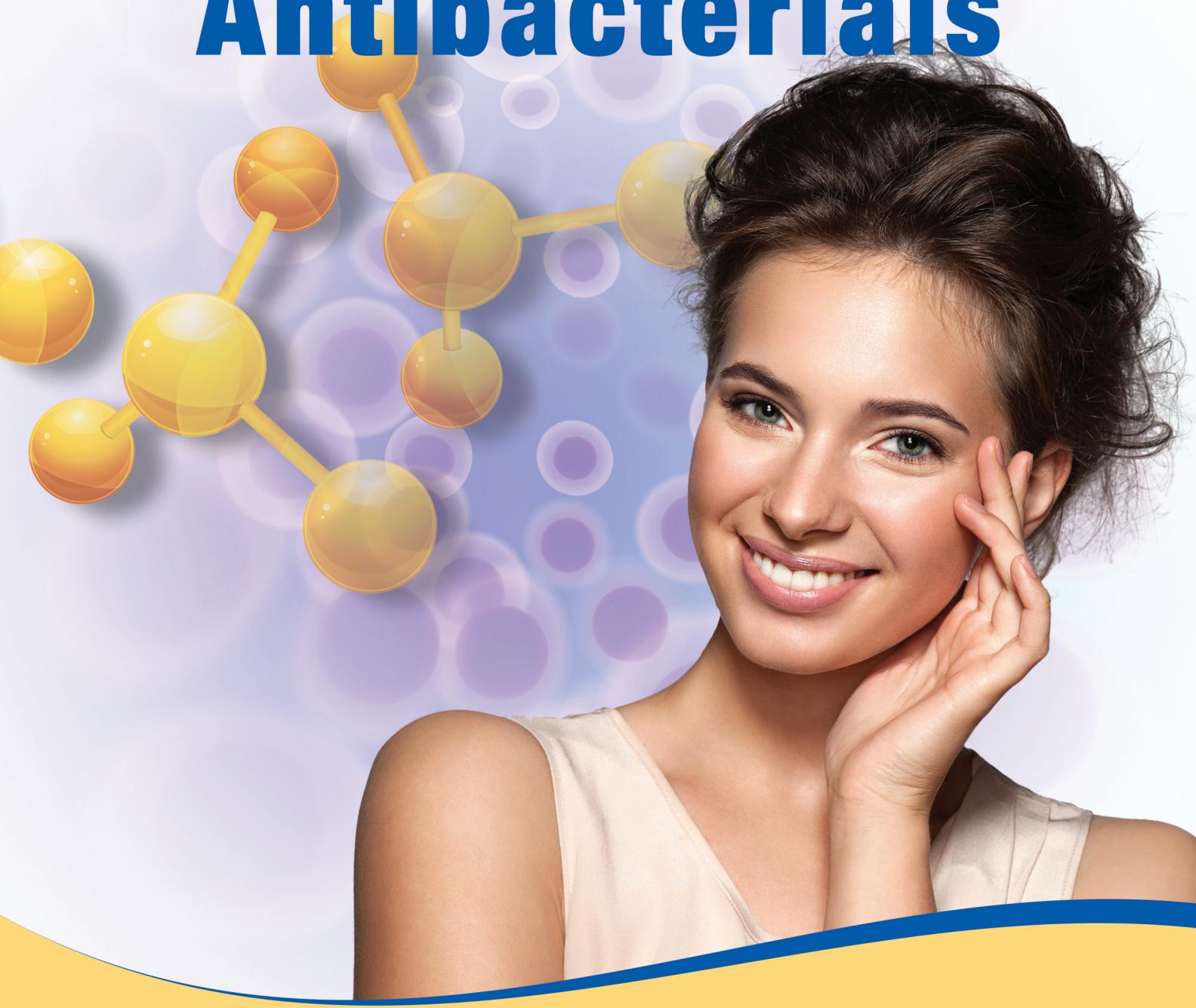


MEDICINE
UPDATE



CONTINUING MEDICAL EDUCATION

Antibacterials



Program Information

CME objectives

1. To identify briefly the clinical presentations of different types of skin and soft tissue infections.
2. To broadly understand the microbiology, diagnostic and treatment approach for common skin and soft tissue infections.

Target participants

Physicians

Course director

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DNB (Dermatology)

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Method of participation in CME

- Enroll for the program by filling enrollment form
- You will receive the program module containing complete CME with post - test questions
- Study all parts of the educational activity
- Complete the online questions and submit your answers
- A Medicine Update CME Certificate will be issued to participants upon completing the post - test with a score of 60% or better.

CME activity

Release Date : 1st July, 2018

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Bacterial skin and soft tissue infections

INTRODUCTION

Bacterial skin and soft tissue infections (SSTIs) are a common problem in clinical practice - in both the community (outpatient) and hospital care (inpatient) settings,¹ which result in or occur as a consequence of disruption in the skin's integrity.² These infections account for a significant proportion of dermatological diseases, and represent one of the most important differential diagnoses in individuals presenting with reddened and swollen skin and soft tissue.³⁻⁵

Bacterial SSTIs can have a wide range of presentations, and can be classified in a number of ways (Table 1).^{2,6,7} Nevertheless, traditionally, they are divided into uncomplicated and complicated SSTIs; box 1 describes the conditions which signify presence of complicated SSTIs.⁸ Based on this, uncomplicated SSTIs such as folliculitis or carbuncles would be considered complicated if patients have underlying comorbidities impacting the management.⁹ Another classification typically impacting the management of bacterial SSTIs is based on the manner of infection development, and thus classifying the infections as either 'primary bacterial infections' or 'secondary bacterial infections'. It suggests that primary SSTIs occur when microorganisms invade otherwise healthy skin, whereas secondary SSTIs occur when, because of underlying disease, microorganisms infect already damaged skin. Figure 1 illustrates the human skin structures and the corresponding locations of various SSTIs.⁷

Regardless of these classifications adopted, SSTIs are known to exert considerable healthcare burden, and this seems especially concerning in the extreme of ages.¹⁰⁻¹³ While on one hand, these infections vary widely clinically in children and constitute significant number of office-based visits in pediatric settings as the single most common skin disorder for which children seek care;^{14,15} concurrently, they are a common cause of hospital

Table 1: Classification of bacterial SSTIs

Criteria	Classification
Based on the extent of tissue involved	<ul style="list-style-type: none"> • Superficial (epidermis and dermis) • Deep (hypodermis, fascia and muscle)
Based on secretions	<ul style="list-style-type: none"> • Purulent infections (e.g., furuncles, carbuncles, abscesses) • Non-purulent infections (e.g., erysipelas, cellulitis, necrotizing fasciitis)
Based on severity	<ul style="list-style-type: none"> • Mild • Moderate • Severe
Based on healthcare setting	<ul style="list-style-type: none"> • Community acquired • Hospital acquired/nosocomial
Based on pathogen invasion	<ul style="list-style-type: none"> • Primary bacterial infections • Secondary bacterial infections

Sources: 1. Templer SJ, Brito MO. Bacterial Skin and Soft Tissue Infections. *Hospital Physician* 2009;26:9-16. 2. Bernard P. Management of common bacterial infections of the skin. *Curr Opin Infect Dis.* 2008;21(2):122-8. 3. Chahine EB, Sucher AJ. Skin and Soft Tissue Infections. *PSAP* 2015:5-26. 4. Palit A, Inamadar AC. Current concepts in the management of bacterial skin infections in children. *Indian J Dermatol Venereol Leprol.* 2010;76(5):476-88. 5. Pulido-Cejudo A, Guzmán-Gutierrez M, Jalife-Montaña A, et al. Management of acute bacterial skin and skin structure infections with a focus on patients at high risk of treatment failure. *Ther Adv Infect Dis.* 2017;4(5):143-161.

admission among the elderly patients.¹⁶ Diagnosis and treatment of even the milder forms of bacterial skin infections thus seems important in these populations because of the long-term morbidity associated with them.

