

Biofilm-based wound care: how to cleanse, debride and manage chronic wounds

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Biofilm-based wound care (Figure 1) has been the focus of many recent publications and best practice statements on the treatment of chronic wounds (Bianchi et al, 2016; Wounds UK, 2017; Malone and Swanson, 2017). The majority of all chronic wounds, around 80%, have a biofilm associated with them that impedes wound healing (Malone et al, 2017). In addition, a recent report by Guest et al (2015) has indicated that many chronic wounds are costing the NHS over 5 billion pounds a year in terms of clinical care and appropriate dressings. Guest et al (2015) also reported that only 1.3 million wounds healed (61%) and 0.9 million remain unhealed (39%) during the study period (1 year). Most of these chronic wounds need intervention to help them heal and are managed in primary care and the community (Dowsett, 2015).

In order to move chronic wounds with biofilms onto healing, it is important to

ensure that everyone is working to the same standard of care and undertaking the same consistent wound management procedures. We must reduce the burden of non-healing chronic wounds as outlined by Guest et al (2017) and ask ourselves as clinicians, why is this happening? Dowsett (2015) reported that there were difficulties in defining the roles and responsibilities for wound care in primary care and suggested that hard-to-heal wounds were more likely to require hospital referral for specialist assessment and in some cases hospital admission for treatment. But you have to ask yourself, why do these chronic wounds not heal in primary care within a reasonable time frame when other comorbidities are addressed?

Consensus views indicate that presence of a biofilm in the wound should be assumed and that the correct regimen of wound management should be initiated. This includes cleansing, debridement and the application of an appropriate antimicrobial dressing — to keep the numbers of microorganisms reduced. The patient pathway and wound management plan needs to be consistent. The TIME concept should be used to assess the wound and surrounding skin. A cleansing and debridement regimen should be initiated and undertaken regularly, and an antimicrobial dressing should be applied and used for up to two weeks before being reassessed for continuation or change to help reduce biofilm and move the wound onto healing.

However, who decides on the care of the individual patient and the pathway needed to heal the wound in primary care? What cleansing, and debridement techniques should be used? Which

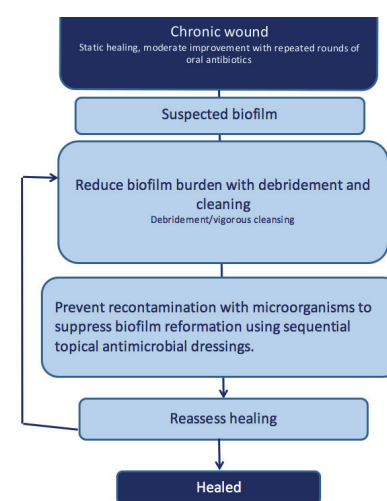


Figure 1. Decision tree for use in biofilm-based wound care modified from Bjarnsholt et al (2016)

antimicrobial dressing should be used to help reduce that bioburden further and stop the biofilm from reforming once the wound has been cleansed?

This debate has been put forward to help clinicians in primary care make those decisions where choice is limited and carrying out the techniques in practice can be difficult. Should all hard-to-heal wounds be referred to hospital or a specialised clinic? This group of experts will answer the posed questions to help you decide.
Professor Val Edwards-Jones

1. What is recommended for cleansing a chronic wound in primary care or a community setting?

LA: Wound bed cleansing is only recommended if there is visible debris on the base of the wound, this is due to the risk of reducing the wound bed temperature or causing trauma to it. If wound cleansing is

required, tap water or sterile water/saline are suitable for cleansing chronic wounds. However, when treating patients with leg ulceration, it is important that the skin health on the lower limb is maintained, therefore, the limb should be washed, cleansed and moisturised at each dressing change as per local guidelines.

BCH: We feel this is dependent on the outcome of a holistic wound assessment. The wound aetiology, wound factors, patient factors and even the environment all need to be considered. Cleansing techniques used vary from simple irrigation with pods containing sterile 0.9% normal saline solution to warm tap water to polyhexamethylene biguanide (PHMB) to soft cloth debridement or a combination of approaches. Where the presence of a biofilm is suspected, we find the latter combination to be quite effective as part of the overall management.

