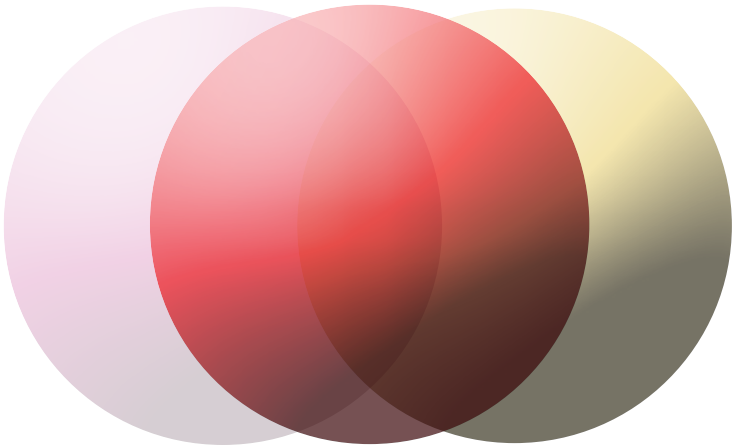
WUK BPS

# Best Practice Statement

## Antimicrobial stewardship strategies for wound management

2020



**Antimicrobial stewardship in wound care**

**Understanding the infection continuum**

**Antimicrobial treatment selection**

**The role of infection prevention**

**Future developments**

Wounds UK

**BEST PRACTICE STATEMENT: ANTIMICROBIAL STEWARDSHIP STRATEGIES FOR WOUND MANAGEMENT**

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# Introduction

Since the 1940s, antibiotics have been used systemically for treating spreading and systemic infections of acute and chronic wounds. However, their widespread use and misuse in medicine and agriculture has allowed the emergence of microbial strains with resistance to one or more antibiotics.

The United Nations and other international agencies estimate that if no action is taken, antimicrobial drug-resistant diseases could cause 10 million deaths each year by 2050, costing £66 trillion (Interagency Coordinating Group on Antimicrobial Resistance, 2019).

## WOUND CARE

Driven by an increase in microbial antibiotic resistance, topical antimicrobials are being increasingly used in wound care, especially for infected or open wounds healing by secondary intention. However, it is imperative that clinical practices minimise the possibility of micro-organisms developing resistance to these therapies as well. With ageing populations, increased prevalence of wound care complications, rising costs of wound treatment (Guest et al, 2015) and diminishing prospects of developing new antibiotics (O'Neill, 2014), novel approaches to optimising and conserving all antimicrobial interventions in wounds are indicated (Cooper and Kirketerp-Møller, 2018). This approach to combat antimicrobial resistance is known as antimicrobial stewardship (AMS).

This document is derived from a one-day meeting of the Expert Working Group that convened to discuss AMS strategies in wound care. This document was developed with the overall objectives to:

- Raise awareness of AMS within wound care in the UK
- Establish the role of wound care in the wider landscape of AMS
- Promote achievable AMS practices for all involved in the care of people with wounds.

To emphasise the importance of patient involvement, each Best Practice Statement is accompanied by a related Patient Expectation that supports communication with the patient and explains what the patient should expect from their care. All patient communication should take into account the individual's needs, concerns, readiness to learn, preferences and abilities.

# Antimicrobial stewardship

Everyone caring for patients with, or at risk of, wounds should be aware of the causes of antimicrobial resistance. They should also understand the importance of antimicrobial stewardship to combat and slow the emergence and spread of antimicrobial resistance.

**Best Practice Statement**

Your healthcare professional may explain to you and your family/carers what antimicrobial resistance is and why it is of concern. They may explain how as a society we can combat and/or slow its emergence.

**Patient expectation**

Antimicrobials are a group of agents that either kill or inhibit the growth and division of micro-organisms. They include antibiotics (which act on specific cellular target sites), antiseptics, disinfectants and other agents, such as a antiviral, antifungal, antibacterial and antiparasitic medicines (which act on multiple cellular target sites). Antimicrobial resistance (AMR) describes when micro-organisms evolve over time and no longer respond to any antimicrobial therapy.

## GENETIC CAUSE OF AMR

The primary function of micro-organisms is to reproduce and survive. Therefore, microbes continually adapt to their environments to ensure their survival. If something stops their ability to grow, such as an antimicrobial, genetic changes can occur that enable the microbe to survive (National Institute of Allergy and Infectious Disease, 2011).

Understanding the genetic basis of AMR is paramount in order to develop therapeutic approaches to combat and slow the emergence and spread of AMR. The major genetic mechanisms of AMR are:

- **Mutational resistance** — caused by a genetic change in the organism that affects the activity of the drug, resulting in preserved cell survival in the presence of the antimicrobial.
- **Horizontal Gene Transfer (HGT)** – caused by the acquisition of foreign DNA material. It is one of the most important drivers of bacterial evolution and it is frequently responsible for the development of AMR.

Genetic modifications can lead to the following AMR modes of action in bacteria:

- **Drug modification or destruction**: bacteria either inactivate or destroy the antibiotic molecule itself.
- **Efflux mechanisms**: bacteria have mechanisms to remove antibiotics that have entered the cell.
- **Permeability barrier**: bacteria block the entry of antibiotics into the cell.
- **Altered target site**: bacteria modify the antibiotic target site so that the antibiotic is no longer able to have an effect (Munita and Arias, 2016).

## HUMAN CAUSES OF AMR

Societal pressures also act to accelerate the increase of AMR.

- **Inappropriate or overuse of antibiotics** is one of the biggest causes of antibiotic resistance in medicine and agriculture.
- **Inadequate infection diagnostics** with incomplete or imperfect information encourages the prescription of antimicrobials 'just-in-case' or the prescription of a broad-spectrum antimicrobial when a specific antibiotic might be better (McGow, 2019).
- **Critically ill patients** in hospital are more susceptible to infections and, thus, often require antimicrobials. The extensive use of antimicrobials and close contact among sick patients creates a fertile environment for the spread of antimicrobial-resistant germs (e.g. methicillin-resistant *Staphylococcus aureus* [MRSA]).
- **Poor hygiene, sanitation and lack of access to clean water** (Interagency Coordinating Group on Antimicrobial Resistance, 2019).

## ANTIMICROBIAL STEWARDSHIP

The solution to reducing and preventing further AMR is a multi-modal approach known as antimicrobial stewardship (AMS). This includes infection prevention and the promotion of judicious use of antimicrobials to preserve their future effectiveness (NICE, 2014; NICE and PHE, 2019), while also improving the safety and quality of patient care.

To do so requires a systemic change in behaviour through increased public awareness and education. While efforts have substantially decreased the use of narrow-spectrum antibiotics, the use of broad-spectrum antibiotics (e.g. ampicillin) has not decreased at the same rate (PHE, 2019), identifying a continuing education need for AMS support.

