

How to Treat

WOUND INFECTION Prevention and treatment

Richard Everts



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How much do you already know?

Try this quiz

1. Topical antiseptic agents are more likely than topical antibiotics to cause allergic reactions.
True/False
2. Saline is preferred over tap water for cleansing and irrigation of acute traumatic wounds.
True/False
3. Very severe pain is a common feature of necrotising infection.
True/False
4. Isolation of *Pseudomonas aeruginosa* from a chronic ulcer or wound usually indicates a need for systemic antibiotic therapy, such as ciprofloxacin.
True/False

Answers on page 10

Wound infection: Prevention and treatment



Wound infection following traumatic injury or minor surgery is inconvenient, painful and can lead to failure or delay in wound healing and poor cosmetic outcomes. It can also cause systemic infection requiring urgent intervention. This article reviews the preventive and treatment approaches to this problem, the burden of which all primary healthcare professionals can help reduce

Thousands of bacteria live normally on every square centimetre of your skin. If the skin barrier is disrupted as a consequence of trauma, surgery or disease, these bacteria may invade and cause a symptomatic infection. Micro-organisms from the environment (eg, soil, water) or from a mucosal surface (eg, following a bite) may also contaminate a skin wound.

The incidence of wound infection ranges from 2 to 17.5 per cent after trauma and from 1 to 1.5 per cent after minor dermatological surgical procedures. Infections are inconvenient and painful, and lead to failure or delay in wound healing and poor cosmetic outcomes.

In some cases, wound infection is very severe, causing necrotising cellulitis or fasciitis; spread into local bone, tendon or joint tissues; systemic disease (eg, shock); or metastatic spread to the spine or other distant sites.

Wound infections increase the cost of care and antibiotic consumption. In the last five years, the Accident Compensation Corporation (ACC) in New Zealand has accepted more than 32,000 new claims for infections related to trauma.

For all of these reasons, it is important that doctors, nurses and pharmacists know how to prevent and treat infections in traumatic wounds, burns and minor surgical wounds. This article also deals

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with how to prevent, recognise and treat infections in chronic ulcers and wounds.

Practising evidence-based medicine in the field of wound care is a challenge given that much of the evidence is weak or equivocal. This leaves the subject prone to “expert” opinions and product promotion. This article sets out to provide clear information and useful recommendations for primary care healthcare staff and others in New Zealand.

Topical antiseptics: advantages over topical antibiotics

Antimicrobial medication and products, both topical and systemic, play an important role in preventing and treating



wound infections.

Topical *antiseptic* agents generally have multiple mechanisms of action and a broad spectrum of antimicrobial activity, and uncommonly suffer from resistance or cause allergic reactions, but are too toxic for systemic use in humans.

Topical antiseptic agents include high-concentration ethanol, hydrogen peroxide (eg, Crystaderm), iodine, chlorhexidine (± cetrimide, eg, Savlon), sodium hypochlorite (bleach), superoxidizing solutions (eg, Microdacyn), polyhexanide (with betaine, eg, Pronto-san), acetic acid (vinegar), benzalkonium (eg, Bepanthen), chloroxylenol (eg, Dettol), honey and silver. Bacteria have not developed resistance to iodine, silver or polyhexanide, for example, despite over 50 years of use.

In contrast, topical *antibiotic* agents – such as mupirocin (eg, Bactroban), fusidic acid (eg, Foban), gramicidin (eg, Sofradex, Viaderm KC, Kenacomb), clindamycin, neomycin (eg, Pimafucort, Viaderm KC, Kenacomb, Neosporin, “triple antibiotic cream”), framycetin (eg, Sofradex), ciprofloxacin, clioquinol (eg, Locorten-Vioform), sulfadiazine, chloramphenicol and metronidazole – have fewer mech-

anisms and a narrower spectrum of antimicrobial activity. They suffer from resistance and sometimes lead to cross-resistance, and cause allergic reactions more frequently than antiseptic agents. But, many are safe enough for systemic use in humans.

Mupirocin, for example, is an antibiotic active against *Staphylococcus aureus* and beta-haemolytic streptococci. Mupirocin resistance rates in *S. aureus* have increased to over 60 per cent in some places overseas, and to over 20 per cent in New Zealand in 2000, after nine years of over-the-counter availability. Since restricting access to mupirocin in New Zealand to prescription-only, in 2001, the *S. aureus* resistance rate has fallen to less than 8 per cent. Mupirocin or fusidic acid resistance sometimes develops in *S. aureus* even during the course of treatment with those agents.

Another example of a topical antibiotic is neomycin, an aminoglycoside agent similar to gentamicin and tobramycin: neomycin causes allergic reactions in up to 13 per cent of patients (compared with iodine at <1 per cent) and its use probably promotes gentamicin and tobramycin resistance.

