Recommended management of common bacterial skin infections

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Topical treatment of bacterial skin infections should be reserved for very mild cases, otherwise systemic antibiotics are recommended. Our Drug review discusses the features of common infections and their usual treatment, followed by sources of further information.

Although the skin is populated with a very large number of bacteria that may be resident or transiently carried, it forms a very effective barrier against invasion. It is tough, constantly desquamating and self-renewing, dry and acidic in pH, all of which contribute to its defence. In order for bacterial infection to develop, the defensive mechanisms of the skin must be overcome. The commonest conditions predisposing to bacterial skin infections (BSIs) involve breaches to the integrity of the skin barrier. Trauma such as lacerations, abrasions, excoriation, inflammatory skin conditions and ulceration associated with vascular disease may all render the skin vulnerable.

The primary bacterial infections of the skin most commonly encountered in clinical practice are due to either *Staphylococcus aureus* or *Streptococcus pyogenes*, or both organisms together.

Common primary infections

BSIs may be classified according to the level of involvement of skin and associated structures, such as hair follicles, and by whether or not there is extension of infection into the lymphatics and subcutaneous tissue. Pathogens most frequently implicated in commonly encountered primary BSIs are outlined in Table 1.

**Impetigo (see Figure 1)**

Impetigo is a superficial, intraepidermal BSI. The infection and associated skin lesions are confined to the epidermis and do not ulcerate and, therefore, heal without scarring. Clinically there are two recognised forms of impetigo: bullous, which is due to certain strains of *Sta. aureus* that produce an exfoliative toxin, and nonbullous, which is most commonly caused by *Sta. aureus* but may be caused by *Str. pyogenes* alone or in combination with *Sta. aureus*. The nonbullous form is most common, accounting for almost 75 per cent of cases.
Bacterial skin infections

Impetigo occurs more frequently in children than adults, and is most common during hot and humid summer weather. The most common sites of lesions in nonbullous impetigo are exposed areas of skin, such as on the face or extremities, and there is frequently a predisposing breach in skin integrity with a cut or area of excoriation. Impetigo develops as superficial vesicles and pustules that then rupture, with the purulent discharge forming a thick adherent crust ‘stuck on’ to the underlying erythematous area.

Management requires antibacterial therapy that may be administered either topically or systemically, depending on the extent and severity of the infection. Where impetigo is mild, nonbullous and the lesions localised, topical antibacterial therapy is appropriate. Efficacy of topical antibiotic therapy is increased if crusting areas are removed before application by soaking in soapy water.

Fusidic acid is the first-line recommended topical agent and should be used three to four times per day. Retapamulin (Altargo) and mupirocin are alternative treatments.  

Table 1. Pathogens most frequently implicated in common primary bacterial skin infections

<table>
<thead>
<tr>
<th>Infection</th>
<th>Bacterium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impetigo</td>
<td>Sta. aureus alone</td>
</tr>
<tr>
<td></td>
<td>Sta. aureus with Str. pyogenes</td>
</tr>
<tr>
<td></td>
<td>Str. pyogenes alone</td>
</tr>
<tr>
<td>Folliculitis</td>
<td>Sta. aureus</td>
</tr>
<tr>
<td>Furuncles (boils)</td>
<td>Sta. aureus</td>
</tr>
<tr>
<td>and carbuncles</td>
<td>Str. pyogenes</td>
</tr>
<tr>
<td>Erysipelas</td>
<td>occasionally Group C or G beta-haemolytic streptococci</td>
</tr>
<tr>
<td>Cellulitis</td>
<td>Str. pyogenes</td>
</tr>
<tr>
<td></td>
<td>Sta. aureus</td>
</tr>
<tr>
<td></td>
<td>Str. pyogenes plus Sta. aureus</td>
</tr>
<tr>
<td></td>
<td>Group B, C or G beta-haemolytic streptococci</td>
</tr>
</tbody>
</table>

Figure 1. Topical treatment of impetigo is best reserved for very mild infection or very localised lesions
Pamulin is a topical antibacterial approved for use in impetigo in patients aged nine months or over that is generally recommended as second-line treatment if use of fusidic acid has failed. As mupirocin is an essential component of the topical decolonisation schedule for meticillin-resistant Staphylococcus aureus (MRSA), first-line use of mupirocin should be reserved for the treatment of impetigo caused by MRSA. Topical treatments are prescribed for five days.

Due to concerns about increasing antimicrobial resistance, it has been recommended that topical antibiotic therapy should be used judiciously. It is best reserved for cases where infection is very mild and limited to very localised lesions. If lesions are widespread or the infection is more severe, then systemic antibacterial therapy is indicated. First-line recommended oral antibiotic therapy is flucloxacillin with erythromycin or clarithromycin as an alternative if the patient has a history of penicillin allergy. Recommended treatment duration with oral antibiotics is seven days.

