

# Using single use negative pressure wound therapy for patients with complicated diabetic foot ulcers: an economic perspective

## KEY WORDS

- ▶ Diabetic foot ulcer
- ▶ Health economics
- ▶ Negative pressure
- ▶ Wound therapy
- ▶ Patient empowerment

**Aim:** This case series aims to give insight into the impact of single-use Negative Pressure Wound Therapy (NPWT) (PICO 7) on improving service delivery to patients with complicated diabetic foot ulcers in a UK NHS Trust. **Method:** Service delivery was modified to utilise the new features available on the single-use NPWT (PICO 7) device. The features of the device and how to use it was explained and demonstrated to all patients and carers involved in the case series. As part of normal, best practice, advice and guidance on deteriorating characteristics of an ulcer as well as emergency symptoms, such as spreading infection, were given. Patients were also given all relevant services' contact details. **Discussion/results:** Four DFU patients were included in this case series. In all cases, the adoption of single-use NPWT resulted in changes to the treatment pathway, leading to improved efficiency. Patients or their carers were able to self-assess the dressing's status by use of the dressing-full indicator. Contact by phone determined the need for an outpatient clinic visit or a district nurse visit. Consequently, patients only had to attend out-patient clinics when necessary and dressings were only changed when needed. This gave economic benefits associated with a reduced frequency of out-patient clinic visits of 1 to 2 per patient over the treatment period and a reduction in the frequency of district nurse visits from 3–4/week to 1–2/week. Over a 12-week treatment period, this could deliver clinical time and cost savings. **Conclusion:** Utilisation of the single-use NPWT device gives the potential to improve service delivery in patients with complicated DFUs and infers efficiency savings.

There are estimated to be 3.6 million people in the UK with diabetes, which equates to one in every 16 people (Diabetes UK, 2016).

It is also estimated that 2–2.5% of patients with diabetes will have an active foot ulcer (Kerr, 2017).

Diabetic foot ulcers (DFU) are predisposed to peripheral arterial disease and/or peripheral neuropathy. Once a foot ulcer has occurred these factors, in addition to infection, contribute to the delay in normal wound healing continuum in the person with diabetes (Dowsett and Newton, 2005; Young et al, 2013; Guest and Vowden, 2015; NHS England, 2017). A DFU that is delayed in healing is classified as a chronic ulcer. Recognizing the

severity and likelihood of chronicity requires a valid and reliable baseline assessment tool. For DFU the SINBAD (Site, Ischaemia, Neuropathy, Bacterial infection, Area and Depth) classification system has been shown to help identify the baseline characteristics and provide a score to indicate severity and healing times (Ince et al, 2008; NHS Digital, 2018). Each element of the SINBAD score is scored in a binary format with a maximum score of 6 achievable (Ince et al, 2008). A SINBAD score of 3 or more is considered a severe, or complicated DFU and the time to heal range is 126–577 days versus a SINBAD score of 2 or less, which is considered a less severe DFU with a mean healing time of 77

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days (NHS Digital, 2018). The SINBAD scores of the patients within the case series are shown in *Table 1*.

The fiscal impact of diabetes on NHS providers is significant. 10% of the entire NHS budget is spent treating diabetes and 1% (0.72-0.83%) or £972m–£1.13bn spent solely on the complications associated with the disease (Diabetes UK, 2012; Kerr, 2017). Guest et al (2017) estimated the mean cost over 12 months of wound care to be £7,800 per diabetic foot ulcer. If contacts for redressing ulceration were reduced by 25%, then the mean cost associated with the treatment of DFUs would decrease by up to 10% (Guest et al, 2017). Diabetic foot ulceration is the most common precursor to major lower limb amputation (Brownrigg et al, 2015; Armstrong et al, 2017). People with diabetes experience six times the rate of amputation when compared to the non-

diabetic population (Ahmad et al, 2016).

This case series aims to give insight into the impact of single-use NPWT (PICO 7) on improving service delivery to patients with complicated DFUs in a UK NHS Trust, with a particular focus on promoting patient empowerment.

