Applied Wound Management supplement

Part 2 Implementation

Wounds UK

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Wound Management

nip it in the bud

Some wounds seem to go on and on for ever. But why wait until a wound is in full bloom to sort it out?

PROMOGRAN* speeds healing[1,2] by rebalancing protease levels and protecting growth factors.[3] This results in a clinically significant reduction in wound size,[2] faster wound closure[4] and a better healing rate[1,2] compared with good wound care alone.

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References: 1. Veves A, Sheehan P, Pham HT. A Randomised Controlled Trial Of PROMOGRAN* vs. Standard Treatment in the Management of Diabetic Foot Ulcers. Arch Surg 2002 Jul; **137**(7): 822-7. **2.** The healing properties of Promogran in venous leg ulcers. Vin F *et al.* J Woundcare 2002; **11**: 335-41. **3.** Instructions for Use, Nov 2002. **4.** PROMOGRAN* experience in pressure ulcers. Cassino R. 7th EPUAP Open Meeting, Finland 3-6 Sept 2003.

Wounds UK

The basic concepts of Applied Wound Management were first mooted in a series of national study days throughout 2002/3. From the early stages, each component (that is the three continuums — Healing, Infection and Exudate), has been refined and developed. This has coincided with the availability of dedicated software to enable clinicians to employ the approach in everyday wound management.

The time has now come for the contributing authors to present the latest refinements, putting Applied Wound Management into context with respect to important advances such as the articulation of critical colonisation, and the management of exudate according to the six 'Cs' (cause, control, components, containment, correction and complications). Ultimately, a more accurate and systematic assessment will lead to better guidelines for treatment options such as dressing choice.

The following articles provide an overview of Applied Wound Management, and elaborate on the three continuums. The final article also describes the various clinical tools and computer software available to facilitate the implementation of Applied Wound Management.

Applied Wound Management is now supported by a range of clinical tools and educational materials, enabling its implementation in practice.

David Gray, Richard White, Pam Cooper

Understanding Applied Wound Management

The development of the Wound Bed Preparation and TIME concepts has led to an increased awareness of the need for systematic approaches to wound management. Applied Wound Management (AWM) seeks to develop this approach by utilising three continuums — Healing, Infection and Exudate — to facilitate a systematic assessment of wounds healing by secondary intention. This approach not only supports clinical decision making, but, in conjunction with AWM software, also facilitates clinical audit by producing data that reveals the true extent of wounds healing by secondary intention in the UK.

David Gray, Richard White, Pam Cooper, Andrew Kingsley

KEY WORDS

Applied Wound Management
Wound Healing Continuum
Debridement
Surgical debridement
Sharp debridement

Wound management is a constantly evolving speciality with regular developments in terms of products and knowledge. The most recent advances have seen the introduction of Wound Bed Preparation (WBP; Schultz et al, 2003; Jones, 2004) and the TIME (Dowsett and Ayello, 2004) concepts, which clearly promote the adoption of a systematic approach to wound management. The key principles underlying the concepts (debridement, wound bioburden control, and exudate management), have been recognised as good practice for some time (Dealey, 1994; Sibbald et al, 2000). However, WBP seeks to incorporate these issues into a systematic approach leading to appropriate dressing selection. As identified by Jones (2004), this could be described as a paradigm shift, and for those active in the field there is a need to work within this new paradigm.

In this article, the authors present an Applied Wound Management (AWM) framework that utilises three different continuums, each relating to a key wound parameter:

- Healing
- Infection
- Exudate.

Healing is represented by the tissues in the wound and is a colour-based continuum. Infection is subdivided into named stages representing varying host responses to bioburden, each identified by clinical cues. Wound exudate is represented by volume and consistency parameters, and each can be graded according to a 'matrix' continuum. This practical application to everyday wound care will enable the practitioner to approach wound assessment logically and systematically. Increased workloads across the NHS require decision-making to be sytematic, clear and coherent. The AWM system aids this type of decision-making, reducing the risk of poor practice and litigation.

Within the UK, little is known of the true extent of wound healing by secondary intention. National average healing rates for leg ulcers and pressure ulcers simply do not yet exist; in fact, it is very difficult to even estimate how many of these wounds exist in the first place. The AWM framework allows the categorisation of most wounds healing by secondary intention and, if applied in a clinical setting, can facilitate clinical audit, producing data which could define the true extent of wounds healing by secondary intention in the UK.

Using AWM

The Wound Healing Continuum

The Wound Healing Continuum (WHC) is an aid to understanding the

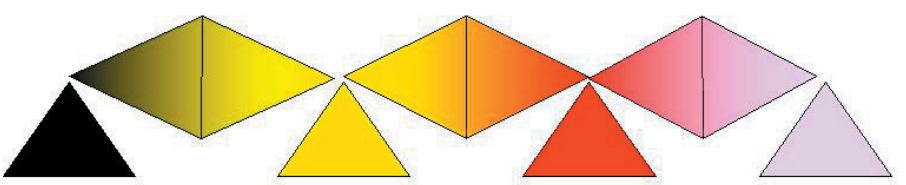

Figure 1. The Wound Healing Continuum.

David Gray and Pam Cooper are Clinical Nurse Specialists, and Richard White is Senior Research Fellow, Department of Tissue Viability, Grampian Acute Health Services, Aberdeen, and Andrew Kingsley is Clinical Nurse Specialist Tissue Viability, North Devon District Hospital, Devon

type of tissue present in, and the progress of, the wound (Gray et al, 2004). The key is to determine which type of tissue is of primary importance (*Figure 1*). As the continuum is followed from left to right, i.e. from black to pink, it correlates with the colours seen in a healing wound (Krasner, 1995). Not all wounds will naturally progress in this fashion, but even where wounds deteriorate or oscillate between healing and stasis, the WHC will be capable of recording their status. Not all wounds will exhibit black tissue during their lifetime.

Using the WHC

When using the WHC, first identify the colour that is furthest to the left of the continuum; for example, if the wound contains yellow slough and red granulation tissue, it would be defined as a 'yellow/red wound'. In this instance, the management plan should focus on removal of the yellow sloughy tissue and promotion of the red granulation tissue. As this objective is achieved, so the wound can progress along the continuum towards the right, and to 'pink /healing' status.

The Wound Infection Continuum

The Wound Infection Continuum (WIC) is an aid to understanding the level of bacteria present in the wound (i.e. the bioburden), and the level of host response (Kingsley, 2001; White et al, 2003). There are four stages that also progress from left to right with the most severe, 'spreading wound infection' on the far left. The continuum moves to the right through the stages of 'local infection' and 'critical colonisation' to 'colonisation' (*Figure 2*). Spreading infection (e.g. rapidly increasing cellulitis) can be a life-threatening condition. The principal visible clinical cue is a rapidly advancing redness (greater than 2cm around the wound margin), which may be accompanied by other signs and symptoms, notably pain, and often includes very high exudate levels, malodour, and, in the surrounding tissues, heat, swelling, and blistering. Local infection is characterised by less than 2cm of redness around the wound margin, sometimes with symptoms similar to spreading infection being present but to a lesser degree (Kingsley, 2003).

Critical colonisation, a term first coined by Davis in 1998, is now an accepted state (Kingsley, 2003; Cooper, 2005; Jorgensen, 2005) characterised by delayed healing, with malodour, raised exudate levels and slough often being present. However, the wound will not present as if locally infected, so there will be an absence of surrounding cellulitis (Cutting, 2003; Kingsley, 2003; Scanlon, 2005).

It is important to understand that bacterial colonisation, which is a state of host manageable bioburden, is normal in a wound healing by secondary intention and does not hinder progression towards closure at expected rates (Bowler, 2002; 2003). Therefore, the term 'colonisation' on the infection continuum describes a wound that is free of untoward or unexpected symptoms for a healing wound (e.g. tenacious slough, excessive wetness, malodour, dull granulation, etc) and is actively improving. A clearly visible reduction in the wound size over a two-week period would suggest an acceptable level of colonisation (Flanagan, 2003).

Using the WIC

The WIC is a simple sliding scale that can be used as an aid to clinical decision-making regarding the level of bacterial colonisation of a wound (Cutting, 2003; Scanlon, 2005). A wound may never move from the furthest point to the right on the continuum, 'colonisation', during the entire treatment period up to healing. However, where a patient is identified as having a wound which has a spreading or localised infection, or a critical colonisation, consideration should be given to addressing these states when developing a wound management plan.

The Wound Exudate Continuum

The Wound Exudate Continuum (WEC) (*Figure 3*) is an aid to estimating both the volume and viscosity of wound exudate. Traditionally, wound exudate has been considered in terms of its volume, with only little thought given to its viscosity. However, the viscosity of the exudate can be an important indicator of the wound's status (Vowden and Vowden, 2004). The gradings for both parameters are:

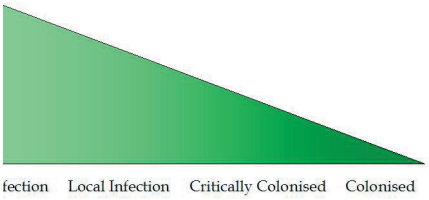

Figure 2. The Wound Infection Continuum.

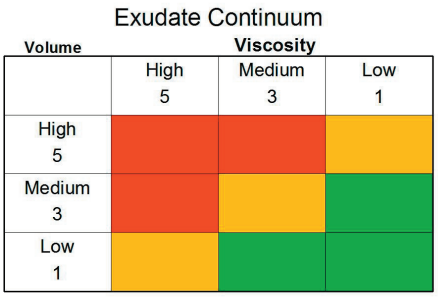

Figure 3. The Wound Exudate Continuum.

- High
- Medium
- Low.

This allows wound exudate to be categorised by a score, e.g. a low volume and of medium viscosity would be a 'Low/Med' category and would score 4, placing it in the low exudate portion of the continuum. Any score falling in the green zone should be seen as advantageous to wound healing. Any score in the amber zone would only cause concern if the previous recording had been green, but not if the previous recording had been red: in this case, an amber reading would demonstrate a step in the direction of healing. A score in the red zone should be investigated further as this may indicate local or spreading infection.

Using the WEC

To use the Wound Exudate Continuum (WEC), the exudate in the wound and on the dressing should be assessed. The number of dressing changes required over a 48-hour period should also be considered. Any wound assessed as having both high viscosity and a high volume of wound exudate would score a full ten points and be regarded as a cause for serious concern. Such a wound may indicate a spreading infection, sinus or fistula formation, or some other cause for concern. Any wound scoring 6 points

Figure 4. Burn at presentation.

Figure 5. Burn at first review.

would be regarded as requiring regular review. It might be that this finding is entirely consistent with the treatment applied, e.g. the liquefying of wound slough. In this case, the wound may have previously been scored in the red zone and, as such, a score of 6 would indicate an improvement. If a wound had previously scored between 2–4 points, but was then graded in the amber zone (i.e. scoring 6 points), this could be an early sign of critical colonisation, or of the development of a wound infection and should be acted upon accordingly.

Wound type

Most wounds can be categorised into one of six different types:

- Pressure ulcer
- Leg ulcer
- Diabetic foot ulcer
- Surgical wound
- Trauma wound
- Complex wound.

It is vital that before embarking on a plan of care for a person with a wound, that the cause of the wound is identified and treated if required, e.g. all leg ulcers should be assessed using national guidelines. Failure to do so can lead to delayed healing and potentially damaging complications. A paper written to support the AWM framework provides more detailed information (Cooper et al, 2003).

Using AWM in the clinical setting

Following the application of the three continuums, the wound can be defined in terms of:

- Tissue/colour (WHC)
- Bioburden/host response (WIC)
- Exudate volume/consistency (WEC).

It is at this stage that consideration must be given to the cause (aetiology) of the wound. Such an assessment would, for example, in the case of a heel pressure ulcer, necessitate a very different form of management/treatment than if it were a leg ulcer or a diabetic foot ulcer. Each wound would require treatment/management relevant to the underlying pathology, despite recording the same initial results following AWM assessment by the three continuums. To summarise, when using AWM, assess:

- Healing (WHC)
- Bioburden (WIC)
- Exudate (WEC)
- Wound type/aetiology
- Underlying pathology.

