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Skin and Soft Tissue Infections

Skin and soft tissue infections (SSTIs) are encountered commonly in the emergency department (ED), presenting as a range of disorders, from uncomplicated cellulitis, impetigo, folliculitis, erysipelas, and focal abscesses to necrotizing fasciitis. Each year between 1998-2006 in the United States, there were 650,000 hospital admissions for cellulitis, with estimates of 14.5 million cases annually treated as outpatients, accounting for $3.7 billion in ambulatory care costs.[1,2]

Patients with simple cellulitis typically present with an area of expanding erythema that is warm and tender to touch. Other features may include swelling and fluid drainage. The diagnosis of cellulitis is made primarily by history and physical findings, and differentiated from other skin and soft tissue findings by appearance. (*See Table 1.*) Diagnostic modalities may be indicated to reliably discern cellulitis from other more serious infections or a true emergency, such as necrotizing cellulitis. Once the diagnosis of cellulitis is made, empiric treatment should be instituted in the ED based on common pathogens. The usual pathogenic organisms include beta-hemolytic streptococci and methicillin-sensitive *Staphylococcus aureus* (MSSA).[1] Failure to respond to appropriate first-line antibiotics within five days of initiating therapy may indicate resistant organisms, polymicrobial infection, pseudocellulitic mimicry, underlying immunosuppression, or a deep space infection not treatable with oral antibiotics.

Figure 1. Shin Cellulitis

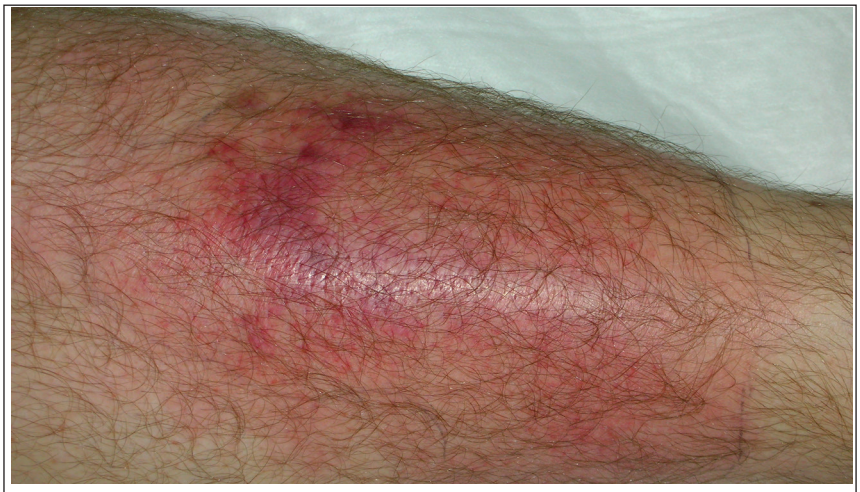


Image courtesy of J. Stephan Stapczynski, MD.

EXECUTIVE SUMMARY

- Cellulitis most often is due to beta-hemolytic streptococci or methicillin-sensitive *Staphylococcus aureus* (MSSA).
- Cellulitis is primarily a clinical diagnosis.
- The ALT-70 score may be used to differentiate patients with lower extremity cellulitis from pseudocellulitis mimics.
- The LRINEC score may be useful to identify patients with necrotizing fasciitis.
- Blood cultures have very little clinical utility in patients with cellulitis, even in febrile patients.
- Most cases of cellulitis can be treated with oral antibiotics.
- Empiric treatment should be started with antibiotics with activity against beta-hemolytic streptococci and MSSA, unless there are features suggesting the possibility of methicillin-resistant *Staphylococcus aureus* (MRSA).

While generally of little concern for patients with cellulitis and other superficial skin infections, the initial ED evaluation of patients presenting for care and treatment of skin infections consists of assessment and stabilization of life and limb threats that begins with assessment and management of airway, breathing, and circulation. In all patients with skin and soft tissue infections, assessment of circulation in the involved region is important. The capillary refill should be checked in the involved area and, if the infection is on a limb, the arterial pulses above and below the area should be checked. If pulses cannot be palpated, Doppler assessment of flow is advised. Absent palpable pulses and Doppler flow indicate potential limb-threatening ischemia. A vascular surgeon should be consulted and additional imaging studies, such as CT angiography, typically are done.

After assessing arterial inflow, look for signs suggestive of impaired venous outflow, such as dependent edema, stasis dermatitis, and prominent varicose veins on the legs. Venous insufficiency may mimic cellulitis and impair the response to antibiotic therapy.

Emergency physicians should consider diseases and injuries that are the most serious and treatable during the ED visit. Because cellulitis can be challenging to diagnose properly in the ED, hospital admission and further clinical deliberation may be prudent in cases of uncertain diagnosis.[3] Because cellulitis generally is more responsive to treatment than other similar conditions (drug reactions, venous stasis, which may give a clue in their bilaterality), emergency physicians often err on the side of initiating empiric treatment even when the diagnosis is uncertain.[4] They also may admit patients with cellulitis to the hospital to monitor for worsening of the condition. The practice of hospitalizing patients from the ED provisionally diagnosed with cellulitis in order to validate the diagnosis and observe the response to empiric treatment has been questioned recently.[5,6]

Empiric treatment of primary cellulitis starts with antibiotics effective against the two most common pathogens: beta-hemolytic streptococci and MSSA. Patients who have recurrent cellulitis or do not respond to initial therapy should be treated with antibiotics that have an expanded spectrum to include methicillin-resistant *Staphylococcus aureus* (MRSA). Consider expanded antibiotic spectrum to include MRSA in patients at risk for this pathogen, such as athletes, children, military recruits, IV drug abusers, prisoners, men who have sex with men, nursing home residents, and those with prior MRSA exposure.[1,8,14]

Epidemiology and Risk Factors

Impetigo occurs in about 20/1,000 people per year, and erysipelas occurs in about 1/1,000 people per year.[9] Despite this high frequency, there are limited data on the frequency with which specific bacteria are associated with these infections.

