Combatting Wound Infection Policy Paper

There has been much said and written about the sharp rise in chronic diseases such as diabetes. But behind the headlines is a serious issue that tends to be ignored; the associated rise in non-healing wounds.

In this policy paper ***Dr. Tonny Karlsmark of Bispebjerg Hospital, Copenhagen*** *lays a foundation for a discussion about prevention and treatment of infected, non-healing wounds.*

Objective

This policy paper is designed to establish the foundation for a discussion about a major but over-looked problem; the prevention and treatment of infected, non-healing wounds.

The forgotten suffering behind the headlines

There has been much said and written about the sharp rise in chronic diseases such as diabetes. These issues grab attention and make headlines. But behind the headlines is a serious issue that tends to be ignored; the associated rise in non-healing wounds. The significant and accelerating rise in patient numbers is a growing burden on our health care system and increases the suffering of those with non-healing wounds. It is vital that we use readily available treatments to address this problem and relieve the suffering of this large group of patients.

The problems with non-healing wounds urgently need to be addressed

Non-healing wounds cause considerable discomfort and pain. A wound is generally considered to be non-healing if it has not healed in 4–6 weeks. Patients with non-healing wounds suffer from pain, exudate and odour; these symptoms are often associated with poor sleep, loss of mobility, and social isolation. Diabetic foot ulcerations and venous leg ulcerations are by far the two most common types of non-healing wounds. Apart from the above conditions, the risk of non-healing wounds is also increased by a number of lifestyle factors, including obesity, smoking, poor hygiene, and lack of exercise.

An estimated ***1-2%*** of the population in developed countries will ***experience non-healing wounds*** in their lifetime[1]

In the UK the costs associated with non-healing wounds has been conservatively estimated at £2.3–3.1 bn per year, at 2006 prices.[2]

It is important to understand that most of these patients are suffering in their own homes and are easily forgotten. The patient is left to care for themselves or by their loved ones. For the wellbeing of patients and to ease the burden on health care systems and society, non-healing wound treatment needs to be addressed as a matter of urgency.

Globally, diabetes prevalence has more than doubled since 1980 for men and increased by 60% for women (Fig. 1).[3] This trend is expected to continue. Between 2010 and 2030, a 69% increase in numbers of adults with diabetes in developing countries and a 20% increase in developed countries is expected.[4]

"I feel non-healing infected wounds are one of the fastest growing challenges for nurses but it doesn't get the support it deserves."

Mazizi Njokweni, Podiatrist, Leratong Hospital

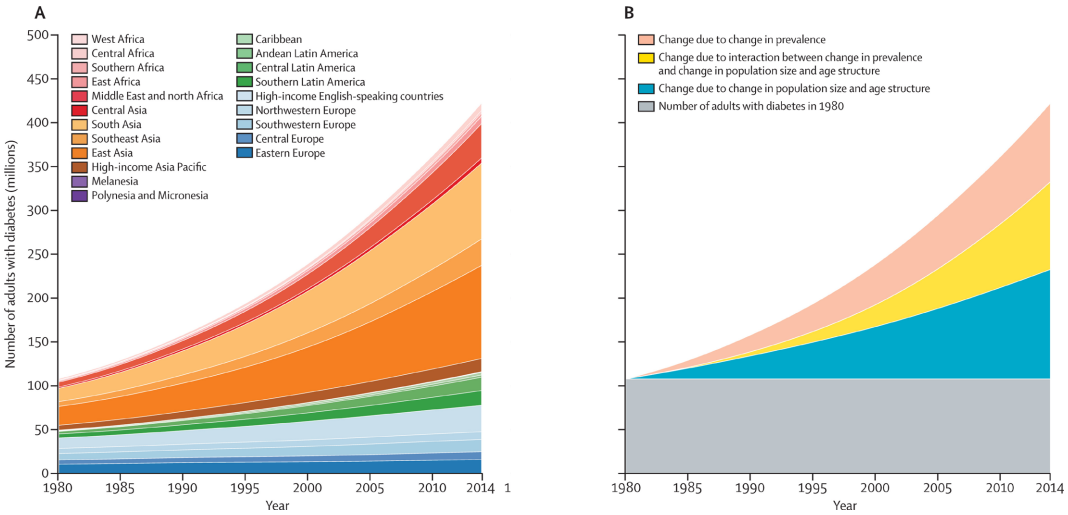

Figure 1. Trends in the number of adults by region (A) and decomposed into the contributions of population growth and ageing, rise in prevalence, and interaction between the two (B).[3] Reproduced in line with Creative Commons Attribution License.

