



# Evaluation of a dynamic mattress replacement system within a community setting

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Within the UK and beyond, pressure ulcers are still considered largely preventable with national high-profile strategies highlighting the need for action to reduce this avoidable harm. Organisations are now monitored on the quality of care they provide and may be incentivised or penalised depending on the number of patients with pressure damage occurring within their care. It is important that local decision-making regarding the selection of products used for pressure ulcer prevention and management is appropriately informed. Limited financial resources and increasing costs of health care challenge clinicians to be proactive and participative in helping organisations meet the needs of their patient population. Reducing risk both to the patient and the organisation will positively influence patient outcomes. This evaluation sought to determine the clinical and cost-effectiveness of a dynamic mattress replacement system across three community hospitals. Based on the available evaluation data of 98 patients, results indicated a reduction in both the number and grade of pressure ulcers. In addition, 96% of patients rated the mattress as 'comfortable' to some extent, and over 98% of staff provided positive feedback regarding the service received from the supplier. Further work should focus on comparing the mattress used in this evaluation with other pressure-relieving equipment.

## KEYWORDS:

Pressure ulcers ■ Prevention ■ Pressure-relieving equipment  
■ Dynamic mattress

The management and treatment of pressure ulcers has been identified as being a huge burden on healthcare resources within the United Kingdom. Annual costs to the National Health Service have been estimated as ranging from £1.4 billion to £2.1 billion (Dealey et al, 2012). Approximately 4–10%

of patients cared for in hospital will develop pressure damage (National Institute for Health and Care Excellence [NICE], 2005), and it is estimated that up to 20% of these may occur in the patient's own home or within a care home environment (NHS Institute for Innovation and Improvement, 2013). Costs to the individual patient may include the negative effect to their emotional, physical, mental and social wellbeing. Although the effects of pressure ulceration to the individual are difficult to quantify, it is recognised that there is a significant impact on their quality of life and that of their families (Moore and Cowman, 2009).

A pressure ulcer can be defined as 'a localised injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure or pressure in combination with shear' (European Pressure Ulcer Advisory Panel [EPUAP], National Pressure Ulcer Advisory Panel [NPUAP], Pan Pacific Pressure Injury Alliance [PPPIA], 2014).

Development of pressure damage is often associated with the quality of care delivered and prevention strategies implemented (Ousey, 2011). The Department of Health (DH) introduced a Commissioning for Quality and Innovation (CQUIN) target to incentivise organisations to demonstrate a reduction in the number of pressure ulcers acquired within their care (DH, 2012). A report investigating poor standards of care in a large acute hospital in the UK made recommendations on the importance of applying fundamentals of care, to include pressure ulcer prevention as a key element of maintaining patient safety (Francis, 2010). Clinicians are accountable and have a duty of care to patients (Nursing and Midwifery Council [NMC], 2008). It is crucial, therefore, that they are able to understand the causes of pressure ulcer development and have the ability to apply evidence-based strategies in their prevention (Ousey, 2011).

In early 2012, the NHS Midlands and East Strategic Health Authority launched an initiative to eliminate 100% of avoidable pressure damage categorised as 2, 3, or 4 by December 2012 (McIntyre et al, 2012). An element of the programme was to improve standards of care and patient safety. The focus of this preventative tissue damage initiative was:

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- ▶ Risk assessment
- ▶ Early detection
- ▶ Implementation of prevention strategies.

This 'Stop the Pressure' campaign ([www.stopthepressure.com](http://www.stopthepressure.com)) included videos, online resources and documentation to support clinicians in their day-to-day practice. A SSKIN care bundle was also introduced as part of the strategy. This was used to address the key elements of care required for an effective framework of pressure ulcer prevention, as SSKIN denotes:

- ▶ Surface
- ▶ Skin inspection
- ▶ Keeping your patients moving
- ▶ Incontinence/moisture
- ▶ Nutrition.

