

# DEMYSTIFYING THE COMPLEXITIES OF WOUND HEALING

In this article, the authors aim to highlight some of the complex issues surrounding wound healing. They will attempt to highlight how current dressing options can contribute to a considered approach to managing wounds, with particular reference to the 'at-risk' patient. In order to achieve this, the authors have included a case study, which demonstrates the practical application of dressings.

## FINANCIAL BURDEN OF WOUND CARE

Wound care has been described as being a high-volume, high-risk, high-cost and unreliable healthcare activity. Delayed healing and infections related to inappropriate treatment can result in preventable pain and reduced quality of life (O'Brien et al, 2011).

Tissue viability is a major area of expenditure for the acute and primary care sectors, with the Department of Health (DoH) estimating costs at more than £80m in 1997. Additionally, wound dressings account for about £120m of prescribing costs in primary care in England each year (Shorney and Ousey, 2011).

Chronic wounds, therefore, represent a significant burden to patients and the

NHS. It is estimated that in the UK around 200,000 patients have a chronic wound. A conservative estimate for the cost to the NHS of caring for patients with a chronic wound is £2.3bn–£3.1bn per year (Posnett and Franks, 2008).

It has been suggested that with proper diagnosis and appropriate treatment, much of the burden could be avoided. Some of the symptoms, however, have a major impact on the lifestyle of a person suffering with chronic wounds. These may include ulceration involving pain, exudate and odour. These symptoms are frequently associated with poor sleep, loss of mobility and social isolation (Posnett and Franks, 2008).

The DoH (2010a) has proposed a national programme of work streams that focus on long-term conditions, with the intention of improving quality and productivity across care pathways. It is fair to say, however, that the NHS faces many challenges at present, none more so than the pressure to achieve improved quality and productivity under severe economic pressure (Ousey and Bielby, 2011).

With this in mind, the role of wound care, including wound care products, is crucial, in order to achieve optimum health outcomes for those experiencing ulceration.

**'Wound care has been described as being a high-volume, high-risk, high-cost and unreliable healthcare activity'**

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**Table 1**  
**Main wound care themes (Ousey et al, 2011)**

<i>The healthy process</i>	<i>Holistic and wound assessment</i>	<i>Recognising risk factors</i>
<i>Identifying underlying aetiology</i>	<i>Correcting aetiology</i>	<i>Wound infection</i>
<i>Prevention</i>	<i>Recognising evidence-based care</i>	<i>Implementing valid and reliable evidence based-care</i>
<i>Wound bed preparation</i>	<i>Product selection</i>	<i>Patient education/health promotion</i>
<i>Follow-up</i>	<i>Resource management and allocation</i>	

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## KEY WORDS

- ▶▶ Chronic wounds
- ▶▶ Diabetes
- ▶▶ High risk assessment
- ▶▶ Referral
- ▶▶ Appropriate dressing choice
- ▶▶ PHMB

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## WOUNDS

There are various definitions of what constitutes a chronic wound, with no universal agreement having been reached. Siddiqui and Bernstein (2010) state that most authors consider a wound to be chronic if it has not healed in four to six weeks, which may be further defined as a wound that has not shown a 20% to 40% reduction in its area after two to four weeks of optimal therapy. They suggest that standard surgical textbooks define chronic wounds as those that have not healed in three months and that regardless of the duration, wounds that fail to proceed through an orderly process, which produces an adequate anatomic and functional result, are considered chronic.

## WOUND CARE AND THE 'AT-RISK' PATIENT

It is known that patients with chronic wounds are often older and have a higher incidence of co-morbidities, such as heart disease, diabetes mellitus, peripheral arterial disease and neuropathy, among others (Siddiqui and Bernstein, 2010; Escandon et al, 2011). Therefore, these pre-existing conditions would classify a patient as 'at risk' of developing a foot ulcer.

These patients require expert care from appropriate members of the multidisciplinary team. The underpinning knowledge required to be an 'expert' has recently been discussed by Ousey et al (2011), during an online Wounds UK debate. *Table 1* illustrates a summary of some of the main themes that should be taught in pre- and post-registration training to ensure that quality wound care education can be maintained.