Infections, the usual suspects

The reasons behind non-healing wounds are complicated and they are most often caused by an underlying disease or condition. Many factors can impair wound healing, including tissue maceration, ischemia, and infections. Other factors, such as advanced age or malnutrition may also play a role. A number of more complicated issues on the molecular level also seem to play important roles, and many new therapeutic options focus on exactly this level. However, infections remain a key problem.[5-8]

A Danish study investigated the presence of bacteria in non-healing venous leg ulcers.[9] The authors found that bacteria were almost always present in the ulcers. The study also found that the presence of Pseudomonas aeruginosa was associated with a significant enlargement of the ulcers. It is now well established that presence of bacteria in wounds is one of the most important factors in delayed healing.

"We need to detect infections in wounds earlier but that requires more education in the many different symptoms."

Vibeke Vestergaard,
Nurse in Plastic Surgery, Aalborg University Hospital

In recent years much attention has been paid to the existence of what is known as biofilm in wounds. Biofilms are communities of microorganisms that co-exist in a complex network, making treatment more difficult. Biofilms are formed when planktonic bacteria multiply and adhere to each other in the wound, followed by a maturation stage.[7,10,11]

Another problem that is often associated with wound infections is the presence of what is known as dead space in the wound. Dead spaces are cavities that are not filled by the chosen wound dressing. Hence, they can fill up with exudate, an excellent medium for bacterial growth.[12]

Biofilms
A biofilm is essentially a complex community of microorganisms (Fig. 2). The complex structure provides microorganisms with protection against the immune response and antimicrobial treatment, and makes treatment more difficult. Bacteria are also able to transfer genetic information between species, such as genes coding for antibiotic resistance. Biofilms can grow on the wound surface as well as in the tissue below the wound bed. Simplified, biofilms are an aggregate of bacteria tolerant to treatment and the host defence.[8]

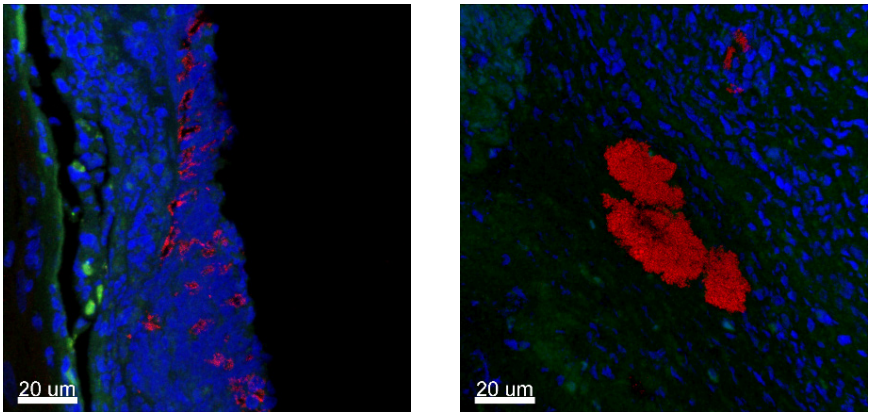

Figure 2. Confocal laser scanning microscopy (CLSM) on biopsies from an infected porcine wound model (*Pseudomonas aeruginosa*). Pig tissue (eukaryotic cells) is stained with DAPI (blue) and the microorganisms/biofilms are stained with specific PNA-FISH for bacteria only (red).[11]

Current treatments and developments

Efforts to improve wound healing have focused much on basic care. Good nursing care, wound preparation through cleansing and debridement, and of course proper hygiene are all essential requirements and much progress has been made. Another major advance has been the realisation that moist wounds heal better than dry wounds. A moist occlusive dressing helps support the inflammatory phase increasing the rate of re-epithelialisation.[6]

Recently we have also seen the development of growth factor solutions to promote healing by stimulating cell proliferation, promoting angiogenesis, and regulating the synthesis and degradation of the extracellular matrix, thereby stimulating the wound healing process. However, to date no major breakthroughs have been achieved in addressing the problems with non-healing wounds. Most new approaches do not address the underlying problem of wound infection.

