

**Assignment Title:**

“Pressure Ulcer Preventative Practices in the Acute Hospital Setting. A Literature Review”

**Module Title:** NU4S01 – Literature Review

**Course Title:** BSc General Nursing

## Abstract

**Background:** European prevalence figures suggest that 20% of patients will develop a pressure ulcer while in an acute hospital setting (Grey *et al.* 2006; Vanderwee *et al.* 2007). However, pressure ulcers are largely preventable when appropriate assessment, planning and care is provided. Therefore, pressure ulcer incidence is often viewed as an indicator of the standard of nursing care (Elliot 2010).

**Research Aim:** The purpose of this literature review is to examine pressure ulcer preventative practices in the acute hospital setting.

**Search Strategy:** Five electronic databases were searched with a limitation of ten years. Reference lists of relevant research were also examined. A total of 24 articles were selected for review. Three themes lead the literature review: 'Pressure ulcer risk assessment', 'The relief of pressure', and 'Education and knowledge'.

**Key Findings:** Risk assessment – The use of a structured risk assessment scale was found to be beneficial. The Braden scale was found to be the most reliable scale. Relief of pressure – An alternating pressure air mattress was found to be the optimal pressure-relieving device. Repositioning schedules should be based on an individuals risk status. The 30-degree tilt was found to be the optimal position to relieve pressure. Education and knowledge – Despite satisfactory levels of knowledge displayed by nurses, it was found that this knowledge was often not applied to practice.

**Conclusions:** Pressure ulcers are largely preventable in the acute hospital setting. Results from the literature conclude that all patients should undergo a structured risk assessment on admission. Preventative care should subsequently be planned based on a patient's individual risk status. All at-risk patients should be nursed on an alternating pressure air mattress.

**Recommendations:** More studies need to be carried out to explore nursing education surrounding pressure ulcer prevention. More randomised controlled trials exploring preventative practices in the acute hospital setting may be beneficial.

**Key words:** Pressure ulcers; Prevention; Acute hospital; Risk assessment; Pressure relief; Education.

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## Introduction

Pressure ulcers, which are also known as pressure sores, bedsores or decubitus ulcers, have been defined as a localized injury to the skin and underlying tissue. Pressure ulcers usually occur over a bony prominence, and are caused by prolonged exposure to pressure, shear or friction (European Pressure Ulcer Advisory Panel [EPUAP] 2014). This prolonged exposure to pressure results in decreased capillary flow, obstruction of blood and lymphatic vessels, and subsequent tissue ischaemia (Grey *et al.* 2006). Pressure ulcers affect one's quality of life through pain, suffering and loss of self-esteem. They are also a significant economic burden (Riordan & Voegeli 2009). Risk factors for the development of pressure ulcers include poor mobility, poor nutritional status, cognitive impairment, and acute or chronic illness/disease (Elliott 2010).

It has been suggested through European prevalence figures that 20% of patients will develop a pressure ulcer while in an acute hospital setting. The highest incidence is seen in elderly patients with orthopaedic problems, where the prevalence can be as high as 70% (Grey *et al.* 2006; Vanderwee *et al.* 2007). In Ireland, 18.5% of patients in acute hospital settings were found to have a pressure ulcer, with 76.6% of these found to be hospital acquired (Gallagher *et al.* 2008). Noteworthy differences have also been depicted between patients with and without a pressure ulcer. These include differences in cognition, mobility, urinary continence, serum albumin concentration and length of hospital stay (Gallagher *et al.* 2008).

The aim of this literature review is to explore pressure ulcer preventative practices in the acute hospital setting. This topic became of interest to the researcher while working with the Tissue Viability Nurse Specialist (TVNS) during clinical placement. Although the prevalence of hospital-acquired pressure ulcers is high, they are largely preventable when appropriate assessment, planning and care is provided. Furthermore, the incidence of pressure ulcers is often viewed as an indicator of the quality of nursing care being provided (Elliot 2010). The prevention of pressure ulcers in the acute hospital setting is a complex and multi-dimensional process, and a vast amount of research has been conducted in this domain. Prevention strategies include risk assessment, pressure relief

and education (Riordan & Voegeli 2009). These three prevention strategies will be explored in this literature review.

### **Search Strategy**

A search of the literature was conducted to gather research surrounding the chosen topic. Five electronic databases were utilized, which included Academic Search Complete, AMED, MEDLINE, CINAHL and Proquest. Refining the research question before beginning the literature search was important to ensure findings were accurate, precise and relevant (Jaffe & Cowell 2014). Search strings were created from the research question following preliminary trial-and-error searches. These search strings were combined using the Boolean operators 'AND' or 'OR', and consisted of "pressure ulcer" (or "pressure sore" or "bed sore" or "decubitus ulcer"), "prevention", "nursing" (or "nurse's role" or "nurse"), and "acute hospital" (or "hospital" or "acute setting" or "acute hospital setting"). A time limit of ten years was applied to ensure retrieval of up-to-date research. Searches were limited to "peer reviewed", to ensure that all literature retrieved was of the highest quality and was reliable and valid (Gerrish & Lacey 2010). A second search of the literature was undertaken using the search strings "risk assessment", "relief of pressure" (or "pressure relief" or "pressure relieving" or "pressure reducing"), "repositioning" and "education". Various websites were also accessed to ensure all relevant literature was found. These included The Health Service Executive (hse.ie), The World Health Organisation (who.int), The European Pressure Ulcer Advisory Panel (epuap.org), The Department of Health (health.gov.ie) and The National Pressure Ulcer Advisory Panel (npuap.org). Reference lists of relevant literature and literature reviews were screened to ensure all noteworthy literature was included in the review.