Table 1 gives further examples of this type of decision making and two cases studies will now be presented that illustrate the use of the AWM framework.

AWM case studies

Case study 1

An eighty-five year old male was admitted to orthopoedics with a fractured neck of femur. On assessment he also presented with a partial-thickness dermal burn to his left shoulder blade area. The wound measured 12cm x 5cm on initial assessment.

WHC

Figure 4 illustrates the wound presenting with a deep dermal burn of black/yellow tissue, which needs rehydrating to facilitate the debridement of the devitalised tissue.

Figure 5 illustrates an improvement in the wound bed condition, with debridement of necrotic tissue. However, reference to the wound healing continuum still demonstrates that there is black/yellow/red and pink tissue present. Of primary importance is the black tissue, followed secondly by the yellow. The treatment aim is to focus on the debridement of the black/yellow tissue by rehydration.

WIC

The wound infection continuum offers the reader the opportunity to consider if the wound has altered healing due to the presence of bacteria. In both images there are no signs of local or spreading infection. The wound is progressing and improving which would rule out any form of critical colonisation. However, the wound is a chronic wound which was caused by a burn, therefore, the wound will be colonised, but this will not inhibit healing.

WEC

Review of *Figures* 4 and 5 show that there are low volumes of exudate with low viscosity. This indicates that exudate management is not a problem with this wound and can be categorised as 'low'. However, to facilitate debridement, a degree of moisture should be provided by the dressing. Once black/yellow tissue begins to soften, there may be an increase in the levels of exudate, but this does not indicate an infection according to the Wound Infection Continuum.

Summary

In summary, the wound presents as 'black/yellow', therefore requiring debridement. The wound is 'colonised', with 'low' exudate levels and 'low' viscosity. The wound should be managed by application of a dressing which facilities debridement by providing a moist environment (i.e. autolytic), but is not required to absorb exudate or to have any antimicrobial properties.

Case study 2

A 75-year-old female who was cared for in a long-term care of the elderly unit following a cerebral vascular event, presented with a pressure ulcer to her right heel, which occurred due to a deterioration in her physical condition, despite deploying all preventative strategies.

WHC

According to the WHC, the wound shown in *Figure 6* is clearly 100% black necrotic tissue. Therefore, the initial management of this wound is to facilitate debridement of this devitalised tissue. *Figure 7* shows that debridement of the black tissue has occurred and that the wound now presents as a yellow/red wound. The colour of importance now is yellow, with debridement of the yellow tissue pivotal to the wound's ongoing progress. The presence of red tissue indicates that the wound is reaching a stage where debridement can stop and stimulation of granulation can occur.

WIC

The initial picture is of a moist black wound. There are no clinical signs of infection, but the wound is malodorous. The odour is due to the presence of anaerobes, but does not indicate that the wound is infected. In fact, the wound is colonised because, as yet, no healing delay has occurred. *Figure 7* shows a wound that is critically colonised – categorised as such, since it has stayed in this 'dormant' condition for a number of weeks without any sign of improvement. The treatment required is the application of a topical antimicrobial, to reduce the bioburden and to 'kick-start' the healing process. No systemic antibiotics are necessary.

WEC

The wound started off with low levels of low viscosity exudate, scoring as 'low' on the continuum, but, as the wound progressed, the levels and the viscosity increased to warrant a 'medium' score. This change in exudate should act as a prompt to the clinician that a change has occurred, and a review of current treatment should be triggered. The wound is 'critically colonised' according to the WIC and, therefore, treatment with an antimicrobial should be commenced. As there is an increased level of exudate, an appropriate absorbent secondary dressing should be considered.

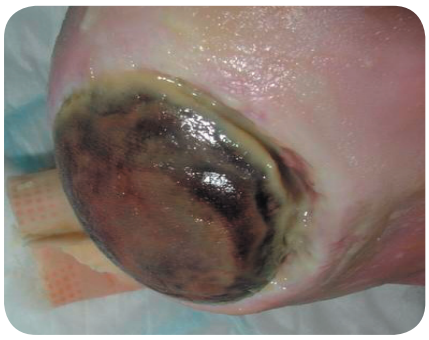

Figure 6. Heel ulcer at presentation.

Figure 7. Heel ulcer at first review.

Table 1

Using Applied Wound Management

	Wound Continuum	Treatment objectives	Patient assessment	Wound type	Management plan	Treatment
Figure 5	Healing=Black Infection=colonised Exudate=low/low	Debride Maintain Hydrate	A frail individual with a poor overall condition due to CVA. Poor prognosis	Pressure ulcer to heel	Rehydrate and debride necrotic tissue on heel Prevent further damage by utilising a heel protector device	Hydrocolloid: change every 5–7 days, or sheet hydrogel change every 2–3 days, or amorphous hydrogel change every 2 days Heel protector in situ at all times
Figure 6	Healing=Yellow/red Infection=locally infected Exudate=Low/medium	Debride /promote granulation Reduce bacterial load	As above	As above	Debride tissue while promoting Manage local infection/ prevent spreading infection	Alginate/hydrofibre with antimicrobial properties or Cadexomer iodine or honey ointment Absorb exudate Absorbent foam dressing to cover

Summary

In summary, the wound started off as a 'black wound' with no infection and minimal exudate. As debridement proceeded, the wound changed to a 'yellow/red wound' that was critically colonised due to non-healing and the presence of bacteria; this led to an increase in the levels of exudate.

Discussion

At the centre of the AWM framework is the WHC. This has attempted to address the shortcomings of previous colour-based assessment tools. It recognises the variance in colour and requires the practitioner to rate the wound according to the colour closest to the left of the continuum. The WIC is aimed at providing a structure and logic to wound bioburden assessment as, with the WHC, the aim is to move the wound status to the right of the continuum. The WEC addresses exudate as an indicator of the wound condition, and needs the user to rate both the viscosity and volume of the exudate. Once this assessment has been completed, the exudate rating will fall into one of three categories, giving an indication as to the wound's underlying condition. When all three Continuum ratings are taken together, they provide the practitioner with a clear, logical and coherent assessment of the condition of the wound. Only when these three assessments are considered in light of the type of wound, its underlying pathology, and the key principles of its management, can the practitioner design an appropriate treatment/management plan.

Conclusions

The principles of WBP and TIME are now recognised as new paradigms in wound management, and it is up to those active in the field to interpret these concepts in a manner relevant to their own clinical practice. The AWM framework is the authors' response to the need to develop a more systematic and practical approach to wound assessment.

The AWM system can be of benefit to those less familiar with wound healing/management by introducing a systematic approach to decision making. For the specialist practitioner, utilising the framework facilitates clinical audit, and the supporting software can generate relevant clinical data. Whatever the level of knowledge of the practitioner, the AWM system can facilitate systematic clinical decision making and clinical audit of practice. WUK

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Key Points

- Wound healing/management requires a more systematic approach to ensure high standards.
- AWM can facilitate clinical decision making for those less familiar with wound management.
- AWM supports clinical audit of benefit to the specialist practitioner.

Using the Wound Healing Continuum to identify treatment objectives

The use of colour has been recognised as a valuable intervention in the assessment of wounds and selection of treatment interventions. The Wound Healing Continuum is a colour progression tool going from left (black tissue) to right (pink tissue). If a wound presents with black, yellow and red tissue, according to the continuum, the primary colour of focus is the colour furthest left, and the treatment aims would reflect this. The Wound Healing Continuum is a method by which clinicians can assess wounds, in conjunction with their own clinical judgement, and it also enables them to audit and review their clinical decisions.

David Gray, Richard White, Pam Cooper, Andrew Kingsley

KEY WORDS

Applied Wound Management
Wound Healing Continuum
Debridement
Surgical debridement
Sharp debridement

The assessment of wounds is a subjective matter, with methods varying considerably from one clinician to another (Fletcher, 2003). Uniformity and consistency in assessment are key to continuity of quality care; hence, a standard for assessment is essential. In recent years, many systems of wound assessment have been published, with each focusing on the type of tissues in the wound as a basic assessment parameter. The practical use of such an approach is intended to add consistency in management from clinician to clinician, and to provide a quick reference to the progress in healing. Yet, even though practitioners can be looking at the same wound, they often articulate what they see in different ways (Dealey, 1994). The Wound Healing Continuum (Gray et al, 2003) is a system designed to introduce essential consistency into wound assessment and wound description.

David Gray and Pam Cooper are Clinical Nurse Specialists, and Richard White is Senior Research Fellow, Department of Tissue Viability, Grampian Health Services, Aberdeen, and Andrew Kingsley is Clinical Nurse Specialist in Tissue Viability, North Devon District Hospital, Devon

Wound tissue types

The tissues in a wound (within the wound bed and margins) left to heal by secondary intention indicate the relevant pathologies present, reflect the state of healing and, consequently, the success of the management approach. Thus, a black wound (as opposed to black skin changes in melanoma, gangrene or frostbite) indicates the presence of eschar or necrosis (Bale, 1997). Wound eschar is full-thickness, dry, devitalised (dead) tissue that has arisen through prolonged local ischaemia. In relation to pressure ulcers, eschar might arise after a sudden large vessel occlusion caused by shearing injury (Witkowski and Parish, 1982). Unless removed, the eschar will delay healing, as healing cannot proceed effectively without a moist wound environment (Winter, 1962; Parnham, 2002).

Wound tissue that is yellow and fibrous, adheres to the wound bed, and cannot be removed on irrigation, indicates the presence of slough (Tong, 1999). This adherent, fibrous material is derived from the proteins fibrin and fibrinogen (Tong, 1999). In combination with wound exudate, it serves as an ideal environment for bacterial growth and, consequently, infection (Colebrook et al, 1960; O'Brien, 2002; Davies, 2004). It also serves to impair healing by restricting re-epithelialisation (Kubo et al, 2001). The clinical objective of managing a sloughy wound is to debride (Tong, 1999; Hampton, 2005).

The red, moist tissue in a wound is a combination of new blood vessel growth (angiogenesis) and a matrix of fibroblasts (connective tissue or dermal cells) known as granulation tissue. This is usually indicative of a healing wound and is often accompanied by signs of re-epithelialisation (epidermal regrowth) (Gray et al, 2003). It is important to remember that not all red wounds are healthy; they may be critically colonised and non-healing/static, or show evidence of haemolytic bacteria (if a dull brick-red colour) (Dowsett et al, 2004).

Colour and wound assessment

Previous assessment methods have used wound colour as the basis for identifying the tissues of clinical importance. Thus, for ease of identification, necrosis is termed 'black', slough 'yellow', granulation 'red', and epithelialisation 'pink'. The earliest colour systems were based on three ▸▸

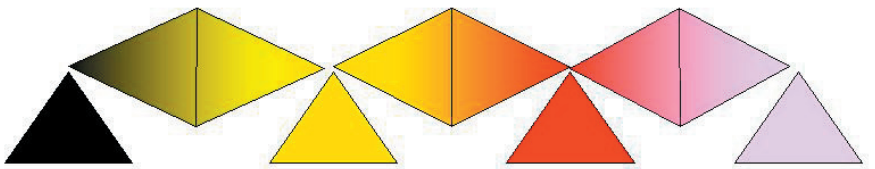

Figure 1. The Wound Healing Continuum.

colours: red, black and yellow (Cuzzell, 1988, 1995; Stotts, 1990; Loughry, 1991; Krasner, 1995; Meaume et al, 1997; Lorentzen et al, 1999; de Peyrolle, 2002). This approach has been described as being easy to use and to teach (Goldman and Salcido, 2002), but is criticised for being simplistic (Maklebust, 1997). In some instances, the inclusion of green, to signify infection (wounds containing *Pseudomonas* spp. are often green or green-blue) has been used. This is also too simplistic as there is no evidence to suggest that a green or green-blue wound is infected, i.e. anything other than colonised or critically colonised (Villavicenzio, 1998; Kingsley et al, 2003; Kingsley et al, p15–20).

