

How effective is pressure ulcer prevention?

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Abstract

Background: How do we know when an intervention has altered the natural history of a developing pressure ulcer? **Objectives:** To determine the fate of 2574 pressure-ulcer free subjects admitted to hospitals in the UK and US. **Method:** Prospective observation of a cohort of hospital patients.

Results: 108 subjects developed pressure ulcers. The incidence (among the high to very-high risk group), number and severity of ulcers were similar between subjects in the UK and US. Based upon an apparently homogeneous group of 460 subjects (all at high to very high risk of developing ulcers, and confined to bed, or bed and chair) conversion rates were calculated for five types of support surface. Two distinct groups were found reflecting the use of static or alternating devices, with the lowest conversion rates observed upon static devices. **Conclusions:** This suggests either that static devices are more effective or, more probably, that the true risk of developing ulcers among subjects allocated to either device type differed. **Declaration of interest:** Study funded by Pegasus.

KEY WORDS

Pressure ulcer
Prevention
Cohort study
Support surface
Static or alternating devices

Over the past 20 years, considerable attention has been directed towards the prevention of pressure ulcers (Clark, 2001). This focus perhaps stems from three fundamental beliefs: the humanitarian, economic and quality of life benefits to be gained by preventing ulcers. For the individual, having a pressure ulcer may reduce one's quality of life. Taking a wider perspective, prevention may cost less than treating ulcers, and it is believed that most ulcers are readily preventable and, therefore, should not occur in health systems devoted to providing high

quality care. While the basis for each of these three tenets has been discussed (Clark, 2001), one key question remains largely unaddressed — how do we know when a pressure ulcer has been prevented? When a person with intact skin receives health care, and attention is given to maintaining their skin, does the subsequent absence of a pressure ulcer mark good quality prevention or was this person resistant to developing ulcers in the first place?

Perhaps pressure ulcer risk assessment scales, such as the Waterlow (1985) or Braden (Bergstrom et al, 1987), could be used to quantify the inherent risk of developing a ulcer. If the number of people at greatest risk was known, this could be used as a denominator allowing construction of a 'conversion rate' from being at risk to developing ulcers (Hagisawa and Barbenel, 1999; Clark, 2001). This assumes that the risk assessment scale is a precise measure of vulnerability, rather than a general indicator of potential risk. The use of conversion rates also assumes that in the absence of preventive care, all vulnerable subjects will develop ulcers. While data is scant, one study (Xakellis

et al, 1998) reported pressure ulcer incidence rates and Braden scores (calculated retrospectively) within a US long-term care facility where no pressure ulcer preventive care was performed. In this study, 38.2% of apparently vulnerable patients developed ulcers. While conversion rates may offer some insights into the effectiveness of preventive care, especially within homogeneous or risk-adjusted populations, such data must be subject to careful interpretation, given the current lack of a precise measure of vulnerability to ulcer development.

Recently (Clark et al, 2002a,b), data collected on pressure ulcer prevention and treatment within UK hospital in-patients recruited to a multi-national, multi-centre prospective non-randomised cohort study has been described. In this study, a maximum of 11.3% of the most vulnerable subjects developed ulcers. This low conversion rate may infer that the preventive care allocated was effective. The present paper addresses in detail the effectiveness of pressure ulcer prevention within this population. The project also collected similar data from a US acute care population, although ►►

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the methods of data collection did differ between the two countries. In the UK, data was collected from review of medical and nursing notes, along with direct observation of the subject; in the US, only record reviews were available. The two data sets have been combined in this paper, to allow examination of the effectiveness of specific interventions used in pressure ulcer prevention.

Methods

A full description of the design and execution of this study was reported by Clark *et al* (2002a,b). The UK and US acute care data have been combined with respect to data elements gathered in both countries from medical and nursing records. Risk assessment scores were collected in both countries; however, the US records contained Braden or Norton scores (Norton *et al*, 1962), while the UK employed the Waterlow scale. The Waterlow scores were grouped into four different categories of risk:

- ▶▶ Minimal
- ▶▶ Low
- ▶▶ High
- ▶▶ Very high,

according to the standard use of the scale (Waterlow, 1985). Arbitrarily, both the Norton and Braden scores were also grouped into similar categories with the appropriate sensitivity analyses performed to check the robustness of the analyses based upon these artificial groups.

