skin infections

aetiology & treatment

Disease	Suspected pathogens	Antibiotic therapy	Remarks
Impetigo	*S. aureus*, group A streptococci	First generation cephalosporin, erythromycin, penicillin, dicloxacillin.	
Folliculitis	*S. aureus*, *Candida* spp., *Pseudomonas aeruginosa*, *Pityrosporum ovale*		Local therapy usually sufficient, antibiotic treatment only with cellulitis.
Erysipelas	Group A streptococci (occasionally group B, C, G), *S. aureus*	Penicillin (if no underlying disease and possible to observe), 1st-generation cephalosporin, flucloxacillin.	Enterobacteriaceae in diabetes; 3rd-generation cephalosporin or carbapenem.
Cellulitis	Group A streptococci, *S. aureus*; rarely, various other organisms	Flucloxacillin, 1st-generation cephalosporin, erythromycin (for severe penicillin allergy)	Resistance in *S. pyogenes* and *S. aureus* against erythromycin exists.
Necrotizing fasciitis	Type I: Anaerobic species (Bacteroides, peptostreptococcus spp.), together with facultative anaerobes non-A streptococci, enterobacteriaceae (*E. coli*, *Enterobacter*, *Klebsiella*, etc.) Type II: group A streptococci alone or with *S. aureus*	Carbapenem, 3rd-generation cephalosporin plus clindamycin	Surgical debridement absolutely essential. Empirical therapy must cover for all pathogens.
Pyomyositis	*S. aureus*, group A streptococci (rarely). Gram-negative bacilli (very rarely), anaerobic bacteria other than *Clostridium*	Flucloxacillin, or 1st generation cephalosporin plus clindamycin.	Surgical drainage absolutely essential. Cave compartment syndrome. Change to penicillin, if streptococcal origin.
Myonecrosis	*Clostridium perfringens*, *C. septicum*	High dose penicillin plus clindamycin 3 × 600 mg i.v.	Surgical exploration and debridement crucial with open wound healing; hyperbaric oxygen debated.

*Once causative pathogen(s) has(ve) been identified, antibiotic choice can be modified and spectrum narrowed.

general

- Staphylococcus aureus is the most common cause of cutaneous infection as a primary pathogen, a source of secondary infection on an underlying dermatosis, and as a superantigen where it causes an inflammatory cascade manifesting clinically as recalcitrant dermatitis.
- In all longstanding cases of S. aureus infection, a nasal or perineal carrier state should be suspected. Other family members easily acquire the bacteria, with or without frank infection, and they may become carriers. S. aureus most often causes superficial infections, which are not hazardous and can sometimes be managed by topical therapy only.
- Cutaneous infections may also be due to beta-haemolytic streptococci, usually group A (Streptococcus pyogenes).
- Although this organism may also cause trivial superficial infections, it has a tendency to become invasive, resulting in cellulitis.
- Streptococcal skin infections may be complicated by a variety of post-infectious immune-mediated diseases (eg glomerulonephritis and vasculitis) and should therefore always be treated with systemic antibiotics.
- Other bacteria causing skin infection are encountered uncommonly.
- The incidence of Haemophilus influenzae cellulitis previously seen in young children is now much lower because of immunisation.
- Pseudomonas aeruginosa rarely causes frank infection, although moist areas or ulcers may be colonised.

cellulitis

- The causative organism in spontaneous rapidly spreading cellulitis is almost always Streptococcus pyogenes.
- Staphylococcus aureus is important with wound-associated purulent cellulitis.
- Now that Hib vaccination is widespread, Haemophilus influenzae rarely causes cellulitis.
- Cellulitis following an injury in fresh or seawater may be caused by Aeromonas or Vibrio species and appropriate specimens should be taken and initial antimicrobials commenced
- In immunosuppressed patients, a wide variety of organisms including Gram-negative bacteria, fungi and mycobacteria may also be responsible.

- Cellulitis in children is often periorbital.
- Cellulitis in adults most often affects the lower legs.
- It is often unilateral, at least initially, and there is usually an underlying condition or abnormality (eg tinea pedis, fissured dermatitis, lymphoedema, lymphatic malformation, previous deep vein thrombosis, vascular surgery, radiotherapy).
- A search for a portal of entry should be made to prevent possible recurrences.
- Recurrent cellulitis may result in lymphoedema, which in itself worsens the situation.
- Cellulitis may also complicate wounds (eg cuts, abrasions), insect bites or scabies.

- Erysipelas is a localised superficial form of cellulitis classically involving the face.
- It presents with a sudden onset of butterfly erythema associated with fever, and constitutional upset.
- There may be an underlying facial sinus or dental infection.
- It is almost always caused by Streptococcus pyogenes.
- Dental examination and imaging of sinuses is recommended.
- Recent evidence indicates that erysipelas is also commonly found on the lower legs where it resembles a well-demarcated superficial cellulitis.