The approach taken in the Wound Healing Continuum is to incorporate intermediate colour combinations between the four key colours *(Figure 1)*.

In order that this system may be used to the optimum clinical benefit, it is first important to identify the colour that is furthest to the left of the continuum. For example, if the wound contains yellow slough and red granulation tissue, it would be defined as a 'yellow/red wound'. A key objective of the consequent wound management plan would be to remove the yellow tissue and promote the growth of red granulation tissue (Gray et al, 2005). In this instance, the management plan should focus on removal of the yellow sloughy tissue and promotion of the red granulation tissue. As this objective is achieved, the wound can progress along the continuum towards the right to the 'pink /healing' status. It is important to remember that, in addition to this focus on the wound bed and margins, care must be taken to protect the skin surrounding the wound. The interaction of otherwise healthy skin with exudate can lead to maceration and wound enlargement (White and Cutting, 2003).

Identifying and obtaining treatment objectives

Debridement

Where the wound exhibits dead tissue, e.g. black, black/yellow, yellow, or yellow/red, a key treatment aim should be the debridement of the devitalised tissue unless contraindicated by the patient's overall physical condition or disease process, such as peripheral vascular disease (ETRS, 2003). There are a large number of debridement options open to the practitioner, and each patient's requirements are unique and require individual management. Many different clinical presentations and challenges are likely to face the practitioner when a wound needs to be debrided. The level of exudate present, or the presence of infection, must be considered, but the types of treatment available can be categorised into three separate categories:

Table 1 Wound management treatment: debridement

Treatment options		Black	Black/Yellow	Yellow	Yellow/Red	Red	Red/Pink	Pink
Active								
	Surgical debridement							
	Sharp debridement							
	Larval therapy							
Autolytic [Moisture donation]								
	Hydrocolloids							
	Hydrogels							
	Honey #							
	Silver sulphadiazine #							
Autolytic [Moisture absorption]								
	Alginates *							
	Cadexomer iodine #							
	Hydrofibre *							

These products have an antimicrobial effect
* Some products in this category have antimicrobial effects

- Active
- Autolytic (moisture donation)
- Autolytic (moisture absorption).

Active debridement

Surgical debridement: Surgical debridement involves removal of dead tissue from the wound bed. It is usually carried out under surgical conditions in locations such as operating theatres, and results in a bleeding wound bed. This form of debridement is carried out by surgeons/podiatrists and specialist nurses and using surgical instruments such as scalpels and forceps. Surgical debridement removes dead tissue and results in an inflammatory response from the wound, thus stimulating healing (Bale, 1997).

Sharp debridement: Sharp debridement is the removal of dead tissue. This technique involves debulking the wound of slough and necrotic tissue (i.e. reduces the amount of dead tissue within the wound). As the objective is not to create a bleeding wound bed (that is the complete removal of dead tissue), some slough and necrosis is left. The removal of dead tissue, as may be achieved by sharp debridement, is essential for wound healing(O'Brien, 2002). This process, unlike surgical debridement, is usually carried out at the patient's bedside, or in the patient's own home. It requires the use of surgical instruments, such as specialist wound debridement packs.

Larval therapy: The use of maggot larvae to debride the wound of dead tissue has become a mainstream therapy in the UK during the past decade. The larvae liquefy the dead tissue and, where the treatment is successful, can result in rapid debridement (Thomas et al, 1998).

Autolytic debridement

Autolytic debridement is the process by which the body attempts to shed devitalised tissue by the use of moisture. Where tissue can be kept moist it will naturally degrade and deslough from the underlying healthy structures. This process is facilitated by the presence of enzymes (matrix metalloproteinases) which disrupt the proteins that bind the dead tissue to the body (Schultz et al, 2003). The process can be enhanced by the application of wound management products which promote a moist environment. These products can be divided into two categories: those that donate moisture to the dead tissue and those that absorb excess moisture produced by the body. Both are designed to facilitate the autolytic debridement process.

Figure 2. Black wound.

Autolytic (moisture donation): The groups of products listed in *Table 1* facilitate autolytic debridement by donating moisture to the dead tissue, and are designed to facilitate the natural process of autolysis. Hydrocolloids, hydrogels, honey and silver sulphadiazine donate moisture to the wound and thus enhance the process of debridement (Cooper et al, 2003). These products can be used at all stages of the Wound Healing Continuum and some also have antimicrobial activity. The use of antimicrobial products should always be based on clinical need and not used as a matter of routine.

Autolytic (moisture absorption): The groups of products listed in *Table 1* (alginates, cadexomer iodine and hydrofibres) facilitate autolytic debridement by absorbing moisture from the wound (exudate) while ensuring the necrotic tissue does not dry out. (Cooper et al, 2003). By absorbing excess exudate, these products avoid damage to the surrounding skin from maceration. As with the moisture-donating products, some of the products within the moisture-absorption group also have an antimicrobial effect. *Table 1* indicates where these products can be used across the Wound Healing Continuum.

Clinical use of debridement techniques

It is likely that during the debridement process, treatments from more than one group may be required to achieve full debridement of the wound. With reference to the heel pressure ulcer presented in *Figure 2*, the first image shows necrotic tissue which has been rehydrated using an autolytic (moisture-donating) treatment. As a result of donating moisture to the necrotic tissue, the necrotic eschar has begun to lift at the wound margins, separating from the slough below. The necrotic tissue is categorised as 'black' on the Wound Healing Continuum.

In the next image *(Figure 3)*, the wound has been subjected to sharp debridement and the necrotic tissue removed to leave the slough below

Figure 3. Black/yellow wound post-sharp debridement.

Figure 4. Yellow/red wound.

Figure 5. Red wound.

exposed. The wound is now categorised as a 'yellow' wound on the Wound Healing Continuum. No bleeding or pain has been caused. Following sharp debridement, the patient is treated with a moisture-donating product to continue the process of autolytic debridement.

The wound in *Figure 4* is producing high levels of moisture which need to be absorbed. The wound bed is covered with slough which requires debriding. The wound is categorised as a 'yellow/red' wound on the Wound Healing Continuum. By utilising an autolytic (moisture-absorption) treatment, the wound is successfully debrided and has moved on to the next stage of the Healing Continuum – 'red' *(Figure 5)*.

Granulation and epithelialisation

Granulation (red) and epithelial (pink) tissue are the final two stages of the Wound Healing Continuum. Granulation tissue is formed in the wound bed as a result of the action of fibroblasts stimulated by the growth factors provided by macrophages. Angiogenesis, the development of new capillary buds, leads to the development of new blood vessels. Granulation presents as a red uneven surface. It is highly vascular and needs to be kept moist to facilitate its growth. As granulation develops in the wound, the margins begin to show signs of epithelial growth and pink tissue forms across the surface of the granulation. This is the final stage of healing. This layer is only one cell thick and requires protection from desiccation and trauma. Where a wound has been categorised as 'red' or 'red/pink', the main objective is the promotion of granulation and then epithelialisation.

Both granulation and epithelial tissue need to be kept moist and protected from trauma. There are three different categories of treatment available when healing by secondary intention: active, moisture donation and moisture absorption. Many products can donate and absorb moisture in a granulating wound and, for the purposes of this article, they have been categorised in relation to their main function as interpreted by the authors. Active treatments, such as skin grafting and skin substitutes, have not been included in this article.

Active treatment

Topical negative pressure therapy (VAC – vacuum assisted closure) is used in the management of large granulating wounds, particularly cavity wounds. It works by placing a foam pad into the wound which is then sealed and

Table 2 Wound management treatments: granulation and epithelialisation

Treatment options		Black	Black/Yellow	Yellow	Yellow/Red	Red	Red/Pink	Pink
Active	Topical negative pressure							
Autolytic [Moisture donation]								
	Hydrocolloids							
	Hydrogels							
	Honey #							
Autolytic [Moisture absorption]								
	Alginates *							
	Cadexomer iodine #							
	Collagen products*							
	Foam*							
	Hydrofibre *							

These products have an antimicrobial effect
* Some products in this category have antimicrobial effects

negative pressure applied via a vacuum pump. This facilitates the promotion of granulation tissue as well as removing excess exudate (Moore, 2005). As a result of the partial vacuum created by the therapy, exudate is removed from the wound while still maintaining a moist wound environment (Banwell, 1999). Where high exudate levels occur, such as in severe pressure ulcers or dehisced abdominal wounds, this therapy can facilitate the management of large volumes of exudate. Angiogenesis can be stimulated by the application of topical negative pressure (Argenta and Morykwas, 1997).

Moisture donation

The fragile nature of granulation tissue means that it to be kept moist to prevent desiccation and delayed tissue growth. Products, such as hydrocolloids, hydrogels and honey, can all deliver moisture to the wound bed, thus supporting granulation. Hydrocolloids, sheet hydrogels and sheet honey dressings can also provide an element of moisture absorption (Cooper, et al, 2003), but this is not their main function, which is that of moisture donation. Some of these products may also have an antimicrobial action.

Figure 6. Red wound.

Moisture absorption

An excess of moisture on the wound bed can lead to maceration of the wound margins and delayed healing (Cameron and Powell, 1992). The products listed in *Table 2* (alginates, cadexomer iodine, collagen products, foams and hydrofibres) absorb exudate and thus provide the ideal environment for the promotion of granulation tissue and epithelialisation of the wound. Some of the products may have an antimicrobial capability.

Promotion of granulation and epithelial tissue in clinical practice

In *Figure 6,* the patient has presented with an abrasion to the knee and the wound is categorised 'red' on the Wound Healing Continuum. An

Figure 7. Pink wound.

accurate assessment of the patient would reveal whether or not the wound is producing sufficient exudate to facilitate healing. Depending on the outcome of the assessment, the correct product selection will lead to a 'pink' wound as seen in *Figure 7.*

Discussion

The Wound Healing Continuum supports a systematic assessment of the wound and the identification of clear treatment objectives. Where there is dead tissue, debridement is likely to be the treatment objective unless otherwise contraindicated by the patient's condition. Where debridement is identified as the treatment objective, the clinical judgement of the practitioner will be needed to decide

Key Points

- The assessment of wounds using colour has been recognised as a valuable intervention in the assessment of wounds and selection of treatment interventions.
- The Wound Healing Continuum aims to get clinicians to work with a colour progression tool going from left (black tissue) to right (pink tissue).
- Using the Wound Healing Continuum supports the practitioner in identifying relevant treatment objectives, which should be based upon a holistic assessment of the patient's needs.

the method of debridement required. As previously stated it is likely that more than one method will be used as the wound progresses to a 'red' wound bed. It is important that treatments are prescribed only after a holistic assessment of the patient's needs has been carried out.

Similarly, following a systematic assessment of wounds in the 'yellow/red' to 'pink' categories, the treatments must be selected to promote granulation and meet the needs of the patient. Ensuring the rapid growth of granulation and epithelialisation tissue not only reduces the time required to achieve healing, but also reduces the risk of wound infection (Gray et al, 2003). A balanced, moist environment can be achieved using many different treatments; however, it is vital that the selection of such treatments is underpinned by regular, accurate assessments.

Conclusion

The Wound Healing Continuum promotes a systematic approach to wound assessment and the identification of treatment objectives. Using the Continuum supports the practitioner in identifying relevant treatment objectives, based upon an holistic assessment of the patient's needs. WUK

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Using the Wound Infection Continuum to assess wound bioburden

The presence of micro-organisms, particularly bacteria, in chronic wounds can have a variety of effects: either 'no effect' where healing occurs predictably without antimicrobial treatment; 'critical colonisation' where healing is delayed or arrested; and, infection, either local or spreading. We now know the basics of how and why wound bacteria can influence these clinical outcomes. For the purposes of routine wound management, it is important to be able to quickly, and accurately, assess the bioburden of the wound. The Wound Infection Continuum, and its related treatment guidelines, is one assessment tool that can be used to do this.

