Defying hard-to-heal wounds with an early antibiofilm intervention strategy: 'wound hygiene'

Abstract: Biofilm has been implicated as a barrier to wound healing and it is widely accepted that the majority of wounds not following a normal healing trajectory contain biofilm. Therefore, strategies that inform and engage clinicians to reduce biofilm and optimise the wound tissue environment to enable wound progression are of interest to wound care providers. In March 2019, an advisory board was convened where experts considered the barriers and opportunities to drive a broader adoption of a biofilm-based approach to wound care. Poor clarity and articulation of wound terminology were identified as likely barriers to clinical adoption of rigorous and proactive microbial decontamination that is supportive of wound healing advancement. A transition to an intuitive term such as 'wound hygiene' was proposed to communicate a comprehensive wound decontamination plan with an associated message of expected habitual routine. 'Wound hygiene', is a relatable concept that supports meticulous wound practice that addresses barriers to wound healing, such as biofilm, while aligning with antimicrobial stewardship programmes.

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A biofilm-based approach to wound care has already been defined.[1,2] However, it has previously been questioned if we are waiting too long before starting biofilm-based wound care (BBWC).[3] It is widely accepted that biofilm is present in the majority of hard-to-heal wounds and is a barrier to healing.[4–6] While biofilm is not necessarily visible to the naked eye, the clinical signs and symptoms associated with its presence are broadly accepted.[2,5] Delayed wound healing is considered a notable, recognised, indirect sign of biofilm presence.[5,7,8]

Biofilm is a complex polymicrobial community of microorganisms embedded in a self-produced hydrated extracellular matrix (ECM) that provides protection from antimicrobial agents and host defences.[9] Biofilm can contain bacteria with genetic resistance to antibiotics. In addition, biofilm can display phenotypic tolerance to antibiotics as a consequence of being in the biofilm structure.[10] Biofilm forms rapidly in wounds, with extensive regrowth demonstrated within 24–48 hours.[11,12]

Given the evidence for a biofilm-based approach to wound care, the question then becomes 'why are we waiting to start earlier intervention?' A group of experts met to consider the barriers and opportunities to improve uptake of biofilm-based practice more broadly among all health professionals involved in wound care. Pragmatic solutions were derived to address the barriers and opportunities identified in order to change current practice and improve patient care. The aim of this article is to summarise the discussions from this initial brainstorming session.

Methods

This article summarises discussions of nine experts at an Advisory Board Meeting held in March 2019 in London. In addition, feedback from two further experts (JA and MT) were provided via separate face-to-face, teleconference meetings and written communications. Experts were asked to describe their wound care practices and whether they would wait to start BBWC when treating a hard-to-heal wound. They were then asked to identify barriers to broader uptake of BBWC by health professionals. Finally, the group were asked to propose solutions that could help overcome the identified barriers.

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The case for early intervention?

It was accepted that the majority of wounds not following a normal healing trajectory contain biofilm, that biofilm is a barrier to healing and that it forms rapidly. Regardless of the care setting, it was agreed that physical removal of biofilm is essential to provide a healthy healing environment. Various mechanical and surgical debridement techniques to remove biofilm were considered desirable to ensure thorough wound bed preparation. However, while debridement procedures are the critical first step, it was recognised that this is not a complete strategy because the biofilm quickly regrows. Therefore, additional suppression of biofilm reformation is a requirement in BBWC. In addition, managing other recognised risk factors, such as perfusion, infection, diabetes, pressure off-loading and compression where warranted, was considered crucial because delay of wound healing by such factors encourages the development of biofilm.

Since risk or costs associated with early intervention including debridement, suppression of biofilm regrowth and management of underlying factors are likely to be less than those associated with biofilm-related wound complications, it was agreed that we should not wait to start BBWC.

Barriers to adoption of biofilm management

When considering the potential barriers to broader adoption of earlier intervention with a biofilm-based approach among all health professionals, the following were identified as major contributing factors:

- Biofilm detection at the point of care: clinical biofilm detection is an emerging science and not currently available to the majority of clinical environments. Not being able to see or detect the biofilm can result in doubts regarding its presence thereby discouraging action
- Wound terminology: wound terminology was considered a barrier to a true common understanding of the problem faced by health professionals and the required action. It was strongly agreed that the term 'chronic' (wound) does nothing to promote action or a sense of urgency in a condition that is timely and may have serious health consequences if not addressed aggressively. Rather, 'chronic' suggests the wound cannot be healed thus inaccurately implying that minimal management is acceptable. Furthermore, the term 'chronic' falsely suggests to payors of health costs a long-term, unresolvable condition and potentially discourages allocation of the necessary and critical resources to effectively address complex wounds to achieve closure. Thus 'chronic' as a term may lead to inadequate focus and resources on what has been well-identified in the literature as an urgent, high expense health-care condition globally[13–15]
- Poor understanding of terms: for many clinicians, a confusing term is 'infection', which may prompt the prescription of antibiotics.[16] Yet this state can be difficult to absolutely identify unless quite advanced, particularly in people with longstanding wounds who may often be immunosuppressed. This unclear status may lead to overuse of antibiotic prescriptions not necessarily needed and thus not aligned with antimicrobial stewardship practices[16,17]
- Education: since the role of biofilm in delayed wound healing is a relatively new concept, training and education is required to improve clinical practice in most areas.

