

UNDERSTANDING THE ROLE OF ANTIMICROBIAL DRESSINGS

The effective diagnosis of bacterial colonisation, along with appropriate intervention, is crucial in preventing local wound infection and improving patient outcomes. There is a vast range of antimicrobial dressings available and making a clinically informed choice can prove challenging. The aim of this article is to support healthcare professionals in selecting an appropriate antimicrobial agent when undertaking wound management.

'It is important for healthcare professionals to understand the difference between bacterial colonisation and local wound infection'

Wound infection is often the inevitable outcome following a chain of dynamic interactions between a host (patient), a potential pathogen and the surrounding environment (Vowden and Cooper, 2006). Most open wounds are colonised by microbial species and yet the majority are not infected, meaning that healing can still progress despite their presence (Angel et al, 2011). This is often the result of an effective immune response that enables the body to maintain the bacterial burden within the wound bed at a safe level.

Antimicrobial dressings contain agents that either inhibit or kill the growth or replication of a broad spectrum of microbes. These are microorganisms that are commonly found in wound beds and are capable of causing local wound infection (Vowden and Cooper, 2006).

With the ever-increasing prevalence of antibiotic resistant organisms, the role of antimicrobial dressings in reducing bacterial colonisation and potentially preventing local wound infection has become significant.

The diagnosis of bacterial colonisation

It is important for healthcare

professionals to understand the difference between bacterial colonisation and local wound infection in order to implement an effective management plan. As part of a holistic nursing assessment, it is the interaction between the host and colonisation, not merely the presence of bacteria within the wound bed that will influence wound healing and wound management strategies (Angel et al, 2011).

The diagnosis of bacterial colonisation and local wound infection is complex and is considered to be a clinical decision based upon clear symptom criteria in line with a holistic patient assessment (World Union of Wound Healing Societies [WUWHS], 2008). Practitioners commonly identify symptoms such as redness, odour and pain as indicators of wound infection. However, these can be present for many other reasons and in certain patient groups for example those who are immunocompromised these symptoms may not be present at all (WUWHS, 2008).

The misdiagnosis of wound infection can often lead to the inappropriate use of systemic antibiotic therapy when antimicrobial dressings may actually be the key to the management of local

wound colonisation. Often, bacterial communities within the wound bed have built barriers (biofilms) to protect themselves from growth-inhibiting factors such as antimicrobials. In the presence of biofilm, antibiotic therapy is unlikely to make an impact at the wound surface and, therefore, should be reserved for progressive soft tissue or systemic infections.

Selecting an appropriate antimicrobial dressing

The selection of an antimicrobial dressing should be based upon a comprehensive nursing assessment with a primary objective of optimising wound bed conditions to prevent further wound deterioration and to support progressive new cell regeneration (Wounds UK, 2011).

Antimicrobial dressings will have different physical characteristics. Healthcare professionals need to be familiar with the product's recommendations for use and would be encouraged to seek support from local tissue viability services or the representatives from the dressing manufacturer for clinical support if required (Wounds UK, 2011).

It is important to consider:

- ▶▶ The agent's ability to inhibit or kill resistant bacterial strains
- ▶▶ The amount of the antimicrobial agent available in the dressing for release
- ▶▶ Are there contraindications for using the agent?
- ▶▶ The ability of the carrier (dressing) product to conform to the wound effectively
- ▶▶ The duration of effective action — how long can you leave the dressing in place?
- ▶▶ Is there any potential of toxicity to new cell growth?

Once treatment has been implemented, the recommendations within evidence-based best practice documents recommend that a single antimicrobial dressing should be used for two weeks

before further action is considered (Vowden and Cooper, 2006; Wounds UK, 2010). It is important that the wound is reassessed frequently during the treatment process to monitor for signs of deterioration or progressive soft tissue infection.

If, during this time, the local wound infection or colonisation has abated and the wound bed is showing signs of improvement, it is recommended that the antimicrobial agent be stopped and the dressing choice altered to reflect moist wound healing and patient needs (Vowden and Cooper, 2006).

The management of localised wound infection or colonisation can be multifactorial. In many cases, manufacturers have sought to incorporate antimicrobial agents into topical dressings, which can also help to promote a viable wound healing environment. The following warrants close consideration prior to dressing selection. Can the dressing:

- ▶▶ Effectively manage increased exudate levels?
- ▶▶ Prepare the wound bed through effective removal of devitalised tissue, i.e. necrosis or slough?
- ▶▶ Reduce malodour (this can often be achieved through effective exudate and dead tissue management)?
- ▶▶ Meet patient expectations and agreed treatment goals?
- ▶▶ Reduce pain?

