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Reducing the burden of chronic wounds in the community using single use NPWT

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We need to reduce the future burden of chronic wounds

Demand for healthcare resources continues to increase as population demographics change, long-term conditions become more prevalent, patient expectations rise and medical technology becomes more sophisticated. The ageing population — together with other factors such as modern lifestyle changes — are driving an upward trend in chronic conditions like diabetes and cardiovascular disease. As the number of older people increases, the prevalence of chronic wounds will also continue to grow — so much so that by 2019 the number of people with a wound is projected to rise by 9.8%, from 239,700 in 2014 to 263,200 (Dowsett et al, 2014).

Wounds represent a significant cost to patients as well as to the health economy. Chronic wounds are often hard to heal, resulting in a cycle of pain, anxiety and reduced quality of life for the patients as well as considerable treatment costs. The estimated cost of treating chronic wounds in the UK is between £2.5–3.1 million per year, accounting for 2–3% of the entire healthcare budget (Posnett et al, 2009). Further estimates suggest that there are 3.37 people with one or more wounds per 1,000 of the population, of which 74% are being treated in community settings and 21% in acute care (Drew et al, 2007).

Although most patients are treated in the community, the majority of wound care costs arise in hospitals — on any given day, 27–50% of acute hospital beds are likely to be occupied by patients with a wound (Posnett et al, 2009). Many of these chronic wounds are longstanding — having lasted for over six months — and as a result are more likely to develop complications that result in hospital admission or delayed discharge (Ousey et al, 2013). Additionally, patients themselves are becoming more complex, with 76% of those with a chronic wound having three or more comorbidities and up to 46% having diabetes, making their wounds much harder to heal.

Data on health service expenditure suggests that funding is unlikely to keep pace with demand and that fundamental changes will need to be made in the way wound care is delivered to reconcile supply with demand (Dowsett et al, 2014). To balance the cost of services with the provision of high-quality care, clinicians need to be more proactive in their approach, adopting new and advanced technologies that increase healing, involve patients in their own care, and create economic value. A proactive approach to managing chronic wounds can reduce cost and improve patient outcomes, as demonstrated by high impact actions such as 'Your skin matters' (Dowsett, 2010).

Strategies that focus on wound prevention not only lessen the number of wounds requiring treatment, but also reduce the burden of wound care in the future. There has been a strong focus on reducing harm from pressure ulcers in the UK as part of the 'harm-free care' agenda, and most healthcare providers are working towards the elimination of avoidable grade 3 and 4 pressure ulcers altogether. Another example of how the burden of chronic wounds can be reduced is the focus on preventing recurrence of venous leg ulcers through service redesign — for instance, one nurse-led leg ulcer service that focused specifically on patients with healed ulcers showed a reduction in recurrence rates from 18–20% to 5.8% (Dowsett, 2011).

Treatment strategies can also improve the lives of patients with a wound, particularly the adoption of new techniques that enhance the efficiency of wound management and release resources to be re-deployed elsewhere. Innovative wound management products such as negative pressure wound therapy (NPWT) can increase efficiency by reducing the number of dressing changes and nurse visits required, as well as reducing time to heal. The availability of NPWT in the community has significantly improved the lives of patients with wounds by allowing them to be cared for at home, releasing cost savings of up to £4,814 per patient (based on an average treatment period of 20.4 days) (Dowsett et al, 2012). As with most technologies, NPWT devices have now become even smaller and are available for single-use, meaning patients can continue with their normal daily activities. This supplement includes some good examples of the positive impact NPWT has had on the lives of patients and on wound healing.

Unfortunately, the burden of chronic wounds will continue to grow and service providers need to bridge the gap between supply and demand to provide safe, effective and person-centred care. In the future, we need to reassess the standard of chronic wound treatment we provide and make the best use of any available resources that will reduce the impact of chronic wounds on patients, clinicians and the healthcare economy.

Caroline Dowsett, nurse consultant, tissue viability, East London Foundation Trust

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Understanding chronic wounds...

Chronic wounds are increasing in prevalence as the population ages and the number of people living with multiple comorbidities that put them at risk of developing wounds rises (Gottrup et al, 2013). As the majority of care for chronic wounds is carried out in the community setting (Posnett et al, 2009), it is important that clinicians understand wound chronicity, its causes, the consequences for the patient and healthcare provider, and how to identify and manage the cause of wounding so that chronicity can be avoided where possible.

WHAT IS A CHRONIC WOUND?

A wound that has been present for more than six weeks is generally regarded as chronic. Acute wounds heal in a well-organised process, passing through the normal stages of wound healing within an expected time frame for the wound type. For example, a partial-thickness wound (i.e. one that extends only through the epidermis and may involve part of the dermis, but not the subcutaneous tissue or underlying structures) is expected to heal in a week, while a full thickness wound can take far longer. *Box 1* outlines the normal, overlapping stages of wound healing. Chronic wounds do not follow this normal-healing process but become stuck in one of the stages, resulting in delayed healing or a failure to heal.

Box 1:	Stages of normal wound healing
Stage	Description
Haemostasis	This is the first stage when the body tries to stop the bleeding if there is a break in the skin
Inflammation	The preparatory stage of healing, which can last for 0–3 days, as blood vessels shrink to stop the bleeding (i.e. to use the analogy of a disaster in the home, this stage could be seen as similar to when the emergency services first arrive [Shipperly and Martin, 2002])
Destruction	This is when the body starts to remove necrotic tissue and any debris from the wound, which can last for about 2–6 days (i.e. when the refuse collectors arrive [Shipperly and Martin, 2002])
Proliferation	This is when the body starts to repair the damage (about three days after the injury) and the wound bed starts to fill up with new, collagen-rich tissue and new cells grow. The duration of this stage is dependent on the size of the wound but can take up to several weeks (i.e. the builders arrive and put up their scaffolding in preparation for repairing the damage [Shipperly and Martin, 2002])
Maturation	This is when epithelial tissue covers and closes the wound (i.e. the final stage when the decorators arrive [Shipperly and Martin, 2002])

RISK FACTORS

Healing of a wound may be delayed by local, systemic or psychosocial factors (*Box 2*) (Timmons, 2006; Eagle, 2009). The different factors may interact to promote or delay wound healing. Any that are identified as contributing to delayed healing should be promptly addressed. For example, improving the patient's nutrition, or a change in dressing choice.

Box 2:	Risk factors for developing a chronic wound	
Local factors	Systemic factors	Psychosocial factors
Local infection Hypoxia Trauma Presence of foreign bodies Chronic wound exudate Mechanical stress Temperature	Comorbidities such as: › Diabetes mellitus › Malnutrition › Immunodeficiency › Medication › Renal disease › Rheumatoid arthritis › Age › Circulatory insufficiency	Living environment Lifestyle

HOW DO CHRONIC WOUNDS DIFFER FROM NORMAL WOUNDS?

Chronic wounds cannot heal because of cellular and molecular abnormalities within the wound bed. Chronic wounds contain elevated amounts of inflammatory cytokines and proteases, low mitogenic activity and cells that respond poorly to growth factors compared with acute wounds. Upon healing, this pattern shifts back to one resembling an acute healing wound (Ovington and Schultz, 2004). Inflammation is a hallmark of chronicity, as chronic wounds often stall in the inflammatory stage (Werdin et al, 2009). Signs and symptoms of chronicity include:

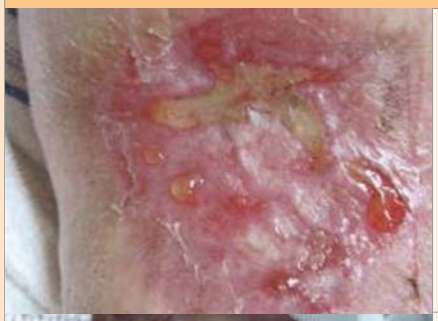
- Moderate-to-high exudate levels, the presence of which further delays healing (Vowden and Vowden, 2004). Chronic wound exudate has a different composition to acute wound fluid with high levels of inflammatory mediators and activated matrix metalloproteinases which have a negative effect on healing
- Oedema in wounds where there is venous insufficiency. This is characterised by chronic swelling caused by excessive fluid in the tissues
- Low perfusion and hypoxia: chronic wounds often have an inadequate blood supply which causes delayed healing and unhealthy formation of granulation tissue (Younes et al, 2006). Overgranulation can occur because the wound is in a prolonged inflammatory state, it is occluded, there is excessive exudate, or there is a cellular imbalance (Stephen-Haynes and Hampton, 2010).

CAN CHRONIC WOUNDS BE AVOIDED?

With appropriate diagnosis and management, the majority of chronic wounds can be healed within 24 weeks (Posnett and Franks, 2007). In practice,

Common chronic wound types seen in the community

The most commonly encountered chronic wounds in the community setting are leg ulcers, diabetic foot ulcers and pressure ulcers (Drew et al, 2007).

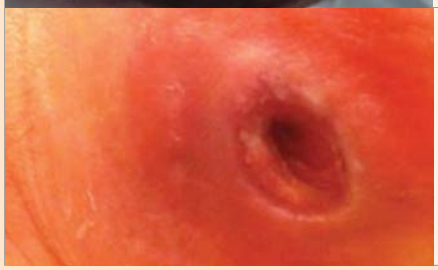


LEG ULCERS

Venous leg ulceration is a result of underlying venous disease. It is estimated that between 70,000–190,000 people in the UK have an open ulcer at any time (Posnett and Franks, 2007). These wounds can have a negative impact on patient wellbeing by causing pain, odour, stress, low self-esteem and even depression (Upton et al, 2012).

