses can be applied three times a day.[9] Treating patients who have recurrent erysipelas with long-acting penicillin has not been found to be efficacious with long-term recurrence.[14]

Implications for practice: Erysipelas is serious in older adults and advances quickly to tissue necrosis that can lead to hospitalization. Erysipelas can be difficult to distinguish from cellulitis; cellulitis involves the subcutaneous fat deep into the dermis, whereas erysipelas involves the upper dermis and superficial lymphatics.[9,11] A careful history and physical exam are essential to avoid misdiagnosis.

Cellulitis of the knee

The photo shows a child with cellulitis of the knee after a minor injury. The child presented to the emergency department with fever and lymphangitic streaking.

Source: Fleisher GR, Ludwig W, Baskin MN. *Atlas of Pediatric Emergency Medicine.* Philadelphia, PA: Lippincott Williams & Wilkins; 2004.

Cellulitis

Etiology: Cellulitis is an inflammatory, nonnecrotizing condition that involves the deeper dermis and the subcutaneous fat.[9] It is commonly caused by *S. pyogenes* or *S. aureus* that move into the dermis of the skin via a break or fissure. Group B, C, or G beta-hemolytic streptococci can also be the cause.[13] Cellulitis associated with furuncles, carbuncles, or abscesses is usually caused by *S. aureus* and is often associated with a penetrating trauma. Surgery that involves disruption of lymphatic drainage (such as procedures for breast and gynecologic cancer) can lead to cellulitis.[9] Prophylaxis with a penicillin antibiotic may help prevent occurrence of cellulitis following a surgical procedure. Orbital and periorbital cellulitis can be associated with sinusitis and is found commonly in children.[3]

Clinical presentation: With cellulitis, the skin appears erythemic, swollen, and inflamed with increasing warmth (see *Cellulitis of the knee*). Additionally, the skin is tender to the touch. Cellulitis is commonly seen on the arms, legs, and face, but can be seen anywhere on the body. Cellulitis usually appears at an area of broken skin or a surgical site. The skin should be assessed frequently because of the rapid-spreading nature of cellulitis.

Diagnosis: Diagnosis is based on history of a break in the skin (although this is not always reported) and presenting

symptoms of swelling, erythema, warmth, and complaints of pain upon palpation. A thorough patient history should include questions regarding the following possible causes of infection: sports activities, animal or insect bites, trauma, or dirty water contact.[13] Blood cultures are not required unless the cellulitis becomes extensive and has additional symptoms of fever and malaise.

Prevention: Cellulitis is one of the most common skin infections found in the older adult patient. Obesity, comorbidities, and having prior cellulitis infections are risk factors for recurrent cellulitis.[8] Diligent skin care of patients who have had prior episodes of cellulitis includes prompt treatment of fungal infections support stockings, and inspection of the skin, including all skin folds and between the toes. Oral antibiotics should be started immediately upon initial symptoms.

Treatment: Most patients can be treated on an outpatient basis with antibiotics that provide coverage for streptococcus, and if the infection does not respond, hospitalization may be necessary, and an antibiotic that covers MRSA should be initiated.[14] Patients with cellulitis that results from trauma should be started on beta-lactam therapy (penicillins, cephalosporins, or cephamycins). Clindamycin is a treatment option for patients with penicillin allergy.[9] If the infection is not responding within 72 hours or the patient develops a fever, increased pain, or increasing redness, a culture should be obtained, and coverage for MRSA should be started.[14] Coverage for MRSA is especially important in areas known to have high rates of MRSA. A fluoroquinolone antibiotic may be as effective as a beta-lactam antibiotic in noncomplicated cases of cellulitis.[14] Cultures should be performed to ensure that the fluoroquinolone chosen is effective against the organism. Fluoroquinolones should not be used during pregnancy unless the benefit to the mother prevails over the risk to the fetus. If cellulitis affects an extremity, elevation is warranted to decrease swelling and pain. Nonsteroidal anti-inflammatory drugs including ibuprofen or naproxen can be added to relieve pain and inflammation. Leg ulcerations combined with cellulitis require longer treatment times.[8] Patients with comorbid conditions (such as diabetes or venous insufficiency) may require a longer treatment course, and systemic corticosteroids may be required.[9] Uncomplicated periorbital cellulitis is treated with warm soaks and oral antibiotics (penicillin); patients should also be referred to an ophthalmologist for evaluation. Orbital cellulitis (postseptal cellulitis) is an ocular emergency and the patient needs immediate referral to the ED and evaluated by an ophthalmologist.[3,14]

Folliculitis

A female patient with folliculitis of the thigh.

Source: Goodheart HP. *Goodheart's Photoguide of Common Skin Disorders.* 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.

Implications for practice: Cellulitis should be distinguished from erysipelas, necrotizing fasciitis, gout, and contact dermatitis. Necrotizing fasciitis is a life-threatening condition that destroys skin, underlying tissue, and muscle. Erysipelas has raised well-defined borders, and contact dermatitis can be reddened but is commonly itchy, less tender, and warm to the touch.[8] Gout can be distinguished from cellulitis by aspiration of the reddened joint for uric acid crystals. Cellulitis is one of the most common bacterial skin infections that can result in hospitalization–especially in the older adult.[11] Cellulitis hospitalizations have been increasing, especially those due to MRSA.[11]

Folliculitis displays as pustules with the hair shaft commonly seen in the center of the pustule.