KG: If the wound is acute or there are signs of soft tissue infection, i.e. erythema, oedema, heat, purulence, pain or secondary signs of infection such as increased exudate, change in exudate colour, friable granulation, hypergranulation, or visible debris then normal saline or antimicrobial irrigation/ lavage is used. If the wound is chronic and there are no signs of increased bacterial load or infection, tap water is sufficient.

2. Are there different techniques for different wound types, e.g. leg ulcers, pressure sores, diabetic foot ulcers?

LA: The wound cleansers themselves have not changed, it is still appropriate to use sterile water/saline or tap water. However, different wound types require different cleansing routines. Patients with leg ulcers often have their foot/limb cleansed, including the wound bed. Patients with pressure ulcers only tend to have their wound cleansed if visible debris is

present. Cleansing is very rare in patients with diabetic foot ulcers, as they are often advised to keep the wounds/dressings dry.

BCH: Again this needs to be based on the outcome of a holistic wound assessment and may require a multidisciplinary consultation involving podiatry, vascular or dermatology specialists as appropriate. For patients with venous leg ulceration we might recommend emersion of the lower limb in lined bucket of warm water and use debridement cloth. However, if the patient's condition or environment precluded this approach, or for other types of wound such as pressure ulcers, we might advise use of a pre-moistened debridement cloth containing a surfactant. More often, we advocate using soft cloth debridement followed by gauze soaked in solution containing PHMB which is applied to a wound for around 10 minutes to assist in the disruption and sequestration of the biofilm matrix.

KG: I don't think there are different techniques for different types *per se*, however, if indicated applying gauze soaked with an antimicrobial cleanser for 5–10 minutes rather than irrigation alone, may be helpful, especially with cavities. Johani et al (2018) demonstrated that short exposure, i.e. 15 minutes or less to an antimicrobial wound cleansing solution were ineffective against microbial biofilms and therefore this is not routine practice. In my opinion, this is still useful for removing debris from the wound and helpful adjunct to maintaining the wound microbiome.

3. What are the various debridement techniques that can be effectively used in primary care and the community setting?

LA: There are a number of debridement techniques used in primary care but access to these are dependent on commissioning, local formulary and

practitioner skill/competency. Debridement via dressings, which encourages autolytic debridement, are common place and used by all; debridement pads are widely used in community practice and by many practitioners. Larvae therapy is also seen within primary care settings. Some community practitioners may even be skilled in blade debridement, however, this varies greatly dependent on the role and individual competency.

BCH: We use a variety of techniques to ensure the approach used meets individual patient needs and circumstances. If there is obvious devitalised tissue, autolytic debridement remains popular and convenient for practitioners. Specialist nurses may undertake sharp debridement, but this is dependent on patient factors (e.g. pain, unstable clotting factors), location of the wound (face, neck, hand and foot), wound factors (e.g. malignancy, proximity to vascular structures or organs etc) and environment and ability to maintain asepsis. We tend not to be big users of larval therapy but know other community healthcare Trusts and organisations where this is a popular method for debridement. For us, soft debridement cloths are now widely used across our organisation, as they provide fast, convenient and safe debridement and removal of hyperkeratosis. Alongside this, the use of certain antimicrobial products are used to assist in promoting debridement as well as inhibit biofilm formation. The regimen which tends to be used is an antimicrobial dressing followed by soft cloth debridement at the dressing change, with possible inclusion of a PHMB 10 minute soak after the active debridement. We tend to use the antimicrobial dressing for around 2 weeks and then review. Dressings containing honey may also be used, but further research is required to demonstrate their effectiveness in preventing biofilm formation.

KG: As a podiatrist, I would suggest that mechanical or sharp debridement is a very effective method of removing biofilms and vital in wound bed preparation. Monofilament debridement pads are excellent for clinicians who are not able to perform sharp debridement, or on wounds where sharp debridement would be unsuitable or poorly tolerated. Various agents can be used to promote autolytic debridement such as hydrogels, hydrocolloids, honey, sugar paste, films, oxyhaemoglobin sprays or cadexomer iodine gels. Larval therapy is also very effective however, for me, cost effectiveness and patient tolerance must be carefully considered. I'm not sure that I could advocate hydrosurgery in primary care but others may disagree.