As impetigo is very infectious, it is advised that children should stay away from school or nursery until the lesions have scabbed over, or for 48 hours after starting antibiotic treatment.

Ecthyma resembles impetigo but extends deeper to the dermis. This BSI is more commonly encountered in debilitated and older patients and most frequently occurs on the lower extremities. Lesions appear as shallow skin ulcers covered by thick, adherent crusts and heal to leave scarring. Treatment with the same systemic antibacterial therapy as for impetigo is indicated.

**Folliculitis (see Figure 2)**

Bacterial infection occurring within hair follicles results in folliculitis. Staphylococcus aureus is the usual cause, most frequently seen in the beard region, axillae or buttocks. Occasionally, folliculitis may follow pseudomonal infection associated with inadequately chlorinated water in whirlpools or hot tubs, with lesions classically occurring on the trunk.
Superficial staphylococcal folliculitis may respond well to simple local antiseptic measures, but recalcitrant cases may require topical antibacterial therapy with an antistaphylococcal antibiotic such as fusidic acid.

If the folliculitis is widespread or severe, then systemic therapy with an oral antistaphylococcal agent such as flucloxacillin or erythromycin for seven days may be warranted. Erythromycin or clarithromycin is an alternative for patients with penicillin allergy.

Furuncles and carbuncles

Follicular infection with *Sta. aureus* may extend to a deeper level than in superficial folliculitis, resulting in furuncles (boils, see Figure 3) or carbuncles. A furuncle is a deep inflammatory nodule developing from a preceding folliculitis; it begins as a firm, tender, erythematous nodule that becomes fluctuant and painful and commonly ruptures spontaneously with drainage of pus.

If a number of adjacent furuncles coalesce, a more extensive lesion known as a carbuncle is formed. Multiple abscesses may develop within the large carbuncle that discharge pus to the surface along hair follicles.

Furuncles are more commonly seen on the face, axillae and buttocks, whereas carbuncles are more commonly found on the nape of the neck, back or thighs.

Management of furuncles and carbuncles is aimed at drainage of pus. Many furuncles and some small carbuncles may drain spontaneously or following application of moist heat, which accelerates localisation and drainage. Larger nodules will usually require incision and drainage, together with treatment with an antistaphylococcal antibiotic such as flucloxacillin.11,12 Erythromycin and clarithromycin are first- and second-line options, respectively, for patients with penicillin allergy. Recommended length of treatment with oral antibiotics is seven days.5

Episodes of severe or recurrent furuncles or carbuncles may be due to strains of *Sta. aureus* that produce a toxin called Panton-Valentine leukocidin (PVL).

Groups at risk include participants in close-contact sports such as wrestling, judo and rugby, and members of communities with close contact such as military training camps, gyms and prisons.13 While in many countries, including the USA, Canada and Australia, PVL-associated *Sta. aureus* infections in the community are widespread, to date these infections remain uncommon in the UK.14

PVL-associated *Sta. aureus* may be meticillin/flucloxacillin sensitive or resistant. Swabs for culture should be sent when patients present with recurrent furuncles or carbuncles to identify such strains.13,14 Management of infection should be discussed with a microbiologist.

**Cellulitis and erysipelas**

Cellulitis and erysipelas are acute, spreading BSIs in which the skin is red, hot and swollen. Cellulitis involves the subcutaneous tissues. Erysipelas (see Figure 4) is a clinically distinctive form of cellulitis that is usually more superficial but with lymphatic involvement.

Classical erysipelas is clinically differentiated from cellulitis by the appearance of a well-defined and raised border, which sharply demarcates it from adjacent noninfected skin. In contrast, the advancing margins of cellulitis are less well demarcated and flat. In practice, it may be difficult to distinguish the two conditions.

Erysipelas was classically described as occurring most commonly on the face and frequently bilateral, but more recent reports indicate that it now most frequently involves the legs and feet.15 Erysipelas is caused by *Str. pyogenes* in most instances, with the remaining minority due to other streptococci, such as Group C or G beta-haemolytic streptococci. Erysipelas is treated with a penicillin or alternatively erythromycin.

![Figure 3. A furuncle: the aim of treatment is drainage of pus; larger nodules may require incision and treatment with flucloxacillin](image)

![Figure 4. Erysipelas now frequently involves the legs and feet; treatment is with a penicillin](image)
Table 2. Local management of cellulitis

Cellulitis is more commonly seen on the lower limbs, frequently involving the calf. In many cases there is an obvious antecedent skin lesion, such as a traumatic wound or ulcer, or other area of damaged skin, such as interdigital athlete’s foot, which provides a portal for bacterial entry. The vast majority of cases are caused by Str. pyogenes, Sta. aureus, or both organisms together. While Str. pyogenes is the most commonly implicated streptococcus in cellulitis, Group B, C or G beta-haemolytic streptococci are sometimes the cause.