Severe cellulitis
- If patient has significant systemic features or is not responding to oral therapy after 48 hours, commence IV therapy.
- Rest and elevation of the affected area are advisable.
- If the skin has eroded, use nonstick dressings.
- IV therapy should be continued until the patient is afebrile and the erythematous rash has substantially improved. This may vary from 3 days to 2 weeks.
- The patient can then change to oral therapy for a further 10 days.
- To treat infection with either streptococci or staphylococci, use initially:
flucloxacillin 2 g (child: 50 mg/kg up to 2 g) IV, 6-hourly.
- For patients hypersensitive to penicillin (excluding immediate hypersensitivity), use initially:
cephalothin 2 g (child: 50 mg/kg up to 2 g) IV, 6-hourly
OR
cephazolin 2 g (child: 50 mg/kg up to 2 g) IV, 8-hourly.
For patients with immediate penicillin hypersensitivity, use initially:
clindamycin 450 mg (child: 10 mg/kg up to 450 mg) IV or orally, 8-hourly
OR
lincomycin 600 mg (child: 15 mg/kg up to 600 mg) IV, 8-hourly
OR
vancomycin 25 mg/kg up to 1 g (child <12 years: 30 mg/kg up to 1 g) IV, 12-hourly (monitor levels)

diabetic foot infections

- Always regard diabetic foot infections as serious, and treat vigorously.
- Culture may be unhelpful because of polymicrobial infections and superficial colonisation, but may guide therapy particularly if Staphylococcus aureus or multiresistant pathogens are found. Anaerobic organisms are almost always involved, often with mixed Gram-positive and Gram-negative aerobic organisms.
- Surgical debridement is often necessary and antibiotic therapy should be effective against the mixed aerobic and anaerobic organisms frequently responsible.
- Consider underlying osteomyelitis or septic arthritis.
- Assess vascular supply.

- For severe limb- or life-threatening infection (systemic toxicity/septic shock, bacteraemia, marked necrosis/gangrene, ulceration to deep tissues, severe cellulitis, presence of osteomyelitis), use initially:
piperacillin+tazobactam 4+0.5 g IV, 8-hourly
OR
ticarcillin+clavulanate 3+0.1 g IV, 6-hourly
OR
meropenem 500 mg IV, 8-hourly.
- Alternatively, and for patients with penicillin hypersensitivity, use initially:
ciprofloxacin 400 mg IV, 12-hourly or ciprofloxacin 750 mg orally, 12-hourly
PLUS EITHER
clindamycin 900 mg IV, 8-hourly (slow infusion required)
OR
lincomycin 900 mg IV, 8-hourly (slow infusion required).
- Depending on the organisms subsequently isolated from deep tissue specimens, other antibiotic combinations may be indicated.
- The duration of IV treatment will depend upon the response.
- Change to oral therapy after substantial improvement

water-related infections

General
- In a patient presenting with a wound infection, cellulitis or sepsis, which may be related to contact with water (eg in fishermen, swimmers or aquarium owners), the following organisms may be encountered:
(i) Aeromonas species (source: fresh or brackish water);
(ii) Mycobacterium marinum (source: fish tanks);
(iii) Shewanella putrefaciens,
(iv) Vibrio vulnificus, Vibrio alginolyticus and other noncholera vibrios (source: salt or brackish water).
- Treatment of most of these infections is difficult and advice should be sought from a clinical microbiologist or an infectious diseases physician.

Mycobacterium marinum
- Mycobacterium marinum causes a localised papular or nodular skin lesion associated with exposure to fresh water (fish-tank or swimming-pool granuloma).
- Diagnosis is often made by biopsy, and antibiotic therapy may not be required if a single lesion is successfully excised - seek expert advice.
- There have been no controlled trials that compare the multiple treatment regimens for M. marinum. Combination therapy may be preferable to monotherapy, particularly in severe or unresponsive cases.
- The optimal duration of therapy is not known, but treatment is suggested for 1 to 2 months after the resolution of all lesions (typically 3 to 4 months in total). Use:
clarithromycin 500 mg (child: 12.5 mg/kg up to 500 mg) orally, 12-hourly
OR
doxycycline 100 mg (child >8 years: 2.5 mg/kg up to 100 mg) orally, 12-hourly
OR
trimethoprim+sulfamethoxazole 160+800 mg (child: 4+20 mg/kg up to 160+800 mg) orally, 12-hourly.
- In severe or unresponsive cases, consider combination therapy (eg clarithromycin plus rifampicin or ethambutol).

Vibrio species
- Vibrio species should be suspected in skin infections in patients who have been exposed to salt water.
- Life-threatening infection can rapidly develop in patients with cirrhosis or iron overload.
- Local management of skin lesions may include incision, drainage and debridement.
- There is considerable variability in antimicrobial susceptibility.
- Initial treatment should include:
doxycycline 200 mg (child >8 years: 5 mg/kg up to 200 mg) orally or IV, for the first dose, followed by doxycycline 100 mg (child >8 years: 2.5 mg/kg up to 100 mg) orally or IV, 12-hourly.
- Alternative antibiotics which could be considered are cefotaxime, ceftriaxone, ciprofloxacin or minocycline.

Coral cuts
- Coral cuts are often infected with Streptococcus pyogenes, but infection may also occur with marine pathogens.
- For mild infection, treat as for impetigo, and if unresponsive or severe, treat as for severe cellulitis.
- Treatment may need to be modified depending on response and culture results.

Aeromonas species
- Infections by Aeromonas species are associated with exposure to fresh or brackish water or mud (water activities, caving) through cuts and abrasions. The resulting illness may be a superficial skin infection, myositis or sepsis with metastatic complications.
- In about 25% of cases the patient has an underlying systemic illness. Use:
ciprofloxacin 400 mg (child: 10 mg/kg up to 400 mg) IV, 12-hourly
or ciprofloxacin 500 mg (child: 10 mg/kg up to 500 mg) orally, 12-hourly.
- meropenem or imipenem are possible alternatives for polymicrobial infection.