The impact of pressure ulcer risk assessment on patient outcomes among hospitalised patients

Mohammad Saleh, Denis Anthony and Sam Parboteeah

Aims and objectives. To determine whether use of a risk assessment scale reduces nosocomial pressure ulcers.

Background. There is contradictory evidence concerning the validity of risk assessment scales. The interaction of education, clinical judgement and use of risk assessment scales has not been fully explored. It is not known which of these is most important, nor whether combining them results in better patient care.

Design. Pretest–posttest comparison.

Methods. A risk assessment scale namely the Braden was implemented in a group of wards after appropriate education and training of staff in addition to mandatory wound care study days. Another group of staff received the same education programme but did not implement the risk assessment scale and a third group carried on with mandatory study days only.

Results. Nosocomial Pressure Ulcer was reduced in all three groups, but the group that implemented the risk assessment scale showed no significant additional improvement. Allowing for age, gender, medical speciality, level of risk and other factors did not explain this lack of improvement. Clinical judgement seemed to be used by nurses to identify patients at high risk to implement appropriate risk reduction strategies such as use of pressure relieving beds. Clinical judgement was not significantly different from the risk assessment scale score in terms of risk evaluation.

Conclusions. It is questioned whether the routine use of a risk assessment scale is useful in reducing nosocomial pressure ulcer. It is suggested clinical judgement is as effective as a risk assessment scale in terms of assessing risk (though neither show good sensitivity and specificity) and determining appropriate care.

Relevance to clinical practice. Clinical judgement may be as effective as employing a risk assessment scale to assess the risk of pressure ulcers. If this were true it would be simpler and release nursing time for other tasks.

Key words: Braden Score, clinical judgement, nurses, nursing, pressure ulcers, risk assessment scales

Accepted for publication: 1 October 2008

Introduction

The authors have undertaken a recent literature review on risk assessment scales (RASs) (Anthony et al. 2008) and we do not intend to cover this ground again here. However, the main points we made were ‘There is contradictory evidence concerning the validity of RASs. The interaction of education, clinical judgement (CJ) and use of RASs have not been fully explored. It is not known which of these is most important, nor whether combining them results in better patient care’. This study based on a work by Saleh (2007) aims to address this gap in the knowledge identified in our earlier review.

The root problem is that while RASs have been implemented in many settings and have been shown to reduce
incidence of pressure ulcers (PUs), implementation necessarily involves education of staff on the risk tool and this may be beneficial in terms of raising awareness and could lead to improved CJ. The question thus is: when a RAS is implemented, is it the education and possible improved CJ or it is the use of the RAS itself, or some combination, that improves incidence? It is also possible that staff awareness could be raised simply by being aware that a study looking at PU risk was ongoing, the well known Hawthorn effect. A recent review (Pancorbo-Hidalgo et al. 2006) found only three studies that looked at clinical effectiveness of RAs, all using the Norton Score. Thus, no known study has considered the clinical effectiveness of the Braden Score.

One might argue that it does not matter what gives the improvement, as long as it happens. However, having (say) improved CJ and thus reduced incidence of PUs, it would be a waste of valuable staff time recording RAS scores, which might be better used on other activities. Thus it is important to tease apart the effects of RAS, education and CJ.

Study design

Ideally, one would conduct a controlled trial of a RAS (with necessary education to implement it) compared with education alone and with a control where neither RAS nor education is an intervention. In countries such as the UK where the first RAS, the Norton score (Norton et al. 1962), was developed it is ethically problematic to conduct such a study. RAs such as the Norton score have been in use for nearly half a century and current use of the Waterlow (Waterlow 1985, 1988, 1991) score is ubiquitous, similar comments relate to the USA with regard to the Braden (Braden & Bergstrom 1987) score. Removal of a RAS, when it is well established that the RAS has been validated in terms of risk assessment would be difficult. However, the Riyadh Military Hospital (RMH) had not used a RAS to measure risk of PU or determine preventive measures, but planned to implement one (the Braden). Thus this seemed an ideal arena to conduct an evaluation of a RAS.