Fig 1. A static wound in need of 'wound hygiene'; displaying skin scaling, devitalised tissue, potential biofilm and chronic rolled edges

Pragmatic solutions to overcome the identified barriers

After establishing the key barriers to more widespread, earlier adoption of BBWC, pragmatic solutions were derived to overcome these:

- Improved access to a point-of-care biofilm detection tool would be advantageous in changing behaviour, as 'seeing is believing'. Biofilm detection at the point-of-care could also be beneficial to ensure debridement has adequately removed the biofilm
- Review of selected terminology, for example, replace 'chronic' with 'hard-to-heal' to illustrate the potential for successful outcome with appropriate care, and avoid lethargic strategies
- Development of reliable diagnostics to identify infection presence and improved clarity in use of the terms 'infection' and 'biofilm' to avoid inappropriate use of systemic antibiotics
- Proactive and intuitive terminology that promotes action such as debridement to reduce biofilm, without

suggesting the need for systemic antibiotics for uninfected wounds. 'Wound hygiene' was proposed as a new concept that can communicate the consistent need to clean and decontaminate the wound to reduce microbial burden
- Improved training and education are critical components to drive awareness, understanding and adoption of the new 'wound hygiene' concept.

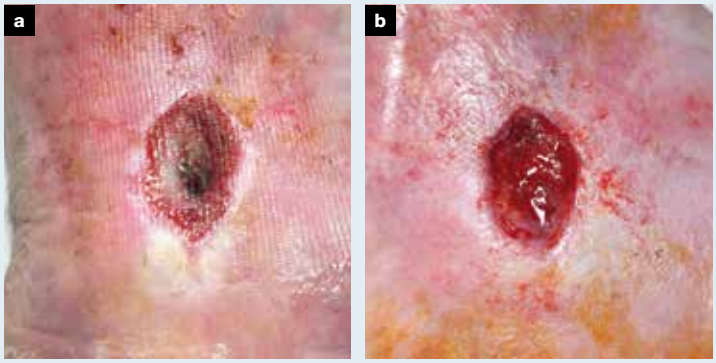
Wound hygiene

The term 'wound hygiene' was selected as an intuitive term to resonate with health professionals to support optimal care. It was decided that since 'hygiene' is a common term used in the home and in health-care as an expected standard for everyday activities important for health, this term is likely to be well understood and accepted. For example, oral hygiene involves brushing, flossing, toothpaste and mouthwash; personal hygiene involves soap, water, sponges and moisturiser; hand hygiene involves soap, water, sanitiser and moisturiser. Hygiene activities are accepted as repetitive, regular, frequent and necessary, rather than something we do only once. Hygiene is perceived as a required standard, rather an optional activity. This terminology clearly communicates that effective 'wound hygiene' to promote healthy healing environments should be the standard for every patient. A static wound in need of 'wound hygiene' is shown in Fig 1.

In brief, the proposed practice of 'wound hygiene' in hard-to-heal wounds involves:
- Skin and wound cleansing — decontamination of periwound skin and wound using wound cleansers to remove dead skin, loose debris, exudate and microbes to prevent re-colonisation of the wound
- Wound debridement — mechanical or sharp physical removal of adherent biofilm, necrotic and infected tissue, slough, foreign bodies, at every dressing change if necessary
- Refashioning of the epithelial edge — after decontamination of the wound edge, refashion or open the edges of the wound (scraping to pinpoint bleeding) to remove necrotic, crusty and/or overhanging edges that may be harbouring biofilm, and ensuring the continuation of the skin edges with the wound bed to facilitate epithelial advancement and wound contraction. This process includes removal of hyperkeratotic callus from periwound
- Biofilm treatment and prevention — retardation strategies to delay regrowth of biofilm using biofilm dispersal agents such as enzymes, metal chelators, or surfactants and topical antiseptic dressings (for example, polyhexamethylene biguanide (PHMB), iodine, or silver).

A wound before and after 'wound hygiene' is shown in Fig 2.

Fig 2. Wound before (**a**) and after (**b**) 'wound hygiene'



Conclusions

Evidence supports that biofilm is a critical barrier to achieving successful closure of 'chronic', or more accurately termed 'hard-to-heal' complex wounds. As a first step, we identified unclear terminology as a major barrier to understanding and adoption of early intervention with BBWC. Therefore, we suggest a transition to a simple, easy to grasp term such as 'wound hygiene' to provide impetus to support a change in practice and improve patient care. Hygiene activities are accepted and performed frequently, thus 'wound hygiene' is an intuitive term that communicates regular action to decontaminate the wound which may improve wound healing and reduction of bacterial burden may reduce systemic antibiotic use. The 'wound hygiene' concept is consistent with previous work that has demonstrated that regular, early intervention with multiple therapies, with a step-down approach, provides the best healing environment for hard-to-heal wounds.[5] As 'wound hygiene' supports the maintenance of antimicrobial stewardship programmes it also aligns with motivations of stakeholders and this is a key component of the adoption process. To further define the details of 'wound hygiene', a formal consensus meeting has subsequently taken place and more detailed evidence-based recommendations are currently in development. Training and education will be critical in the implementation of early intervention with 'wound hygiene'. JWC

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Reflective questions

- In your practice setting, how much do you think the word 'chronic' influences providers, patients and payers in their thinking about the urgency of the growing wound problem, allocation of resources to address wounds and ability to heal?
- To what extent do you consider biofilm management in your current practice and has this changed in recent years?
- In your experience, how effective is antibiotic therapy in eradicating wound infections, and are clinicians clear on when to prescribe?
- What strategies are available to you to optimise your biofilm based wound care practice? Are there gaps in your resources?

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