DIABETIC FOOT ULCERS

These usually occur over bony prominences, with sloughy and/or necrotic tissue. They have a high risk of complications (and can result in amputations if not treated promptly and appropriately). A multidisciplinary team approach is required.



PRESSURE ULCERS

These localised areas of damage to the skin occur as a result of pressure, with or without shear, usually over bony prominences. Although mainly preventable, the incidence of pressure ulcers still remains high. They have been identified as 'never events' by the Department of Health (DH, 2009), with prevention being one of the high impact actions (HIAs), and as indicators of the quality of care being given (Griffiths, 2010).

healing may take longer because diagnosis and treatment choice is not adequate. A study by Dowsett et al (2014) revealed that of 1,166 wounds managed across eight community settings, 26.4% of wounds had been present for over six months, and 16.5% over one year. Wounds of a long duration increase the risk of infection and other complications, presenting a considerable burden on both the healthcare system and patient.

MANAGEMENT

Most chronic wounds can be encouraged to heal by removing underlying barriers to healing, such as improving nutrition and controlling underlying medical conditions. The wound bed can then be prepared for healing. If these factors are addressed and there is no improvement, further intervention may be required.

FUTURE OF CHRONIC WOUNDS IN THE COMMUNITY

Nurses carry out the majority of chronic wound care in the community setting. As the number of patients with chronic wounds is set to increase over the coming years, healthcare providers need to look closely at optimising the future delivery of care (Dowsett et al, 2014; Hampton, 2015). JCN

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IN BRIEF

- NPWT uses a pump device to provide controlled subatmospheric pressure to a sealed, airtight wound.
- Recently, single-use NPWT systems have been introduced which are more portable and simpler to use and apply.
- These systems provide a cost-effective means of treating wounds in different care settings.
- Portable NPWT systems provide good clinical outcomes but with the additional benefits of simplicity and affordability.

KEY WORDS:

- NPWT
- Community
- Cost-effectiveness
- Portable systems
- Single-use

What is the mode of action of negative pressure wound therapy?

Elizabeth Huddleston

Negative pressure wound therapy (NPWT) has made a significant impact on the management of wounds. First described by Morykwas et al (1997) almost 20 years ago, the therapy uses a pump device to provide controlled application of subatmospheric pressure to a sealed, airtight wound.

The use of a wound filler (usually a foam or gauze dressing) ensures delivery of this subatmospheric or 'negative' pressure to the entire wound surface, while the resulting pressure gradient encourages simultaneous removal of wound exudate through the dressing material. NPWT provides a closed system which not only protects the wound from external sources of contamination, but creates the optimal conditions for complex wounds in particular to progress towards healing and closure.

NPWT has become widely adopted by clinicians for the treatment of many different wound types, including chronic wounds such as diabetic foot ulcers, pressure ulcers, and venous leg ulcers, as well as acute wounds such as split thickness skin grafts, burns, orthopaedic or soft tissue traumatic wounds, and post-surgical dehiscence.

'... NPWT minimises many of the concerns for patients living with chronic wounds such as leakage of wound exudate from dressings, soiling of clothes or bedding, and exposure to wound odour.'

With its suitability for use in such a wide variety of wound types, it is likely that NPWT will provide different clinical benefits depending on the individual wound and the particular treatment goals, i.e. wound closure, reduced exudate volume, etc.

BENEFITS OF NPWT

The benefits to the wound are often apparent within days of applying NPWT and include rapid wound contraction, removal of sloughy material, appearance of granulation tissue and overall reduction in wound volume. This, in turn, reassures patients and carers that wounds have been 'kick-started' into a healing trajectory.

A key benefit NPWT offers is the management of wound fluid in moderate-to-highly exuding wounds, as well as creating a micro-environment that supports healing (*Table 1*).

NPWT provides an effective method of sealing the wound, and is particularly beneficial in managing large complex wounds where exudate can be contained and removed, usually via a canister. Fewer dressing changes may be needed as a result of NPWT's ability to manage exudate, offering greater convenience to both patients and clinicians.

Additionally, NPWT's sealed environment offers protection of the periwound skin and reduces the risk of contamination from wound fluid as well as reducing the risk of contamination to and from the outside environment. Thus, NPWT minimises many of the concerns for patients living with chronic wounds such as leakage of wound exudate from dressings, soiling of clothes or bedding, and exposure to wound odour — all of which can cause considerable patient distress, low self-esteem and negatively impact on quality of life (World Union of Wound Healing Societies [WUWHS], 2007; Jones et al, 2008).

Elizabeth Huddleston PhD, clinical science director, Global Medical and Clinical Affairs, Advanced Wound Management, Smith & Nephew UK

Table 1:	NPWT benefits
Wound	› Promotion of granulation tissue › Improvement in blood flow ~ increased delivery of oxygen and nutrients › Control of exudate ~ decreased wound oedema and congestion ~ improved wound environment › Reduced risk of infection
Patient and carer	› Greater patient comfort: ~ better management of exudate ~ reduced frequency of dressing changes ~ reduced wound odour ~ increased mobilisation › Reduction in wound area and depth › Reduced overall treatment costs

MODE OF ACTION

To date, knowledge of the mechanisms of action of NPWT has largely been gained from animal and laboratory studies and there appears to be no single mechanism responsible for the clinical benefits seen. NPWT's mode of action can be summarised as:

- Micro- and macromechanical deformation of tissue
- Changes in blood flow patterns
- Removal of fluid and reduction in oedema
- Wound homeostasis (prevention of desiccation, minimises contamination).

Tissue deformation

The beneficial effects of NPWT on wound healing are thought to depend on the delivery of mechanical forces (often termed macromechanical and micromechanical forces) to the tissue.

The notable contraction of wounds upon application of NPWT demonstrates the macromechanical force or tension that is being applied to the tissue under vacuum. It is thought that the application of tension upon the tissue edges 'stretches' the tissue and stimulates cells to undergo increased proliferation and matrix production, resulting in the growth of new skin tissue (granulation and epithelialisation) (Saxena et al, 2004).

Interestingly, in studies of tissue contraction in animals where NPWT was removed 48–72 hours after application, wounds did not revert back to their original size. This demonstrates a degree of permanency in the contraction effect and supports the hypothesis that NPWT contributes to increased cell and matrix production (Malmsjö et al, 2012).

Perhaps the most notable of all NPWT's effects is the stimulation of tissue granulation and a dramatic improvement in the appearance of the wound bed. This relatively rapid phenomenon is the result of microscopic interactions between tissue and wound dressing materials placed under vacuum. The combination of both negative and positive pressures creates micro-deformation of tissue and the resultant strain generates increased responsiveness to growth factors, cell proliferation, production of extracellular matrix and angiogenesis (formation of new blood vessels) (Wilkes et al, 2009).

Numerous animal studies have recreated the stimulation of granulation tissue in open wounds using a variety of wound fillers and pressure levels (Morykwas et al, 1997; Malmsjö et al, 2012), while histological analysis of clinical biopsies following NPWT clearly shows a more angiogenic environment (Malsiner et al, 2013; Fraccalvieri et al, 2014).

It is the combination of these macro- and microdeformations (wound contraction and filling of tissue defects with new granulation tissue) that ultimately leads to the visible reduction in wound area and wound depth. Rate of volume reduction varies by wound type, but clinical studies demonstrate a reduction of between 15–32% in wound volume per week (Campbell et al, 2008; Bondokji et al, 2011; Dorafshar et al, 2012).

Blood flow changes

Despite being one of the most widely studied effects of NPWT, tissue perfusion remains a subject of intense debate. Spanning almost 20 years of research, experimental studies have shown that NPWT results in both an increase and decrease in tissue perfusion, which very much depends on the method of detection used in the study, location and pressure levels being applied. This area of research has mostly been limited to experimental studies with little clinical evidence owing to the invasive procedures involved in attempting to measure local tissue perfusion.

Morykwas et al (1997) were the first to report changes in blood flow associated with NPWT. Using laser Doppler flowmetry in a pig wound model, it was shown that periwound blood flow increased upon the application of NPWT. Subsequent studies have shown that NPWT causes an immediate increase in blood flow in the periwound area (2cm from the wound edge); whereas blood flow at the wound edge is reduced, creating a 'zone of hypoperfusion' (Wackenfors et al, 2004).

This reduction in blood flow observed at the wound edge is most likely due to the compression caused by the wound filler material pressing against the surface of the wound. It is not known whether wounds progress because of, or despite this zone of hypoperfusion. One theory is that the subsequent hypoxic environment is a potent stimulator for angiogenesis, which is also a key precursor to granulation tissue formation (Malsiner et al, 2013).

Removal of fluid and oedema

Wound exudate, particularly that seen in chronic wounds, can contain elevated levels of inhibitory factors such as proteases and inflammatory mediators that impair wound healing and keep the wound in a stalled state (Schultz et al, 2003). By removing excess fluid and reducing tissue oedema, the wound is more likely to

progress through the inflammatory phase of healing, stimulating cellular proliferation and allowing granulation to occur.

Analysis of wound exudate collected in canisters following NPWT has been shown to contain exudate-associated proteases and cytokines, which demonstrates that they can be removed from a wound with NPWT; while tissue biopsies and serum analysis of NPWT-treated wounds have shown a reduction in inflammatory infiltrate and a modulation of cytokines, resulting in reduced inflammation (Stechmiller et al, 2006; Mouës et al, 2008).

The presence of inflammation in chronic wounds leads to a rise in capillary permeability and an increase in interstitial fluid, both of which result in tissue oedema. Oedema compresses local capillaries and increases the distance between capillaries, thereby limiting the supply of oxygen and nutrients to tissues. Reducing oedema is widely reported to be a key mode of action in NPWT, particularly in closed incisions following surgery. However, clinical or experimental evidence to support this theory is limited due to the difficulty in measuring oedema. The application of mechanical forces (in this case NPWT) to wound tissue may improve oedema either by directly removing excessive interstitial fluid or preventing further leakage from the capillaries through the application of compressive force — it is also possible that the enhanced drainage of interstitial fluid through the lymphatic system plays a role (Kilpadi and Cunningham, 2011).