Results from the literature search yielded 389 articles. After reviewing the titles, 102 articles appeared relevant. The abstracts of these articles were reviewed and 41 articles were found to be relevant to the literature review. A more detailed review of these resulted in 17 articles being discarded, as they were based in long-term care facilities/rehabilitation centers. Of the remaining 24 articles, three were set in long-term care settings, however the findings were applicable to the acute care setting. Four were set in intensive care units (ICUs), and 13 were based in miscellaneous areas of acute

hospitals. Studies emanated from Ireland (3), Germany (3), Sweden (3), Belgium (3), Spain (3), The United Kingdom (UK) (2), The United States of America (USA) (2), and China (2). Of the 24 selected articles, 22 were research studies (See Appendix 1), one was a literature review, and one was a systematic review (See Appendix 2).

The review of the literature identified three leading themes: Pressure ulcer risk assessment, the relief of pressure, and education and knowledge.

## **1. Pressure Ulcer Risk Assessment**

A pressure ulcer risk assessment should be carried out for each patient on admission to the acute hospital setting. A reassessment should be undertaken if there are any changes in the patient's condition. There are a variety of risk assessment scales (RAS) available. The purpose of an RAS is to determine an individuals' risk of developing a pressure ulcer based on a number of risk factors (for example: mobility, cognitive status, nutritional status etc.) (Nazarko 2005). Commonly used RAS's used include: the Norton scale (Norton *et al.* 1962), the Waterlow scale (Waterlow 1988), and the Braden scale (Begstrom & Braden 1992) (See Appendix 3). The purpose of this theme is to explore the benefits of using an RAS in the prevention of pressure ulcers, and which scales are considered the most reliable. This theme will explore nine articles, which focus on the benefits of an RAS, documentation, and different RAS's available.

### **1.1 The Benefits of a Structured Risk Assessment Scale**

A mixed-methods explorative study was conducted by Balzer *et al.* (2014) to examine how nurses assess pressure ulcer risk without the use of a structured RAS. The quantitative aspect ( $N=106$ ) of this study explored what factors assist nurses in assessing pressure ulcer risk based on clinical judgement alone. This was the control study for a quasi-experimental trial where a structured RAS was used. Balzer *et al.* (2014) did not report the results of the quasi-experimental trial in their study. The qualitative aspect ( $N=16$ ) involved semi-structured interviews with nurses to discuss pressure ulcer risk. Eight case vignettes, each representing a fictitious patient case study, were presented for discussion. The quantitative results show a strong correlation between poor mobility, orthopaedic

problems and incontinence with the association of a high-risk status. However, conditions related to tissue tolerance/vulnerability (co-morbidities or malnutrition) are overlooked. The qualitative results were similar, and found that a patient would be more likely to be assessed as high risk if they were in high need of nursing support for daily activities. A limitation of this study was that the nurse's ability to assess risk was not compared to pressure ulcer prevalence.

Two studies compared pressure ulcer prevalence in patients who underwent a structured risk assessment in comparison to those patients who were assessed based on clinical judgement alone. The first of the two was a pretest-posttest comparison study by Saleh *et al.* (2009). The sample was 265 patients. All nurses participating in the study were provided with the same education regardless of being in the structured RAS group, or the clinical judgement group. The education included the use of a structured RAS (the Braden scale) and wound care study days. The results of this study did not show any significant difference between using a structured RAS and clinical judgement.

In comparison, the second study, a cross-sectional survey by Moore *et al.* (2015), found a significant difference in pressure ulcer prevalence between the two groups. The study took place in two acute hospital settings – one in Ireland, and one in Norway. A structured RAS (the Maelor Score) was used in the Irish site ( $N=121$ ). Risk was assessed based on clinical judgment alone in the Norwegian site ( $N=59$ ). A risk assessment was undertaken for 85% of patients admitted to the Irish site, in comparison to only 8% of patients admitted to the Norwegian site. The results show that a higher proportion of pressure ulcers were acquired in the hospital setting in Norway (81%) in comparison to Ireland (38%). It was also noteworthy that there were no pressure-reducing mattresses in use in the Norwegian site, whereas there were 27 in use in the Irish site. The results of this study suggest that the use of a structured RAS draws attention to the importance of pressure ulcer risk assessment, and subsequent preventative practices.

The difference in results between the last two studies could be the fact that in the study by Saleh *et al.* (2009) all nurses received the same education despite research group. In the study by Balzer *et al.* (2014) it was reported that some risk factors are overlooked when risk is assessed based on clinical judgement alone. These results reflect the results

of the study by Moore *et al.* (2015), where pressure ulcer incidence was found to be lower when a structured RAS was utilized. Therefore it can be concluded that based on these studies, the use of a structured RAS is beneficial in pressure ulcer prevention.

