WUK BPS

Best Practice Statement

Use of silver dressings in wound care

2021

The role of silver

Myths and truths

Identification of infection with the TILI score

Managing bioburden

Wounds UK

BEST PRACTICE STATEMENT: USE OF SILVER DRESSINGS IN WOUND CARE

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Wounds UK
A division of Omniamed Communications,
108 Cannon Street,
London
EC4N 6EU, UK
Tel: +44 (0)20 3735 8244
Web: www.wounds-uk.com

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EXPERT WORKING GROUP:

- **Jacqui Fletcher (Chair),** Independent Consultant
- **Leanne Atkin,** Vascular Nurse Consultant, Mid Yorks NHS Trust; Lecturer Practitioner, University of Huddersfield
- **Val Edwards-Jones,** Professor Emeritus of Medical Microbiology, Manchester Metropolitan University, and Institute of Skin Integrity and Infection Prevention, University of Huddersfield
- **Jeanette Milne,** Chief Matron Community, Northumbria Healthcare NHS Foundation Trust, Northumbria
- **Sue Murray,** Clinical Lead, Tissue Viability, Central London Community Healthcare NHS Trust
- **Karen Ousey,** Professor and Director for the Institute of Skin Integrity and Infection Prevention, University of Huddersfield
- **Andrew Sharpe,** Advanced Podiatrist, Salford Royal NHS Foundation Trust

REVIEWER:

- **Claire Acton,** Head of Tissue Viability, Kent Community Health NHS Foundation Trust

Foreword

Infection is an important issue in wound care. Early identification and intervention are key to the patient's wellbeing and healing outcomes. Effective identification and treatment of wound infection remains a challenge in clinical practice.

Assessment and identification of infection should be carried out according to evidence-based best practice within a structured framework to standardise care. Identifying infection can be a challenge as the signs and symptoms of infection can be subtle. The Therapeutic Index for Local Infections (TILI) score is a diagnostic tool that was developed to facilitate identification of wound infection and aid decision-making for staff, regardless of level of expertise (Dissemond et al, 2020a). Once it is determined that a wound is infected, decision-making around treating infection can be complicated as there is a plethora of antimicrobial agents and products available.

Any infection management regimen should encompass awareness of biofilm and treatment strategies as appropriate, particularly in chronic or hard-to-heal wounds. Antimicrobial resistance (AMR) is also a global concern that requires consideration, and all infection treatment should take an approach informed by antimicrobial stewardship (AMS).

Silver is an effective antimicrobial, which can be incorporated into an AMS-based approach to infection management. It is important to note that not all silver products are the same and a decision-making framework such as the TILI score can help to guide appropriate selection.

This best practice document aims to:

- Provide an overview of silver as an antimicrobial and dispel myths about silver products and their use within wound care
- Introduce the TILI score as an assessment tool in practice to guide decision-making and facilitate early intervention
- Provide guidance on how to incorporate appropriate use of silver dressings into practice.

Jacqui Fletcher, Chair

Overview of wound infection management

Understanding the risk factors, and the signs and symptoms, of wound infection is imperative for all health professionals (IWII, 2016). It is also important that, when wound infection has been identified, this leads to appropriate action, selecting therapeutic treatments based on the individual patient, their wound and the severity of infection. Infection must be effectively managed in order to ensure patient safety, minimise impact to patients' quality of life, improve healing outcomes and reduce resource use and costs to healthcare systems.

Topical antimicrobials have long been used in wound care to manage infection, current usage being driven in part by an increase in AMR (Fletcher et al, 2020a). Topical antimicrobials, such as silver, differ from antibiotics and the potential for widespread resistance to them is low; therefore, topical antimicrobial products should be regarded as an important tool in managing infected wounds (Kramer et al, 2018). See Box 1 for further information on AMR and the need for an AMS-based approach to infection management.

The COVID-19 pandemic has affected many aspects of clinical practice and looks set to continue to do so. Reports have suggested that infection in patients with wounds has increased and, in some cases, early intervention has not been possible, affecting outcomes for patients (Fletcher et al, 2020b). This has been particularly evident in the podiatry setting, with an increase in vascular issues and foot wounds at elevated risk of infection due to delayed presentation (Chadwick et al, 2020). With the increase in self- and supported care during and post-pandemic, it is more important than ever to closely monitor patients predisposed to localised wound infection and for clinicians to know the signs and symptoms of infection.

All infection management strategies should incorporate knowledge of AMR and take an AMS-informed approach.

Best Practice Statement

THE STAGES OF WOUND INFECTION

It is important to understand the stages of wound infection and the potential impact on the care required by the patient. The stages in the wound infection continuum describe the gradual increase in the number and virulence of microorganisms, together with the response they invoke within the host. See Box 2 and Figure 1 for more information on the stages of the infection continuum. For more information on biofilm in wound infection see page 12.

Box 1. Overview of AMR and an AMS-informed approach (adapted from Fletcher et al, 2020a)

Antimicrobials are a group of agents that either kill or inhibit the growth and division of micro-organisms. They include antibiotics, antiseptics, disinfectants, and other agents, such as antiviral, antifungal, antibacterial and antiparasitic medicines.

Antimicrobial resistance (AMR) describes when micro-organisms evolve over time and no longer respond to specific antimicrobials, groups of antimicrobials or even to any antimicrobial therapy. 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).

One potential 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 (as well as knowing when not to use them), to preserve their future effectiveness, while also improving the safety and quality of patient care.

Adopting an AMS-informed approach requires a systemic change in behaviour through increased public awareness and education. In wound care, the prevention of infection and, where it occurs, the identification of infection is an integral part of AMS in practice.

Clinicians dealing with wounds at risk of infection should understand the stages of the infection continuum.