Future developments may focus on the processes occurring inside the wound. Proteinase inhibitors could be one such target, as could gene therapy. Even the development of skin equivalents from stem cells is being considered. While such new therapeutic options may seem far away, it is important to remember that the key to successfully improving wound healing is the focus and interest of clinicians. Unfortunately, this may prove the most important barrier as wound care remains hidden at home, away from the front pages reserved for high-profile diseases, and has generated little interest from researchers.[13]

Key takeaways

- The number of patients at risk of non-healing wounds will dramatically increase in the years to come
- Non-healing wounds have serious consequences for patients and for society
- Wound infection is a key reason for the non-healing of wounds
- Most, if not all, patients with non-healing wounds will experience bacterial colonisation of the wound
- Patients will suffer from pain, increased exudate and odour from the wound, symptoms often associated with poor sleep, loss of mobility, and social isolation
- Identification of wound infection is difficult and there is a lack of easy-to-use and understand guidelines for home care

The challenge of identifying wound infections and symptoms

Non-healing wounds are an often-neglected story and wound infections can be challenging to identify. Symptoms that can reveal infections include periwound oedema, bleeding, odour or discoloured wounds, increased exudate, lack of granulation or incomplete epithelialisation. Clinicians need to be trained to recognise these symptoms. It is important to realise that patients with non-healing wounds will not always display these symptoms. In diabetics, neuropathy may hide any changes in pain. Older adults may not mount an adequate fever response and can show non-specific signs and symptoms.

Unfortunately, wound management is not part of the standard education and curriculum for most health care providers. Hence, the level of understanding, training and expertise in wound care management remains fairly low, despite the magnitude of the problem.

"For some reason everybody takes for granted that a nurse can manage all kinds of wounds – even the complicated non-healing infected ones. The fact is that wound management is not part of the standard education as a nurse. We really need to change that."

Martine Vrijs,
Wound and Ostomy Nurse, AZ Dietist Hospital

As a consequence, a consistent approach to wound care management might often be lacking with various and often conflicting solutions being applied to patients. These solutions might counteract or hinder one another from reaching their full healing potential.

Diagnosis should also often be supported by microbiological analysis that can guide appropriate management. Unfortunately, microbiological analysis is not always available, especially in a home care setting.

It is important to make a clinical assessment of the wound and patient and to monitor progress, for example, using the Triangle of Wound Assessment, which can guide the assessment of wound bed, wound edge and periwound skin (Fig. 3).[15]

It should be used in the context of a holistic assessment that involves the patient, caregivers and family.

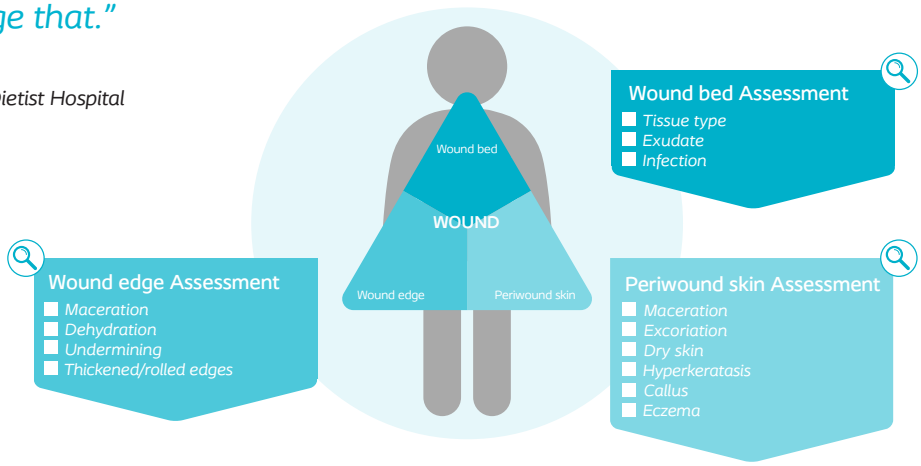

Figure 3. The Triangle of Wound Assesment.[15]