Impetigo is a skin infection that is ubiquitous worldwide. It occurs most frequently among economically disadvantaged children in tropical or subtropical regions, but also is common in northern climates during summer months, and all epidemics show this seasonal proclivity.[9] As well, the incidence of impetigo is highest in children younger than 5 years of age, followed by children 5 to 14 years of age; the incidence then decreases rapidly in those between 14 and 44 years of age, and is at a minimum among the elderly (> 65 years of age).

Erysipelas affects mostly adults in their 60s and 70s and involves the lower extremities in more than 80% of cases.[10] The incidence of lower-extremity cellulitis in Olmsted County, MN, was estimated at 2/1,000 people per year when both erysipelas and cellulitis affecting the leg were considered.[11] Predisposing factors are well identified for erysipelas or cellulitis of the leg, including disruption of the cutaneous barrier (leg ulcer, wound, toe-web intertrigo, pressure ulcer), lymphedema, chronic edema, or local surgical operations. Toe-web intertrigo appears to be the main portal of entry with or without dermatophytes being coincident. Lymphedema is a very strong risk factor, but any type of edema is both a risk factor and a consequence of the disease.[12,13] Other comorbidities, such as obesity or diabetes, and prior history of cellulitis are surprisingly less compelling as risk factors.

To date there are no consistent data on the prevalence or incidence of folliculitis and furunculosis in the community. However, there are reports of some individuals with repeated attacks of furunculosis. For most of these patients, the only identifiable predisposing factor is the carriage of *S. aureus* in the anterior nares. Twenty to forty percent of the general population harbors staphylococcal colonies in the nares.

Table 1. Clinical Findings of Skin Infections

Skin Infection	Clinical Findings
Cellulitis	Localized erythema, induration, warmth
Impetigo	Erythema, yellow or brown crusting; possible bullae
Erysipelas	Well-demarcated erythema with raised border, often facial; may have fever and systemic illness
Ecthyma	Erythema with dermal and epidermal erosions
Folliculitis	Papules, pustules associated with hair follicles
Furuncle	Erythema, fluctuence, pustules associated with hair follicles
Abscess	Erythema, warmth, fluctuance

Table 2. ALT-70 Prediction Tool for Lower Extremity Cellulitis

Factor	Score
Asymmetry: unilateral leg involvement	3
Leukocytosis: white blood cell count ≥ 10,000	2
Tachycardia: heart rate ≥ 90	2
Age ≥ 70 years	2
With an ALT-70 score of 0 to 2, the positive likelihood ratio (LR+) is 1.21 and the negative likelihood ratio (LR-) is 0.09. With an ALT-70 score of 5 to 7, the LR+ is 2.10 and the LR- is 0.55.	

There is literature on longitudinal outbreaks of furunculosis caused by MSSA as well as by MRSA.[21,14] Risk factors for outbreaks include being part of a small community (i.e., family groups) and other settings involving close personal contact (i.e., athletics), inadequate hygiene, and exposure to others having furuncles.

Researchers in Chicago looked at community-acquired (CA)-MRSA infections, which mainly manifested clinically as abscesses. These investigators identified risk factors including incarceration, African-American race/ethnicity, and residing in the close quarters of geocentric public housing complexes, and found an inverse correlation among the elderly residents of these urban settings.[15]

As noted above, outbreaks of epidemic furuncles due to CA-MRSA occur in young otherwise healthy people. In many U.S. cities, MRSA has become the most common pathogen isolated in the ED from patients with SSTIs.[16,20] Bacterial endocarditis in patients with CA-MRSA furunculosis has emerged as a complication, but unfortunately there are no large, community-based prospective studies to assess the risk of endocarditis from MRSA SSTIs.

Clinical Findings of Cellulitis

Of the common bacterial skin infections, impetigo is the most common in children worldwide. It consists of superficial, nonfollicular, discrete, purulent lesions that are caused by *S. aureus* or beta-hemolytic streptococci and may have a honey-crusted, pustular, or cornflake-like appearance.

Boils (furuncles) are infections of the hair follicle and often are caused by *S. aureus*. Therefore, they may have suppuration that extends to the deep dermis, where small abscess pockets can develop. Furuncles differ from folliculitis, which is more superficial as pus remains within the epidermis.

Erysipelas is an acute, superficial, non-necrotizing, dermal/deep dermal infection that is caused mainly by beta-hemolytic streptococci of group A, but also group B, C, and G, and rarely by staphylococci.[16] The clinical diagnosis is based on findings of sharply demarcated, shiny erythematous plaques that appear suddenly and are tender to the touch, with associated local swelling and fever.

Cellulitis is a skin infection that extends deeper into the subcutaneous tissues than erysipelas. These cellulitis infections may have associated regional lymphadenopathy and red streaking, and are more prone to local complications (abscess formation, necrosis) than is seen with erysipelas. With more of the skin loft (depth) involved, petechiae, ecchymoses, and bullae develop in the inflamed skin, which may result in a hemorrhagic appearance.[17] Bulla formation is a frequent local complication of the disease and may be indicative of greater severity of infection.