Antimicrobial agents

Topical antimicrobial agents are compounds that are often contained within topical dressings. The majority of agents are described as broad spectrum, which means they have the ability to either kill or control the growth of organisms commonly found within an open wound bed. Within this section, the most commonly known broad-spectrum compounds — silver, iodine and honey — are discussed in more detail.

With a wide range of dressings available, making an appropriate

antimicrobial selection to meet wound management objectives can be overwhelming. It is important that practitioners focus on providing rapid relief of unpleasant symptoms while encouraging a positive environment for new cell growth (Wounds UK, 2011). This can be achieved through understanding the physical characteristics of the antimicrobial agent, as well as the conformability of the dressing it is contained within.

Clinical decisions may be based upon:

- ▶▶ How does the agent work (mode of action)?
- ▶▶ How is the agent released into the wound bed — is it slow-release or short-acting?
- ▶▶ How much of the agent is available within the dressing?
- ▶▶ How long is the agent effective for?
- ▶▶ Are there contraindications for use?

Honey

Honey has been used for centuries for its broad spectrum antimicrobial activity and ability to reduce the potential for wound infection and accelerate wound healing. Due to the high sugar concentration, water is drawn into the honey from higher levels in the wound bed, creating a hostile environment. This is called the osmotic effect. Bacterial cells require water to survive, therefore, having water drawn from their infrastructures causes permanent damage. During this process a further antibacterial product is produced called hydrogen peroxide, which aids the decomposition of bacteria by working at the wound surface to render them ineffective.

The osmotic effect of honey also supports moist wound healing and, therefore, can create an environment in which devitalised tissue, such as necrosis or slough (which can be a primary source of bacterial activity), is rehydrated and removed by fluid naturally available in the wound bed. This process is known as autolytic debridement and enables the

preparation of a viable wound bed, while reducing bacterial load.

It is also thought that antioxidants within honey can produce an anti-inflammatory effect through the eradication of free radicals. Free radicals are atoms often found in wounds, which can exist independently but in abundance can create a prolonged inflammatory response, causing living cell damage and often death in and around the wound (Hampton, 2010).

Generally, honey dressings consist of either a honey-impregnated tulle or alginate or a mixture of substances to form a honey-gel consistency (*Table 1*). The antibacterial action varies between honey products and this should be a consideration during the dressing selection process. Practitioners should refer to local wound management guidelines and dressing formularies when making their choice.

The cautious use of honey-based products in those patients with diabetes and known sensitivities to bee stings and bee products is widely debated within the research. Further exploration is not undertaken within this article, but should be a consideration before safe implementation of treatment.

Silver

The element silver is more commonly known for its decorative beauty and electrical conductivity (Oxford University Press, 2001), however, it has been used for medicinal purposes or as a preservative for many centuries. Silver has been used as a broad-spectrum antimicrobial in relation to wound management since the early 19th century (Leaper, 2011).

When a silver-dressing is applied to a wound, silver ion is released. In order for silver to kill bacteria it must take on the form of charged particles — ions (Hampton, 2010). These silver ions are absorbed by bacteria, which in turn bind to the DNA structures to affect cell function and respiration. The

overall effect is a cessation of bacterial replication and reduced formation of colonies (Graham, 2005).

The range of silver dressings is large and their mode of antimicrobial action is diverse. This varies from those that actively deliver silver to the wound surface either in low or high concentrations (nanocrystalline technology), or others which retain and kill bacteria within the structures of the dressing.

The common types of silver used in wound dressings are nanocrystals and silver sulfadiazine (SSD). In terms of the former, small particles of silver ions are usually contained within knitted fabric non-contact layer, activated charcoal, foam or alginate dressings.

Nanocrystalline dressings are generally able to sustain a controlled higher level of silver activity for shorter periods of time (Maillard and Denyer, 2006; Leaper, 2011).

As for SSD dressings, silver ions are mixed with a sulphonamide antimicrobial, providing a moderated broad spectrum aqueous agent. SSD

works slowly under the action of sodium chloride originating from wound exudates (White and Cooper, 2003).

Absorption of Silver depends on the:

- ▶▶ Type of silver used within the dressing
- ▶▶ Depth and surface area of the wound
- ▶▶ Frequency of dressing application
- ▶▶ The amount of silver incorporated into the dressing
- ▶▶ Levels of wound exudate secreted from the wound.

The widespread debate regarding the safety of silver in relation to systemic absorption and toxicity to human cells cannot be addressed in this article. However, it is thought that this occurs when silver ions are released into the wound bed too quickly over a sustained period of time. Most modern dressings are now designed to modulate the release of free silver ions into the wound bed, therefore, reducing this eventuality (Leaper, 2011).