### 1.2 Documentation of Pressure Ulcer Risk Assessment

A mixed methods study by O'Brien & Cowman (2011) explored the documentation of pressure ulcer risk assessment and subsequent care planning. The nursing records ( $N=85$ ) from two acute care wards in an Irish hospital were evaluated for the quantitative study. The qualitative aspect was a focus group of 13 nurses. The results reported that 61% of patients had a weekly risk assessment documented. One follow-up risk assessment was documented in 25% of cases. Despite strong links between pressure ulcer development and nutrition, only 48% of at-risk patients were nutritionally assessed. Documented care planning was evident in 45% of patient records; with only 47% of these showing evidence of care plans being implemented. The use of a pressure-reducing mattress or overlay were reported in 53% of cases, while only 1% of charts showed evidence of education being provided. The qualitative findings reported that nursing staff felt that risk assessment was not a priority on admission, and was often overlooked. Barriers to documentation included lack of time, and lack of staff.

A two-cycle audit carried out by Mahalingam *et al.* (2014) in an acute care setting in London also assessed the consistency of documented risk assessments. However, in contrast to O'Brien & Cowman (2011), this audit also explored the accuracy of the risk assessment. The Waterlow scale was the RAS used in both studies. During cycle one, nurses were asked to fill out questionnaires after handover regarding the use of the Waterlow scale and preventative practices. Following this, a short education session was held. Cycle two commenced after two years of intervention, and nursing staff were not aware the audit was being carried out until completion. In total, 100 patients were recruited during each cycle. The results report that during cycle one, 81% of patients underwent a risk assessment, which increased to 100% during cycle two. There was a significant difference noted between the accuracy of the documented risk score during cycle one and cycle two, with it being more accurate during cycle two. This suggests that



the provision of education and training in relation to the use of an RAS is beneficial for nursing staff.

### 1.3 Pressure Ulcer Risk Assessment Scales

A systematic review of 33 studies was undertaken by Pancorbo-Hidalgo *et al.* (2006). The aim was to determine the effectiveness of RAS's in the prevention of pressure ulcers. The first pressure ulcer RAS created, the Norton scale, was found to have low reliability. This is due to the insufficient amount of validation studies conducted. The Waterlow scale had high reliability values, although many false-positive results were reported due to high sensitivity. This resulted in increased expenditure on prevention strategies that may have been unnecessary. Twenty-two studies were located with validation data on the Braden scale. The Braden scale is therefore considered to have optimal validation. Sensitivity was found to be between 38.9% and 100%. The Braden scale was found to have the best balance between specificity and sensitivity out of the three main RAS.

Inter-rater reliability of the Braden and Waterlow scales and a risk assessment based on clinical judgement were compared in an observational study by Kottner & Dassen (2010). Nurses in this study assessed patients' ( $N=45$ ) risk of developing a pressure ulcer using both the Braden scale and the Waterlow scale. Patients were also assessed based on clinical judgement. The results show that the inter-rater reliability for the Waterlow scale was lower than for the Braden scale. These results support the results of the systematic review by Pancorbo-Hidalgo *et al.* (2006). The results of the review by Pancorbo-Hidalgo *et al.* (2006) also found nurses' clinical judgement to have reasonable sensitivity (approx. 50%). However, it was found that most studies do not give information regarding nurses' clinical experience/qualifications. This was the case in the study conducted by Kottner & Dassen (2010), however nurses' had been randomly selected from a whole team of nurses, suggesting a varied skill mix.

Similarly, a non-experimental prospective study ( $N=429$ ) carried out in two acute care hospitals, found the Braden scale to be more reliable than the Norton scale (Kwong *et al.* 2005). However, they further modified the modified Braden scale by excluding the nutrition component, and adding skin type and body build. The results showed all three

RAS's demonstrated the same sensitivity (89%), however, the modified Braden scale had the highest specificity, and was therefore the least likely to give a false positive result. This study was not included in the systematic review conducted by Pancorbo-Hidalgo *et al.* (2006).

In a similar prospective cohort study by Chan *et al.* (2009), the validity of the modified Braden and Braden scale was assessed in the acute hospital setting ( $N=197$ ). The results of this study differ from the results of the study by Kwong *et al.* (2005), where all RAS's demonstrated the same sensitivity. According to Chan *et al.* (2009), the Braden scale only scores 67% for sensitivity. However, both studies found that the nutrition subscale is not significant in the prevention of pressure ulcers.

It can be concluded from these studies that the Braden scale is the most reliable when assessing pressure ulcer risk.

## **2. The Relief of Pressure**

Reducing the extent and duration of any pressure that the patient is exposed to is key in the prevention of pressure ulcers (McInnes *et al.* 2008). Relief of pressure is achieved through frequent repositioning, the use of pressure-reducing/relieving devices, and reducing shear and friction. Numerous studies have been carried out regarding how often repositioning should occur (2/4/6 hourly), the optimal position to relieve pressure, and the most effective pressure reducing/relieving device (Riordan & Voegeli 2009). However, conflicting ideas still exist regarding these topics (Moore *et al.* 2011). This section of the literature review will explore research conducted in this area over the last 10 years. Ten articles have been selected for review in this theme.

