Evaluation of patient outcomes: pressure ulcer prevention mattresses

Linda Rafter

Abstract

This article reports the findings of a small evaluation audit which compares the Dyna-Form Mercury Advance Mattress to that of the Softform Premier Active Mattress (a foam mattress with dynamic underlay). A small group of patients with similar co-morbidities who were an emergency admission were recruited to an evaluation audit. Their median age and Waterlow score indicated that these patients were at high risk of pressure ulcer development. All patients were given the same nursing care on the two mattresses and all were moved, handled and repositioned 2-4 hourly. Of the patients nursed on the Dyna-Form Mercury Advance mattress, three did not develop pressure ulcers. The two who already had pressure ulcers when they were recruited appeared to have healed within four days. Of the patients nursed on the Softform Premier Active mattress, three patients did not develop ulcers and two did. Although the sample size was small, the comprehensive assessment gave interesting results, particularly on the Dyna-Form Mercury Advance. A larger study may be of benefit to demonstrate efficacy of these products further.

Key words: Elderly vulnerable patients ■ Pressure ulcer prevention ■ Patient outcomes ■ Dyna-Form Mercury Advance mattress ■ Softform Premier Advance mattress

The prevalence and incidence of skin breakdown is expected to continue increasing as the elderly population continues to grow within the UK. Finding ways to prevent the development of skin breakdown and treat it more effectively would be expected to create economic benefits by preventing the need for expensive treatment and equipment. Recognizing and managing pressure ulcers at an early stage to avoid skin lesions turning into pressure ulceration will be absolutely essential (Ousey and White, 2010). The prevention and treatment of pressure ulcers will assist the practioner in meeting the targets set by Comissioning for Quality and Innovations (CQUINS), High Impact Interventions and inspections by the Care Quality Commission. The National Patient Safety Agency (NPSA) aims for 2010 were:

- To reduce avoidable harm
- Support nurses to reduce harm associated with pressure ulcers
- Further reduce patient deaths from pressure ulcers. (NPSA, 2010)

The cost of preventing and treating pressure ulcers is difficult to identify as the cost is distributed across many different areas of patient care. A provisional return on investment (ROI) analysis conducted by the NHS High Impact Actions found for every £1 spent on care home support from tissue viability nurses, a saving of circa £50 can be made (Dowsett, 2010). However, the overall costs are considered to be substantial. A study completed in 2004 suggests that the cost of treating ulcers varies from £1064 for a category 1 ulcer to £10 551 for a category 4 ulcer. The total cost of pressure ulcers in the UK is estimated as being £1.4-2.1 billion and this equates to 4% of the NHS budget (Bennett, Dealey and Posnett, 2004).

A support surface is defined by the European Pressure Ulcer Advisory Panel (EPUAP) and the National Pressure Ulcer Advisory Panel (NPUAP) (2009) as a specialized device for pressure redistribution designed for the management of tissue loads. Support surfaces redistribute interface either by mechanical means or varying the pressure at different locations beneath the patient so that the duration of pressure is reduced, by moulding around the patient so that the weight is dispersed over a large area (McInnes et al, 2008; Matsuo et al, 2011).

Clinicians are faced with a range of mattresses that may be used to prevent the development of pressure ulcers, following a holistic assessment of their skin integrity (National Institute for Health and Clinical Excellence (NICE), 2005). EPUAP encourages the clinicians to consider the cost, quality of equipment and maintenance costs of replacement parts and decontamination. Alongside these considerations, the literature needs to provide evidence to support effectiveness of patient outcomes, patient comfort and economic implications. There is still lack of evidence from randomized controlled trials on support surfaces and they fail to highlight the most appropriate pressure redistributing support surfaces (Clark, Hiskett and Russell, 2005).

Development of pressure ulcers

A pressure ulcer is an area of localized damage to skin and underlying tissue over a bony prominence, as result of pressure, or pressure in combination with shear. A number of contributing or confounding factors are also associated with pressure ulcers; the significance of these factors is yet to be elucidated (EPUAP, 2009).