Iodine

Iodine is an effective, broad spectrum antimicrobial. The exact mode of action

Table 1
Honey dressing modalities

<i>Dressing type</i>	<i>Description</i>
<i>Honey gel or ointment</i>	<i>Presented in a tube and often useful for cavity or sinus wounds where alginate or fibrous dressings are difficult to place. Generally, more effective in low exudating wounds</i>
<i>Honey-impregnated tulle</i>	<i>A synthetic, fine weave non-adherent dressing. This dressing has little absorbency so, therefore, would be better suited to superficial wounds with low to moderate exudates</i>
<i>Honey gel sheet</i>	<i>The gel sheet consists of a mix of honey and sodium alginate. This dressing can often conform well to uneven wound surfaces and cavity wounds. Generally effective at managing low to moderate exudate levels</i>
<i>Honey-impregnated calcium alginate dressing</i>	<i>An alginate impregnated with honey useful for cavity wounds with moderate-to-high exudate levels</i>

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is not yet fully understood but it is thought to disrupt microbial enzymes, proteins and cell membranes through reacting with cell amino acids (Sibbald et al, 2011).

There are two types of iodine-based dressings — cadexomer and povidone.

Cadexomer iodine

The antibacterial agent is held in highly absorbent microbeads and the iodine is slowly released when it comes into contact with exudate (Boothman, 2009). The following considerations apply to cadexomer iodine:

- ▶ It is often available in powder, paste or ointment modalities and is indicated in moderate-to-high exuding wounds, including cavity wounds
- ▶ Maximum single application should be 50g — weekly application should not exceed 150g and treatment should not exceed two weeks in a single course (British Medical Journal/ Royal Pharmaceutical Society [BMJ/RPS], 2011).

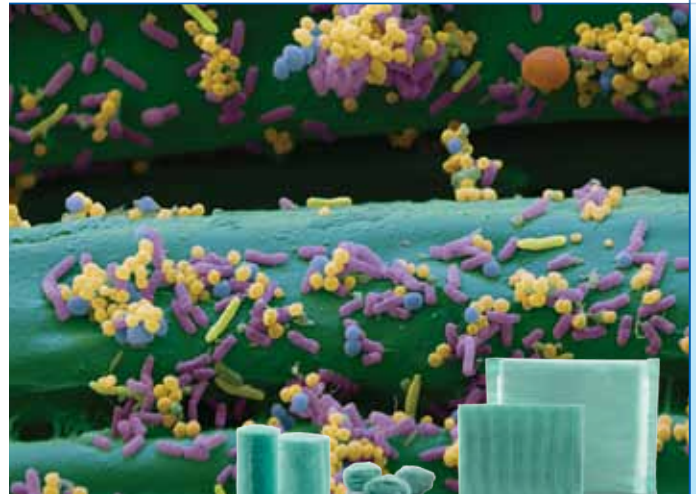
Povidone iodine

Usually administered in a single knitted viscous dressing impregnated with 10% povidone iodine. It is used for superficial skin loss injuries.

The iodine agent can be quickly deactivated by pus or high exudate levels (Sibbald et al, 2001). Generally, the iodine is absorbed within 24 hours and is indicated by dressing colour changes from brown to white.

Polyhexamethylene biguanide (PHMB)

PHMB is a broad spectrum antimicrobial which has been used primarily in commercial products, such as contact lens solutions, for many years. It is a synthetic product of a naturally occurring antibacterial peptide (Moore and Gray, 2007). It works by inhibiting bacterial cell metabolism and natural defence mechanisms through binding to the outer cell membrane.



Wound bacteria and fungi
Staph. aureus (yellow),
Pseudomonas (purple) and
Klebsiella (green) bound to
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1) Haycocks S, Chadwick P (2011). Use of a DACC coated antimicrobial dressing in people with diabetes and a history of foot ulceration. Wounds UK Vol 6 No 4 2) Powell G (2009) Evaluating Cutimed Sorbact: using a Case Study Approach. British Journal of Nursing 18 (15): S30, S32-S36 3) Ljungh et al (2006) Using the principle of hydrophobic interaction to bind and remove wound bacteria. Journal of Wound Care, 15 (4): 175-80 4) Hampton S (2007). An evaluation of the efficacy of Cutimed Sorbact in different types of non healing wounds. Wounds UK Vol 3 No 4.