In wound care, early identification of infection and infection risk is an integral

part of AMS and the reduction of antimicrobial use (Sandy-Hodgetts et al, 2020). AMS programmes generally focus on the following key strategies (Lipsky et al, 2016; Roberts et al, 2017; Stryja et al, 2020):

1. To increase efforts towards effective infection control methods and hand hygiene practices.
2. To create a consistent knowledge base and educational opportunities for clinicians on the effective use of antimicrobials and to reduce variation in practice – thus reducing diagnostic uncertainty, clinical ignorance, ritualistic behaviour, clinical fear and patient demands.
3. To prescribe the appropriate antimicrobial treatment when therapy is indicated, minimising the unnecessary use of antimicrobials, overly broad-spectrum treatment regimens and the use of antibiotics for non-infected wounds.
4. To prescribe the appropriate antimicrobial duration, at an optimal dose, administered through the most appropriate route for the indicated condition and patient status (the 'Five Rights' – see page 14 for more information).
5. To use an agent that has the lowest risk of adverse effects.

Figure 1 illustrates the multi-modal approach to AMS practices underpinned by education.

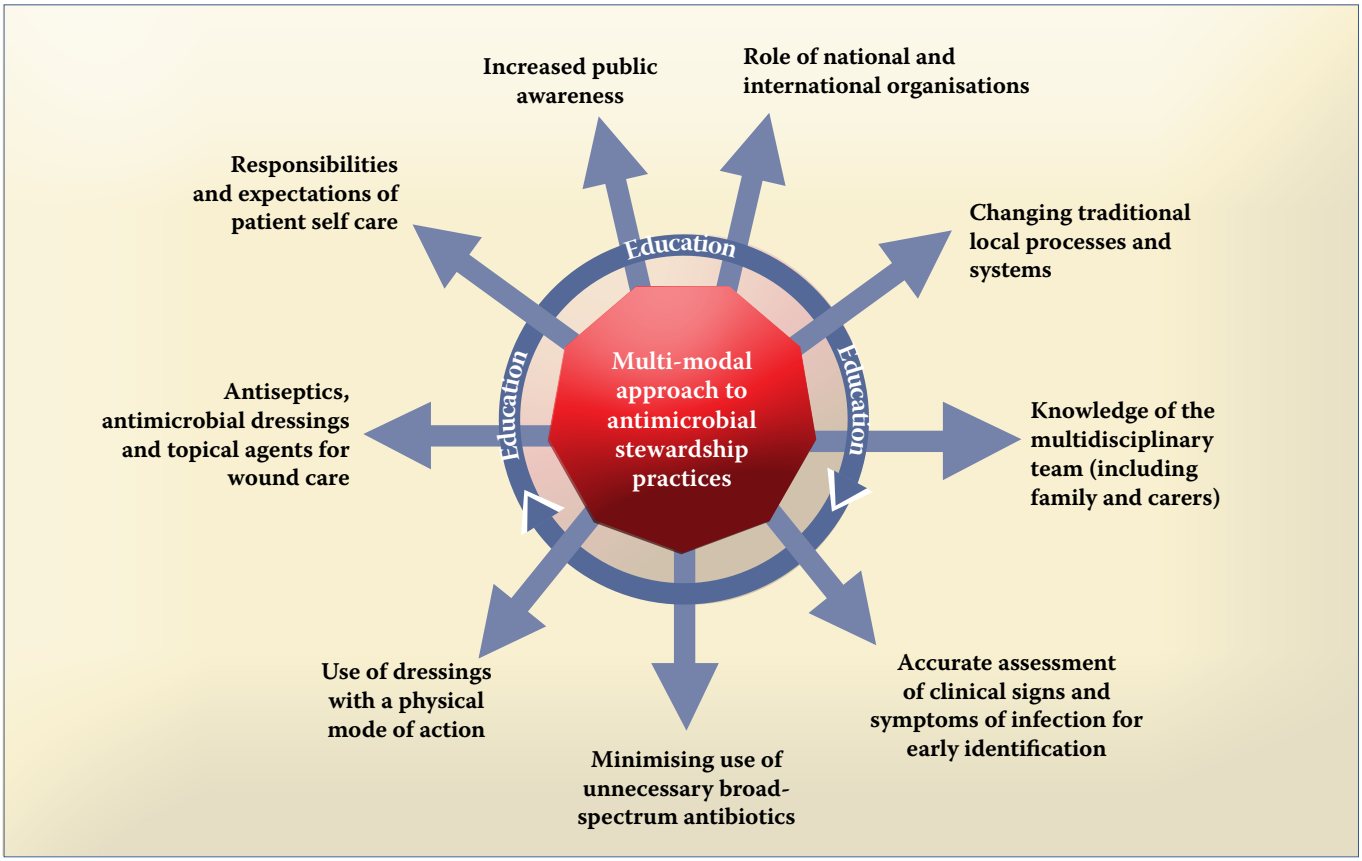


**Figure 1:** Multi-modal approach to antimicrobial stewardship practices underpinned by education

# AMS in wound care – whose responsibility is it?

Everyone should be able to access appropriate information, training and education that can be translated and implemented into clinical practice to allow the early identification of infection and infection risk.

**Best Practice Statement**

Everyone, including you and your family, has a responsibility to reduce the impact of antimicrobial resistance.

**Patient expectation**

Policies and procedures at a local, national and international level, shared decision-making with healthcare organisations, and the assurance that individuals take ownership of their understanding of AMS are crucial to appropriate antibiotic prescribing and limiting the implications of AMR in wound management (Ousey and Blackburn, 2020).

## National and international organisations responsibility

International agencies and the World Health Organization (WHO) are working together to increase awareness of infections caused by multidrug-resistant bacteria, and to educate and train clinicians (WHO, 2015). NICE have produced guidelines, tools and resources on AMS (NICE, 2015) and antimicrobial prescribing for leg ulcer infection (NICE, 2019a), which are frequently reviewed and updated.

## The public responsibility

Everyone should be encouraged and supported to identify and understand when antimicrobial treatment is and is not necessary. The public should be aware of, and follow, public health guidance and campaigns (e.g. flu vaccinations for those who are eligible, guidance on the signs and symptoms of COVID-19).

## The clinician responsibility

AMS practices are the responsibility of every member of the multidisciplinary team, including nurses, podiatrists, support staff, paramedics and pharmacists.

The clinician's responsibility is to educate the patient so that they are aware of the consequences of delaying treatment. Patient education should include:

- Expectations of treatment
- Expectations of management long-term (i.e. will the wound ever heal?)
- Red flags that require urgent treatment
- Infection prevention strategies
- Infection risk reduction strategies.

Fears and anxiety related to infectious diseases, recently COVID-19, have limited some patients from accessing services for life- and limb-threatening and non-life-threatening conditions, even when clinicians explain that the severity of their limb condition places them at significant risk (Adderley, 2020). Patients may present later to medical services, meaning that their infections are more advanced and require more intensive treatment. Additionally, AMS activities have become less of a priority, with staff being redeployed to respond to the COVID-19-related workload. Hard-to-reach patient groups may be worst affected by the reduction in outpatient services and become more vulnerable, e.g. the homeless, intravenous drug users, and those who live on their own, or may not be confident using telemedicine.

## The patient's responsibility

Patients who are able and willing to self care and reduce their modifiable infection risk should be supported by clinicians. As care shifts towards an increase in the use of telemedicine for the foreseeable future, patients and their carer(s)/family take a larger role in wound care and supporting AMS practices.

### COVID-19 terminology

COVID-19 is an acronym for "Coronavirus Disease 2019", and is the official name of the disease.

