# Using a portable, multi-week single-patient use negative pressure wound therapy device to facilitate faster discharge

KEY WORDS
- Negative pressure wound therapy
- Wound management
- Cost effectiveness
- Patient acceptability

Negative pressure wound therapy, while used in various forms since circa 400 BC, has mainly been utilised in surgical wound management such as in the open abdomen or in trauma wounds. However, over the past decade, its use in chronic wound management has gained traction, with a variety of systems for home and secondary care use now available. In this article, two case studies are presented where a single-patient NPWT device, the Avance® Solo, was used to manage wounds in the community. The system proved to be clinically effective, cost-effective and acceptable to the patients, allowing them to continue with their daily activities at home.

LINDA GLEESON
*Consulting Centre Sister, The Clementine Churchill Hospital, Sudbury Hill, Harrow*

MARY BOND
*The Clementine Churchill Hospital, Sudbury Hill, Harrow*

It is said that if you live long enough, you'll see things come round again. While this may be true for platform shoes, most of us were not alive when the precursors to negative pressure wound therapy (NPWT), 'sucking' and 'cupping', were first used. Since around 400 BC, poisons and toxins have been either sucked out of a wound by the 'physician', for example, in cases of snake bite, or cupped out (Kubek et al, 2013). Both methods of removing toxins from wounds use suction. Over the centuries, methods were refined and the first mention of a 'vacuum' wound treatment appeared in the Russian literature in the 1980s (Kubek et al, 2013). Variations on the theme continued until the mid-1990s, when the Vacuum Assisted Closure (VAC™) system, the forerunner of most modern negative pressure wound therapy (NPWT) systems, was developed by Argenta and Morykwas (1997).

Meta-analyses (Suissa et al, 2011; Zhang et al, 2014), systematic reviews (Bruhin et al, 2014, Xie et al, 2011), literature critiques (Stannard et al 2012; Krokowicz et al, 2014), and evidence based recommendations (Vig et al, 2011; The National Institute for Health and Care Excellence [NICE], 2013), provide a plethora of evidence to show the financial, clinical and patient benefits associated with the use of NPWT. These include:

- Rapid wound granulation, epithelialisation and contraction (Armstrong and Lavery, 2005)
- Reduction in the number of dressing changes required, thus less clinician time required (Mouës et al, 2005)
- Good exudate management and reduction of oedema (Morykwas et al, 1997)
- Mechanical deformation of the wound edge tissue (Morykwas et al, 2006)
- Direct stimulation of granulation tissue (Webb, 2002)
- Improvement in patient quality of life (QoL) (Ousey et al, 2014)
- Reduced wound management costs (Searle and Milne, 2010).

## THE MECHANICS OF ACTION

Negative pressure wound therapy (NPWT), also known as topical negative pressure or vacuum-assisted closure therapy, uses a closed drainage system to apply controlled suction to the wound bed. A wound contact layer may be applied, followed by a wound filler (open-pore polyurethane foam or saline-moistened gauze), or the filler may be applied directly to the wound bed. The choice of gauze or foam filler depends on the wound and/or system used, and should take into account patient preference and any clinical/environmental factors. Gauze can be more conformable to the wound, so is particularly useful for large and/or irregular wounds (Jeffrey,

2009); it may also minimise scarring (Jeffrey, 2009). Studies have demonstrated that using foam filler produces thick, hypertrophic granulation tissue, whereas gauze produces thinner, dense granulation tissue (Borgquist et al, 2009). However, it must be acknowledged that if a wound contact layer is not applied when using a foam filler, granulation tissue may grow into the foam (Borgquist et al, 2009), causing pain and/or bleeding on removal, disruption of the wound bed tissue, and the possibility that foam may be left in the wound bed, acting as a focus for infection.

When negative pressure is applied, the filler is compressed into the surface of the wound, leading to a reduction in microvascular blood flow at the wound bed and contraction at the wound margins (macro-deformation). Exudate is sucked from the wound through the dressing and is transported via tubing to the collection canister.

Suction is applied either continuously or intermittently (Henderson et al, 2010); continuous suction is recommended at the start of NPWT and for highly exuding wounds, whereas intermittent suction can be used once exudate levels have decreased, although it has been associated with heightened pain (Malmsjö and Borgquist, 2010). Negative pressure is often applied at -125 mmHg, although this may cause some pain to patients (Malmsjö and Borgquist, 2010). Clinical studies have demonstrated that healing can be achieved with pressure as low as -75 mmHg (Malmsjö and Borgquist, 2010), although Malmsjö and Borgquist (2010) cite evidence that suggests that the pressure may be tailored to the patient's risk of ischaemia and pain tolerance.