Clinicians who are active at this level of wound care education need to be able to critically analyse the evidence, in order to recognise its validity and reliability and then demonstrate the ability to implement it into treatment planning and care pathways. It is also essential that they understand the importance of inter-professional and multidisciplinary working.

## THE DIABETIC FOOT

Diabetes is known to increase the complications in wounds and in a recent study it has been reported that patients with diabetes mellitus who have foot ulcers are at an increased risk of mortality compared with people who have diabetes

and do not have a foot ulceration, with mortality rates being similar to patients suffering with common types of cancer (Escandon et al, 2011).

Diabetes is currently recognised as one of the leading causes of morbidity and mortality in the UK (Jeffcoate and Harding, 2003; Bilous and Donnelly, 2010). It is estimated that, worldwide, there are 285 million people with diabetes, and, of those, around three million live in the UK. This is anticipated to grow by a further 54% worldwide by 2030 (DoH, 2010b; Shaw et al, 2010; Holman, 2011).

The DoH (2010c) describes diabetes as a chronic and progressive disease, which has an impact on almost all aspects of life. Diabetes is a condition that can further affect the microvascular and macrovascular system (Bilous and Donnelly, 2010).

## The context and cost of diabetes in healthcare

Diabetes care in the NHS has an approximate price tag of £9bn, with up to 20% (£600m) being used to treat diabetic foot problems (Roberts, 2006; NICE, 2011). The main cause of non-traumatic lower limb amputations is diabetic foot ulceration (Clayton and Elasy, 2009) and it is estimated that £252m is being spent annually on amputations (NICE, 2011). Recent figures reported by NICE (2011) suggest that each year in the UK, around 5,000 people with diabetes undergo leg, foot or toe amputations — equivalent to 100 occurring each week (NICE, 2011).

The NICE clinical guidelines for prevention and management of type 2 Diabetes (NICE, 2004), report figures produced by Neil et al (1989), Walters et al (1992), Kumar et al (1994) and, more recently, Shakher and Stevens (2011), indicating that 20–40% of people with diabetes are estimated to have neuropathy and about 5% have a foot ulcer. Recognising those people at risk of ulceration is, therefore, crucial. Essentially, foot ulceration occurs due to neurological, vascular and/or mechanical force problems. These are summarised in *Table 2*.

## WOUND BED PREPARATION, INFECTION AND EXUDATE MANAGEMENT

The use of antimicrobials in wound care

KEY POINTS

- ▶▶ High-risk patients must be assessed for appropriate wound dressing
- ▶▶ The financial burden on the NHS remains a problem that may be reduced with appropriate wound management
- ▶▶ PHMB is an appropriate first-line antimicrobial treatment choice

is not a new phenomenon. The current trend is to reduce the amount of antibiotics used as antibiotic-resistant bacteria, such as methicillin-resistant *Staphylococcus aureus* (MRSA), are on the increase (Kingsley, 2009).

Wound care, therefore, needs to focus on recognising the early stages of infection. All chronic wounds are contaminated with bacteria to some degree and low levels of bacteria can, in certain circumstances, facilitate healing (De Haan et al, 1974; Pollack, 1984; Kingsley, 2009). When the bacterial burden of the wound overtakes the host response, this is when clinical signs of bacteria are noted.

**Bacterial burden**

The following terms indicate the bacterial numbers in a wound:

*Colonisation*

Colonised wounds contain multiplying bacteria but the host does not have obvious clinical symptoms, nor is the healing of the wound affected by their presence. All wounds have a level of bacterial burden.

*Critical colonisation*

Critically colonised wounds require a reduction in the bacterial burden if the wound is to heal. Chronic wounds are often critically colonised and this may be identified when the wound margins fail to change. Critical colonisation may

appear as a dull brick red colour with an increase in serous exudate. Sloughy fibrous tissue may also be present, which requires debridement and can be an early indicator of possible signs of localised infection.