Best Practice Statement

Box 2. Stages of the infection continuum (adapted from IWII, 2016)

Contamination
Virtually from the time of wounding, all open wounds are contaminated with microbes. Chronic wounds become contaminated from endogenous secretions (i.e. natural flora) and exogenous microbial sources, including poor hand hygiene and environmental exposure. Unless compromised, the host defences respond swiftly to destroy bacteria through a process called phagocytosis.

Colonisation
Colonisation refers to the presence within the wound of microbial organisms that undergo limited proliferation without evoking a host reaction. Microbial growth occurs at a non-critical level, and wound healing is not impeded or delayed. Sources for micro-organisms may be natural flora, exogenous sources or as a result of environmental exposure.

Local infection
Wound infection occurs when bacteria or other microbes move deeper into the wound tissue and proliferate at a rate that invokes a response in the host. Local infection is contained in one location, system or structure. Especially in chronic wounds, local wound infection often presents as subtle signs that can be considered covert signs of infection that may develop into the classic, overt signs of infection.

Spreading infection
Spreading infection describes the invasion of the surrounding tissue by infective organisms that have spread from a wound. Micro-organisms proliferate and spread, to a degree that signs and symptoms extend beyond the wound border. Spreading infection may involve deep tissue, muscle, fascia, organs or body cavities.

Systemic infection
Systemic infection from a wound affects the body as a whole, with micro-organisms spreading throughout the body via the vascular or lymphatic systems, which can lead to sepsis and organ dysfunction.

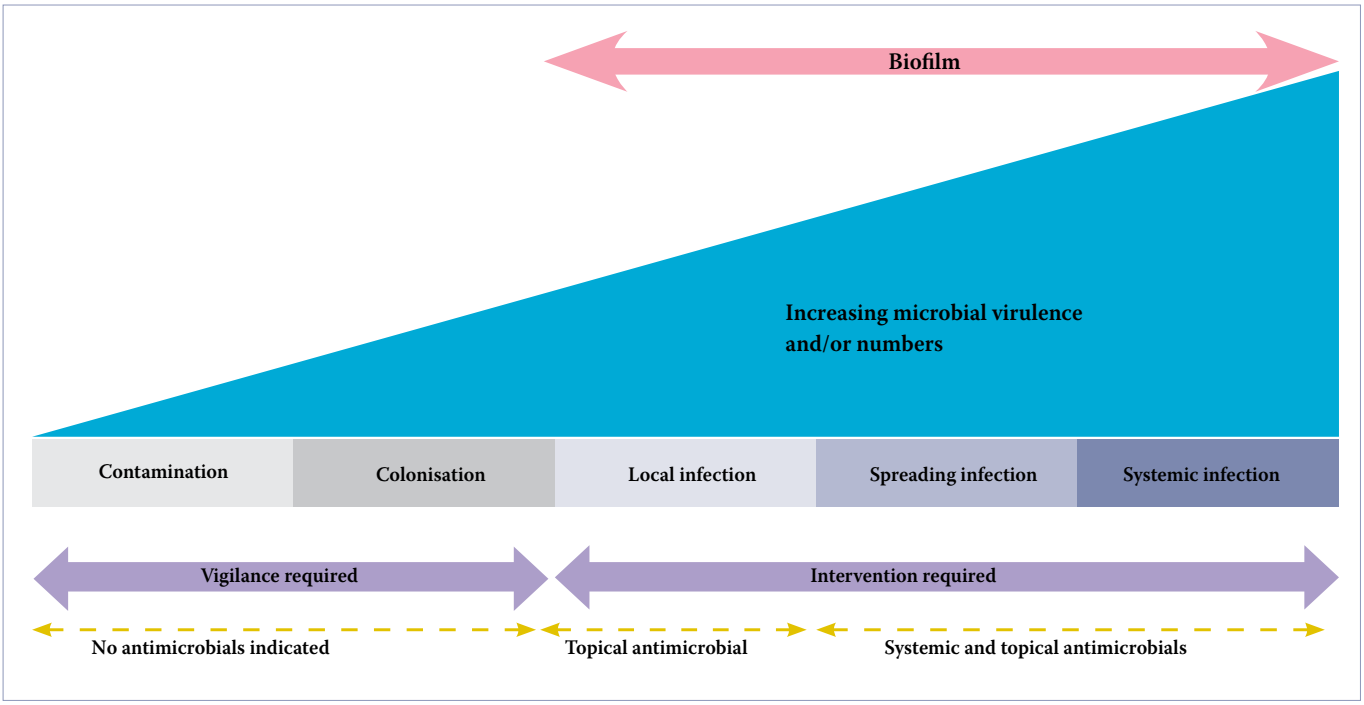

Figure 1: The infection continuum (IWII, 2016)

Overview of wound infection management *(Continued)*

All wound care should be conducted with an awareness of infection prevention.

Best Practice Statement

INFECTION PREVENTION

While all open wounds are contaminated with microbes, infection prevention measures should be employed to minimise the risk of wounds becoming infected. The aim with any wound is to achieve healing as quickly as possible, as intact skin acts as a natural barrier to potentially pathogenic micro-organisms and all wounds are at risk of infection developing, particularly in the presence of patient comorbidities and other risk factors (IWII, 2016).

The group discussed basic measures that should always be taken, which include:

- Environmental and equipment cleanliness
- Good hand hygiene
- Use of personal protective equipment (PPE)
- Aseptic non-touch technique
- Use of single-use consumables
- Correct waste disposal.

In community settings where it is not possible to manage the environment (e.g. in the patient's home), fundamental infection prevention measures should be taken where possible, such as:

- Expose the wound for the shortest time possible
- Clean a surface with antibacterial wipes if possible
- Use sterile field in dressing pack
- Consider assessing the patient in a clinic setting if possible.

The role of silver as a topical antimicrobial

All clinicians dealing with wounds should understand silver as an antimicrobial and how it works in practice.

Best Practice Statement

While silver has been used historically in wound care for hundreds of years, over the past decades, a wide range of wound dressings that contain elemental silver or a silver-releasing compound have been developed (Wounds International, 2012).