COVID-19 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

# Infection prevention

Healthcare professionals caring for people with wounds should be aware and understand the relevant up-to-date local/national/international guidelines and follow the fundamental foundations of the back-to-basics approach to reduce the risk of infection.

**Best Practice Statement**

Your healthcare professional will assess your risk of wound infection. If you are assessed as being at high risk of infection, you should expect your healthcare professional to discuss with you and your family/carers how to reduce the risk, with simple approaches that include hand hygiene and maintaining a clean environment.

**Patient expectation**

The foundation of infection prevention in wound care should reflect a back-to-basics approach (Figure 2). The components of the back-to-basics approach include:

- Hand hygiene/decontamination
- Use of personal protective equipment (PPE)
- Good waste management
- Comprehensive documentation
- Management of the patient's environment.

## HAND HYGIENE/ DECONTAMINATION

Hand hygiene removes bacteria, viruses and fungi to help prevent diarrhoea and respiratory infections and may even help prevent skin and eye infections. Micro-organisms can be present and transferred to other objects, like handrails or table tops, and then transferred to another person's hands.

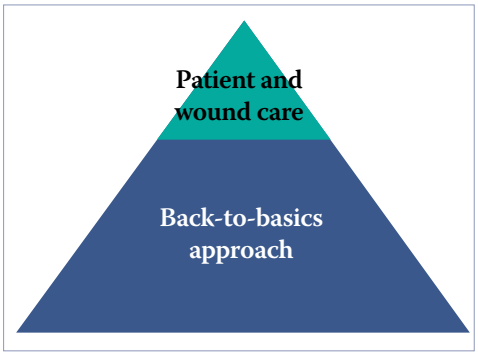


**Figure 2: The back-to-basics approach is the foundation of patient and wound care**

Micro-organisms enter the body through the eyes, nose and mouth and people often touch their face without realising. Therefore, hand washing and maintaining clean hands is becoming an integral part of daily life for all, as well as in the healthcare setting. The '5 Moments for Hand Hygiene' approach (Sax et al, 2007) defines the key moments when any person performing healthcare (e.g. healthcare professional, family or carer) should perform hand hygiene:

- Before touching a patient
- Before clean/aseptic procedures
- After body fluid exposure/risk
- After touching a patient
- After touching a patient's surroundings.

Soap and water remove dirt and grime when the hands are visibly soiled or potentially contaminated with body fluids (e.g. vomit or diarrhoea), regardless of whether or not gloves have been worn (NICE, 2014; 2017). Alcohol-based handrub destroys most micro-organisms and reduces the bio-burden. Alcohol gels are very effective at removing certain micro-organisms such as coronavirus, but do not remove *Clostridium difficile* (Gold and Avva, 2020).

Maintaining good infection control can be more difficult in some patients' homes, so it may be pertinent to assess the hand hygiene facilities in their home and document the results so that other healthcare professionals are prepared (Nazarko, 2016).

## USE OF PPE

Selection of PPE must be based on an assessment of the risk of transmission of micro-organisms to the patient, and the risk of contamination of the healthcare worker's clothing and skin by patients' blood, body fluids, secretions or excretions (NICE, 2017).

In wound care, PPE will always include clean or sterile gloves, and may include disposable gowns, face masks/shields, and goggles. Single-use PPE should be disposed of as per local protocol.

### Correct removal of PPE

Gloves, plastic aprons, gowns and single-use masks are single-use items and should be disposed correctly. If the patient or their family or carer(s) are performing care, they should be advised on the correct handling, storage and disposal of healthcare waste (NICE, 2017).

Between each step of doffing to remove PPE, use alcohol handrub and once all items are doffed, wash hands with soap and water. Items should be removed in the following order: gloves, gowns and masks.

### 1. Removal of gloves

Pinch the glove at the wrist level and pull it away from the skin without touching the forearm. Peel the glove down from the hand so it turns inside out and releases

the hand. Hold the removed glove in your remaining gloved hand. Peel off the second glove by putting your fingers inside the glove at the top of your wrist. Turn the second glove inside out while pulling it away from your body, leaving the first glove inside the second. Discard immediately in a closed bin; clean hands with alcohol-based handrub or soap and water.

Myth: **You can wash your hands with soap and water or use alcohol gel while wearing gloves.**
Truth: **Gloves are labelled as single-use and should be used once and then disposed of appropriately (NICE, 2017).**

### 2. Removal of gown

Untie behind the neck and waist (do not touch the front of gown); discard immediately in a closed bin; clean hands with alcohol-based hand rub or soap and water.

### 3. Removal of mask

Masks are effective only when used in combination with frequent hand hygiene with soap and water or alcohol-based hand rub (WHO, 2020). Box 2 explains how to apply and remove a face mask correctly.

## GOOD WASTE MANAGEMENT

Appropriate waste management should be in place to dispose of waste that contains antimicrobial agents. Additionally dressings or material that might be contaminated with AMR bacteria should be disposed of safely according to local protocols. Infectious waste is defined as anything contaminated with human tissue or bodily fluids (e.g. blood, saliva, pus, faeces, urine, and vomit). Not all agents can be removed from waste water systems using current technologies, which can exacerbate AMR (Anjali and Shanthakumar, 2019). Unused antimicrobials should be returned to the local pharmacy.

**Box 2. Mask application and removal (WHO, 2020)**

- Before putting on a mask, clean hands with alcohol-based handrub or soap and water.
- Cover mouth and nose with mask and make sure there are no gaps between your face and the mask.
- Avoid touching the mask while wearing it; if you do, clean your hands with alcohol-based handrub or soap and water.
- Remove it from behind each ear (do not touch the front of the mask).
- Replace mask with a new one as soon as it is damp or at the end of the care provided.
- Do not reuse single-use masks.
- Masks should not be worn around the neck.

## COMPREHENSIVE DOCUMENTATION

Full and comprehensive documentation should be carried out for all patients with, or at risk of, a wound. Documentation for all patients should include:

- Wound, skin, limb and patient assessment, including infection risk.
- Optimisation, management and referral of comorbidities (e.g. diabetes).
- Hydration and nutrition.
- Appropriate skin care.
- Wound treatment where applicable.
- Regular review of the patient's treatment and progress to identify lack of progress and/or deterioration quickly (Wounds UK, 2018).

Infections and the risk of infection should be documented in order to identify patterns and associations, which may help to reduce incidence. Table 1 includes the individual, wound and environmental factors associated with an increased risk of wound infection.

Multidisciplinary team communication and collaboration – both in person and via the patient's records – are vital. 'Huddles' have been used successfully in the acute sector to improve processes and safety, and could be used within other settings. Huddles are short meetings (2–3 minutes) with the purpose of team communication and empowering all members to have their voice heard. Wherever possible as the healthcare landscape evolves, there must be clear communication between health and social care sectors.

## MANAGEMENT OF THE PATIENT'S ENVIRONMENT

The patient's environment, in hospital or in the community, should be monitored to ensure infection prevention practices are followed. Ensuring that the patient's environment is clean in the community is a challenge. *Pseudomonas aeruginosa* lives in the environment and can be spread to people in healthcare settings when they are exposed to contaminated water, hands, equipment or surfaces. Micro-organisms can exist on surfaces for days (e.g. MRSA), or for months (e.g. gram-positive and gram-negative bacteria) on dry surfaces (Kramer et al, 2006).

