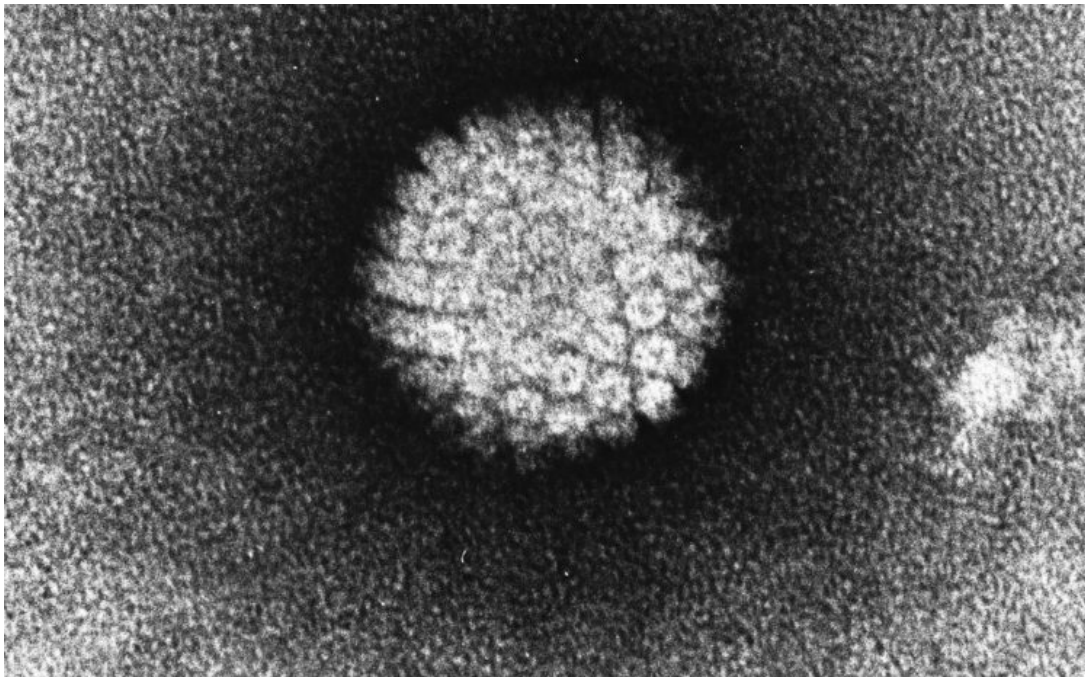


Skin and Soft Tissue Infections in Children

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Skin and soft tissue infections include impetigo, skin abscesses, acne, carbuncles, and staph-scalded skin syndrome. Necrotizing fasciitis is a more severe form of soft tissue infections that are usually caused by *Streptococcus pyogenes*, but can also be polymicrobial. *Staphylococcus aureus* is more commonly associated with abscesses and purulent skin infections. Genital and non-genital warts caused by the human papillomavirus are becoming more commonly seen in children. *Molluscum contagiosum* is a common viral skin infection of young children. Antibiotic therapy is indicated for bacterial soft tissue infections, while cryotherapy and other lesional destructive therapy are usually used for viral skin and soft tissue infections.



Definition of Skin and Soft Tissue Infections in Children

Bacterial skin and soft tissue infections are defined as acute illnesses that are characterized by **localized or diffuse skin and subcutaneous infection**. This definition includes **impetigo, folliculitis**, and **deep subcutaneous infections**. Viral causes of skin infections might be implicated in **warts** or other superficial skin lesions related to **molluscum contagiosum**.

Epidemiology of Skin and Soft Tissue Infections in Children

Skin and soft tissue infections (SSTIs) are becoming more commonly recognized and diagnosed in children. Some studies link this increase in the incidence of SSTIs to a concomitant increase in the incidence of **methicillin-resistant Staphylococcus aureus** in the community.

