**Definition:** Skin and soft tissue infection is a painful, erythematous infection of the dermis and subcutaneous tissue that has poorly demarcated borders and is characterized by an inflammatory response including: erythema, edema, lymphangitis, and advancing borders. The most common manifestation is abscess. (1-4) Erysipelas is a form of cellulitis with marked superficial inflammation and sharply demarcated borders typically affecting the lower limbs and face. (2) Cellulitis, along with impetigo and folliculitis, is the 28th most common diagnosis in hospitalized patients. (5) Staphylococcus aureus is the most common cause of skin and soft tissue infection accounting for up to 50% of cases of cellulitis. (6) Community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) is of major concern accounting for approximately 50% of *S. aureus* isolated from hospitalized children in the geographic area surrounding Houston, Texas. (7-9) Among *S. aureus* causing skin and soft tissue infections at TCH, approximately 50% are methicillin-resistant. At TCH, among community-acquired MRSA causing SSTI, approximately 17% are clindamycin-resistant; among CA-MSSA SSTI, there is a similar rate of clindamycin resistance. (Unpublished TCH Data)

**Pathophysiology:** When squamous epithelial cells with strong intercellular bonds, part of the integumentary barrier, are compromised bacteria are allowed to enter the dermis. Cellulitis is more serious in patients with underlying diseases such as diabetes or patients who are immunocompromised. (10)

**Inclusion Criteria**
- Age >2 months

**Exclusion Criteria**
- Periorbital or perianal cellulitis
- Chronic wound
- Impetigo
- Folliculitis
- Fascitis or deeper infection
- Lymphadenitis
- Diabetes
- Immunocompromise
- Sepsis
- Postoperative wound infection
- Infected animal bite
- Dental abscess
- Pregnancy

**Differential Diagnosis**
- Deeper infection (e.g., pyomyositis, septic arthritis, osteomyelitis)
- Thermal injuries
- Bug/Snake bites
- Sunburn, photodermatitis

**Diagnostic Evaluation**

Children with skin and soft tissue infection have a risk of progressing to septic shock.

**Table 1. Vital Sign Changes of Sepsis (11)**

<table>
<thead>
<tr>
<th>Age</th>
<th>Heart Rate</th>
<th>Resp Rate</th>
<th>Systolic BP</th>
<th>Temp (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0d - 1m</td>
<td>&gt;205</td>
<td>&gt;60</td>
<td>&lt;60</td>
<td>&lt;36 or &gt;38</td>
</tr>
<tr>
<td>&gt;1m - 3m</td>
<td>&gt;205</td>
<td>&gt;60</td>
<td>&lt;70</td>
<td>&lt;36 or &gt;38</td>
</tr>
<tr>
<td>&gt;3m - 1y</td>
<td>&gt;190</td>
<td>&gt;60</td>
<td>&lt;70</td>
<td>&lt;36 or &gt;38,5</td>
</tr>
<tr>
<td>&gt;1y - 2y</td>
<td>&gt;190</td>
<td>&gt;40</td>
<td>&lt;70 + (age in yr x 2)</td>
<td>&lt;36 or &gt;38,5</td>
</tr>
<tr>
<td>&gt;2y - 4y</td>
<td>&gt;140</td>
<td>&gt;40</td>
<td>&lt;70 + (age in yr x 2)</td>
<td>&lt;36 or &gt;38,5</td>
</tr>
<tr>
<td>&gt;4y - 6y</td>
<td>&gt;140</td>
<td>&gt;34</td>
<td>&lt;70 + (age in yr x 2)</td>
<td>&lt;36 or &gt;38,5</td>
</tr>
<tr>
<td>&gt;6y - 10y</td>
<td>&gt;140</td>
<td>&gt;30</td>
<td>&lt;70 + (age in yr x 2)</td>
<td>&lt;36 or &gt;38,5</td>
</tr>
<tr>
<td>&gt;10y - 13y</td>
<td>&gt;100</td>
<td>&gt;30</td>
<td>&lt;90</td>
<td>&lt;36 or &gt;38,5</td>
</tr>
<tr>
<td>&gt;13y</td>
<td>&gt;100</td>
<td>&gt;16</td>
<td>&lt;90</td>
<td>&lt;36 or &gt;38,5</td>
</tr>
</tbody>
</table>