This care bundle is seen as a structured way of improving processes of care and positive patient outcomes, and increases the likelihood that clinicians will acknowledge and address every component to this sequence of assessment steps with appropriate intervention (NHS Institute for Healthcare Improvement, 2014). Failure to follow this systematic approach may increase the potential for the development of pressure damage (Stephen-Haynes, 2011).

Patients may have multiple risk factors, but it is well recognised that immobility is considered to be one of the major contributory factors predisposing a patient to pressure ulcer development (EPUAP/NPUAP/PPPIA, 2014). Frequent patient repositioning and the use of appropriate pressure-relieving devices, including mattresses and cushions, can reduce the likelihood of a patient developing a pressure ulcer and should form part of the prevention strategy (Guy et al, 2013).

Dynamic support surfaces are routinely used in the prevention and management of pressure damage and are of benefit when patients do not have the ability to reposition themselves independently (NICE, 2014). The provision of dynamic pressure-

relieving devices is a cost factor to any healthcare provider organisation, and although a key consideration, clinical-effectiveness and optimum levels of service must be of equal importance in any procurement process. Clinicians should have the ability to rationalise their decisions when selecting an appropriate support surface for pressure ulcer prevention or management, and have an understanding of the key features and benefits of pressure-relieving/reducing devices and how to operate them safely (Fletcher et al, 2014).

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### **'Frequent patient repositioning and the use of appropriate pressure-relieving devices, including mattresses and cushions, can reduce the likelihood of a patient developing a pressure ulcer and should form part of the prevention strategy'**

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To support the local strategy for pressure ulcer reduction, an audit was conducted across three community hospital wards with the aim of identifying the dynamic pressure-relieving equipment in use. This audit highlighted a vast range of available equipment that was both owned and rented, and which was ageing and costly and in need of frequent repair. With such a varied array of equipment, staff reported difficulty in being familiar and confident with the effective operation of all of the individual dynamic systems, which had the potential to increase clinical risk. The organisation considered it important to streamline the availability of products for clinician ease, cost-containment and maintenance of patient safety, in conjunction with service need and demand.

Shelden Healthcare Ltd have a wide experience of supplying pressure-relieving mattresses predominantly to the nursing home setting, but understood the

importance of gathering clinical feedback of product evaluations within a hospital setting. The consultant nurse for tissue viability initially sought agreement from the organisation to conduct a pilot clinical evaluation to include 20 inpatients. During the pilot study, an alternating air mattress replacement system (Dual Professional) was provided by Shelden Healthcare Ltd, as a suitable replacement to existing products for the purpose of identifying one standard dynamic pressure-relieving mattress system that could be used across the selected ward areas. The pilot study attempted to explore clinician and patient experience while using Dual Professional. Due to the overwhelming positive feedback regarding the product and the service received, it was decided by the organisation to continue using the product under a rental agreement and to evaluate a further 80 patients, which would increase the dataset to 100 participants.

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### **SAMPLE**

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The community hospitals have a total of 70 inpatient beds, each with a specific focus on rehabilitation, stroke and end-of-life care. Patients who were admitted into one of the three community hospital wards between September 2013 and March 2014 were eligible to take part in the evaluation. Seven hundred and seventeen patients in total were admitted onto the wards during this timeframe; of these, 20 patients were recruited into the pilot study and a further 80 were recruited into the study overall (14% of all admissions). A total of 98 patients' data were included within the evaluation (two patients died during their episode of care and were withdrawn).

Using the Waterlow risk assessment tool (Waterlow, 2005) and clinical judgement, patients included were assessed as being at high risk and very high risk of developing pressure damage. Patients considered at low risk were offered alternative pressure-relieving/redistributing

equipment and were excluded from the evaluation. Patients who were unable to tolerate dynamic alternating pressure and whose body mass index (BMI) exceeded the safe weight range of the mattress were also excluded and a suitable alternative product was provided. Local organisational policies and guidelines were observed and adhered to regarding the assessment and management of patients considered at risk of, or with pressure damage.