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PHMB is indicated for use on lightly to moderately exuding, superficial or deep, critically colonised and infected wounds. PHMB has been incorporated into a range of dressing modalities including — non-adherent dressings, gauze dressings, gels and wound cleansing solutions. The concentration levels of the biguanide will vary depending on the dressing modality used.

Dialkylcarbamoylchloride (DACC)

DACC is a fatty acid derivative, which can be used to coat materials and create a wound dressing that is highly water repellent (hydrophobic). Hydrophobicity describes the process by which isolated microorganisms spontaneously bind in the presence of moisture to form a defence force against the hostile wound environment (Hampton, 2010). Most microorganisms are hydrophobic, therefore, in exuding wounds are attracted to the DACC-coated dressing. They are irreversibly bound to the dressing material, rendering them inert (Butcher, 2011).

DACC-coated dressings can be effective at reducing bacterial load as the microorganisms are removed from the wound bed on each dressing change, along with the dressing (Butcher, 2011). The product range comprises mostly of a green acetate swab or a green-coloured ribbon and can accommodate low-to-highly exuding wounds. In replicating the natural binding characteristics of bacteria, the need for an integral antimicrobial agent within the dressing is excluded. Therefore, DACC coated dressings are often considered for prophylactic bacterial bioburden management (Hampton, 2010; Butcher, 2011).

Conclusion

The use of an antimicrobial dressing is considered to be the single most important treatment in preventing localised wound infection. With

escalating concern within Europe regarding systemic antimicrobial resistance (European centre for Disease Prevention and Control [ECAC] and The European Medicines Agency [EMA] (2009), the onus on the appropriate use of antimicrobial dressings falls to healthcare professionals knowing when and how to use them.

This can only be achieved once clinicians have developed the necessary skills to effectively diagnose the differences between bacterial colonisation and localised wound infection. **WE**

References

BMJ/RPS (2011) BNF No. 62 (September 2011). Available at: <http://bnf.org/bnf/bnf/current/> (Accessed on 14 June, 2012)

Boothman S (2009) *Iodine White Paper: The Use of Iodine in Wound Therapy*. Systagenix Wound Management.

Butcher M (2011) DACC antimicrobial technology: Introducing a new paradigm for bioburden management. *J Wound Care* JWC/BSN supplement S4–S19

ECAC and EMA (2009) *Joint Technical Support. The Bacterial Challenge: Time to React. A Call to Narrow the Gap Between Multidrug Resistance Bacteria in the EU and the Development of New Antimicrobial Agents*. ECDC, Stockholm

Graham C (2005) The role of silver in wound healing. *Br J Nurs* (Tissue Viability Supplement) 14(19): S22–S28

Gray D, Acton C, Chadwick P, Fumaro S, Leaper D et al (2003) Consensus guidance for the use of debridement techniques in the UK. *Wounds UK* 7(1)

Hampton S (2010) How and When to use antimicrobial dressings. *Nursing and Residential Care* 12(11): 522–29.

Leaper D (2011) An overview of the evidence on the efficacy of silver dressings. In *The Silver Debate: A New Consensus on what Constitutes Credible and Attainable Evidence*. *J Wound Care* MA Healthcare Ltd: London

Maillard JY, Denyer SP (2006) Demystifying Silver. In *European Wound Management Association (EWMA) (2006). Position Document: Management of wound infection*. MEP Ltd, London 7–10

Moore K and Gray D (2003) Using PHMB antimicrobial to prevent wound infection. *Wounds UK* 3(2): 96–102

Oxford University Press (2001) *Oxford Dictionary Thesaurus and Word-power Guide*. Oxford University Press, Oxford

Sibbald RG, Leaper DJ, Queen D (2011) Iodine made easy. *Wounds International*. 2(2), S1–S6. Available at: <http://www.woundsinternational.com/made-easy/iodine-made-easy&print> (Accessed on 14 June, 2012)

Vowden P and Cooper RA (2006) An integrated approach to managing wound infection. In *European Wound Management Association (EWMA) (2006). Position Document: Management of wound infection*. MEP Ltd: London, 2–6

White RJ, Cooper RA (2003) The use of topical antimicrobials in wound bioburden control. In White RJ (Ed) (2003) *The Silver Book*. Quay Books Division, MA Healthcare Limited: Dinton

Wounds UK (2010) *Best Practice Statement: The use of topical antiseptic/antimicrobial agents in wound management* (1st ed). Wounds UK, London

Wounds UK (2011) *Best Practice Statement: The use of antiseptic/antimicrobial agents in wound management* (2nd ed). Wounds UK, London

WUWHS (2008) *Principles of best practice: Wound infection in clinical practice. An international consensus*. London: MEP Ltd