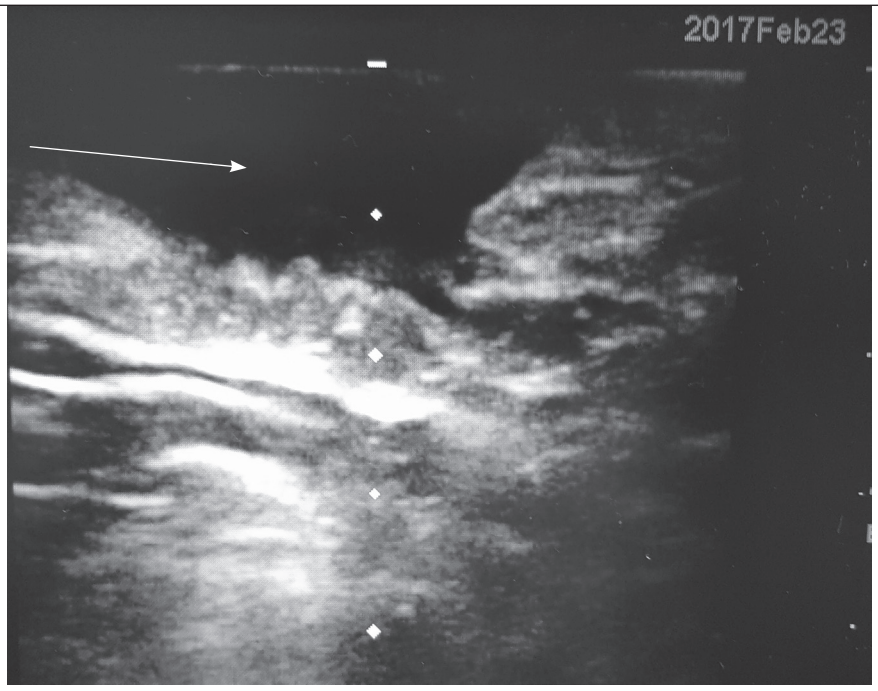
If untreated, these superficial SSTIs can lead to regional and systemic complications.Consider the presentation of the toxic adolescent patient describing what he perceives to be superficial severe skin pain overlying a limb but not involving a nearby joint. He explains that he plays hockey and a month ago sustained an injury to his knee area from an opponent's skate that cut through his knee pad. The wound hardly bled and healed by secondary intention without additional medical attention. On exam, the skin surface appears undamaged and completely normal, yet the slightest touch causes significant pain. This exam is consistent with pain out of proportion to the exam, and other etiologies should be considered, such as thrombophlebitis, osteomyelitis, or deep space infection. There are well-described cases of septic thrombophlebitis with acute osteomyelitis[19] and endocarditis that can complicate the aftermath of SSTIs.[18]

Other bacterial associations with skin infection include *Pasteurella multocida* following cat or dog bites, *Vibrio* species after salt water exposure, *Aeromonas hydophila* following immersion in fresh water, *Haemophilus influenzae* in periorbital cellulitis in children, or, rarely, epiglottitis in adults.

Table 3. LRINEC Prediction Tool for Necrotizing Fasciitis

Factor	Value	Score
Serum sodium	≥ 135 mEq/L	0
	< 135 mEq/L	2
Serum glucose	> 180 mg/dL	1
	≤ 180 mg/dL	0
Serum creatinine	> 1.6 mg/dL	2
	≤ 1.6 mg/dL	0
C-reactive protein	< 150	0
	≥ 150	4
Leukocyte count	< 15,000	0
	15,000 to 25,000	1
	> 25,000	2
Hemoglobin	> 13.5 g/dL	0
	11.0 to 13.5 g/dL	1
	< 11.0 g/dL	2

Figure 2. Ultrasonographic Appearance of Subcutaneous Abscess



Note sonographic appearance of fluid-filled sac (dark appearance).

As another example, natural disasters such as the massive tsunami that struck southern Thailand on December 26, 2004, provide perhaps the greatest experience in managing acute SSTIs following aquatic injuries. Soon after the wave decimated the coastline, Hiransuthikul et al reported acute SSTIs in 515 of 777 (66.3%) patients with crush injuries to the legs transferred to four regional referral hospitals in Bangkok.[19] Wounds and/or pus was cultured from 396 (76.9%) of these patients. The majority of specimens were polymicrobial (71.8%), and the most common organisms isolated were Gram-negative bacteria, including *Aeromonas* species (22.6%), *Escherichia coli* (18.1%), *Klebsiella pneumoniae* (14.5%), *Pseudomonas aeruginosa* (12.0%), and *Proteus* species (7.3%). Only 4.5% of the isolates were Gram-positive bacteria, most commonly staphylococcal species.[19]

Another group of investigators reported on a subset of European tsunami survivors who developed late-onset (median 60 days) chronic post-traumatic SSTI caused by rapidly growing marine mycobacteria.[20] These infections occurred in undamaged skin located near sutured traumatic wounds or skin grafts. These patients required antimycobacterial therapy, and healing was protracted, occurring within a year in most cases.