To control other factors, ideally patients would be randomly allocated to one group or the other. However, this is not practical. For each patient would need to be nursed by staff who either have implemented the RAS and/or having had specific education on RAs or none of these. One would have the situation where some staff on each ward would need to – themselves – be in each group and they could only nurse patients in their group. Further, staff on the ward who are in the RAS group would have to not have any effect on other staff, e.g. not talk to them about the RAS and similarly the education group only would not be permitted to talk about this to control staff. This is clearly not sensible.

As staff and patients need to be in the same group, it is much more practical to make wards the smallest unit of allocation. This means that all nurses in a given ward will be automatically in the same group as patients. ‘Contamination’ of groups (e.g. nurses discussing the education among themselves) is less likely where allocation is on a ward base. With sufficient wards randomised to each group, differences in wards in the two groups should not be significantly different. However, this is problematic as it would need a very large and thus expensive study.

Therefore, for pragmatism, this study randomly allocated nine wards into three groups. The Braden score ≤ 18 was used as a cut off score to determine at risk patients. The US Agency for Health Care Policy and Research (1992) PU classification system was used to measure PU incidence:

1. Group A nurses (The Braden scale group) received a mandatory wound care management study day, PU prevention training programme and specific training on the application of the Braden scale. These nurses were required to implement the Braden scale on their patients in the post intervention stage;
2. Group B nurses (The training group) were identical to A but were not required to implement a RAS;
3. Group C nurses (The CJ group) received only a mandatory wound care management study day.

Pretest patients were recruited from February 2006–September 2006, posttest patients from October 2006–March 2007.

Most patients at RMH stay for several weeks and patients with PU are known to have longer patient stays (Anthony et al. 2004). To give a standard measure of incidence of nosocomial PU a definition of incidence was where a patient developed nosocomial PU within eight weeks of admission. Thus patients were followed up for eight weeks. This seems a long time from (say) a UK perspective where most patients stay a few days in hospital, but in the RMH 72.5% of patients with the entry criterion (a Braden score ≤ 18) stayed at least eight weeks. Patients discharged within eight weeks were excluded from initial analysis, though these were included in further analyses to check whether inclusion of more acute patients made a difference.

Each patient was monitored for protective measures. This included the following categories:
1. Protective mattresses such as the standard hospital bed mattress (Stryker®, Inc., Hamilton, ON, Canada), alternating pressure relief system Therakair® (Kinetic Concepts, Inc., San Antonio, TX, USA), Gen Air 8000® (Genadyne,
Inc., Great Neck, NY, USA), Atmosair® (Kinetic Concepts, Inc., USA) and gel overlay or air fluidised bed (Clinitrion®, Hill-Rom, Inc., Batesville, IN, USA);

2 Creams and skin barriers;
3 Vitamin supplements and special nutritional formulas;
4 Patients’ turning (positioning) schedules every two, three to four, or six hours.

A CJ rating scale was devised, going from 1 (no risk), 2 (minimal risk), 3 (moderate), 4 (high) – 5 (severe risk). The nurses were asked to complete the CJ scale and to assign a score according to their experience with patients at risk of PU development. The rating was completed immediately following research team’s assessment and then it was handed to be included in the patient’s record.

The data were collected by MS, who was the Tissue Viability Nurse Specialist at the RMH and two staff nurses. The two staff nurses were recruited to the wound care team and each had medical–surgical nursing experience of six to eight years, as well as being available as part of the RMH nursing team. The two staff nurses received training before they started the actual data collection. They attended the wound care study day, research training, PU training and the Braden scale training courses. They were subsequently instructed and introduced to the data collection protocol which included patient observation according to the instrument, data recording, data filing and the patient follow up procedure. Special consideration was given to the PU classification system, skin assessment and PU location. The methods used in the research team’s training included case studies, PowerPoint presentations, video tapes, CDs, internet access to (American) National Pressure Ulcer Advisory Panel (NPUAP) and European Pressure Ulcer Advisory Panel (EPUAP) and demonstration in clinical wards. They conducted a pilot on a group of patients and minor modifications on the data collection instrument were made by the research team as a result.