**Table 2. Signs and Symptoms of Shock (11)**

<table>
<thead>
<tr>
<th>Exam Abnormalities</th>
<th>Cold Shock</th>
<th>Warm Shock</th>
<th>Non-Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral Pulses</td>
<td>Decreased or weak</td>
<td>Bounding</td>
<td></td>
</tr>
<tr>
<td>Capillary Refill</td>
<td>≥3 sec</td>
<td>Flash (&lt;1 sec)</td>
<td></td>
</tr>
<tr>
<td>(central vs. peripheral)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin</td>
<td>Mottled, cool</td>
<td>Flushed, ruddy, erythroderma (other than face)</td>
<td>Petechiae below the nipple, any purpura</td>
</tr>
<tr>
<td>Mental Status</td>
<td></td>
<td></td>
<td>Decreased, irritability, confusion, inappropriate crying or drowsiness, poor interaction with parents, lethargy, diminished arousability, obtunded</td>
</tr>
</tbody>
</table>

**History: Assess for**
- Traumatic skin injury, tinea infection, leg ulcers, boils, etc.
- Query patient/parent about bite wounds, marine exposures, possibility of foreign body that can serve as a nidus for cellulitis

**Physical Examination**
- Evaluate for cardinal signs of infection: erythema, tenderness, pain, warmth, induration/edema, and drainage/fluctuance
Critical Points of Evidence*

Evidence Supports

- Obtain an ultrasound only when the diagnosis is equivocal. (12-19) – Strong recommendation, moderate quality evidence
- Consider the following options for cellulitis: Clindamycin (no age restriction), trimethoprim-sulfamethoxazole (children >2 months), or doxycycline (children ≥8 years only). If streptococcal infection is suspected, consider an alternative antibiotic to trimethoprim-sulfamethoxazole; if streptococcal infection is diagnosed, use penicillin or amoxicillin. Use caution when selecting clindamycin due to increased resistance rates in \textit{S. aureus} isolates at TCH. Consider flavoring if administering PO clindamycin. (12,13,20-31) – Weak recommendation, low quality evidence
- Consider the following options for erysipelas: Clindamycin (no age restriction) or doxycycline (children ≥8 years only). Consider flavoring if administering PO clindamycin. (12,13,20-31) – Weak recommendation, low quality evidence
- Consider the following options for well-drained abscesses with overlying cellulitis, well-drained abscesses >3 cm, or well-drained abscesses with systemic symptoms (e.g., fever, vomiting): PO trimethoprim-sulfamethoxazole (preferred antibiotic; children >2 months only), PO doxycycline (children ≥8 years only), or PO clindamycin (no age restriction). PO cephalaxin is a reasonable option for treating MSSA if contraindications preclude administering any of these options. Abscesses caused by Group A streptococcus are uncommon but if streptococcal infection is suspected, consider an alternative antibiotic to trimethoprim-sulfamethoxazole; if streptococcal infection is diagnosed, use penicillin or amoxicillin. Use caution when selecting clindamycin due to increased resistance rates in \textit{S. aureus} isolates at TCH. Consider flavoring if administering PO clindamycin. (12,13,20-31) – Weak recommendation, low quality evidence
- Consider IV vancomycin for the following: large abscess or abscess involving critical area (e.g., face, hand), worsening clinical status, or concern for progression. Add IV nafcillin if the patient’s condition is severe. (12,13,20-31) – Weak recommendation, low quality evidence
- Consider admission for the following: systemic symptoms (significant fever, SIRS), rapidly expanding or large lesion, age <3 months, concern for inadequate drainage of large abscess, abscess location that requires subspecialty consult, unable to tolerate oral antibiotics, significant pain, failed treatment with 48 hours of appropriate antibiotics, or follow-up concerns. (12,13,20,31,32) – Weak recommendation, very low quality evidence
- Consider dilute bleach baths, especially in cases of multiple recurrences. (20,33-35) – Weak recommendation, low quality evidence
- Consider whole-body washing with chlorhexidine to prevent recurrent abscesses. (20,33,36-44) – Weak recommendation, moderate quality evidence