The forgoing cases demonstrate that a history of injury should be elicited from the patient, and the possibility of interval healing must be considered. Emergency physicians need to think about the possibility of a retained foreign body, slow-growing organisms, and the potential for deeper tissue contamination dating back to an index event even a year out. As well, the emerging problem of CA-MRSA, which is responsible for fully half of the cases of cellulitis with purulent exudates, also causes infections in patients lacking typical risk factors (hospitalization, long-term care factors).[21]

Necrotizing fasciitis represents a severe soft tissue infection with associated high morbidity and mortality.[22] Risk factors include diabetes mellitus, injection drug use, hypertension, and obesity. Necrotizing fasciitis may present with significant pain, erythema, ecchymosis, purulence, and/or crepitus caused by subcutaneous air. Systemic signs of sepsis may be present. The most commonly infected sites include the perineum, lower limbs, upper limbs, and axillary region.[23]

Prompt recognition of necrotizing fasciitis is essential to ensure timely administration of broad-spectrum antibiotics and surgical debridement.[24]

Figure 3. A Patient With a History of Injection Drug Use Presented With Forearm Pain and Redness

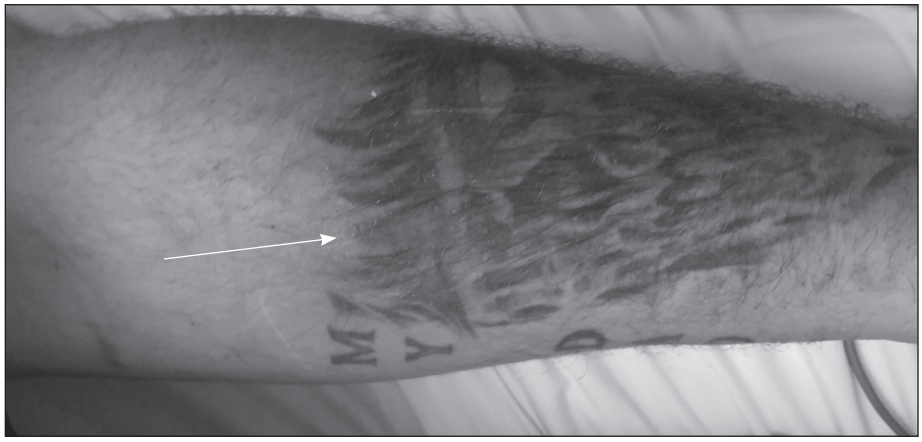
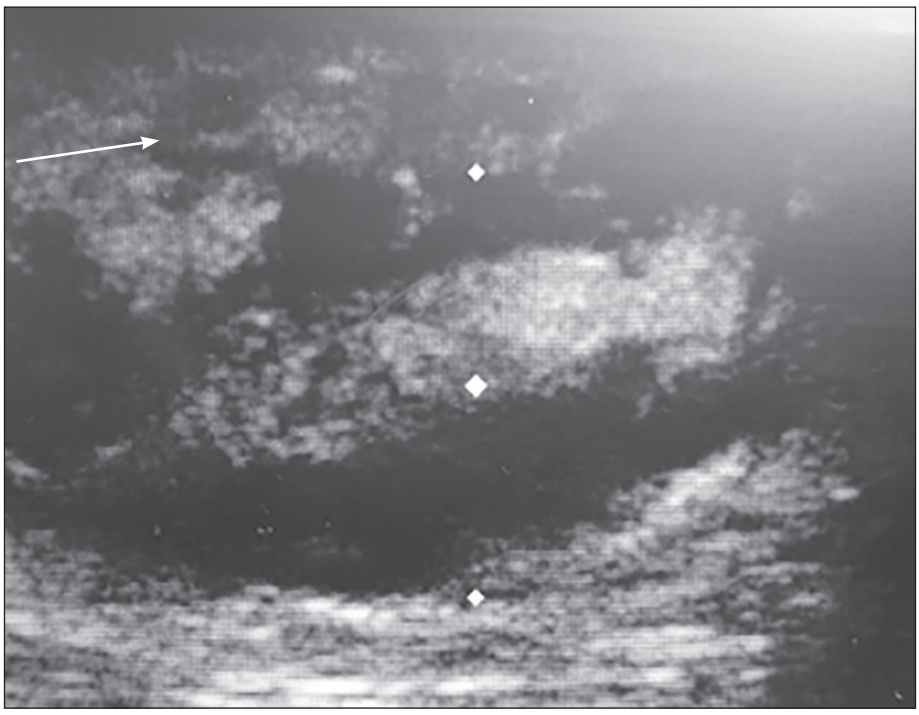


Figure 4. Bedside Ultrasound Appearance of Cellulitis Demonstrating "Cobblestoning" Appearance of Subcutaneous Edema



Several studies have identified predictors of mortality, which may include advanced age, female gender, signs of sepsis or septic shock, obesity, diabetes, chronic heart disease, cirrhosis, skin necrosis, tachycardia, serum creatinine, hypertension, multifocal infection, severe peripheral vascular disease, hospital-acquired infection, and polymicrobial or Gram-negative infections.[25,26,27,28]

Diagnostic Tests

SSTIs are diagnosed primarily by clinical findings. Cellulitis typically is a clinical diagnosis, supported by the clinical findings of erythema, warmth, edema, and pain. An abscess is supported by the findings of localized erythema, swelling, and fluctuance. Unilateral findings are most suggestive of cellulitis as compared to venous stasis, which often is bilateral.

Individual laboratory tests have limited value in establishing the diagnosis of cellulitis. Multifactorial prediction tools incorporating laboratory tests may be more useful. Such prediction tools have been developed for lower extremity cellulitis and necrotizing fasciitis.