The broad spectrum of activity, minimal risk of resistance or cross-resistance and low risk of allergic reactions give topical antiseptic agents short-term and long-term advantages over topical antibiotics in wound care, and this is reflected in the recommendations in this article. Almost all of the topical antiseptic agents discussed are available over the counter and in public hospitals in New Zealand.

In view of the worsening global crisis with antibiotic-resistant bacteria, topical antibiotic use should be avoided in wound care. Oral and intravenous antibiotic agents have an important but limited role for prophylaxis and treatment of wound infection.

Topical antiseptic agents generally have multiple mechanisms of action and a broad spectrum of antimicrobial activity

Practice point 1

Antiseptics vs antibiotics

Topical antiseptic agents are preferred over topical antibiotic agents because they are broader in their spectrum of activity, practically unaffected by antimicrobial resistance and less likely to cause allergic reactions.

Are antiseptic agents safe to put on a wound?

Numerous animal and human studies undertaken since the 1960s show topical antiseptic agents have beneficial effects in acute and chronic wound care. The popularity of antiseptic agents was seen to decline after in vitro studies published in the 1990s and 2000s showed that these agents damage fibroblast and keratinocyte cell types in laboratory models.

Since then, however, a number of studies have shown that, at lower concentrations, antiseptic agents cause less human cytotoxicity.

Further, certain topical antiseptic agents (super-oxidizing solutions, polyhexanide, diluted sodium hypochlorite, chlorhexidine, silver and cadexomer

iodine) cause less human cytotoxicity than others (hydrogen peroxide, povidone-iodine) at bactericidal concentrations.

Moreover, the in vivo applicability of these in vitro cytotoxicity studies has been challenged because, in the laboratory, the fibroblasts and keratinocytes are grown without the usual vascular support and proteinaceous environment, and because most comparative clinical trials show no impairment of wound healing in the antiseptic arms.

Potentially important differences between antiseptic agents

In addition to human cytotoxicity, there are other potentially important differences between antiseptic agents. Some gram-negative bacilli are resistant to chlorhexidine and benzalkonium, and recent strains of *S. aureus* (especially MRSA, methicillin-resistant *S. aureus*; including in New Zealand) are resistant to chlorhexidine, cetrimide or benzalkonium, which potentially limits the use of these agents in the future.

In contrast, there is no resistance in clinically important bacteria to super-oxidizing solutions, polyhexanide, sodium hypochlorite, silver, iodine, hydrogen peroxide or honey. Super-oxidizing solutions and Prontosan (the betaine

component) have additional anti-biofilm activity, which may be an advantage when treating chronic ulcers and wounds.

Polyhexanide, cadexomer iodine products and sustained-release silver dressings have long-lasting activity, which reduces the need for frequent dressing changes. Sustained-release silver products are more effective and safer than older silver formulations such as silver nitrate or silver sulfadiazine; similarly, cadexomer iodine is more effective for treating chronic ulcers and wounds than povidone-iodine.

Super-oxidizing solutions, like Microdacyn, have performed better than povidone-iodine and other comparators in a number of clinical trials.

Most of the topical antiseptic agents can occasionally cause local irritation or local or systemic allergic reactions, but these adverse effects are less common than with topical antibiotic agents and rarely occur with super-oxidizing solutions.

Sodium hypochlorite (bleach) requires dilution (Table 1), which is a hassle, but it is an effective and cheap antiseptic agent and, therefore, a good option in low-resource situations.

Choosing an antiseptic agent from the range of options described in this article comes down to individual preference, availability and cost.

Practice point 2

Modern antiseptic agents

Most modern antiseptic agents are safe to put in a wound. Super-oxidizing solutions, polyhexanide, dilute bleach, chlorhexidine (\pm cetrimide), sustained-release silver, cadexomer iodine, povidone-iodine and honey are generally effective and safe in wound care (see later sections for details and recommendations).

Local irritation or local or systemic allergic reactions... rarely occur with super-oxidizing solutions

Table 1 Sodium hypochlorite* dilution recommendations for use as a wound or skin antiseptic

Undiluted original bleach product ¹	Volume of bleach to add ^{2,3}			
	To 500ml water	To 1L water	To 15L bucket	To 30L water (a full-sized bath with 10cm water)
Budget brand – Regular (21.5g/L, 2.15%)	1ml (¼ teaspoon)	2ml (½ teaspoon)	35ml (2 tablespoons)	70ml (5 tablespoons)
Clor-o-gene (31.5g/L, 3.15%)	0.75ml	1.5ml (¼ teaspoon)	24ml (5 teaspoons)	48ml (3 tablespoons)
Homebrand – Regular (42g/L, 4.2%)	0.6ml (⅙ teaspoon)	1.2ml (¼ teaspoon)	18ml (3½ teaspoons)	35ml (2½ tablespoons)
Janola – Premium (42g/L, 4.2%)	0.6ml (⅙ teaspoon)	1.2ml (¼ teaspoon)	18ml (3½ teaspoons)	35ml (2½ tablespoons)