Andrew Kingsley, Richard White, David Gray, Pam Cooper

KEY WORDS

Wound Infection Continuum
Wound microbiology
Infection
Bioburden
Critical colonisation

Two of the most important factors in chronic wound management are underlying pathologies and infection. The former is usually managed through measures such as compression bandaging (for venous leg ulcers), pressure off-loading and blood sugar control (for diabetic ulcers), and pressure area care for pressure ulcers. Infection in these wounds is usually as a result of bacteria (White et al, 2001). While all chronic wounds left to heal by secondary intention will contain bacteria throughout, it is the delicate balance between the host (immune) response and the pathogen that must be managed if infection is to be avoided (Casadevall and Pirofski, 2000). The mere presence of colonising bacteria in a chronic wound is usually of no clinical significance, as this level of bioburden does not impair healing (Leaper, 1994).

David Gray and Pam Cooper are Clinical Nurse Specialists, and Richard White is Senior Research Fellow, Department of Tissue Viability, Grampian Health Services, Aberdeen, and Andrew Kingsley is Clinical Nurse Specialist in Tissue Viability, North Devon District Hospital, Devon

From a clinical management perspective, it is the recognition of the state of the wound – with respect to the infection status – that is the challenge. Research informs us of the bacteria that contribute to the wound bioburden and of the criteria for infection. However, the key to good wound management is to avoid infection. Thus, it becomes important to recognise the subtle signs and symptoms that precede infection, and then to intervene accordingly. These factors are included in the evolving 'Wound Infection Continuum' and the related treatment guidelines.

Wound bioburden: a factor for chronicity

Many wounds healing by secondary intention become indolent, causing extended periods of discomfort and inconvenience for the patient, as well as an increase in healthcare costs and workload for staff. A common cause for this indolence is the effect of the wound bioburden (Browne et al, 2001); this is the result of either invasive infection, the quantity or mixture of microbes present, or, the effect of their various virulence determinants (i.e. toxins; Finlay and Falkow, 1997). The indiscriminate use of antibiotics in all open wounds will raise healthcare costs and contribute to the development and selection of multiresistant micro-organisms. Therefore, systemic antibiotics are reserved for proven cases of spreading wound infection.

However, diagnosis of infection is restricted to the recognition of certain clinical signs and symptoms, with qualitative microbiology providing information for the checking of empirically-initiated antibiotic prescriptions for the identified species and strain resistance patterns they possess. The use of microbiology (qualitative, semi-quantitative or quantitative) alone, is flawed, because results require interpretation based on the prevailing wisdom of the relative importance of bacteria and/or quantities of bacteria, in any particular context, on the body. As infection is a clinical diagnosis, there remains large scope for either over- or under-treatment, dependent on the diagnostic skills of the clinician.

Wounds that do not exhibit the classical signs of infection may become indolent through the effects of bioburden and, although they might benefit from an antimicrobial strategy, either topical or systemic, they often go untreated. Improving the clinicians' ability to make a clinical diagnosis requires a consolidation of microbiological status and the incorporation of clinical signs and symptoms into an easily understood package. It could be argued that there is no clear consensus as to ▸▸

Glossary

Wound bioburden: *the microbial community in the wound at any time; usually bacterial but may also include yeasts, fungi and/or viruses.*

Secondary intention: *wound healing by the growth of the wound bed tissues and migration of the margin to fill the defect.*

Qualitative microbiology: *an assessment of the species of micro-organisms.*

Semi-quantitative microbiology: *an estimate of growth in vitro based on 'light', 'medium', or 'heavy' often denoted as +, ++, and +++*

Quantitative microbiology: *a measure of the numbers of micro-organisms, usually by log values i.e. 10^5 colony-forming units (cfu)/gram.*

Colonisation: *the presence of multiplying bacteria with NO overt host (immunological) reaction or clinical symptoms. Many colonised wounds will heal uneventfully; all wounds healing by secondary intent will heal as colonised wounds – without the need for antimicrobial intervention.*

Critical colonisation: *a term applied to that situation where the host defences cannot maintain the balance of organisms in a wound.*

Indolent wound: *a wound that is neither progressing towards healing in a normal timeframe or deteriorating, i.e. is static, stuck or delayed.*

what constitutes the clinical signs of wound infection; however, these have recently been clarified (Cutting and White, 2005).

Thus, it is necessary to extrapolate the principles of microbiological growth, transmission and pathological potential developed in the laboratory to the clinical setting. The concept for building a bridge between microbiological theory and clinical practice is called the Wound Infection Continuum. This continuum seeks, in highly simplified form, to align the states of colonisation, critical colonisation, local infection and spreading infection, with the probable bacterial bioburden and host response, enabling the practitioner to interpret what is happening. In particular, it is possible using the Wound Infection Continuum to guide appropriate use of the plethora of new antimicrobial therapies that are now available. This makes for good 'prescribing' in terms of both clinical and cost-effectiveness.

In clinical practice, the main focus is on reducing the high levels of organisms that are causing problems. However, the ultimate aim is to achieve this without toxicity to healing cells, bacterial resistance, or elevating costs.

The Wound Infection Continuum

The Wound Infection Continuum is a key part of applied wound management (Gray et al, 2005) and represents the varying levels of bioburden in the wound (Kingsley, 2001; White, 2003; Edwards and Harding; 2004). The continuum uses conceptual names for increasingly severe forms of wound bioburden that link with the patient's host (immune) response. The use of the term 'continuum' in this context is not new, and has been used to describe abdominal contamination, infection and sepsis (Schein et al, 1997).

Quantification of bioburden may prove difficult, as clinical outcomes rely on the ability of the host to mount an immune response, and this will be different for each individual. Progression along the continuum in the direction of increasing clinical severity denotes increasing bioburden, which only becomes clinically relevant for chronicity once the state of colonisation has been passed. It is crucial to remember, that in the wound healing by secondary intention, colonisation is the 'healthy' situation (Edwards and Harding, 2004). Colonised wounds heal, often without the need to control bioburden artificially by means of antimicrobial manoeuvres because the host immune response is adequate on its own (Leaper, 1994).

The most controversial point on the continuum is that of critical colonisation; a state of delayed healing. This has now been rationalised in a scientific study by Stephens et al (2003). Although the authors did not claim this to be the case, their findings strongly suggest that soluble metabolites from anaerobic cocci can give rise to 'delayed healing' through the impaired metabolism of key wound cell populations. Clinical management has been defined as a need for topical, sustained release antimicrobial (not antibiotic) wound dressings (Kingsley, 2003; Hermans and Bolton, 2004).

The quantity and diversity of microbes representing the states of colonisation, critical colonisation and infection are individual and dependent on the quality of the host immune response. Some wounds progress quickly from colonisation to infection via a clinically indistinct 'critical colonisation' state. Other wounds stop at that point and become indolent (Heggers et al, 1992; Ennis and Meneses, 2000). Critically colonised wounds will become increasingly 'chronic', or indolent, because cellular cascades are disordered and there is a biochemical imbalance arising from bacterial metabolism (Wall et al, 2002; Stephens et al, 2003). Once that is established, wounds in this state can prove resistant to adjustment with current therapy, as well as emerging novel therapies such as protease inhibitors, extracellular matrix components and topical growth factors. Thus, early recognition of disordered healing caused commonly, either wholly or partly, by microbes is vital to achieving good outcomes.

Infection, critical colonisation and colonisation

The Wound Infection Continuum has historically been drawn to show increasing severity of clinical and microbiological states, from left to right (Kingsley, 2001). However, it can be reversed to link with the Wound Healing and Exudate Continuums, so providing a 'global' wound assessment of key presenting features: Healing (tissues in

Revised Wound Infection Continuum with diagnostic and treatment information

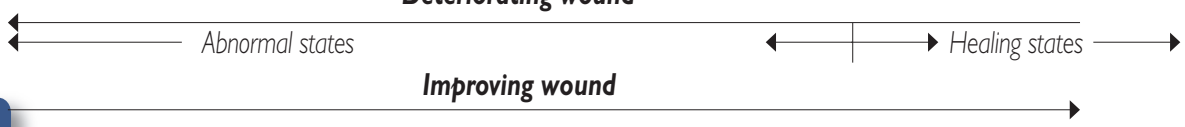

Table 1

	Spreading Infection	Local Infection	Critical Colonisation	Colonisation
Key local characteristic	>2cm redness with pain (unless insensate).	2cm or less redness with pain. Sudden necrosis on wound bed (red inflammatory zone may not be present).	Static (despite appropriate therapy). No cellulitis.	Expected progression towards healing. No cellulitis (but may be small degree of inflammation in early stages consistent with inflammatory phase – generally not more painful to pressure than background wound pain).
Other local characteristic	Heat. Swelling.	Heat and swelling (can be difficult to identify in small red inflammatory zone).		
Additional local characteristics that may be present in addition to key ones	Extension to main wound at skin level. Blistering (fluid filled). New satellite wounds in red inflammatory zone. Increased wetness. Haemorrhagic patching or spotting in surrounding skin. Purulent exudates*. Maceration, if control of exudates is inadequate. Extensive necrotic and/or sloughing necrotic tissue.	Extension to main wound at skin level. Extension to wound at its base (pocketing). Increased wetness Purulent exudates*. Maceration if control of exudates is inadequate. Extensive necrotic and/or sloughing necrotic tissue. Discolouration of granulation tissue (darkening). Friable bleeding granulation tissue (possibly with very bright red tissue) Foul odour.	Thick slough not responding to standard debridement techniques. Fast returning thick slough after sharp or maggot debridement. Wet wound. Purulent exudates. Maceration if control of exudates is inadequate. Blue/green exudate (*Pseudomonas aeruginosa*). Foul odour. Discolouration of granulation tissue (darkening). Friable bleeding granulation tissue (possibly with very bright red tissue).	Debride damaged tissue under standard therapeutic approaches. Gently moist wound surface. Slough but light and mobile in consistency. Inflammation from initial wounding consistent with expectation for inflammation phase of wound healing but fading away or gone if wound older. Granulation tissue of healthy red colour. Epithelial tissue with colour different from, but relevant to, normal skin tone. Reducing wound size in last 1–2 weeks.
Possible systemic features	Neutrophilia. Rising C-reactive protein. Fever. Rigors. Confusion (in the elderly). Bacteraemia. Tachycardia. Tachypnoea. Lymphangiitis. Lymphadenitis.	Neutrophilia. Rising C-reactive protein.	None.	None.
Suggested treatment	Systemic antibiotics – oral if red zone static and still localised even if >2cm – I.V if red zone more than an obvious local ring around wound or if actively spreading. Use local formulary. Consider topical antiseptic dressings – at this stage medicated dressings may not be cost or clinically effective, though it is clinically reasonable to use them in the diabetic foot ulcer, critically ischaemic wounds, burns, and the severely immuno-compromised patient.	Systemic antibiotics – oral. Use local formulary. Topical antiseptic dressings – normally iodine or silver in formulation or combination suitable for wet wound. Locally infected wounds with a necrotic eschar will need a wetter formulation. Adjunctive measures – rapid debridement of necrotic tissue may be necessary, consider relevant strategy, e.g. sharp or surgical.	Topical antiseptic dressings – normally iodine or silver in formulation or combination suitable for wet wound. Slow release formulations are preferred. Medical grade Manuka honey may be considered, especially to control foul odour. Use local formulary. Consider topical antiseptic irrigations – some authors suggest use of dilute vinegar to control *Pseudomonas* if blue/green exudate is present. Adjunctive measures – debridement of necrotic tissue may be necessary. Consider relevant strategy, e.g. maggots. Use of anti-protease therapy may be valuable with antimicrobials.	Standard wound therapy and control of underlying aetiological factors (e.g. venous hypertension, forces of pressure) as local guidelines. Topical antiseptic dressings – normally, no antimicrobials are necessary, however, prophylaxis may be considered in vulnerable wound groups, such as diabetic foot ulcer or vulnerable immuno-suppressed patients . It can also be considered if the patient has a recurrent history of infection in this wound.