Ethical considerations

Ethical approval was obtained from the Research and Ethics Committee at the RMH, project number 292/2004 and from the Ethics Committee of the Faculty of Health and Life Sciences at De Montfort University in 2004. Furthermore, written permission from Braden and Bergstrom was obtained to use the Braden scale.

Results

There were no significant differences between the three groups (A, B and C) for PU incidence (see Table 1) or PU grade 2–4 in the pre-intervention or post-intervention (chi square $p = 0.90$ and $p = 0.38$ respectively). However, there were differences between the groups that could affect PU incidence. These included medical diagnoses (see Table 2), protective measures (see Table 3), referral to the wound care team (19.2% were referred), use of barrier creams (46.8% received barrier creams) and vitamin therapy (39.9% received vitamins).

Chi square was used to test (nosocomial) PU incidence (all ulcers) and PU incidence grades 2–4. This showed that medical diagnosis was significantly associated with the former but not the latter ($p = 0.002$ and $p = 0.31$ respectively).

Table 1 Nosocomial PU by group

<table>
<thead>
<tr>
<th>Group</th>
<th>No PU</th>
<th>PU</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>Pretest A</td>
<td>53</td>
<td>26</td>
<td>79</td>
</tr>
<tr>
<td>B</td>
<td>64</td>
<td>27</td>
<td>91</td>
</tr>
<tr>
<td>C</td>
<td>65</td>
<td>30</td>
<td>95</td>
</tr>
<tr>
<td>Total</td>
<td>182</td>
<td>83</td>
<td>265</td>
</tr>
<tr>
<td>Posttest A</td>
<td>58</td>
<td>16</td>
<td>74</td>
</tr>
<tr>
<td>B</td>
<td>59</td>
<td>17</td>
<td>76</td>
</tr>
<tr>
<td>C</td>
<td>90</td>
<td>16</td>
<td>106</td>
</tr>
<tr>
<td>Total</td>
<td>207</td>
<td>49</td>
<td>256</td>
</tr>
<tr>
<td>Excluded A</td>
<td>59</td>
<td>13</td>
<td>72</td>
</tr>
<tr>
<td>B</td>
<td>51</td>
<td>10</td>
<td>61</td>
</tr>
<tr>
<td>C</td>
<td>55</td>
<td>10</td>
<td>65</td>
</tr>
<tr>
<td>Total</td>
<td>165</td>
<td>33</td>
<td>198</td>
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Table 2 Diagnoses

<table>
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<tr>
<th>Diagnostic group</th>
<th>Count</th>
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<tr>
<td>Medical</td>
<td>289</td>
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<tr>
<td>Surgical orthopaedic</td>
<td>155</td>
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<tr>
<td>Oncology</td>
<td>72</td>
</tr>
<tr>
<td>Renal</td>
<td>38</td>
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<tr>
<td>neuro-surgical</td>
<td>29</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>52</td>
</tr>
<tr>
<td>Vascular</td>
<td>2</td>
</tr>
<tr>
<td>Not recorded</td>
<td>82</td>
</tr>
<tr>
<td>Total</td>
<td>719</td>
</tr>
</tbody>
</table>