4. Do you use antibiotics as part of your treatment strategy?

LA: Yes antibiotics are commonly used. However, they are only used where systematic infection is present or where there is evidence of bone infection. The use of topical antibiotics is not supported. The decision of which antibiotic to use is based on the microbiology results, known allergies, local pathways and microbiologist input.

BCH: Antimicrobial stewardship is included in our Pan-Birmingham wound management formulary. Dressings with antimicrobial properties are recommended for localised wound infection and biofilms. Systemic antibiotics are not used for treatment of biofilms and we do not advocate use of topical antibiotics but may occasionally recommend metronidazole gel in palliative care where malodour is an issue.

KG: Only if two or more cardinal signs of infection are present, otherwise it's just not good antimicrobial stewardship. My advice would be, if the peripheral circulation is sufficient, to debride with sharp or mechanical debridement, irrigate and then

apply a topical antimicrobial that is suitable for the wound type. This should be changed appropriately and its ongoing use reviewed weekly. Topical antimicrobials are an effective method that does not contribute to antimicrobial resistance and can prevent biofilms re-seeding.

5. What would be the typical decisions you need to make to choose the best topical antimicrobial treatment?

LA: Where bacteria has been thought to be delaying wound healing, e.g where there is evidence of localised infection or the wound is failing to heal so biofilm is suspected, the decision as to which topical antimicrobial is based on a number of factors including: what is on local formulary, access to the product, evidence base, effectiveness data, the wound bed tissue type, the level of infection, the location of the wound, the depth of the wound and how the dressing will be retained.

BCH: Our Pan-Birmingham wound management formulary includes a flow chart to guide practitioners on the management of wound infection but does not specifically mention treatment for biofilms. However, the regimens we use for biofilms echo the treatments used for local wound infection. Furthermore, there are products in the formulary that carry specific recommendation for use in breaking down biofilms. The dressings with antimicrobial properties are divided into first and second line products. A first-line product is implemented and progress evaluated after 2 weeks. If there is no improvement, a second-line product is then selected and again a review takes place after 2 weeks.

KG: I start by asking what am I trying to achieve and is the patient allergic to anything? Then I take into consideration the wound base and determine a treatment aim. Finally, I consider which product will be most clinically effective and most cost

effective in promoting wound healing and helping me achieve the treatment aim. For example, do you want an antimicrobial and to also rehydrate? If so, an antimicrobial hydrogel may be of use or a honey-based product. If you need to manage moisture and bioburden, then an absorbent pad with an antimicrobial layer may be required. If wanting to control odour and bacterial load, then an antimicrobial paired with a charcoal layer is useful. If the aim is to dry the wound and prevent infection as with gangrene and limb ischaemia, then an astringent such as iodine could be used or a dry dressing impregnated with an antimicrobial element such as PHMB.

6. Are silver dressings okay to use?

LA: Silver dressings are ok to use as these have a CE mark and are, therefore, safe. However, there needs to be consideration about silver uptake into the systematic system. Additionally, silver dressings need to be used responsibly as they are more expensive. They need to be used within clinical pathways where regular review, at every 2 weeks, is undertaken to assess the ongoing need and clinical effectiveness.

BCH: Whilst dressings containing silver may be used, these tend not to be our first line choice for treatment of biofilms, largely due to the wound management formulary recommendations. However, this decision ultimately depends on patient and wound factors, including recent and past history of treatment and if there are contraindications. In accordance with these factors, we would also consider silver if there had been no improvement after 2 weeks treatment with one of the primary line wound management formulary products. Whilst there is a plethora of studies that indicate the effectiveness of various types of silver in the treatment for biofilms, we do find cadexomer iodine very effective. However, silver does seem to have a better cytotoxic effect on those biofilms with an obvious pseudomonas

presence, often recognisable by a pyocyanin-related green-blue appearance to the wound bed or exudate.