CLINICAL MANIFESTATIONS OF SKIN INFECTIONS

Bacterial skin infections produce a considerable diversity of clinical manifestations, which vary from disease to disease.¹⁷ In general, while mild infections present with

Box 1: SSTIs are considered 'complicated' when:

- The patient has associated co-morbidity like diabetes mellitus or other immunosuppressed states, affecting the response to usual treatment
- Deeper structures like fascia and muscle are involved, necessitating surgical intervention
- The lesions involve the perineal and/or perianal region, with the risk of infection by anaerobic and Gram-negative pathogens.

Source: Palit A, Inamadar AC. Current concepts in the management of bacterial skin infections in children. *Indian J Dermatol Venereol Leprol*. 2010;76(5):476-88.

local signs only, moderate to severe infections are often associated with systemic signs of infection resulting from cytokine-induced changes in thermoregulation and vascular resistance; including fever (temperature $>40^{\circ}\text{C}$ or $<35^{\circ}\text{C}$), tachycardia (heart rate >90 beats/minute), tachypnea (respiratory rate >24 breaths/minute), or leukocytosis [white blood cells (WBC) $>12 \times 10^3$ cells/mm 3 .⁷

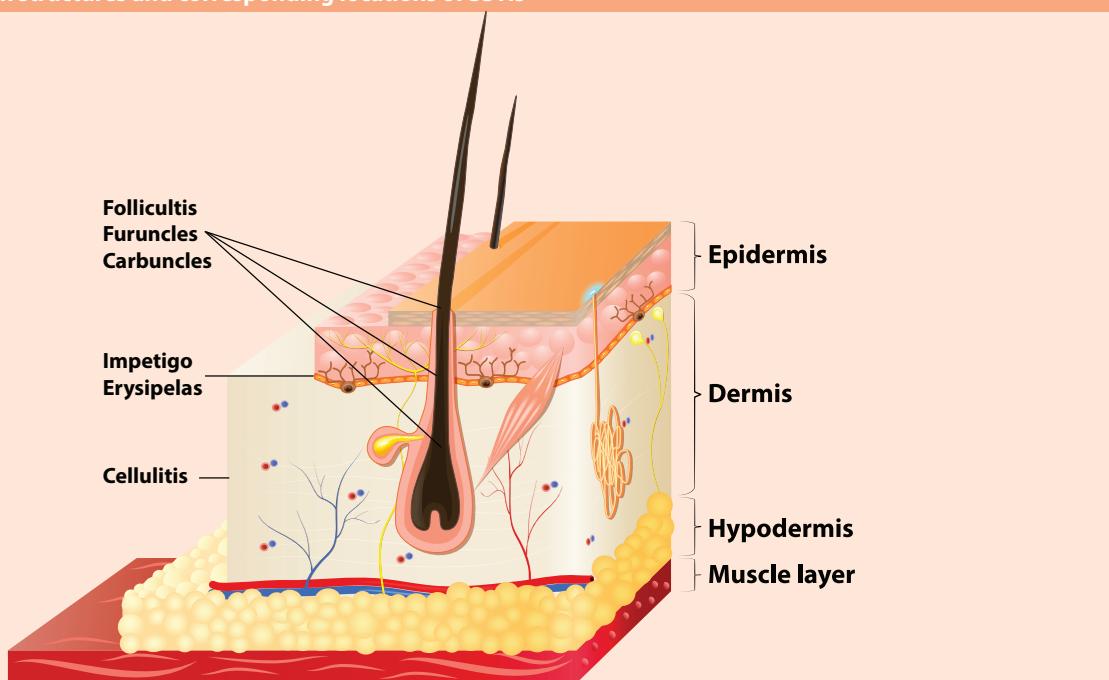
With regards to the physical appearance, most skin infections present with non-specific features such as erythema, and other signs of inflammation (pain, warmth, and edema); though focal accumulations of pus (furuncles) or fluid (vesicles, bullae) may also form

in cases of increasing severity.^{17,18} Such characteristic morphology of eruptive lesions is important information, as it can limit the diagnostic possibilities; arrangement of individual lesions to each other and the body, and their distribution on particular anatomical sites could provide useful adjunctive data for an initial clinical impression. Furthermore, the presence or absence of pus can be used to consider the probability of an infection being staphylococcal (purulent) or streptococcal (non-purulent).⁹

MICROBIOLOGY OF BACTERIAL SKIN INFECTIONS

A number of bacterial pathogens have been implicated in SSTIs, but this microbiology may vary with the means of pathogen entry; etiology may thus be normal host flora transferred from the instrument of entry or transferred from the environment. Furthermore, etiologies differ between the community-acquired and hospital-acquired SSTIs.¹⁷ Generally, it has been noticed that the majority of bacterial SSTIs are caused by Gram-positive organisms, including *Staphylococcus aureus*, group A and B streptococci, *Streptococcus viridans*, and *Enterococcus faecalis*; whereas less common causes include Gram-negative organisms such as *Haemophilus influenzae*,

Figure 1: Human skin structures and corresponding locations of SSTIs



Source: Chahine EB, Sucher AJ. Skin and Soft Tissue Infections. PSAP 2015:5-26.

Pasteurella multocida, Capnocytophaga species, *Vibrio* species, *Mycobacterium* species, *Pseudomonas* species, *Aeromonas* species, *Proteus* species, *Clostridium* species, and other anaerobes that are mainly involved in more complicated infections.¹⁹

Amongst these organisms, *S. aureus* and streptococci species overall represent the most commonly identified pathogens in SSTIs;^{2,20-22} Herein, *S. aureus* is the predominant pathogen for infections like impetigo and furunculosis, with methicillin-resistant strains playing a growing role in both the diseases. Cellulitis, erysipelas and abscesses are also mainly caused by Gram-positive bacteria, including *S. aureus*, *S. pyogenes*, and other beta-hemolytic streptococci.⁹ Erysipelas is mainly caused by streptococci, though local complications (i.e. abscesses or blisters) may be due to staphylococci, including the methicillin-resistant strains in involved geographic areas.⁶

In wound infections, the anatomical location of the wound appears to influence the etiology; usually, Gram-negative bacteria are the most likely causative agents in wound infections in perianal or lower abdominal area.⁹ The typical bacteria that colonize the skin above the waist are usually Gram-positive species, such as *Staphylococcus epidermidis*, *Corynebacterium* species, *S. aureus* and *S. pyogenes*. Conversely, the typical organisms that colonize the skin below the waist are both Gram-positive and Gram-negative species. It is speculated that this difference could be secondary to the proximity to the anorectal region.¹⁷

PRIMARY AND SECONDARY SKIN INFECTIONS

Primary skin infections

As mentioned earlier, primary skin infections usually affect the normal skin. They are generally caused by a single pathogen, and have a characteristic clinical picture and disease course. Impetigo, folliculitis, and boils are examples of common types of primary bacterial skin infections seen in clinical practice.¹⁸ The most common skin pathogens associated with primary skin infections include the *S. aureus*, β-hemolytic streptococci, and coryneform bacteria; these bacteria usually gain entry into body through a break in the skin.¹⁸

Secondary skin infections

The damaged skin associated with preexisting skin lesions is a fertile breeding ground for various microorganisms;

predisposing the hosts to secondary/superimposed skin infections that can complicate the disease course.^{18,23-25} Elderly patients may be more prone to secondary skin infections possibly due to the persistent pruritus associated with increasing dryness of the aging skin.¹⁶ In general, skin diseases complicated by secondary bacterial invasion can be broadly classified into itchy skin conditions, wherein scratching provides a portal of entry to microorganisms, and those characterized by absence of skin barrier.²⁶ Regardless, since secondary infections can be potentially life threatening and may progress rapidly, their early recognition and proper management are important.