Folliculitis

Etiology: Folliculitis develops when the hair follicles become inflamed after injury or infection. Folliculitis is considered superficial when it is found in the epidermal layer of the skin, whereas cellulitis is found deep in the dermis.[2] Folliculitis is most commonly caused by *S. aureus* or MRSA; it is seen in cases of skin breakage from trauma and close skin-to-skin contact (for instance, wrestling, hockey, and football).[6,7] It is a superficial infection of the pilosebaceous follicles and can be seen anywhere on the body—especially

in areas where the hair is coarse (for example, the face, neck, and axillary region). Deep folliculitis is caused by staphylococci and involves the deeper portion of the hair follicle. Folliculitis can also be caused by the following gram-negative bacteria: *Klebsiella*, *Enterobacter*, and *Proteus* in patients on long-term antibiotics for treatment of acne.[3] Infections resulting from usage of poorly chlorinated hot tubs, sponges, and bathtubs are commonly caused by *Pseudomonas aeruginosa*.[3,8,15]

Clinical presentation: Folliculitis displays as pustules with the hair shaft commonly seen in the center of the pustule. The patient might complain of tenderness at the site, and several areas of the body can be affected—especially areas where hair is thick (for example, beard, trunk, and extremities). The patient is rarely febrile. Lesions that extend deep into the hair follicle will appear reddened, swollen, and will cause scarring after healing (see *Folliculitis*).

To prevent folliculitis, athletic equipment should not be shared, and routine skin checks should be performed in at-risk athletes.

Diagnosis: Folliculitis is diagnosed by the characteristic pustules and papules on the body that are reddened and around areas of hair follicles. Superficial pustules can be tender to the touch and usually heal without complications or scarring. The patient will complain of intensive itching in the area, and the patient history should include questions about use of a hot tub or spa. Lesions from use of a hot tub are usually found on the trunk and extremities and occur up to 72 hours after contact. Other questions to include in the patient history are regarding the use of oils on the skin that can act as irritants or the use of wax to remove hair. A patient with recurrent folliculitis should have a fasting glucose performed, and diabetes mellitus should be one of the differential diagnoses. It is prudent practice to culture lesions, nares, axillae, and groin areas with chronic folliculitis to determine carrier state and correctly prescribe antibiotics.[16]

Prevention: To prevent folliculitis, athletic equipment should not be shared among players, and skin checks should be performed routinely among athletes at risk for development. Players with lesions should not be allowed to return to participating in a sport until all lesions have subsided. Clothing must be cleaned daily, and all players and trainers should be washing their hands or using waterless soap before and after practice. Long-sleeved shirts used in practice can help prevent skin-to-skin contact.[7] Tight-fitting clothing should be avoided, and patients should be advised to avoid multidirectional shaving. Instead, patients should shave the hair in the direction of its growth.[8] Hot tubs and spas should be appropriately chlorinated to avoid the growth of bacteria.

Treatment: Warm soaks of half benzoyl peroxide and half water or chlorhexidine gluconate can be applied to the lesions three times a day with a clean towel.[13] The area should be dried thoroughly, and a topical antibiotic cream should be applied. Mupirocin should be applied to the area (spread thinly). If multiple areas of the body are involved or the lesions do not abate within a few days, oral antibiotics are required.[13] Mupirocin is used watchfully in patients with renal disease or burns. Topical clindamycin gel is an option if folliculitis affects the beard or scalp area.[13] Men who shave the face can develop folliculitis from shaving up and down instead of just down in the direction of hair growth. Administration of one of the following antibiotics that are effective against MRSA is prudent: trimethoprim-sulfamethoxazole or clindamycin.[7,13] Deep folliculitis should be treated with oral antibiotics, such as fluoroquinolones, cephalosporins, or penicillinase-resistant penicillins.[3] Folliculitis may look similar to acne, however, some patients may present with both folliculitis and acne. The patient with severe nodular acne that is unresponsive to conventional therapy can be treated with isotretinoin with careful monitoring of liver function values and changes in personality. Women placed on isotretinoin must be tested for pregnancy prior to use, and upon a negative test, placed on oral birth control. The patient will be enrolled in the iPledge Program, a computer-based system to ensure that she will not become pregnant while using isotretinoin.

Implications for practice: Although folliculitis infections have low morbidity and low mortality, they can stop athletes from playing and can be irritating. If MRSA is the organism of causation, the lesions can be more difficult to eradicate and can spread throughout the skin. If the patient has MRSA colonization in the nares, subsequent infections can occur. An estimated one-third of the U.S. population could be colonized with MRSA in the anterior nares.[6] MRSA is most likely to be colonized in children between the ages of 6 and 11 and to be carried by females over the age of 60.[6]

Moving forward

Bacterial skin infections may be misdiagnosed and can be confused with other differential diagnoses: acne, contact dermatitis, herpes zoster, tinea corporis, and allergic reactions. It is important for the NP to be able to diagnose and

treat the common bacterial skin infections: impetigo, erysipelas, cellulitis, and folliculitis. A thorough history and physical exam can reveal the important signs and symptoms to correctly diagnose and treat common infections. It is also imperative to teach child caregivers, coaches, athletes, and others at risk how to prevent bacterial skin infections.

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