* Bleach. 1. Use regular, not perfumed, bleach. 2. Based on a target concentration of 0.05g/L (0.005%), but up to five times more concentrated (0.25g/L, 0.025%) may be more effective and is still likely to be safe. 3. Add double the volume of bleach to the water if the bleach product is near its expiry date, as sodium hypochlorite weakens with time to approximately half of its original strength by the expiry date

Preventing infection in acute traumatic wounds

The risk of wound infection after trauma ranges from 2 to 17.5 per cent. Significant risk factors for infection are highlighted in Panel 1.

Wound cleansing and debridement

Wound cleansing and debridement aim to remove foreign bodies, non-viable matter (exudates, slough, eschar) and contaminating bacteria. The theoretical benefits of cleansing and debridement are that the remaining tissue is well vascularised and devitalised tissue that might support microbial growth and prevent access to leukocytes is removed.

Wound infection risk is higher when there is contamination with foreign material, such as wood or soil, and especially clay. Although a Cochrane review in 2012 (CD003861.pub3) failed to find strong evidence that cleansing wounds per se increases healing or reduces infection, many studies show a benefit from wound irrigation. Prompt cleansing and irrigation of traumatic wounds are widely

Topical antiseptic agents...may be applied at the time of initial cleansing and subsequent dressing changes

recommended, including:

- manual removal of large foreign bodies
- use of moist gauze or gentle scrubbing with a brush to remove small pieces of foreign material
- use of a scalpel, scissors or curette to remove necrotic, devitalised or macerated tissue
- irrigation with fluid (tap water and saline have equal outcomes).

Using pressure to cleanse or irrigate a wound may not be important, based on a recent, large randomised trial in over 2500 patients with open fractures, in which there was no difference in outcomes between high-pressure, low-pressure and very low-pressure irrigation.

Topical antiseptic agents in acute trauma

Experimental animal studies (mostly with povidone-iodine) show either no effect or a reduction in wound bacterial count or clinical infection rate with the use of topical antiseptic agents.

Human trials show reduced (most trials) or little to no change in infection rates after acute traumatic skin break with topical antiseptic or antibiotic treatment, compared with control; the reduction in infection rate ranges from 10 to 70 per cent. For example, a randomised trial of a triple-antibiotic gel or povidone-iodine cream for school children with accidental skin injuries reduced the infection rate from 12.5 per cent (placebo) to 1.6 per cent ("triple-antibiotic" gel) or 3 per cent (povidone-iodine).

There should be less concern about the human cytotoxicity seen in vitro with some antiseptic agents when these agents are used in acute traumatic wounds, especially those with healthy underlying tissue and a reasonable blood supply.

Although most of the studies of antiseptic agents in acute traumatic wounds involved povidone-iodine, it is likely other topical antiseptic agents would also prevent infections in these patients. Based on their broad spectrum of activity, evidence of clinical efficacy in various wound care situations and low risk of toxicity, super-oxidizing solutions, polyhexanide, dilute bleach (in low-resource situations), chlorhexidine (± cetrimide), cadexomer iodine, povidone-iodine, hydrogen peroxide and sustained-release silver are likely to be effective and reasonably safe. Benzalkonium (Bepanthen)

may be effective, but is not well studied. Honey-containing products may be effective, but one brand of honey dressing did not improve outcomes in a small randomised trial of patients with acute minor traumatic wounds.

This author recommends the routine use of topical antiseptic agents in patients with acute traumatic wounds, especially those with extra risk factors for infection. These agents may be applied at the time of initial cleansing and subsequent dressing changes. Different antiseptic products are used in different ways – liquids may be applied to the wound by irrigation, spray or soaked gauze; gels and creams may be applied to the wound before or after closure; and antiseptic-containing dressings placed on the wound.

Dressings for acute wounds

Dressings provide numerous theoretical advantages in the management of acute wounds, including the maintenance of a moist environment, removal of exudates and slough, thermal insulation and reduction of further trauma. Dressings probably reduce the risk of wound infection.

The choice, frequency of change and duration of dressing use are beyond the scope of this article but, for an acute traumatic wound, the dressing should ideally protect against further trauma, have some capacity for absorption of discharging fluid and blood, and be shower-proof (eg, an "island" or foam dressing). The higher the risk of infection in the wound (see above), the more frequently the dressing should be removed and the wound checked.