Wound infection is defined as the presence of microorganisms in sufficient number or virulence to cause a host response locally and/or systemically.[7] All open wounds are contaminated with microorganisms, most often by bacteria normally present on the patient's skin (Fig. 4). If the microorganisms start to multiply, the wound is described as colonised. An actual wound infection occurs when microorganisms move deeper into the wound tissue and proliferate leading to local immune response. Eventually the infection may spread to nearby areas or become systemic and life threatening. Early identification of local infection with targeted early intervention is key to preventing the wound infection spreading or becoming systemic.

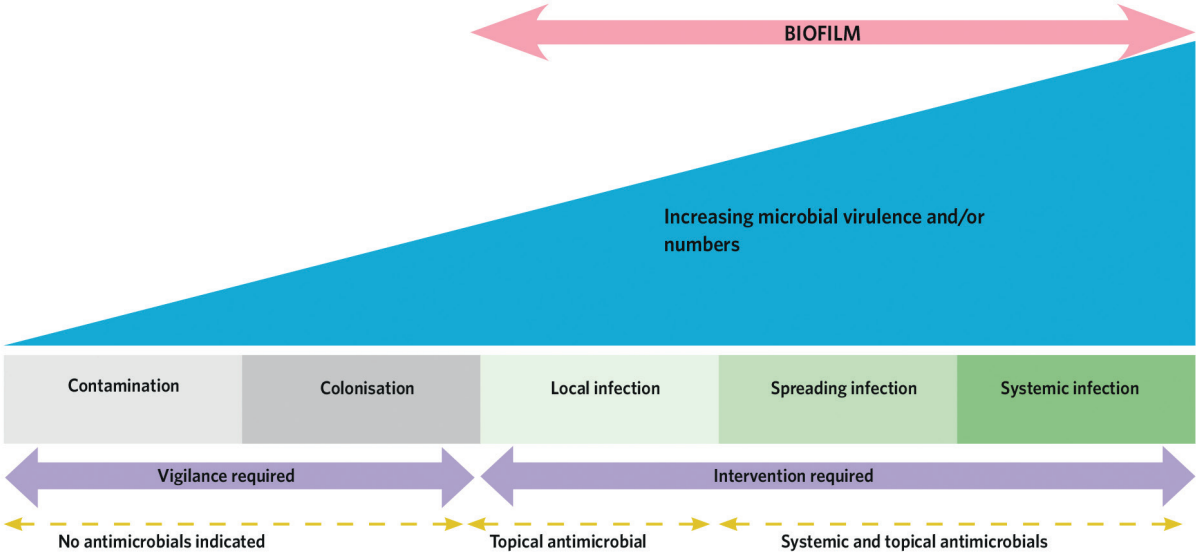

Figure 4. IWII Wound Infection Continuum.[7] Reproduced from the International Wound Infection Institute (IWII) Wound infection in clinical practice. Wounds International 2016.

Unfortunately, it is not always easy to recognise an infection in a non-healing wound. To prevent further infection clinicians need to react promptly to the signs and symptoms of infection. If a wound does not heal as expected, infection should always be suspected.