KG: Absolutely. However, the considerations mentioned previously must be taken into account. I have always seen silver as a 'heavy hitter' and kept it for those instances where I've needed a potent and sustained antimicrobial. Cost-effectiveness should always be a factor and be rationally balanced with clinical effectiveness. Silver dressings can work in one of two ways, by donating silver ions to the wound or by absorbing exudate into the dressing where bacteria are then killed upon contact; in patients with severe renal impairment the latter may be preferable. Clinicians should, therefore, understand the pharmacodynamics of the dressings they are using. Silver being a 'heavy hitter' is effective against Methicillin-resistant *Staphylococcus aureus* (MRSA), Vancomycin-resistant *Staphylococcus aureus* (VRSA) and *Pseudomonas* spp and, therefore, an ideal adjunct in the treatment of these infections. Argyria has been reported with heavy and sustained use but this is not a complication I have personally seen.

7. Is there sufficient monitoring of treatment plans and outcomes?

LA: This varies from clinical areas, in some areas there are clear care plans in place which include the requirement for regular review of outcomes, however, in other areas service are more designed around the task of 'dressing renewal' so can lack the needed evaluation of outcomes and review of treatment plan.

BCH: The Wound Assessment CQUIN (NHS England, 2018) has highlighted some issues with recognition of biofilms and subsequent effective treatment. Biofilms do not exhibit the same characteristics as wound infection, therefore can be difficult to detect. This potentially may be exacerbated by lack of continuity with the same healthcare staff attending the patients and subsequently not recognizing subtle changes or lack of progress. It is likely this has been brought about by the shortfall in community nurses and large caseloads and subsequent reliance on bank and agency staff who may not be familiar with patients. Whilst there are educational opportunities and resources available in the Trust which assist practitioners in detecting and managing biofilms, it has become evident that further work is necessary and is currently being considered.

KG: Personally, I have found that in practice, unless there is clear and concise documentation this is often poorly implemented. Treatment plans should have a clear **Aim**, **Start date**, **Review date** and a **Maximum duration** stated in the notes. The following mnemonic may be helpful:

All Stars wRite Mnemonics. For example:

Aim: To improve bacterial burden, return exudate colour back to serous.

Start date: 1/1/18

Review date: 8/1/18

Maximum duration (days and date):
14 days (15/1/18)

REFERENCES

- Bianchi T, Wolcott RD, Peghetti A et al (2016) Recommendations for the management of biofilm: a consensus document. *J Wound Care* 25(6):305–17
- Bjarnsholt T, Cooper R, Wolcott RD et al (2016) *World Union of Wound Healing Societies, Position Document, Management of Biofilm*. Wounds International
- Dowsett C (2015) Breaking the cycle of hard-to-heal wounds: balancing cost and care. *Wounds International* 6(2): 17–21
- Guest JF, Ayoub N, McIlwraith T et al (2015) Health economic burden that wounds impose on the National Health Service in the UK. *BMJ Open* 5:e009283 (accessed 20th July 2018).
- Guest JF, Ayoub N, McIlwraith T et al (2017) Health economic burden that different wound types impose on the UK's National Health Service. *Int Wound J* 14(2):322–30
- Johani K, Malone M, Jensen SO et al (2018) Evaluation of short exposure times of antimicrobial wound solutions against microbial biofilms: from in vitro to in vivo. *Journal of Antimicrobial Chemotherapy* 73(2):494–502
- Malone M, Bjarnsholt T, McBain AJ (2017) The prevalence of biofilms in chronic wounds: a systematic review and meta-analysis of published data. *J Wound Care* 26(1):20–25
- Malone M, Swanson T (2017) Biofilm-based wound care: the importance of debridement in biofilm treatment strategies. *Br J Community Nurs* 22(Sup6):S20–25
- NHS England (2018) *Commissioning for Quality and Innovation (CQUIN)*. Available at: <https://www.england.nhs.uk/wp-content/uploads/2018/04/cquin-guidance-2018-19.pdf> (accessed 5.09.2018)
- Wounds UK (2017) *Best Practice Statement: Making Day-To-Day Management of Biofilm Simple*. Available at: <https://www.wounds-uk.com/resources/details/best-practice-statement-making-daytoday-management-biofilm-simple> (accessed 5 September 2018)