Table 3 Protective measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard mattress</td>
<td>400</td>
</tr>
<tr>
<td>Alternating air mattress/overlay/mattress replacement system</td>
<td>106</td>
</tr>
<tr>
<td>Low air loss + pulsating/Therakair</td>
<td>130</td>
</tr>
<tr>
<td>Low air mattress replacement system/Gen Air</td>
<td>26</td>
</tr>
<tr>
<td>Self Adjusting Technology Air mattress/Atmosair</td>
<td>49</td>
</tr>
<tr>
<td>Gel overlay/Pressure Reducing</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>719</td>
</tr>
</tbody>
</table>
Protective measures were significantly associated with both 
\( p = 0.006 \) and \( p = 0.04 \). Referral to the wound care team was significantly associated with both \( p = 0.002 \) and \( p < 0.001 \). Use of creams was significant for both \( p = 0.02 \) and \( p = 0.002 \). Use of vitamins was not significant for either 
\( p = 0.22 \) and \( p = 0.12 \). All such items except barrier creams 
\( p = 0.76 \) were also significantly different between the three 
groups. It is plausible that differences in medical diagnoses, 
protective measures, referral to the wound care team but not 
the use of barrier creams could create differences in PU 
incidence between the groups. Thus the fact that the three 
groups show no significant differences may be an artefact, 
with significant differences in care or patient profile masking 
differences in PU incidence were these variables to be similar 
is each group.

In addition, the risk of PU as measured by the Braden Score 
and CJ was significantly different with respect to group 
\( \text{ANOVA} \). Thus it could be that (say) group A were higher risk 
and the fact that this group had a similar incidence as the 
other groups could show an effect of using a RAS. In fact 
groups A and C were similar in terms of Braden score and 
group B was at significantly higher risk \( \text{ANOVA} \ p < 0.001 \) 
with \textit{post hoc} testing showing differences between A and B 
and B and C, Sheffe \( p < 0.05 \).

For subsequent analysis nominal variables such as protec-
tive factors were used to create dummy variables (e.g. true/
false for each of the various pressure relieving beds).

Differences between pretest and posttests were:

- Position, with fewer posttest two hourly and six hourly 
  positional change and more 3–4 hourly positional change 
  \( p < 0.001 \);
- Vitamins used less in posttest \( p = 0.045 \);
- Standard mattress used less in posttest \( p < 0.001 \);
- Therakair used more in posttest \( p < 0.001 \);
- Gen Air used more in posttest \( p < 0.001 \);
- Alternating mattress used less in posttest \( p = 0.045 \);
- Atmosair used more in posttest \( p < 0.001 \);
- Braden score was higher (lower risk) in posttest 
  \( p = 0.008 \).

However, not referral to wound care team \( p = 0.8 \), use of 
crèmes \( p = 0.08 \), gel \( p = 0.063 \), prevalence of PU on 
 admission \( p = 0.23 \) CJ \( p = 0.9 \). There were also no 
significant differences of specialty in pretest compared with 
posttest.

Similar, but smaller, changes were seen in the use of 
Therakair and Gen Air 8000 beds. The lack of significance 
for the latter compared with Atmosair could be a Type II 
error (though we are not suggesting it necessarily is) 
because of the lack of power resultant on the smaller effect 
change.

To test the effect of group allocation all the significant 
factors above plus age and PU on admission were entered into 
a logistic regression analysis with incidence as the outcome 
variable using the forward conditional method of entry and 
entry criterion \( p = 0.05 \), removal \( p = 0.1 \). The factors that 
remained in the regression equation were Braden score, age, 
referral to the wound care team and use of the Atmosair 
mattress. However, group allocation was not significant.

Repeating the analysis after including patients discharged 
within the eight weeks did not change the main outcomes of 
the study, in that group was still excluded from the logistic 
regression equation, though standard mattress and creams in 
addition to the other items were kept in the equation (creams 
being protective, standard mattress being a risk factor).

Discussion

The evidence appears to be that wards with nurses employing 
CJ after mandatory training did as well as wards whose 
nurses have had additional training and those who further 
had implemented a RAS. One might argue CJ, while recorded 
as a single value, may be a summation of several dimensions 
integrated by the clinician and given as one figure. But CJ was 
measured in this study as a one dimensional (scalar) variable 
and we will treat it as such. The Braden scale is assumed to 
measure many dimensions which are then summed into one 
total score but this may not really be multi-dimensional? The 
sub-scores of the Braden were entered into a logistic 
regression analysis and of the six sub-scores only one was 
significant (sensory perception). One would have expected 
that as the tool is measuring several risk factors associated 
with PU, most if not all sub-scores would be significant.