Researchers recently developed a diagnostic prediction tool for lower extremity cellulitis from 259 patients admitted from the ED for presumed cellulitis.[29] (*See Table 2.*) Ultimately, 180 (69.5%) of the patients were diagnosed with cellulitis, while 79 (30.5%) were diagnosed with other disorders, termed pseudocellulitis. The derived decision tool, named ALT-70, had a score range from 0 to 7. The higher the score, the more likely the patient had cellulitis. The authors divided the patients into three categories based on the score, along with a recommended course of action. Patients with a score of 0 to 2 had a negative predictive value of 83%, so the recommended course of action was reassess. Patients with scores of 3 and 4 had indeterminant predictive values, so the recommended course of action was to consult a specialist, such a dermatologist, who could perform skin biopsy and other tests. Patients with scores of 5 to 7 had a positive predictive value > 82%, so the recommended course of action was to treat for cellulitis with antibiotics.

Elevated C-reactive protein (CRP) levels may be seen in necrotizing fasciitis.[30] The Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) is a score that may be used to identify patients at higher risk for necrotizing fasciitis. The LRINEC is comprised of serum sodium, glucose, creatinine, CRP, leukocyte count, and hemoglobin.[31] LRINEC scores range from 0 to 13, with higher scores associated with increased risk of necrotizing fasciitis. The authors who developed the score proposed threshold values of 6 for moderate (50% to 75%) risk of necrotizing fasciitis and a score 8 for high (> 75%) risk of necrotizing fasciitis. (*See Table 3.*)

A systematic review of 16 studies with a total of 846 patients found the mean LRINEC score was 6.06 for patients with necrotizing fasciitis and 2.45 for patients without.[31] The receiver operating characteristic (ROC) curve

was calculated using LRINEC scores; the fitted ROC area was 0.927, indicating the LRINEC was an excellent test to discriminate patients with necrotizing fasciitis from those without.

The LRINEC has been criticized as lacking adequate sensitivity for excluding patients with low scores. Both prospective and retrospective studies have found that about 20% to 30% of patients with necrotizing fasciitis will have LRINEC scores of 5 or less.[31,32]

Blood cultures have a low rate of positivity, a low rate of impact on clinical decision making, and a high false-positive rate, and are not recommended routinely for the treatment of cellulitis, even in febrile patients.[33,34,35,36,37] Similarly, cultures of the soft tissues are low yield and of limited usefulness in clinical decision making.[38,39]

Several recent studies have demonstrated the utility of bedside ultrasound in clinical decision making, with findings that may result in a change in management.[40,41] Ultrasound is of value in differentiating cellulitis from abscess.[42,43] (*See Figures 2 and 4.*) Ultrasound also may be of particular use in the evaluation of hand infections[44] and may help to identify foreign bodies. Sonographic evidence of necrotizing fasciitis may include subcutaneous air, abscess, edematous soft tissues, and/or muscle necrosis.[45]

Computed tomography (CT) or magnetic resonance imaging (MRI) may be indicated for anatomic areas of concern for vascular or other anatomic involvement, such as the face, neck, pelvis, or perineum, or if necrotizing fasciitis or other deep space infection is suspected.[46,47,48]

Plain radiographs are of limited utility unless there is a history of trauma.[49] Plain radiographs may be used to screen for radiopaque foreign bodies, osteomyelitis, or soft tissue gas suggestive of suspected deep space necrotizing infections. However, radiographs lack sufficient sensitivity to be the sole test for any of these conditions.

Differential Diagnosis

Several conditions may mimic cellulitis. Venous stasis may present with edema and erythema, but most commonly is bilateral and may be associated with chronic skin changes, such

