

In response to the Wound Infection Institute's article - 'The Significance of Biofilms in Wound Infections' posted on the www.woundinfection-institute.com website in July 2009.

Thank you for the invitation and opportunity to provide feedback on articles posted on the Institute's website.

We agree that bacterial count alone is a poor indicator of wound infection status and the opening paragraph reflects the opinions expressed by Bowler¹ in 2003. Despite being able to track the use of the term 'critical colonisation' back to 1994², it remains poorly understood. We attempted to address this in a review publication³ considering the existence of biofilms in wounds, by pictorially correlating the stages of biofilm formation with a general microbial progression model. Perhaps the Wound Infection Institute is an appropriate forum to promote a clearer definition of critical colonisation or develop an alternative term. We have considered using the term 'local infection' or 'persistent non-invasive local infection', but these may not be sufficiently discriminating. We are currently in favour of 'silent infection' as promoted by Hurlow⁴, this is both descriptive and more widely recognised by clinicians in other areas of medicine describing similar phenomena.

The terms *planktonic* and *sessile* readily differentiate the environment and behaviour of bacterial cells, but with the terminology of biofilms still evolving, perhaps it is appropriate to employ an additional descriptor such as 'biofilm phenotype'⁵ to capture a bacterium's potential for collaborative intercellular behaviour such as virulence expression and quorum sensing within a population. Similarly, the variety of terms that are captured in the field of biofilmology by the acronym EPS (exopolysaccharide, extracellular polymeric substance, extracellular polysaccharide substance) only partially describe the complexity of the composition of a biofilm. EPS does not necessarily lead us to immediately consider the contribution of other constituents to the effects of biofilms, for example: the fluid component and the dissolved matter such as salts, enzymes and waste toxins. A broader term such as 'biofilm extracellular matrix' may be helpful here.

The assumption that all slough is biofilm and *visa versa* is an over simplification and is not sufficiently justified by the current evidence. It has been suggested that biofilms may not necessarily be confluent sheets but could exist as islands or isolated colonies of bacteria that are constantly changing in composition⁶. Hurlow³ describes clinically observed biofilms in many forms and specifically concludes that the macroscopic appearance of biofilms in wounds is quite different from slough.

We agree that biofilm maturity is an important parameter in wound progression and have suggested links to pathogenicity³. Using a variety of biofilm models (both standard and adaptations) and multiple methods of analysis^{5,7,8} including total counts, visualization with confocal laser-scanning microscopy and bacterial survival against reference antimicrobials, we have come to the conclusion that biofilm maturity is a complex function of bacterial species, strain, substrate and growth conditions (such as nutrition and fluid flow). Therefore it is not appropriate to make generalised comments on results based on growth time alone – for example we were able to develop mature *Pseudomonas aeruginosa* biofilms in as little as 18 hours but *Klebsiella pneumonia*, *Candida albicans*, *Staphylococcus aureus* and *Enterobacter cloacae* took considerably longer. Our research has also shown that even under *in vitro* conditions that maximise dressing efficacy, none (including silver, cadexomer iodine and povidone iodine) were capable of consistently eradicating biofilms and preventing their regrowth. As your paper suggests, the observed

antimicrobial activity of cadexomer iodine is probably due to a physical effect rather than the nature of the antiseptic. Consequently, care should be taken not to give the reader the impression that iodine *per se* is an effective antibiofilm agent.

The Frequently Asked Questions section is a much more difficult proposition as it assumes that we have a complete understanding of biofilms in wounds. It can only represent the authors' current opinions and offer generalised responses many of which we have drawn attention to above. The use of precise and consistent language is essential as biofilms, infection and slough should not be thought of as synonymous. It is clear that there are many gaps in our knowledge but that our understanding is rapidly improving. We believe that forums such as the Wound Infection Institute have a very important part to play in ensuring that good scientific research together with clinical observation is made available to practitioners in a way to enable them to provide the best possible treatment for their patients.

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References

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