Table note:

*** 'Wound exudates need not be purulent in the setting of infection, as bacterial phospholipases and other enzymes and toxins can rapidly destroy neutrophils, producing the classical watery exudates or "dishwater" pus seen in polymicrobial necrotizing infections' — Dow et al, 1999**

Table 2 Wound treatments and their use across the Wound Infection Continuum

Mode of action	Product	Spreading infection	Local infection	Critically colonised	Colonised
Active	Alginates with silver				
	Film with silver				
	Cadexomer iodine				
	Hydrocolloids with silver				
	Honey				
	Hydrogel sheets with honey				
	Hydrofibre with silver				
	Iodine tulle				
	Nanocrsytaline silver cloth				
	Silver sulphadiazine cream				
Passive	Activated charcoal cloth with silver				
	Foam with silver				

the wound); Infection (wound bioburden); and, Exudate (Gray et al, 2005) to promote ease of assessment and documentation of progress in clinical practice. In the original infection continuum (Kingsley, 2001), the states of 'sterility' and 'contamination' were included to reflect the presence of microbial growth from the outset of wounding. Sterility represents the absence of any organism in the wound and is a very unusual situation in wounds healing by secondary intent (Leaper, 1994). For the purpose of clinical practice, understanding this state can be ignored. Similarly, contamination, which means presence of organisms with no active growth and not accompanied by a visible host response, is of no relevance to clinical practice.

The normal microbiological state of a healing wound is that of colonisation which represents a stable state where growth and death of organisms is balanced or below the immune system's healing disruption threshold (Isenberg, 1998; Heinzelmann et al, 2002).

Some authors differentiate infection into 'local' and 'systemic' (Sibbald et al, 2000; Edwards and Harding, 2004). This classification has been used to provide guidance on the route of administration for systemic antibiotics. Schultz et al (2003) describe four levels of microbial interaction:

- Contamination
- Colonisation
- Critical colonisation
- Infection.

Edwards and Harding (2004) include two further levels:

- Spreading invasive infection
- Septicaemia.

Dow et al (1999) and Schultz et al (2003) utilise, with other factors, a ring of cellulitis of <2cm to suggest antibiotic treatment via oral route, with extensive cellulitis (by absence of further definition presumed to be >2cm) requiring intravenous therapy.

The choice of route of antibiotic delivery is linked to the time taken to achieve a therapeutic level of antibiotics at the site, with intravenous delivery naturally being faster than oral administration. Intravenous therapy is indicated in the more severe cases where the consequences of systemic infection can be grave, e.g. lymphoedema (Keeley, 2000). It seems logical to relate the extent of the inflammation with the severity of infection and provide guidance for intervention, but to our knowledge, the choice of the 2cm threshold and therapeutic response are not yet validated by published research.

The use of the word 'systemic' for infection that has spread beyond 2cm from the wound edge could also be unintentionally misleading. Some wounds have wider zones of peripheral redness but remain local in character, meaning that the inflammation zone does not continue to extend and the patient does not exhibit systemic infection signs produced by the consequences of bacteraemia, notably fever, rigor, and positive blood culture. Therefore, for the purposes of reconsidering the states to depict on the Wound Infection Continuum, the terms 'local' and 'spreading' infection will be used, denoted by the 2cm threshold as previously discussed in the literature. Further information on this can be found in *Table 1*.

The remaining state lies between colonisation and infection and is called critical colonisation (Davis, 1998; Schultz et al, 2003; Edwards and Harding, 2004). This state has also been referred to as covert infection (Dow et al, 1999; Dow, 2001), or localised infection (Gardner et al, 2001). Indeed, the so-called 'stunned' wound (i.e. a wound that begins on a normal healing trajectory and then plateaus, becoming recalcitrant) could be critically colonised (Ennis and Meneses, 2000). However, some authorities claim that critical colonisation could equally be described as 'sub-clinical' infection (George et al, 2001). These terms are used to identify different states of microbiological and immunological activity. The change from one state to another depends on many factors *(Table 2)*.

Each successive stage from left to right on the Continuum (*Figure 1*) involves an increase in the quantity of microbes, a new pathogen arrival, an increase in the quantity of virulent organisms, or an increase in the virulence (Wilson et al, 2002) of the collective species mixture through bacterial synergy (Bowler et al, 2001). The situation may shift in favour of the

micro-organisms if the host immune response is impaired or suddenly reduced (Bowler, 2002; Heinzelmann et al, 2002). In addition, shift may result from the presence of potentiating factors such as the introduction of foreign bodies that reduce the necessary inoculum needed to produce a worsening microbiological environment.

Identifying treatment objectives using the Wound Infection Continuum

The Wound Infection Continuum is a useful adjunct to the identification of treatment objectives (Gray et al, 2005). At different stages of the Continuum there is likely to be the need for a different treatment objective. It is, however, vital that the identification of such objectives is only arrived at once a full assessment of the patient has taken place and the implications of the presence of systemic illness or disability understood.

Spreading infection: remove blood stream infection and reduce wound and surrounding tissue bioburden

The presence of a spreading infection associated with an open wound is a systemic disease, which requires a systemic response. As such, the choice of dressing will have little impact on the spreading infection. A systemic response in the form of antibiotics is likely to be the treatment of choice and the wound dressing can seek only to reduce the level of bacteria at the wound surface and thus help prevent re-infection. A spreading infection should be recognised as a serious systemic illness, and appropriate medical management sought at the earliest point.

Localised infection: remove infection from surrounding tissue and reduce wound bioburden

Where the wound is identified as locally infected there are a number of options open to the practitioner. Some authors suggest that a localised infection can be treated using topical antimicrobials alone without recourse to antibiotics (European Pressure Ulcer Advisory Panel, 1999). Others, however, recommend the use of topical antimicrobials with oral antibiotics (Kingsley, 2005). Where the practitioner is satisfied that the patient's overall condition does not suggest a high risk of the infection developing into a spreading infection, it would seem reasonable to adopt a topical antimicrobial-only approach. However, the practitioner should remain alert to the possibility of an advancement of the infection and be prepared to alter the treatment as required. In addition, it would be valuable to set a period of time from the outset in which a reduction of signs and symptoms of infection would be expected to start (e.g. <7 days or perhaps by the return of swab culture results), as it would not be appropriate to unnecessarily allow continuation of pain or the potential for wound bed deterioration.

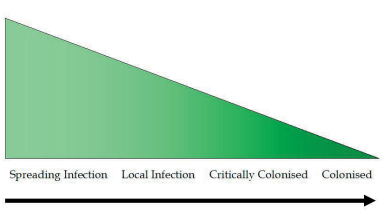

Figure 1. The Wound Infection Continuum.

Critical colonisation: reduce wound bioburden

Critically colonised wounds require a reduction in the level of bacteria in the wound to allow progression to healing. The topical application of an antimicrobial is probably the most effective way in which to reduce the critically colonised wound bioburden to levels that allow the wound to heal (Cooper, 2004).

Colonised: maintain wound bioburden

Wounds that are identified as colonised do not require any form of topical antimicrobial as the wound bioburden is in a healthy state. Only where there are concerns regarding the patient's immune response or overall medical condition should topical antimicrobials be used prophylactically, for example, wounds with a history of recurrent infection including some diabetic foot ulceration and wounds on lymphoedematous limbs. The indiscriminate prophylactic use of antimicrobials is to be discouraged.

Wound products used to obtain treatment objectives

Topical antimicrobial dressings are varied in their form of presentation and action in the wound. As a result there exists a large range of products suitable to aid the practitioner in the achievement of Wound Infection Continuum treatment objectives. In the interest of clarity, the authors have sought to categorise the wound treatments available into two distinct groups: active and passive. These terms describe the mode of the respective dressings, as some dressings donate antimicrobial properties into the wound (active) and others seek to act upon the bacteria as they pass into the dressing (passive). Each form of dressing has its place and it is for practitioners to decide upon the action they require, and the product they select, based on a holistic assessment of the patient.

While the wound dressings available can be divided into two distinct groups by mode of action, there still remain differences in the form such dressings take. In *Table 3* the authors present the dressings in terms of the mode of action, type (e.g. hydrofibre) and where they may be used across the Wound Infection Continuum. As with any dressing selection, the practitioner must be satisfied that the selection process includes a full assessment of the patient and a full understanding of the actions of the dressing.

Conclusion

Accurate assessment of a wound's bioburden and the impact of bacteria on the wound are essential components of wound management. The Wound Infection Continuum encourages practitioners to categorise the level of wound bioburden and identify the relevant treatment objectives. Once treatment objectives have been identified, it is important that the practitioner is comfortable that any treatments selected are appropriate for the patient. It is also important to recognise that topical treatments can only be effective when used appropriately, and that their potential to impact on the wound is not misunderstood.

Topical antimicrobials will not eradicate a spreading infection and such cases require urgent medical intervention. However, topical antimicrobials are of benefit in the reduction of wound bioburden, and have a leading role to play in the eradication of local infections and

Key Points

- Micro-organisms in chronic wounds can have a variety of effects: either 'no effect', where healing occurs predictably without the need for antimicrobial treatment: critical colonisation, where healing is delayed or arrested: and infection, local or spreading.
- The bacteria that contribute to wound bioburden and the criteria for infection are known. However, the key to good wound management is to avoid infection.
- Using the WIC supports the practitioner in identifying relevant treatment objectives, which should be based upon a holistic assessment of the patient's needs.

in cases of critical colonisation (Bolton and Hermans, 2004; Bowler et al, 2001). Where the decision is taken to treat a local infection without recourse to antibiotics, the practitioner should be confident that the patient has been appropriately assessed. This can only be achieved following a full assessment of the patient as a whole, taking into consideration his/her physical, psychological and social circumstances. The use of topical antimicrobials on colonised wounds is to be avoided unless there are overriding concerns regarding the patient's immune response or some particular medical concern. The widespread use of topical antimicrobials as a preventive measure where no such concerns exist is to be avoided.

The Wound Infection Continuum offers the practitioner the opportunity to approach assessment of the wound's bioburden in a systematic manner which leads to the identification of clear treatment objectives. The practitioner is faced with a wide variety of products that can be of benefit in the achievement of treatment objectives, and it is important that such choices are made in the full knowledge of the patient's requirements and the product's abilities. WUK

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The Wound Exudate Continuum: an aid to wound assessment

Wound exudate is a key component of healthy wound healing. In this paper, the authors present the Wound Exudate Continuum, an assessment tool intended for use as part of the Applied Wound Management framework. Through using the Wound Exudate Continuum, it becomes possible to assess both the viscosity and volume of wound exudate in terms of the health of the wound and to rank this combination in terms of clinical significance. When used alongside the Wound Healing and Infection Continuums, a systematic approach to wound assessment can be achieved.

Richard White, David Gray

KEY WORDS
Wound exudate
Volume
Viscosity
Infection
Assessment

Wound healing occurs in four overlapping phases: haemostasis; inflammation; granulation/epithelialisation; and tissue remodelling (Davidson, 1992). Upon injury, vasoconstriction occurs with the aim of reducing blood loss. Haemostasis is achieved by the formation of a clot, which seals the wound. Following haemostasis the inflammatory process begins, during which wound exudate is produced by the tissues surrounding the wound. Normal serous exudate is essential to the healing of the wound. (Field and Kerstein, 1994). However, wound exudate is not always 'normal' in terms of volume and/or consistency; it can present significant management challenges and be a sign of underlying problems relating to the wound

David Gray is Clinical Nurse Specialist, and Richard White is Senior Research Fellow, Department of Tissue Viability, Grampian Acute Health Services, Aberdeen

bioburden (Cutting and Harding, 1994; Gilchrist, 1999; Vowden and Vowden, 2003, 2004; Cutting, 2004).

Where a wound is healing without complication, exudate can be considered a normal feature. It is produced when blood vessels dilate, post-haemostasis, as part of the inflammatory process. Endothelial cells swell and so open gaps in the vessel wall permitting extravasation of serous fluid. The presence of this fluid in the tissues surrounding the wound contributes to localised pain, heat, and swelling; symptoms that are associated with inflammation.