The PICO 7 NPWT system consists of a single-use pump, together with a multi-function dressing. The pump produces a nominal negative pressure of -80 mmHg and is disposable after 7 days of use. It also includes a dressing-full indicator which is intended to reduce unnecessary dressing changes and wastage. The dressing has a unique design in which each layer works together to ensure that negative pressure is delivered to the wound bed and exudate is removed through absorption and evaporation (Malmsjö et al, 2014). PICO 7 is well placed to deliver NPWT

Details	Case 1 (86 year-old male)	Case 2 (81 year-old male)	Case 3 (51 year-old male)	Case 4 (65 year-old male)
<b>Dimensions</b>	2.5 cm x 0.4 cm x 0.4 cm depth, (area=1 cm <sup>2</sup> )	1.2 cm x 0.6 cm x 0.5 cm depth (area=0.72cm <sup>2</sup> )	6 cm x 10.5 cm x 0.5 cm depth (area= 63.5 cm <sup>2</sup> )	2.5 cm x 4.5 cm x 0.4 cm depth (area= 11.25 cm <sup>2</sup> )
<b>SINBAD score (0–6)</b>	3 (I, N & A)	3 (I, N & D)	3 (S, N & A)	4 (S, N, B and A)
<b>Wound duration at the start of PICO 7 treatment (weeks)</b>	8 weeks post-amputation	22 weeks post-amputation	8 weeks	4 weeks
<b>Relevant medical history</b>	<ul style="list-style-type: none"> <li>▶▶ (H/O) amputation (2nd -5th toes on right foot)</li> <li>▶▶ Right common femoral artery percutaneous transluminal angioplasty</li> <li>▶▶ Type 2 Diabetes Mellitus</li> <li>▶▶ Hypertension</li> <li>▶▶ Hyperlipidaemia</li> <li>▶▶ Intermittent Claudication</li> </ul>	<ul style="list-style-type: none"> <li>▶▶ Type 2 Diabetes Mellitus</li> <li>▶▶ Bed-bound</li> <li>▶▶ Hyperlipidaemia</li> <li>▶▶ Left common femoral artery percutaneous transluminal angioplasty</li> </ul>	<ul style="list-style-type: none"> <li>▶▶ Type 2 Diabetes Mellitus</li> <li>▶▶ Obesity (BMI &gt;35) Recent admission due to lower back pain and housebound during the evaluation period</li> </ul>	<ul style="list-style-type: none"> <li>▶▶ Type 2 Diabetes Mellitus</li> <li>▶▶ Charcot Neuroarthropathy</li> <li>▶▶ CKD stage 3</li> <li>▶▶ Peripheral Neuropathy</li> <li>▶▶ Hyperglycaemia</li> </ul>
<b>Duration of PICO 7 treatment</b>	4 weeks	12 weeks (4 weeks PICO 7, 2 weeks break, 8 weeks PICO 7)	5 weeks	6 weeks. Patient then discharged out of area
<b>Final outcome overview</b>	<ul style="list-style-type: none"> <li>▶▶ Ulcer size improved</li> <li>▶▶ Exudate levels and the periwound areas were noted to improve</li> <li>▶▶ Pain levels reduction reported from 7/10 to 3/10</li> </ul>	<ul style="list-style-type: none"> <li>▶▶ Ulcer size improved over initial 4-week treatment</li> <li>▶▶ Over the following 2 weeks the wound deteriorated and PICO 7 was re-started (Figure 2c). The ulcer improved over 8 weeks</li> <li>▶▶ PICO 7 was stopped as wound healing was stable</li> </ul>	<ul style="list-style-type: none"> <li>▶▶ Ulcer size improved</li> <li>▶▶ Lost-to-follow-up at week 5 due to hospital admission</li> <li>▶▶ Dressing change frequency was reduced from daily to twice per week</li> <li>▶▶ Ulcer bed improvement in granulation tissue content</li> </ul>	<ul style="list-style-type: none"> <li>▶▶ Ulcer size improved</li> <li>▶▶ Wound bed had improved with a reduction in depth and promotion of epithelisation</li> <li>▶▶ The periwound area had also improved with a reduction in maceration</li> </ul>



Case study 1. Figure 1a. Pre-PICO 7



Figure 1b. After 4 weeks of PICO 7 treatment

in both hospital and community settings and may improve patient mobility and implicitly, perhaps, quality of life and wellbeing (Hudson et al, 2015).