General measures in managing acute wounds

The control of hyperglycaemia in patients with diabetes may aid healing and prevent wound infection. Clinicians should follow up-to-date guidelines for tetanus prevention, such as those in the *New Zealand Immunisation Handbook* (Ministry of Health, 2014).

Prophylactic systemic antibiotics for acute wounds

Some acute wounds are considered at such high risk of infection that systemic antibiotics are given at the time of injury

Continued on page 7

Panel 1 Significant risk factors for infection after acute trauma

- ▶ certain host factors: advanced age, obesity, diabetes and immune compromise, such as that due to chemotherapy or high-dose steroids
- ▶ wound location – this probably relates to arterial supply, venous or lymphatic stasis and degree of contamination: the highest risk is on the distal limbs
- ▶ wound type and devitalised tissue: burst lacerations, crush injuries, large wounds
- ▶ wound contamination: bites, faecal flora, soil, foreign bodies
- ▶ delayed wound closure (possibly)

Panel 2 Wounds generally requiring prophylactic systemic antibiotics

- ▶ crush injuries
- ▶ bites or oral wounds
- ▶ wounds with gross contamination with soil or wood
- ▶ wounds to the feet or legs in the patient with lymphoedema or diabetes
- ▶ deep injuries (involving tendon, cartilage, joint or open fracture)
- ▶ wounds in patients with immune compromise (eg, poorly controlled diabetes or immune-suppressive medication)

Preventing infection after minor surgical procedures

Compared with traumatic wounds, the risk of infection following an elective, minor, clean surgical procedure is low – generally less than 1.5 per cent. In these patients, preoperative skin disinfection and postoperative dressings are probably effective in preventing infection.

Studies in patients undergoing major surgical procedures show that a combination of alcohol plus chlorhexidine or alcohol plus iodine is most effective for preoperative skin disinfection. The common practice of applying a topical antimicrobial agent once or more after a minor dermatological surgical procedure has also proven to reduce the risk of infection.

A meta-analysis of four randomised controlled trials of antimicrobial agents versus controls, including study populations totalling over 4000 patients, showed that applying bacitracin, chloramphenicol, mupirocin or gentamicin postoperatively significantly reduced the infection risk, with a pooled odds ratio of 0.71 (*J Dermatol Treat* 2015; 26[2]:151–58).

In these minor surgical cases, the baseline risk of infection is so low that

topical antibiotic treatment will likely result in more allergic or other adverse reactions than infections prevented. Moreover, widespread use of topical antibiotic prophylaxis after minor surgical procedures will promote resistance and cross-resistance.

Although there has been no comparative trial of a topical antiseptic agent in this situation, it is likely these agents are as effective as the antibiotics studied, but without as high a risk of adverse reaction and without promoting antibiotic resistance. Therefore, if doctors or nurses wish to use an antimicrobial agent or product to reduce the risk of infection after a minor dermatological procedure, they should use an antiseptic agent.

Based on their broad spectrum of activity, evidence of clinical efficacy in various other wound care situations and low risk of cytotoxicity, super-oxidized solutions, polyhexanide, chlorhexidine (\pm cetrimide), slow-release silver, cadexomer iodine, povidone-iodine and hydrogen peroxide are likely to be effective and safe.

Honey dressings have shown mixed success in comparative trials of postoperative wounds.



Topical antibiotic prophylaxis after minor surgery will promote resistance

Practice point 4

Preventing infection after minor surgical procedures

1. Preoperatively disinfect skin with a combination product including alcohol *plus* either chlorhexidine or iodine.
2. Use an intraoperative or postoperative antiseptic (not antibiotic) agent – eg, super-oxidizing wound care solution or hydrogel, polyhexanide liquid or gel, chlorhexidine (\pm cetrimide), hydrogen peroxide, sustained-release silver, cadexomer iodine, povidone-iodine or honey.
3. Apply a protective, absorbent, shower-proof dressing (eg, an “island” dressing).

Continued from page 6

to prevent infection. Experimental animal studies show prophylactic antibiotics reduce acute wound infection, and human clinical trials show prophylactic antibiotics reduce acute wound infection in high-risk situations.

Prophylactic systemic antibiotics are not indicated in low-risk, simple wounds but are generally indicated in more high-risk wounds (Panel 2).

Amoxicillin+clavulanate, cefalexin, clindamycin and doxycycline are common antibiotic choices, the latter two especially in patients at high risk of MRSA colonisation (see later section on treatment). Prophylactic treatment usually continues for three to five days after a traumatic injury, or longer if a bony fracture is contaminated.

Delayed wound closure

Closing (suturing) an infected wound or a highly contaminated wound may cause more harm than good. A delay

between injury and presentation increases the risk of contamination and infection in most studies, so it is common practice to delay closing the wound when the patient presents a long time after the injury.