**METHOD**

The motivation for carrying out the evaluation was to support the organisation in managing clinical risk by selecting clinically-effective pressure-relieving equipment, in collaboration with an appropriate commercial partner. To gather appropriate information a data

collection tool was developed by the local consultant nurse for tissue viability, together with the ward managers and the tissue viability team, to capture relevant study parameters from multiple clinical perspectives (Boynton and Greenhalgh, 2004).

This tool was able to elicit feedback on products and services, and determine the experience and knowledge of participants (Boynton and Greenhalgh, 2004). Information gathered included generic data relating to the patient and staff members' experience of using the mattress, and evaluation of the service received from the mattress supplier, Shelden Healthcare Ltd (Table 1). The pilot evaluation conducted on 20 patients was to determine the efficacy of this data collection tool (Holford, 2013), with results indicating that no changes were required, and so the

same method was replicated for the following 80 patients.

Following admission to the ward, patients were comprehensively assessed by a registered nurse and, where suitable, recruited into the evaluation and part one of the data collection tool was completed (Table 1). Part two of the evaluation was carried out on the day the patient discontinued using the mattress, with the reason being noted. In addition, baseline data was reassessed and additional information collected to capture any significant changes in the patient's general health condition, their experience of using the mattress and the duration that the device was in use.

The evaluation requested each patient to rate the level of comfort of the mattress as either very or fairly comfortable, or uncomfortable. Ease of getting on and off the mattress was assessed in comparison to the previous mattress used. In addition, the nurse caring for the patient also reported on questions relating to the ease of cleaning the mattress and the customer service given by the mattress supplier (Table 1).

Full training was given to ward staff before the pilot evaluation and again during the full roll-out across the three community hospital wards. Training included the full use of the mattress, its features and benefits, and processes regarding deliveries and collections by the commercial supplier. A telephone helpline was made available for any enquiries needing an immediate response.

**FINDINGS**

**Participants**

A total of 100 patients were recruited in the evaluation; of these, two patients died during their admission so their data were excluded from analysis. Participants included 40 male and 58 female patients. Data analysis was based only on those cases where all analysed values were present (which explains the variability of n). Table 2 shows the mean ages,

**Table 1: Information gathered in the data collection tool**

<b>Evaluation — part 1:</b>									
<ul style="list-style-type: none"> <li>Age, gender, weight, height</li> <li>Diagnosis</li> <li>Equipment used before (if any)</li> <li>Waterlow score</li> <li>Category and location of pressure ulcer</li> </ul>			<ul style="list-style-type: none"> <li>Continence status</li> <li>Mobility and time spent in bed</li> <li>Pressure relief when seated, including ability to reposition independently</li> </ul>						
<b>Evaluation — part 2:</b>									
<ul style="list-style-type: none"> <li>Weight (if changed)</li> <li>Any change in general condition</li> <li>Duration of use of equipment</li> </ul>			<ul style="list-style-type: none"> <li>Waterlow score</li> <li>Category and location of pressure ulcer</li> </ul>						
<b>Experience of using the mattress</b>									
Reported by the patient: <ul style="list-style-type: none"> <li>Comfort</li> <li>Noise level</li> </ul>			Reported by staff: <ul style="list-style-type: none"> <li>Ease of patient getting in and out of bed independently or assisted</li> <li>Ease of day-to-day cleaning</li> </ul>						
<b>Service received from the mattress supplier</b>									
Reported by the staff: <ul style="list-style-type: none"> <li>Politeness and courteousness of supplier staff</li> <li>Whether appropriate information/instructions were left by the engineer</li> <li>Ease of contacting the supplier</li> <li>Responsiveness to reported faults or issues</li> <li>Training delivery</li> </ul>									

**Table 2: Participants' age, weight and Waterlow scores on admission (n excludes any missing values)**

	Age			Waterlow score			Weight (kg)		
	Mean	(SD)	n	Mean	(SD)	n	Mean	(SD)	n
Females	83	(12)	58	18	(4)	57	63.78	(17)	57
Males	81	(9)	40	18	(4)	38	79.41	(31)	34
Total	82	(11)	98	18	(4)	95	69.62	(24)	91