Silver-containing dressings are generally easy to apply, may provide sustained availability of silver, and may need less frequent dressing changes. There are potentially additional benefits, such as management of excessive exudate, maintenance of a moist wound environment, or facilitation of autolytic debridement (Wounds International, 2012).

It is important to remember that not all silver dressing products are the same. Silver may be incorporated into dressings as a coating, within the structure of the dressing, or a combination of the two. Silver is available in a number of different forms (e.g. elemental silver, an inorganic compound such as silver oxide or silver sulphate, or an organic complex such as silver alginate). The amount of silver found in dressings also varies considerably; however, it should be noted that although attempts have been made to quantify the availability of silver from silver dressings, such measurements are currently of very limited value in predicting clinical efficacy, as availability of silver ions is the key element that makes a silver dressing effective (Wounds International, 2012).

Silver dressings also vary based on the 'carrier dressing': the characteristics of the dressing aside from its antimicrobial properties. These characteristics, such as exudate handling, adhesion, and dressing materials, should be selected based on holistic assessment of the patient and their wound, as well as according to the antimicrobial properties required.

For more information about the mode of action involved in silver products, and how ionic silver works, see Box 3.

Box 3. How ionic silver works (adapted from Wounds International, 2012)

In its metallic (elemental) form, silver is unreactive and cannot kill bacteria. To become bactericidal, silver atoms (denoted as Ag or Ag^0) must lose an electron and become positively charged silver ions (Ag^+). Elemental silver ionises in air, but ionises more readily when exposed to an aqueous environment, such as wound exudate.

Silver ions initially bind to the bacterial cell wall, preventing nutrients and oxygen from entering the cell. The silver ions are then transported through the cell membrane and into the cell, where they prevent the cell from producing further energy. The silver ions finally enter the DNA of the bacterial cell, changing the sequence of the DNA; therefore, the cell is unable to replicate its DNA and expand exponentially.

Silver ions are active against a broad range of bacteria, fungi and viruses, including many antibiotic-resistant bacteria, such as methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococci* (VRE). Studies of the effects of silver dressings on experimental models of biofilms have suggested that silver may reduce bacterial adhesion and destabilise the biofilm matrix, as well as kill bacteria within the matrix and increase susceptibility of bacteria to antibiotics; however, further research is needed in this area (Percival and McCarty, 2015).

Myths and truths about use of silver in practice

While there are now many silver products available for use in clinical practice, there has been discussion surrounding the use of silver and its effectiveness, leading to many misconceptions. These now need to be challenged so that, following holistic assessment, silver can be used appropriately and effectively.

The VULCAN Study (Michaels et al, 2009a; 2009b) was a controversial study that influenced practice, despite significant concerns that the study's findings were potentially misleading (White et al, 2009; Gottrup and Apelqvist, 2010; Leaper and Drake, 2011).

The study randomised 213 patients with venous leg ulcers to receive either one of a number of silver-containing dressings or a clinician-selected non-antimicrobial control dressing. The main outcome measured was the rate of complete healing at 12 weeks.

The study concluded that there was no statistically significant difference between the use of silver-containing dressings and the control dressings for the proportion of ulcers healed, time to healing or rates of recurrence. Cost-effectiveness analysis found a higher cost associated with the silver dressings.

The principal concern with this study was that it did not use silver dressings in line with clincial recommendations, and so could not be expected to provide clinically relevant information on efficacy. For instance, silver dressings are not recommended for routine use; they are only clinically indicated when there are concerns about increased bacterial burden or signs of infection. The patients recruited within this study were not assessed for risk of infection, and there was no evaluation of the wounds either clinically or microbiologically for presence of infection at any point.

Products containing silver rarely claim to increase healing rates; their primary function is to reduce infection. Although this may improve healing rates in wounds with infection, it will have no impact on wounds that are not infected. It is important to note that other evidence from large-scale studies has shown the effectiveness of silver dressings on infected wounds (Dissemond et al, 2017).

Silver is not cost-effective.

MYTH

A number of studies support the cost-effective use of silver.

TRUTH

These studies have demonstrated the beneficial effects on wound management and outcomes, quality of life and the patient's overall experience when silver is appropriately used (Jemec et al, 2014). Additionally, silver dressings are not generally more expensive than other antimicrobial dressings and are associated with other overall cost benefits.

Bioburden and infection have been proven to delay healing (IWII, 2016). The aim of treatment with silver dressings is to reduce wound bioburden, treat local infection and prevent systemic spread.

Silver dressings do not improve healing rates.

MYTH

Silver dressings improve wound conditions to expedite healing.

TRUTH

Their main purpose is not to promote wound healing directly, although the carrier dressing materials within which the silver is delivered will support this function.

Clinical guidelines recommend that silver dressings are used for wounds where infection is already established or an excessive wound bioburden is delaying healing, with regular re-evaluation (IWII, 2016).

Silver dressings cause systemic toxic effects.

MYTH

Silver is non-toxic and very little is absorbed systemically.

TRUTH

Studies have shown that silver is safe for use and non-toxic (Brouillard et al, 2018). Silver dressings have had to undergo extensive testing to ensure that they are safe for use in practice. Additionally, only a small proportion of silver is delivered from the dressing to the wound site. The majority of the silver remains within the dressing or binds to proteins in the wound or wound debris, so very little is systemically absorbed (Wilkinson et al, 2011). Even if absorbed systemically, silver is excreted mainly via the biliary route in faeces, with some also excreted in urine (Hadrup et al, 2018).

Bacteria will become resistant to silver.

MYTH

Resistance to silver is extremely rare.

TRUTH

Bacterial resistance to silver appears to be rare and much less common than might be expected given the considerable time that silver preparations have been in use and the widespread distribution of low levels of silver in the environment. It has been reported that resistance to silver is exceptionally rare and generally of no clinical significance (Marx and Barillo, 2014), although it has also been highlighted that more research is needed in this area (Dissemond et al, 2020b).