*Local and systemic infection*

This is recognised as cellulitis, erythema, oedema, localised heat, pain and limited function, and may include increased discharge, wound breakdown, slough and odour. Localised infection would be less than 2cm and systemic infection greater than 2cm. Infection is better treated with antibiotics, but can be accompanied by topical antimicrobials.

*Septicaemia*

Septicaemia is characterised by chills, high fever, rapid breathing, rapid heart rate and the person appearing very ill. This is a clinical emergency and requires hospital admission for IV antibiotics (Cutting and Harding, 1994; Schultz et al, 2003; Edwards and Harding, 2004; Kingsley, 2009; Gray et al 2010).

As well as wound bed appearance and level of infection, the final element in wound healing focuses on wound exudate levels and viscosity (Vowden and Vowden, 2004; Gray et al, 2005). The higher the viscosity and exudate levels, the higher the incidence of infection (Figure 1).

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**Table 2**  
Associated problems with the high-risk foot

Vascular	Neurological
<i>Ischaemia</i>	<i>Sensory neuropathy</i>
<i>Gangrene</i>	<i>Motor neuropathy</i>
<i>Tissue viability</i>	<i>Autonomous neuropathy</i>
	<i>Charcot neuro-arthropathy</i>
Mechanical	Infective
<i>External pressure</i>	<i>Osteomyelitis</i>
<i>Altered mechanics leading to internal and external pressure issues</i>	<i>Cellulitis</i>
	<i>Lymphangitis</i>
	<i>Critically colonised wound/ulcer</i>
Other	
<i>Tumour</i>	
<i>Foreign bodies</i>	



## Antiseptics and the role of PHMB in wound care

The use of antimicrobials in the UK has historically been focused around honey, silver and iodine.

The use of polyhexamethylene biguanide (PHMB) is not currently widespread in the UK, however; its use in the US and Europe is commonplace, with the European consensus being that it is the first-line choice for topical antimicrobial therapy (Kingsley, 2009; Barrett et al, 2010).

PHMB is an appropriate first-line antimicrobial treatment choice as the synthetic compound is a structure similar to naturally occurring antimicrobial peptides (AMPs) and has a broad spectrum activity against bacteria, viruses and fungi (Moore and Gray, 2007; Kingsley, 2009). Furthermore, PHMB has been in widespread use for approximately 60 years with no evidence of the development of resistance or cytotoxicity (Moore and Gray, 2007; Kingsley, 2009).

Another concern when using antimicrobial agents is the risk of bacterial adaptation. One study investigated the incidence of bacterial adaptation (in this case *S. aureus*) in antiseptics. The study compared PHMB with silver and found that PHMB demonstrated a much lower potency to induce adaptation (Wiegand et al, 2009).

## CASE STUDY

The patient is a 72-year-old man with a history of type 2 diabetes mellitus dating back approximately 27 years. His self-monitored biometric data levels are erratic and his HbA1C levels are often recorded at 69–102mmol/mol (8.5%–11.5%). He has been encouraged

to commence insulin therapy, but refuses due to his fear of needles.

## Wound aetiology and assessment

While visiting friends, the patient developed a small black area on the fourth toe of his left foot. On returning home, he decided to visit A&E due to the pain in the area. He was admitted to hospital that day, due to a gangrenous toe with surrounding cellulitis. He was prescribed intravenous antibiotics and an urgent vascular referral was made. Within 24 hours, the vascular surgeon had reviewed him and amputated his second to fifth toes, while a balloon angioplasty was performed to improve the circulation to his extremities.

The patient was managed as an in-patient for a further week before being discharged. He was then initially managed by the district nursing service following the vascular service's request for daily dressing changes. Within four weeks, the wound deteriorated and required specialist podiatrist intervention for assessment and appropriate sharp debridement (Figure 2). The patient was then managed jointly by the district nursing service and podiatry services.

## Wound at presentation to podiatry service

The patient presented to podiatry with an ulcer, which was predominantly sloughy at the post-operative amputation site with a small area of red granulation tissue. There was no localised cellulitis, or any cardinal sign of surrounding tissue infection, but the wound displayed signs of a high bacterial burden consistent with a classification of critical colonisation.