A 2013 Cochrane review on this topic (CD008574.pub3) concludes there are no proper comparative trials to answer the question of immediate versus delayed closure for patients presenting some time after injury.

A general recommendation from other reviews and experts is that the higher the risk of contamination, the better it is to delay closure, irrigate and debride the wound, apply a dressing, consider antibiotic prophylaxis and re-evaluate two to five days later.

Low-risk wounds (eg, scalp, face) can generally be closed up to 24 hours after the person sustains the injury, and high-risk wounds (eg, hands, diabetic feet, heavily contaminated, crush injuries, bites) can generally be closed up to 10 hours after injury.

Practice point 3

Preventing infection in acute traumatic wounds

1. Cleanse and debride all wounds to remove foreign bodies, soil and non-viable tissue.
2. Topical antiseptic agents probably reduce infection risk and may be used in all acute traumatic wounds, at the time of initial injury and subsequent dressing changes. Avoid topical antibiotic agents.
 - a. Topical antiseptic options include super-oxidizing wound care solution or hydrogel, polyhexanide liquid or gel, dilute bleach (in low-resource situations, see Table 1 for dilution instructions), chlorhexidine (\pm cetrimide), hydrogen peroxide, sustained-release silver, cadexomer iodine and povidone-iodine. Benzalkonium and honey may also be effective.
3. Apply a protective, absorbent, shower-proof dressing (eg, “island” or foam dressing) or an absorbent pad.
4. Provide tetanus prevention, if appropriate.
5. Provide antibiotic prophylaxis (eg, amoxicillin+clavulanate for three to five days) for wounds at highest risk of infection (eg, large crush injuries; bites; gross contamination with soil; wounds in feet or legs with lymphoedema or diabetes; deep injuries involving tendon, cartilage, joint or open fracture; immune-compromised patients).

Preventing infection after minor burns

Bacterial infection is a common complication of burns, especially large or deep burns. In addition to cleansing and debridement of necrotic skin and eschar, topical antimicrobial agents are recommended for patients with burns that compromise the skin integrity.

There is no consensus on which antimicrobial agent should be used, but topical antiseptic agents have advantages over antibiotic agents in terms of the risk of adverse reaction or resistance. Silver sulfadiazine, for example, which includes a sulphur-group antibiotic, has been the most common antimicrobial agent used in burns for decades but has been associated with delay in healing,

Older silver products have been superseded by sustained-release silver dressings

requires frequent and painful dressing changes and may lead to antibiotic resistance and allergic reactions. Silver nitrate has also been associated with impaired healing. These older silver products have been superseded by sustained-release silver dressings, which improve outcomes compared with standard care in comparative trials.

A Cochrane review of honey (CD005083.pub4) reports that honey dressings heal burn wounds faster than other treatments. There are some data, albeit limited, to support the use of chlorhexidine, super-oxidizing solutions or dilute bleach in burns care. MEBO, a popular Chinese herbal dressing, has not performed well in comparative trials.

Practice point 5

Preventing infection after minor burns

1. Cleanse and debride burn wounds to remove non-viable tissue and eschar.
2. Topical antiseptic agents probably reduce infection risk and aid healing in burns in which there is loss of skin integrity. Options include sustained-release silver products, honey, super-oxidizing wound care solution or hydrogel, cadexomer iodine or dilute bleach (in low-resource situations; see Table 1 for dilutions).
3. Apply an appropriate dressing.

Recognising and treating infection in acute wounds

Infection in an acute wound usually presents with local pain, swelling, redness or exudate, and sometimes with regional lymphangitis or lymphadenitis, systemic malaise, fever, abnormal vital signs or raised C-reactive protein. Wound swabs are not indicated in every case but are most likely to give useful information when the patient has high risk factors for MRSA (eg, recently known as MRSA-positive or household contact MRSA-positive), is failing antibiotic treatment or has frank pus draining.

Incision and drainage of any substantial collection of pus is essential. Systemic antibiotic treatment is generally necessary if invasive infection has spread beyond the wound. For mild-to-moderate infections treated in the community, recommendations for antibiotic choice are provided in Table 2.

More severe wound infections may require intravenous antibiotics and surgical assessment, and some complex wounds require – during or after infection treatment – negative pressure wound therapy (NPWT), also known as VAC (vacuum-assisted closure). Necrotising fasciitis and necrotising cellulitis are surgical and medical emergencies and require imme-



Post-traumatic wound with surrounding cellulitis

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diate transfer to an acute surgical team; the features of a necrotising infection are presented in Panel 3. A GP may administer intravenous amoxicillin+clavulanate or ceftriaxone before the patient is taken by the ambulance to hospital if necrotising infection or severe sepsis is suspected.