Professor Linda Rafter is Honorary Professor in the Nursing Faculty of Health and Life Sciences of De Montfort University of Leicester and that of Wound Care Solutions. Linda also practices as a Tissue Viability Nurse Specialist, Burton On Trent, Staffordshire

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There are three key components to the predisposition and development of pressure ulcers, either on their own or in conjunction with each other (Defloor, 1999):

- Compressive force
- Shear force
- Tissue tolerance to oxygen .

Compressive force

A compressive force is a force exerted perpendicular to the tissue that is affected by the duration and intensity exerted on the skin. A pressure on the skin higher than the capillary slows down the flow in capillary and lymph nodes, resulting in insufficient supply of oxygen and nutrients and inadequate evacuation of waste products. Therefore cell death can result.

Shear

Shear forces are one of the most dangerous problems facing a patient who is being nursed semi-recumbent or in a chair. Shearing forces produce destruction of the micro-circulation by thrombosis of the vessels and occur when the patient slips down the bed, or when their heels are dragged on the bed while being lifted up (Versluysen, 1986; Defloor 1999; Waterlow, 2005). The degree of shear force(s) required to occlude blood flow is less than direct pressure on the skin and soft tissue in elderly patients so the effect of shear is enhanced (Harding, 2007).

Tissue tolerance

Tissue tolerance to oxygen can be described as a factor that changes the capacity of the tissue to redistribute pressure and influences oxygen distribution. Other factors that influence oxygen distribution are medication, protein deficiency, smoking, reactive hyperaemia, vascular occlusion, blood pressure and diseases. Tissue tolerance for pressure will influence whether a pressure ulcers develops. If the pressure exerted on the skin and subcutaneous tissues is many times greater then capillary blood pressure, a pressure ulcer may develop. This will also be affected by tissue mass, ageing, dehydration, protein, vitamin C, stress and corticosteroids (Defloor, 1999).

Moisture

An excess of moisture can cause pressure damage, now classified as moisture lesion (EPUAP, 2006). The increase in moisture from incontinence, combined with bacterial and enzymatic activity can result in vulnerable skin breaking down owing to increased skin drag co-efficient, particularly in those who are young or elderly (Cooper, Clark and Bale, 2006).

The clinician needs to consider not just the extrinsic factors but encompass the wide-ranging intrinsic factors that cannot be altered such as age, sex and physical status, as well as the factors that may respond to therapy or modification, such as disease condition, nutritional and fluid status (Stephen-Haynes, 2010).

Patient outcomes

Outcome measurement is a comparatively new concept used within health care as a means of evaluating the efficacy of various treatments (Price, 1999; Steed et al, 2006). The Department of Health *Outcomes Framework* (2010) focuses on what matters most to the patients and five key areas which are pertinent to tissue viability:

- Preventing patients dying prematurely
- Supporting patients with long-term conditions
- Helping people to recover with long-term conditions
- Helping people to recover quickly from ill health or injury
- Ensuring patient safety and providing a positive experience for patients and public.

This evaluation aims to provide the experiences of patients and staff. Outcome measuring has become increasingly important over the last few years. There can be a range of outcomes; clinical, financial or educational that are now being considered (Price,1999; Steed et al, 2006). Outcome measures can be difficult to define as measuring the effect of an intervention should also take into account the needs of the patient. The clinical decisions may not necessarily be that important to the patient (Stephen-Haynes, 2010).

Patient comfort

There is little in nursing literature dealing specifically in relation to the comfort of pressure-relieving systems. The prime reason for this may be that comfort is very subjective and individual: For example: 'What pleases one patient may pain another' (Russell et al, 2000). Several small clinical trials have assessed comfort but often data has been collected by nurses who have their own perceptions of whether a bed is comfortable or not. Furthermore, assessments of comfort have often been made after only relatively short periods of time, before the patient has become used to the bed's characteristics, or no indication of the delay before survey has been given. A visual analogue scale was described by Gray and Campbell (1994) who assessed the comfort of Softform mattresses when new, versus Link Nurse mattresses. Gray and Campbell (1997) used a repeat of the trial and their findings were reported at a Tissue Viability Society meeting. They stated it was not possible to inspect the NHS mattresses as they failed testing and had been replaced. The Softform mattresses were all in acceptable condition with the exception of two covers.