Figure 5. Computed Tomography Confirming the Diagnosis of Cellulitis

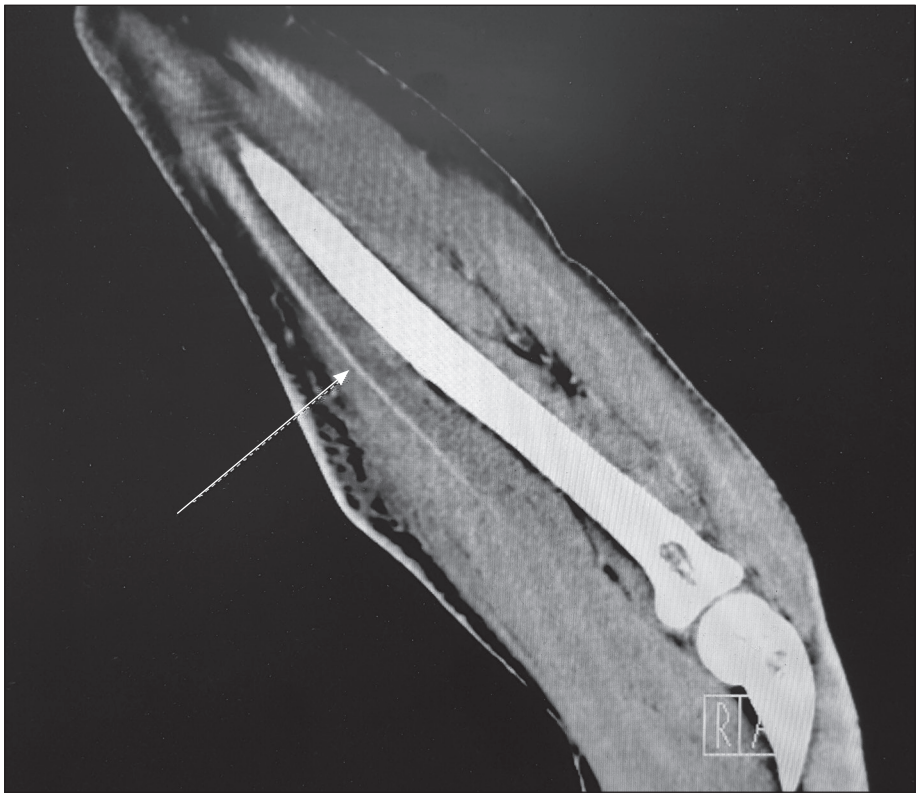


Table 4. Empiric Treatment of Skin and Soft Tissue Infections

Conditions	Suggested Antibiotic	Duration of Therapy
Purulent cellulitis	Clindamycin, trimethoprim-sulfamethoxazole, doxycycline, minocycline, or linezolid	5-10 days
Nonpurulent cellulitis	Clindamycin or linezolid, or combination therapy with doxycycline or minocycline, plus a beta-lactam, such as amoxicillin-clavulanate	5-10 days
Complicated cellulitis in hospitalized patients	Intravenous vancomycin, oral or intravenous linezolid, intravenous daptomycin, intravenous telavancin, or intravenous or oral clindamycin	7-10 days
Impetigo	Topical mupirocin or retapamulin, or oral therapy to include dicloxacillin or cephalexin	5 days
Ecthyma	Dicloxacillin or cephalexin	7 days
Necrotizing fasciitis	Vancomycin or linezolid plus piperacillin-tazobactam or a carbapenem Alternatives may include ceftolozane-tazobactam, ceftazidime-avibactam in association with an anti-anaerobic agent (metronidazole or clindamycin)	

Table 5. Antibiotic Doses for Outpatient Treatment

Drug	Adult Dose	Pediatric Dose	Comments
Penicillin VK	250-500 mg QID PO	25-75 mg/kg per day in 4 divided doses PO	For nonpurulent cellulitis
Amoxicillin-clavulanate	875/125 mg BID PO	25 mg/kg per day of the amoxicillin component in 2 divided doses PO	For nonpurulent cellulitis and impetigo
Cephalexin	250-500 mg QID PO	25-50 mg/kg per day in 4 divided doses PO	Use in penicillin-allergic patients except those with immediate hypersensitivity reactions
Dicloxacillin	250-500 mg QID PO	25-50 mg/kg per day in 4 divided doses PO	Agent of choice in adults with methicillin-susceptible *Staphylococcus aureus* (MSSA)
Clindamycin	300-450 mg QID PO	25-30 mg/kg per day in 3 divided doses PO	Important option for methicillin-resistant *Staphylococcus aureus* (MRSA) treatment children
Doxycycline	200 mg once PO, followed by 100 mg BID PO	Not recommended for age < 8 years	Limited recent clinical experience
Minocycline	200 mg once PO, followed by 100 mg BID PO	Not recommended for age < 8 years	Limited recent clinical experience
Trimethoprim-sulfamethoxazole	1-2 double strength (DS) tablets BID PO Each tablet 800 mg trimethoprim and 160 mg sulfamethoxazole	8-12 mg/kg per day based on trimethoprim component in 2 divided doses PO	For purulent cellulitis
Linezolid	600 mg BID PO	< 5 years old: 30 mg/kg per day in 3 divided doses PO 5-11 years old: 20 mg/kg per day in 2 divided doses PO ≥ 12 years old: 600 mg BID PO	Use for MRSA and complicated purulent skin infection Retail price for 600 mg # 28 tablets about $3,000-4,000, but significant discounts available
Mupirocin 2% ointment	Apply to lesions BID	Apply to lesions BID	Retail price for 22 gram tube about $52
Retapamulin 1% ointment	Apply to lesions BID	Apply to lesions BID	Retail price for 15 gram tube about $250

as hyperpigmentation, lichenification, or ulcerations. Deep venous thrombosis may present with unilateral pain, swelling, and erythema, and may be differentiated from cellulitis by ultrasonography of the lower extremities. An abscess may be distinguished from cellulitis by ultrasonographic appearance.

Empiric Treatment

Empiric treatment is indicated for cellulitis, as the precise pathogen rarely is known in the ED setting. Tetanus immunization should be updated if not current.

Guidelines from the Infectious Diseases Society of America may be used to guide empiric therapy. (*See Table 4.*) Purulent cellulitis should be treated with 5-10 days of antibiotics, such as clindamycin, trimethoprim-sulfamethoxazole, doxycycline, minocycline, or linezolid, to cover MRSA. Nonpurulent cellulitis should be treated with 5-10 days of antibiotics, such as clindamycin, trimethoprim-sulfamethoxazole, or linezolid, or combination therapy with doxycycline or minocycline, plus a beta-lactam/beta-lactamase inhibitor combination such as amoxicillin/clavulanate, to cover beta-hemolytic streptococci.[50] Oral therapy is as efficacious as intravenous therapy for uncomplicated cellulitis.[51] (*See Table 5.*)

Risk factors for failure of outpatient therapy include fever, chronic leg ulcers, chronic edema or lymphedema, prior cellulitis in the same area, and cellulitis of a wound site.[52]

Complicated cellulitis in hospitalized patients should be treated with broad-spectrum antibiotics, including empiric therapy for MRSA. Antibiotic choices may include intravenous vancomycin, oral or intravenous linezolid, intravenous daptomycin, intravenous telavancin, or intravenous or oral clindamycin. Therapy should be given for 7 to 14 days.[53]

Recurrent infections should be managed with appropriate antibiotic therapy, as well as environmental management, including frequent hand washing, covering wounds, and environmental hygiene of household surfaces. For patients with recurrent infections despite appropriate therapy and environmental hygiene, decolonization may be considered with a regimen including nasal mupirocin and a topical antiseptic solution, such as chlorhexidine or dilute household bleach.