Table 2 is a summarised checklist of considerations for infection prevention and AMS practices that considers the patient and wound, environment, healthcare professionals and carer, and care protocol itself.

**Table 1. Checklist of factors associated with increased risk of wound infection (adapted from IWII, 2016)**

| Characteristics of the individual (Schultz et al, 2003; Swanson et al, 2015) | | |
|---|---|---|
| ❒ Poorly controlled diabetes | | |
| ❒ Prior surgery (Sandy-Hodgetts et al, 2019; Wounds UK, 2020) | | |
| ❒ Radiation therapy or chemotherapy | | |
| ❒ Conditions associated with hypoxia and/or poor tissue perfusion (e.g. anaemia, cardiac or respiratory disease, arterial or vascular disease, renal impairment, rheumatoid arthritis, shock) | | |
| ❒ Immune system disorders (e.g. acquired immune deficiency syndrome, malignancy) | | |
| ❒ Inappropriate antibiotic prophylaxis, particularly in acute wounding | | |
| ❒ Protein-energy malnutrition | | |
| ❒ Alcohol, smoking and drug abuse (Wounds UK, 2018; WUWHS, 2020a) | | |
| ❒ Presence of significant lymphoedema, skin conditions, haematoma, seroma, abscess, fistula (Beeckman et al, 2020) | | |
| ❒ A history of self harm (Hunt, 2018) | | |
| ❒ A carrier or infected with a multi-drug resistant organism (i.e. 'alert organism') | | |
| ❒ Recent travel (i.e. abroad, between multiple care settings) | | |
| ❒ Level of mental capacity, knowledge and understanding (WUWHS, 2020a) | | |
| **Characteristics of the wound (Schultz et al, 2003; Swanson et al, 2015)** | | |
| Acute wounds | Chronic wounds | Both wound types |
| ❒ Contaminated or dirty wounds | ❒ Degree of chronicity/duration of wound | ❒ Foreign body (e.g. metal work, drains, sutures) |
| ❒ Trauma with delayed treatment | ❒ Large wound area | ❒ Haematoma |
| ❒ Pre-existing infection or sepsis | ❒ Deep wound | ❒ Necrotic wound tissue |
| ❒ Spillage from gastro-intestinal tract | ❒ Anatomically located near a site of potential contamination (e.g. perineum or sacrum) | ❒ Impaired tissue perfusion |
| ❒ Penetrating wounds over 4 hours | | ❒ Increased exudate or moisture |
| ❒ Inappropriate hair removal | | |
| ❒ Operative factors (e.g. long surgical procedure, hypothermia, blood transfusion) | | |
| **Characteristics of the environment (Schultz et al, 2003; Torpy et al, 2005; Swanson et al, 2015)** | | |
| ❒ Hospitalisation (due to increased risk of exposure to antibiotic resistant organisms) | | |
| ❒ Poor hand hygiene and aseptic technique | | |
| ❒ Unhygienic environment (e.g. dust, unclean surfaces, mould/mildew in bathrooms) | | |
| ❒ Inadequate management of moisture, exudate and oedema | | |
| ❒ Inadequate pressure off-loading | | |
| ❒ Repeated trauma (e.g. inappropriate dressing removal technique) | | |

**Table 2. Summary of infection prevention and AMS practice considerations (Best et al, 2014; IWII, 2016)**

| Patient and wound | Environment | Healthcare professionals and carers | Protocol |
|---|---|---|---|
| ■ Avoid any break in the skin and preserve overall skin integrity (i.e. keep skin clean, dry and well hydrated) according to local policy and international guidance (LeBlanc et al, 2018)<br>■ Implement wound bed preparation to reduce wound or skin microbial load:<br>- Debride the wound of necrotic tissue, debris, foreign bodies, wound dressing remnants and slough<br>- Cleanse the wound at each dressing change<br>- Use aseptic technique for acute wounds and a clean technique for chronic ulcer<br>■ Optimise management of comorbidities (e.g. diabetes, tissue perfusion/oxygenation)<br>■ Optimise nutritional status and hydration<br>■ If the patient is at considerable risk, decontamination measures should be considered (e.g. cleaning and waste disposal), and in some cases isolation may be considered<br>■ Patient capacity for self-care should be established; in the home setting, education about hygiene may be needed (e.g. how best to apply creams without increasing infection risk, suitable bathing products, how best to dry their skin with a clean towel)<br>■ Consider antimicrobial treatment in some instances, such as suspected diabetic foot infections (NICE, 2019b) and suspected surgical site infections (NICE, 2019c). | ■ Clean/disinfect surfaces before use<br>■ Reduce clutter (e.g. ensuring appropriate storage spaces for equipment and dressings)<br>■ Use appropriate waste disposal facilities for unused antimicrobial therapy and dressings and materials that may harbour antimicrobial resistant bacteria<br>■ Provide adequate lighting<br>■ In the patient's home: Consider the impact of any pets in the home environment (i.e. keeping them away from the wound and ensuring general hygiene is maintained). | ■ Hand hygiene<br>■ Adhere to uniform policy, and consider that this may not provide full and up-to-date information; for example the following should be avoided:<br>- False nails/gel nails (dirt behind long nails is an infection risk)<br>- Jewellery (apart from a wedding band and stud earrings)<br>- False eyelashes<br>- Wearing hair down (touching or below the collar)<br>- Fitness tracking watches or devices<br>■ Training for new staff: ensure that all staff have up-to-date with local protocols<br>■ Staff with skin conditions: assess on an individual basis if they should be working or require extra PPE<br>■ Staff illness: staff should be encouraged to stay at home if there is an infection risk. | ■ Prevent cross-infection by implementing universal precautions and aseptic technique<br>■ Work to reduce/manage exposure of dressings/ bandages to urine, faeces or other contaminants (use barrier cream where necessary)<br>■ Avoid 'double dipping' in larger pots of creams and ointments<br>■ Improve documentation of infection<br>■ Routine review of antibiotics and antimicrobials<br>■ Store equipment and supplies appropriately<br>■ Regularly review local policies and procedures<br>■ Remember that AMS is everybody's responsibility throughout the patient journey. |

# Understanding the infection continuum

People caring for patients with, or at risk of, a wound need to be able to recognise the signs and symptoms of wound infection. Occurrence of wound/skin infections should be monitored, reported and investigated.

**Best Practice Statement**

Your healthcare professional should advise you on the signs to look out for in case your wound becomes infected (e.g. warmth, swelling, new or increasing pain, increasing odour coming from the wound) and when you need to seek urgent clinical attention (e.g. lethargy, loss of appetite, fever).

**Patient expectation**

Wound infection is a clinical challenge that can delay healing. The infection continuum describes the relationship between increasing microbial virulence and the clinical response invoked within the patient. The continuum encourages vigilance to encourage early identification to trigger when intervention is required (Figure 3; IWII, 2016). Table 3 describes the signs and symptoms associated with each stage of the infection continuum.

## STAGES OF THE INFECTION CONTINUUM

### Contamination

Wound contamination is the presence of non-proliferating micro-organisms within a wound at a level that does not evoke a host response. All open wounds are contaminated with endogenous and exogenous microbial sources caused by environmental exposure and the patient's natural skin flora (Sibbald et al, 2003). Unless the host defences are compromised, the host immune system will respond swiftly to destroy bacteria. Vigilance is required, but antimicrobials are not indicated at this stage.

