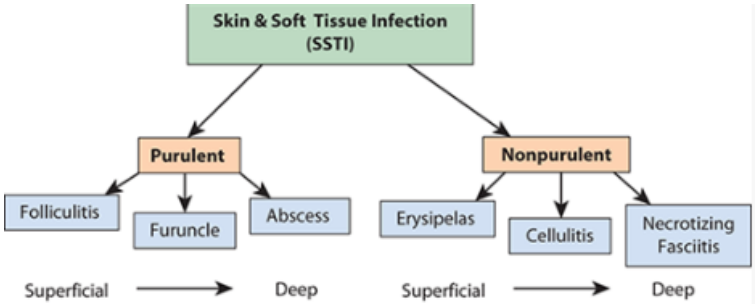
Skin and Soft Tissue Infection (SSTI) Guideline

Definition:

The term skin and soft tissue infection (SSTI) includes a heterogeneous group of infections including cellulitis, cutaneous abscess, and necrotizing soft tissue infections. The symptoms and signs for the different forms of skin and soft tissue infection overlap making an accurate diagnosis challenging. These infections can be classified based on three characteristics. First soft tissue infections should be classified as to whether they are purulent or nonpurulent. As shown below, purulent infections include folliculitis, furunculosis, and skin abscesses and nonpurulent infections include erysipelas, cellulitis, and necrotizing fasciitis. Second they should be classified with regards to the depth of the infection. The more superficial infections include impetigo, erysipelas, and folliculitis. These primarily are caused by *S. aureus* or beta-hemolytic *Streptococci* and rarely require hospitalization as they often respond to local/topical measures. As these infections penetrate deeper, they may become cellulitis, furunculosis (associated with hair follicles), hidradenitis (associated with sweat glands), and skin abscesses. Third, these infections should be classified based on the severity of illness.[29]



Source: Frederick S. Southwick: Infectious Diseases: A Clinical Short Course, 4e Copyright McGraw-Hill Education.

Type of SSTI	Definition	Examples
Purulent	Fluctuant tender red nodule, actively draining pus, evidence of fluid collection surrounded by rim of erythematous swelling, phlegmon	Furuncle, folliculitis, abscess
Non-Purulent	Infection of the skin and underlying soft tissue associated with erythema, swelling, tenderness, warmth and absence of focus of purulence/abscess	Cellulitis (not well-demarcated) or erysipelas (well-demarcated)

Incidence:

In the pediatric population, a 2006 study shows there were 48,228 ± 2,223 admissions for SSTI, which represented 1.77% of all pediatric hospitalizations and corresponded to a rate of 62.7 SSTI hospitalizations per 100,000 children per year. [26] A second study utilizing a large United States population database indicated cellulitis plus abscess was the most common dermatologic diagnosis for children in the Emergency Department representing 39.9% of dermatologic complaints, which was almost four times higher than the next diagnosis of unspecified urticaria. Cellulitis plus abscess was the most common dermatological diagnosis at 39.9%, which was almost four times higher than the next most common diagnosis of unspecified urticaria.[28]

Etiology:

Cellulitis, abscess, or both are among the most common skin and soft tissue infections. Predisposing factors associated with risk of cellulitis and/or skin abscess include: [13-22]

- Skin barrier disruption due to trauma (such as abrasion, penetrating wound, pressure ulcer, venous leg ulcer, insect bite, injection drug use)
- Skin inflammation (such as eczema, radiation therapy, psoriasis)
- Edema due to impaired lymphatic drainage
- Edema due to venous insufficiency
- Obesity
- Immunosuppression (such as diabetes, chronic steroid or biologic use, malignancy)
- Skin breaks between the toes ("toe web intertrigo"); these may be clinically inapparent
- Pre-existing skin infection (such as tinea pedis, impetigo, varicella)

Differential Diagnosis:

Several noninfectious conditions can be confused with cellulitis.

- contact dermatitis
- local allergic skin reaction
- erythema nodosum
- trauma-related inflammation
- deep vein thrombosis
- nonspecific dermatitis
- thrombophlebitis
- venous stasis dermatitis

Guideline Inclusion Criteria:

All immunocompetent children > 59 days of age with suspected skin and soft tissue infection.

Guideline Exclusion Criteria:

Children younger than 59 days of age or over 18 years old.