The most common causes of secondary bacterial infections are staphylococci and streptococci. An Egyptian study aimed to detect the types of bacteria commonly complicating skin diseases of patients of dermatology department, and found that *S. aureus* was the most common cause of secondary infection in all skin lesions.²⁶ Nonetheless, the etiology may often vary according the site of lesion.^{24,27} *S. aureus* and group A beta-hemolytic streptococci are the most prevalent aerobes and are isolated from all body sites; whereas organisms that reside in the mucous membranes close to lesions predominate in the infections next to these membranes.

COMMON PRIMARY BACTERIAL SKIN INFECTIONS

The four most common primary bacterial skin infections are impetigo, erysipelas, cellulitis, and folliculitis (Table 2).^{28,29}

Impetigo

Impetigo is a common localized acute bacterial skin infection, characterized by multiple erythematous, vesicular, and pruritic lesions.⁷ It presents as a superficial blister atop a red macule, which quickly evolves to form eroded, exudative, yellow “honey-crusted” lesions.^{30,31} Clinically infection in impetigo becomes apparent approximately 10 days after colonization with bacteria.² The condition mainly affects exposed areas of the body, such as the face and extremities, but may also affect trunk, perineum and other body sites.

There are two main forms of impetigo, recognized on the basis of clinical, bacteriological, and histological findings: non-bullous or crusted impetigo (distinct yellow, crusting lesions) and bullous impetigo (bullae

that rupture to form a brown crust).^{1,29} The non-bullous impetigo is the most common form, most often occurs in young children (aged 2 to 5 years), on the face or extremities. It presents with small fluid-filled vesicles that soon develop into pustules that rupture, leaving golden-yellow crusts.⁷ The condition is caused by *S. pyogenes* alone or as part of a mixed infection with *S. aureus*.³¹ Untreated impetigo usually resolves within 2 to 4 weeks without scarring.³¹ However, treatment is justified as it speeds healing of the lesions by 1-2 days, decreases spread of the lesions, and significantly shortens the duration of contagious period.³²

Bullous impetigo usually occurs in babies in the diaper area and axillae, and is always associated with *S. aureus*;³² lesions in this form are superficial, thin-walled, and bullous. It presents with vesicles that develop into yellow fluid-filled bullae that rupture, leaving brown crusts.^{7,29,31} The thin, transparent, varnish-like crust that appears on rupturing of the lesions can be distinguished from the stuck-on crust of common impetigo. This distinctive appearance of bullous impetigo results from local action of the epidermolytic toxin (exfoliation) - it is considered that bullous impetigo is due to staphylococcal exfoliative toxins (exfoliatin A-D), which target desmoglein 1 (a desmosomal adhesion glycoprotein), and cleave off the superficial epidermis through the granular layer. No trauma is required, as the bacteria can infect intact skin.³¹

A 3rd, deeper, form of impetigo is known as ecthyma, in which lesions (ulcerations) form beneath the crusted plaques.²² The lesions usually occur on the legs and other covered areas of the body; often occurring as a complication of debility and infestation. Ecthyma starts as non-bullous impetigo but develops into a punched-out necrotic ulcer; ulcers have a punched-out appearance when the crust or purulent materials are removed. It is usually caused by *S. pyogenes*, but co-infection with *S. aureus* may occur. Lesions in ecthyma generally heal slowly and leave scars.^{18,31}

Hair follicle infections (folliculitis, furuncles and carbuncles)

Folliculitis is an infection of one or more hair follicles that may affect any area of the body with hairs; thus excluding the palms and soles.⁷ In **folliculitis**, a small red bump, or pimple, develops at the site of the involved hair follicle, and this may be associated with rash or pruritus.^{7,30} Folliculitis can be further divided into two major categories on the basis of histological location:

Table 2: Descriptions of most common primary bacterial skin infections

Impetigo^a Large vesicles and/or honey-crusted sores	
Folliculitis^b Papular or pustular inflammation of hair follicles	
Furuncle^c Painful, firm or fluctuant abscess originating from a hair follicle	
Carbuncle^d A network of furuncles connected by sinus tracts	
Cellulitis^e Painful, erythematous infection of deep skin with poorly demarcated borders	
Erysipelas^f Fiery red, painful infection of superficial skin with sharply demarcated borders	

Source: Stulberg DI, Penrod MA, Blatny RA. Common Bacterial Skin Infections. *Am Fam Physician* 2002;66:119-24.

Image sources: a. https://commons.wikimedia.org/wiki/File:Impetigo_elbow.jpg b. https://commons.wikimedia.org/wiki/File:Isolated_folliculitis.jpg c. https://commons.wikimedia.org/wiki/File:Furuncle-MIN-IMG_2589.jpg d. [https://bio.libretexts.org/TextMaps/Map%3A_Microbiology-\(OpenStax\)/21%3A_Skin_and_Eye_Infections/21.2%3A_Bacterial-Infections_of_the_Skin_and_Eyes](https://bio.libretexts.org/TextMaps/Map%3A_Microbiology-(OpenStax)/21%3A_Skin_and_Eye_Infections/21.2%3A_Bacterial-Infections_of_the_Skin_and_Eyes) e. <https://commons.wikimedia.org/wiki/File:Cellulitis3.jpg> f. https://commons.wikimedia.org/wiki/File:%C3%89rysip%C3%A8le_jambe_Leg_erysipelas_-profil.jpg [Accessed on 22/11/2017].

superficial and deep. The presentation thus depends on its severity, which ranges from superficial inflammation of an individual hair follicle to a deeper infection of the follicle (**furuncle**) to clusters of coalescing abscesses

found deeper in the subcutaneous tissues (**carbuncles**). Common bacterial causes of folliculitis include *S. aureus*, *S. pyogenes*, *Pseudomonas* species, and *Proteus* species.

The most superficial form of skin infection is staphylococcal folliculitis, caused by *S. aureus*, and manifested by minute erythematous follicular pustules without involving the surrounding skin. It mostly presents at scalp and extremities, as red, often itchy, papules and/or pustules at the base of the hair shaft.³² In deep folliculitis, infection extends deeply into the follicle, and the resulting perifolliculitis causes a more marked inflammatory response than that seen in superficial folliculitis.¹⁸

Furuncles and carbuncles occur as the follicular infection progresses deeper and extends out from the follicle. Commonly known as an abscess or boil, a furuncle represents a tender, erythematous, firm or fluctuant mass of walled-off purulent material, arising from the hair follicle. These lesions may occur anywhere on the body, but have a predilection for hairy areas that are exposed to friction and macerations.⁷ Pus may drain from the boil along with a plug of inflammatory cells and dead tissue. The pathogen is usually *S. aureus*.²⁹

Furuncles may progress to carbuncles, which is an aggregate of furuncles penetrating to deeper layers of skin, forming broad, swollen, erythematous, deep, and painful masses that usually open and drain through multiple tracts.²⁹ A **carbuncle** thus typically represents a confluence of boils, as a large erythematous, indurated painful lesion with multiple draining sites; these pus draining openings are often associated with fever, swollen lymph nodes, and fatigue.⁷ Carbuncles usually develop in areas of the body where the skin is thick, such as the back of the neck.