### **2.1 Pressure Reducing/Relieving Devices**

Two studies compared the effectiveness of alternating pressure air mattresses (APAM's) versus alternating pressure air overlays (APAO's) in the prevention of pressure ulcers (See Appendix 3). The first was a prospective quasi-experimental study by Manzano *et al.* (2013) ( $N=221$ ). The results show that the incidence of pressure ulcer development (grade

2 or above) was 18.67 cases per 1000 days in the APAO group, and 12.41 cases per 1000 days in the APAM group ( $p=0.003$ ). These results indicated a significantly lower risk of pressure ulcer development when patients are nursed on an APAM in comparison to an APAO. The second, a comparative study by Demarré *et al.* (2013) ( $N=617$ ) also found that there was a significantly lower pressure ulcer incidence in the APAM group (3.6%) compared to the APAO group (8.9%) – ( $p=0.045$ ).

In comparison, a randomised controlled trial (RCT) conducted by Vanderwee *et al.* (2005) investigated the effectiveness of the APAM in comparison to standard prevention (foam mattress and 4 hourly repositioning) ( $N=447$ ). During the study period, 15.3% of patients in the experimental group and 15.6% of patients in the control group developed a pressure ulcer. The difference between the groups was not statistically significant ( $p=1$ ). However, in this study, patients in the experimental group were not repositioned. This is different from the studies by Manzano *et al.* (2013) and Demarré *et al.* (2013), where patients were repositioned as per normal protocol despite being nursed on an APAM. This could explain the varied results.

Vanderwee *et al.* (2008), the same researchers who conducted the RCT in 2005, conducted a literature review examining the use of APAM's as a preventive measure for pressure ulcers. The results of 15 RCT's they included in the review suggest that the use of an APAM is more beneficial than a standard hospital mattress in the prevention of pressure ulcers. This was also evident from reviewing the above studies, where the use of an APAM was found to be more beneficial than an APAO or standard prevention in the prevention of pressure ulcers.

## 2.2 Manual Repositioning

A randomised clinical trial by Manzano *et al.* (2014) compared the effectiveness of two repositioning schedules (two and four hourly) in the prevention of pressure ulcers. All patients ( $N=329$ ) in the trial were nursed on an APAM. Patients were repositioned either two hourly (2-h group) or four hourly (4-h group). Although 10.3% of patients in the 2-h group and 13.4% in the 4-h group developed a pressure ulcer, the difference was not statistically significant ( $p=0.73$ ). Therefore, a two hourly repositioning schedule in

comparison to four hourly cannot be considered beneficial for patients. Vanderwee *et al.*s (2006) ( $N=235$ ) study yielded similar results with 16.4% of patients in the experimental group (2-h) and 21.2% in the control group (4-h) developing a pressure ulcer. Again, the difference was not significantly different ( $p=0.40$ ).

The association between frequent repositioning (2-h) and pressure ulcer incidence was investigated by Rich *et al.* (2011). However, in this study the patient's ( $N=269$ ) risk status (as per the Braden RAS) was taken into consideration. Findings revealed that high-risk patients had a lower incidence of pressure ulcers when repositioned 2-h, whereas lower risk patients had a higher incidence of pressure ulcers when repositioned more frequently than for those repositioned less frequently. These results suggest that the frequency of repositioning should be based on the patient's level of risk (using a RAS). As the studies by Manzano *et al.* (2014) and Vanderwee *et al.* (2006) did not take the patients' risk status into consideration, this may explain why a significant difference was not noted between the two groups in their studies.

An RCT conducted by Moore *et al.* (2011) in Ireland compared pressure ulcer incidence among patients ( $N=213$ ) using two different repositioning regimens – three hourly with 30° tilt (experimental group); and six hourly with 90° lateral rotation (routine prevention-control group). During the study, 3% of patients in the experimental group and 11% in the control group developed a pressure ulcer, which was found to be significant ( $p=0.038$ ). The results of this study suggest that regular repositioning is highly effective in the prevention of pressure ulcers.

From these studies regarding optimal repositioning regimes, it can be concluded that the frequency of repositioning should be based on an individual's risk status. The use of a structured RAS should be utilized prior to planning pressure-relieving care.

### 2.3 Interface Pressure

Although regular repositioning has been shown to reduce the incidence of pressure ulcers (Moore *et al.* 2011), it has been questioned if it is possible to relieve all at-risk tissue during standard repositioning in high-risk patients. In light of this, Peterson *et al.* (2013)

investigated whether routine repositioning was effective in relieving the at-risk tissue of the peri-sacral area. The sample in this descriptive observational study was 23 patients from an acute care setting. All patients in the study had been identified as high-risk of developing a pressure ulcer (Braden score <18). A pressure mapping system was used to obtain measurements of interface pressure of the peri-sacral area every 30 seconds while the patient received routine care. The results indicate that in general, position does not significantly affect interface pressure. However, it was noted that certain positions resulted in significant changes in interface pressure on an individual basis – i.e. there was no general optimal position found, but it differs greatly on an individual basis. Despite regular (2-h) repositioning, the results of this study indicate that at-risk patients continue to have areas of skin that do not get relieved and remain at-risk despite the change in position.