- necrotizing fasciitis
- immunocompromised
- sepsis
- post operative wound infection
- animal bite
- osteomyelitis
- septic arthritis

- perianal/perirectal cellulitis/abscess
- periorbital/orbital cellulitis
- breast abscess
- pilonidal abscess
- dental abscess
- deep neck infection
- cervical lymphadenitis
- chronic or recurrent cellulitis/abscess at same site
- pressure ulcer

Diagnostic Evaluation:

The diagnosis of cellulitis, erysipelas, and skin abscess is usually based upon clinical manifestations. Cellulitis and erysipelas manifest as areas of skin erythema, edema, induration, tenderness and warmth. Erysipelas lesions are raised above the level of surrounding skin with clear demarcation between involved and uninvolved tissue. A skin abscess manifests as a painful, fluctuant, erythematous nodule, with or without surrounding cellulitis.

Critical Points of Evidence

Evidence Supports

Diagnosis for Purulent SSTI

- Ultrasound can improve diagnostic accuracy in cases of indeterminate clinical assessment. (42-46)

Treatment for Purulent SSTIs

- Gram stain and culture of pus from carbuncles and abscesses are recommended, but treatment without these labs is reasonable in typical cases *(strong, moderate)*.(25)
- Incision and drainage is the recommended treatment for inflamed epidermoid cysts, carbuncles, abscesses, and large furuncles *(strong, high)*.(25)
- Loop Drainage Technique has proven safe and effective in the treatment of subcutaneous abscesses in children in all anatomical locations. These findings eliminate the need for repetitive wound packing and simplify postoperative wound care.(34) The loop drain prevents skin closure prematurely and allows time for proper drainage, which is an essential component of abscess treatment. McNamara et al. suggest improved cosmesis with the loop drain over open incision and drainage.(35-39)
    - Packing of drained abscess cavities is not supported in the literature for abscesses < 5 cm.(40)
    - Loop Drainage Technique (LDT) is associated with a lower failure rate than CID (Conventional Incision and Drain). Given the potential for less pain, decreased scarring, and lower associated healthcare costs, this technique should be considered for the treatment of skin and soft tissue abscesses in the ED setting.(32,35-39)
- The decision to administer antibiotics directed against S. aureus as an adjunct to incision and drainage should be made based upon presence or absence of systemic inflammatory response syndrome (SIRS), such as temperature >38°C or <36°C, tachypnea >24 breaths per minute, tachycardia >90 beats per minute, or white blood cell count >12 000 or <400 cells/µL *(strong, low)*.(25)
- An antibiotic active against MRSA is recommended for patients with carbuncles or abscesses who have failed initial antibiotic treatment or have markedly impaired host defenses or in patients with SIRS and hypotension *(strong, low)*.(25)

Cellulitis

- Cultures of blood or cutaneous aspirates, biopsies, or swabs are not routinely recommended *(strong, moderate)*.(25)

Evidence Lacking/Inconclusive

Decolonization

- Limited data proving efficacy of preventing future SSTI's in healthy people using decolonization procedures with methods such as nasal mupirocin or chlorhexidine/diluted bleach baths.[24]

Evidence Against

- Needle aspiration used infrequently and generally is not recommended for simple cutaneous skin and soft tissue abscesses. This technique is not reliable for obtaining any purulent material despite ultrasound guidance and, in general, is not a recommended treatment option.[31]

- Routine ultrasound for abscess diagnosis if clinical exam is clear. [42-46]

- Routine blood cultures are not useful in immunocompetent children with uncomplicated SSTIs. Consider in infants < 2mo or systemically ill children. [47-52]

Practice Recommendations and Clinical Management

Diagnosis:

Cellulitis is a spreading bacterial infection of the skin and underlying soft tissue characterized by redness, pain, tenderness, erythema, edema and warmth with relatively sudden onset. These symptoms are caused both by the bacteria themselves and by the body's attempts to fight the infection. The infected skin becomes hot and swollen and may look slightly pitted, like an orange peel. Fluid-filled blisters, which may be small (vesicles) or large (bullae), sometimes appear on the infected skin. The borders of the affected area are not distinct.

It is generally caused by streptococci or staphylococci and usually occurs around open wounds and in pus-filled pockets (skin abscesses). However, many other bacteria can cause cellulitis. Children presenting with cellulitis might feel mildly ill. Some may have fever, chills, rapid heart rate, headache, low blood pressure and confusion, which usually indicates a severe infection. As the bacterial infection spreads, nearby lymph nodes may become enlarged and tender, and the lymphatic vessels may become inflamed.

It is important to assess whether the patient has nonpurulent cellulitis, in which there is no evidence of fluid collection, phlegmon or abscess OR purulent cellulitis in which there is evidence of a fluid collection, phlegmon, or abscess associated with the cellulitis.