Evidence

In 2006, Thompson evaluated the Softform Premier Active mattress on 40 patients with a Waterlow Score of 18-30. Patients were recruited with up to EPUAP category 1-2 pressure ulcers. Thompson (2006) discovered the Softform Premier Active mattress may be used in prevention of high-risk patients and has the possibility of reducing the dependency on alternating systems.

Gray et al (2008) studied 100 patients on the Softform Premier Active mattresses versus a standard air mattress on pressure ulcer incidence in two elderly care wards. Of the 50 patients using the Softform Premier Active mattress, four developed superficial EPUAP category 2 sacral ulcers (n=3) and heel ulcer (n=1). While standard air mattresses also developed EPUAP category 2 sacral ulcers (n=2) and heel ulcer (n=2). This result shows an incidence of 8% in both groups. Gray et al (2008) concludes that the Softform

Table 1. Results from Evaluations Audit of the Dyna-Form Mercury Advance Mattress V Softform Premier Active Mattress

Mattress	Age	Waterlow score	Sex	Must	Diagnosis	Number of days on mattress	EPUAP category	Site of PU	Able reposition	Outcome
DMAM	86	30	F	1	Circulatory disease, Diabetes mellitus	12	0	0	Yes	No Ulcers
DMAM	77	21	F	3	Arthritis, Parkinson's disease, Paralysis due to cerebrovascular disease	16	2 when recruited	Sacrum	Yes	Healed in 4 days
DMAM	30	20	F	2	New Diabetes mellitus	7	0	0	No	No Ulcers
DMAM	94	24	F	6	Circulatory disease, Diabetes mellitus niddm	16	1	sacrum	No	Yes healed Within 3 days
DMAM	78	11	F	0	ENT problems	22	0	0	No	No ulcers
SPAM	84	19	M	0	Glaucoma	26	0	0	No	No Ulcers
SPAM	76	16	M	1	Skin Disease, Leg Ulcers, Renal impairment	11	2 when recruited	Left heel	Yes	Developed category 1 natal cleft Left heel healed in 10 days
SPAM	76	21-26	F	1	Rheumatoid arthritis, Hypertension	29	1 2	Left heel Right heel Moisture lesions	No	Developed Category 1 &2 and moisture lesion
SPAM	83	15	M	0	Circulatory system disease	11	0	0	Yes	No Ulcers
SPAM	65	16	M	0	Diabetes mellitus insulin	14	0	0	Yes	No Ulcers

Key: Dyna-Form Mercury Advance Mattress = DMAM; Softform Premier Active. Mattress = SPAM

Premier Active mattress was found to be as effective in reducing the incidence of pressure ulcers as the standard alternating mattress in high-risk population.

Dyna-Form Mercury Advance

The Dyna-Form Mercury Advance mattress is suitable for patients at high/very high risk of pressure ulcer development and for the treatment. It has the advantage of being a static mattress combined with a dynamic alternating system. This mattress design is unique as the foam is actually inside the alternating cells. The pump has a cycle of 10 minutes. The cover is made of a multi-stretch, vapour-permeable fabric and the seams are of a welded design, with a protective zip with a ring-pull feature that allows easy inspection for ingress fluids. There is a CPR and static mode. It has an automatic pump that is also adjustable in two modes for patient comfort and 'dynamic use' (dynamic use refers to an alternating cell mattress driven by an electrical pump with air sacks which sequentially inflate and deflate to relieve pressure for short periods under the patient). The system can accommodate up to the weight 40 stone (254kgs), however, the best clinical outcome has been found up to that of 24stone (152kgs). All components are interchangeable, making it cost advantageous and assistive to that of environment management.