### Colonisation

Colonisation refers to the presence of micro-organisms in the wound that have undergone some proliferation, but there is no host reaction. Microbial growth occurs, but at a level that is non-critical and wound healing is not delayed or impeded (IWII, 2016).

### Local wound infection

Wound infections are caused by the multiplication of micro-organisms in the wound of a susceptible patient at a rate that the host defences are unable to overcome the micro-organism in the wound. Intervention is generally required to assist the host defences in destroying invading micro-organisms. Micro-organisms can enter into wounds in a number of ways:

- **Direct contact** – transfer from surgical equipment or the hands
- **Airborne dispersal** – surrounding air contaminated with micro-organisms that deposit onto the wound
- **Self-contamination** – physical migration of the patient's own endogenous flora, which is present on the skin, mucous membranes or gastrointestinal tract.

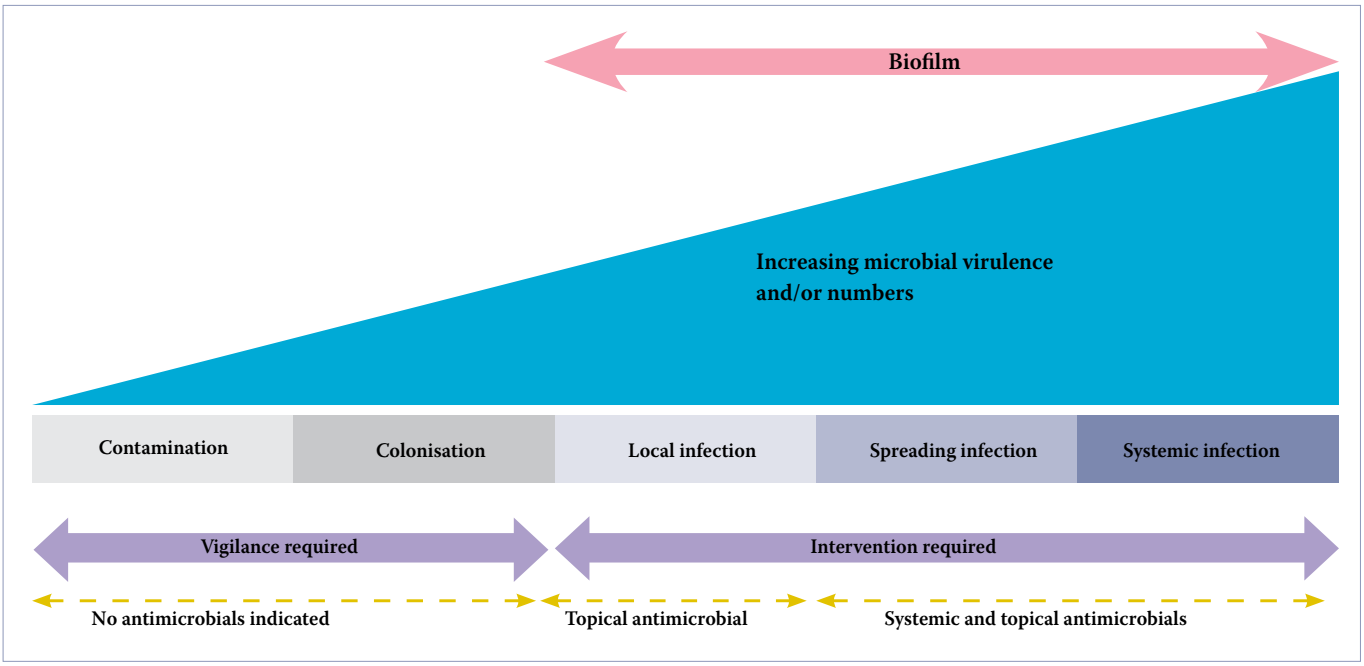


**Figure 3: Infection continuum (IWII, 2016)**

Table 3. Signs and symptoms associated with stages of the wound infection continuum (IWII, 2016)

| Contamination | Colonisation | Local infection | | Spreading infection | Systemic infection |
|---|---|---|---|---|---|
| All wounds may acquire micro-organisms. If suitable nutritive and physical conditions are not available for each microbial species, or they are not able to successfully evade host defences, they will not multiply or persist; their presence is therefore only transient and wound healing is not delayed | Microbial species successfully grow and divide, but do not cause damage to the host or initiate wound infection | Covert (subtle) signs of local infection:<br>■ Hypergranulation (excessive 'vascular' tissue)<br>■ Bleeding, friable granulation tissue<br>■ Epithelial bridging and pocketing in granulation tissue<br>■ Wound breakdown and enlargement<br>■ Delayed wound healing beyond expectations<br>■ New or increasing pain<br>■ Increasing malodour | Overt (classic) signs of local infection:<br>■ Erythema<br>■ Local warmth<br>■ Swelling<br>■ Purulent discharge<br>■ Delayed wound healing beyond expectations<br>■ New or increasing pain<br>■ Increasing malodour | ■ Extending in duration +/- erythema<br>■ Lymphangitis<br>■ Crepitus<br>■ Wound breakdown/ dehiscence with or without satellite lesions<br>■ Malaise/ lethargy or non-specific general deterioration<br>■ Loss of appetite<br>■ Inflammation, swelling of lymph glands | ■ Severe sepsis<br>■ Septic shock<br>■ Organ failure<br>■ Death |

**Box 3. Clinical indicators of biofilm (IWII, 2016)**

- Failure to respond to antibiotic/ antimicrobial treatment
- Recurrence of delayed healing on cessation of antibiotic/ antimicrobial treatment
- Increased exudate/ moisture
- Low-level chronic inflammation
- Low-level erythema
- Poor granulation/ friable hypergranulation
- Wound breakdown and enlargement

## Biofilm

It is now widely accepted that biofilm is present in 70–100% of chronic wounds (Malone et al, 2017). However, identification and management of biofilm remains a complex task. A biofilm is an aggregated community of slow-growing bacteria that are tolerant to host defences and to antimicrobial treatment (Schultz et al, 2017). Their altered metabolism, umbrella-like protective matrix and altered low-oxygen microenvironment increases their tolerance to antimicrobials (WUWHS, 2020b). Biofilms are often polymicrobial, involving clusters of different types of bacterial cells growing at different rates, which are challenging to treat. Biofilms are not visible to the naked eye and can be difficult to confirm unless a biopsy is taken and visualised by microscopy, therefore, there are subtle clinical indicators of biofilm that are relied upon for diagnosis (Box 3).

## Spreading and systemic infection

Spreading infection describes the invasion of the surrounding tissue by micro-organisms that have spread from the wound to deep tissue, muscle, fascia, organs or body cavities. Micro-organisms spread via the vascular or lymphatic system and can spread to the whole body.

If systemic or spreading infection is present, antibiotic therapy must be started immediately while awaiting culture results. A sample/wound swab must be taken to determine the bacteria present and guide appropriate antibiotic use (Lipsky et al, 2016). The therapy should be reviewed and revised based on clinical response and microbiological culture/susceptibility results.