Clinical Comorbidities:

- Many studies support the relationship between AD and other atopic disorders such as asthma, allergic rhinitis and food allergies.

Infectious Complications:

- Increased risk of superinfection due to staphylococcus aureus, streptococcus and HSV.

Risk Factors:

- FLG gene mutations
- Family history of atopic disease

Laboratory Testing

In patients with cellulitis, blood cultures are positive in less than 5% of cases and thus not routinely recommended. Blood cultures are recommended in:

- patients with systemic signs of infection/severely ill patients
- immunocompromised or neutropenic patients
- patients with certain exposures (for example, salt water leading to possible Vibrio infection).[27, 47-52]

Laboratory testing is not required for patients with uncomplicated infection in the absence of comorbidities or complications.

Imaging
Radiographic examination can be useful to determine whether a skin abscess is present (via ultrasonography) if diagnosis is not clear, and for distinguishing cellulitis from osteomyelitis.

Antibiotic Therapy:
Etiology and Local Susceptibilities (DCMC FY19):
Most non-purulent cellulitis is caused by *Streptococcus* species (mainly Group A *Streptococcus*). These isolates continue to retain excellent (~100%) susceptibilities to cefazolin. Purulent cellulitis may be caused by a variety of pathogens with *Staphylococcus aureus* and Group A *Streptococcus* as leading etiologies. In a local retrospective review of 75 isolates recovered from drainage of purulent cellulitis from 2019-2020, the leading pathogens were: MSSA (43%), MRSA (33%), and Group A *Streptococcus* (13%). Of note, clindamycin resistance rates have been increasing both locally and nationally for *Staphylococcus aureus* isolates. At DCMC, clindamycin susceptibilities are at 79% for MRSA isolates and 83% for MSSA isolates.

	Percent Susceptible	
Antibiotic	**MSSA**	**MRSA**
Cefazolin	100	N/A
Clindamycin	83	79
TMP-SMX	98	94
Doxycycline	96	94
Vancomycin	100	100

Non-purulent:
Non-purulent cellulitis without systemic signs of infection should receive an antimicrobial agent that is active against streptococci.[1] First-generation cephalosporins (cefazolin or cephalexin) should be used as first-line treatment empiric and definitive in patients with non-purulent cellulitis.[1,2] *(strong, moderate)* The addition of an MRSA-active agent to cephalexin does not improve clinical outcomes and is not recommended.[3,4] *(strong, high)* Sulfamethoxazole-trimethoprim should not be used if streptococcal infection is suspected due to inadequate coverage.[2] The recommended duration of antimicrobial therapy for non-purulent cellulitis is 5 days, but treatment should be extended if the infection has not improved within this time period.[1,5] *(weak, high)*

Purulent:

Antimicrobials active against *Staphylococcus aureus* should be used.[1]

For well drained abscesses without overlying cellulitis or systemic symptoms present, antibiotics are not recommended if there is no overlying cellulitis or systemic symptoms.[1,6] *(strong, moderate)*

For purulent cellulitis that has been successfully drained with overlying cellulitis or systemic symptoms, sulfamethoxazole-trimethoprim should be used as first-line treatment.[6-10] *(weak, moderate)* Clindamycin and doxycycline (≥8 years only) are alternatives to , sulfamethoxazole-trimethoprim.[9,11] *(strong, moderate)*
Of note, caution should be used if clindamycin is used without confirming susceptibilities, due to increasing clindamycin resistance in S. aureus isolates at DCMC. Consider IV vancomycin if toxic or ill-appearing, worsening clinical status, or concern for progression.

Whenever available, culture results should be used to guide definitive therapy.[1] If treating MSSA, oral cephalexin should be used as first-line treatment.[11,12] *(strong, high)* For these infections, the recommended duration of antimicrobial therapy for purulent cellulitis is </=5-7 days status post incision and drainage. [1, 5, 6, 8, 13] *(strong, moderate)*

Failure of Initial Outpatient Antibiotics:

After failure of initial outpatient antibiotics (defined as lack of improvement after 48 hours of appropriate antibiotics or new fluctuance or fever at any time), evaluation should include review of past cultures, antibiotic selection and dosing, and evaluation for underlying condition such as evolving abscess, bone/joint infection, foreign body, pyomyositis, etc. It may be appropriate to use the same antibiotic if the reason for failure is identified as lack of source control (i.e., inadequate drainage, evolving abscess) if the pathogen is known.