Softform Premier Active

The Softform Premier Active mattress consists of a foam mattress with a dynamic underlay. The underlay alternates on 2-cell 10-minute cycle time through the pump. The pump is also able to assess the patient's weight and adjusts the supply of an appropriate level of air to provide an alternating surface for patients at high level of risk of the development of pressure ulcers. There is a two-way stretch vapour permeable cover and welded seams that are fully concealed. The weight limit is up to 39 stone (248kgs).

Both systems permit stepping up and down for patients, as the mattresses can be used as a static system when an alternating surface is not required. The pump can be

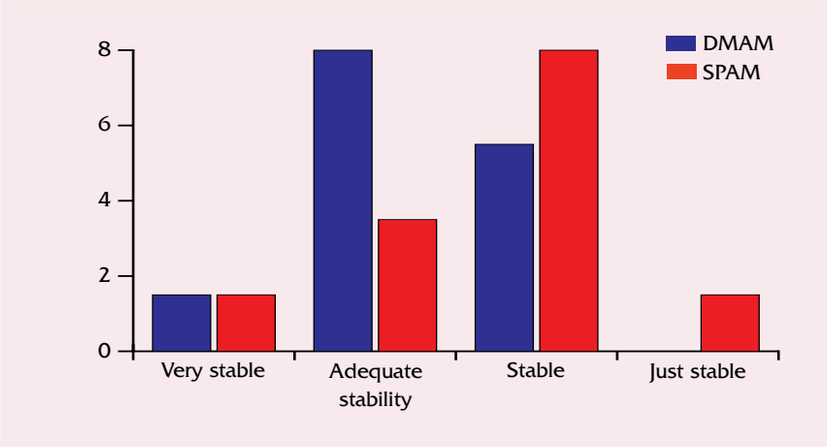

Figure 1. The mattress system's stability when the patient is sitting on the edge of the bed