## USE OF NPWT IN THE COMMUNITY

Historically, negative pressure wound therapy was generally used only in secondary care, partly reflecting its initial use in surgery, but mainly due to the size of the units, rental/purchase costs, and the associated consumables. Thus, its use in primary care has been restricted (Newton et al, 2006; Dowsett et al, 2012). However, government initiatives have called for rapid discharge of patients from in-patient and out-patient hospital care and a greater emphasis of care in community and home settings (Department of Health [DH], 2009; 2011). Therefore, as cited by Ousey and Milne (2014), the DH has acknowledged that NPWT could be used to manage complex wounds in community settings. Accordingly, smaller, more portable units such as the Avance® (Mölnylcke Health Care), the VAC™ Freedom Therapy Unit (KCI) and Renasys (Smith and Nephew) systems have now become available, as have single-patient use NPWT devices such as PICO (Smith & Nephew) and the Avance® Solo NPWT system (Mölnylcke Health Care). Here, the authors present two case studies demonstrating how the use of one such single-patient device, the Avance® Solo NPWT system, facilitated faster discharge of patients from an acute care facility, thereby effecting better clinical and psychological benefit for the patients and cost savings for the healthcare provider.


**Figure 1. The Avance Solo NPWT unit.**

This article presents two simple case studies where Avance® Solo was used. Both patients gave consent for their cases and photographs to be used.

## AVANCE® SOLO

The portable Avance® Solo single-patient use pump delivers negative pressure for multi-week treatment. As it is small and light (only 400 g), the Avance® Solo pump can be easily and discretely carried or worn so that patient have greater flexibility and mobility (*Figure 1*). This small, easy-to-use system facilitates early discharge from the hospital, thus allowing patients to continue with negative pressure wound therapy at home for up to 60 days with the same pump.

Because Avance® Solo is a single-patient use system, the usual time-consuming administration

associated with transferring units between sectors, pump rental, tracking and management is negated because, as with any other consumable, the pump belongs to the patient.

Other benefits include:

- A choice of multiple levels of negative pressure (between -60 and -175 mmHg)
- Both continuous and intermittent modes
- Ease of use; only four buttons to operate
- Flexible dressing options (foam or gauze dressings)
- Easy storage.

## Case study 1

Mrs Brown (pseudonym), a 67 year old who had undergone fusion of C3/C4 cervical vertebrae for Stage 1 posterior cervical decompression, was referred to the tissue viability nurses (TVNs) eleven days after surgery. Her medical history included compressive cervical myelopathy at C3/C4, hypertension, severe osteoarthritis, hypercholesterolaemia, and hypothyroidism.

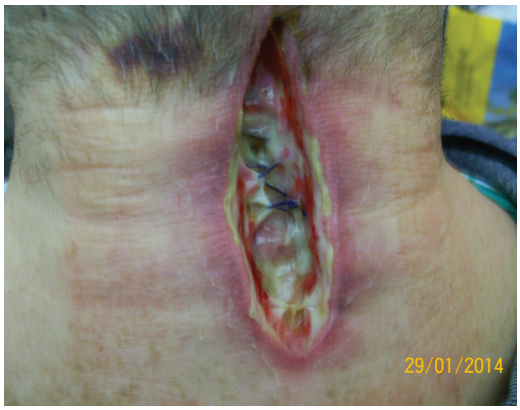


Figure 2. Case 1 - Wound after sharp debridement (day 6).

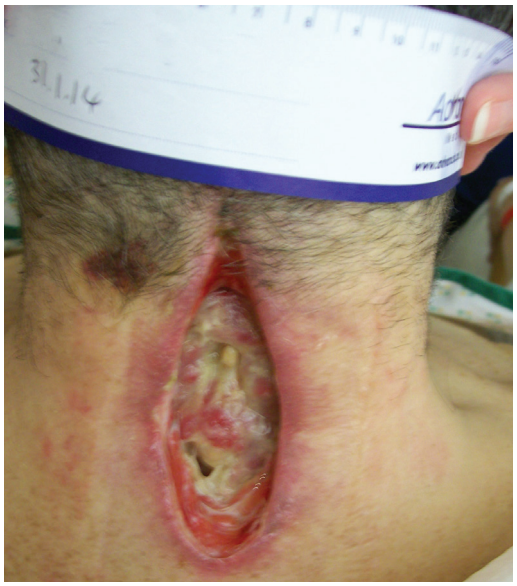

Figure 3. Case 1 - Wound prior to application of Avance Solo.