Impetigo should be treated with topical mupirocin or retapamulin, or with oral therapy to include dicloxacillin or cephalexin. Similarly, ecthyma may be treated with oral therapy, such as dicloxacillin or cephalexin.[53]

If necrotizing fasciitis is suspected, prompt administration of

broad-spectrum antibiotics and surgical consultation for emergent debridement are indicated.[54] Antibiotic regimens may include vancomycin or linezolid plus piperacillin-tazobactam or a carbapenem.[53] Alternatives may include ceftolozane-tazobactam, ceftazidime-avibactam in association with an anti-anaerobic agent (metronidazole or clindamycin). Other newer treatment alternatives may include ceftaroline, ceftobiprole, oritavancin, or dalbavancin.[55]

Disposition

Disposition of patients with cellulitis should be determined based on severity of disease, presence of systemic symptoms, ability to ambulate, ability to care for self, and ability to comply with outpatient medical therapy and follow-up. Uncomplicated cellulitis may be treated with outpatient oral antibiotic therapy. Complicated or severe infections require inpatient parenteral therapy. Outpatient parenteral therapy may be considered for select cases.[56,57] For patients requiring a single dose of intravenous therapy, this may be given in the ED or observation unit, followed by outpatient antibiotics.[58]

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CME/CE Objectives

Upon completion of this educational activity, participants should be able to:

- recognize specific conditions in patients presenting to the emergency department;
- apply state-of-the-art diagnostic and therapeutic techniques to patients with the particular medical problems discussed in the publication;
- discuss the differential diagnosis of the particular medical problems discussed in the publication;
- explain both the likely and rare complications that may be associated with the particular medical problems discussed in the publication.

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CME/CE Questions

1. A 26-year-old zookeeper presents with concern for a progressive skin infection he says began after cleaning cat cages yesterday. The patient has a low-grade fever. His left lower leg is erythematous, tender, and warm. There is serosanguinous drainage and fat is exposed at the base of 2.0 x 0.5 cm deep wound. What skin disorder does this presentation describe?
   a. Cellulitis
   b. Erysipelas
   c. Furunculosis
   d. Impetigo
   e. Psoriasis
2. In addition to antibiotics, what other measures should be taken to treat non-necrotizing cellulitis?
   a. Incision and debridement where indicated
   b. Abscess localization and drainage assisted by ultrasound
   c. Wound elevation and immobilization
   d. Tetanus booster if last booster was more than five years ago
   e. All of the above
3. Pseudocellulitic states can mimic cellulitis, making diagnosis challenging. What feature often helps to distinguish the two?
   a. History of chemotherapy and widespread rash
   b. Bilateral vs. unilateral limb involvement
   c. Dependent edema vs. lymphedema
   d. Evidence of venous insufficiency and stasis
   e. History of insect bites and finding of focal erythema
4. Methicillin-resistant *Staphylococcus aureus* is a serious condition in a healthcare setting because:
   a. it is resistant to first- and second-line antibiotics.
   b. it is acquired in hospitals and community settings.
   c. it occurs in otherwise healthy young people who may be carriers.
   d. carriers may exhibit variable contagious patterns.
   e. All of the above
5. Which of the following is true regarding community-acquired MRSA (CA-MRSA)?
   a. It is the most common pathogen isolated in U.S. EDs from patients with skin and soft tissue infections.
   b. The prevalence of MRSA causing skin and soft tissue infections leading to endocarditis is well-known.
   c. It is responsible for 50% of the cases of cellulitis with purulent exudates that respond to non-beta-lactam antibiotics, including trimethoprim-sulfamethoxazole, vancomycin, and clindamycin.
   d. Both a and c only
   e. All of the above
6. All of the following are components of the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) *except*:
   a. creatinine.
   b. C-reactive protein.
   c. erythrocyte sedimentation rate.
   d. glucose.
   e. sodium.
7. Which diagnostic test is most accurate for differentiating abscess from cellulitis?
   a. C-reactive protein
   b. Erythrocyte sedimentation rate

CME/CE INSTRUCTIONS

To earn credit for this activity, please follow these instructions:

1. Read and study the activity, using the references for further research.
2. Log onto AHCMedia.com and click on My Account. *First-time users must register on the site.*
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c. Plain radiography
d. Ultrasound
e. White blood cell count

8. All of the following are acceptable empiric agents for single-agent outpatient treatment of uncomplicated cellulitis *except*:
   a. amoxicillin.
   b. clindamycin.
   c. linezolid.
   d. trimethoprim-sulfamethoxazole.
9. What is the typical ultrasonographic appearance of cellulitis?
   a. Cobblestoning
   b. Decreased Doppler flow
   c. Decreased echogenicity of subcutaneous tissue
   d. Decreased attenuation of muscle
   e. Fluid-filled cavity
10. Which type of soft tissue infection has the highest morbidity and mortality?
    a. Necrotizing fasciitis
    b. Purulent cellulitis
    c. Purulent myositis
    d. Subcutaneous abscess

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Skin and Soft Tissue Infections

Clinical Findings of Skin Infections

Skin Infection	Clinical Findings
Cellulitis	Localized erythema, induration, warmth
Impetigo	Erythema, yellow or brown crusting; possible bullae
Erysipelas	Well-demarcated erythema with raised border, often facial; may have fever and systemic illness
Ecthyma	Erythema with dermal and epidermal erosions
Folliculitis	Papules, pustules associated with hair follicles
Furuncle	Erythema, fluctuence, pustules associated with hair follicles
Abscess	Erythema, warmth, fluctuance