One other major difference between UK and US data collection was the recruitment of subjects nominally at minimal risk; these subjects were recruited in the UK but were rarely entered into the US data-set. Consequently, the analyses reported in this paper are based upon subjects considered to be at high to very high risk only. Subjects were able to enter the database on multiple occasions, depending upon their readmission to hospital; all analyses are based upon data collected during the first admission to the database.

Primarily this paper considers the relative effectiveness of the different

groups of pressure redistributing beds and mattresses used in the care of subjects who entered hospital without pressure ulcers. Conversion rates were calculated for five intervention groups:

- ▶▶ Standard mattress
- ▶▶ Low-pressure foam mattress
- ▶▶ Static overlay
- ▶▶ Alternating overlay
- ▶▶ Alternating pressure replacement mattress.

These conversion rates were derived by dividing the number of subjects who developed ulcers upon each intervention, by the total number of high and very high subjects nursed upon the intervention.

Results

Three thousand, six hundred and ninety eight subjects were recruited across the four acute care providers in the UK (n=2496), and the single participating hospital in the US (n=1202). Eleven subjects were excluded, given either their pressure ulcer outcome was unreported (n=2) or their vulnerability to future pressure ulcers was unknown (n=9). From the remaining 3687 subjects, further exclusions targeted subjects at a perceived minimal risk of developing ulcers (UK, n=721; US, n=84), along with those who presented with pressure ulcers when admitted to hospital (UK, n=100; US, n=244). Thirty-seven subjects presented with ulcers on admission but were perceived to be at minimal risk of developing further pressure damage (1 in the UK, 36 in the US).

The subjects recruited in the US were both older (t=-6.66, df=2573, p<0.0001) and stayed longer in hospital than those in the UK (Mann-Whitney U=588255.5, z=-9.028, p<0.0001)(Table 1). The median length of stay in hospital was 12 and 9 days in the US and UK, respectively. In both the UK and US the majority of subjects were female, however, the difference between the sex of subjects was most marked in the US (c2=6.95, df=1, p<0.01). Subjects recruited in the UK appeared to be at a higher degree of risk of developing pressure damage, with 24.1% at 'very high risk' with only

Table 1

Characteristics of subjects at low to very high risk of developing pressure ulcers recruited in the UK and in the US

	Location of subjects	
	UK	US
Number recruited	1668	906
Age(mean range)	70.06 (16-103)	74.50 (16-104)
Sex (Male:Female)	707:961	336:570
Length of stay (median range)	9 (3-227)	12 (1-441)
Ulcers developed	114	88
Pressure ulcers at admission	100	244

9.9% of US subjects at a similar risk (c2=79.66, df=2, p<0.0001). Seven UK subjects developed severe ulcers (defined as full-thickness wounds) and while 9 US subjects developed similar wounds, this difference was not significant (c2=1.64, df=1, p>0.05). Multiple ulcers developed in 17 and 15 UK and US subjects respectively, but this difference was not significant (c2=0.51, df=1, p>0.05).

Overall, conversion rates were calculated for the UK and the US based upon only those subjects marked at 'high' and 'very high risk' of developing pressure damage. In the UK, the conversion rate between 'being at risk' and 'developing an ulcer' was 106/952 (11.1%); and, in the US, the overall conversion rate was 54/413 (13.1%), this difference could have occurred by chance (c2=1.05, df=1, p>0.05). For the combined sample, the overall conversion rate was 160/1365 (11.7%). Table 2 marks the conversion rates recorded among subjects nursed exclusively upon one of five types of PR support surface; standard foam mattress, low-pressure foam mattress, static overlay, alternating pressure mattress overlay and alternating pressure mattress replacements. ▶▶

The lowest conversion rate was recorded among subjects nursed on standard mattresses (0.057), and the highest on alternating pressure mattress overlays (0.320). While all subjects were considered to be at an elevated risk of developing pressure ulcers based upon the calculated risk assessment scores, the level of activity of these subjects showed marked differences (Table 3).