Maintenance of homeostasis

The role of NPWT as a closed system is often underestimated, but it contributes to a micro-environment that is conducive to wound healing. Moisture balance is important across all phases of wound healing — too little moisture can cause cell death and tissue necrosis, whereas too much results in maceration to the surrounding tissue. A closed system also minimises the likelihood of wound contamination from the external environment. The fact that NPWT requires fewer dressing changes than traditional wound care practices (Hurd et al, 2014) further minimises disruption to the wound's homeostasis and/or exposure to external contamination.

CONSIDER NPWT CHOICES

It is clear from the evidence that there are multiple mechanisms of action associated with NPWT, many of which are interrelated. However, the body of knowledge around these mechanisms has remained largely the same since the first experimental studies were published almost 20 years ago (Morykwas et al, 1997).

The publication of NPWT-related research has increased in recent years, as new devices and wound filler options become available and clinicians and manufacturers begin to question the accepted principles of NPWT treatment in areas such as optimum pressure levels, pressure modalities (continuous or intermittent), optimum filler materials, and pump choice.

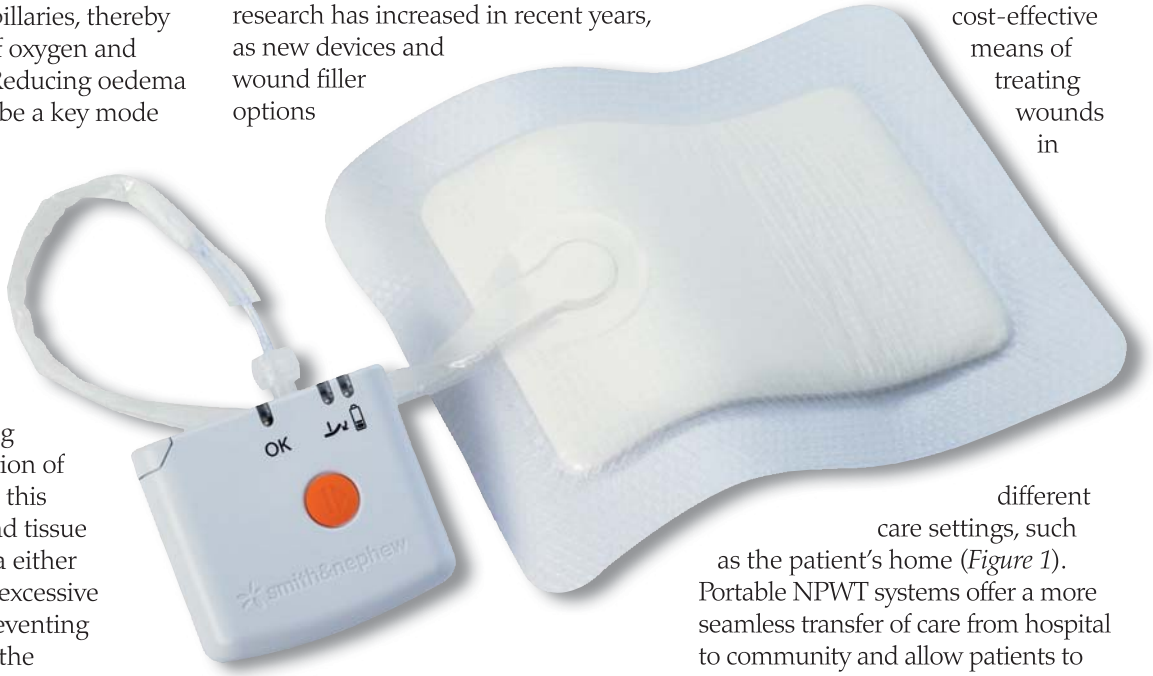

Figure 1. *Portable NPWT system.*

Recently published randomised controlled trials (RCTs) comparing different systems suggest that NPWT is consistently effective across a variety of wound types and care settings, irrespective of the simplicity or complexity of the source of the vacuum, the type of wound filler or the level of pressure applied (Armstrong et al, 2012; Dorafshar et al, 2012; Rahmanian-Schwarz et al, 2012).

Such studies continue to challenge some of the assumptions that have surrounded NPWT for so long and are beginning to reinforce the notion that NPWT can offer clinicians a flexible yet effective approach to managing wounds, in particular by paying closer attention to the needs of their patients.

Portable NPWT systems

Recent developments in NPWT technology have led to the introduction of single-use NPWT systems, which are smaller, more portable (they can be worn on the person rather than carrying a large heavy device), simpler to use and apply, and provide a cost-effective means of treating wounds in different care settings, such as the patient's home (*Figure 1*). Portable NPWT systems offer a more seamless transfer of care from hospital to community and allow patients to receive the benefits of NPWT with minimal impact on daily living.

With respect to NPWT's key modes of action, experimental studies have demonstrated that single-use NPWT units function in the same manner as larger, traditional NPWT devices (Malmsjö et al, 2014). Similarly, clinical studies have shown that single-use systems offer equivalent clinical outcomes to traditional NPWT devices. For instance, Armstrong et al (2012) compared an ultraportable single-use NPWT system with traditional NPWT in 132 patients

with lower extremity chronic wounds. The portable mechanically-powered system was used in conjunction with a gauze wound filler, while the larger system used foam, although pressure levels were applied equally in both groups. Over a 16-week study period there was no significant difference in wound closure outcomes between the devices (Armstrong et al, 2012).

Similarly, Hurd et al (2014) recently published a non-comparative evaluation of 326 patients treated with another portable NPWT system (PICO™; Smith & Nephew) for an eight-week period in a community setting in Canada. The majority of patients (68%) achieved complete wound closure within eight weeks. When compared to records of patients in their practice previously treated with conventional NPWT systems, the researchers found equivalent healing outcomes, with a 77% reduction in wound area in the portable system compared to 70% with conventional NPWT over eight weeks (Hurd et al, 2014).

CONCLUSION

Over the past 20 years, NPWT has become widely accepted by clinicians as an efficient treatment for many different wound types. Research has shown that for patients living with chronic wounds the technique helps to reduce the impact of problems such as exudate leakage, soiling of clothes or bedding, and wound odour. From the clinician's point of view, NPWT results in fewer dressing changes due to its ability to manage exudate, and the benefits to the wound itself — including rapid wound contraction, removal of sloughy material, appearance of granulation tissue and overall reduction in wound volume — are often apparent within days of application.

As the adoption of single-use portable NPWT systems becomes more widespread in a variety of wound indications and patient settings, the growing body of evidence suggests that portable NPWT units will be able to replicate the clinical outcomes of larger systems, but with the additional benefits of simplicity and affordability. JCN

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IN BRIEF

- Wound care represents a large part of the community nurse's role.
- Recently, negative pressure wound therapy (NPWT) devices have become more portable, facilitating earlier hospital discharge and increased home use.
- Wound measurement is a method of giving patients feedback on clinical progress, as well as determining the efficacy of the treatment chosen.
- Patients should be fully involved and informed about their therapy.

KEY WORDS:

- Treatment pathway
- Portable NPWT
- Wound measurement
- Outcomes

Using disposable negative pressure wound therapy in the community

Jeanette Milne

Provision of wound care makes up a large proportion of community nursing time (around 70%) (Drew, 2007), as well as accounting for 4% of total healthcare expenditure (Posnett et al, 2009). The Government strategy to move more care into the community (Department of Health [DH], 2009), has also led to increasingly complex wound management being provided in patients' homes.

The use of advanced therapies to promote wound healing is increasing (Falanga, 2005). Indeed, the development of such products was one of the drivers behind the DH's proposal that more complex wound care should be undertaken in the community setting (DH, 2009). However, it is essential that nurses who treat wounds choose the most appropriate product — balancing the need to provide optimal care with increasing demands for cost-effective treatment.

Negative pressure wound therapy (NPWT) has the potential to promote wound healing, alleviate exudate and odour, and improve quality of life (Wounds UK, 2008). While it was seen as being an expensive treatment modality, used in secondary care by specialists (Ousey and Milne, 2009), the introduction of more portable and affordable systems has made it more accessible to patients in the community (Dowsett et al, 2012) .

NPWT is commonly used to treat chronic wounds — category 3 and 4 pressure ulcers, surgical wounds healing by secondary intention, diabetic foot ulcers (DFUs) (Chadwick et al, 2009), or venous leg ulcers in conjunction with compression — especially those that have been non-respondent to alternative therapies. It can be used with different clinical goals in mind; either as a bridge to surgical closure or to achieve wound closure by reducing wound dimensions and improving the quality and speed of deposition of granulation tissue.

This article provides practical guidance on when and how to successfully use disposable NPWT in the community setting.

TREATMENT PATHWAYS

The benefits of a formalised care pathway approach are that it:

- Introduces a standard of care that facilitates staff training
- Improves communication between organisations and staff
- Facilitates audit/outcomes tracking
- Reduces variation in practice
- Can lead to improvements in patient experience.

Care pathways can also be used to support the rationale for use, duration of use and patient selection criteria when justifying a therapy to the funding authorities in a business case.

To ensure the greatest chance of success, it is essential that nurses using NPWT adhere to the manufacturer's indications, contraindications and precautions (*Table 1*). A typical treatment pathway is shown in *Figure 1*, but it is also important to bear in mind the following when considering NPWT.