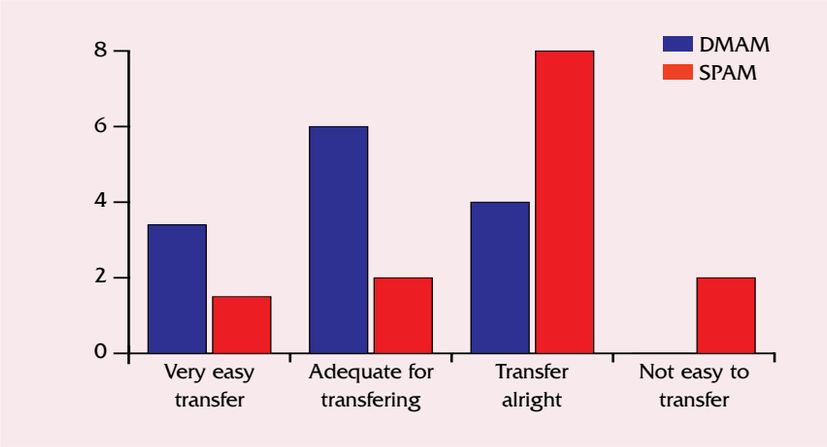

Figure 2. The mattress system's stability when transfering patients from the bed

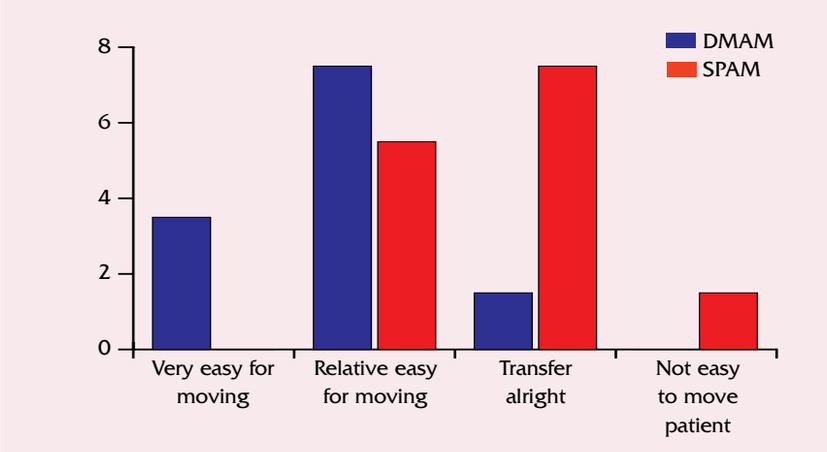

Figure 3. Turning and positioning of patients on the mattress system

disconnected and the system can become a non-alternating pressure-reducing mattress. This also reduces the amount of moving and handling by having to lift a static mattress and also cleaning of the alternating system. This also has an implication on nursing time, being able to have a dual system in one mattress. The pump can be stored away or employed on another mattress. The clinical benefit of a single system is that it can meet the needs of patients in hospital and community and meet the demands of the health service while not comprising a patient's skin integrity.

The aims of study

The aims of the evaluation audit were:

- To determine the effect of the Dyna-Form Mercury Advance Mattress versus Softform Premier Active Mattress on pressure ulcer incidence for that of high risk rehabilitation wards over a 1-month period
- To gain patients' opinion of the mattresses' comfort
- To determine the staff's and allied health professionals' opinions on the performance of the two mattresses.

Methodology

All of the ward staff and allied health professionals were trained on the two systems, a week before the evaluation audit commenced. They were trained in how to set the mattresses up, the various functions of the two mattresses, and how to clean and decontaminate mattresses.

On admission to the ward, patients were assessed using Waterlow Score risk assessment and clinical judgement in accordance with local guidelines. As it was an evaluation audit, it did not require ethic approval and permission was obtained from the organization before commencement. Patients considered to be at high risk of pressure ulcer development were randomly allocated Dyna-Form Mercury Advance or Softform Premier Active. An evaluation audit form was designed from previous studies (Russell et al, 2000). Participants, selected by the ward staff, had no existing skin damage or up to category 2 EPUAP pressure ulcers. Patients were excluded if they were unwilling to participate, if they were re-admitted with pressure ulcers and if they weighed above 25 stone.

Patients were asked by the auditor if they were happy to participate in an evaluation audit of the trial mattress, explanations of the trial were given to the patient and their involvement. The patients were given 24 hours to consider if they were happy to enter into the evaluation audit. Their skin was assessed daily for any changes or development of pressure ulcers by ward staff and by the co-ordinator of the audit three times a week. Any pressure ulcers were categorized by the tissue viability nurse specialist. In addition to pressure ulcers, the Waterlow score, the Malnutrition Universal Screening Tool (MUST) Score, demographics, mental status and other medical conditions were also monitored. Medication, the repositioning of patients and the mattresses the patient had been nursed on prior to the recruitment to the trial were also documented. All data was analysed by Microsoft Excel and the sample size was not big enough to use statistical tests.

Patients were asked their opinions on the comfort aspects of the mattress. Patient questionnaires were carried out only when the patient had been on a mattress for one week or if the patient had been withdrawn from the evaluation for their own reasons. An independent person (a ward volunteer) assisted the patient to complete the patient comfort questionnaire, where necessary.

After the 4-week trial, ward staff were also given a questionnaire to gain their opinions of the two mattresses.

Results

During the study period, there were five subjects on Dyna-Form Mercury Advance mattress (median (4) age = 73 years) and Waterlow score median (4) = 21.1 and ranged from 11-30

and Must Score 0-6. The weights of the subjects was between 41-66kgs (*Table 1*). There were five subjects on the Softform Premier Active mattress (median age 76.8 years), Waterlow score median = 18.4 and ranged from 15-26 and Must Score 0-1. The weights of the subjects ranged from 61-101kgs. Of the patients nursed on the Dyna-Form Mercury Advance mattress, three patients did not develop pressure ulcers. The two patients that had superficial pressure ulcers when recruited to the trial, appeared to be healed within 4 days. Of the patients nursed on the Softform Premier Active mattress, two patients developed superficial ulcers while on the systems. The other three patients did not develop pressure ulcers.