Silver has multiple actions against microbial cells. This reduces the chance that resistance to silver will develop. In contrast, antibiotics generally have a single target site and hence bacterial cells may more easily develop resistance.

Silver may make bacteria resistant to antibiotics.

MYTH

There is no evidence that silver contributes to antibiotic resistance.

TRUTH

The major cause of resistance remains misuse or overuse of antibiotics themselves. Silver has been found to be a suitable antimicrobial agent for use in practice as part of an AMS-informed approach. Silver has been reported to enhance the antibacterial activity of antibiotics, in cases where they are needed, and to help make antibiotics effective against resistant bacteria, although further research is needed (Barras et al, 2018).

The levels of silver in the dressing are important.

MYTH

The availability of silver ions within the wound is more important.

TRUTH

The most important factor for efficacy of silver dressings is the availability of silver ions, which is not the same as the levels of silver. Higher levels of silver do not automatically indicate a more effective dressing.

Clinicians should select silver products as appropriate based on current evidence.

Best Practice Statement

The cornerstones of infection management

In all wounds where infection is an issue, thorough cleansing and WBP must be carried out before antimicrobial products are considered.

Best Practice Statement

The four cornerstones of infection management should be followed throughout all stages of the wound infection continuum.

Best Practice Statement

When considering infection management, a 'back to basics' approach is required. Any use of antimicrobial products needs to be underpinned by thorough cleansing of the wound and surrounding skin, and appropriate wound bed preparation (WBP) practices to facilitate healing.

The basic principles that should be applied to all wounds where infection is an issue, representing the four cornerstones of treatment, are:

- Pathophysiology
- WBP
- Cleansing
  - Wound
  - Periwound
  - Limb
- Infection management and antibiofilm strategies.

The four cornerstones of infection management should be followed throughout all stages of the wound infection continuum, including regular reassessment and treatment review.

PATHOPHYSIOLOGY

In wound care, pathophysiology refers to underlying causes that disrupt the normal healing processes, causing a wound to become hard-to-heal or chronic, increasing the risk of further complications such as infection. Wound healing is a complex process that can be divided into at least three continuous and overlapping processes: an inflammatory reaction, a proliferative process leading to tissue restoration, and, eventually, tissue remodelling (Li et al, 2007).

In order to prevent healing processes from stalling, and the wound becoming hard-to-heal, it is important to consider factors that may affect healing, and to manage these where possible (Snyder et al, 2017). These may include comorbidities such as diabetes, obesity or circulatory disorders; lifestyle factors, such as excessive alcohol intake, smoking or poor nutrition; or specific medications, such as steroids, NSAIDs, or immunosuppressants (Snyder et al, 2017). Therefore, it is important to recognise that managing stalled/chronic wounds requires a multi-disciplinary team approach and referral to specialist services should be explored.

WOUND BED PREPARATION (WBP)

WBP means optimising conditions at the wound bed, in order to promote healing, identifying and addressing barriers to healing (Ousey and Schofield, 2021). WBP should be based on assessment using a structured framework, such as TIMERS (Atkin et al, 2019). This updated framework encompasses the following elements:

T: tissue viability
I: infection/inflammation
M: moisture balance
E: wound edge
R: repair/regeneration
S: social- and patient-related factors.

WBP should form a multifaceted approach that includes cleansing and debridement to enhance the effectiveness

Box 4. Debridement (adapted from Ousey and Schofield, 2021)

There are many ways to debride a wound; the most common are:

- Autolytic
- Mechanical
- Sharp debridement.

The choice of technique will depend on results of the wound bed assessment, local policy and capability level of the clinician. It is important to note that delays in debridement will elongate time to healing and, if debridement cannot be achieved in a timely manner with the products that facilitate autolytic debridement, the patient should be referred to a specialist service. Delays in referral or not referring the patient to a specialist can be potentially harmful to the patient. Many wound care specialists will have completed training in a range of debridement techniques (e.g. curette or sharp debridement) in a safe and competent manner. Debridement options may sometimes be limited by the care settings; if successful debridement is not possible in the care setting, the patient must be referred on.

of therapeutic measures and prepare the wound for healing (Falanga, 2000; Schultz et al, 2003). For more information on debridement, see Box 4.

CLEANSING

Appropriate wound cleansing is a vital part of WBP and should include both the wound and surrounding skin. As well as removing/reducing contaminants and bacteria, wound cleansing has additional benefits, such as improved visualisation of the wound bed and edges, removal of organic and non-organic material, and removal of excess exudate (Weir and Swanson, 2019).

There is still considerable debate and discussion about the clinical efficacy of wound cleansing solutions, and the value of using cleansing agents over tap water, sterile water or saline in practice. Potential factors to consider include risk of cytotoxicity versus efficacy, cost effectiveness, availability and ease of use (Weir and Swanson, 2019). Certain wounds may benefit from use of specific cleansing products; see Table 1 for more information on the role of cleansing agents.

It is important to note that antimicrobial agents will often not work as effectively on a 'dirty' wound (i.e. one that has slough, necrosis or other debris on the surface), so the wound should be cleaned and debrided (if appropriate) before any further treatment options are commenced. Silver dressings are available that incorporate a 'cleaning' action, which may improve the

Table 1. Common cleansing agents and their characteristics (IWII, 2016)