**METHOD**

In order to improve patient convenience and optimise resource use, service delivery was modified to utilise the new dressing full indicator feature available on the PICO 7 device. This was used to allow patients or their carers to assess the need for dressing change with regards to exudate management. Once the dressing full indicator was illuminated, the patient or their carer could contact the clinical team to alert them to the need for a dressing change. Contact by phone determined the need for an outpatient clinic or a home visit. Consequently, patients only had to attend out-patient clinics when absolutely necessary and dressings were only changed when needed, thus minimising clinician contact and intervention. Dressing changes were conducted in either outpatient clinics (usually for more mobile patients) or through community nurse visits (more common for housebound patients) to promote patient convenience and optimise resource use. Four

patients were included in this evaluation.

The number of clinician contacts was expressed as hours of clinician time by multiplying the number of visits by published values of average time per visit. We assumed an equivalent duration for both nurse and podiatrist contacts, assumed at 31-minute duration (including travel time) (O’Keefe, 2006). For example, where there were three patient contacts per week, the total time per week was estimated at 3 x 31 minutes = 93 minutes or 1.55 hours.

Ethics committee approval was not required for this evaluation.

**RESULTS**

In all cases, PICO 7 performed well clinically in terms of delivering against the required treatment goal (Table 1; Case studies 1–4). The required treatment goal for all these patients was to promote healing and/ or prevent wound deterioration, as well as manage exudate levels. There was an improvement in all four cases with regards to the ulcer size, with a mean ulcer area reduction of 49% (range 31–56% reduction). Visually all four case studies showed improvement in exudate levels as there was noted



Case study 2. Figure 2a. Pre-PICO 7

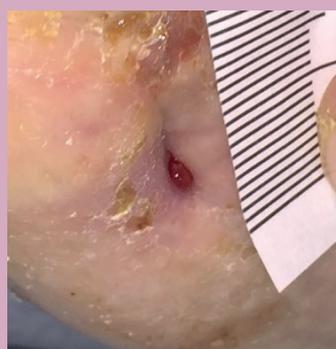


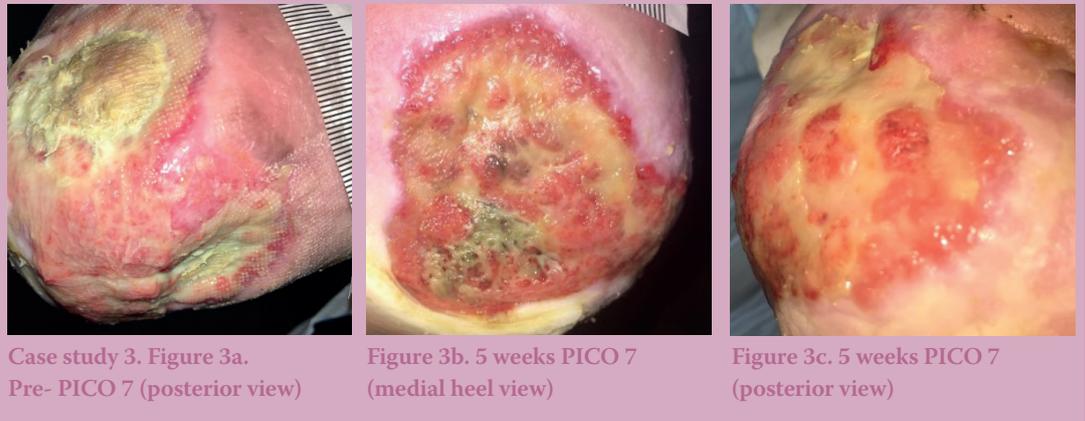
Figure 2b. 4 weeks PICO 7



Figure 2c. Prior to PICO 7 restart



Figure 2d. After 12 weeks PICO 7



Case study 3. Figure 3a. Pre- PICO 7 (posterior view)

Figure 3b. 5 weeks PICO 7 (medial heel view)

Figure 3c. 5 weeks PICO 7 (posterior view)

improvement in the peri-wound area and the frequency of dressing changes was reduced. In all cases, the use of PICO resulted in changes to the way the service was delivered, leading to improved efficiency. *Table 2* shows details of the weekly clinical contacts for each of the four cases. It demonstrated clear resource benefits associated with a reduced frequency of clinician contacts (an average of just over 2 per patient over the treatment period). *Table 3* shows the weekly resources associated with patient contacts, in terms of hours of clinician time. The mean weekly release of time across the four cases was estimated to be approximately 4.5 hours of clinician time.