Staff questionnaires

There were 14 nurses that completed the questionnaire and the graphed results are displayed *Figures 1-4*. These graphs demonstrate that the nursing staff found the Dyna-Form Mercury Advance mattress more stable when patients are sitting on the edge and on transferring patients. The moving and handling of patients also appears to be better on the Dyna-Form Mercury Advance mattress. Both of the mattresses appear to be easy to set up and use. Overall, eight of the staff preferred the Dyna-Form Mercury Advance mattress whereas six nurses favoured the Softform Premier Active mattress.

Patient comfort

There were six patients that were able to respond to the patient questionnaire; three in each mattress group. The other patients involved with the audit were not questioned as they were confused (owing to a decline in normal cognitive ability which may be acute or chronic and progressive. In older people, confusion is most likely to be a symptom of delirium or dementia). The graph in *Figure 5* demonstrates the finding of comfort of each mattress systems.

All the patients slept well on both mattress systems. Patients were asked if they had been nursed on a different mattress. Three patients had previously been nursed on alternating mattresses and one on a static mattress.

Discussion

During the last decade the use of alternating mattresses has increased despite the reported lack of efficacy of this equipment (Cullen et al, 2000; Russell et al, 2003; Mclnnes et al, 2008). The evidence does state that a high-quality foam mattress is the best, cost-effective option for preventing pressure ulcers. Defloor et al (2005) states that alternating mattresses are likely to reduce the incidence of pressure ulcers.

The results of this evaluation audit is of a relatively small group of patients with similar co-morbidities recorded. In addition to having had an emergency admission, their median age and their Waterlow score recorded, indicated that these patients were at high risk of pressure ulcer development. Support surfaces alone will not prevent or heal pressure ulcers. The mattresses were used in conjunction with good nursing care and moving and handling. It has been demonstrated that clinically the Dyna-Form Mercury Advance mattress and the Softform Premier Active mattress provide the right pressure redistribution, reduction in shear and microclimate for the patient.