**Table 3: Patient continence, mobility and general condition**

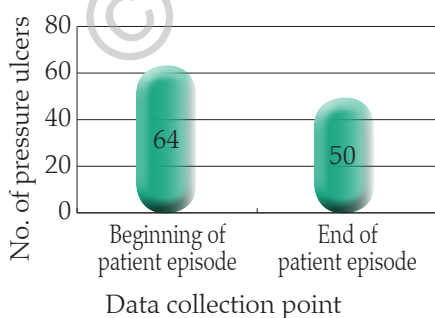
	Females (n)	Males (n)	Total (n)
Incontinent of urine	13	11	24
Doubly incontinent	11	7	18
Patients who could not move unaided in the bed	18	8	26
Patients who could not mobilise unaided	45	33	78
Patients whose general health condition deteriorated while in care	3	4	7

weight and Waterlow scores of participants on admission.

Participants had an average length of stay of 21 days (SD=17). The total duration of time patients spent on the mattress was calculated by multiplying the mean number of hours per day the patient was recorded to have spent in bed on admission and discharge, by their length of stay. This ranged from 26 hours to 1,560 hours (mean=293 hours, SD=286). Sixty-eight of the patients were known to have used other forms of pressure relief when seated, and information regarding patient continence and mobility (on admission) and deterioration (on discharge) was recorded (Table 3).

**Reduction in the number and category of pressure ulcers**

A test was used to determine whether the reduction in number of pressure ulcers was statistically significant, the one-tailed Wilcoxon signed-rank test was used to confirm this (Wilcoxon, 1945, cited in Field, 2005). Fifty-eight patients' data were complete and showed 64 pressure ulcers at the beginning of their patient episodes. The average number of pressure



**Figure 1.** Number of pressure ulcers before and after episodes of care on the mattress (n=58).

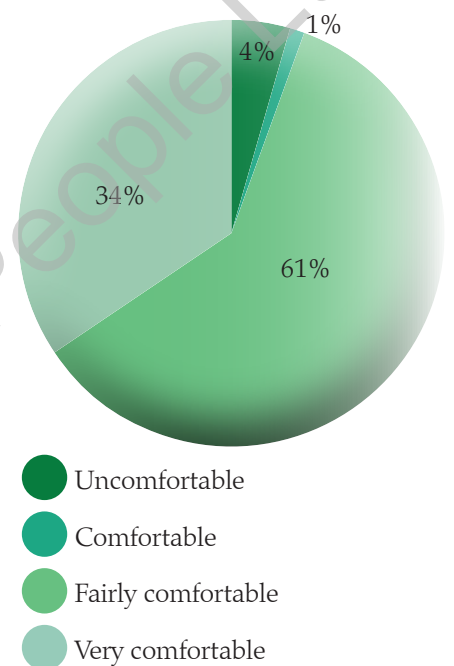
ulcers for the 58 patients was 1.10 (SD=0.83). A statistically significant reduction was found in the number of pressure ulcers when comparing participants before and after their time on the mattress (n=58, z=-2.5, p<0.01, r=-.232, Figure 1). There was also a positive partial correlation between the total duration of hours on the bed and a reduction in the number of pressure ulcers, when controlling for variables on admission (patient weight, age, gender, Waterlow score, mobility in and out of bed, continence), and general health condition on discharge (df=40, r=.347, p [one-tailed] <0.05). Although three pressure ulcers were seen to deteriorate, these were associated with end of life. Overall, a Wilcoxon signed-rank test found a statistically significant reduction in the amount of tissue loss (n=55, z=-2.713, p<0.01, r=-.234) and, although it is not conventional to measure a reduction in category, healing was evident. Indeed, in the authors' clinical opinion, were the patients assessed at this stage, the pressure ulcers would have been categorised lower. This indicated that tissue damage did not deteriorate further, despite the patient population, which was particularly vulnerable due to increasing age (mean=82 years), immobility and having a high Waterlow risk score (mean=18).