Cellulitis

Cellulitis is a painful, erythematous infection of the dermis and subcutaneous tissues that is characterized by warmth, edema, and advancing borders. It commonly occurs near breaks in the skin, such as trauma, tinea infections, or ulcerations, but may occasionally present in the normal appearing skin;^{18,29} the pathogen generally invades through a breach in the skin surface, and infection is promoted by presence of tissue edema. Cellulitis is usually caused by *S. pyogenes* or *Staphylococcus* species.^{7,29}

Common physical findings in cellulitis include erythema, edema, warmth, and tenderness of the

affected area. In addition, patients may also experience fever, tender lymphadenopathy, and abscess formation, especially if *S. aureus* is implicated as the causative agent. Unlike erysipelas, the involved area in cellulitis is poorly demarcated.²² Cellulitis is generally considered a serious infection because of the propensity of the microorganism(s) to invade lymphatic tissue and blood; if left untreated, it can progress to adjacent tissues and cause an abscess, septic arthritis, or osteomyelitis.⁷

Erysipelas

Erysipelas, also known as St. Anthony's fire, is a superficial form of cellulitis with sharply demarcated borders. It usually presents acutely as an intensely erythematous infection, often with associated lymphatic streaking (involving dermis and dermal lymphatics).^{22,29} Erysipelas is often confused with cellulitis; however, there are few features, which may help in differentiating the two (box 2).³³ Clinically, it is more superficial, and is characterized by a bright red erythematous lesion with a sharp margin as opposed to the undefined border of cellulitis.⁷ This condition is often associated with fever, burning pain, and lymphangitis, caused by prominent lymphatic compromise of the affected area.¹⁸ However, lymphatic spread and subsequent bacteremia are rarely found because of the superficial nature of the disease, making blood culture collection unnecessary in suspected cases.² The most common pathogen causing erysipelas is *S. pyogenes*.

Contrary to the earlier trends which suggest facial involvement as the most common presentation, erysipelas most often develops on the lower extremities. Predisposing factors for this condition include *S. pyogenes* colonization of the skin or recent oropharyngeal

Box 2: Differentiating features of cellulitis and erysipelas

- Cellulitis involves the deeper dermis and subcutaneous fat; erysipelas involves the upper dermis and superficial lymphatics.
- Cellulitis may present with or without purulence; erysipelas is nonpurulent.
- Patients with erysipelas tend to have acute onset of symptoms with systemic manifestations including fever and chills; whereas patients with cellulitis tend to have a more indolent course with development of localized symptoms over a few days.

Source: Spelman D, Baddour LM. Cellulitis and skin abscess: Clinical manifestations and diagnosis. Available at: <https://www.uptodate.com/contents/cellulitis-and-skin-abscess-clinical-manifestations-and-diagnosis> [Accessed on 18/11/2017].

infection, dermatophyte infection between the toes or of the toenails (i.e., tinea pedis), chronic venous stasis, and preexisting leg ulcers.

MISJUDGMENT OF THE DISEASE (DIFFERENTIAL DIAGNOSES)

Because of its delicate and intricate anatomy and physiology, skin is very prone to irritation, abrasion or trauma, and even to the development of lesions generated from within its own structures (e.g.: folliculitis). Erythematous skin lesions may not always represent infections, and a broad range of differential diagnoses, both infectious and non-infectious, exist, which may present similar to common skin infections, (Table 3,4,5).^{17,32}

SURGICAL SITE INFECTIONS

Surgical site infections (SSIs) are usually divided into two categories: incisional SSIs, and organ or space SSI; while the incisional SSIs are further subdivided into superficial (skin and subcutaneous tissue) and deep (deep soft tissue–muscle and fascia) infections.³⁴ The

pathogens that are isolated from SSIs may vary with the type of surgical procedure. *S. aureus* is the usual cause of infections associated with clean surgical procedures in which the gastrointestinal, gynecologic, and respiratory tracts have not been entered; whereas a polymicrobial aerobic-anaerobic flora closely resembling the normal endogenous microflora of the surgically resected organ is most frequently found in other categories of surgical procedures, including clean-contaminated, contaminated, and dirty-infected. The diagnosis of SSIs is generally based on purulent incisional discharge; positive culture of aseptically obtained material; local signs of pain, swelling, erythema, and tenderness; or assessment by the attending surgeon/physician. Usually, majority of SSIs are seen to occur more than four days after the operation.⁷

MANAGEMENT OF BACTERIAL SKIN INFECTIONS

Diagnostic considerations

Similarities in the clinical presentation and limitations in ability to timely identify causative pathogens often makes

Table 3: Differential diagnosis for impetigo

Disease		Description
Contact dermatitis ^a		<ul style="list-style-type: none"> Patient would have recent contact with an unknown plant, chemical, or topical medicine. Lesions would be limited to exposed area. Distinguished by: sudden onset of severe pruritus; asymmetric distribution; location; allergy history.
Tinea corporis (ringworm) ^b		<ul style="list-style-type: none"> May form similar looking pustules, but has a clear central area surrounded by red, rash-like ring.
Viral skin diseases ^c		<ul style="list-style-type: none"> Viral skin diseases such as cold sores, shingles or chickenpox which may blister but have a clear exudate. Herpes simplex or herpes zoster may resemble impetigo; however, the lesions are not honey-colored. Cold sores usually occur singly around border of lips. Chickenpox lesions usually develop over the trunk and extremities as well as the face. Shingles follows a unilateral distribution along dermatome tracks.

Source: Superficial Bacterial Skin Infections - Guidelines for Prescribing Topical Antibiotics for impetigo and folliculitis. Available at: <http://medsask.usask.ca/professional/guidelines/superficial-bacterial-skin-infections.php> [Accessed on 13/11/2017].

Image sources: a. https://commons.wikimedia.org/wiki/File:Poison_ivy_contact_dermatitis.jpg b. https://commons.wikimedia.org/wiki/File:Ringworm_on_the-arm,_or_tinea_corporis_due_to_Trichophyton_mentagrophytes_PHL_2938_lores.jpg c. https://commons.wikimedia.org/wiki/File:Herpes_labialis_-_opryszczka-wargowa.jpg [Accessed on 22/11/2017].

Table 4: Differential diagnosis for folliculitis and furuncles (boils)

Disease		Description
Irritant folliculitis ^a		<ul style="list-style-type: none"> Caused by shaving, plucking, waxing, etc. Advise patient to stop hair removal procedure for three months after symptoms of folliculitis resolve. Topical antibiotics are not effective.
Acne vulgaris ^b		<ul style="list-style-type: none"> May present as pustules or cysts on face and upper back or gluteal area. Other acne lesions will likely be present.
Hidradenitis suppurativa ^c		<ul style="list-style-type: none"> It is the presence of boil-like pustules in the axillae and groin. Occurs more frequently in women of 20 - 40 years of age.