Patients with mild or moderate cellulitis who are afebrile and without systemic illness or uncontrolled co-morbidities can usually be managed with oral antibiotic therapy in primary care, but should be given large doses in order to control disease and avoid escalation to admission and intravenous therapy.7,16,17

All patients with severe cellulitis and any patient with cellulitis associated with fever and systemic illness or uncontrolled co-morbidities (such as peripheral vascular disease, chronic venous insufficiency or morbid obesity) should be referred for assessment for hospital admission and intravenous antibiotic therapy.

Cellulitis is treated with antibiotics that are active against Sta. aureus and Str. pyogenes. In sufficient dosage, flucloxacillin may cover both organisms. Most UK authorities now recommend flucloxacillin alone as first-line therapy provided the patient is afebrile and otherwise healthy.7,16,17 Erythromycin or clarithromycin is an alternative for penicillin-allergic patients. Antibiotics are prescribed for seven days initially, followed by clinical review. If there is a slow response at seven days, antibiotics are continued for a further seven days.5,7,17

The physical management of limb cellulitis with elevation, skin care and, in some instances, mild compression is important to hasten recovery (see Table 2).

For mild facial cellulitis, oral co-amoxiclav is recommended for first-line therapy to cover organisms from the mouth and sinuses. Patients with moderate or severe facial cellulitis should be referred for assessment for intravenous antibiotic therapy.

If the cellulitis is associated with a freshwater- or saltwater-contaminated wound, treatment should be discussed with a microbiologist.

PVL-associated Sta. aureus, as described under furuncles and carbuncles, may also be associated with severe or recurrent cellulitis. Swabs should be sent for culture in this clinical scenario.7 PVL-associated Sta. aureus may be either flucloxacillin sensitive or resistant. Management of infection should again be discussed with a microbiologist.

Table 3. Oral antibiotic management of common bacterial skin conditions

<table>
<thead>
<tr>
<th>Skin infection</th>
<th>Antibiotic agent</th>
<th>Oral dose (adult)</th>
</tr>
</thead>
</table>
| Impetigo                     | flucloxacillin or erythromycin or clarithromycin | 500mg every 6 hours  
500mg every 12 hours |
| Folliculitis, widespread/severe | flucloxacillin or erythromycin or clarithromycin | 500mg every 6 hours  
250-500mg every 6 hours  
250-500mg every 12 hours |
| Large furuncles (boils) and carbuncles | flucloxacillin or erythromycin or clarithromycin (plus incision and drainage if indicated) | 500mg every 6 hours  
250-500mg every 6 hours  
250-500mg every 12 hours |
| Erysipelas                   | amoxicillin or erythromycin or clarithromycin | 500mg every 6 hours  
500mg every 8 hours  
500mg every 12 hours |
| Cellulitis - nonfacial       | flucloxacillin or erythromycin or clarithromycin | 500mg every 6 hours  
500mg every 6 hours  
500mg every 12 hours  
500/125mg every 8 hours |
| Cellulitis - facial          | flucloxacillin or erythromycin or clarithromycin co-amoxiclav | 500mg every 6 hours  
500mg every 6 hours  
500mg every 12 hours  
500/125mg every 8 hours |

Treatment

Topical antibiotics

Fusidic acid is active against most Gram-positive bacteria, but is particularly active against staphylococci. However, there have been a number of recent reports in the UK of increasing resistance to fusidic acid among Sta. aureus isolates from patients in the community, directly in line with topical fusidic acid usage.5,7 This has resulted in recommendations for reserving its use for mild and very localised skin infections. Fusidic acid is used topically on skin as a 2 per cent preparation and is generally without significant side-effects, although rarely hypersensitivity reactions may occur.

Mupirocin, a fermentation product of Pseudomonas fluorescens, has a broad spectrum of activity and is highly active against both staphylococci and streptococci. Emergence of resistant isolates of Sta. aureus has been observed following prolonged use for dermatological conditions, so topical treatment courses should not exceed 10 days.

Mupirocin is available as a 2 per cent topical preparation and is generally well tolerated, although it may sting. The ointment base contains polyethylene glycol which, if absorbed from damaged skin, may be nephrotoxic, and the manufacturer advises caution in renal impairment.

Retapamulin is a novel antibacterial agent, the first of the pleuromutilins approved for use in the treatment of superficial skin infections due to Sta. aureus (meticillin-sensitive Sta. aureus) and Str. pyogenes. Retapamulin inhibits bacterial protein
synthesis with a novel site of action on bacterial ribosomes. It is available as a 1 per cent topical ointment and is generally well tolerated. Irritation at the site of application is the most frequently encountered adverse effect.