Choosing the right filler

Both foam and gauze fillers/dressings are available for use with NPWT. *Table 2* shows their positive and negative properties.

Level of negative pressure

It has been found that -80mmHg is the appropriate level of negative pressure in most wound types and has optimum effects on (Malmsjö et al, 2009):

- Microvascular blood flow
- Wound contraction

Remember

NPWT should not be considered as a substitute for thorough debridement and is contraindicated in wounds containing necrotic tissue.

Jeanette Milne, tissue viability nurse specialist, South Tyneside Foundation Trust

- Granulation tissue formation
- Stabilisation of wounds, i.e. sternotomy wounds.

Using a standard device and pressure higher than -80mmHg

When using NPWT in wounds with high volumes of exudate, a traditional negative pressure device and pressure higher than -80mmHg can be used (Malmsjö et al, 2009).

It is important to note that wound exudate volume is a symptom and can provide clues as to the wound's condition, i.e. if it is infected — its bacterial load (World Union of Wound Healing Societies [WUWHS], 2007; Morgan, 2014). To manage exudate effectively, it is essential to establish the underlying cause. If the volume is simply related to wound size, choosing NPWT to help achieve other goals, as well as to contain exudate is acceptable. However, exudate management alone should never be the primary reason for choosing NPWT, as failing to address the underlying cause of exudate will lead to prolonged and unsuccessful treatment, and potentially increase costs.

When to use lower pressures

A pressure lower than -80mmHg can be used in the following situations (Malmsjö et al, 2009):

- Poorly vascularised wounds
- Paediatric patients
- If the patient reports pain.

It is generally accepted that pressure levels below -40mmHg are sub-optimal, and, as such, therapy should be discontinued in favour of more appropriate treatment options that are matched to the primary treatment objectives and licenced/designed to address presenting signs and symptoms. There is no evidence of any therapeutic benefit below 40mmHg (Malmsjö et al, 2009) and continued use will result in increased overall treatment costs (Searle and Milne, 2010).

Intermittent, variable or continuous therapy

Intermittent and/or variable NPWT can be set on standard devices and is a means of applying and removing the pressure delivered by automatically switching on and off the suction applied to the wound bed at pre-set or clinician-defined intervals. The most commonly used setting is five minutes on and two minutes off.

Intermittent and/or variable NPWT can be used in the following circumstances:

- All wounds, except those producing excess exudate
- To achieve greater blood flow in the periwound tissue
- To achieve greater mechanical shearing forces at the wound dressing interface (the NPWT acts by 'massaging' the wound surface)
- To achieve more granulation tissue and faster healing (Saxena et al, 2004).

NPWT facts...

NPWT systems consist of a:

- Wound contact layer and dressing: traditionally foam or gauze that fills the wound cavity
- Film: this is applied over the foam or gauze filler to form an air-tight seal
- Drainage tube: this is connected to a suction device with a canister that collects and evacuates exudate.

Standard devices consist of a pump which is attached to a canister to collect exudate, this in turn is connected to non-collapsible tubing that is attached via a port to the patient's dressing. These devices have a choice of incremental pressure settings that can be selected by the clinician. As discussed, generally -80mmHg is sufficient to give optimal benefit. You may wish to vary the pressure settings to optimise NPWT therapy based on individual patient need and the lead clinician's guidance. Negative pressure may be increased by 10mmHg increments if:

- High volumes of exudate/excessive drainage are present
- Wound volume/size are large
- There is a tenuous seal/positional difficulties maintaining the seal.

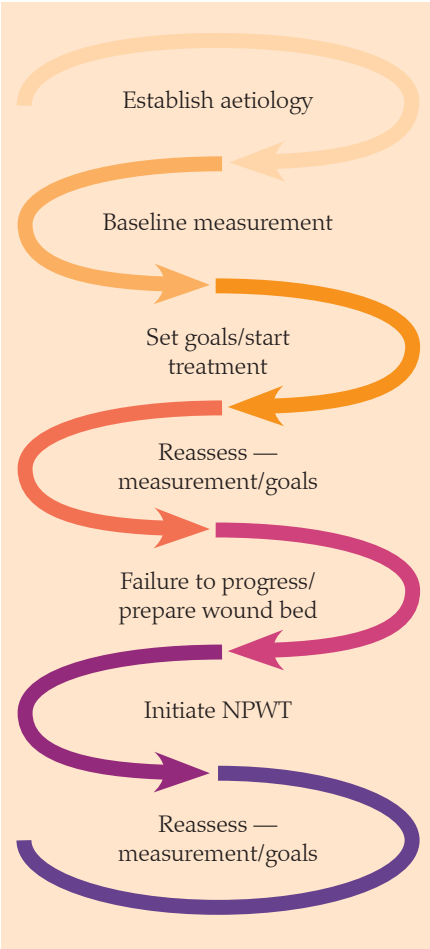

Figure 1. *Typical NPWT treatment pathway.*

Continuous NPWT should be used for:

- Wounds that are producing a high volume of exudate
- Large wounds that require stabilisation of structures, i.e. sternotomy wounds, as NPWT provides splinting and stabilisation as the pressure is applied continuously to the tissue and offers support.

DISPOSABLE NPWT

For small-to-medium sized wounds with low-to-moderate volumes of exudate, disposable NPWT systems (such as PICO™) combine the benefits of negative pressure with the simplicity of advanced wound care dressings. For instance, the dressing used in PICO comprises:

- A silicone adhesive wound contact layer which helps establish an effective seal, yet is gentle on the periwound area
- An airlock layer that distributes the negative pressure across the dressing

Table 1: NPWT: indications, contraindications and precautions

Indications
Acute, sub-acute, traumatic and dehisced wounds
Chronic wounds, diabetic foot ulcers, leg ulcers or pressure ulcers, skin grafts/flaps, closed surgical incisions
Partial-thickness burns
Contraindications
Wounds with any necrotic tissue and/or eschar, or greater than 50% soft slough in the wound bed
Previously confirmed, untreated osteomyelitis (bone infection)
Malignancy in wound (with exception of palliative care to enhance quality of life)
Exposed arteries, veins, organs or nerves, or anastomotic sites (surgically connected structures, such as blood vessels, tendons, etc)
Emergency airway aspiration
Pleural, mediastinal or chest tubing drainage
Surgical suction
Non-enteric and unexplored fistulae
Anastomotic sites
Precautions
Patients with previous history of non-concordance with treatment modalities; those receiving anticoagulant therapy or platelet aggregation inhibitors; any patient with active bleeding
Untreated malnutrition
Wound infection must be treated concomitantly with appropriate antibiotics or antimicrobial agents
Care must be taken at all times to ensure that the NPWT pump and tubing does not lie in a position which could cause damage to the patient; trail across the floor where it could become contaminated or cause a trip hazard; present a risk of strangulation or a torniquet effect; or become twisted or trapped so that negative pressure is prevented
See manufacturer's instructions for a full list of precautions

Table 2: Pros and cons of different NPWT fillers

	Positive qualities	Negative qualities	Wound types
Foam	› Stimulates rapid granulation tissue formation, wound contraction › Removal of high volumes of exudate	Can be difficult to apply to wounds with an irregular shape/contours	› Compartment syndrome › Acute wounds with large tissue loss › Postoperative open abdomens and sternotomy wounds
Gauze	› Easy and fast to apply to uneven, large, deep wounds › Reduced pain and trauma reported on removal › Slower initial stimulation of granulation tissue › Reduced post therapy contraction may reduce scarring	Not as efficient as foam at facilitating exudate removal	› Cosmetic surgery › Skin flap preparation/ stabilisation › Skin grafts and use over joints

- A superabsorbent layer which holds the wound exudate away from the skin
- A film which ensures a high moisture-vapour-transmission rate (MVTR), which allows for one-way transpiration of the collected exudate vapour, making a canister redundant.

The dressing forms part of a pack that can be prescribed when required. The pack contains a single-use pump — which lasts for seven days — and two individually packed dressings with fixation strips (allowing the wound to be inspected if necessary).

The pump is operated by a single orange button and uses normal lithium AA batteries. At the end of a treatment cycle, the batteries can be recycled, while the pump should be disposed of as non-clinical waste. The PICO system incorporates three lights so that clinicians and patients know that the system is working:

- A green light which flashes constantly to indicate it is working properly
- Two amber alarm lights which flash if there is an issue (one indicates an air leak; a second shows that the battery charge is low).

The batteries may be replaced within the seven-day life of the pump.

The pressure is nominally set at -80mmHg and a single push of the orange button starts the therapy. If the button is pushed again, the therapy will pause and will automatically restart after an hour if the button is not pressed again before this time. A range of dressing sizes are available, but the dressing should be big enough to cover both the wound and allow the port to be situated on healthy periwound skin. It is essential to ensure that the port is not placed on the open wound as this may lead to fluid transfer via the dressing into the tubing that connects the dressing to the device. This can affect treatment, as it could cause a blockage which would lead to reduced or no pressure being delivered.

It has been demonstrated that the action of PICO dressings alone, or in combination with a foam or gauze filler, is virtually identical to the mechanism of action of conventional, more cumbersome NPWT devices (Borgquist et al, 2010).

The patient/carer does need to be able to manage the device, which involves understanding how to silence the alarms, troubleshoot, and disconnect and reconnect the device

Application tips

Tips to ensure successful NPWT application include:

- Wound size and volume: wounds greater than 0.5cm in depth are likely to require a foam or gauze sub-filler and wounds treated with larger dressing sizes should generally be no more than 2cm in depth — the filler will need to be changed two or three times per week
- Amount and type of exudate: when used on moderately exuding wounds, the size of the wound should be no bigger than 25% of the dressing pad
- The wound should fit comfortably within the area of the pad, allowing the port to be situated over healthy skin
- Showering is permissible: the pump should be disconnected and kept in a safe location outside of the shower, and the dressing tubing should hang downwards to prevent any water getting in.

to allow activities of daily living to take place, such as bathing, dressing, etc. Consideration should also be given to the following issues:

- Can the patient store/carry the pump safely when mobilising?
- Does the patient know who to contact in an emergency, e.g. heavy bleeding?
- Is the patient psychologically/cognitvely capable of coping with NPWT?