Evidence Against

- Do not routinely obtain blood cultures in children with SSTI. Obtain blood cultures in children with signs of systemic toxicity, rapidly spreading lesions, persistent fevers, or suspected deeper infection; consider obtaining blood cultures in children <3 months. (12,13,45-50) – Strong recommendation, very low quality evidence
- Do not obtain an ultrasound when the diagnosis is clear. (12-19) – Strong recommendation, moderate quality evidence
- Do not routinely administer antibiotics as an adjunct to I&D; consider administering antibiotics for systemic symptoms (e.g., fever, tachycardia, vomiting), overlying cellulitis, or abscess >3 cm. (12,13,20,51,52) – Strong recommendation, high quality evidence

Evidence Lacking/Inconclusive

- Consider additional imaging for admitted patients who are not improving on adequate antibiotics or if there is concern for new fluctuance or evolving abscess. (12,13) – Consensus recommendation
- Do not routinely use the following when administering antibiotics for SSTI: Linezolid (practical limitations) or IV trimethoprim-sulfamethoxazole. – Consensus recommendation
- Do not routinely administer prophylactic systemic antibiotics to prevent recurrence. (20,53) – Consensus recommendation

*NOTE: The references cited represent the entire body of evidence reviewed to make each recommendation.
Condition-Specific Elements of Clinical Management

**Wound/Infection Management**
- Measure and mark site and monitor for advancing area of involvement
- See treatment algorithm and antibiotic table for antibiotic options
- Monitor and manage pyrexia
- Elevate limb and use bed cradle, if applicable
- Utilize Contact Precautions for handling contaminated items
- If admitted, reevaluate patient frequently to determine need for further treatment or discharge readiness

**Pain Management**
- Assess need for pain management
- Provide oral/IV pain medications for I&D

**Admission Criteria**
Consider admission for:
- Systemic symptoms (significant fever, SIRS)
- Rapidly expanding or large lesions (>3 cm; significant cellulitis after abscess drainage)
- Age <3 months
- Concern for inadequate drainage of large abscess
- Abscess location that requires subspecialty consult
- Unable to tolerate oral antibiotics
- Significant pain
- Failed treatment with 48 hours of appropriate antibiotics
- Follow-up concerns

**Discharge Criteria**
- No fluctuance
- Erythema, size, and induration receding from outline
- Improving fever curve
- Tolerating oral intake
- Pain controlled with oral medications
- Ability to bear weight or use involved extremity

**Consults/Referrals**
- Consult surgery for I&D in the OR, if required

**Prevention**
- Strict handwashing
- Clean technique for dressing change

**Measures**

**Process**
- Type and duration of antibiotic administration (especially mupirocin and vancomycin)
- Appropriate laboratory tests and radiologic studies ordered
- Appropriate oral/IV pain management for I&D procedures performed outside of the OR
- Missed diagnosis of deeper process
- Use of dilute bleach baths
- Length of stay

**Outcome**
- EC visit within 7 days for SSTI
- Recurrent episodes requiring drainage

---

### Antibiotic Table

<table>
<thead>
<tr>
<th>Trimethoprim (TMP) and Sulfamethoxazole (SMX)</th>
<th>Age Restrictions</th>
<th>Dose and Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple SSTI (If proven group A strep, add PCN)</td>
<td>Children &gt;2 months</td>
<td>ORAL: 8-12 mg TMP/kg/DAY divided every 12 h; MAX: 160 mg TMP/dose</td>
</tr>
</tbody>
</table>

| Doxycycline | Simple SSTI if suspect CA-MRSA | Children ≥8 years | ORAL: 2-4 mg/kg/DAY divided every 12-24 h; MAX: 100 mg/dose or 200 mg/DAY |