Source: Superficial Bacterial Skin Infections - Guidelines for Prescribing Topical Antibiotics for impetigo and folliculitis. Available at: <http://medsask.usask.ca/professional/guidelines/superficial-bacterial-skin-infections.php> [Accessed on 13/11/2017]

Image sources: a. <http://www.peds.org.uk/clinical-guidance/folliculitis-an-overview> b. <https://www.gponline.com/acne-clinical-review/dermatology/article/1186594> c. https://commons.wikimedia.org/wiki/File:12895_2011_Article_124_Fig1_HTML.jpg [Accessed on 22/11/2017].

Table 5: Differential diagnosis for cellulitis

Disease		Description
Erythema migrans ^a		<ul style="list-style-type: none"> Erythema migrans is an early manifestation of Lyme disease; it consists of a region of erythema at the site of a tick bite, often with central clearing and a necrotic center. The diagnosis is established based on serologic testing, although sensitivity in early disease is low. A similar lesion may occur in patients with southern tick-associated rash illness.
Herpes zoster ^b		<ul style="list-style-type: none"> The rash of herpes zoster begins as erythematous papules that evolve into grouped vesicles. The rash is generally limited to one dermatome but can affect two or three neighboring dermatome. The diagnosis is established by polymerase chain reaction.
Septic arthritis ^c		<ul style="list-style-type: none"> Cellulitis may overlie a septic joint. Clinical manifestations include joint pain, swelling, warmth, and limited range of motion. The diagnosis of septic arthritis is established based on synovial fluid examination.
Osteomyelitis ^d		<ul style="list-style-type: none"> Osteomyelitis may underlie an area of cellulitis. It is prudent to pursue imaging for assessment of bone involvement in the setting of chronic soft tissue infection that fails to improve with appropriate antibiotic therapy.

Non-infectious

Acute gout ^e		<ul style="list-style-type: none"> • Acute gouty arthritis consists of severe pain, warmth, erythema, and swelling overlying a single joint. • The diagnosis can be established by synovial fluid analysis, which should demonstrate characteristic urate crystals of gout or calcium pyrophosphate crystals of pseudogout. • Additional clues suggestive of gout include involvement of the first metatarsophalangeal joint, prior self-limited attacks of arthritis, and presence of tophi.
Vasculitis ^f		<ul style="list-style-type: none"> • The morphology of cutaneous lesions of vasculitis is variable. • Macular and papular lesions are characteristically nonblanchable due to presence of extravasated erythrocytes in the dermis, which occur as a result of damaged vessel walls. • The diagnosis is established by skin biopsy.
Deep venous thrombosis ^g		<ul style="list-style-type: none"> • Findings suggestive of cellulitis involving the lower extremity should prompt consideration of deep venous thrombosis; the evaluation consists of ultrasound evaluation.
Vaccination site reaction ^h		<ul style="list-style-type: none"> • A local reaction to vaccination manifests with erythema, swelling, and tenderness at the injection site; these are typically self-limited.

Sources: 1. Spelman D, Baddour LM. Cellulitis and skin abscess: Clinical manifestations and diagnosis. Available at: <https://www.uptodate.com/contents/cellulitis-and-skin-abscess-clinical-manifestations-and-diagnosis> [Accessed on 18/11/2017]. 2. Sukumaran V, Senanayake S. Bacterial skin and soft tissue infections. *Aust Prescr*. 2016;39(5):159-163.

Image sources: a. https://commons.wikimedia.org/wiki/File:Erythema_migrans_-_erythematous_rash_in_Lyme_disease_-_PHIL_9875.jpg b. https://commons.wikimedia.org/wiki/File:Herpes_zoster_back.png c. <https://www.omicsonline.org/india/septic-arthritis-peer-reviewed-pdf-ppt-articles/> d. https://www.researchgate.net/figure/46111248_Fig2_Figure-2-X-Ray-of-chronic-osteomyelitis-of-the-femur-with-bone-in-bone-appearance e. https://commons.wikimedia.org/wiki/File:Gout_in_foot.jpg f. <https://emedicine.medscape.com/article/333891-overview> g. <http://www.healthhype.com/deep-venous-thrombosis-leg-vein-clot-dvt-pictures-symptoms.html#prettyPhoto/2/> h. <http://vaccine-safety-training.org/vaccine-reactions.html>

the initial diagnosis and treatment of SSTIs challenging. It is therefore suggested that a careful assessment of the degree of severity, with a detailed medical history and physical examination would be required to appropriately diagnose and manage a patient presenting with an SSTI.⁷

Usually, as in most cases the diagnosis of SSTIs is based on clinical impression, the first step is the clinical suspicion of an SSTI; laboratory investigations then may help to confirm the diagnosis and elucidate characteristics of specific etiologies, but are seldom required as they are unlikely to change the management of localized SSTIs in otherwise healthy, immunocompetent patients.²⁰ As mentioned earlier in clinical presentation, the minimum criterion here is a skin lesion with cardinal signs of an

SSTI, such as erythema, edema, tenderness to palpation, and increased warmth;² while in some cases the affected area may also become dysfunctional depending on the severity of infection.¹⁷ The symptom that highly increases the suspicion of an SSTI is fever, and it is more likely to be present in deeper infections. Other signs and symptoms, such as fluctuance, crepitus, induration, blisters, or bullae may help the clinician determine the depth of infection or the presence of an abscess, thus helping to augment the clinical suspicion and confirm the diagnosis.¹⁷ Overall, in most cases of bacterial SSTIs, clinical examination and laboratory investigations (staining and/or culturing of a specimen of pus or exudates) is often adequate for making the diagnosis.¹⁸

Laboratory investigations

Laboratory investigations in bacterial SSTIs are generally used to support the initial clinical impression, and may include blood cultures, tissue swab with culture, needle aspiration, x-ray, ultrasound and computed tomography (CT) scan or magnetic resonance imaging (MRI) screen, depending on the clinical manifestations.

Blood culture

In the presence of systemic symptoms, such as fever and hypotension, blood cultures may help to assess for bacteraemia. However, it is here important to consider that blood cultures generally produce a low yield, with less than 5% of cases being positive;¹⁷ several studies in fact suggest that blood cultures are not necessary for most patients with SSTIs.³⁵ However, when indicated, selection of the medium is important, seeing that most pathogenic skin bacteria grow on artificial media. For general use, blood agar plates (preferably 5% defibrinated sheep blood) can be used, though in many situations, a selective medium together with a general-purpose medium is recommended; for instance, *S. aureus* may overgrow *S. pyogenes* in blood agar medium when both organisms are present, but when crystal violet (1 µg/ml) is added to the blood agar, *S. pyogenes* is selected over *S. aureus*.

Specimen collection for bacterial infections – tissue swabs vs. aspiration

Similar to bacterial culture, cultures of the secretions draining from skin lesions may assist in determining the causative organism, but this may have limited value when considering the initial management. For instance, culture of a bullae or purulent drainage may yield the causative pathogens; but, empiric therapy is usually initiated before culture results become available. Besides, ordering cultures may not always be cost effective.²

While collecting the tissue specimen, it is of utmost importance that the specimen is collected in such a way as to avoid contamination by skin flora or other normal flora from adjacent contaminated structures.³⁵ Usually, specimens from bacterial infection sites are collected with the help of a blade or by swabbing the involved areas of the skin.¹⁸ However, a typical difficulty with swab test could be in determining that which positive swab cultures represent the pathogenic agents and which represent skin colonization. Therefore, it is important that before swabbing, the ulcerated wound is debrided

and cleansed with normal saline irrigation to increase the diagnostic yield.