**Day 0 (referral, 11 days post operatively):**
On assessment, the suture line was inflammed and highly exuding. A wound culture swab was taken and the wound was dressed with Aquacel® Ag rope (ConvaTec). Results showed moderate growth of *Staphylococcus aureus*.

**Day 2:**
The consultant explored and laid open the lower aspect of the wound. Prontosan gel® (B Braun) was used to clean the wound, which was then packed with Aquacel® Ag (ConvaTec). A Sorbion® sachet (H&R Healthcare) was used as the secondary dressing. At this time, the wound dimensions were: depth 3 cm, length 5 cm, and width 2 cm.

**Day 6:**
The patient was reviewed by the TVNs and the consultant reviewed the patient. An area of slough in the wound was debrided by the consultant (*Figure 2*). Mrs Brown was informed that further exploratory surgery was a possibility.

The TVNs and the consultant discussed using NPWT, but as there was exposed bone in the wound, it was agreed to discuss this option with the Mölnylcke Health Care representative—while not contra-indicated where bone is exposed, it should be used with caution (Henderson et al, 2010).

**Day 7:**
On assessment the wound showed 80% granulation tissue and 20% infected/sloughy tissue, and a healthy-looking peri-wound area. No pain was reported. The dressing was changed and the regimen continued

**Day 8:**
After examination by the consultant, the patient was taken to theatre for insertion of a Redivac drain. This was removed at day 12.

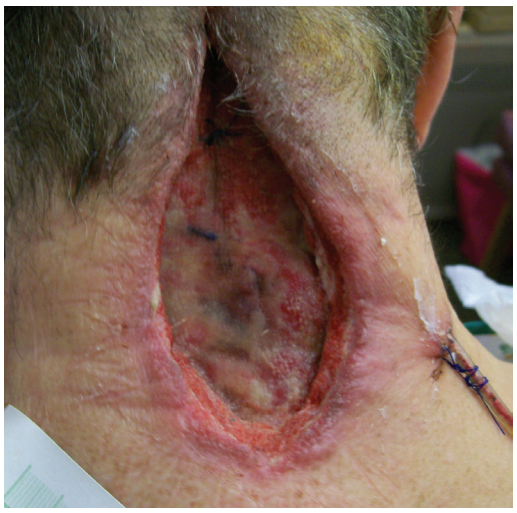

Figure 4. Case 1 wound two days post-application of NPWT.

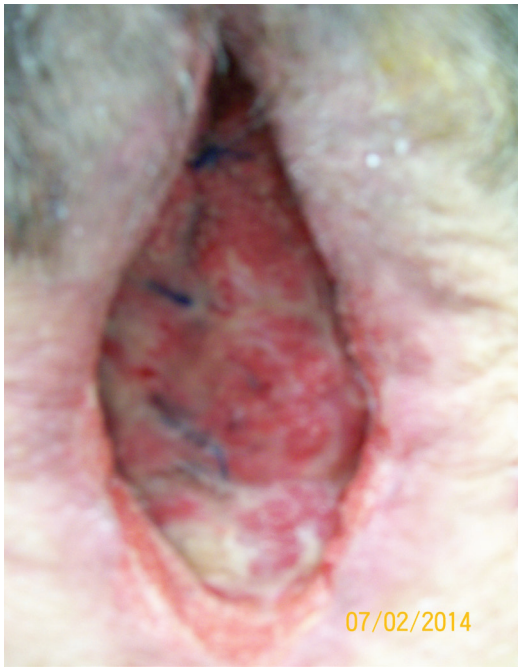


Figure 5. Case 1 wound 4 days post-application of NPWT

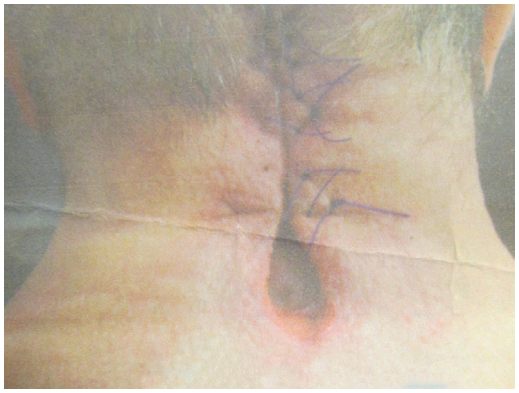

Figure 6. Case 1 wound 10 days post-application of NPWT

An Avance® Solo pump, using continuous pressure at -100 mmHg, was applied. *Figure 3* shows the wound prior to using NPWT. UrgoTul® SSD (Urgo Medical) was used as a wound contact layer to protect the exposed bony structure, and two pieces of Avance Foam applied. Mepiseal® with Safetac® (Mölnlycke Health Care) was used to ensure a good seal as the wound bed was predominately in the hair line.