Over a 12-week treatment period, the use of PICO 7 could result in a release of 13.5 clinician hours per patient on average. Importantly, from a patient perspective, this also leads to an equivalent reduction in their time associated with health care appointments and visits.

**DISCUSSION**

The ageing population and increasing prevalence of associated chronic long-term conditions have resulted in a continually increasing demand for NHS wound care services (Dowsett et al, 2014; Guest, 2017; Office for National Statistics, 2017). At the same time, the capacity to treat patients with wounds is challenged by other factors such as shortages of trained staff (Dowsett et al, 2014). For wounds treated in the community care setting, clinicians' time makes up by far the largest part of the utilisation of resources (Vowden et al, 2009), with wound care products and materials representing a relatively small proportion. As a consequence of all these factors,

there is a need to increase the capacity of services in order to undertake more activity with similar or reduced resources ("more with less"). Freeing up staff time is, therefore, a valuable way to increase capacity.

- ▶ Increasing service capacity could have several important consequences, such as:
- ▶ Enabling the service to better meet current demands, releasing time to allow other activities such as training, administrative duties or spending more time with patients to take place
- ▶ Allowing the service to improve its resilience, i.e. the extent to which it is able to deal with peaks and troughs in demand
- ▶ Helping to ensure that patients receive an expert assessment at an earlier stage. The recent National Diabetes Foot Care Audit (NDFA) audit (2016) showed that for ulcers where the time to first expert assessment was two months or more, the ulcer was more likely to be severe.
- ▶ Decreasing the time to expert assessment is likely to reduce the incidence of severe ulcers
- ▶ Providing a way to ensure the sustainability of services for the future.

Severe ulcers (SINBAD score 3 or more) also cost over four and a half times as much to treat (£77.33 versus £359.20). The costs are based primarily on the difference between the number of dressings required and the amount of the professional's time to treat (Kerr, 2017). For the severe ulcers included in this evaluation, the author (AS) observed that the dressing full indicator has the potential to empower the patient to know if the dressing needs changing before their planned review. A treatment choice that balances unit cost with reduced clinician time may result in a reduction in average weekly cost, whilst



Case study 4. Figure 4a. Pre-PICO 7



Figure 4b. 6 weeks PICO 7

appropriately maintaining the clinical outcome of the ulceration.

Approaches that focus on complicated wounds are potentially useful for any wound care service striving to increase capacity because these wounds incur a disproportionate level of resource use. All the ulcers included here fall into this category, and it is encouraging to see that the use of PICO 7 in this evaluation resulted in some clear improvements in service delivery. Importantly, patients/carers were able to make use of the features of PICO 7 to increase empowerment in self-care and were able to optimize the number of clinic visits and dressing changes. This has potential benefits for patients as well as for the wound care service.

In addition, this case series demonstrates the ability of PICO to manage wounds in notoriously hard-to-dress anatomic locations on and around the foot.

**CONCLUSION**

Utilisation of the single-use NPWT device gives the potential to improve service delivery in patients with complicated DFUs and infers efficiency savings. **WUK**

**CONFLICT OF INTEREST**

David Myers and Richard Searle are employees of Smith and Nephew, Hull, UK. Smith and Nephew provided

the equipment for this evaluation and Andrew Sharpe received an honorarium from Smith and Nephew for the additional work required to complete the evaluation.

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**Table 2. Use of resources**

Case	Contacts per week	
	Pre-NPWT	During NPWT
1	3 contacts (1 Pod HV + 2 DN HV)	1 contact (1 Pod HV)
2	2 contacts (1 Pod HV + 1 DN HV)	1 contact (1 Pod HV)
3	7 contacts (1 Pod HV + 6 DN HV)	2 contacts (2 Pod HV)
4	3 contacts (1 Pod clinic + CC out-pt)	2 contacts (CC out-pt)

Notes: HV = Home visit; DN = District nurse; Pod = podiatrist; CC out-pt = Acute based casting clinic, seen by plaster technician and podiatrist

**Table 3. Weekly clinician time required (minutes)**

Case	Clinician time pre-NPWT (minutes/week)	Clinician time during NPWT (minutes/week)	Time-saving (minutes/week)
1	93	31	62
2	62	31	31
3	217	62	155
4	93	62	31
<b>Total time saving 279 (4 hours 39 minutes)</b>			

Notes: clinician includes podiatrist, nurse and plaster technician

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