Solution	Type	Cytoxicity	Effect on biofilm	Comment
Sterile normal saline 0.9%	Isotonic	None	None	Sterile, non-antiseptic soloution
Sterile water	Hypotonic	None	None	Sterile, non-antiseptic soloution
Potable tap water	Varies in content	Unknown/ variable	None	Not sterile
Polyhexamethylene biguanide (PHMB)	Surfactant anitmicrobial	Low to none	Surfactant qualities disrupt biofilm attachments Highly effective against Gram negative biofilm with 15-minute exposure	Lowers liquid surface tension, allowing greater spread and facilitating separation of non-viable tissue Does not promote bacterial resistance
Octenidine dihydrochlorine	Surfactant anitmicrobial	Low to none	Delays attachment and inhibits growth of biofilm and planktonic bacteria Studies have shown that shorter time needed to soak to reduce bacterial burden	Lowers liquid surface tension, allowing greater spread and facilitating separation of non-viable tissue Does not promote bacterial resistance long term effect not known
Superoxidized solution, Hypochlorous acid and sodium hypochlorite	Antiseptic	May very depending on concentration	Conflicting evidence from *en vivo* data but complete reduction of Gram negative biofilm and >4 log reduction with Gram positive biofilm with 15-minute exposure	Hypotonic and functions through osmotic gradients facilitating moistening and separation of viable/non-viable tissue osmotically
Povidone iodine antiseptic solution 10%w/v equivalent to 1%w/v available iodine	Antiseptic	Yes, varies on concentration and duration of exposure	Very effective on Gram positive and Gram negative biofilm with 15-minute exposure	Rinse after cleaning
Chlorhexidine with cetrimide 0.015% irrigation solution	Cationic broad-spectrum biocide with cetrimide surfactant properties	May vary depending on concentration	Very effective on Gram positive biofilm and 3.96 log reduction with Gram negative biofilm 15-minute exposure	

The cornerstones of infection management *(Continued)*

efficacy/availability of the silver, resulting in improved outcomes and cost savings.

INFECTION MANAGEMENT AND ANTIBIOFILM STRATEGIES

When the wound bed has been prepared and cleansed, infection management and antibiofilm strategies can be selected and commenced. See following section on 'Identification of infection in practice' for further information on how to identify infection, ascertain the type of infection and decide on the appropriate action to take. For more information on biofilm and antibiofilm strategies, see Box 5. Silver dressings have been found to be useful in treating biofilms, particularly during the window of opportunity following thorough cleansing and debridement, to help to prevent biofilm reformation (Kostenko et al, 2010). A study found that silver-containing dressings achieved total bacterial kill in the biofilm after 48 hours (Percival et al, 2008). This research has shown that silver-containing dressings were effective in killing the tested bacteria evident in both mono- and polymicrobial biofilms, providing valuable evidence that silver may have an effect on biofilms found in recalcitrant chronic wounds. See page 15 for more information on 'Managing bioburden with silver', including treatment guidance for all stages of the infection continuum and when managing biofilm.

Box 5. Biofilm and antibiofilm strategies

A biofilm is an aggregated community of slow-growing bacteria that are tolerant to host defences and to antimicrobial treatment (Schultz et al, 2017). It is widely accepted that biofilm is present in 70–100% of chronic wounds (Malone et al, 2017); if a wound is progressing as expected there is no requirement to initiate antibiofilm strategies.

Biofilms are often polymicrobial, involving clusters of different types of bacterial cells growing at different rates, which are challenging to treat (Fletcher et al, 2020a). 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 can be used for diagnosis (IWII, 2016):

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

The formation of biofilm occurs through an array of processes that are potentially reversible in the early stages of microbial colonisation; however, as biofilm formation progresses, disruption and eradication become increasingly difficult (Bjarnsholt et al, 2017).

Clinicians are encouraged to take an initial aggressive approach to treating biofilm through debridement and cleansing; one that is then revised through ongoing assessment, which may result in stepping down treatment or referral to specialist services if current treatment is not progressing the wound towards healing (Murphy et al, 2020). Frequent debridement is central to this step-down approach, with physical removal of microbial aggregates being key to opening up a therapeutic 'window' during which the bacteria are most susceptible to antimicrobials (Schultz et al, 2017).

The general principles behind biofilm-based wound care and treatment strategies should include (WUWHS, 2016):

- Structured WBP
- Physical removal or attack of biofilm, to open a 'window of opportunity' for increased antimicrobial susceptibility before biofilm reformation
- Selection of appropriate antimicrobial treatment.

All wound infection management strategies should incorporate recognition and ongoing treatment of biofilm.

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Antibiofilm strategies should always include thorough cleansing/debridement as well as topical antimicrobial treatment.

Best Practice Statement

Identification of infection in practice

Assessment, identification and early intervention should be considered priority in all patients with (potential) wound infections.

Best Practice Statement

Wound infection must be identified and treated as early as possible, particularly in patients with hard-to-heal wounds (Dissemond et al, 2020a). If not identified and treated early, infection can have severe consequences, such as risk of systemic infection or sepsis, and can also have a significant effect on the patient's quality of life and the overall impact on healthcare systems (Dissemond et al, 2020c).

The Therapeutic Index for Local Infections (TILI) score is a diagnostic tool that was developed to facilitate identification and decision-making around infection for staff of all levels, including those not specialised in wound care (Dissemond et al, 2020a). The TILI score is intended for use by any caregiver in daily practice to diagnose local infections and hard-to-heal wounds. The scoring system is a validated tool and was developed by an expert group, and is easy to use in practice.

The TILI score focuses on nine clinical criteria for local wound infection. Six of the criteria are non-direct indicators and three are direct indicators (see Table 2).

If at least five of these six non-direct indicator criteria, or at least one direct indicator criteria, is met, this indicates that antiseptic wound therapy could be started. It should be noted that there are also specific health conditions for the individual clinical situation, which are a direct indication for antimicrobial wound therapy. These include the presence of wound pathogens, such as methicillin-resistant *Staphylococcus aureus*, septic surgical wound or the presence of free pus, or cases of post-surgical wound infection. See Table 2 for full information on the criteria and in the cases of direct or indirect indication for antiseptic wound therapy.