Subjects nominally at considerable risk of developing pressure ulcers were often reported to be either fully mobile or mobile, with some restrictions (for example, 71.9% (n=179), of all subjects nursed on standard mattresses fell into these categories). Subjects allocated to alternating pressure devices were typically confined to bed or confined to bed and a chair (for example, 62.2% (n=51) of subjects allocated an alternating pressure mattress replacement had such major limitations on their activity). Conversion rates were calculated for those subjects confined to bed or chair (Table 4). In this case, the highest conversion rate was calculated among subjects nursed on alternating pressure replacement mattresses, while the lowest conversion rates were observed among subjects nursed on static overlays.

Discussion

This paper has reported the combination of UK and US data collected within a multi-national, multi-centre, prospective, non-randomised cohort study of the prevention of pressure ulcers among acute care patients. Such data combining was restricted due to differences in the methods through which data was collected in the two countries. In the US, data was drawn solely from nursing and medical records, while, in the UK, observation and interview of subjects were also available. Consequently, this report only considers common data items collected through the medical and nursing records.

Clear differences emerged regarding the characteristics of

Table 2

Pressure ulcer conversion rates among high and very-high risk subjects nursed upon one of six support surface groups

	Standard mattress	Low pressure foam mattress	Static overlay	Alternating overlay	Alternating replacement mattress
Number ulcer free	246	423	171	32	78
Number developed ulcers	15	36	16	13	25
Conversion rate	0.057	0.078	0.085	0.288	0.320

Table 3

Restrictions upon the activity of high and very-high risk subjects nursed upon one of six support surface groups

	Standard mattress	Low pressure foam mattress	Static overlay	Alternating overlay	Alternating replacement mattress
Fully mobile	26	43	16	3	6
Restricted activity	153	121	94	11	25
Confined to bed and chair	47	44	28	13	28
Confined to bed	21	165	33	4	23
Unknown	14	86	16	14	21

Table 4

Pressure ulcer conversion rates among inactive (confined to bed or bed and chair) high and very high-risk subjects nursed upon one of six support surface groups

	Standard mattress	Low pressure foam mattress	Static overlay	Alternating overlay	Alternating replacement mattress
Number ulcer free	66	207	61	17	45
Number developed ulcers	8	21	5	8	20
Conversion rate	0.108	0.092	0.076	0.320	0.444

subjects recruited in the two countries: US subjects tended to be older than their UK counterparts, while a higher proportion of women were recruited in the US. Interestingly, the median length of stay in hospital was greater in the US (12 days US vs 9 days UK). It also appeared that the UK subjects were more likely to be at the highest risk of developing ulcers. However, this final observation must be treated with caution for risk was assessed using different tools in the two countries

(Waterlow Scale in the UK, the Norton or Braden Scales in the US). Despite these demographic differences, and perhaps the greater acuity of UK subjects, little difference was observed in the recorded pressure ulcer outcomes. No significant differences were found between UK and US subjects with respect to the incidence of ulcers (when calculated in those subjects at 'high' or 'very high' risk of developing ulcers), number of ulcers per subject, or their severity. ►►

Conversion rates were calculated to illustrate the number of subjects who developed ulcers while nursed upon different groups of pressure redistributing (PR) beds or mattresses. Regardless of whether the denominator was based upon all subjects nursed on a support surface, or was restricted to those confined to bed or chair and allocated the support surface, two distinct groups emerged. Calculated conversion rates were lowest upon static mattresses and overlays, and higher upon alternating devices. This could suggest that the 'best' prevention was achieved on static devices, or that the populations allocated to static or alternating devices were not comparable. This study attempted to define homogeneous patient groups (all at high or very high risk, nursed exclusively upon one type of support surface during their stay in hospital, and confined to bed or chair). However, nursing staff who allocated subjects to PR devices may have used other cues to target the use of the relatively scarce alternating pressure devices. The validity of this explanation for the difference between the conversion rates upon static and alternating devices needs to be examined in future studies.

This cohort study has followed the fate of 2574 subjects drawn from hospitals in the UK and the US, and has enabled the relative effectiveness of different interventions to be compared using incidence (or conversion) rates, calculated within relatively homogeneous groups. Although this comparison is of practical value, perhaps the key finding has been the difference between the conversion rates calculated for apparently comparable groups nursed on static or alternating devices. It is interesting to speculate, and later to test, whether such a difference reflects the skill of nurses to use cues, other than risk assessment scores and major restrictions on patient mobility, to judge which patients are at greatest need of a scarce resource, such as an alternating pressure mattress. [WUK](#)

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