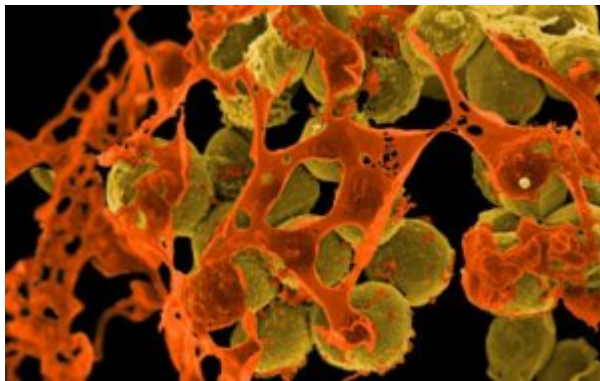


Image: "Scanning electron micrograph of methicillin-resistant Staphylococcus aureus (MRSA, brown) surrounded by cellular debris. MRSA resists treatment with many antibiotics." by NIAID/NIH. License: Public Domain

The incidence of SSTIs related to Staphylococcus aureus alone has doubled in the last decade; therefore, the costs of treating these infections nowadays is estimated to be around 4.22 billion dollars signifying a serious burden on the health-care system.

Another possible cause for the recent increase in the risk of SSTIs could be the increased prevalence of **human immunodeficiency virus** among children, in addition to the survival of children with the **impaired immune system** due to recent advances in medicine.

Etiology of Skin and Soft Tissue Infections in Children

1. **Staphylococcus aureus:** The most common causes of **impetigo** are *Staphylococcus aureus* and streptococcus infections. *Staphylococcus aureus* acquired from the community is becoming **resistant to methicillin**, which is a serious problem.
2. **Streptococcus pyogenes:** **Group A streptococcus** is responsible for more invasive SSTIs that might be associated with **monomicrobial necrotizing fasciitis** (type I). One commonly identified organism of this group is the *Streptococcus pyogenes*.
3. **Polymicrobial Infection:** Due to mixed infection of Staphylococci, *Peptostreptococcus*, *Bacteroides*, or *Clostridium* **Polymicrobial** necrotizing fasciitis (type I) occurs in children.
4. **Viral etiologies** implicated with SSTIs include **molluscum contagiosum** and the **human papillomaviruses**. Molluscum contagiosum infections are more common among children aged 1 to 4 years. Warts caused by the human papillomavirus are common in older children and adolescents.

Cellulitis and **erysipelas** are also common non-purulent SSTIs caused by Staphylococcus infections. Purulent SSTIs include **furuncle**, **carbuncle** and the formation of **abscesses**. These conditions are also related to Staphylococcus aureus infection. **Staph-scalded skin syndrome** (SSSS) is a condition that is caused by toxin-producing *Staphylococcus aureus* strains.



- Group A Strep
- **Staph aureus**
- Pseudomonas (rare)
 - Adults with IDDM, doesn't usually happen in children
 - Hot tub folliculitis
 - **Nail through sneaker rubber into foot**
 - Very rare: children with vasculitis of the extremities

Clinical Presentation of Skin and Soft Tissue Infections in Children

1) Impetigo

Simple impetigo (Non-Bullous Impetigo) presents with localized single or multiple **skin lesions** that are crusted and brown or honey-colored, usually on the face or extremities. It is common in children with 2 to 5 year of age. A complicated case of impetigo (Bullous Impetigo) presents with deeper skin involvement, possibly with a purulent discharge and sometimes vesicles may enlarge (bullae). Bullous Impetigo is exclusively caused by *aureus* due to release of epidermolytic toxin into the local tissues.

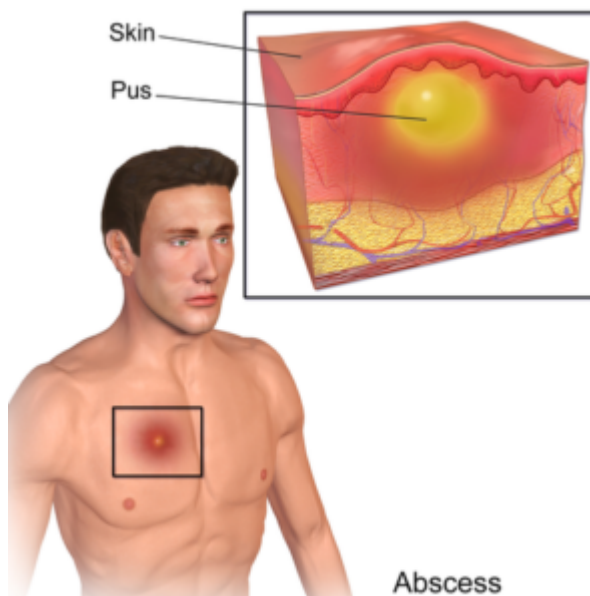


Image: "Abscess" by Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014". Wikijournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. - Own work. License: [CC BY 3.0](https://creativecommons.org/licenses/by/3.0/)

2) Cellulitis

Cellulitis presents with localized swelling, warmth, redness and pain in an area. It involves the dermis and subcutaneous fat and may form abscesses. *Haemophilus influenzae* was initially considered as the major reason for the facial cellulitis in children 3-24 months of age. Recent studies have reported other flora such as including *Escherichia coli*, *Peptostreptococcus* species, *Bacteroides fragilis* apart from *S. aureus* in infected tissue.