As follows, another important factor thus seems the need to collect tissue or fluid specimens, rather than swab samples, for culture.³⁵ Although swabs are inexpensive and easy to use, swab samples have several disadvantages (box 3), which may limit their clinical utility. Tissue swabs are likely to be most useful in wounds with skin breakdown characterized by cardinal manifestations of SSTIs, given high pretest probability of infection. Additionally, positive swabs of superficial ulcers in diabetic patients are also useful in determining the microbiological etiology of the underlying infection.¹⁷

When pustules or vesicles are present, a sterile surgical blade is used to remove the roof or crust, and the pus or exudate is then spread as thinly as possible on a clear glass slide for Gram-staining. Such staining method can provide preliminary (and often definitive) diagnoses more rapidly than can culture, but they also may be necessary for assessing the clinical relevance of culture results, particularly when cultures yield bacteria, which could be either pathogenic or a contaminant.³⁵

For some infections, such as postoperative wound infections or infections associated with fluid-filled vesicles, use of fine-needle aspiration has been found to be superior to the use of wound swabs for obtaining specimens.^{17,35} Similarly, for actinomycetes, collection of pus is done from closed lesions by aspirations using a sterile needle and syringe. This technique – needle aspiration –however remains a controversial investigation in SSTIs, with different approaches. This is because while some studies advise a leading edge aspirate, others advocate attempting a central aspirate. Nonetheless, evidence demonstrates no added benefit to either of the method. Furthermore, it has also been seen that patients with underlying diseases or fever are more likely to have positive needle aspirate cultures. From draining sinuses, specimen is collected by holding a sterile test tube at the edge of the lesion and allowing the pus and granules to run into the tube. Pus and other exudates are then examined microscopically.¹⁸

Imaging studies

Imaging studies are not routinely performed in SSTIs, and generally performed only when suspecting deeper infections. Here, both an x-ray and ultrasound may be used to explore the subdermal involvement in SSTIs.¹⁷ The x-ray may reveal bony involvement, such as with

Box 3: Disadvantages of swabs

- They are more likely than tissue or fluid specimens to be contaminated
- They contain and release insufficient volumes of specimen for culture
- They inhibit the growth of certain pathogens
- Bacteria survive less well in swabs than in aspirated fluid or pus
- Microorganisms may adhere to swabs and, therefore, not appear on Gram staining, giving a false-negative test result.

Source: Wilson ML, Winn W. Laboratory Diagnosis of Bone, Joint, Soft-Tissue, and Skin Infections. *Clinical Infectious Diseases* 2008; 46:453–7.

osteomyelitis, though its sensitivity and specificity is limited. Furthermore, x-rays may reveal presence of air in the tissues or air fluid levels, which indicate presence of gas-producing organisms such as Clostridium species. On the other hand, ultrasound (USG) may be used to investigate fluctuance and crepitus, and to detect fascial inflammation or abscess formation.^{2,36} Nevertheless, if a more detailed exploration of the deeper soft-tissues is desired, a computerized tomography (CT) scan or a magnetic resonance imaging (MRI) screen may be considered. Both CT and MRI are most helpful in diagnosing patients with rapidly progressive skin infections, which often present superficially later in their course.¹⁷ Both of these imaging methods may show air in the tissues or enhancement with intravenous contrast, but these signs are not specific to necrotizing SSTIs. Even so, they may have therapeutic significance in cases which require early surgical evaluation. MRI can help to determine the depth of infection by showing increased thickness and/or enhancement of the fascia; though in some instances it has also been noted to overestimate the depth of the infection.²

Treatment considerations

Generally, most bacterial SSTIs common in primary care can often be managed in an outpatient setting,³⁷ and only in few cases more urgent care or inpatient management would be required. This makes it important that primary care providers are able to diagnose, manage, and provide appropriate care for frequently seen skin infections.³⁸ However, physicians must concurrently remain alert for signs and symptoms indicative of a more serious infection, and requiring rapid evaluation and hospital admission (box 4);² patients with evidence of rapidly progressive infection, high fevers, or other

signs of systemic inflammatory response would require monitoring in the hospital setting.

An adequate treatment in bacterial SSTIs must assess the severity of the infection, the patient comorbidity and the risk for multidrug-resistant microorganism.^{16,39} In general, purulence is indicative of a staphylococcal infection for which incision and drainage (I & D) is the key management component, unlike non-purulent infections which tend to be streptococcal and for which antibiotic therapy is the mainstay of treatment.⁹ Furthermore, it is important to include basic wound care techniques, including dressings, as part of the management of SSTIs. Wound dressings may range from debriding agents to growth-enhancing measures, and constitute part of the overall management of SSTIs as they may enhance the healing process.²

When to use topical and systemic therapy?

Management of bacterial SSTIs requires antibacterial therapy that may be administered either topically or systemically, depending on the extent and severity of the infection.⁴⁰ In this context, recent data supports the use of topical antibiotics (generally given for 5 days) for simple infections confined to the skin and underlying superficial soft tissues, such as non-complicated impetigo; whereas systemic antibiotics covering Gram-positive cocci are recommended for complicated cases of impetigo and deeper non-purulent SSTIs.

As mentioned earlier, I&D represent the mainstay of therapy for all purulent SSTIs.⁷ Localized mild purulent bacterial SSTIs can be treated with I&D alone, but more systemic involvement would require treatment with systemic antibiotics covering *S. aureus* species, especially the community acquired MRSA; box 5 summarizes conditions in which antibiotic therapy is recommended after I&D.^{7,10} Furthermore, moderate purulent infections are treated with I&D and oral antibiotics; while severe purulent infections are treated with I&D and an initial course of intravenous (i.v.) antibiotics followed by oral antibiotics when appropriate.⁷ Similarly, mild non-purulent infections are treated with oral antibiotics, whereas moderate non-purulent infections are treated with an initial course of i.v. antibiotics followed by oral antibiotics when appropriate. Severe non-purulent infections are treated with surgical debridement and i.v. antibiotics.⁷ Table 6 provides dosing regimens of different antimicrobial agents used to treat SSTIs in adults and children.¹⁷

Box 4: Factors that favor hospital management of SSTIs

- Comorbid conditions (renal impairment, diabetes, congestive cardiac failure, splenectomy) or immunosuppression
- Rapidly progressive infection
- Concern for deep space infection (presence of bullae, necrosis or muscle involvement)
- High fevers and rigors
- Hemodynamic instability
- Suppurative wound or bite (especially on face or hand) requiring surgical drainage
- Lack of systemic or local response to oral antibiotics, or rising or unchanging C-reactive protein (CRP) concentrations despite adequate therapy
- Positive blood cultures
- Inability to tolerate or absorb oral antibiotics.

Source: Sukumaran V, Senanayake S. Bacterial skin and soft tissue infections. *Aust Prescr*. 2016;39(5):159–163.