When considering the criteria for the TILI score, it should be noted that erythema (generally defined as 'redness' although it may not always present as such) of the surrounding skin may present differently depending on the patient's skin tone. Visual cues for changes in skin appearance may be easily observed in light-coloured skin; however, with dark pigmentation it may be harder to spot visual signs of localised wound infection, therefore clinicians need to use their observation skills and base their decision-making on clinical judgement and holistic assessment of the patient (Clark, 2010).

Table 2. Therapeutic Index for Local Infections (TILI) score criteria (adapted from Dissemond et al, 2020a)

Non-direct indication
Erythema to surrounding skin
Heat
Oedema, induration or swelling
Spontaneous pain or pressure pain (NB: exercise caution in patients with polyneuropathy or when using painkillers)
Stalled wound healing
Increase and/or change of colour or smell of exudate
Direct indication
Presence of wound pathogens
Surgical septic wound
Presence of free pus

Assessment of the presence of wound infection should be made according to a structured, evidence-based framework such as the TILI score.

Best Practice Statement

WHEN TO SWAB A WOUND

While clinical judgement is normally used to identify infection, in some cases a swab may be used to provide detailed information. Laboratory investigation via swabbing provides clinicians with information about the pathogens present in a wound and their antibiotic sensitivities, which can inform decisions about future management strategies. Swabs should therefore be collected only when clinical criteria indicate a wound infection is present and ideally before any antimicrobial interventions have been initiated (Cooper, 2010; IWII, 2016).

When taking a wound swab, the Levine technique (rotating the wound swab over a 1–2cm^2 area of the wound) has been found to be superior to the Z technique (Angel et al, 2011). This is due to the Levine technique's ability to express fluid from the wound bed and thereby sampling a greater concentration of micro-organisms from both the surface and slightly below the surface of the wound (Angel et al, 2011).

INCORPORATING THE TILI SCORE IN PRACTICE

The TILI score provides an evidence-based framework to support decision-making and standardise practice. The scoring system has been validated and found to be suitable for use: the criterion validity, which measures the validity of the TILI score compared with the current gold standard, was analysed to confirm that the score correctly classified local infection and confirmed the need for antimicrobial therapy (Dissemond et al, 2020d).

The TILI score prioritises early intervention and use of antiseptic agents over systemic antibiotics wherever possible. The tool is suitable for use as part of an AMS-focused approach to wound care (Dissemond et

Identification of infection in practice *(Continued)*

If a wound swab is required, the Levine technique should be used to obtain the sample.

Best Practice Statement

Decision-making pathways should be incorporated into everyday practice alongside other existing appropriate treatment pathways.

Best Practice Statement

al, 2020a). It should also be noted that management of localised wound infection should always be targeted and time-limited, with regular reassessment (see page 15 for more details on the two-week challenge; Dissemond et al, 2017).

In the case of diabetic foot ulcers (DFUs), the TILI score can be used in tandem with the IWGDF (2019) guidelines on wound infection, which provide specific guidance on grading severity of infection in patients.

The TILI score allows for early detection of covert signs of infection. The pathway (Figure 2) also incorporates the National Early Warning Score (NHSE Patient Safety Alert, 2018), highlighting the importance of early recognition of, and response to, 'soft signs' indicating physical deterioration of the patient and enabling early intervention.

It is important that treatment pathways are incorporated into clinical practice in a practical and sustainable way, and that all staff are trained in how to use the TILI score and what this means for early diagnosis and intervention. The aim should always be simplicity, with pathways making practice easier rather than more complicated.

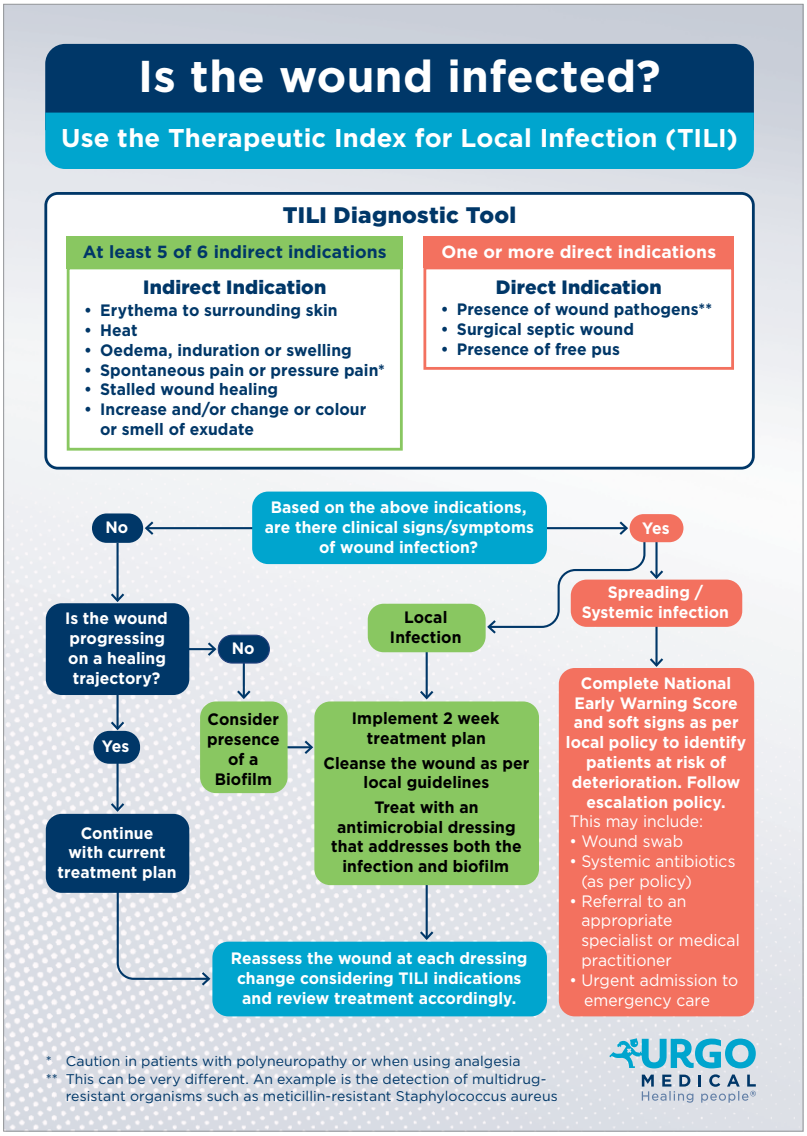

Figure 2: Pathway for use of the TILI score in practice

Managing bioburden with silver

Identification of localised infection should trigger immediate action with a topical antimicrobial.