In contrast, a study by Källman *et al.* (2015), found that interface pressure is lowest in the 30° supine tilt and the 30° lateral position (32.9 + 9.1mmHg and 29.5 + 10.4mmHg) in comparison to the 90° lateral position and the 0° supine position, where interface pressure appeared to be highest (48.4 + 16.3mmHg and 44.7 + 11.7mmHg) ( $p < 0.001$ ). The difference with this study was that patients ( $N=25$ ) risk status was not disclosed and was not taken into consideration, whereas the patients in the study by Peterson *et al.* (2013) had all been identified as high risk. It is noteworthy that this study monitored interface pressure in general, whereas the study by Peterson *et al.* (2013) focused solely on the peri-sacral area.

### **3. Education & Knowledge**

Nursing education regarding pressure ulcer prevention is an important step in improving care in this domain, and may improve patient outcomes (Cullen & Cox 2005). Nursing staff in the acute care setting play a key role in the prevention of pressure ulcers, and therefore require continuing education regarding skin care and wound management (Smith & Waugh 2009). Through searching the literature it was evident that a wide range of research has been conducted regarding nurses knowledge of pressure ulcer prevention. Fewer studies have been conducted regarding the education of nurses, and

only very few studies focused on patient education regarding pressure ulcers, none of which were applicable to this literature review.

### 3.1 Nurse Education

In a study by Wilborn *et al.* (2009), nursing textbooks were examined to explore the extent to which the information on pressure ulcer prevention was evidence-based. The most commonly used nursing textbooks ( $N=44$ ) were compared to the German Expert Standard of Pressure Ulcer Prevention (GESPU). Only one textbook (Menche 2004) completely relayed all recommendations from the GESPU. Two or more recommendations were missing from all other textbooks, mainly: informing the multi-disciplinary team (MDT) of risk status, and patient/relative education. This study concludes that nurses should be able gain and evaluate information from a combination of a wide range of resources, and not just textbooks, for example, research, workshops, conferences etc.

A second study in this domain by Samuriwo (2010) focused on the practical element of education and its effect on nurse's values of pressure ulcer prevention. Data were collected through semi-structured interviews with 16 nurses. Findings suggest that although formal education was provided regarding pressure ulcer prevention, participants reported they did not fully appreciate the importance of this until they experienced a pressure ulcer during clinical practice. Furthermore, all participants felt they learned more about pressure ulcers after qualifying from nursing school. Post-registration education proved to be very useful in clinical practice.

### 3.2 Nurse's Knowledge

A study by Pancorbo-Hidalgo *et al.* (2007) explored nurse's knowledge regarding pressure ulcer prevention, and the application of this knowledge to clinical practice ( $N=740$ ). Data were collected through a questionnaire designed around recommendations from the Spanish Pressure Ulcers and Chronic Wounds Advisory Panel. The results show that >75% of nurses reported nutritional assessment, the use of barrier creams/topical agents, patient/relative education, and repositioning as important in pressure ulcer prevention. A

total of 31.4% reported the use of cologne/alcohol on the skin, while 59.9% reported the use of massage over areas of redness as suitable preventive measures, despite clinical guidelines and experts advising against these theories. The results also showed significant differences between knowing what is suitable according to knowledge, and actually putting it into practice. For example, 49.9% reported repositioning as a suitable preventive measure, while only 17.4% reported using this is always used in practice.

In a similar study by Källman & Suserud (2009), over 85% of nurses ( $N=154$ ) could successfully identify pressure ulcers (stages 1-4) (See Appendix 3). Those who attended post-registration education in this domain had better knowledge than those who did not ( $p<0.05$ ). The results showed that nurses' had good knowledge about suitable preventive practices, however this knowledge was not always applied to clinical practice. An agreed plan of care for pressure ulcer prevention was reported by 37% of nurses. A RAS was used by only 9% of nurses, despite 60.8% reporting a risk assessment should be regularly carried out during a patient's stay in the acute hospital setting.

A mixed-methods descriptive study by Sving *et al.* (2012) explored nurses' ( $N=9$ ) attention to pressure ulcer prevention, and yielded similar results to the studies by Pancorbo-Hidalgo *et al.* (2007) and Källman & Suserud (2009). Nurses in this study discussed many barriers to providing preventive care, despite the knowledge of its importance. These included high workloads (felt pressure relief was not a priority), and patients not co-operating. Nurses in this study also felt that clinical judgement is more important than the use of a RAS. A wide variation was noted between different nursing staff and different wards with regards to pressure ulcer prevention and compliance with evidence-based guidelines.

Although these studies show that nurses have sufficient knowledge with regards to pressure ulcer prevention, this knowledge is rarely put into practice. This would likely affect pressure ulcer prevalence, as it has been shown that compliance with evidence-based guidelines will positively affect the incidence of these ulcers (Cuddigan *et al.* 2001).

## **Conclusion**

The aim of this literature review was to explore pressure ulcer preventative practices in the acute hospital setting. While searching the literature, three leading themes became apparent. These were pressure ulcer risk assessment, the relief of pressure, and education and knowledge.