However, it is possible that the Braden score in this 
population was in fact a one dimensional tool. Thus, any 
apparent advantage of using the Braden score over CJ may 
be illusory as they may both be measuring risk in a similar 
way.

It is, therefore, relevant to compare CJ to the Braden score 
to, determine which is superior in prediction of PU. Plotting 
receiver operating characteristic (ROC) shows Braden to be 
superior to CJ in terms of predicting nosocomial PU, (Fig. 1) 
but the 95% confidence interval for area under the curve 
(AUC) for \( \text{CJ} \ (0.501, 0.618) \) and \( \text{Braden} \ (0.594, 0.704) \) 
overlap, so there may not be a significant difference. Note 
that comparing AUC pretest \( 0.627 \) and posttest \( 0.658 \) 
Braden, the predictive performance is not reduced. Adding 
(previously excluded) patients discharged within eight weeks 
made little difference to the AUC except to reduce the 
difference for AUC between CJ \( 0.525, 0.628 \) and Braden 
\( 0.589, 0.687 \).
Thus, having allowed for Braden on admission, PU on admission and age (none of which are within the control of the ward nurses) the two factors that seemed relevant to nosocomial PU are referral to the wound care team and use of a protective mattress (and possibly creams). But it is uncertain what causes these to change. Patients with lower (more at risk) Braden scores or higher (more at risk) CJ scores are more likely to be referred to the wound care team (Mann–Whitney \( p < 0.001 \) for both). Similarly patients with PU on admission are also more likely to be referred (chi square \( p < 0.001 \)).

Thus, patients who have a history of PU, or are considered higher risk assessed by Braden score or CJ are all more likely to be referred and those referred are more likely to put on protective mattresses. It does not seem that increased turning of patients is associated with either reduced PU incidence or referral to the wound care team and this may be because some support systems obviate the need for increased turning. A logistic regression of use of Atmosair with predictive variables Braden, clinical judgment and referral to wound care team showed only the Braden score stayed in the equation. If Braden is removed then only CJ stays in the equation. This is consistent with higher risk patients, either from CJ or use of the Braden score, getting increased use of special pressure relieving beds and it happens that these are also more likely to be referred, rather (possibly) than referral to the wound care team caused increased use of these systems.

Possibly, counter-intuitively, it is the groups B and C that increased the use of Atmosair beds the most. The pretest use of Atmosair was 1.5%, 1.7% and 1.8% respectively for groups A, B and C and the respective posttest percentages were 1.4%, 9.8% and 13.7%.

**Conclusion**

This study evaluated the implementation of a RAS. There was no significant difference between the group that implemented it and two other groups (one that had additional education on RASs and one that had no change) in terms of nosocomial PU. However, there was an across the board reduction in nosocomial PU. Once level of risk, presence of PU on admission and age were accounted for, referral to the wound care team and increased use of some special pressure relieving beds seemed the main recorded variables that were significantly linked to nosocomial PU. Furthermore, referral to the wound care team was not significantly linked to increased use of such beds once risk level was accounted for.

It is likely that the decrease in nosocomial PU is an example of the Hawthorn effect and that the increased awareness generated by the study benefited patient care. It is possible that the many before and after studies of implementations of RAS without controls are similarly misleading. If it is a Hawthorn effect then one would expect the improvement to suffer decay and it will be interesting to examine the rates of PU in this setting at a later date. Further, it seems that there is little difference between the Braden score and CJ in terms of

<table>
<thead>
<tr>
<th>Source of the curve</th>
<th>Clinical judgement</th>
<th>Reversed braden score</th>
<th>Reference line</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not use mattress</td>
<td>Did use mattress</td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>Posttest</td>
<td>Type</td>
</tr>
<tr>
<td>0.0</td>
<td>0.2</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**Figure 1** Change in use of Atmosair.