## Red flag: acute deterioration or sepsis

Sepsis is a rare, but potentially fatal, condition. Recognising and treating infection early, before sepsis develops, is vital. If the patient looks ill, has triggered the National Early Warning Score (pulse, blood pressure, respiratory rate, oxygen levels, temperature and conscious level), or there are signs of infection – then the patient should be screened for sepsis (Royal College of Physicians, 2017).

Patients and their carers and/or families should be made aware of the symptoms of sepsis so that they can seek urgent medical attention (Box 4). Urgent action includes immediate, high-level resuscitation with fluids, oxygen and systemic antibiotic therapy (IWII, 2016).

# DIAGNOSIS

Diagnosis using gold standard methods should be mandatory prior to initiation of

**Box 4. Symptoms of sepsis**

**Seek medical help urgently if you (or another adult) develop any of these signs:**

- **S**lurred speech or confusion
- **E**xtreme shivering or muscle pain
- **P**assing no urine (in a day)
- **S**evere breathlessness
- **I**t feels like you're going to die
- **S**kin mottled or discoloured

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antibiotics; however, approaches to infection diagnosis depend on clinical expertise and locally available methods. These may include: bedside assessment of the clinical signs and symptoms of each stage of the infection continuum, surface wound swabbing (e.g. the Levine technique), the use of point-of-care digital devices, or wound biopsy.

There is ongoing debate on the accuracy of available methods. Recent evidence suggests that point-of-care digital diagnostic devices may yield more accurate results (Serena et al, 2019), but these devices require clinical expertise and are not always locally available.

Diagnosis of wound infection should combine the clinician's professional judgement and the clinical presentation of the wound and patient.

## Role of swabbing and sampling

Wound swabbing is a simple, convenient, widely available and non-invasive procedure, but it is not a tool that can be used to diagnose in isolation. Swabbing guides antibiotic selection against the organisms causing the clinical signs of infection – it does not determine whether infection is present or not.

Routine swabbing in the absence of clinical indicators of infection is neither helpful nor cost-effective. Therefore, careful consideration of whether swabbing should be conducted is paramount. Box 5 includes questions to consider when deciding whether to swab the wound bed.

**Box 5. Questions to consider when deciding whether to swab (Everett et al, 2018)**

- Is the current therapy appropriate based on the last results?
- Has the therapy had time to work (2–3 days)?
- Is there deterioration? If so, is this deterioration deep (i.e. is a tissue sample required at theatre level)?
- Are there signs of spreading or systemic infection?

If swabbing is indicated, the Levine technique should be used over the 'Z' technique (Angel et al, 2011). The Levine technique involves rotating the swab whilst pressing lightly over a 1cm$^2$ area of the wound; the Z technique involves rotating the swab between the fingers in a zigzag fashion across the wound without touching its edge.

Once the sample has been collected it should be labelled with the patient identification details, date and time of the sample and wound site and sent as quickly as possible to the laboratory as per local protocol.

## Interpreting results

Most laboratories will provide information on the bacteria cultured from a wound swab, the number of organisms grown (either quantitatively or semi-quantitatively), and the antibiotic susceptibility of the grown organisms, which should guide treatment.

A swab will always identify the presence of micro-organisms (Cooper, 2010). The presence of an organism in an infected wound does not necessarily mean that it has caused the infection, and in practice it is not possible to differentiate between pathogenic and non-pathogenic organisms.

Bacterial infection with multiple species produces a synergistic effect, leading to increased production of virulence factors and greater delays in healing, suggestive of biofilm. The most common causative organisms associated with wound infections include *S. aureus*/MRSA, *Streptococcus pyogenes*, *Enterococci* and *P. aeruginosa*.

# Antimicrobial treatment selection

All staff caring for people with wounds should be aware of how to manage wound infection according to local protocol. There should be regular review of antimicrobial treatment. Frequent comprehensive reassessment of the patient and wound should be undertaken to identify whether changes to the management strategy are required.

**Best Practice Statement**

Your healthcare professional should explain if you have a wound infection, and how to follow your treatment correctly (especially if you are prescribed antibiotics). During your consultations, you should expect to have your medication(s) and or dressing(s) reviewed to check that they are working correctly and are still required. If you are prescribed antibiotics, you should finish the course.

**Patient expectation**

**Box 6. 'Five Rights' of drug administration**

1. Right patient
2. Right drug
3. Right time
4. Right dose
5. Right route

The clinician must undertake and document a holistic assessment of the patient, wound and the wound care environment, in order to guide antimicrobial treatment (Wounds UK, 2018). If a bacterial cause for a spreading or systemic infection is suspected, appropriate microbiological investigations should be started to identify the type of micro-organism. The use of antibiotics must comply with local AMS policies (Sandy-Hodgetts et al, 2020).

## FIVE RIGHTS

The 'Five Rights' of drug administration are a crucial component in medication safety, particularly antibiotics (Box 6). Here, the 'Five Rights' have been adapted for the appropriate prescribing of topical antimicrobials in wound care:

1. Right diagnosis and care plan.
2. Right antimicrobial and delivery system.
3. Right time to initiate antimicrobial treatment.
4. Right antimicrobial dose.
5. Right duration of antimicrobial treatment.

### 1. Right diagnosis and care plan

Comprehensive assessment of the individual and their wound aids early detection and timely and correct treatment of infection. Following diagnosis, the care plan should include the following principles for effective management of wound infection (IWII, 2016):

- Optimisation of the individual host response considering patient factors that increase risk for infection. Table 1, page 9, outlines factors that are associated with increased risk of infection.
- Reduction of the wound microbial load (e.g. wound bed preparation, care to the surrounding skin, antimicrobial and dressing selection).
- Promotion of environmental infection prevention measures.
- Regular reassessment.

Ensure the prescription is individualised to the patient following thorough assessment of the wound and patient (including any allergies). The patient should understand why treatment has been prescribed (i.e. explain the rationale behind treatment decisions, with a focus on shared decision-making) so that they engage with their treatment. Any adverse reactions should be monitored, recorded and reported.

### 2. Right antimicrobial and delivery system

Choice of drug or dressing should be made according to data on pharmacology, microbiology, clinical experience, economy, local availability and local AMS protocol. The *Summary of antimicrobial prescribing guidance – managing common infections* by NICE and PHE (2019) should be followed to select the antimicrobial agent, dosage and duration for leg ulcer infection, cellulitis and erysipelas, and diabetic foot infections. Box 7 explains the different types of antimicrobial agents.

**Box 7. Antimicrobials, antibiotics and antiseptics (Nankervis et al, 2016)**

Antimicrobials refer to a group of agents that aim to reduce the possibility of infection and sepsis.

- Antibiotics are often derived from soil-dwelling bacteria. As bacteria produce most antibiotics they have evolved mechanisms of resistance and these make their way from environment to clinic. Antibiotics can kill bacteria (bactericidal) or prevent their multiplication (bacteriostatic).
- Antiseptics are applied to the skin but not absorbed significantly. They reduce the possibility of infection.

#### Antibiotics

Antibiotic misuse in wound care occurs because of diagnostic uncertainty concerning the presence of a bacterial infection, lack of knowledge of lower limb infections (e.g. bilateral lower limb cellulitis, also known as red leg, can be often mistaken for infection), clinicians' fear of achieving unfavourable patient outcomes and patient demand (Roberts et al, 2017).