The wound exudate levels and the viscosity of the wound also implied that there was



Figure 2: Wound at presentation, post-debridement. The wound is critically colonised. There are no signs of systemic or localised infection, therefore, the treatment focused on topical antimicrobials.

Volume	Viscosity		
	High - 5	Medium - 3	Low - 1
High - 5			
Medium - 3			
Low - 1			

Figure 1: Exudate continuum (Gray et al, 2005).

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## ‘The wound exudate levels and the viscosity of the wound also implied there was a high bacterial burden’

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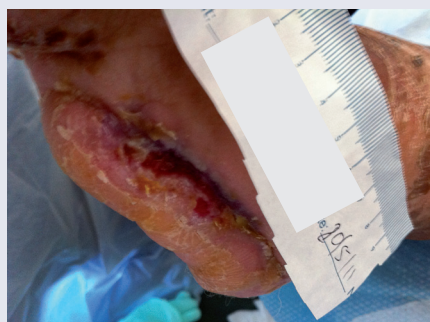


Figure 3: Wound at eight weeks, the base wound is healing well and close to fully healing.



Figure 4: Wound bed is 100% granulated and there is no current need for antimicrobials, although their prophylactic use has been considered.

a high bacterial burden and if not treated appropriately the wound and the localised tissue could become infected. Therefore, the treatment plan was focused on the use of antimicrobial therapy.

The treatment plan initiated for this patient focused primarily on antimicrobial care — Suprasorb® X +PHMB) (Activa Healthcare) was used at the primary dressing — with podiatry input for specialist sharp debridement and an appropriate secondary dressing (Tegaderm® Foam Dressing [non-adhesive]; 3M®) to deal with the exudate management.

Due to the potentially prolonged use of the antimicrobial dressing, it was felt that silver and iodine have a higher potential risk factor associated with them, due to known sensitivity and systemic absorption noted in these antimicrobials.

The hydro-balance nature of Suprasorb X +PHMB also made it more favourable than other antimicrobial agents available (Kingsley, 2009). Providing a moist wound environment is an essential part of wound healing. In this case study Suprasorb X +PHMB was used according to its indicated uses, including:

- ▶▶ Light to moderately exuding wounds
- ▶▶ Superficial or deep wounds
- ▶▶ Pressure ulcers
- ▶▶ Leg ulcers
- ▶▶ Second-degree burns
- ▶▶ Postoperative wounds
- ▶▶ Skin donor and recipient sites.

The plan at this stage was to review and redress the wound three times per week, which was reduced after two weeks to biweekly review. The use of Suprasorb X +PHMB was discontinued at eight weeks and it was replaced with a low absorbent

dressing. The rationale for the change was the reduction in exudate volume and viscosity, with 100% granulation of the wound bed achieved (Figures 3 and 4).

The ulcer dressing was changed to a low absorbent type at this stage due to the wound having 100% granulation and low, serous exudate.

In the ‘at-risk’ patient, prophylactic antimicrobials may be advantageous, as the bacterial host resistance in a person with diabetes is decreased and bacteria have a relative advantage (Schultz et al, 2003; Ousey, 2010).

The ulcer had almost healed after 12 weeks and dressing reviews consequently reduced to once a week. The ulcer fully healed at 14 weeks and remains healed at the time of writing.

### CONCLUSION

Diagnosing the level of risk for a patient and optimising healing, requires a multifaceted approach. The expertise of multidisciplinary foot care teams can maintain optimum care pathways that will include critically appraised evidence to support decision making. Within current wound management pathways, there must be recognition of the role of wound care products to enhance the healing process.

PHMB products offer a new dimension to antimicrobial wound care, especially as current trends show resistance to antibiotic therapy. Sensitivity and systemic absorption of current topical antimicrobials makes product choice difficult, therefore, the introduction of a low-sensitivity product is always to be welcomed. [WUK](#)