Consider lodging an ACC claim for infection following a traumatic wound. This claim should clearly define the traumatic event (not just a minor everyday twist, strain or friction) and document the objective physical evidence of

trauma, such as a skin laceration, abrasion or bruising. Clear documentation of the time, circumstances and sequence of the traumatic event, signs of physical injury, and the time of onset and description of the infection will assist ACC to assess the claim. It would help to document any other factors that might have contributed to the infection, such as previous skin or wound infections, chronic skin conditions (eg, eczema, psoriasis), lymphoedema at the site of infection or diabetes.

Diagnosing infection in chronic ulcers and wounds

Infection in chronic ulcers and wounds is difficult to define. Patients present anywhere along a spectrum from simple, harmless colonisation to frank invasive disease, such as cellulitis, underlying joint or bone involvement, or septic shock. Diagnosis at either end of this spectrum (no infection or infection) may be easy. The middle of the spectrum, however, is more difficult, especially if there is underlying arterial insufficiency causing pain, or venous disease causing stasis dermatitis.

The further along this spectrum towards invasive disease, the more likely it is the patient presents with pain, swelling, redness or exudate, regional lymphangitis or lymphadenitis, systemic malaise, fever, abnormal vital signs or raised C-reactive protein.

At the invasive disease end of the spectrum, the most likely causative organisms are *S. aureus* and beta-haemolytic streptococci. In the middle of the spectrum, heavy colonisation with gram-negative bacteria (eg, *Escherichia coli*, *Klebsiella spp.*, *Acinetobacter spp.* or *Pseudomonas aeruginosa*) or anaerobes may contribute to

pain, discharge, a stinky odour and delay in healing. These gram-negative bacteria and anaerobes most often colonise ulcers and chronic wounds without any clinical impact.

The culture results from a swab sample of the ulcer or wound also correlate with invasive infection, but not exactly. Whether or not to take a swab and how to interpret the result both require some thought.

If clinical infection is not suspected, the swab result will very likely be misleading, so it is best not to take it in the first place. Even if clinical infection is suspected, the swab result should not change your management if the patient is responding to empiric antibiotic treatment targeting *S. aureus* and beta-haemolytic streptococci. A swab is more likely to give useful information when the patient has high risk factors for MRSA, is failing antibiotic treatment or has frank pus draining.

When taking a swab for culture from a chronic skin ulcer or wound, it is commonly recommended the infected site is first cleaned by wiping or irrigating with sterile water or saline to clear away any

debris and exudate, and debrided to remove any necrotic tissue or eschar. Then moisten the swab, especially if the ulcer or wound is dry, and twirl the tip of the swab for a few seconds with pressure over the ulcer or wound bed.

The presence of white cells on microscopy and a predominant pathogen on culture in the laboratory report suggest an infection. *S. aureus* and beta-haemolytic streptococci are premier soft-tissue pathogens and are most likely to be associated with invasive infection; they represent causative pathogens.

Panel 3 Clues to necrotising infection

- ▶ severe pain and tenderness, sometimes out of proportion to the appearance
- ▶ rapid spread of signs
- ▶ blackish, haemorrhagic blisters, skin necrosis, a dusky colour, sometimes a sticky discharge, sometimes numbness
- ▶ shock, confusion, respiratory dysfunction, acute kidney injury, lactic acidosis and other signs of severe sepsis and multiorgan failure

Table 2 Oral antibiotic choices for mild-to-moderately infected wounds^{1,2}

Infection type	Antibiotic choices
Infected post-traumatic wounds ³	AMOXICILLIN+CLAVULANATE po 625mg tds ▶ Mild penicillin allergy: cefalexin po 500mg qid and metronidazole po 600mg bd ▶ Severe penicillin allergy: ciprofloxacin po 500mg bd and clindamycin po 450mg tds
Infected penetrating injury through a shoe	CIPROFLOXACIN po 500mg bd
Infected injury associated with exposure to fresh or salt water	CIPROFLOXACIN po 500mg bd and CLINDAMYCIN po 450mg tds
Infected bite or clenched-fist injury	AMOXICILLIN+CLAVULANATE po 625mg tds ▶ Penicillin allergy: metronidazole po 600mg bd and either doxycycline po 100mg bd or trimethoprim+sulfamethoxazole po 960mg bd
Surgical site infections – limb or upper body ³	FLUCLOXACILLIN po 1000mg qid ▶ Mild penicillin allergy: cefalexin po 500mg qid ▶ Severe penicillin allergy: clindamycin po 450mg tds
Surgical site infections – abdomen or pelvis ³	AMOXICILLIN+CLAVULANATE po 625mg tds ▶ Penicillin allergy: trimethoprim+sulfamethoxazole po 960mg bd and metronidazole po 600mg bd

bd, twice daily; po, orally; qid, four times a day; tds, three times a day. 1. Based on guidelines written by the South Island Hospital Antimicrobial Guidelines Group: New Zealand, 2016. 2. Duration of treatment is five to 10 days, depending on severity, drainage and response. 3. Cover MRSA if known to be recently MRSA-positive or failing beta-lactam therapy despite adequate surgical management. Oral antibiotic choices for MRSA include clindamycin, doxycycline, trimethoprim+sulfamethoxazole or macrolides.