**Day 12:**
At this dressing change, only one piece of foam was required (*Figure 4*). The patient was able to mobilise at will and happy to have visitors because she felt that the fluid collection canister was small and discreet.

**Day 14:**
The wound continued to progress (*Figure 5*).

**Day 17:**
The consultant and the TVNs discussed a surgical closure of the wound. However, the tissue viability team suggested continuing NPWT for a further period, increasing the negative pressure to -125mmhg (continuous) to further promote granulation.

**Day 20:**
It was agreed with the patient that the top of the wound would be sutured while the base would be left open and NPWT continued. Wound suturing was undertaken by the consultant in theatre. (*Figure 6*)

**Day 24:**
The wound was now 2 cm long and 0.2 mm deep, so it was decided to discontinue the NPWT. The wound was dressed with Aquacel® Ag rope and a Sorbion® sachet.

**Day 26:**
The patient seemed much happier, but anxious for the wound to granulate. Continuous pressure NPWT was recommenced.

**Day 31:**
The NPWT was discontinued. As prophylaxis, the wound was dressed with Aquacel® Ag rope,

a Sorbion® sachet and Mepore® Film (Mölnylcke Health Care).

**Day 32:**
The patient was discharged to the care of her general practitioner.

**Day 35:**
The sutures were removed at the follow-up clinic. The wound had healed

Within the BMI group, pain is assessed using a scale of 0–3. Mrs Brown's pain level remained at 0 at each Avance® Solo dressing change due to the ease of atraumatic dressing removal.

## Case study 2

Mr Wise (pseudonym), aged 87 years, was referred to the tissue viability service by the vascular consultant for out-patient management of a trauma-related leg ulcer.

**Day 0:**
On assessment, it was noted that the patient had an area of necrotic tissue on the inner aspect of the lower limb; this was removed by sharp debridement (by the surgeon). It was decided that the wound was suitable for NPWT, so an Avance® Solo system was ordered. In the interim, the wound was packed with UrgoClean® (Urgo Medical).

**Day 3:**
When the dressing was removed, the wound dimensions were: width 5.5 cm, length 5.5 cm and depth 1.5 cm: some undermining to the upper aspect was noted. NPWT using Avance® Solo was started. The regimen included three pieces of foam, Mepiseal® with Safetac® and -125 mmHg continuous negative pressure.

**Day 5:**
On assessment, the wound dimensions were: width 5 cm, length 5 cm and depth 1 cm, with 1 cm of undermining (*Figures 7a* and *7b*).

**Day 13:**
The wound was redressed. Two pieces of foam were used.

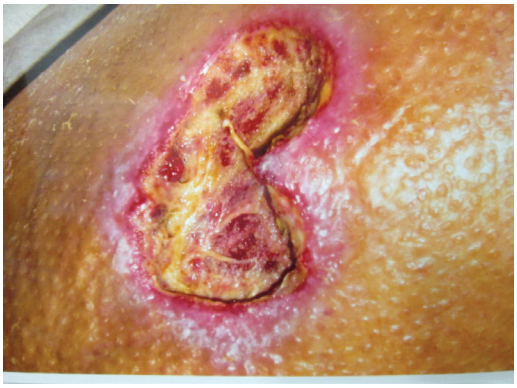

Figure 7a. Case 2 wound at day 5 (prior to application of NPWT)

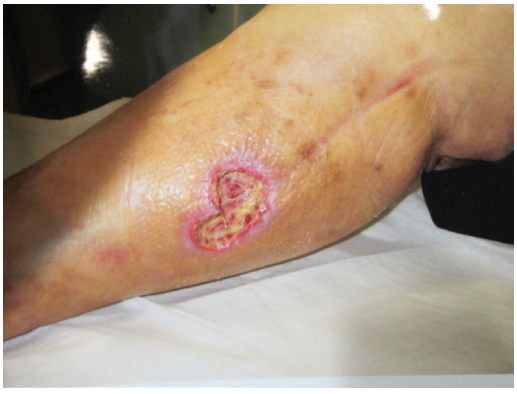

Figure 7a. Case 2 wound at day 5 (prior to application of NPWT)

**Day 18:**
On attendance at the clinic, it was noted that the dressing had come off and the pump was not working. A red macerated area just below the wound was noted.