3) Abscesses

It usually presents with localized swelling or a lump in an inflamed area. Abscesses can be seen in the subcutaneous tissue of an upper or lower limb. Patients with the purulent disease are more likely to have a fever and be toxic.

4) SSSS (Staphylococcal Scalded Skin Syndrome)

It presents with a **painful desquamative skin rash**, especially around the nose, mouth, and anus. The rash can also be seen around flexures. It is caused by exfoliating toxins produced by aureus. These toxins expressed at the site of infection and cause bullous impetigo and while acting systemically they cause SSSS. Patients with SSSS might be feverish, develop **hypotension**, have **multisystemic dysfunction** or develop **sepsis**. Therefore, SSSS is considered as a **pediatric emergency** that needs urgent treatment and adequate fluid replacement therapy.

5) Acne

Acne is another common presentation of **Propionibacterium infection** or Streptococcus superficial skin infections.

5) Molluscum Contagiosum

Patients with molluscum contagiosum present with self-limited skin lesions that are round and umbilicated. The lesions resemble skin warts.

6) Skin Warts

Skin warts caused by the human papillomavirus can occur in the hands or feet, in the genital tract or in the mouth and nasopharynx. Patients presenting with anal or genital warts, who are too young to be involved in sexual activity, should raise suspicions of **possible sexual abuse**.

6) Folliculitis

It is caused by inflammation of the hair follicles due to *Pseudomonas aeruginosa*, *S. aureus*. It is associated with acne.

Diagnostic Workup for Skin and Soft Tissue Infections in Children

The first and most important step in the evaluation of the patient with SSTIs is to determine whether the child has a deep abscess. **Abscesses** need to be incised and drained for optimum treatment. After careful examination, most SSTIs do not need any further diagnostic workup.

A **complete blood count** might be indicated in the evaluation of the patient presenting with severe SSTIs such as SSSS. **Leukocytosis** might be seen in that case. **Electrolyte**

imbalances are also common with severe SSTIs, such as SSSS.

Culture and sensitivity testing of the infected sites might be indicated in case of failure to respond to typical **antibiotic therapy**. Methicillin-resistant *Staphylococcus aureus* is becoming more commonly identified in community-acquired cases of impetigo and other SSTIs.

Skin warts or lesions caused by *Molluscum contagiosum* rarely need further diagnostic workup as they are easy to diagnose clinically. Cases of genital warts that are extensive might warrant the determination of the human papillomavirus type to determine the risk of developing **dysplasia** or **malignant transformation**.



- Diagnosis is clinical.
- Ultrasound may help distinguish between “drainable abscess” and “non-drainable phlegmon.”
- **Blood tests are unhelpful and not indicated.**
- If an abscess is drained, culture should be obtained.

Treatment of Skin and Soft Tissue Infections in Children

Skin and Soft Tissue Infections can be broadly classified as :

1) Superficial infection: erysipelas, cellulitis, bullous impetigo, bite infections, and periorbital cellulitis

- Nonpurulent SSTIs**, such as non-bullous or bullous impetigo, can be treated with **topical antibiotics**. Possible choices of topical antibiotics include **mupirocin**, **retapamulin**, and **fusidic acid**. Fusidic acid is not available in the United States but has the advantage of being active against *Propionibacterium acnes*.