Enteric gram-negative bacilli (like *E. coli* or *Klebsiella spp.*), *Acinetobacter sp.*, *P. aeruginosa* and anaerobes are less likely to be associated with invasive infection but may contribute to patient symptoms and failure to heal. For example, only about one in seven patients with *P. aeruginosa* isolated on a wound swab has an invasive infection due to these bacteria that requires systemic antibiotic treatment. Common skin flora such as coagulase-negative staphylococci, alpha-haemolytic streptococci and diphtheroids are usually harmless colonisers.

Managing infected or heavily colonised chronic ulcers and wounds

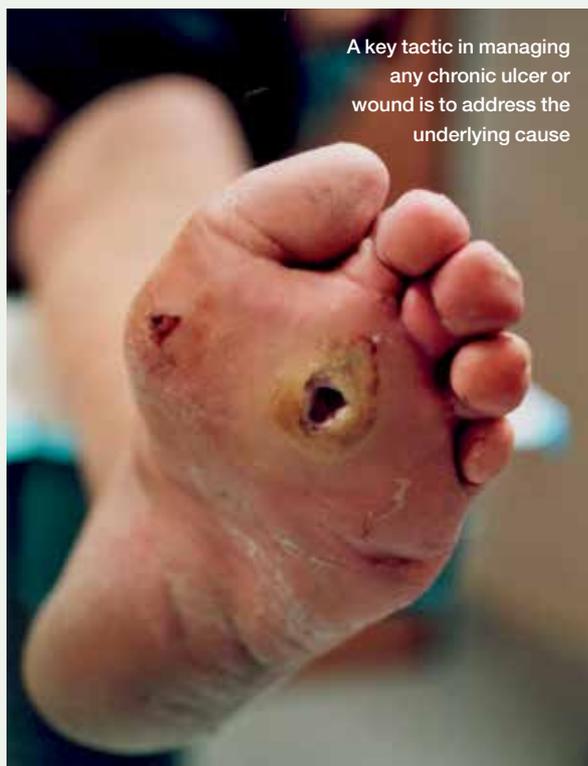
A key tactic in managing any chronic ulcer or wound – whether it is infected or not – is to correct the underlying cause of the failure to heal, such as arterial disease, pressure, venous or lymphatic stasis, oedema, vasculitis or nutritional deficiency. This often requires referral to a vascular surgical clinic or wound-care nurse specialist in your region.

Another key tactic in managing a chronic ulcer or wound is to optimise the local healing environment – a topic that wound-care nurses are expert in. Healing is likely to be enhanced by debriding necrotic, devitalised tissue and eschar, washing away slough, correct moisture balance and appropriate dressings. The choice of dressing, other than the use of antiseptic

agents, is beyond the scope of this article.

If invasive infection is suspected, an empiric systemic antibiotic agent such as amoxicillin+clavulanate is likely to cover the usual pathogens (see Table 2 for common doses). If there is a mild penicillin allergy then use both a cephalosporin and metronidazole. If the patient has a severe penicillin allergy or any cephalosporin allergy, use both ciprofloxacin and clindamycin. Subsequent antibiotic choice can be guided by the results of culture, provided the sample was correctly taken and the result is correctly interpreted (see above).

Topical antiseptic agents have been shown to reduce the bacterial load on and below the surface of chronic ulcers and wounds, and to improve clinical signs of infection. Although many studies are of poor design and the results are somewhat conflicting, randomised trials show, overall, that some topical antiseptic agents improve chronic ulcer and wound healing.



A key tactic in managing any chronic ulcer or wound is to address the underlying cause

FIGURE 6

Practice point 6

Managing infected or heavily colonised chronic ulcers and wounds

1. Treat invasive infection (eg, cellulitis) with systemic antibiotic agents (eg, amoxicillin+clavulanate, or cefalexin **and** metronidazole, or ciprofloxacin **and** clindamycin).
2. Treat heavily colonised ulcers and wounds with topical antiseptic agents.
 - a. Options include cadexomer iodine paste, ointment or sheets; super-oxidizing wound care solution or hydrogel; and polyhexanide (with betaine; Prontosan) liquid or gel. Sustained-release silver dressings and dilute bleach (in low-resource situations; see Table 1 for dilutions) may also be effective.
3. Cleanse and debride to remove necrotic and non-viable tissue, eschar and slough.
4. Treat reversible underlying causes of the chronic ulcer or wound (eg, pressure, venous stasis).