SETTING TREATMENT GOALS

The best way to demonstrate outcomes from any intervention is to establish treatment goals. In relation to NPWT, these might include:

- Decreasing wound size (length, width and depth)
- Managing/reducing exudate volume
- Kick-starting healing in a stalled wound
- Increasing granulation tissue
- Symptom management/other patient-related factors, e.g. in palliative wound care.

Treatment goals should be reassessed weekly to ensure that NPWT continues to be the most appropriate therapy. It is also essential to address any underlying pathophysiology, for example offloading and glycaemic control in patients with DFUs; treating venous hypertension with compression; or managing poor nutrition.

NPWT can be started to expedite wound healing and/or to kick-start healing in stalled wounds. Before initiating therapy, clinicians should assess the following:

- Patient suitability for treatment in relation to the home environment
- Support and coping mechanisms
- Accessibility of and selection of the correct type of device to manage the wound.

Furthermore, the wound bed should be assessed and debrided if there is slough or necrosis present (i.e. the preparation phase), and any underlying systemic factors should be addressed, such as malnutrition or venous hypertension in conjunction with the therapy. A goal should also be established (i.e. promote healing) and an evaluation date set.

KNOWING WHEN TO STOP OR CHANGE TREATMENT

NPWT should be discontinued when the initial therapy objectives have been met, for example:

- When there is 100% granulation tissue in the wound bed
- Where the granulation tissue is level with the surrounding skin
- Where the exudate volume has been reduced to under 20mls per day
- If the patient requests that NPWT be stopped
- When no improvement/reduction in wound size is seen after two consecutive dressing changes.

Campbell et al (2008) suggested that nurses should look for double-digit exudate volume reduction week-on-week as a general guide to assessing the efficacy of NPWT treatment. In the author's clinical experience, the benefits of NPWT will be evident within the first week of treatment. As a result, accurate wound measurement is an integral part of the assessment process and to evaluate treatment. Unfortunately, uninformative statements such as 'healing well' are often used in wound documentation where actual measurements are required to demonstrate progress (Hon and Jones, 1996; Sterling, 1996).

Measuring wound size

The recording and monitoring of changes in wound size, including percentage change from baseline, can provide valuable clinical information. More importantly, it can help to predict wound healing (Tallman et al, 1997; Sheehan et al, 2003), which is important in the current health service where monitoring costs is paramount. Similarly, if onward referral and investigations are warranted, accurate measurements of wound area are an important piece of medical information (Gethin, 2005).

As the wound heals, fresh granulation tissue reduces the wound depth and volume, while new epithelium reduces the wound area. Therefore, measurement of size provides a direct indicator of healing (Schultz et al, 2005). Being able to predict whether wounds will heal readily with conventional treatment and deciding which patients are candidates for more expensive new treatments is also important (Tallman et al, 1997; Kantor and Margolis, 2000). Continuous monitoring of changes in wound size is key to this process.

Benefits of disposable NPWT

- Smaller, more manageable device that is easy to carry/conceal
- No canister to empty/dispose of
- Fewer dressing changes (weekly or twice-weekly)
- Battery-operated without wires
- Easy to use — on/off button only
- Visual display provides reassurance that the device is active and working
- No risk of losing the device as it is disposable
- Fully reimbursable in the UK through prescription

The value of being able to measure the wound size has been demonstrated by Margolis et al (2000). In a retrospective cohort study of 260 patients, the researchers were able to predict healing in venous leg ulcers at 24 weeks in 95% of cases through wound measurement.

An additional advantage of monitoring wound size is that plotting healing rates against the initial wound measurements and then comparing them with a defined standard helps to inform clinical decision-making and reduces the likelihood of prolonged use of ineffective treatments (Flanagan, 2003). Similarly, in the long term, information on wound size can help establish baseline healing rates for different wound types — this can aid analysis of healing patterns, allow objective comparisons of different treatments and assist with reliable cost-benefit analysis (Flanagan, 2003).

Flanagan (2003) also suggested that a percentage reduction in wound size of 30% or more after four weeks of treatment can reliably predict ulcer healing. The period of four weeks is a good guide for nurses when considering how long to continue with a particular course of treatment (provided no adverse changes occur). This time period can be used alongside objective wound

monitoring data to enhance nurses' decision-making, as determining the healing rate will help to plan appropriate therapeutic strategies and avoid unnecessary or irrational changes in therapy. It also helps when evaluating a wound's progress and ensures that any planned change in treatment matches the next stage of the healing process. For example, dressings used to stimulate granulation tissue are generally occlusive, as wound healing is driven by tissue hypoxia, however continued use of these when granulation tissue is level with the periwound skin may lead to overgranulation. Thus, more breathable products that stimulate and support the epithelial process should then be used.

If the wound is failing to progress, further investigation is warranted. Regular reassessments are currently the only way of determining the effectiveness of a treatment, quantifying and documenting progress, and guiding treatment decisions (Keast et al, 2004).

While it is acknowledged that objective methods such as wound size are invaluable in providing baseline information, they do not comprehensively answer the question: 'Is this wound the same, better or worse than before?'. This can only be determined through ongoing monitoring of patient-reported symptoms and observation of improvement according to the principles of wound bed preparation, i.e. has the condition of the wound bed changed (more/better quality granulation tissue, less slough, has odour reduced, is exudate controlled/less, etc) (Schultz et al, 2005). However, in the author's clinical experience, accurate wound measurement remains an invaluable objective component to wound assessment.

Calculating wound size

Wound measurements are now commonly seen on standard wound care documentation. However, wound size reduction is not. To facilitate the collection of this data, the author and a wound care company (Smith & Nephew) have developed a simple wound size calculator (*Figure 2*). This follows a similar format to the well-established ankle brachial pressure index (ABPI) 'ready reckoners'. One side of the tool helps nurses calculate the wound area using an ellipse formula, while the flip-side can be used to establish if the wound has reduced in size (using a percentage reduction). (Note: the table may not give accurate results if the wound shape differs significantly from an ellipse.)

If baseline measurements are taken, the wound size calculator can be used to establish the progress being achieved or potential for chronicity. *Figure 3* shows the second table that helps work out the percentage change in wound area by comparing previous and current wound measurements. Percentage reduction in wound area is shown in the green cells and any increase by the red cells. A weekly reduction in wound area of 10–15% or more indicates a positive response to treatment with NPWT.

As discussed above, a 30% reduction in the first four weeks of treatment is a good prognostic indicator. Any increases in wound area during the use of NPWT or any therapy, with the exception of palliative wounds where symptom management is the goal, warrants further investigation:

- Is the differential diagnosis correct?
- Has the patient's general condition deteriorated?
- Is the treatment addressing the underlying cause of the wound?

HEALTH ECONOMICS OF NPWT

Practitioners are often asked to justify their use of NPWT, and in particular, year-on-year prescribing expenditure. The absence of large-scale cost-utility analyses supporting NPWT can make justification difficult for funding bodies. Decisions whether to use NPWT, and when to initiate or discontinue the treatment, should be clinically driven and based on the desired clinical outcome, taking into account the clinical indications of the therapy. With this in mind, it is useful to develop relatively simple tools that can be used to compare the weekly cost of treatment. Such calculators can be used as an aid to decision-making when considering switching from advanced wound care to NPWT or vice-versa, and can also be used as treatment progresses at regular intervals to ascertain the point at which the weekly cost of advanced wound care falls below the cost of NPWT (Searle and Milne, 2009).

CONCLUSION

The success or failure of NPWT does not rely solely on the physical signs

Wound area quick carculator

The table shows the wound area in cm² for a given length and width

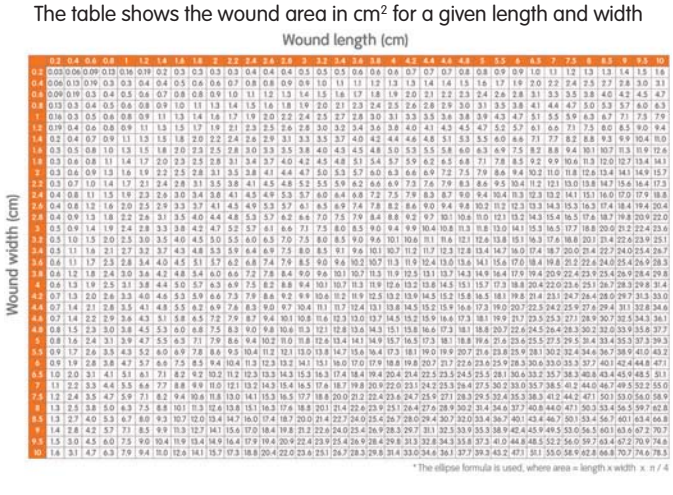

Figure 2. *Wound area quick calculator.*

Wound area change carculator

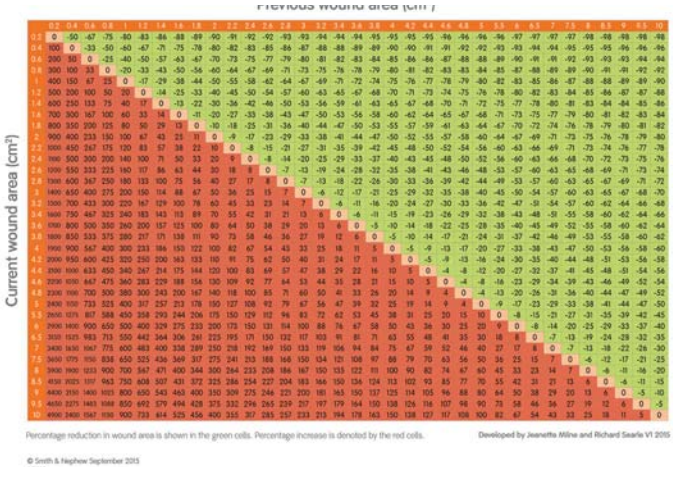

Figure 3. *Wound area change calculator.*

and symptoms of the wound. It is also imperative that the patient involved is able to make an informed choice about the therapy, and also that his/her overall health and wellbeing is considered in the holistic assessment to ascertain if he/she can safely cope with the technique.