| Clindamycin (Refer to guidelines for clindamycin resistance rate) | None | ORAL: 10-13 mg/kg/dose every 8 h; MAX: 1.8 grams/DAY |
| IV: 10-13 mg/kg/dose every 8 h; MAX: 1.8 grams/DAY |

| Cephalexin (For suspected/confirmed group A strep and MSSA) | None | ORAL: 25-50 mg/kg/DAY divided every 6 h; MAX: 500 mg/dose |

| Nafcillin (For suspected/confirmed MSSA) | None | IV: 100-150 mg/kg/DAY divided every 6 h; MAX: 12 grams/DAY |

| Vancomycin (For suspected/confirmed MRSA requiring IV therapy) | None | IV: 15 mg/kg/dose every 8h; MAX: 1 gram/dose |
| For patients with invasive infection: 15 mg/kg/dose every 6 hours |
Begin

Patient presents with ≥1 sign/symptom of SSTI: erythema, warmth, induration/edema, pain/tenderness, fluctuance/drainage

OFF algorithm
- Manage as appropriate to clinical findings

Suspected deeper infection (at fascia or deeper)

OFF algorithm
- Consult surgery
- Refer to acute hematogenous osteomyelitis or septic arthritis clinical standard, if appropriate

Cellulitis (non-purulent)

Concern for underlying abscess (purulent)

- Consult surgery
- Make NPO
- Obtain ultrasound if diagnosis is equivocal AND requested by surgery

- Review admission considerations

Admission required

- Consider administering PO clindamycin\(^1\) (no age restriction) or doxycycline (children ≥8 years only)
- Prevention education
- Discharge home
- Flu with PCP

Yes

No

Evaluate if patient meets discharge requirement at a maximum of 24 hours of IV therapy

Meets discharge requirement

- Discharge

No

- Consult surgery and make NPO if I&D not already done
- Consider additional imaging and/or modification of antibiotics

Continue IV antibiotic therapy

- Modify antibiotic therapy as needed
- Re-evaluate for discharge at a maximum of 48 hours of antibiotics treatment

Meets discharge requirement

- Discharge

Inclusion Criteria
- Age ≥2 months

Exclusion Criteria
- Periorbital or perianal cellulitis, chronic wound, impetigo, folliculitis or deeper infection, lymphadenitis, diabetes, immunocompromise, sepsis, postoperative wound infection, infected animal bite, dental abscess, pregnancy

*Septic Shock Criteria
- If patient is ill-appearing, toxic-appearing, has abnormal vital signs suggestive of septic shock, and/or signs and symptoms of septic shock, refer to Septic Shock Guideline.

- Consult Surgery and make NPO if I&D not already done
- Consider additional imaging and/or modification of antibiotics

Definite abscess

- I&D in OR required

Yes

No

I&D using appropriate procedural pain management

- Meet discharge criteria

Yes

No

- Consider PO antibiotics for overlying cellulitis, abscesses >3 cm, or systemic symptoms (e.g., fever, tachycardia, vomiting)
- Prevention education
- Discharge home
- Flu with PCP in 48-72 hours

Admission Considerations
- Systemic symptoms (significant fever, SIRS)
- Rapidly expanding or large lesion (>3 cm; significant cellulitis after abscess drainage)
- Age <3 months
- Concern for inadequate drainage of large abscess
- Abscess location that requires subspecialty consult
- Unable to tolerate oral antibiotics
- Significant pain
- Failed treatment with 48 hours of appropriate antibiotics

Discharge Criteria
- No fluctuance
- Erythema, size, and induration receding from outline
- Improving fever curve
- Tolerating oral intake
- Pain controlled with oral medications
- Ability to bear weight or use involved extremity

\(^1\)At TCH, among community-acquired MRSA causing SSTI, ~17% are clindamycin-resistant; among CA-MRSA SSTI, there is a similar rate of clindamycin resistance.
References


Clinical Standards Preparation
This clinical standard was prepared by the Evidence-Based Outcomes Center (EBOC) team in collaboration with content experts at Texas Children’s Hospital. Development of this clinical standard supports the TCH Quality and Patient Safety Program initiative to promote clinical standards and outcomes that build a culture of quality and safety within the organization.