**Day 22:**
Due to malodour and the reddened area, antibiotics were prescribed and a swab taken. Negative pressure was discontinued and the wound was dressed with Inadine® (Systagenix) in accordance with the consultant's instruction. The wound measured 2 mm (deep), 5 cm long and 2 cm wide. A reduced K2® bandage (Urgo Medical) was applied.

**Day 24:**
The wound was redressed. Mr Wise reported feeling quite low in mood.

**Day 50:**
The wound had healed. The patient was measured for JOBST® hosiery (*Figures 8a* and *8b*)

While ultimately the wound took some time to heal, the Avance® Solo system was effective in reducing the size of the wound to the point where a simple dressing and compression could be used, so it was considered to be a successful part of the patient's wound management plan. In terms of pain, Mr Wise reported a score of 1, on a scale of 0 to 3, prior to the start of NPWT. Over the course of the next few days, his pain between dressing changes dropped to 0, and no pain was reported at dressing change.

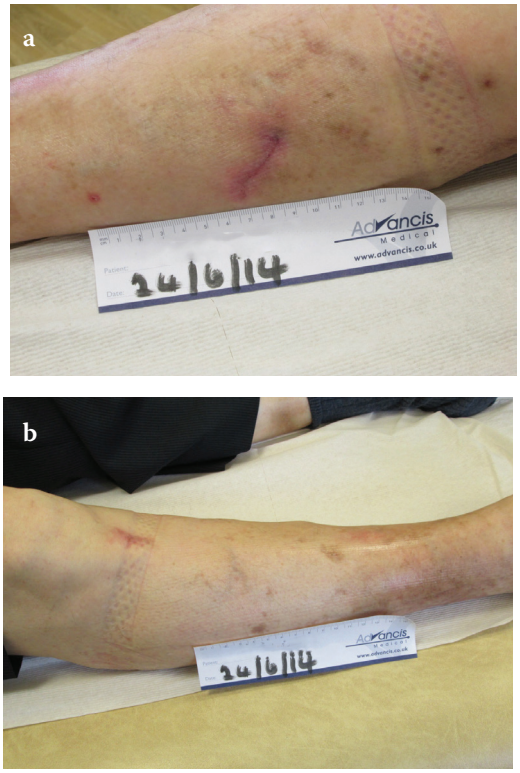


Figure 8 a and b. Case 2 wound at post-discharge review (day 50).

## DISCUSSION

This article reports two case studies on the use of Avance® Solo. No comparisons were made with any other single-use or portable systems. However, based on the outcomes, we suggest that the system has the following advantages, which are reflected in the literature:

### Cost effectiveness

Ousey and Milne (2014) state that the use of NPWT has been shown to reduce costs compared with conventional wound therapy such as interactive dressings; these savings are achieved through improved outcomes and use of fewer nursing resources. Dowsett et al (2012) postulated that using NPWT facilitates earlier patient discharge from secondary to primary care, saving a minimum of £288 per day (on average). For an average NPWT treatment duration of 20 days, the estimated savings are £4,814 per patient. For patients with diabetic foot ulcers, NPWT can reduce the incidence of minor and major amputations (Dowsett et al, 2012).

Schwien et al's (2008) retrospective analysis of 2,288 pressure ulcers in home health settings examined both the clinical and economic benefits of NPWT. A matched cohort of 60 NPWT patients showed lower rates of general hospitalisation, wound problems and emergency admission. Searle and Milne's (2010) literature review of the cost analyses of NPWT concluded that there is strong evidence of NPWT being associated with cost savings compared to conventional therapies.

While these studies do not specifically refer to single-use systems, the cost-benefits can be extrapolated to their use as their mode of action is the same as non-portable devices, and their ability to provide wound care at home means fewer in-patient days, and less nursing interventions are required.

Administration costs are negligible; the Avance® Solo NPWT system is purchased as a complete unit, so tracking of pumps is not required. In addition, it is an 'off the shelf' purchase rather than having to be ordered, so it is always available. No transfer of rental is required, making discharge from hospital to community quicker and easier, thereby freeing up hospital beds.