Further information

Reference

Arnold B, Chambers S, Everts R, Gardiner S, Metcalf S, Ussher J on behalf of the South Island Hospital Antimicrobial Guidelines Group. South Island Hospital Antimicrobial Guidelines, 2016. Published by Canterbury District Health Board. Estimated date of publishing: March 2017

Conflict of interest statement

Dr Everts receives no personal benefit such as payment or sponsorship from any manufacturer or distributor of antiseptic agents.

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Quiz answers

1. False 2. False 3. True 4. True

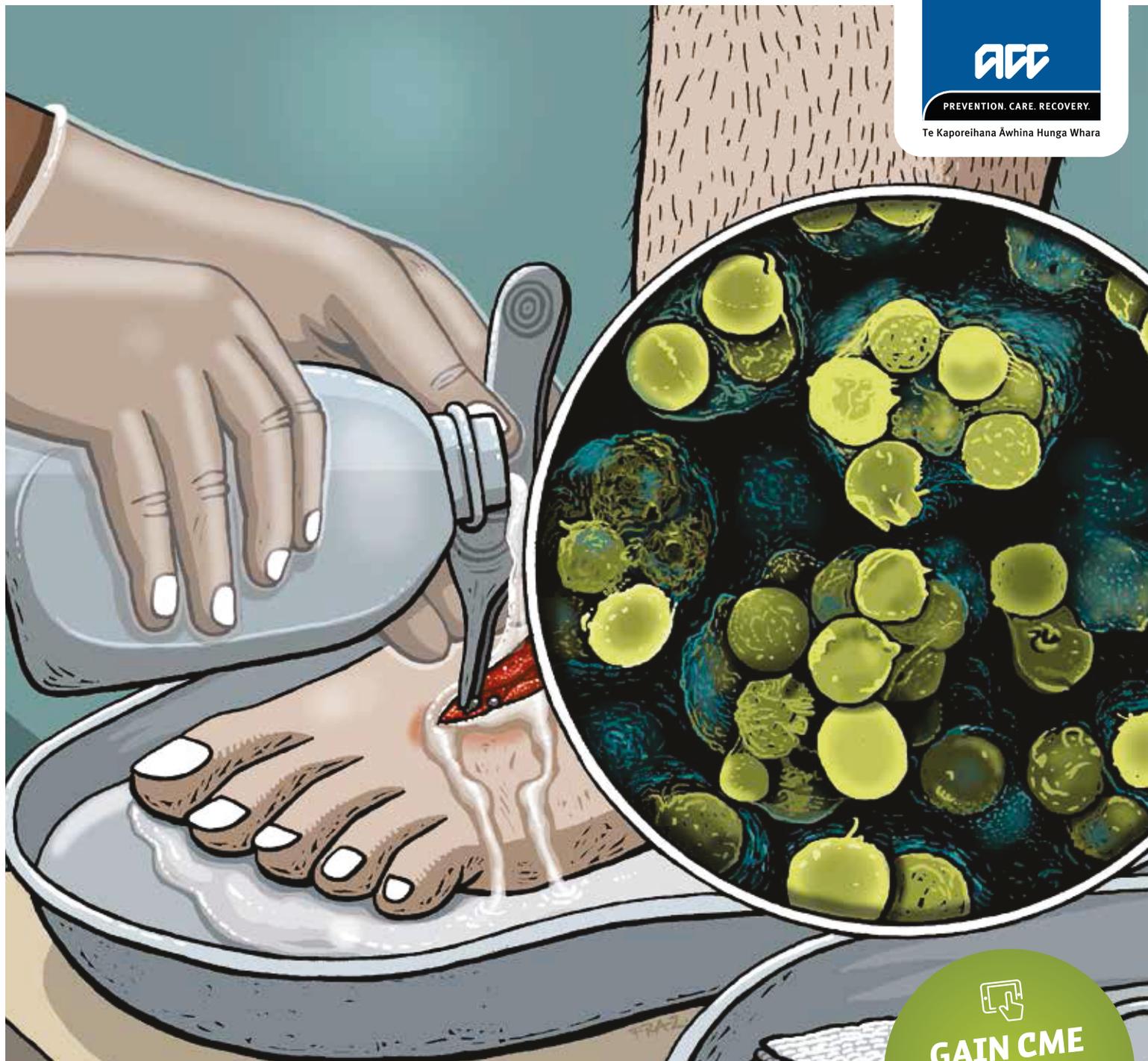
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