These considerations may also differ dependent on the care setting, nurses' knowledge, patients' physical and mental infirmities, and patients' actual and perceived support mechanisms.

In the author's experience, disposable NPWT is a useful addition to the woundcare tool box, as it can successfully and cost effectively achieve wound healing goals. In some instances, such as pilonidal disease, leg ulcers failing to respond to compression alone and sub-acute surgical wounds, it can re-stimulate healing in an otherwise stalled wound. In general, it is acceptable to patients, and the rapid improvements seen in terms of size and volume reduction can offer immeasurable reassurance that progress is being made. Wound exudate is also well managed, as it is diverted away from the skin and contained in the dressing. This not only protects the wound edges and surrounding skin from maceration, but also reduces the frequency of dressing changes, compared with conventional dressings. This, in turn, can lead to reduced pain for the patient, as well as less wound exposure to the external environment. Earlier patient mobilisation also contributes towards a sense of patient wellbeing, such as in skin grafts treated with NPWT (Ousey and Milne, 2009; Timmons and Dowsett, 2012).

There are few tools to aid nurses' treatment choices. As a result, these can become intuitive and based on past experience of managing patients with wounds. Nurses using NPWT should regard wound measurement as a method of feeding back clinical information to patients and family, as a measure of progress, and also to justify treatment choice versus cost-effectiveness. JCN

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Case report 1

Bilateral leg ulceration

Lorraine Grothier, consultant nurse, tissue viability, Tissue Viability Centre, Provide CIC

This lady had a history of long-standing leg ulceration. Healing had been achieved but on an episodic basis and re-ulceration had always occurred.

Initial examination revealed an extensive area of ulceration to the left medial gaiter area, and the ulcer had been increasing in size despite treatment with compression bandaging. The majority of the wound bed was covered in a layer of slough, with no evidence of epithelial advancement.

Despite treating with appropriate wound management products and compression bandaging, there had been no significant advancement towards healing for some time.

PICO™ INTERVENTION

PICO™ was used in conjunction with a PROFORE™ 4-layer bandaging system for three weeks, with polyhexamethylene biguanide (PHMB) gauze to lightly pack the shallow cavity.

During the 21 days of treatment with PICO, the wound made significant progress towards healing. The condition of the wound bed improved considerably, with islands of epithelial tissue emerging within the wound.

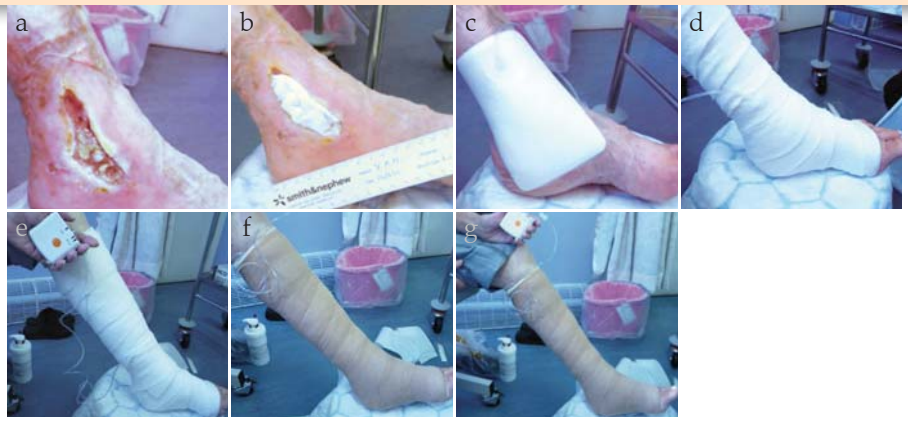


Figure 1.
Application of PICO™ and PROFORE™.

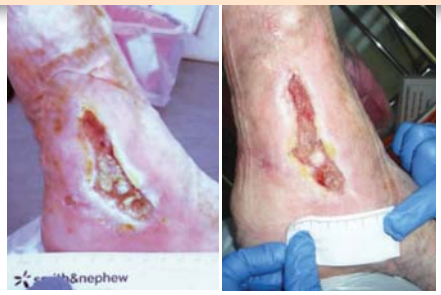


Figure 2.
Appearance of the wound before treatment with PICO (left) and after 21 days of treatment with PICO in conjunction with multilayer compression bandaging (right).

Case report 2

Slow-to-heal leg ulcer

Pat McCluskey, clinical nurse specialist in wound care, Cork University Hospital Group

BACKGROUND

Mrs P was a mother of three in her mid-forties. She led an active lifestyle until recently when she developed a leg ulcer on the anterior aspect of her left lower leg following mole removal by her GP.

MEDICAL HISTORY

She had deep venous thrombosis in her left (x2) and right (x1) legs, for which she was treated with anticoagulant therapy (warfarin). She had a cholecystectomy at 40 years of age. She smoked 10 cigarettes daily for 20 years but had stopped four years ago. Since then she had gained considerable weight (21lbs). Mrs P developed an ulcer on her left leg three years ago, which had healed with compression therapy in 10 weeks. She continued to wear compression hosiery for a short period of time, but then stopped.

RECURRENCE OF LEG ULCERATION

After Mrs P's GP removed a suspicious mole from her left lower leg, the resultant incision dehisced after the sutures were removed revealing a wound of 2.5x2.5cm.

Routine vascular investigations revealed:

- Anke brachial pressure index (ABPI) = 1.1
- Obvious haemosiderin staining
- Ankle flare and oedema.

PREVIOUS MANAGEMENT: YEAR ONE

Despite treatment for one year with the 'Gold Standard' of graduated compression therapy, there was no progress towards healing.

In conjunction with compression therapy, a variety of antimicrobial dressings were employed to address problematic bacterial burden. Oral antibiotics were also prescribed on two occasions to treat wound infection.

Mrs P was upset and anxious due to the wounds's failure to heal, despite a year of intensive treatment.

Given the static nature of the wound, a punch biopsy was taken which showed stasis dermatis.

SURGICAL INTERVENTION

Mrs P was referred to the plastic surgeon to be assessed for potential skin grafting, and was admitted for surgical debridement.

Extensive surgical debridement of the wound and surrounding inflammatory tissue and haemosiderin staining was performed.

A split-thickness skin graft was taken and applied to the wound in conjunction with cannister-based negative pressure wound therapy (NWPT) and compression therapy.

At review five days later, there was 100% take of the graft — compression therapy was continued and Mrs P was discharged after a 10-week inpatient stay.

GRAFT FAILURE

At the initial outpatient clinic follow-up appointment there was 50% loss of the graft.

Bacterial burden was believed to

be the cause, and a wound swab grew *Pseudomonas aeruginosa* and Gram negative Bacilli.

Mrs P was started on oral ciproxacillin, and compression therapy and antimicrobial dressings were used in the following weeks.

However, progress towards healing was extremely slow, and so Mrs P was referred to the clinical nurse specialist for review eight weeks after the initial appointment.

INITIAL PRESENTATION TO CLINICAL NURSE SPECIALIST

At initial assesment by the clinical nurse specialist, the wound's dimensions were 5.8x4.8cm, with a calculated wound area of 21.9cm^2 *(Figure 1)*. The surrounding skin was healthy and Mrs P was no longer on any antibiotic therapy.

PICO™ THERAPY STARTED

Due to the chronic and static nature of the wound, it was decided to initiate PICO™ NPWT in an attempt to kick-start progress towards healing.

PICO was used in conjunction with two-layer full compression bandaging and a silver primary dressing (ACTICOAT™ Flex), as a wound contact layer to help reduce microbial load in the wound bed, where it was suspected that a biofilm might have become established.

PROGRESS WITH PICO: WEEK TWO

At initial follow-up after two weeks of PICO therapy, the wound had made excellent progress following weeks of stasis *(Figure 2)*. There was minimal exudate and the periwound tissue was healthy.

PICO therapy was continued in conjunction with two-layer compression bandaging and an ACTICOAT Flex primary layer.

PROGRESS WITH PICO: WEEK FOUR

At review after four weeks of PICO therapy, the wound had continued to improve and progress towards healing. Epithelial advancement meant that rather than one large ulcer the wound now comprised a number of small isolated areas of healthy moist granulation tissue.

Thus, PICO was continued in conjunction with two-layer compression therapy and the silver primary dressing was discontinued.

FINAL REVIEW: WEEK SIX

At final review following six weeks of PICO therapy, a single small area of broken skin remained at the superior aspect of the graft area *(Figure 3)*.

As the wound was virtually healed at this point, PICO therapy was discontinued, but the use of two-layer compression bandages was continued.

IMPACT OF PICO INTERVENTION

PICO proved highly effective in this case, with the wound progressing almost to complete healing during the six weeks of PICO therapy, despite having failed to make similar progress in the preceding year.