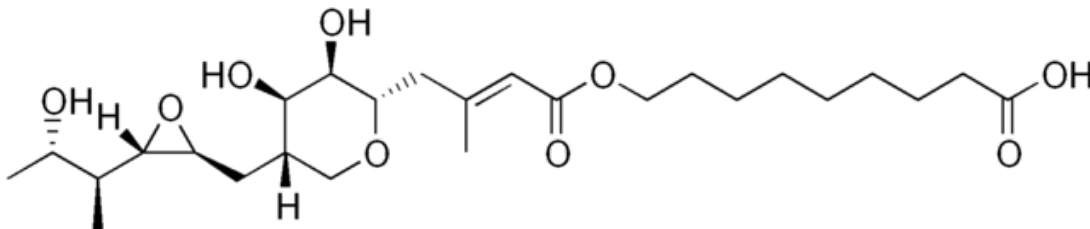


Image: “Chemical structure of mupirocin.” by Edgar181 – Own work. License: Public Domain

2) Deeper infections: orbital cellulitis, necrotizing

fasciitis, and pyomyositis

- a. **Without abscesses:** Patients presenting with moderate **SSTIs that affect deeper tissues** but **do not have any abscesses** should be treated with **oral or intravenous antibiotics**. Possible choices include **ceftriaxone** and **clindamycin**. **Clindamycin** is more likely to be effective against methicillin-resistant *Staphylococcus aureus*, but might be associated with an increased risk of **pseudomembranous colitis**.
- b. **Necrotizing fasciitis** Patients with severe nonpurulent necrotizing fasciitis or SSSS might need **surgical intervention** and **debridement of necrotic tissues**. This group of patients should receive **intravenous vancomycin plus piperacillin** to cover Pseudomonas species. This group of patients should undergo culture and sensitivity testing of the infected regions to identify the causative organism and switch to more specific antibiotics with **narrow-spectrum**.
- c. **Surgery:** Patients with purulent SSTIs, such as **abscesses or carbuncles**, should first undergo **surgical intervention**. **Incision** and **drainage** relieve symptoms, provide material for culture and sensitivity testing and might be curative. Once a sample is collected for culture and sensitivity testing, **empirical antibiotic therapy** is indicated in this group of patients. **Vancomycin** or **Linezolid** are first-line empirical therapies for purulent SSTIs after incision and drainage. Linezolid and quinupristin/dalfopristin are good antibacterial agents for the treatment of highly resistant organisms like methicillin-resistant *S. aureus*, vancomycin-resistant *S. aureus*, and vancomycin-resistant enterococci

Sensitivity tests :

Once the results of the culture and sensitivity tests are available, the main question would be whether the patient has **methicillin resistant or sensitive *Staphylococcus aureus***. Patients with purulent SSTIs caused by methicillin-sensitive *Staphylococcus aureus* should be switched to **nafcillin**. Those who are confirmed to have community acquired methicillin-resistant *Staphylococcus aureus* should continue receiving **vancomycin, linezolid** or be switched to **clindamycin**.

Patients who are confirmed to have *Streptococcus pyogenes* SSTI should be switched from **vancomycin plus piperacillin to penicillin plus clindamycin**. A similar protocol should be followed in cases of clostridial necrotizing fasciitis. Necrotizing fasciitis might also be polymicrobial. In that case, **vancomycin plus piperacillin** should be continued.

Management of abscesses



- **Appropriate technique incision and drainage**
- Packing is unlikely to help and is painful
- Do not drain with a needle
- No antibiotics needed
- Treat with antibiotics if associated cellulitis present (consider MRSA).

Viral SSTIs

Management of molluscum contagiosum and other viral SSTIs is more difficult and the results are usually not as good as with bacterial SSTIs. **Cryotherapy** and **cantharidin** are destructive therapy for molluscum contagiosum with good clinical response. **Potassium hydroxide** has also been used as destructive therapy for skin lesions caused by molluscum contagiosum.

- **Cryotherapy, paring, excision** and the use of **cantharidin** are also possible options for warts caused by human papillomavirus.
- **Imiquimod** has been used as an **immune-modulator therapy** for the treatment of warts, but should not be used in cases of molluscum contagiosum.
- Finally, the **human papillomavirus vaccine** has been found to be effective against genital and, more recently, non-genital warts; therefore, the vaccine is



recommended for all children.

Special considerations

Cellulitis from bite	Broad coverage with amoxicillin/clavulanate
Cellulitis of hand	Admit for IV antibiotics
Pilonidal or perirectal abscess	Consider IBD, consult the surgeon for evaluation for tract
MRSA colonization	Difficult to manage, good hygiene encouraged

References

Rush J, Dinulos JG. Childhood skin and soft tissue infections: new discoveries and guidelines regarding the management of bacterial soft tissue infections, molluscum contagiosum, and warts. *Curr Opin Pediatr.* 2016 Apr;28(2):250-7. doi: 10.1097/MOP.0000000000000334. Review. PubMed PMID: 26900921.

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