**Patient feedback**

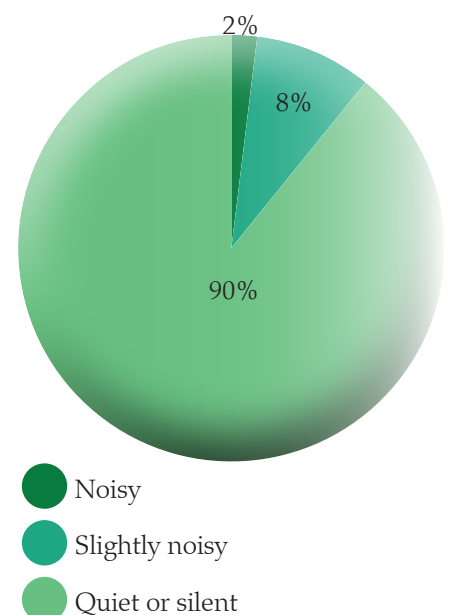
An important part of any service provision is promoting positive patient experience (DH, 2010). Ninety-six percent of patients (n=92) rated the mattress as 'comfortable' to some level, with only 4% (n=4) rating it as 'uncomfortable' (Figure 2). Figure 3 displays the results of patients' responses regarding the noise of the pump.

**Staff feedback**

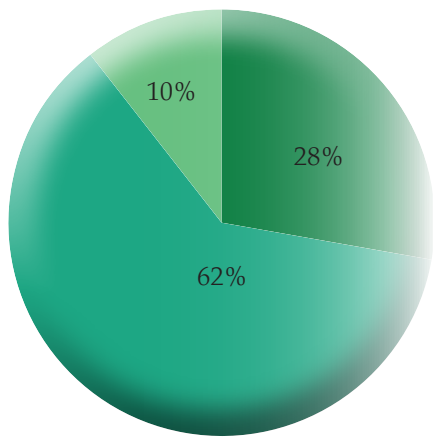
Promoting patient safety involves staff being able to select and use equipment safely and appropriately (NICE, 2014). It also demands that infection prevention and control standards are observed to minimise the risk of healthcare-associated infections (DH, 2008). Mattresses may become contaminated when in use, however potential risk can be significantly reduced if staff are able to easily and correctly



**Figure 2.** Patients' ratings of comfort (n=96).



**Figure 3.** Patients' reported noise of pump (n=98).



- Much easier than previous mattress
- Same as previous mattress
- More difficult than previous mattress

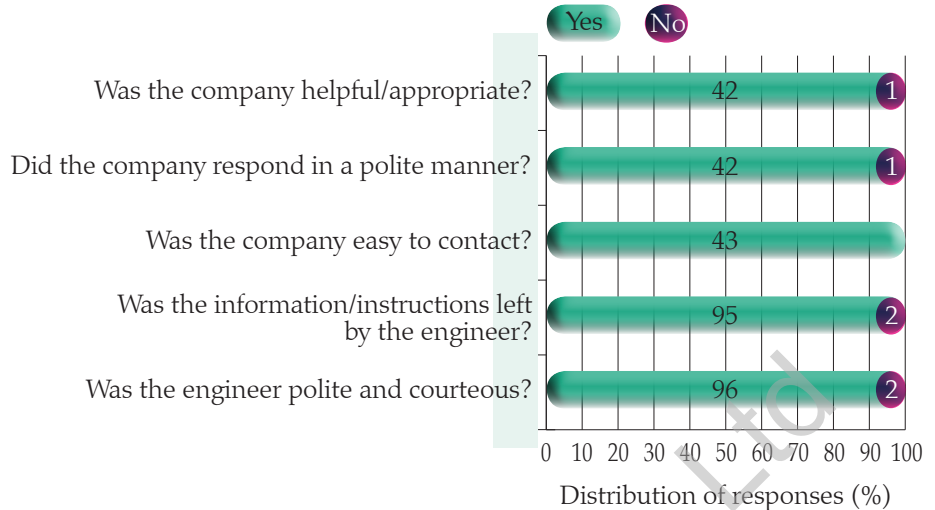
**Figure 4.** Staff members' reports of the ease with which patients could get in and out of bed (n=86).