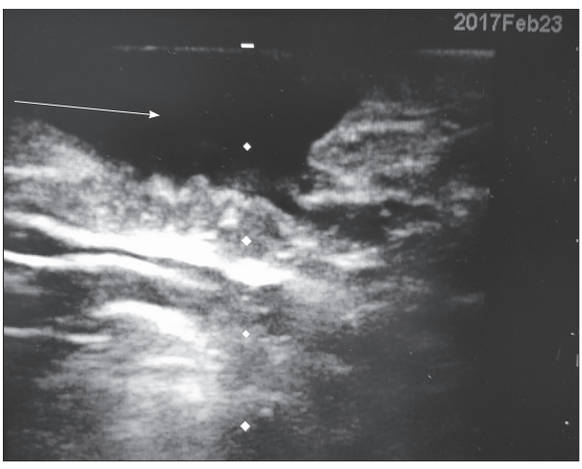
ALT-70 Prediction Tool for Lower Extremity Cellulitis

Factor	Score
Asymmetry: unilateral leg involvement	3
Leukocytosis: white blood cell count ≥ 10,000	2
Tachycardia: heart rate ≥ 90	2
Age ≥ 70 years	2
With an ALT-70 score of 0 to 2, the positive likelihood ratio (LR+) is 1.21 and the negative likelihood ratio (LR-) is 0.09. With an ALT-70 score of 5 to 7, the LR+ is 2.10 and the LR- is 0.55.	

LRINEC Prediction Tool for Necrotizing Fasciitis

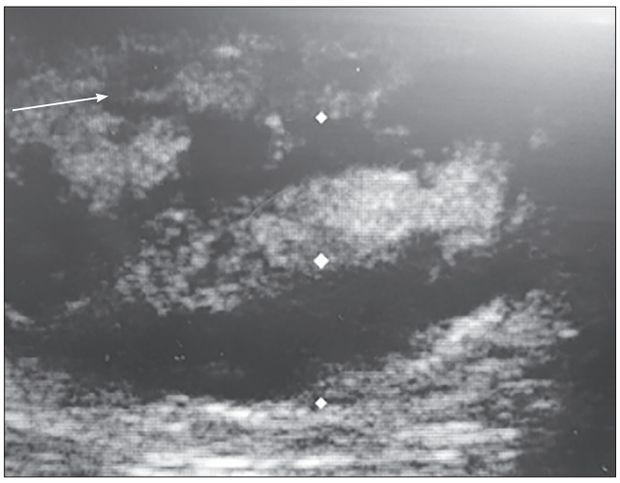
Factor	Value	Score
Serum sodium	≥ 135 mEq/L	0
	< 135 mEq/L	2
Serum glucose	> 180 mg/dL	1
	≤ 180 mg/dL	0
Serum creatinine	> 1.6 mg/dL	2
	≤ 1.6 mg/dL	0
C-reactive protein	< 150	0
	≥ 150	4
Leukocyte count	< 15,000	0
	15,000 to 25,000	1
	> 25,000	2
Hemoglobin	> 13.5 g/dL	0
	11.0 to 13.5 g/dL	1
	< 11.0 g/dL	2

Ultrasonographic Appearance of Subcutaneous Abscess

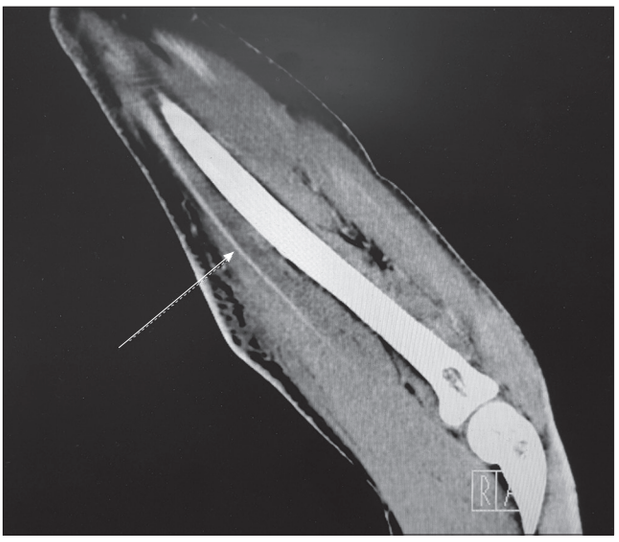


Note sonographic appearance of fluid-filled sac (dark appearance).

Bedside Ultrasound Appearance of Cellulitis Demonstrating "Cobblestoning" Appearance of Subcutaneous Edema



Computed Tomography Confirming the Diagnosis of Cellulitis



Empiric Treatment of Skin and Soft Tissue Infections

Conditions	Suggested Antibiotic	Duration of Therapy
Purulent cellulitis	Clindamycin, trimethoprim-sulfamethoxazole, doxycycline, minocycline, or linezolid	5-10 days
Nonpurulent cellulitis	Clindamycin or linezolid, or combination therapy with doxycycline or minocycline, plus a beta-lactam, such as amoxicillin-clavulanate	5-10 days
Complicated cellulitis in hospitalized patients	Intravenous vancomycin, oral or intravenous linezolid, intravenous daptomycin, intravenous telavancin, or intravenous or oral clindamycin	7-10 days
Impetigo	Topical mupirocin or retapamulin, or oral therapy to include dicloxacillin or cephalexin	5 days
Ecthyma	Dicloxacillin or cephalexin	7 days
Necrotizing fasciitis	Vancomycin or linezolid plus piperacillin-tazobactam or a carbapenem Alternatives may include ceftolozane-tazobactam, ceftazidime-avibactam in association with an anti-anaerobic agent (metronidazole or clindamycin)	

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