The literature surrounding the use of a structured risk assessment scale suggests that their use, when compared with clinical judgement, is beneficial in the prevention of pressure ulcers (Moore *et al.* 2015). It was found that conditions related to tissue tolerance or vulnerability are often overlooked when risk was assessed using clinical judgement alone (Balzer *et al.* 2014). However, in a study by Saleh *et al.* (2009) significant differences were not noted with the use of a structured RAS in comparison to clinical judgement. All nurses in this study received the same education, which may suggest that education on risk assessment is also beneficial for nursing staff.

Studies investigating documentation of risk assessment found that in 25% of cases, only one follow up risk assessment is completed after the initial assessment (O'Brien & Cowman 2011). Again, education surrounding risk assessment and the documentation of this is beneficial in ensuring accurate and appropriate risk assessments (Mahalingam *et al.* 2014). There was a vast array of studies carried out to determine which RAS is most reliable in assessing risk. Studies carried out generally focused on three RAS's – The Waterlow scale, The Norton scale, and the Braden scale. No studies were found to test the reliability or sensitivity of the Maelor scale – which was the scale in use in the study by Moore *et al.* (2015). Of the studies included in this review, the Braden scale was found to have the highest reliability and sensitivity (Pancorbo-Hidalgo *et al.* 2006; Kottner & Dassen 2010; Kwong *et al.* 2005; Chan *et al.* 2009).

The literature surrounding the relief of pressure reports that the best pressure-relieving device is an APAM (Vanderwee *et al.* 2008; Demarré *et al.* 2013; Manzano *et al.* 2013). However, in a study by Vanderwee *et al.* (2008), no significant difference in pressure ulcer prevalence was noted when using an APAM in comparison to a regular foam mattress. In this study patients were not repositioned when nursed on an APAM. This suggests the use of a pressure-relieving device along with regular repositioning is the most optimal preventative measure. With regards to optimal repositioning schedules, no definitive



conclusion was found in the literature. Studies comparing two hourly versus four hourly repositioning were inconclusive – there was no significant difference in pressure ulcer prevalence found (Vanderwee *et al.* 2006; Manzano *et al.* 2014). A study by Rich *et al.* (2011) found that high-risk patients benefit from more frequent repositioning. This suggests more research could be conducted when taking risk status into consideration. Patient position was also found to also affect pressure ulcer prevalence, with the 30° tilt found to be the optimal position (Moore *et al.* 2011; Källman *et al.* 2015).

Very few studies were located regarding nurse education of pressure ulcers, despite knowledge that compliance with evidence-based guidelines can positively affect the incidence of pressure ulcers (Cuddigan *et al.* 2001). A recommendation could be made for more research exploring which type of education is most beneficial for student nurses/nurses in pressure ulcer prevention. It may also be beneficial for more RCT's to be carried out investigating various preventative practices, as very few RCT's were located in this domain.

It is not possible to come to a definitive conclusion on this topic due to diverse research being conducted and many inconclusive results. Overall, it was found that the use of a structured RAS is beneficial, namely the Braden scale. A combination of a pressure-relieving device and a repositioning schedule based on an individuals risk status is the optimal prevention strategy. More research should be conducted regarding nurse education in the prevention of pressure ulcers.

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**Appendix 1: Summary Table for Research Studies Included in the Literature Review**

Author(s) & Title	Study Aims & Objectives	Research Design	Sample	Data Collection Methods	Data Analysis Method	Findings Relevant to the Review
Balzer K., Kremer L., Junghans A., Halfens R.J.G., Dassen T. & Kottner J. (2014) What patient characteristics guide nurses' clinical judgment on pressure ulcer risk? A mixed methods study. <i>International Journal of Nursing Studies</i> <b>51</b> (5), 703-716.	To explore which patient characteristics nurses employ when assessing pressure ulcer risk without using a risk assessment scale.	A mixed method design –  Observational data from the control group of a quasi-experimental trial. Results of quasi-experimental trial reported elsewhere.  Semi-structured interviews with nurses.	<u>Quantitative data:</u> 106 patients from a university hospital in Germany.  <u>Qualitative data:</u> 16 nurses.	A standardized data collection form by trained study assistants.  The Braden Scale to estimate pressure ulcer risk.  Nurse's clinical judgments concerning patients' pressure ulcer risk (Scale of 1 = 'no risk' to 4 = 'high risk').	SPSS 20.0	<u>Quantitative data:</u> Nurses' risk estimates increased with poorer patient condition, higher age or lower BMI.  <u>Qualitative data:</u> Nurses' consider a broad range of patient characteristics when they assess patient's risk. These include previous history, current status, prognosis, physical condition, mental condition, and age.