Systemic antibiotics should be reserved for the treatment of serious bacterial infections in high-risk patients when other treatment options are ineffective or not available. The antibiotic selected should be specifically focused to the micro-organism and administered for the shortest duration possible (Lipsky et al, 2016). Also, switching from intravenous to oral therapy as soon as patients are clinically stable can reduce the length of hospitalisation, thus reducing the risk of hospital-acquired complications, and reducing associated costs (Cyriac et al, 2014; Eckmann et al, 2014).

The only topical antibiotics recommended for wound infections are mupirocin, fusidic acid and metronidazole, and these should be used in limited situations subject to local policy (NICE, 2019a). Box 8 provides practical guidance for patients receiving antibiotic treatment.

**Box 8. Practical guidance for patients receiving antibiotic treatment**

- If you are taking your antibiotics as prescribed and develop symptoms such as fever, rash, upset stomach, lethargy or confusion, you should contact a healthcare professional.
- You will need to read the patient information and follow the instruction, such as when to take your medication, if it should be taken with or without food, what to do if you miss a dose, possible side effects, when to seek help.
- If you do not intend to finish the prescribed dose, seek advice from a healthcare professional.

**Myth: If you are feeling better, you do not need to take the rest of your antibiotics.**
**Truth: You should complete the prescribed course of antibiotics as per the patient information leaflet.**

## Antiseptics

In wound care, antibiotic-resistant bacteria present a serious issue, necessitating the consideration of alternatives to antibiotics, such as topical antiseptics. There is strong and growing evidence that antiseptics can be useful agents in attempts to reduce AMR but are under-used, particularly in the fields of wound care and surgical site management (Roberts et al, 2017).

Antiseptics are non-selective agents that are applied topically in order to stop growth or kill micro-organisms. They are relatively non-toxic and are not significantly absorbed through the skin, as such development of resistance to antiseptics is uncommon. Topical antiseptics are available in dressings, ointments, powders and cleansing solutions (e.g. silver, honey, iodine, octenidine dihydrochloride, polyhexamethylene biguanide [PHMB]).

## Dressings that have a physical mode of action

Treatments for wound infection that do not involve the use of antibiotics, antimicrobials or antiseptics are essential to promote AMS practices (WUWHS, 2020b).

Cleansing lotions that contain surfactants loosen and remove surface debris and the associated microbial load. A surfactant reduces the surface tension holding debris (dried exudate, loose and devitalised mucous membrane) to the wound bed.

Products that offer an alternative approach to the management of increasing bacterial load in chronic wounds, such as dressings with a physical mode of action are effective in wound bio-burden management as there is no risk of bacteria developing resistance (Frykberg and Banks, 2015; Ousey and Chadwick, 2019).

Dressings coated in a fatty acid derivative irreversibly bind to bacteria and sequester their activity. As there is no risk of bacteria developing resistance, these dressings may be used prophylactically, but are best used on unclean, colonised or infected exuding wounds (Ousey and Chadwick, 2019).

### 3. Right time to initiate antimicrobial treatment

The presence of clinical signs and symptoms of infection and indicators of biofilm (Table 3 and Box 3) and local protocol determine when antimicrobial treatment is initiated. Antimicrobial agents should not be routinely used as a precautionary measure if the wound is not clinically infected. However, there are some instances where antimicrobial treatment is indicated if infection is suspected**:**

**Suspected diabetic foot infections:** There are no convincing data to support the concept that prescribing antibiotic therapy for clinically non-infected ulcers either accelerates healing or reduces the risk of developing clinically apparent infection (Abbas et al, 2015). NICE (2019b) recommends to start antibiotic treatment for people with suspected diabetic foot infection as soon as possible. Take samples from the base of the debrided wound for microbiological testing before, or as close as possible to, the start of antibiotic treatment (NICE, 2019c). If a swab at the base of the wound cannot be obtained, take a deep swab because it may provide useful information on the choice of antibiotic treatment.

**Myth: People with diabetes should always use an antimicrobial solution to wash their feet.**
**Truth: A person with diabetes who is at risk of foot ulceration should inspect both feet and the inside of their shoes daily; wash the feet daily (with careful drying, particularly between the toes); use emollients to lubricate dry skin; cut toe nails straight across; and, avoid using chemical agents or plasters or any other technique to remove callus or corns (Bus et al, 2019).**

**Surgical site infection:** Prophylactic antibiotic therapy is usually given as a single dose at induction of anaesthesia, but should not be continued after surgery (WHO, 2018). NICE (2019c) recommends that when a surgical site infection is suspected due to the presence of cellulitis, either by a new infection or an infection caused by treatment failure, the patient should be given an antibiotic that covers the likely causative organisms and considers the results of microbiological tests. The Best Practice Statement *Post-operative wound care – reducing the risk of surgical site infection* provides guidance on strategies that promote AMS (Wounds UK, 2020).

### 4. Right antimicrobial dose

Wound care products and dressings may have different amounts of the active ingredient and have different release mechanisms which make them more or less readily available, such as povidine iodine and cadexomer iodine. For oral antibiotics, there are NICE and PHE (2019) guidelines to guide prescription of common infections, including diabetic foot infections, leg ulcers, and cellulitis and erysipelas. Local protocols and pathways should be in place to advise based on product availability.

### 5. Right duration of antimicrobial treatment

If antibiotics are prescribed, the course should be completed to avoid infection reoccurrence and to reduce the risk of the bacteria becoming resistant to the antibiotics. If the patient does not intend to finish the course, they should be advised to contact the prescriber. If there is no response or improvement after the designated duration of antimicrobial treatment, management needs to be reviewed as per local protocol. The 'two-week' challenge guides the appropriate duration of antimicrobial treatment and reassessment (Box 9).

A wound that does not progress and remains chronic could be indicative of the presence of biofilm. Antimicrobial failure and recurrence of delayed healing on cessation of antimicrobial treatment are well-established clinical indicators of the presence of biofilm (Box 3; IWII, 2016). If the clinical indicators of biofilm are present, this may indicate a different

**Box 9. Two-week challenge (Ayello et al, 2012; IWII, 2016)**

Appropriate duration of antimicrobial treatment is an area of debate, with longer duration being associated with a heightened risk of inducing microbial resistance. The use of a highly effective antimicrobial is required for shorter duration treatments to kill bacteria, thereby minimising the risk of inducing microbial resistance.

Antimicrobial dressings are recommended to be used for a minimum of 2 weeks' duration. After 2 weeks, re-evaluate and either:

(1) discontinue if signs and symptoms of infection have resolved
(2) continue with the antimicrobial if the wound is progressing but there are still signs and symptoms
(3) consider an alternative antimicrobial if there is no improvement and refer to a wound care specialist.

management approach is required, including:

- Debridement to physically disrupt and expose the micro-organisms to make them vulnerable to the effects of topical antiseptics and systemic antibiotics.
- Cleansing to remove any residual debris and antimicrobial intervention against exposed bacteria and residual biofilm.
- Use of an antimicrobial with proven effect against mature biofilms in clinical practice or a dressing with a physical mode of action.

Reassessment should also be triggered if the condition of the wound (Table 4; Wounds UK, 2018) or patient deteriorates (e.g. they develop an acute medical condition or an existing comorbidity worsens).