Normal wound exudate is mainly composed of three elements: serous fluid from the leaking blood vessels; debris from local damaged tissue; and growth factors or cytokines (Chen et al, 1992; Rogers et al, 1995; Cutting, 2004). Wound exudate has a key role to play in the moist wound-healing process as it provides not only moisture, but also components, which support the removal of dead tissue and the formation of new tissue. Factors such as the underlying condition of the patient, dressing selection and the pathology of the wound all affect the production of exudate (White, 2001). Wound exudate has been shown to contain different components at different stages of healing, i.e. acute wounds contain growth factors and chronic wounds contain tissue-degrading enzymes (White, 2001; Cutting, 2004).

Exudate can present significant management challenges. For example, in the case of venous leg ulcers and pressure ulcers, protease enzymes contained in chronic wound exudates (Chen et al, 1992) can, if they come into contact with the surrounding skin, result in the development of excoriation and maceration (Cameron and Powell, 1992). Large quantities of exudate can saturate the wound bed (Lamke et al, 1997) and peri-wound area causing further maceration (Cutting, 1999; White and Cutting, 2003). Wound exudate can also increase the risk of infection if it soaks through a dressing, thus allowing bacteria to 'strike-through' (this is the passage of exudate from the wound bed through a permeable dressing to appear at the dressing surface – it is believed to be an avenue for bacterial contamination from the environment) the wound dressing. However, wound exudate can promote healing if it is managed so as to maintain an optimum moist environment and avoid damage to surrounding skin (Bishop et al, 2003).

Exudate will be found at some point in all wounds healing by secondary ▸▸

Table 1 Exudate management strategy based on six 'Cs' adapted from Vowden and Vowden, 2004

Cause	Control	Components	Containment	Correction	Complications
Systemic Local Wound-related	Whether effective systemic or local control possible	Bacterial load Necrotic tissue Chemical composition Volume and viscosity pH	Dressing seal. At the wound surface, with the dressing and away from the wound	Bioburden control Debridement	Skin protection Protein loss Pain Odour

intention. The volume and viscosity of wound exudate produced by the wound will be influenced by the stage of healing and the presence or absence of factors such as infection. Wounds healing by secondary intention without complication will gradually reduce their production of exudate as the healing process progresses.

Assessing exudate

Traditionally, exudate has been described in terms of its perceived volume, e.g. as light/low, moderate, or heavy (Watret, 1997). This form of assessment is very subjective and difficult to quantify in the absence of significant investigation such as the weighing of dressings pre- and post-use (Thomas, 1997). Vowden and Vowden (2003, 2004) suggest that exudate volume should not be viewed in isolation but in conjunction with viscosity. By considering both these aspects, an insight can be gained into the underlying condition of the wound and of the patient. They are indicative of the infection status (Cutting, 2004).

The authors suggest that wound exudate volume and viscosity be assessed by:

- Considering the exudate that is retained within the dressing
- Noting the number of dressing changes required in 48 hours
- Visual inspection of the wound.

This approach to assessment is complementary to current management strategies, such as the six 'Cs' as proposed by Vowden and Vowden (2003) (*Table 1*).

Figure 1. The Wound Exudate Continuum.

The Wound Exudate Continuum

The Wound Exudate Continuum (*Figure 1*) is offered as an aid to quantifying the volume and viscosity of wound exudate. The gradings for both of these features are 'high', 'medium' and 'low', and allow wound exudate to be categorised by a numerical score. For example, a wound with exudate of low volume and of medium viscosity would be in the low/medium category and would score 4 (placing it in the low exudate [green] portion of the Continuum). Any score in the green zone should be seen as advantageous to wound healing.

If the wound exudate score is 6, then this places the wound in the amber zone. Wounds that are assessed as being in the amber zone require careful consideration as this category could either indicate an improvement or deterioration in the wound's condition. For example, if the previous recording had been in the green zone then the practitioner should seek to identify why the wound has moved (deteriorated) into the amber zone. A change in score to red from amber, i.e. a deterioration, may be because of an alteration in the wound bioburden, indicating critical colonisation or the development of an infection. However, if the previous score had been in the red zone, an amber score would indicate an improvement in the condition of the wound. Any score in the red zone should be investigated urgently as this may indicate local or spreading infection, particularly if the previous score had not been in this zone.

Using the Wound Exudate Continuum to identify treatment objectives

When reviewing the wound, the exudate on the dressing and present in the wound should be assessed using

Table 2 Exudate assessment: Questions to ask

How often has the dressing been changed over the past 48 hours?	Provides an indication as to the volume of exudate being produced
Has there been any leakage from the dressing?	This may provide information on the suitability of the dressing used and give an indication of the volumes of exudate being produced
Is there any residue on the surface of the wound dressing?	High viscosity exudate is likely to be found on the surface of a wound dressing
Have the margins become macerated ?	Maceration is usually associated with high volumes of exudate
Is there any exudate on the wound bed?	High viscosity exudate is more likely to be found adhering to the wound bed
Can the staff or patient offer any information regarding the nature of exudate observed over 48 hours	Often an assessment is difficult because dressings have been removed or the patient bathed before an assessment

Table 3 Exudate management options

Function	Product	Red	Amber	Green
Devices/dressings				
	Topical Negative Pressure			
	Wound Manager			
Primary dressings				
	Alginates *			
	Capillary			
	Hydrofibres*			
Primary/secondary dressings				
	Foams*			
	Films*			
	Hydrocolloids* #			
	Hydrofibres*			
	Hydrogels* #			

* Denotes where some of the products within this category contain an antimicrobial function

# Denotes products which can donate moisture to the wound where there is insufficient moisture

the questions outlined in *Table 2*. This is a highly subjective assessment and should be used to guide clinical judgement and not replace it. Any wound assessed as having both high viscosity and high volume of wound exudate would score a full ten points and be regarded as causing serious concern. It is likely that such a wound may indicate a spreading infection, sinus or fistula formation or some other cause for concern. Any wound scoring 6 points would be regarded as requiring regular review, it maybe that this finding is entirely consistent with the treatment applied e.g. the liquefying of wound slough, the wound may have previously been scored in the red zone and as such a score of 6 would indicate an improvement. Where a wound had previously been scored as 2–4 points and is observed to be in the amber zone (scoring 6 points) this could be an early sign of critical colonisation or of the development of a wound infection and should be acted upon. The overriding aim of the wound exudate continuum is to encourage a systematic approach to wound care and to support clinical decisions making. Regardless of the zone the assessment points to the treatment objectives will fall into one of three categories:

1. Absorb moisture
2. Maintain current moisture balance
3. Donate moisture.

When these objectives are added to the objectives identified using the Wound Healing and Wound Infection Continuums, a clear picture of the overall treatment objectives is achieved.

Using the Wound Exudate Continuum to identify treatments

Once an assessment has been carried out using the Wound Exudate Continuum and a colour zone identified, it is then possible to identify which product may be suitable using *Table3*. In *Table 3* the products have been divided according to their primary function, and placed in the zones of the continuum in which they have been identified to function by their manufacturers. Those products with antimicrobial function have been identified by an asterix. This maybe be particularly useful where an infection or critical colonisation is thought to be present.

Product functions

Device/dressings

In *Table 3* the first category of product are those which can be described as device/dressings. In this category there are two different products. First, Topical Negative Pressure, which works by applying negative pressure to a wound bed and thus removing the exudate via a tube to a canister. This product can function across the spectrum of exudate zones. A Wound Manager is a device which is similar in construction to a colostomy bag and acts as a reservoir where there are large amounts of exudate. This product is limited to the red zone, and, in some cases, the amber zone. Generally, the wound manager has a short-term application in acute situations such as dehisced abdominal wounds.

Key Points

- Wound exudate, when carefully assessed, provides important information on the condition of the wound.
- When removing dressings, take care to note odour, dressing saturation, colour and consistency of exudate.
- The assessment of wound exudate should be based on both volume and consistency.
- The Wound Exudate Continuum provides a practical framework for the everyday management of exuding wounds. It is compatible with other systematic wound assessment tools.

Primary dressings

In this category, the dressings are applied directly to the wound bed and absorb exudate. Two of the dressings in this section have an antimicrobial function; namely, the alginates and hydrofibres. The other dressing, the capillary dressing, has no antimicrobial function but has a large capacity to absorb and wick fluid away from the wound bed. All of the dressings in this category require a secondary dressing to cover them.

Primary/secondary dressings

The dressings in this category can be applied either as a primary dressing which does not require a secondary dressing such as the hydrocolloids or hydrogel sheets or film dressings. The foam dressings can act as a primary dressing but are also frequently used as secondary dressings absorbing exudate which has passed through the primary dressing. Once again some products found within these categories contain an antimicrobial function and some do not. In this category there are products which can also donate moisture to the wound bed if required but this aspect of wound management is covered in more depth within the Wound Healing Continuum section (p.9–14).

Conclusion

The Wound Exudate Continuum provides the user with a systematic approach to wound exudate which goes beyond simply guessing the volume of exudate produced. The Wound Exudate Continuum promotes the view that exudate can shed light on the health of the wound and assists in the identification of different levels of wound bioburden. It can also facilitate the identification of clear treatment objectives which when used with the other aspects of the Applied Wound Management system can deliver a full wound assessment.

Considering wound exudate in terms of its viscosity and volume a valuable insight into the wound's underlying condition can be obtained. The Wound Exudate Continuum is designed to provide the practitioner with a method of assessment based on estimation of viscosity and volume of exudate, which relates to the underlying condition of the wound. Its use is intended as part of a thorough assessment and should be used within the Applied Wound Management (Gray et al, 2005) framework. The values attached to the different levels of exudate are designed to provide the practitioner with an aid to assessment and not to replace sound clinical decision-making. WUK

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Applied Wound Management: clinical tools to facilitate implementation

Applied Wound Management seeks to bring a logical and coherent approach to wound assessment and the identification of treatment objectives using three assessment continuums (Healing, Infection, and Exudate). Once an assessment has been completed and a diagnosis reached, a clear and auditable path is created which facilitates clinical management of the patient and his/her wound. In support of this system, four tools have been developed: a pocket guide; an assessment and documentation chart; a wall chart; and an AWM database.

David Gray, Jamie McGuffog, Pam Cooper, Richard White, Andrew Kingsley

KEY WORDS

Clinical tools
Pocket guide
Assessment chart
Wall chart
Database

Applied Wound Management seeks to utilise three continuums to facilitate wound assessment (Gray et al, 2005). When this system is used in conjunction with an accurate diagnosis of the pathology of the wound, the practitioner is in an informed position to identify treatment objectives and monitor the effects of the treatment by measuring the clinical outcomes against the original assessment. Four tools have been developed to facilitate this process, and this article provides an overview of each and considers how best to utilise these tools to facilitate wound healing/management.

The Applied Wound Management tools

Pocket guide

The pocket guide *(Figure 1)* is an A4 chart which folds into a double-sided A5 pocket guide. The front of the guide shows graphics of the three continuums, while the reverse side provides background information. The aim of this tool is to provide the practitioner with a bedside reminder of the Applied Wound Management systems, and to ensure that the assessment of the patient's wound is carried out in line with the three continuums.

David Gray and Pam Cooper are Clinical Nurse Specialists, and Richard White is Senior Research Fellow, Department of Tissue Viability, Grampian Health Services, Aberdeen, Jamie McGuffog is IT Project Manager, Dalmore Information Systems, Aberdeen, and Andrew Kingsley is Clinical Nurse Specialist in Tissue Viability North Devon District Hospital, Devon

Assessment and documentation charts

The assessment and documentation chart comes in a two- or four-page format and provides the practitioner with the means to collect the information recorded at each dressing change. On the front page there is space to collect basic demographic data on the patient and baseline data relating to the wound. On the inside of the chart there are eight assessment sections. The layout of these sections allows the practitioner to compare the previous assessments and treatments at a glance *(Figure 2)*. By utilising the assessment section, practitioners are encouraged to identify and document clear treatment objectives; thus promoting a systematic approach to wound management and also supporting critical evaluation of those objectives at the next consultation. At each assessment, the user is encouraged to calculate the joint score of the Wound Healing Continuum and the Wound Infection Continuum (p.9–14; 15–20). This score is entered into a table on the front page of the chart; this is completed at each assessment allowing instant insight into the status of the wound *(Figure 3)*.