<p>Chan W.S., Che Pang S.M. &amp; Yung Kwong E.W. (2009) Assessing predictive validity of the modified Braden scale for prediction of pressure ulcer risk of orthopaedic patients in an acute care setting. <i>Journal of Clinical Nursing</i> <b>18</b>(11), 1563-1573.</p>	<p>To assess and compare the predictive validity of the modified Braden and Braden scales.</p> <p>To identify which of the modified Braden subscales are predictive in assessing pressure ulcer risk.</p>	<p>A prospective cohort study.</p>	<p>197 patients from a hospital in Hong Kong, China.</p>	<p>All patients admitted screened using the modified Braden scale.</p> <p>Skin assessment performed daily by the researcher.</p> <p>Nurses performed preventative nursing interventions without knowing the Braden and modified Braden scores.</p>	<p>SPSS version 15.0.</p> <p>Independent <i>t</i>-test and Chi-squared test.</p>	<p><u>Pressure Ulcer Occurrence:</u> 18 patients (9.1%) developed a pressure ulcer after an average of 8.1 days. The sacrum was the most common site (44.5%).</p> <p><u>Risk Factors:</u> Sensory perception; body build/height; skin type – those with poor sensory perception and abnormal build/height and skin type were most at risk.</p>
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<p>Demarré L., Verhaeghe S., Van Hecke A., Grypdonck M., Clays E., Vanderwee K. &amp; Beeckman D. (2013) The effectiveness of three types of alternating pressure air mattresses in the prevention of pressure ulcers in Belgian hospitals. <i>Research in Nursing &amp; Health</i> <b>36</b>(5), 439-452.</p>	<p>To compare the effectiveness of multi-stage and one-stage alternating low-pressure air mattresses (ALPAM) and alternating pressure air mattress (APAM) overlays in preventing pressure ulcers among hospitalized patients.</p>	<p>A comparative design to pool data from two randomised controlled trials.</p>	<p><u>ALPAM:</u> 610 patients from five hospitals in Belgium.</p> <p><u>APAM:</u> 477 patients from seven hospitals in Belgium.</p>	<p><u>ALPAM:</u> Data collected over 3 years. Normal nursing care was carried out daily.</p> <p><u>APAM:</u> Data collected over 2 years. The Braden score was assessed every 3 days, and a skin assessment was carried out daily.</p>	<p>Chi-square test &amp; Fisher's exact tests.</p>	<p><u>Incidence of Pressure Ulcers:</u> 3.6% of patients in the ALPAM group and 8.9% in the APAM group developed a pressure ulcer during the study period.</p> <p><u>Time to Develop a Pressure Ulcer:</u> No difference noted between interventions.</p>
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<p>Källman U. &amp; Suserud B.O. (2009) Knowledge, attitudes and practice among nursing staff concerning pressure ulcer prevention and treatment – a survey in a Swedish healthcare setting. <i>Scandinavian Journal of Caring Sciences</i> <b>23</b>(2), 334-341.</p>	<p>To investigate:</p> <p>(i) Attitudes among nurses regarding pressure ulcer prevention</p> <p>(ii) Knowledge among nurses regarding pressure ulcer prevention and treatment</p> <p>(iii) Practice of risk assessment and documentation regarding pressure ulcers among nurses</p> <p>(iv) To identify perceived possibilities and barriers in pressure ulcer prevention and treatment.</p>	<p>A cross-sectional study.</p>	<p>154 nurses from acute care settings in Sweden.</p>	<p>Questionnaires with an information sheet were handed out to 230 nursing staff from acute care hospitals, and were sent back within two weeks.</p>	<p>SPSS version 13.</p> <p>T-test, the Mann-Whitney test and chi-square tests.</p>	<p><u>Nurse's knowledge</u></p> <p>The majority of nurse's could identify risk factors and suitable preventive practices.</p> <p>Most frequently mentioned: Repositioning (75%); Pressure-reducing mattresses (67%); Pressure relieving (42%); Nutritional habits (40%).</p> <p>55% had read a text/journal article specifically relating to pressure ulcers.</p>
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<p>Källman U., Engström M., Bergstrand S., Ek A-C., Fredrikson M., Lindberg L.G. &amp; Lindgren M. (2015) The effects of different lying positions on interface pressure, skin temperature, and tissue blood flow in nursing home residents.</p> <p><i>Biological Research for Nursing</i> <b>17</b>(2), 142-151.</p>	<p>To compare the effects of different lying positions on interface pressure, skin temperature, and tissue blood flow.</p>	<p>A descriptive comparative study.</p>	<p>25 patients from three long-term care settings in Sweden.</p>	<p>Interface pressure, skin temperature, and each wavelength of blood flow were recorded on a laptop PC using the Labview software.</p>	<p>PASW statistics 20.0 and STATA version 12.1.</p> <p>Independent <i>t</i> tests.</p> <p>ANOVA.</p>	<p>The 30° supine tilt position was found to be the most favorable position, in terms of tissue perfusion.</p> <p>Interface pressure was found to be highest in the 0°supine and 90° lateral positions.</p>