EXPERIENCE OF PICO INTERVENTION

Mrs P found PICO therapy comfortable and easy to live with.

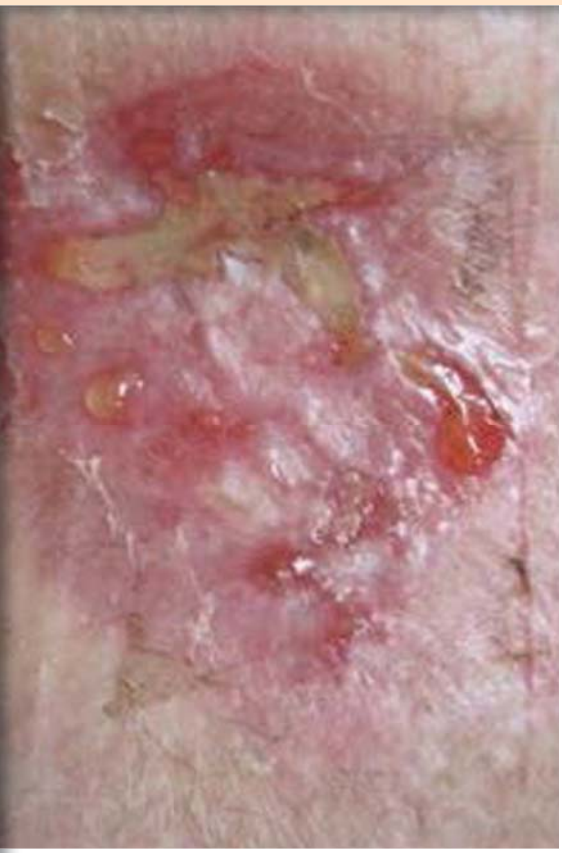


Figure 1.
Wound at initial clinical nurse specialist assessment before PICO therapy (wound dimensions = 4.8x5.8cm; calculated wound area = 21.9cm^2).

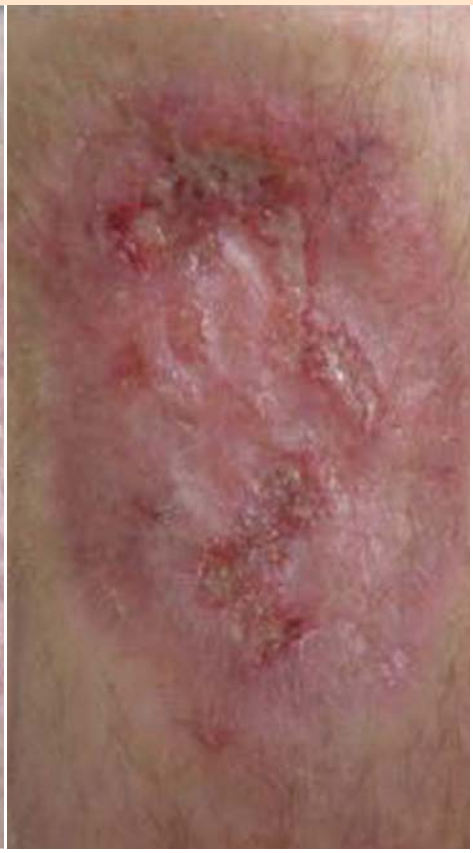


Figure 2.
Wound improving after two weeks of PICO therapy.

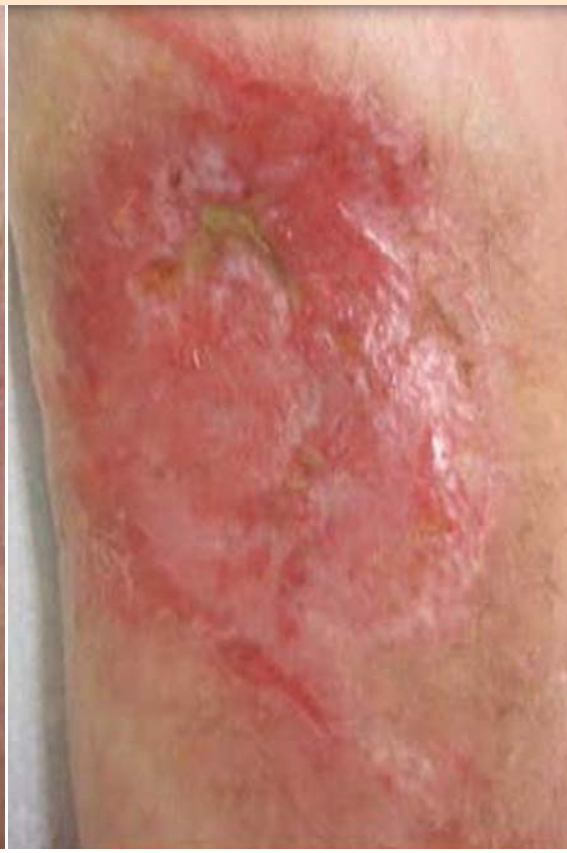


Figure 3.
Wound considerably improved at discontinuation of PICO following six weeks of therapy.

Case report 3

Pressure ulcer

Louise Skerritt, tissue viability, health service executive, Dublin Mid-Leinster

BACKGROUND

Mrs A, a female in her early fifties with a history of multiple sclerosis presented for treatment. She was using a motorised wheelchair and transferred from chair to bed with a standing hoist. She had a pressure-relieving cushion on her chair and an alternating mattress on her bed. Despite these pressure-relieving measures, Mrs A had developed a category III pressure ulcer measuring 3x2x0.5cm (length x width x depth). The wound was located just below the left lateral malleollus and had been present for approximately 18 months.

Initial assessment of the wound identified a stagnant wound bed with smooth, pink, non-granular tissue (*Figure 1*). Wound margins were detached from the surrounding tissue and the periwound skin was red, macerated and oedematous.

This wound had been dressed three times per week, as the anatomical position, coupled with the presence of oedema, made it difficult to secure a dressing in place for more than two days. There was a moderate volume of malodorous exudate.

Mrs A experienced variable levels of wound-associated pain, with discomfort increasing progressively if the dressing was left in place for longer than three days. She found the frequency of dressing changes disruptive to her daily life.

The patient and carer were educated on the importance of regular pressure redistribution and the use of pressure-relieving appliances to mitigate the pressure, shear, and frictional force central to the development and non-healing of pressure ulceration.

PICO™ KICK-START INTERVENTION

During the first week of PICO™ therapy, the wound required two PICO dressing changes due to elevated exudate volumes. This increase in exudate volume was thought to reflect a change in the wound's status to a more acute state, from which it could then begin to progress towards healing.

At the end of the first week, the wound bed showed a 40% increase in granulation tissue and the surrounding oedema was resolving. Exudate volumes decreased by 50% within the first week of using PICO, and this reduction in exudate was maintained for the duration of the PICO treatment period — resulting in a single weekly dressing change. Granulation continued and after 14 days of PICO use the wound bed comprised 100% granulation tissue (*Figure 2*). The condition of the periwound skin had also improved, with the erythema and oedema considerably reduced. On day 21 (*Figure 3*), the final day of using PICO, the wound bed had filled with granulation tissue and was now level with the wound edges, presenting with 90% granulation and 10% epithelial tissue.

PICO KICK-START IMPACT

Following intervention with PICO there was a considerable increase in healing progression within the wound bed. Profuse granulation tissue formation was observed within the wound which had failed to improve during the previous 18 months. The application of PICO also corresponded to enhanced epithelial cell migration from the wound margins. The significant reduction in the volume of exudate led to fewer dressing changes and consequently minimised issues such as damage to delicate new tissue, pain and infection risk.

ALLEVYN™ Gentle Border was applied to maintain a moisture balance within the wound bed and protect the newly-formed granulation and epithelial tissue. The wound management regimen was supported by appropriate pressure area care, including pressure relief redistribution measures and good skin care.

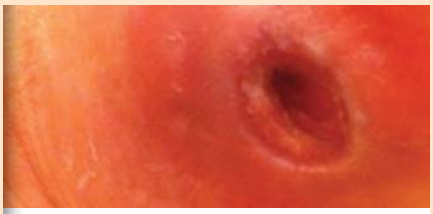


Figure 1.
Day 0.

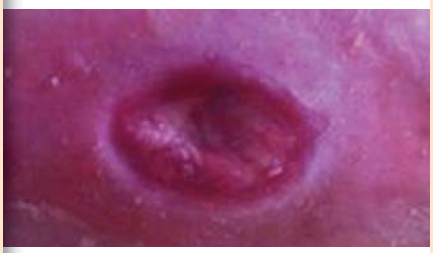


Figure 2.
Day 14.

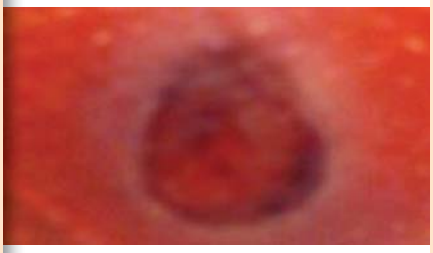


Figure 4.
Day 21.

PATIENT WELLBEING

Mrs A felt restricted by the times she was required to undergo dressing changes. The new regimen of weekly PICO dressing changes therefore proved beneficial. Mrs A reported that the compact size of the PICO pump was very discreet and the dressing eliminated the need for thick absorbent padding. To see that the wound had made such a significant improvement over a short timeframe was also very encouraging and had a positive effect on her mental wellbeing.

NURSING RESOURCES

Due to the anatomical position of the wound and the fact that Mrs A's lower limbs had been affected by multiple sclerosis, her legs needed to be lifted by the nurse while they simultaneously secured a dressing using a conforming bandage. The application of the PICO dressing proved simple, and when applied it contoured well to the anatomical shape of the wound's location, without requiring a bandage to secure it.