As with any consumable, the pump belongs to the patient so he/she can leave the hospital with it. In addition, because Avance® Solo is purchased like a consumable, it can be ordered in predictable volumes, thereby facilitating budget management.

### Discreet, quiet and portable

The patients in these case studies found Avance® Solo discreet and portable. Moffatt et al (2011), in their study of the use of NPWT in the community, found that patients are positive about NPWT, considering it an active intervention associated with improved wound healing and control of symptoms. This positivity and faith in the system had an impact on patient concordance and quality of life. Othman's (2012) review of three 2006

studies reported improved patient quality of life following the use of NPWT in the treatment of chronic wounds.

Mrs Brown (case one) found the system discreet and that it could be easily 'hidden'. This meant she was happy to have friends and family visit because she was not embarrassed by the presence of the system — few people knew it was there.

Mr Wise (case two) welcomed the chance to use NPWT as previous dressings had leaked, which worried him as he felt it could be seen and smelt. Both Mr Wise and his daughter stated that the device was very portable and discreet. As a result, he was able to continue with his daily activities, primarily being able to help care for his wife. He felt that he was in control of his wound, rather than the wound controlling his life. In addition, because the unit is relatively compact, he could wear a suit and hide the pump in a pocket, thus allowing him to attend social events. Mr Wise also felt that the pump was quiet, and therefore it did not disturb his sleep pattern. He and his daughter were very pleased with the therapy and would be happy to recommend it to others.

### Clinical effectiveness

Avance® Solo, as with other NPWT systems, is a closed system and requires fewer dressing changes than conventional wound dressings, thereby reducing the potential for cross-infection. Because it is a single-patient use product, nursing time spent cleaning pumps between patients is not an issue, again reducing the potential for cross-infection.

Unlike some portable, single-use products, Avance® Solo provides intermittent or continuous suction with a range of pressure options, covering the entire therapy range. In terms of wound filler, Avance® Solo allows clinicians to choose between gauze or foam fillers, and a wound contact layer to protect the wound bed (Mölnlycke, 2013).

From a clinician's view, Avance® Solo was found to be easy to use, because of its clear instructions and simple push button technology. The fact that the pump is very light enables patients to easily carry it, even if mobility is an issue. Importantly, its simplicity of use makes Avance® Solo ideal for carers and patients. The patient information leaflet and instructions supplied with it seem clear and concise.

The tissue viability service would consider using this system again and would recommend it to other clinicians.

### Patient benefits

The unit is easy to use, with only four buttons to operate and has an easy canister attachment. The pump comes in a kit with the carrying case, charger and one canister. The small lightweight design enables patient mobility, thus facilitating acceptance and concordance with treatment.

The system was acceptable to both patients and family as they were able to clearly see wound the healing progress.

The Avance® Film with Safetac®, which can be used with the Avance®Solo system, maintains a firm, but gentle, seal, yet is easy to remove, thus minimising the risk of skin stripping (and its associated pain), maceration and peri-wound blisters (Rafter, 2013). The Mepitel® wound contact layer also incorporates Safetac® technology, which again minimises the risk of dressing adherence to the wound bed, thus minimising trauma to the wound bed and pain for the patient. Dressings containing Safetac® technology were studied in a 2008 multinational survey undertaken by White (White, 2008), in which 3,034 patients who had used either dressings with traditional adhesives, or dressings with Safetac® technology, were asked to record their pain level before, during and after dressing change. The results showed that dressings with Safetac® technology demonstrably reduced traumatic injuries to wounds and peri-wound skin, and were associated with significant reductions in the levels of wound-associated pain measured before, during and after dressing change. Similar results have been demonstrated by Meuleneire (2009) and White and Morris (2009).

In these case studies, neither patient complained of pain or discomfort while Avance® Solo was being used. With regard to dressing change, both patients found that if the pump was switched off a few minutes before dressing change, removal was pain-free. No skin-stripping or peri-wound injury was noted in either patient.

## CONCLUSION

The use of the Avance® Solo system may reap clinical, patient-centred and economic benefits. The outcomes demonstrated by the case studies

and the supporting literature suggest that using the Avance® Solo system can help achieve the provision of quality care and resource savings while improving quality of life for patients.

With the inexorable march towards faster discharge and prevention of admission into secondary care, the Avance® Solo system is a useful tool to have in the armoury. WUK

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