Advantage of topical antibacterial agents

As mentioned above, superficial skin infections usually do not require systemic treatment and respond to topical agents. In fact, topical therapies seem to represent the key component in control of simple infections confined to skin and underlying superficial soft tissues;⁴¹ they can be effective in management of most minor skin infections such as impetigo and also secondarily infected skin lesions such as eczema, ulcers, or lacerations.⁴²

Furthermore, the advantage of such topical administration is evident; extremely high local concentrations can be achieved in the infected skin usually without any systemic side effects.^{43,44} Common antibacterial agents available for topical administration include fusidic acid, mupirocin, and the newer retapamulin. Fusidic acid is active against most Gram-positive bacteria, but is particularly active against staphylococci. Mupirocin is a fermentation product of *Pseudomonas fluorescens*. Retapamulin is a newer antibacterial agent, the first of the pleuromutilins, approved for use in treatment of superficial skin infections due to MRSA and *S. pyogenes*.⁴⁰

Herein, an ideal topical antibiotic should be selective (thus, minimizing cross-resistance), have weak sensitization potential, penetrate the skin efficiently, reach adequate local doses at the site of infection, and finally be available in formulations matching the patients' preferences and needs.⁴⁵ Fusidic acid, a selective antibiotic, perhaps meets many of these characteristics, and has been used for different skin infections. In vitro data related to

Box 5. Conditions in which antibiotic therapy is recommended after I&D

- Abscess in area difficult to drain completely
- Associated comorbidities or immunosuppression
- Associated septic phlebitis
- Extremes of age
- Lack of response to incision and drainage alone
- Severe or extensive disease
- Signs and symptoms of systemic illness

Source: Chahine EB, Sucher AJ. Skin and Soft Tissue Infections. *PSAP* 2015:5–26.

fusidic acid has shown that, it has good activity against staphylococci, including both methicillin sensitive and resistant strains, and also has useful activity against *Neisseria* spp, *Bordetella pertussis*, *Corynebacterium* spp and Gram positive anaerobes such as *Clostridium difficile* and *C. perfringens*, *Peptostreptococcus* spp and *Propionibacterium acnes*.^{46,47} In dermatology, the major place of fusidic acid is in the treatment of mild to moderately severe SSTIs, e.g. impetigo, folliculitis, furunculosis, abscesses and infected traumatic wounds; it has been observed to exhibit good penetration to a number of tissues including skin blisters, burns, infected bone and joints.⁴⁸ In fact, pharmacokinetic and pharmacodynamic studies have shown that, in contrast to other topical antibiotics such as gentamicin or mupirocin, fusidic acid exhibits exceptionally good skin penetration and reaches high antimicrobial concentrations at deep skin layers after topical application either on intact or damaged epidermis.⁴⁵

In all, the anti-microbial activity of fusidic acid is specifically aimed at the most common skin pathogens, including *S. aureus*, towards which it has emerged as one of the most potent antibiotics, and it is hence used for the treatment of staphylococcal infections both in hospitals and in community settings.^{49,50} It is licensed in several parts of the world - Western Europe, Canada, Australia, New Zealand and numerous countries in Asia - for the topical treatment of superficial staphylococcal infections affecting the skin.⁴⁹

Overall, data on clinical efficacy, safety, sensitization potential, resistance profile and spectrum selectivity makes fusidic acid a first-choice option in the treatment of primary and secondary skin infection.^{45,46} The optimal dosage schedules of topical fusidic acid 2% cream for treatment of localized pyoderma are up to 3 times daily for up to 10 days.⁸ It has been seen that plain fusidic acid used 2 or 3 times daily in SSTIs, such as impetigo,

Table 6: Common antibacterial agents (topical and systemic) used for SSTIs

Agent	Dosing regimen ^{a,b}
Topical Antibiotics	
Fusidic acid	Localized pyoderma: Apply topical fusidic acid 2% cream up to 3 times daily for up to 10 days
Mupirocin	Skin infections ≥ 2 months: Apply to affected area twice daily for 5 days MRSA decolonization ≥ 12 years: Apply to anterior nares twice daily for 5 days
Retapamulin	Impetigo ≥ 9 months: Apply to affected area twice daily for 5 days
Systemic Antibiotics	
Amoxicillin/clavulanic acid	Adults and children ≥ 40 kg: 875 mg of amoxicillin PO twice daily Children < 40 kg: 25 mg/kg/day of amoxicillin PO divided into 2 doses
Cefazolin	Adults: 1 g IV three times daily Children: 50 mg/kg/day IV divided into 3 doses
Ceftriaxone	Adults: 1 g IV daily Children: 50–75 mg/kg/day IV divided into 1 to 2 doses
Clindamycin	Adults: 300–450 mg PO four times daily Adults: 600 mg IV three times daily Children: 20–40 mg/kg/day IV/PO divided into 3 doses
Dicloxacillin	Adults and children ≥ 40 kg: 250–500 mg PO four times daily Children < 40 kg: 25–50 mg/kg/day PO divided into 4 doses
Doxycycline ^c	Adults and children > 45 kg: 100 mg PO twice daily Children ≥ 8 years and ≤ 45 kg: 2 mg/kg PO twice daily
Linezolid	Adults and children ≥ 12 years: 600 mg IV/PO twice daily Children < 12 years: 10 mg/kg/day IV/PO twice daily
Minocycline ^c	Adults: 200 mg PO on day 1 followed by 100 mg twice daily Children ≥ 8 years: 4 mg/kg PO on day 1 followed by 2 mg/kg twice daily
Penicillin G	Adults: 2–4 million units IV four to six times daily Children: 60,000 to 100,000 units/kg/dose IV four times daily
Penicillin VK	Adults: 250–500 mg PO four times daily Children: 25–50 mg/kg/day PO divided into 2 to 4 doses
Piperacillin-tazobactam	Adults and children > 40 kg: 3.375 g IV three or four times daily Children ≤ 40 kg: 100 mg/kg of piperacillin IV three times daily
Trimethoprim/sulfamethoxazole ^c	Adults: 1 to 2 DS tablet(s) PO twice daily Children: 8–12 mg/kg/day of trimethoprim divided into 4 doses IV or 2 doses PO
Vancomycin	Adults: 30 mg/kg/day divided into 2 doses Children: 40 mg/kg/day divided into 4 doses

^aDoses recommended for patients with SSTIs based on normal kidney and liver functions. ^bPediatric regimens exclude dosing for neonates and infants. ^cNot active against *Streptococcus pyogenes*. DS = double strength (160 mg of trimethoprim and 800 mg of sulfamethoxazole); IV = intravenously; MRSA = methicillin-resistant *Staphylococcus aureus*; PO = per oral.

Sources: 1. Chahine EB, Sucher AJ. Skin and Soft Tissue Infections. *PSAP* 2015;5–26. 2. Palit A, Inamadar AC. Current concepts in the management of bacterial skin infections in children. *Indian J Dermatol Venereol Leprol* 2010;76:476–88. 3. Schöfer H, Simonsen L. Fusidic acid in dermatology: an updated review. *Eur J Dermatol*. 2010;20(1):6–15

is clinically and bacteriologically effective, with minimal adverse events.^{51,52}

Challenges posed by rapid growth of MRSA

Antibiotic resistance remains a pervasive healthcare concern, given that many SSTIs are caused by MRSA and multidrug resistance is common with both community-acquired and hospital-acquired-MRSA infections. In fact, a rapid increase in the rates of community-associated MRSA skin infections has been noticed worldwide,⁵³ which can result in mild to severe SSTIs. It is therefore important to consider the possibility of this pathogen if contemplating empirical antibiotic therapy for bacterial skin infections.¹