clean a mattress on a day-to-day basis (Callaghan, 2013), as well as being able to identify when full professional decontamination is needed. In regards to the ease of day-to-day cleaning, 28% of respondents (n=27) reported that this was 'straightforward', 71% (n=69) reported that it was 'very easy', and only 1% (n=1) found this to be 'quite difficult'. In addition, Figure 4 indicates staff members' perceptions of the ease with which patients could get in and out of the bed. As the focus for many patients within the community hospital setting is rehabilitation, it is important that patients feel confident and safe when getting in and out of bed.

It was important to the organisation that the commercial partner was responsive and professional; therefore, the evaluation also included responses from staff regarding the service received from the mattress supplier. For each question, the majority of responses (over 98%) were positive (Figure 5).

**DISCUSSION**

Although there was a statistically significant reduction in the number



**Figure 5.** Responses regarding customer service received from Sheldon Healthcare Ltd.

of pressure ulcers when comparing patients before and after their episode on the mattress, as this was not a comparison evaluation, it is unknown whether similar results may have been obtained if another

**'Implementation of a care plan to prevent and manage pressure damage should always remain patient-centred'**

type of mattress was used. It was decided by the service manager to evaluate this particular type of mattress because of the advantages they and their team had experienced with it, yet further evaluation should compare the results of this equipment with other dynamic pressure-relieving mattresses.

In addition, although there was a statistically significant correlation between time on the mattress and reduction in the number of pressure ulcers, this does not indicate a direction of causation. Other ratings such as comfort were devised by the service, so future work would benefit from using or creating validated measures where possible. In further scrutinising measurement, the reduction of tissue loss (or that overall pressure ulcers did not deteriorate) was used as an indicator of the efficacy of the mattress, however the difficulty with grading ulcers, particularly category 1 ulcers, is acknowledged (Cullum et al, 2000). More objective

measures such as the size or images of the ulcers were not captured. As grading was used, the study would have benefitted from the ulcers being independently categorised by at least two clinicians rather than depending on one, in order to minimise bias (Cullum et al, 2000).

However, the patient and staff feedback showed a very positive assessment of the mattress and the service provided by the commercial supplier. Other benefits include cost of the products, design of the cable management system, and high level of training support, all of which contribute positively to the evaluation of the product.

Conducting a pilot study gave the team confidence to use the data collection tool, which was designed to establish clinical-effectiveness and capture patient experience of the product. It is important that patients have positive healthcare experiences with prevention strategies, that also promote comfort and independence where possible (Moore and Cowman, 2009). Implementation of a care plan to prevent and manage pressure damage should always remain patient-centred (Moore and Cowman, 2009). As a result of the overwhelming positive feedback received in the pilot study, it was decided to recruit a further 80 patients to the evaluation.

In the authors' clinical experience, products are often chosen as a result

of small-scale data analysis, with little or no substantive evidence. However, this evaluation supported staff to generate local and relevant data, which positively informed organisational decision-making. **JCN**

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## KEY POINTS

- Development of pressure ulcers is often associated with the quality of care delivered and prevention strategies implemented.
- Dynamic support surfaces are routinely used in the prevention and management of pressure damage.
- The NHS Midlands and East Strategic Health Authority launched an initiative to eliminate 100% of avoidable pressure damage categorised as 2, 3, or 4.
- The motivation for carrying out the evaluation was to support the organisation in managing clinical risk by selecting clinically effective pressure-relieving equipment, in collaboration with an appropriate commercial partner.
- The patient and staff feedback showed a very positive assessment of the mattress and the service provided by the commercial supplier. Other benefits include cost of the products, design of the cable management system, and high level of training support, all of which contribute positively to the evaluation of the product.
- This evaluation supported staff to generate local and relevant data, which positively informed organisational decision-making.

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