Wall chart

The wall chart is provided in an A3 format and includes all three of the continuums. Once an assessment has been carried out at the patient's side, this chart provides the practitioner with the opportunity to identify the treatment objectives required for each continuum. For example, where black/yellow tissue has been identified, the treatment objective is to debride the necrotic/sloughy tissue (Kingsley, 2003), unless contraindicated by the patient's condition. Below the black/yellow section of the chart there is a guide to the treatment objective which states 'debride', and below this is a space where each unit/ward/team can insert its preferred option. This system not only facilitates clinical decision-making, but also promotes continuity of care among team members as it acts as a reminder of the local protocol/formulary.

Software/database

The Applied Wound Management software has been developed with two goals in mind: to provide an easy-to-use decision support resource for ▸▸

practitioners; and to collate audit data about wound management practice on a much larger scale than has been done before. This benefits the individual practitioner by allowing him/her to validate his/her judgement against established standards, and benefits the wider wound care community by providing empirical data on the number and types of wounds treated, and the treatment regimes used across different clinical settings.

The software is made up of two parts: a stand-alone application that runs on the practitioner's computer, and a central data repository hosted on secure web servers, which receive anonymous audit data from the practitioners and distribute updated lists of dressings and articles for the decision-support knowledge base (see below).

Data model: The Applied Wound Management software uses a simple data model based around patients, wounds, and reviews. Each patient can have one or more wound and each wound can have one or more review.

The data recorded for each of these features are shown in *Table 1*.

Once a patient record has been entered into the system, any number of wounds can be added for that patient without having to re-enter the patient's details. Similarly, once a wound record has been entered, any number of reviews of that wound can be incorporated.

Data entry: The data entry forms for the application follow the data model closely. After selecting a patient from an existing list (or searching for him/her by unit number) the patient's details are shown, and the practitioner is able to either modify the patient details or view information on the wounds recorded for that patient. Where a patient has more than one wound recorded, forward and next buttons allow practitioners to find the wound that interests them. Once the wound has been selected, the practitioner can look at the reviews of that wound, again using forward and next buttons to step through the reviews.

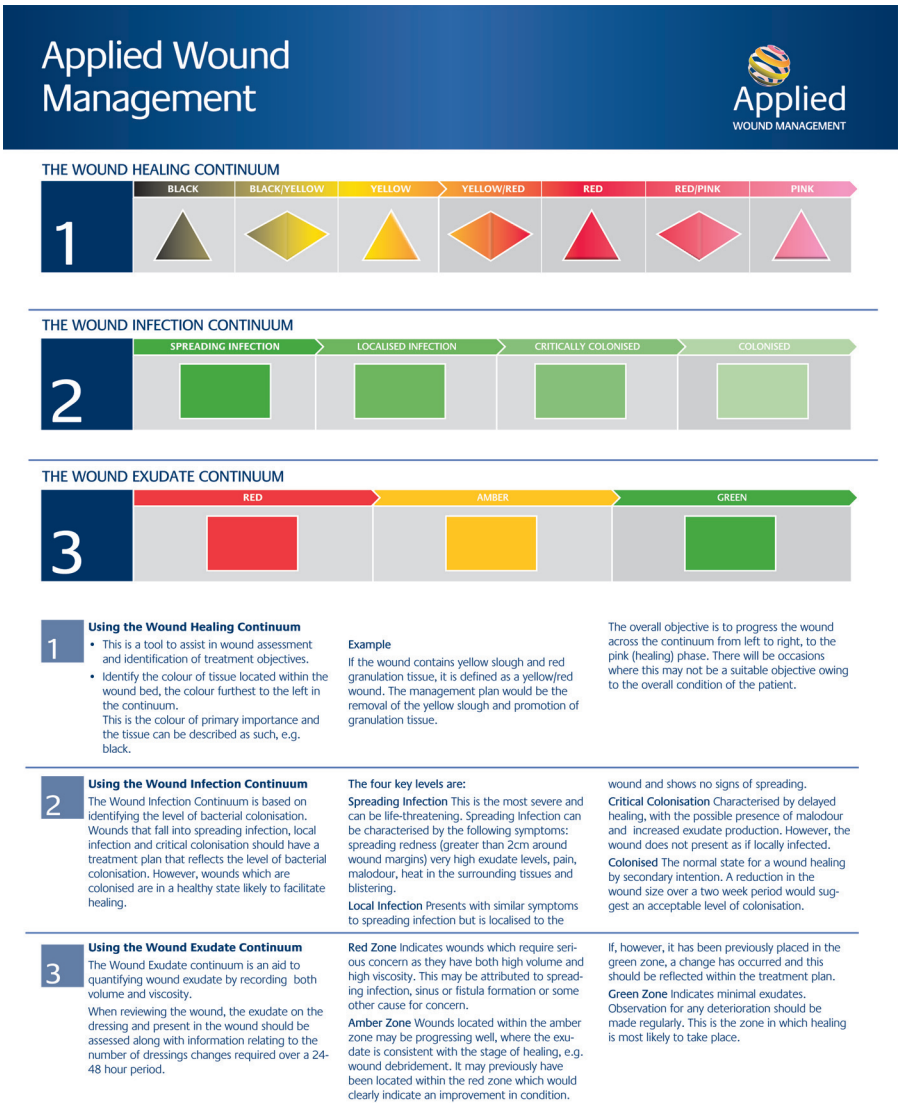

Figure 1. Applied Wound Management pocket guide.

The user interface is split into two distinct sections: a menu section to the left of the screen; and a data-entry section to the right. The menu section is further split into two areas, with navigation items which allow the practitioner to look at a different part of the dataset (e.g. to change from viewing a patient to viewing a wound, or from viewing a wound to viewing a review of that wound). Action items allow the user to make a change to the data.

With regard to entry of wound data *(Figure 4)*, the menu options are context-sensitive, and change depending on what data are currently being displayed. For example, when viewing a wound record as shown in *Figure 4*, action options are available to delete the wound record, to add a new wound record or add a new consultant; in addition, navigation options are available to return to the patient's details or to look at the reviews for the current wound, or to view a report of all the reviews of that wound.

As far as possible, data are entered by selecting the appropriate value from a drop-down list. As well as making the data-entry process significantly quicker, this makes the audit process far more efficient as the same set of values is being referenced by every user of the software. To ensure that the values displayed in the drop-down lists remain current, regular updates can be

To download all

Applied Wound Management resources,

please visit www.wounds-uk.com

transferred from the Applied Wound Management central data repository.

Wound scoring : The process of scoring the wound during a review is instantly recognisable to anyone who is familiar with the three continuums used in Applied Wound Management *(Figure 5)*. The wound is scored by clicking on the appropriate area of the graphic for each continuum, making the wound-scoring process simple and consistent.

Images: Any images taken during a review can be added to the review record. A thumbnail picture of the default image for each review is shown on the review form at all times, and on any reports produced. The practitioner can browse the rest of the images in a gallery, and can select any of these to be the default image.

Knowledge base: A knowledge base of reference documents is available to support the practitioner when making decisions regarding treatment. While the articles in the knowledge base can never be a substitute for clinical expertise, they provide valuable background information and details of best practice. Articles in the knowledge base are ranked according to their relevance to each of the values in each of the three continuums, allowing the practitioner to quickly find information that is appropriate to the wound he/she is treating. New or updated articles can be downloaded from the Applied Wound Management central repository as soon as they are published, ensuring that the practitioner always has access to the most up-to-date information in the field.

Reporting: A variety of reports can be generated directly from the application. A single patient report allows a practitioner to produce a record of all the reviews that have been undertaken of the patient either since the first review, or between certain dates; in addition, a single review carried out on a specific date can be obtained. For example, if a patient attended a clinic at the end of the review, the practitioner could print off a copy of the data entered in a report format and insert it in the patient's notes. Other forms of reports relate to the workload of a particular practitioner or team.

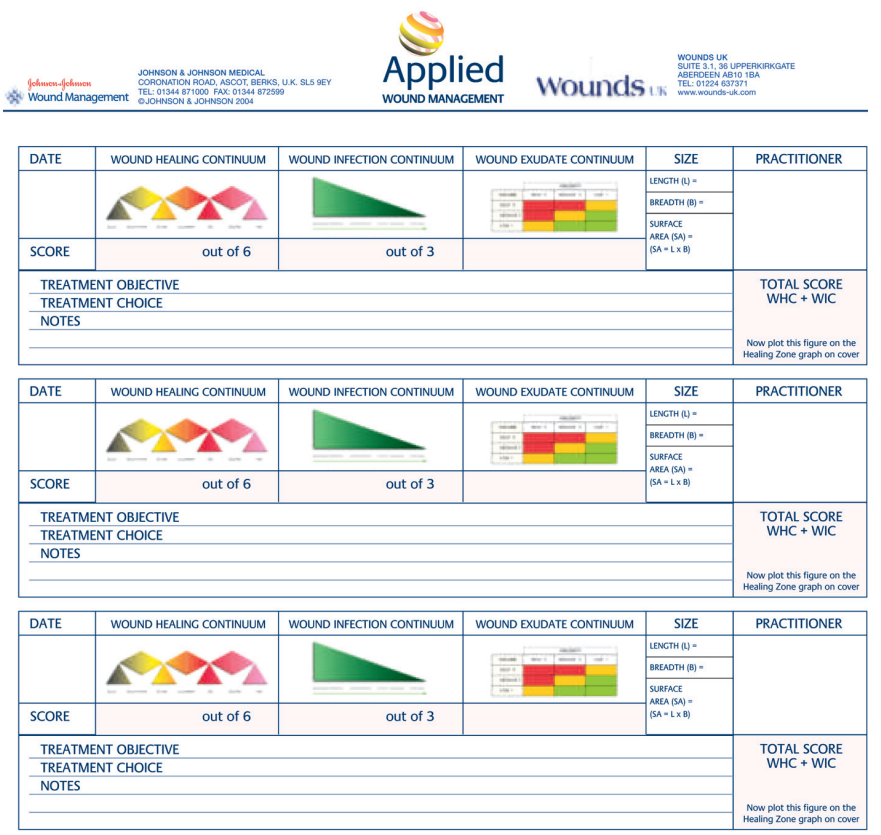

Figure 2. Assessment chart.

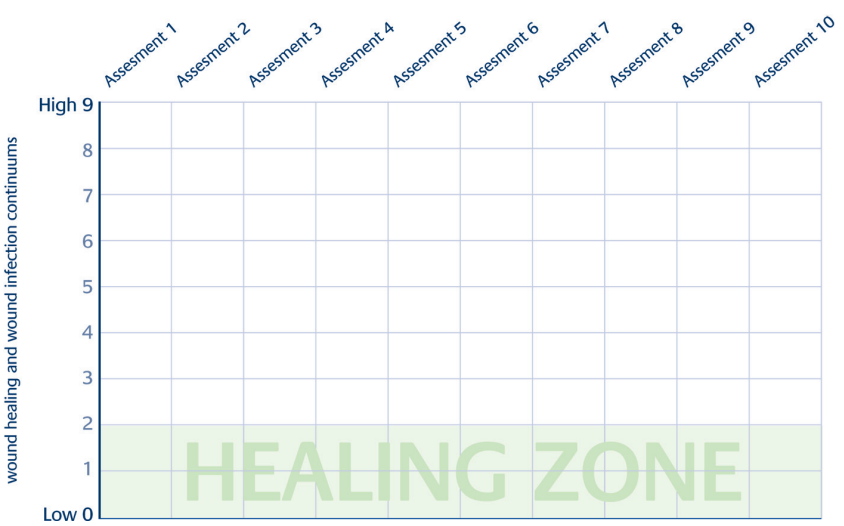

Figure 3. Assessment chart.