Best Practice Statement

When localised infection has been accurately identified using the TILI score, action needs to be taken to treat infection. According to the TILI score, and as advocated by an AMS-informed approach to wound care, a topical antimicrobial such as silver should be used.

This section provides information on selecting an appropriate silver dressing and how this should be used in practice, including tips for use, when to intitiate and when to discontinue treatment.

WHEN TO USE SILVER DRESSINGS

Silver dressings may be used on acute wounds, such as traumatic wounds (including burns) or surgical wounds, and chronic wounds that present with localised (overt or covert) infection. They may also be used on wounds with spreading or systemic infection but in these cases, must be used alongside systemic antibiotics.

A silver dressing should be considered as a topical antimicrobial in suitable patients with localised infection.

Best Practice Statement

See Figure 3 for a guide for when silver dressings should be used in the presence of local, spreading or systemic infection.

The diagnosis of localised, spreading or systemic infection should be recorded in the patient health record. This should include baseline observation data, treatment aims and objectives as well as treatment decision and review date (Wounds International, 2012).

Clinicians treating patients with a wound at risk of infection should understand when to use, and not to use, silver dressings.

Best Practice Statement

WHEN NOT TO USE SILVER DRESSINGS

Silver dressings should not be used in the absence of localised (overt or covert), spreading or systemic infection, unless there are clear indicators that the wound is at high risk of infection or re-infection, or biofilm is suspected (IWII, 2016). See Box 6 for more information on clinical scenarios where silver should not be used.

Box 6. When not to use silver dressings (adapted from Wounds International, 2012)

- In the absence of signs of biofilm (see Box 5) or infection according to the TILI score
- Clean surgical wounds at low risk of infection, such as donor sites or closed surgical wounds
- Chronic wounds healing as expected according to patient factors such as comorbidities and age
- Patients who are sensitive or allergic to silver or any other dressing components
- Wounds being treated with enzymatic debridement
- During pregnancy or lactation
- When specifically contraindicated by the manufacturer; for example, some manufacturers recommend that their silver dressings are not used during magnetic resonance imaging (MRI), or on/near body sites undergoing radiotherapy.

WHEN TO STOP TREATMENT WITH SILVER

Silver dressings are generally designed for short-term use. When considering treatment with topical antimicrobials, there has been a focus on 'the two-week challenge': the recommendation that antimicrobial dressings should be used for two weeks initially and then the wound, the patient and the management approach should be re-evaluated (Wounds UK, 2011; Fletcher et al, 2017).

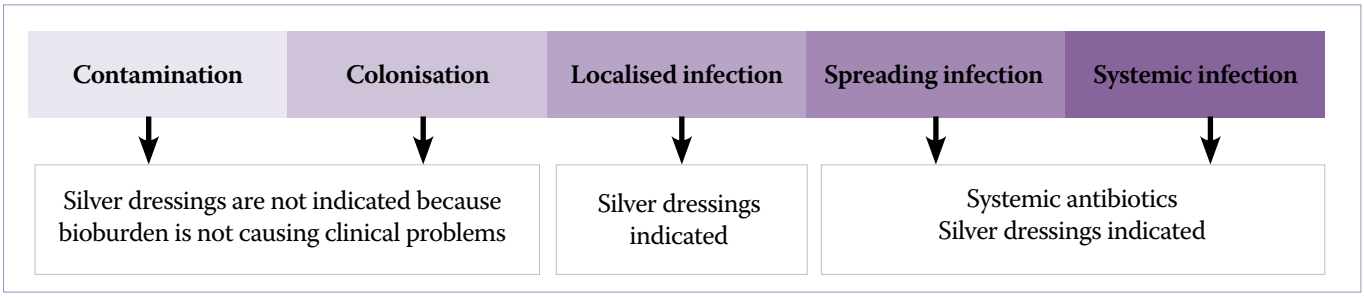

Figure 3: When to use silver dressings (adapted from Wounds International, 2012)

Managing bioburden with silver *(Continued)*

The two-week point of treatment with a silver dressing should be viewed as an opportunity for review, not an automatic stop point, even if the wound is beginning to heal.

Best Practice Statement

If there is no improvement to a wound deemed to have increased bacterial burden/local infection after two weeks, the patient should be reassessed for spreading and systemic infection and comorbidities and a different antimicrobial agent should be considered. The assessment should come before the treatment.

Best Practice Statement

An appropriate non-antimicrobial dressing should be considered only when the wound is improving and signs and symptoms of infection/biofilm have resolved.

Best Practice Statement

There was concern across the expert group that the two-week challenge has been misinterpreted and led to wounds not being treated appropriately after the initial two-week period. While the two-week period provides a suitable assessment timeframe to establish whether a particular antimicrobial treatment is working effectively, it should not be viewed as an automatic stop point for treatment.

The two-week point should be viewed as an opportunity for review. If the wound has improved but is not yet healed, the antimicrobial dressing should not be automatically stopped. If necessary, it can be continued beyond the two-week period. The wound and the patient should be reassessed for signs and symptoms of infection at regular intervals.

If there is no improvement to the wound after two weeks, the silver dressing should be discontinued and consideration given to changing the dressing to one that contains a different antimicrobial agent, reassessing for spreading or systemic infection and the possibility of any untreated comorbidities. There is some evidence that 'switching' or rotating antimicrobials can assist with managing bioburden and facilitating wound healing (Sussman et al, 2014).