Before PICO, community nurses had been visiting Mrs A three times per week for the past 18 months, amounting to approximately 234 visits. The use of PICO enabled this wound to be dressed once a week, leading to a reduction in nursing hours. Pressure ulcers are associated with pain, infection, exudate, malodour and distress, in addition to prolonged hospitalisation and increased mortality. They also contribute to decreased functional status and quality of life. Utilising PICO in the treatment of this pressure ulcer reduced pain, malodour, exudate, dressing frequency and distress that these problematic wounds inflicted on Mrs A. In addition to these benefits, the use of PICO offered the potential to reduce demands on health service budgets and resources.

Case report 4

Diabetic foot ulceration

Andrew Sharpe, advanced podiatrist in wound care, Southport and Ormskirk NHS Trust

BACKGROUND

Mr E was 58 years old with a history of type 2 diabetes and known peripheral arterial disease (PAD). His right first toe had been amputated in 2012.

He presented on 4 February 2015 at the author's clinic with a diabetic foot ulcer that he had been self-managing for three weeks. At this stage, the ulcer was 3x2.2cm (6.6cm^2) and approximately 0.4cm deep (with no known osteomyelitis). Following debridement, it comprised 30% granulation and 70% sloughy tissue. A high–moderate volume of exudate was present (*Figure 1*).

Previous treatments included antimicrobial and absorbent dressings to manage the exudate, which were changed three times a week (once by the podiatry service at his weekly visit and twice at home by his wife, who was a qualified nurse, due to the exudate volume and smell). The wound was significantly impacting on Mr E's lifestyle, due to the volume of exudate and odour, and the fact that he was unable to wear normal footwear.

INTRODUCTION OF PICO™

Six weeks after presentation, due to the chronicity of ulceration, Mr E's history of amputation, increasing volumes of exudate and failure of previous interventions to progess the wound to healing, it was decided to use PICO™ to kick-start the healing process and move the wound from its current chronic state to a dynamic healing state.

At the first dressing change after using PICO for four days (*Figure 2*), the wound had reduced in size to 3x1.7cm (5.1cm^2) — a reduction of 5mm within four days. A further redution was seen at day seven (*Figure 3*), with the wound measuring 2.7x1.7cm (4.59cm^2). Although at the next dressing change (10 days after starting treatment), the wound's dimensions remained the same, there was an improvement in the tissue types present in the wound bed — 70% granulation and 30% sloughy tissue. By day 21, epithelialisation was occurring at the wound edge and the sloughy tissue was lighter and easier to clear away (*Figure 4*).

Throughout the four-week treatment period, the wound consistently improved and measured 2x1.7cm (3.4cm^2) at day 28 (*Figure 5*).

EXPERIENCE OF USING PICO

While there was a problem in securing the seal at the start of PICO therapy, this was quickly overcome with the extra tape provided in the pack. After further discussion about how the system can sometimes buzz after movement, Mr E's initial apprehensions were allayed and he was confident with the system. He was happier that the dressing was less bulky and he could wear his own shoes, enabling him to go out and socialise.

After just four weeks of treatment with PICO, the ulcer site and wound bed improved and, indeed, continued to do so thereafter (*Figure 6*).

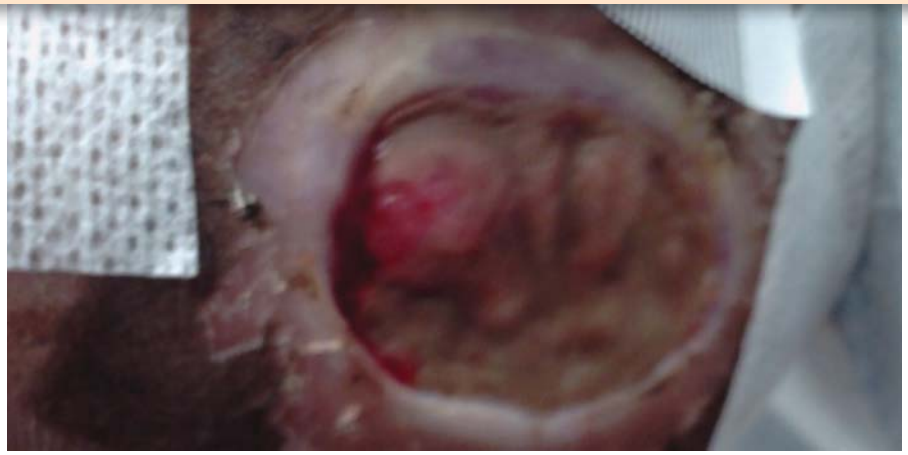


Figure 1.
Day 0: before PICO™ intervention, wound measured 3x2.2cm.

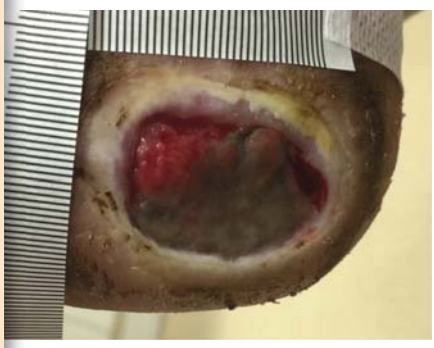


Figure 2.
Day 4: first dressing change.

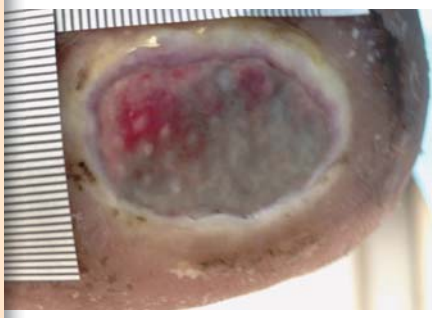


Figure 3.
Day 7: wound measured 2.7x1.7cm.

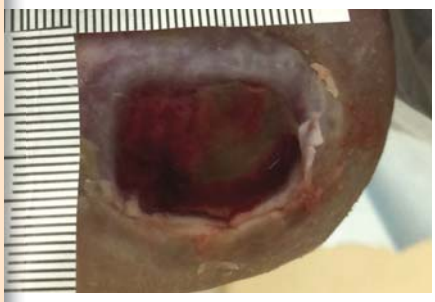


Figure 4.
Day 21: wound measured 2.4x2cm.

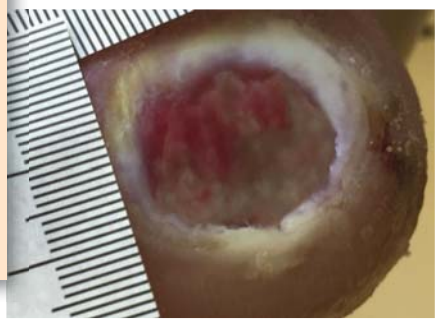


Figure 5.
Day 28: wound measured 2x1.7cm.

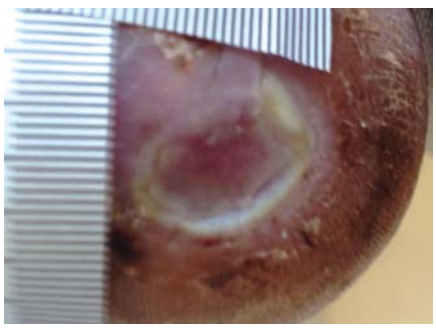
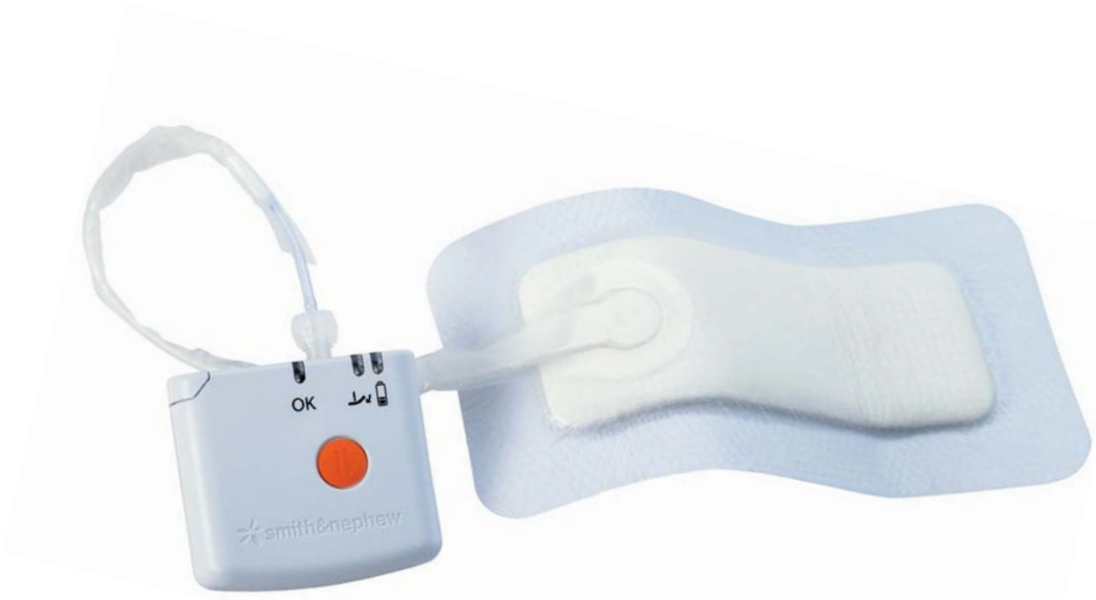


Figure 6.
Day 56: improvement still seen.

Celebrate
POSITIVE LIVES
with PICO



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