It is possible to produce reports which present the entire clinical workload of a tissue viability nurse specialist over a specified period. For example, a specialist nurse could provide a report, with or without clinical images attached, which would show each and every case that he/she

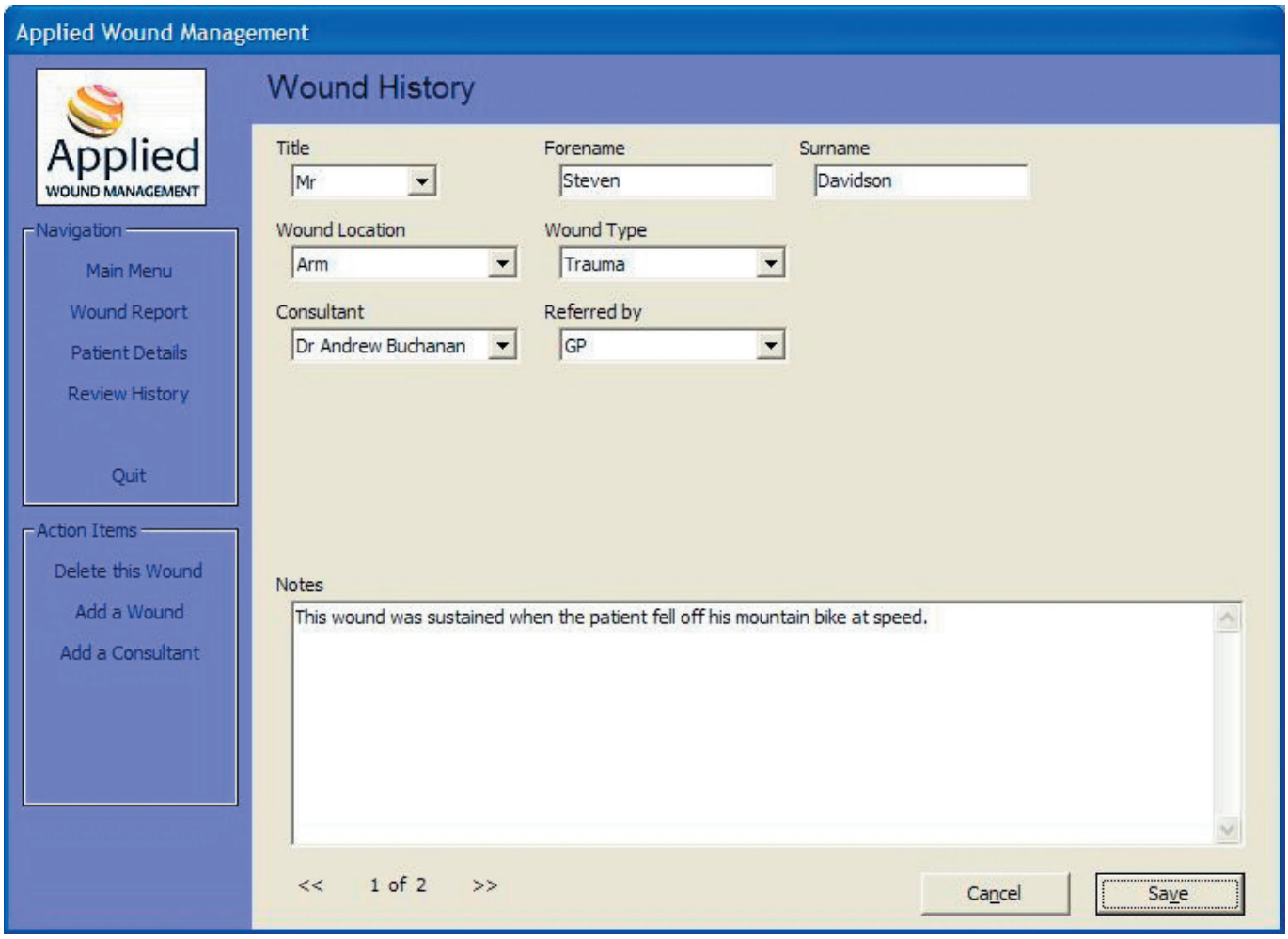

Figure 4. Entry of wound data.

Table 1

Patient	Wound	Review
Name	Wound location	Review date
Unit number	Wound type	Practitioner
Date of birth	Consultant	Review location
Sex	Referral source	Wound score
Notes	Notes	Dressings used
		Wound size
		Image(s)
		Notes

has managed over a 12-month period. This would help in providing evidence of clinical competence and inform those not familiar with specialist practice in this area as to what can be achieved in terms of wound healing/management over a large caseload. Currently, there is limited understanding of the clinical role of the specialist practitioner in wound healing/management. Therefore, such reports would inform and educate the readers as to the variety and depth of the challenges faced on a daily basis by tissue viability nurse specialists.

Sample reports are shown in *Figure 6*. These reports can be produced with all person-identifiable information removed and replaced with generic terms, allowing the reports to be distributed freely without risking a breach of the Data Protection Act.

Discussion

Each of the tools presented in this paper can be used individually or as part of an integrated approach to wound healing/management. The pocket guide, assessment and documentation charts, and the wall chart lend themselves to both the primary- and secondary-care settings, where teams of practitioners work together. These tools can facilitate a systematic approach to wound assessment, the identification of treatment objectives and promote continuity of care. Where an accurate Applied Wound Management assessment of the wound has been carried out, it can be documented in a quick and easy manner, allowing other practitioners to update themselves with the previous assessments and identify why a certain treatment plan was implemented. By ensuring that the local formulary or protocols appear on the wall chart, variances in treatments can be reduced and guidance provided to less

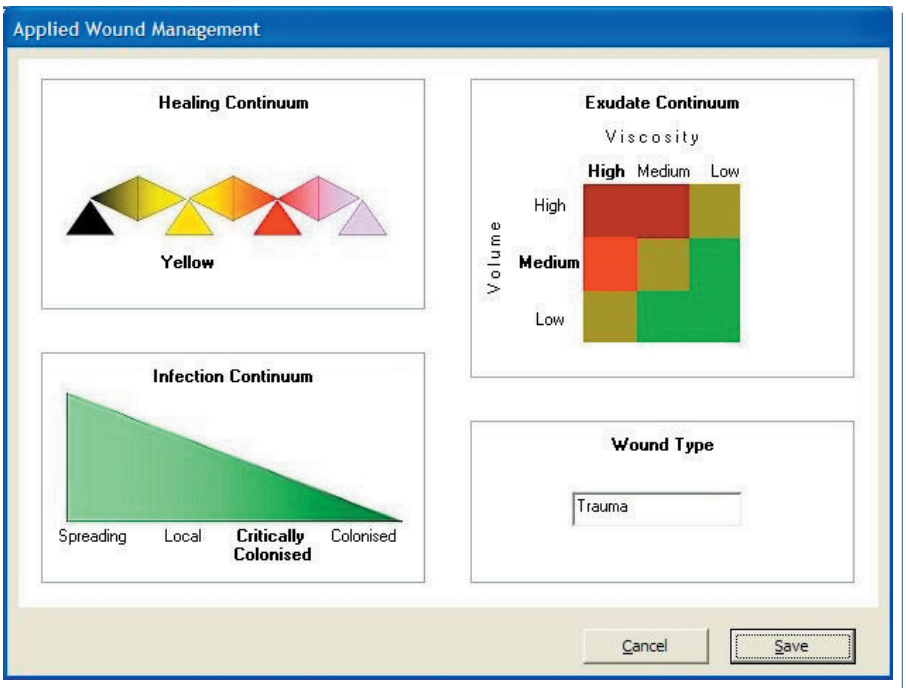

Figure 5. Wound scoring.

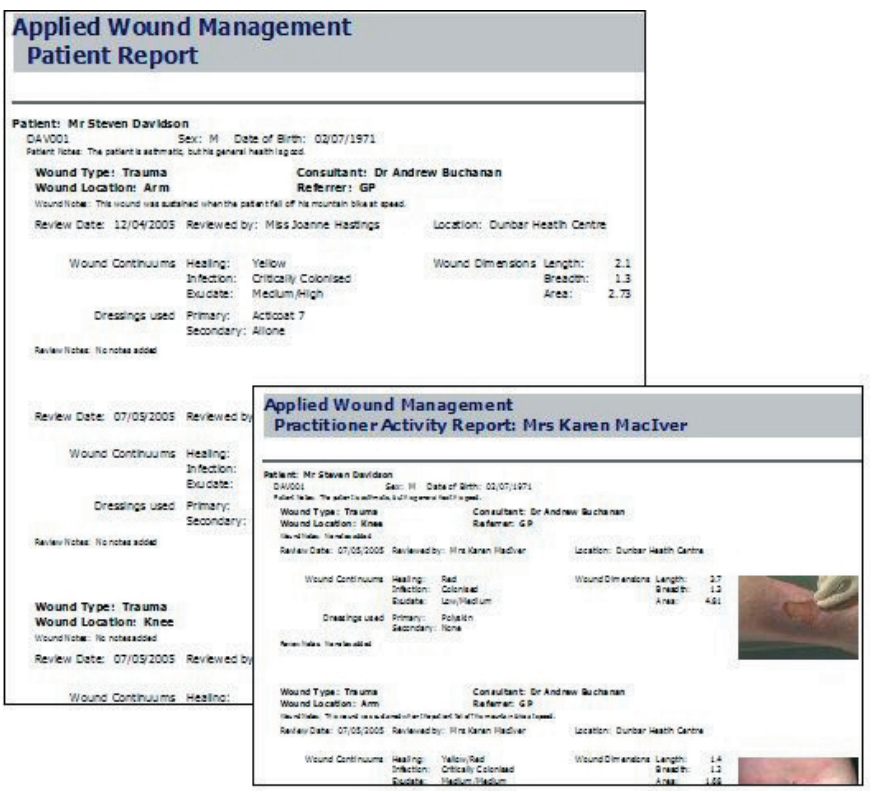

Figure 6. Sample reports.

expert practitioners. These three tools have the potential to facilitate high-quality care across a wide range of practice settings, by improving communication in the areas of assessment, documentation and treatment.

Applied Wound Management software has the potential to facilitate wound healing/management in both primary- and secondary-care settings, but it is on individual practice that it is likely to have an immediate impact. In relation to tissue viability specialist nurses and podiatrists, there is a tendency for their clinical role and the service they provide to be not fully appreciated by the organisation for whom they work. By utilising the Applied Wound Management software, the practitioner can provide accurate data relating to the patients they see, generating reports for the patients' notes, and communicating effectively with other colleagues.

By producing reports which cover specific time-frames, e.g. a year, and which include images, an accurate impression of the quality and impact of the service can be achieved. Such reports will leave the trust board in no doubt as to the benefits associated with specialist services in wound healing/management within the NHS. Where users of the Applied Wound Management software collaborate via the Independent Applied Wound Management Data Panel and provide anonymous data, a picture of wound healing/management in the UK can be developed. Such data will be vital in the drive to identify how many wounds are treated in the UK annually and their impact on the NHS.

Conclusion

Applied Wound Management and the tools presented in this article have the potential to impact on wound healing/management in the UK. First, they can support a systematic approach to wound management and thus improve clinical outcomes. Second, the data gathered via the software can lead to a greater understanding of specialist practice and improved communication between practitioners. Finally, where practitioners choose to share their anonymous data, a greater understanding of the nature of wound healing/management in the UK will emerge. All of these outcomes can bring positive benefits to patients with wounds in the UK. WUK

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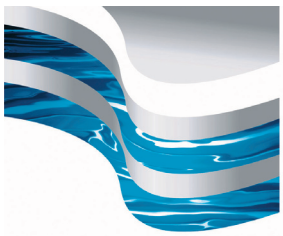

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