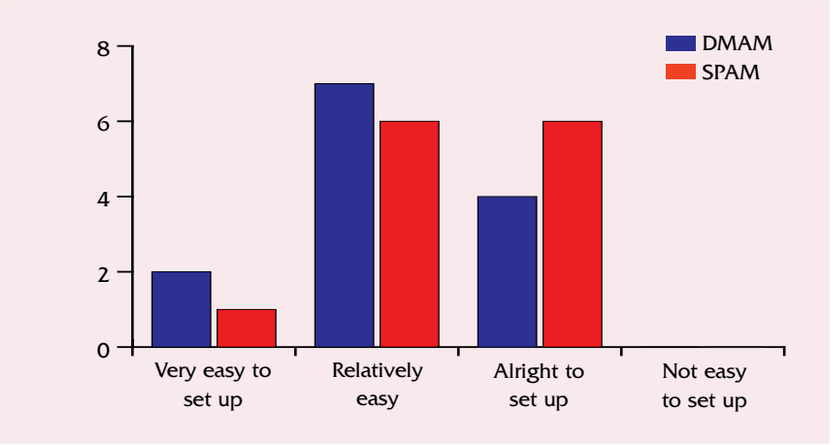

Figure 4. The ease of mattress system being set up

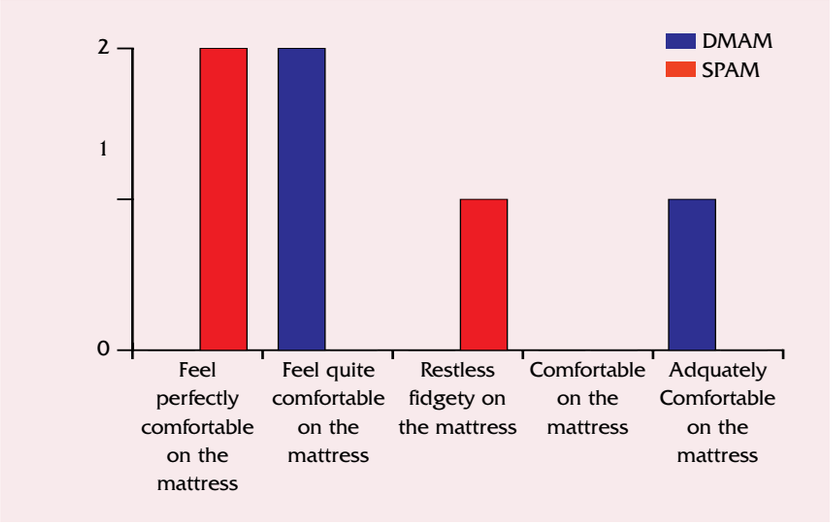

Figure 5. Findings of patient confort for the mattress systems

One of the problems inherent in nursing patients on alternating systems is motion sickness (Beldon, 2002). All of the patients were nursed with alternating element of the two systems.

All patients' responses to the comfort questionnaire were positive as they found both systems comfortable and no motion sickness was reported. Only one patient was restless and fidgety. Overall, patients slept well on both systems. The questionnaire confirmed the new Dyna-Form Mercury Advance mattress appears to perform as well as the Softform Premier Active mattress for the patients nursed on these systems.

One of the problems experienced by patients nursed on static mattresses with overlay is the instability that is created by this combination of equipment. The two systems are at the height of a static mattress. The staff appeared to find the Dyna-Form Mercury Advance Mattress more stable when the patients were sitting on the edge of the bed and when transferring from bed for rehabilitation. They also preferred the Dyna-Form Mercury Advance Mattress when moving and handling the patient in bed and found the mattress system easy to set up.

The effectiveness of these two mattress systems cannot be viewed in isolation and must be considered in the context of nursing care provided. As this is only a small group of patients it is difficult for statistical information to be demonstrated.

However, in this small evaluation audit, it concluded that the Dyna-Form Mercury Advance mattress appears to help prevent the development of pressure ulcers as well as promoting the healing of superficial pressure ulcers. The Softform Premier Active mattresses also prevented the development of pressure ulcers. The limitation of this evaluation audit was the small sample size and a larger study would benefit in order to enhance the findings in greater detail.

Cost implication

Both mattresses have the advantage that they can be employed as a static system or an active mattress. Therefore, financial costs should be considered in relation to the clinical outcomes of alternative products on the market.

Limitations

Limitations of the study included a small sample size and the length of time available to conduct the audit. The size of the audit meant that no statistical tests could be conducted. A larger trial over a period of 3-6 months would need to be conducted in order to strengthen the quality of the evidence.

Conclusion

The preventing of pressure ulcers and reducing the incidence is a quality indicator. In order to prevent pressure ulcers, access and availability to the appropriate equipment is essential. Holistic assessment of the skin, repositioning, nutrition and nursing care by knowledgeable staff make a significant contribution to the overall care that the patient receives. The use of alternating systems has increased over the last decade. Although the results given in this audit demonstrate that Dyna-Form Mercury Advance mattress helps to prevent the development of pressure ulcers as well as healing superficial pressure ulcers, a large trial would further substantiate these results.

In whichever organization the patient is being nursed, health professionals need to be able to prevent the development of pressure ulcers in vulnerable patients effectively, by employing safe equipment with effective patient outcomes that are cost effective. BJN

KEY POINTS

- The prevention of pressure ulcers and reducing incidence is a quality indicator and access to appropriate equipment is essential
- Health organization expenditure is high in association with preventing pressure ulcers and with equipment costs, treatment and litigation
- The Dyna-Form Mercury Advance Mattress gave interesting results on the prevention and treatment of pressure ulcers
- Holistic assessment of the skin, repositioning, nutrition and nursing care by knowledgeable staff make a significant contribution to the overall care that the patient receives

Conflict of interest: This evaluation was supported by Direct Health Care but carried out independently.

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