**Figure 2** Receiver operating characteristic (ROC) curves.
dimensionality (Braden appears to be one dimensional, clinical judgment is measured as one dimension) or predictive value.

There is always a problem validating a RAS as if the nurse uses the score (as should be the case) to avoid risk by implementing preventive measures, the RAS will show lower sensitivity. However, in this study the AUC is actually slightly better (though probably not significantly so) posttest, indicating that preventive measures may not be being put in place based on the Braden score. However, the main thrust of this paper is not validating the Braden, but determining if implementation has an impact on patient outcomes (PU incidence) and it seems it does not.

We do not conclude from this one study that there is no rationale for using a RAS, but certainly doubt has been cast on the need or utility of routinely employing a RAS on all patients, when a much simpler CJ assessment using a scalar (one dimensional) value shows a similar predictive value. It is possible that using a RAS reinforces CJ. However, if using a RAS does help CJ then we would have expected Group A patients to do better and that CJ in group A to be superior to the other two groups and there is no evidence that this is the case.

It is possible that while, for nearly half a century, RASs for PU have been in use and ubiquitous and routine use in some countries (USA and UK for example), they do not reduce nosocomial PU. It is possible nurses use CJ to assess risk as effectively as using a RAS and use their judgement to employ pressure relieving beds (e.g.) in a similar way as when using the RAS score. Thus we are not denying the RAS is valid in terms of assessment of risk (as numerous studies have confirmed) but suggest they offer no additional benefit over CJ (at least in the case of experienced nurses). One might argue that the RAS helps train the nurse by constant reminder of risk until this becomes internalised in the nurse as s/he becomes expert. However, this study offers no support for such a view as the group C which had no previous exposure to a RAS performed as well as the other two groups. We cannot exclude the possibility that nurses had previous experience of RAS that may have honed their CJ. It would have been useful to have asked nurses about previous experience of RASs and these data could have been used in the analysis and in future work we would recommend such data be collected. But it would remain the case that once experienced, a nurse seems to find using the RAS of little or no additional benefit.

Further work needs to be performed to determine if these findings are generalisable. However, as RMH uses modern medical and nursing practices and employs health care personnel similar to Western Europe, Australasia or North America we see no reason why they would not be. Where we might expect there may be a difference would be in areas with high levels of untrained nursing staff, where a RAS may be used with good effect in the absence of trained nurse with the assumed higher levels of CJ. However, it is in just such conditions that a RAS may be less reliable in terms of scoring, as untrained staff may also be less reliable in giving scores and therefore the RAS may not necessarily perform well.

Finally, we note that the AUC for ROC showed both Braden and CJ were quite poor in terms of prediction. An AUC of 0·6 (roughly what both gave) means for two randomly selected patients, one going on to develop a PU and one not, about 60% of the time the patient with the PU will score higher than the patient who does not. This is hardly precise. It may seem attractive to improve upon the RAS, though nearly 50 years of effort and with over 40 different RASs (Thompson 2005) for PU, none clearly superior to the others, suggest this is doomed. This may suggest a totally different approach is needed. Over 20 years ago one of us (DA) did attempt to use sensitive skin tests of colour, cell morphology and bacteriological analysis to improve the sensitivity of a RAS, with total failure (Anthony et al. 1987, Anthony 1993). Possibly rather than try to measure risk more precisely we should use pressure relieving beds on all frail patients. It might be cheaper than treating the wounds.

Acknowledgements

Riyadh Military Hospital (RMH) who allowed data to be used for this study.

Contributions

Study design: DA, SP, MS, data collection and analysis: MS, SP and manuscript preparation: DA.

References


Clinical issues