Literature Table

See Addendum 1: Guideline for SSTI Antibiotic Selection and Dosing

Incision and Drainage

Patients with drainable abscess should undergo incision and drainage. Routine culture of debrided material is not necessary in healthy patients who do not receive antibiotics. Proper drainage of abscess fluid or other focal infections is the mainstay of therapy. Incision and drainage alone is highly effective for the treatment of most uncomplicated cutaneous abscesses. Vessel loop drainage technique is often used.

If there is uncertainty regarding evolution to abscess in a current cellulitis, ultrasound is recommended to confirm the fluid collection, determine its size and nature (e.g., loculations), and locate any possible surrounding vascular structures or foreign bodies.

Pain Management

Pain control during I&D is a major issue, as this is a very painful procedure. One study identified abscess I&D as the second most painful ED procedure — second only to nasal intubation.[(30)] In children, procedural sedation

should be considered in addition to local/regional anesthetics. Appropriate sedation will ensure pain and anxiety control, facilitating proper exploration and drainage of the abscess by the practitioner performing the procedure.

Wound care[41]

The goals of wound care after surgical intervention are:

Let the wound heal rapidly without infection or complication
Let the affected area return to the best level of function and appearance

General wound care instructions following vessel loop drainage include submersion soaks in the bathtub twice a day with warm to hot water to bring warmth to the site. Also it includes washing the area with mild soap and water to allow the area of the loop to continue to provide a tract for drainage to the site.

Education should be provided for patients and their families regarding the transmissibility of S. aureus, particularly through contact with open wounds and contaminated surfaces. Patients should be encouraged to adopt enhanced hygiene practices, including regular bathing and frequent hand washing with soap and water or alcohol-based hand sanitizers. Patients and their contacts should avoid sharing personal hygiene items (e.g., towels or other items that come into contact with the skin).

Patients should watch for signs of cellulitis or recollection of pus. The wound should be kept clean, dry, and covered outside of the timing of soaks or washing.

Follow-up care will include as needed surgical follow up for removal of the vessel loop if it was used.

Admission Criteria

- Systemic symptoms or severe disease
  - ill-appearing, hemodynamic instability, immunocompromised, concern for necrotizing infection, significant fever, concern for sepsis
- Rapidly expanding or large lesion (>3cm; significant cellulitis despite abscess drainage)
- Age <2 months
- Concern for inadequate drainage of large abscess
- Abscess location that requires subspecialty consult
- Unable to tolerate oral antibiotics, poor compliance or previous failure of outpatient treatment (failure defined as a lack of improvement after 48 hours of appropriate antibiotics or new fluctuance or fever at any time)
- Significant pain
- Failed OP treatment with 48 hours of appropriate antibiotics, no improvement
- Follow-up concerns

Consults/Referrals:

Severe disease : consider Infectious Disease consultation

Cutaneous Abscess: ≥ 3 cm total area of involvement, consider Surgery consultation.

Discharge Criteria

- Fever curve downtrending

- Pain well controlled
- Decreased erythema, edema, induration, fluctuance and receding margins of marked lesion
- If indicated, I&D performed for abscess
- Tolerating oral intake and able to transition from IV to oral antibiotics with continued clinical improvement
- Outpatient follow up established with appropriate subspecialist or primary care

Follow-Up Care

16.6% of acute cellulitis cases are unresponsive to initial treatment mainly due to inappropriate antibiotic selection and dosing (weight-based dosing is preferred). [10]

Signs of failed antibiotic treatment are: worsening edema, erythema, purulent discharge, areas of induration or fluctuance concerning abscess development and/or fever after 48-72 hours of treatment.

The patient should follow up with PCP 3-4 days after starting PO antibiotics to evaluate for treatment failure.[1] If cultures were obtained, the speciation and susceptibilities need to be followed by either discharging providers or PCP to ensure appropriate antibiotic selection.

Prevention

Likelihood of developing skin and soft tissue infections can be reduced with the identification and treatment of predisposing conditions, as listed above in the Etiology section. According to the IDSA, some conditions that result in recurrent infections (3-4/year) may benefit from a prophylactic antibiotic program, but this is beyond the scope and recommendations of these guidelines. There also has been limited data proving efficacy of preventing future SSTI's in healthy people using decolonization procedures with methods such as nasal mupirocin or chlorhexidine/diluted bleach baths.[24] We thus do not provide suggestions for decolonization at this time, in our included patient population.