However, since antibiotic sensitivities generally show geographic variations, physicians should familiarize themselves with local susceptibility patterns of commonly encountered organisms. Culture and susceptibility testing of lesions should be used to guide therapy because community-associated MRSA frequently show resistance to beta-lactam antibiotics such as flucloxacillin, dicloxacillin and the cephalosporins.¹ For minor skin infections caused by community-associated MRSA, non-antibiotic treatment consisting of soaks, I&D, and possibly topical antibiotic therapy, suffice. However, once MRSA is confirmed in mild, non-life-threatening SSTIs, clindamycin, trimethoprim-sulfamethoxazole or doxycycline may be used as first-line agents. For MRSA-positive life-threatening lesions, therapy with i.v. vancomycin, clindamycin or trimethoprim-sulfamethoxazole is recommended.¹⁷ Hospital-acquired MRSA is generally susceptible to vancomycin, linezolid, and trimethoprim-sulfamethoxazole. Similarly, community-acquired -MRSA is also usually sensitive to these antibiotics and a broader range of oral antimicrobial agents such as clindamycin.²

PREVENTION OF RECURRENT SKIN INFECTIONS

Prophylactic antibiotic therapy is an option that can be considered for patients with recurrent SSTIs (typically defined as two or more SSTIs at different body sites within 6 months).²⁷ However, whether this addition has a significant impact on future infections or contributes to microbial resistance in patients with erysipelas and cellulitis remains unclear. Long-term therapy is hence usually avoided and reserved for patients without a clear and treatable predisposing condition. Furthermore, other measures to help prevent recurrent SSTIs should

consider treating concomitant fungal infections, reducing edema by compressive stockings, leg elevation, or diuretic therapy and keeping the skin moist to avoid fissures, as possible options.^{2,17}

As nasal colonization with *S. aureus* has been identified as a risk factor for subsequent MRSA infection, different strategies for decolonization may be used in outpatient setting for those with recurrent infections despite appropriate preventive measures. One such strategy is use of topical intranasal antibacterials, either alone or in combination with a skin antiseptic solution, such as chlorhexidine or hexachlorophene, for 5–14 days.⁷ Oral antibiotics are not routinely recommended for decolonization, but a 5- to 10-day course of rifampin together with doxycycline or trimethoprim/sulfamethoxazole may be considered for recurrent infections despite other preventive (appropriate hygiene) and decolonization (nasal and/or topical) measures.⁷

MANAGEMENT OF SECONDARY BACTERIAL INFECTIONS

Role of steroids + antibiotic combination

In primary dermatoses, local application of specific therapies (e.g., steroids) is the mainstay of therapy; nonetheless, given that these are often superimposed by secondary bacterial infections, management of the latter is also essential. In fact, the growing knowledge of the role of *S. aureus* in exacerbating other skin conditions like atopic dermatitis contributes to a plausible rationale for the use of antibiotics when treating atopic dermatitis.⁵⁴ In atopic dermatitis patients, *S. aureus* colonizes almost all eczematous lesions; and this colonization is felt to be both a consequence and a cause of the skin inflammation.^{55,56} Specific anti-infective therapy hence provides an opportunity of fine-tuning and optimizing the treatment in cases of secondary bacterial skin infections complicating skin lesions.⁵⁷ In fact, even when overt infection is not present, the use of anti-staphylococcal agents with topical corticosteroids has been shown to produce greater clinical improvement than topical corticosteroids alone. In many such complications, local application of antibacterial agents and drainage of pus are important components of the treatment, though treatment of serious infection would require systemic antimicrobial therapy.²⁴

Secondary bacterial infection may exacerbate eczema, making it less responsive to topical corticosteroids,

and thus contributing to induction of corticosteroid resistance.⁵⁵ Therefore, combination therapy with corticosteroids and antibiotics is often recommended in the treatment of secondary bacterial skin infections complicating other dermatoses. Combination preparations that contain an antibacterial and a topical steroid and that work quickly are expected to improve compliance and thus treatment outcome.

The pathophysiologic rationale for combination treatment with topical steroids and antibiotics is to reduce inflammation and improve the skin barrier function with steroids, while using antibiotics to reduce *S. aureus* load and chronic inflammation. Furthermore, use of an antimicrobial agent with a low- or mid-potency corticosteroid may potentially allow use of a lower strength corticosteroid, thereby, mitigating some side-effects associated with higher strength corticosteroid monotherapy.⁵⁵ In clinically infected lesions, as well as other lesions where *S. aureus* colonization is suspected as a contributing factor, short-term (3 times daily for 2 weeks) combination topical therapy with an antibiotic and corticosteroid is widely used. Systemic antimicrobial therapy for systemic generalized involvement is often used for 7-10 days.

A number of antibacterial + steroid topical combinations are available, which include combinations with hydrocortisone 1% or with a potent topical corticosteroid such as betamethasone valerate 0.1%.⁵⁴ In these combinations, fusidic acid has advantages over other available topical antibacterial agents – neomycin, gentamicin, clioquinol, and chlortetracycline. As mentioned earlier, the drug shows very good penetration into the skin, and has high anti-staphylococcal activity even against MRSA. Unlike neomycin and gentamicin, fusidic acid has a very low potential to sensitize and induce contact allergic dermatitis; and also has very good cosmetic acceptability, unlike clioquinol and chlortetracycline, which can mark clothes and bedding.⁵⁴ The combination of fusidic acid + steroid works quickly with observable improvement within the first week.

A major concern in using topical antibiotics is the emergence of antibiotic drug resistance, and this could be of particular importance with an antibiotic like fusidic acid, which has a major role against methicillin-resistant staphylococci.⁵⁸ However, it has been observed that since the launch of topical fusidic acid, resistance levels to this antibiotic have remained low. Studies have shown that short-term (2 weeks) use of fusidic acid + corticosteroid

combinations effectively controls infection without risk of drug resistance development.⁵⁴ In fact, even with prolonged treatment of up to one year, as long as fusidic acid preparation is only used for 2 weeks each month, there is no selective pressure on *S. aureus* to develop fusidic acid resistance.

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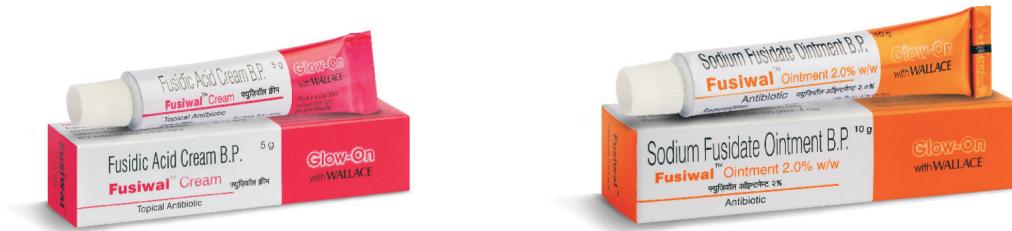
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Rx

Fusiwal

(Sodium Fusidate 2% w/w Ointment / Fusidic Acid 2% w/w Cream)

Skin Deep Solution



Rx

Fusiwal B

(Fusidic Acid 2% w/w + Beclomethasone Dipropionate 0.025% w/w) Cream

Combined Power for Excellence



Rx

Fusiwal M

(Fusidic Acid 2% w/w + Mometasone Furoate 0.1% w/w)



Cream

Potent yet Safe in Infected Dermatoses



Rx

Fusiwal

(Sodium Fusidate 2% w/w Ointment / Fusidic Acid 2% w/w Cream)

Skin Deep Solution



Rx

Fusiwal B

(Fusidic Acid 2% w/w + Beclomethasone Dipropionate 0.025% w/w) Cream

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