Appropriate strategies to treat and prevent wound infections are needed

To facilitate wound healing and combat wound infections, proper care of the wound bed, the wound edge, periwound skin, the patient and the environment is essential. Lately, much attention has been paid to the role of biofilms in wound infections. As previously noted, biofilms are essentially complex communities of microorganisms where the complex structures afford a level of protection to the microorganisms comprised and make treatment more difficult.[10,11]

There is increasing evidence that the formation of biofilms is often a critical step in the transition from colonisation to infection, prolonging the inflammatory phase. The presence of biofilms is also associated with delayed wound healing. Hence finding a way to minimise the formation of biofilms may prove to be a key step in preventing the transition.[13]

When discussing infections, it is important to distinguish between local wound infections and systemic infection. Key wound care strategies to target biofilms include frequent debridement of the wound bed and the use of antimicrobial agents and antibiotics. Most attempts at preventing wound infections have today focused on the use of silver as an adjunct. Silver has been used in wound treatment for more than 2000 years. Others have advocated the use of topical antibiotics, however, with limited success. Another issue with using antibiotics, either topical or oral is the fear of antibiotic resistance, especially relevant with the complexities of biofilms in the wounds. Hence advocating antimicrobial stewardship has become increasingly important.

"We need to pay more attention to cleaning our wounds to prevent infections and the overuse of antibiotics which can lead on to antibiotic resistance."

Emre Ozker,
Prof. Assoc. Dr. Cardiovascular, Acibadem Hospital

Insufficient debridement is unfortunately a cause of delayed wound healing.[6] In some cases, patient wound pain inhibits the health care provider from conducting proper debridement leading to insufficient removal of non-viable tissue. In other cases, the debridement is so 'thorough' that healthy skin is being removed. The removal of healthy skin will enlarge the wound and remove important tissue needed to heal the wound.

"Debridement of infected wounds requires proper education in order to make them heal faster. Remove too little and the infection will accelerate. Remove too much and you take away health tissue that would have helped to heal the wound faster. Debridement of infected wounds really requires proper training... just a shame it is not part of nurses' education."

Helle Damgaard Nielsen,
Nurse in Plastic Surgery, Aalborg University Hospital

Wound preparation through cleansing and debridement is, as mentioned, a key strategy to minimise problems with biofilm formation. Another important aspect in preventing wound infections and the formation of biofilms is the management of what is known as dead spaces – cavities that are not filled by the chosen wound dressing and can fill up with exudate and provide an environment conducive to bacterial growth.[12] As a consequence, management of debridement and dead space are key to the successful prevention of infections.[11,14] Part of the successful management of dead spaces is the use of a dressings that conform to the wound bed.

"We need more training in eliminating space for bacterial growth and biofilm formation in wounds."

Sharon Cassidy, Clinical Nurse Specialist, Canterbury District Health Board (Hospital & Community) / ACC (Private Clinic)

Key takeaways

- Clinicians and nurses should be aware of the key signs and symptoms to identify infections at an early stage
- While microbiological analysis may help in deciding the proper strategy, availability is limited
- Wound preparation through cleansing and debridement and dead space management are key to successfully eliminate infections and remove biofilms
- The use of dressings that conform to the wound bed is essential in managing dead spaces

Summary

1-2% of the population will at some point suffer from non-healing wounds and the problem is increasing with increases in life-expectancy and prevalence of associated diseases, such as diabetes. Non-healing wounds have serious consequences for patients and are associated with significant costs for the health care system.

A key factor in non-healing wounds is wound infection. While nearly all wounds will become contaminated with bacteria, problems arise when contamination progresses to local infection, impairing wound healing. Recent discoveries have pointed to the important role biofilms play in wound infections making treatment more difficult.

We urgently need to take steps to prevent wounds becoming infected. These include establishing guidelines that can be easily implemented in home care to help identify infections through correct wound assessment and to ensure that proper action is taken, such as dressing choice, which may affect the risk of infection.

Proper guidelines in dealing with wound infections also need to be established in home care and should focus on how to minimise problems with biofilm formation. Wound preparation through cleansing and debridement is one of the most important steps in eliminating problems with biofilms. Another important aspect is managing the risk of dead spaces where bacteria can proliferate. Appropriate guidelines should also be in place on how to handle the dead space problem. The use of a dressing that conforms to the wound bed is essential in managing dead spaces.

Discussion

In this policy paper we have outlined the critical situation and urgency required to address the issues surrounding wound infection. We are left with three questions.

How do we prevent wound infections?

How do we prevent infections becoming permanent?

How can we secure timely and appropriate intervention?

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