Once the bioburden is under control and the wound is improving and signs and symptoms of infection have resolved, a non-antimicrobial dressing should be considered based on the needs of the individual and their wound.

It is important to note that, while silver dressings aim to manage bioburden and improve wound conditions rather than have a direct effect on healing, the aim should always be to heal wounds wherever possible rather than just 'manage them'. Treatment aims may vary depending on the individual patient, but the focus should always be on healing, with the exception of palliative wounds.

If the wound bed has not reduced by at least 40% within 4 weeks (50% for DFUs), a full reassessment is needed and a new treatment regimen commenced. If the wound continues not to progress, the patient should be referred on to an appropriate specialist, particularly in the presence of any comorbidities or concerns about underlying pathophysiology.

TIPS FOR USE IN PRACTICE

The manufacturer's instructions should always be followed and care tailored to the individual patient. However, there are some guidelines that should be followed in all use of silver dressings. See Box 7 for tips for use of silver dressings in practice.

INCLUSION OF SILVER DRESSINGS IN FORMULARY

When making the case for silver dressings to be included within a local wound care formulary, it is important to consider the evidence base and other relevant factors. See Box 8 for considerations in assessing silver dressings.

If the wound bed has not reduced by at least 40% (50% in DFUs) within 4 weeks, full reassessment is needed and a new treatment regimen should be commenced. If the wound continues to fail to progress, the patient should be referred on to an appropriate specialist.

Best Practice Statement

When making the case for silver dressings to be included within a local wound care formulary, the evidence base should be considered.

Best Practice Statement

Box 7. Tips for use of silver dressings in practice

- Clinicians should document the rationale for using a silver dressing in the patient's healthcare records
- Selection of the silver dressing should be made based on the individual needs of the patient and the wound, such as exudate level, need for cleansing and removal of debris, tissue type, wound depth, need for conformability, odour control, ease of removal, frequency of change and safety
- Use of the silver dressing should be reviewed after two weeks but not automatically stopped at the two-week point
- Continued use of silver dressings should include regular review
- If the silver dressing is not resulting in improvement to the wound, the patient and their wound should be reassessed, and another antimicrobial agent considered
- Silver dressings should be used within the context of the four cornerstones of infection management (pathophysiology, WBP, cleansing and infection management/ antibiofilm strategies
- Clinicians should follow the manufacturer's instructions regarding indications, contraindications, method of application, wound cleansing procedures, and use in patients undergoing MRI or radiotherapy
- Silver dressings should be used with caution in children and very large wounds
- Dressings containing SSD should not be used in patients with sensitivity to sulfonamide antibiotics or hepatic/renal impairment, or in pregnancy, during lactation or in newborns.

Box 8. Considerations for inclusion of silver dressings in formulary

- Reliability and strength of clinical evidence available
- The dressing's mode of action
- Carrier properties of the dressing in addition to antimicrobial efficacy (e.g. dressings that have a cleaning action)
- Patient-centric factors such as pain reduction and easy removal
- Size/location of wounds
- Cost and availability.

The future

Confusion and misconceptions around silver have highlighted the need for clear guidance around its use as an antimicrobial agent in patients with localised infection and biofilm. In some instances, clinicians report having limited or no access to silver dressing products. In addition, a lack of knowledge or confidence has contributed to patients not receiving appropriate, timely treatment with silver dressings.

As such, silver products should be selected following a structured assessment using a tool to identify infection and support clinical decision-making. The TILI score (Dissemond 2020a) provides an ideal framework for identifying infection and making treatment decisions accordingly. This diagnostic tool should be incorporated into future practice and integrated into existing pathways, to simplify assessment for all clinicians caring for patients presenting with infected or potentially infected wounds.

The guidance provided by the TILI score focuses on topical antimicrobials, such as silver, which is compatible with an AMS-informed approach to practice. It is apparent that there needs to be a behavioural change with a focus on a 'back-to-basics' approach to infection prevention, which promotes both AMS and improved outcomes for patients. Simple, standardised frameworks that combine the back-to-basics approach with a more advanced approach to infection management may help to guide care that is consistent with AMS strategies (Fletcher et al, 2020a).

Shared education and support from industry is necessary, as well as shared decision-making around infection management. All policies and procedures around infection management need to take an AMS-informed approach. Ensuring the impact of AMR is reduced requires understanding of the most appropriate and sustainable method of wound management (Ousey and Blackburn, 2020).

Crucially, cultural change is required, for wound care to focus on healing wounds wherever possible, rather than managing wounds. Education and communication around this issue is vital to influence cultural change. Early intervention is required in patients with wounds where infection or increased bioburden is an issue, but there also needs to be a focus on ongoing care. The needs of the individual patient and their wound should be continually reassessed.

The 'two-week challenge' approach has meant that, in some cases, treatment with silver has been stopped prematurely. A non-antimicrobial dressing should be considered when bioburden has been managed and signs and symptoms of local infection have resolved. If the patient's wound is not healing, referring the patient on or involving the multidisciplinary team should be seen as good practice.

Silver has been proven to be a safe and effective treatment, but there is still confusion around evidence-based best practice. To support this, there is a need for ongoing data collection around the use and effectiveness of silver dressings. Treatment and outcomes need to be monitored in order to support practice and optimise patient care. Even in areas in which more good-quality evidence is needed, standardised practice can help to produce real-world data and provide continuity of care for patients.

Standardised practice through clear pathways and guidance can help inexperienced clinicians to become more confident in delivering care and developing their own clinical expertise. Communication within teams is also vital to ensure best practice is followed and to build the confidence of less experienced team members, for example through regular safety huddles within teams.

Tools such as the TILI score should help to improve outcomes and increase clinician confidence in providing appropriate care.

When implementing a new product or treatment pathway, it is important to collect data: set measurable parameters, and act on outcomes.

Best Practice Statement

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