Outcome Measures

- Increase use of 1st-generation cephalosporins (Cefazolin) for nonpurulent cellulitis
- Decrease blood culture utilization
- Reduce the hospital readmission rate

Methods

Existing External Guidelines/Clinical Pathways

Existing External Guideline/Clinical Pathway	Organization and Author	Last Update
ED Pathway for SSTI	Children's National Health System	2018
Skin and Soft Tissue Infection	Texas Children's Hospital	2017
ED Pathway for the Evaluation/Treatment of the Child with Suspected Cellulitis/Abscess	Children's Hospital of Philadelphia	2019

Any published clinical guidelines have been evaluated for this review using the **AGREE II criteria**. The comparisons of these guidelines are found at the end of this document. **AGREE II criteria** include evaluation of: Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity of Presentation, Applicability, and Editorial Independence.

Review of Relevant Evidence: Search Strategies and Databases Reviewed

Search Strategies	Document Strategies Used
Search Terms Used:	SSTI, Skin and Soft Tissue Infection, Cellulitis, Nonpurulent, Purulent,
Years Searched - All Questions	1995 - 2020
Language	English
Age of Subjects	0-18 years old
Search Engines	PubMed, Scholar Google
EBP Web Sites	https://childrensnational.org/ https://texaschildrens.org https://chop.edu
Professional Organizations	Infectious Diseases Society of America https://www.idsociety.org/ The Society for Pediatric Dermatology https://pedsderm.net
Joint Commission	
Government/State Agencies	None
Other	

Evidence Found with Searches

Check Type of Evidence Found	Summary of Evidence – All Questions
x	Systematic Reviews
x	Meta-analysis articles
x	Randomized Controlled Trials
x	Non-randomized studies
x	Review articles
☐	Government/State agency regulations
x	Professional organization guidelines, white papers, ect.

Evaluating the Quality of the Evidence

The GRADE criteria were used to evaluate the quality of evidence presented in research articles reviewed during the development of this guideline. The table below defines how the quality of evidence is rated and how a strong versus a weak recommendation is established.

Recommendation

Strong	Desirable effects clearly outweigh undesirable effects or vice versa
Weak	Desirable effects closely balanced with undesirable effects
Type of Evidence	
High	Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies
Moderate	Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies
Low	Evidence for at least 1 critical outcome from observational studies, from RCTs with serious flaws or indirect evidence
Very Low	Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence

Addendum 1: Guideline for SSTI Antibiotic Selection and Dosing

Disposition	Medication	Dosing Regimen
Non-Purulent Cellulitis: First-Line^		
Sepsis/SIRS	Refer to Sepsis ED/Inpatient guideline for antimicrobial recommendations	
Inpatient	Cefazolin (IV)	33 mg/kg/dose IV q8h (max 1000 mg/dose)
Outpatient	Cephalexin (PO)	25 mg/kg/dose PO q8h (max 1000 mg/dose)
Non-Purulent Cellulitis: History of Type I reaction or SEVERE adverse reaction to Cefazolin		
Inpatient	Vancomycin (IV)	See Vancomycin Dosing Guideline
Outpatient	Clindamycin (PO)	10 mg/kg/dose PO q8h (max 450 mg/dose PO)
Purulent Cellulitis: First-Line		
Sepsis/SIRS	Refer to Sepsis ED/Inpatient guideline for antimicrobial recommendations	
Inpatient without systemic signs of infection	Clindamycin (IV)	13 mg/kg/dose IV q8h (max 600 mg/dose)
	SMX/TMP* (PO)	5 mg/kg/dose of TMP* PO q12h (max 320 mg of TMP/dose)
Outpatient	SMX/TMP* (PO)	5 mg/kg/dose of TMP* PO q12h (max 320 mg of TMP/dose)
Outpatient (If MSSA)	Cephalexin (PO)	25 mg/kg/dose PO q8h (max 1000 mg/dose)
Purulent Cellulitis: History of Type I reaction or SEVERE adverse reaction to Sulfa		
Inpatient (If MRSA susceptible to clindamycin)	Clindamycin (IV)	13 mg/kg/dose IV q8h (max 600 mg/dose)
Inpatient	Vancomycin (IV)	See Vancomycin Dosing Guideline
Outpatient	Doxycycline (PO) *≥8 years only*	2 mg/kg/dose PO q12h(max 100 mg/dose)
Outpatient (If MRSA susceptible to clindamycin)	Clindamycin (PO)	10 mg/kg/dose PO q8h (max 450 mg/dose PO)
Outpatient (If MSSA)	Cephalexin (PO)	25 mg/kg/dose PO q8h (max 1000 mg/dose)

*SMX/TMP: sulfamethoxazole/trimethoprim

^ SMX/TMP recommended if personal or family history of MRSA; Avoid using SMX/TMP if abscess has not been drained

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