Figure 4 is a pathway to guide the use of antimicrobial treatment for patients with wounds with or without infection risk.

**Table 4. Examples of local indicators of improvement/deterioration of chronic wounds and may indicate infection (adapted from Wounds UK, 2018)**

| Parameter | Change that may indicate: | |
|---|---|---|
| | Improvement | Deterioration |
| Wound bed | ■ Increased amount of granulation tissue<br>■ Decreased amount of slough/ necrotic tissue<br>■ Reduction in wound area/volume* | ■ Increased amount of slough/necrotic tissue<br>■ Decreased amount of granulation tissue<br>■ Granulation tissue is friable<br>■ Increase in wound area/volume |
| Exudate | ■ Levels usually decrease as the wound heals<br>■ Changed to clear if previously cloudy | ■ Increased level<br>■ Changed from clear to discoloured<br>■ Change in consistency, e.g. thinner to thicker |
| Periwound skin | ■ Reduction, if present, of:<br>- Maceration/excoriation<br>- Erythema<br>- Swelling | ■ Development, or increase in extent, of:<br>- Maceration/excoriation<br>- Erythema<br>- Swelling |
| Odour | ■ Less noticeable or resolved if previously an issue | ■ Development, change in or worsening of unpleasant odour |
| Wound-related pain† | ■ Reduced level or frequency | ■ Development, change in nature and/ or increase in level of pain† |

*N.B. Changes in wound area/volume may not be noticeable from one dressing change to the next, and a wound may increase in size when necrotic tissue and slough are removed. Taking photographs and measuring the wound helps to identify if the wound is improving.
†Patients with a diabetic foot ulcer and neuropathy may not experience pain; a patient with sudden onset of pain should be referred urgently

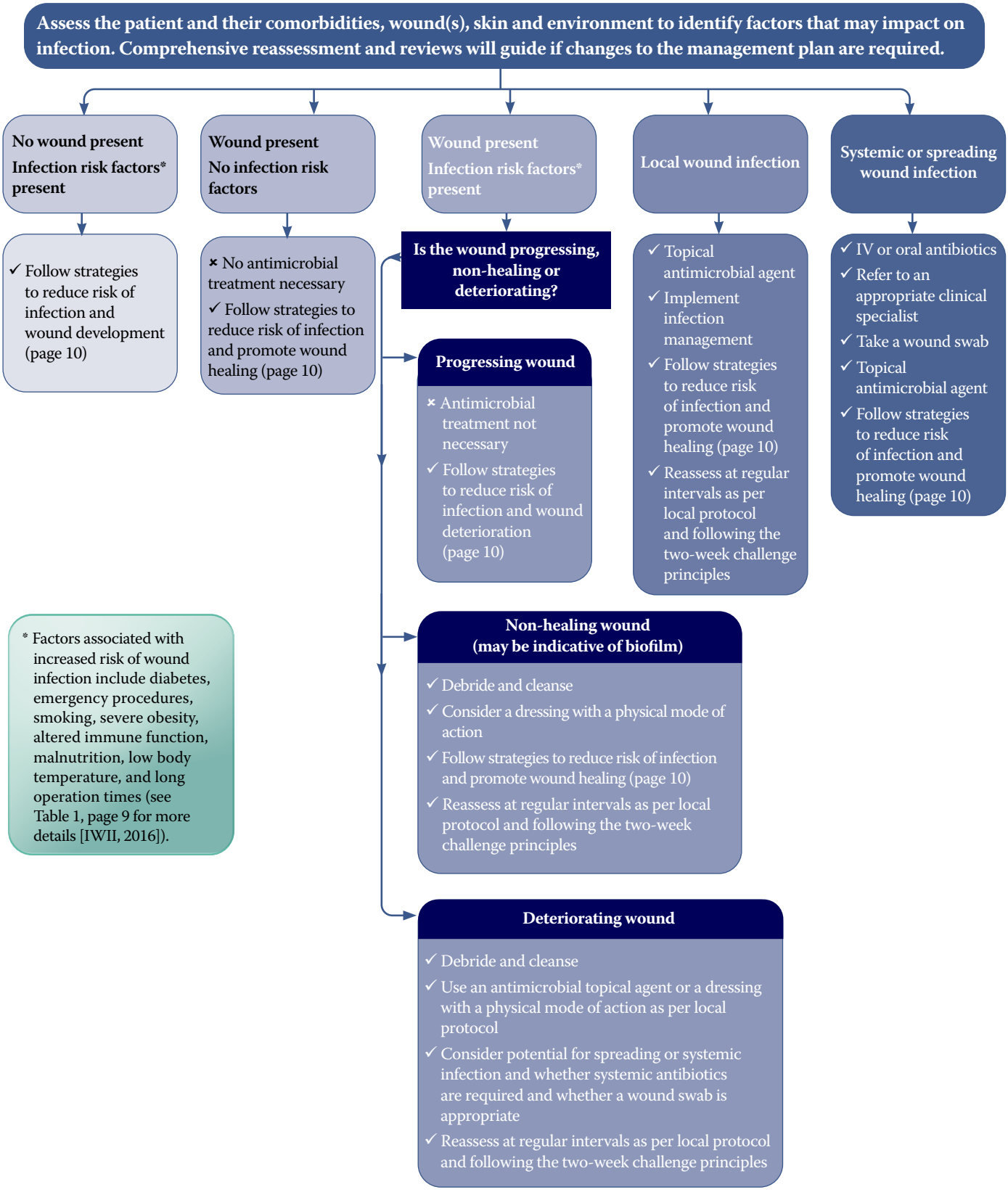


**Figure 4: Pathway to guide management of patients with wounds with or without infection risk considering the principles of antimicrobial stewardship. IV=intravenous**

# Take-home messages

## TAKE-HOME MESSAGES

- AMS encompasses all members of the multidisciplinary team. Equipping non-wound care specialists and patients with tools to support AMS practices can establish consistency across care settings.
- Combating AMR requires a multi-modal approach led by education and understanding of the infection continuum. Early identification of infection will lead to faster and more effective treatment. Training and education to improve the confidence of healthcare professionals to understand and identify the signs of infection is a must.
- If infection is suspected, appropriate microbiological investigations should be used to identify the cause. Point-of-care diagnostic devices, such as MolecuLight (MolecuLight Inc), may offer a more accurate way to identify pathogenesis before there are clinical signs and symptoms of infection (Serena et al, 2019). Such devices are currently not widely available across the UK.
- There needs to be environment that fosters behavioural change with a focus on the back-to-basics approach of infection prevention. Simple pathways that combine the back-to-basics approach with advanced wound care, such as Figure 4, may help to guide care that is consistent with AMS strategies.
- For infection management, dressings that do not contain an active/pharmaceutical component and instead have a physical mode of action to reduce bacterial load offer an ideal option in the drive to promote AMS practices (Ousey and Chadwick, 2019).
- Where possible, patient-reported outcomes must be tracked, reported and published to identify the AMS practices that are successful.
- Shared education, support from industry, as well as shared decision making around AMR policies and procedures are fundamental to ensuring the impact of AMR is reduced and to understanding the most appropriate and sustainable method of wound management (Ousey and Blackburn, 2020).

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