**Oral antibiotics**

*Amoxicillin* As with other beta-lactam antibiotics, amoxicillin exerts its antibacterial effect by interfering with bacterial cell wall synthesis, which is attributed to the absence of penicillin-binding proteins in mammalian cells. Amoxicillin is highly active against streptococci, including *Streptococcus pyogenes*, but most *Staphylococcus aureus* are resistant due to production of a penicillin-inactivating enzyme.

The pharmacokinetic profile of amoxicillin, in particular its reliable oral absorption, makes it a suitable oral penicillin against streptococcal skin infections and, in combination with an antistaphylococcal agent, for treatment of mixed infections.

Potential side-effects include nausea, vomiting and diarrhoea, as well as adverse reactions resulting from hypersensitivity. The most common manifestation of hypersensitivity is a rash, which is estimated to occur in 1–7 per cent of cases.

*Flucloxacillin* is a semisynthetic penicillin that is stable to the penicillin-degrading enzyme produced by *Sta. aureus*. The spectrum of its activity is primarily Gram positive, being active against staphylococci and beta-haemolytic streptococci, although it is less active against the latter than penicillin. Flucloxacillin is well absorbed and the principal side-effects are those of the penicillin group, as described for amoxicillin above.

The majority of meticillin- and flucloxacillin-resistant *Sta. aureus* isolates in the UK are healthcare associated (HA-MRSA). Infections with these resistant isolates are still primarily encountered in patients with a prior history of hospitalisation or other significant direct or indirect healthcare institution exposure. Community-associated MRSA (CA-MRSA) is still uncommon in the UK.

*Erythromycin* belongs to the macrolide class of antibiotics unrelated to penicillins. It is active against staphylococci and streptococci, which makes it a useful agent for use in the treatment of BSIs in patients allergic to penicillins. Resistance, particularly among *Str. pyogenes* isolates, is increasing worldwide, and threatening its use in this setting.

The side-effects most commonly encountered following erythromycin administration are gastrointestinal, including nausea, vomiting and diarrhoea, or skin reactions including urticaria and rash. Clarithromycin, another macrolide, has a similar spectrum of activity to erythromycin but may be better tolerated, producing less gastrointestinal disturbance.

**Summary**

BSIs are among the most frequently seen infectious conditions in the community and account for a significant proportion of patient presentations in primary care.

The commonest primary BSIs are impetigo, folliculitis, furuncles and carbuncles, erysipelas and cellulitis. The majority of these infections are due to *Sta. aureus*, *Str. pyogenes* or both organisms together. In most cases primary infections are mild to moderate in severity and may be managed with either topical or oral antibiotic therapy.

In general, to avoid increasing emergence of resistant isolates in the community, topical antibiotic therapy should be used judiciously and reserved for mild and very localised BSIs. Oral antibiotics, principally beta-lactams and macrolides, are generally well tolerated. Swabs for bacterial culture are not routinely required for the initial management of impetigo, folliculitis, boils and carbuncles but are indicated in recalcitrant or recurrent infections. A swab taken at the commencement of therapy of cellulitis may be useful in order that the therapy can be modified appropriately should empirical treatment fail.

Continued surveillance of resistance patterns among bacterial skin pathogens is needed, together with monitoring for clinical failures associated with such resistance. Unless resistance to these older agents reaches a critical level and is associated with more widespread clinical failures, they remain the most appropriate antibiotics for treating first episodes of primary BSIs in the community.

**References**


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**Table 4.** Properties of oral antibiotics used in bacterial skin infections

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Mode of action</th>
<th>Spectrum of activity</th>
<th>Side-effects</th>
<th>Drug interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillins, <em>eg</em> amoxicillin, flucloxacillin, co-amoxiclav</td>
<td>interfere with bacterial cell wall synthesis</td>
<td>amoxicillin and co-amoxiclav are active against streptococci; flucloxacillin and co-amoxiclav are active against staphylococci</td>
<td>hypersensitivity reactions, diarrhoea, hepatitis, cholestatic jaundice</td>
<td>anticoagulants, methotrexate, oral contraceptive pill, probenecid</td>
</tr>
<tr>
<td>Macrolides, <em>eg</em> erythromycin, clarithromycin</td>
<td>inhibit bacterial protein synthesis, bacteriostatic</td>
<td>Sta. aureus and streptococci</td>
<td>nausea, vomiting, diarrhoea</td>
<td>inhibit liver enzymes affecting metabolism of anticoagulants, carbamazepine, digoxin</td>
</tr>
</tbody>
</table>


Declaration of interests
None to declare.

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Resources

Prescriber articles


Guidelines