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The following financial and/or intellectual conflict was identified and addressed to ensure objectivity: Shabana Yusuf was the lead author of a study included in the literature review.

Development Process
This clinical standard was developed using the process outlined in the EBOC Manual. The literature appraisal documents the following steps:

1. Review Preparation
   - PICOs questions established
   - Evidence search confirmed with content experts

2. Review of Existing External Guidelines

3. Literature Review of Relevant Evidence
   - Searched: PubMed, Cochrane

4. Critically Analyze the Evidence
   - 4 meta-analyses, 14 randomized controlled trials, and 20 nonrandomized studies

5. Summarize the Evidence
   - Materials used in the development of the clinical standard, literature appraisal, and any order sets are maintained in an SSTI evidence-based review manual within EBOC.

Evaluating the Quality of the Evidence
Published clinical guidelines were evaluated for this review using the AGREE II criteria. The summary of these guidelines are included in the literature appraisal. AGREE II criteria evaluate Guideline Scope and Purpose, Stakeholder Involvement, Rigor of © Evidence-Based Outcomes Center
Texas Children’s Hospital

Development, Clarity and Presentation, Applicability, and Editorial Independence using a 4-point Likert scale. The higher the score, the more comprehensive the guideline.

This clinical standard specifically summarizes the evidence in support of or against specific interventions and identifies where evidence is lacking/inconclusive. The following categories describe how research findings provide support for treatment interventions.

- "Evidence Supports" provides evidence to support an intervention
- "Evidence Against" provides evidence against an intervention
- "Evidence Lacking/Inconclusive" indicates there is insufficient evidence to support or refute an intervention and no conclusion can be drawn from the evidence.

The GRADE criteria were utilized to evaluate the body of evidence used to make practice recommendations. The table below defines how the quality of the evidence is rated and how a strong versus weak recommendation is established. The literature appraisal reflects the critical points of evidence.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Quality</th>
<th>Type of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRONG</td>
<td></td>
<td>Desirable effects clearly outweigh undesirable effects or vice versa</td>
</tr>
<tr>
<td>WEAK</td>
<td></td>
<td>Desirable effects closely balanced with undesirable effects</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality</th>
<th>Type of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies</td>
</tr>
<tr>
<td>Moderate</td>
<td>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</td>
</tr>
<tr>
<td>Low</td>
<td>Evidence for at least 1 critical outcome from observational studies, RCTs with serious flaws or indirect evidence</td>
</tr>
<tr>
<td>Very Low</td>
<td>Evidence for at least 1 critical outcome from un systemctlatic clinical observations or very indirect evidence</td>
</tr>
</tbody>
</table>

Recommendations
Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible. The Content Expert Team and EBOC team remain aware of the controversies in the diagnosis and management of SSTI in children. When evidence is lacking, options in care are provided in the clinical standard and the accompanying order sets (if applicable).

Approval Process
Clinical standards are reviewed and approved by hospital committees as deemed appropriate for its intended use. Clinical standards are reviewed as necessary within EBOC at Texas Children’s Hospital. Content Expert Teams are involved with every review and update.

Disclaimer
Practice recommendations are based upon the evidence available at the time the clinical standard was developed. Clinical standards (guidelines, summaries, or pathways) do not set out the standard of care, and are not intended to be used to dictate a course of care. Each physician/practitioner must use his or her independent judgment in the management of any specific patient and is responsible, in consultation with the patient and/or the patient family, to make the ultimate judgment regarding care.

Version History
<table>
<thead>
<tr>
<th>Date</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Jun 2010</td>
<td>Originally completed</td>
</tr>
<tr>
<td>Jun 2017</td>
<td>Updated</td>
</tr>
<tr>
<td>Mar 2018</td>
<td>Revised the discharge criteria</td>
</tr>
<tr>
<td>April 2018</td>
<td>Algorithm revised</td>
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