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<p>Kottner J. &amp; Dassen T. (2010) Pressure ulcer risk assessment in critical care: Interrater reliability and validity studies of the Braden and Waterlow scales and subjective ratings in two intensive care units.</p> <p><i>International Journal of Nursing Studies</i> <b>47</b>(6), 671-677.</p>	<p>To compare the interrater reliabilities of the Braden and Waterlow scores and subjective pressure ulcer risk assessment and to determine the construct validity of these three assessment approaches.</p>	<p>An observational study.</p>	<p>45 patients from two intensive care units in a university hospital in Germany – assessed by 53 nurses.</p>	<p>A data collection form, which included the Waterlow and Braden scales.</p> <p>A 10cm horizontal Visual Analogue scale (VAS) was applied for rating the subjective pressure ulcer risk – nurses were asked to place a mark through the line at a position which best represents their perception of pressure ulcer risk for that patient.</p>	<p>Intraclass correlation coefficients (ICC).</p>	<p>Interrater reliability and agreement for Braden scale sum scores were highest, followed by VAS scores and Waterlow scores.</p> <p>A low overlap was observed between VAS and Waterlow scores, which implied nurses had a different view on pressure ulcer risk in comparison to the measurements obtained from the Waterlow scale.</p>
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<p>Kwong E., Pang S., Wong T., Ho J., Shao-ling X. &amp; Li-jun T. (2005) Predicting pressure ulcer risk with the modified Braden, Braden, and Norton scales in acute care hospitals in Mainland China. <i>Applied Nursing Research</i> <b>18</b>(2), 122-128.</p>	<p>To develop a modified Braden scale, to evaluate its predictive validity, and to identify a more valid pressure ulcer risk calculator for application in acute care hospital among the modified Braden, Braden and Norton scales.</p>	<p>A non-experimental prospective study.</p>	<p>429 patients from two acute care hospitals in China.</p>	<p><u>Demographic data collection form:</u> Patients' characteristics related to factors that increase their risk of developing a pressure ulcer.</p> <p><u>Skin assessment form:</u> To record initial, daily, and final skin assessments</p> <p><u>Nursing checklists:</u> To record preventative nursing interventions.</p> <p><u>Scales used:</u> The modified Braden, Braden and Norton scales.</p>	<p>Independent t-test.</p>	<p>9 patients (2.1%) developed a pressure ulcer during the study period, the most common sites being the sacral area and right iliac region.</p> <p>The modified Braden scale indicated that the most distinct subscale which patients at risk can be identified is the subscale for skin type and body build for height; the subscale for nutrition was found to be the least distinct.</p>
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<p>Mahalingam S., Gao L., Nageshwaran S., Vickers C., Bottomley T. &amp; Grewal P. (2014) Improving pressure ulcer risk assessment and management using the Waterlow scale at a London teaching hospital. <i>Journal of Wound Care</i> <b>23</b>(12), 613-622.</p>	<p>To examine the consistency and accuracy of pressure ulcer risk assessments.</p>	<p>A two-cycle audit.</p>	<p>100 patients from a university hospital in London, U.K.</p>	<p>A short questionnaire regarding pressure ulcer risk assessment using the Waterlow scale.</p>	<p>Fisher's exact and Student's <i>T</i>-test.  ANOVA</p>	<p><u>Risk Assessment:</u> Waterlow score documented for 81% of patients in cycle 1 and 100% of patients in cycle 2.</p> <p><u>Management of 'high risk' patients:</u> 66.7% of patients identified as high risk received a Duo mattress during cycle 1, 100% of high-risk patients received a Duo mattress in cycle 2.</p>
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<p>Manzano F., Colmenero M., Pérez-Pérez A., Roldán D., del Mar Jiménez-Quintana M., Reyes Mañas M., Sánchez-Moya M.A., Guerrero C., Moral-Marfil M.A., Sánchez-Cantalejo E. &amp; Fernández-Mondéjar E. (2014)</p> <p>Comparison of two repositioning schedules for the prevention of pressure ulcers in patients on mechanical ventilation with alternating pressure air mattresses.</p> <p><i>Intensive Care Med</i> <b>40</b>(11), 1679-1687.</p>	<p>To compare the effectiveness of repositioning every two or four hourly for preventing pressure ulcer development.</p>	<p>A pragmatic, single-site, open label, parallel group randomised controlled trial.</p>	<p>329 patients from an intensive care unit in a university hospital in Spain.</p>	<p>A skin assessment by five study nurses, who took part in a group-training program on pressure ulcer recognition before the trial.</p>	<p>Primary analysis: a modified intention-to-treat principle.</p> <p>Chi-square test/Fisher's exact test &amp; Student's <i>t</i> test.</p>	<p>17 (10.3%) patients in the two-hourly group and 22 (13.4%) patients in the four-hourly group developed a pressure ulcer during the study period.</p>
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<p>Manzano F., Pérez A., Colmenero M., Aguilar M., Sánchez-Cantalejo E., Reche A., Talavera J., López F., Frías-Del Barco S. &amp; Fernández-Mondejar E. (2013) Comparison of alternating pressure mattresses and overlays for prevention of pressure ulcers in ventilated intensive care patients: a quasi-experimental study. <i>Journal of Advanced Nursing</i> <b>69</b>(9), 2099-2106.</p>	<p>To compare the effectiveness of alternating pressure air mattresses vs. overlays to prevent pressure ulcers in mechanically ventilated patients in intensive care units.</p>	<p>Prospective quasi-experimental study.</p>	<p>221 patients in an I.C.U. of a university hospital in Spain.</p>	<p>The development of a pressure ulcer was the main outcome variable.</p> <p>Data was collected at I.C.U. discharge.</p>	<p>Fisher's exact; Chi-squared tests; Student's <i>t</i>-test; Kaplan-Meier survival analysis and log-rank test; Cox-proportional-hazard multivariate model.</p>	<p>25 (21.6%) patients in the overlay group and 17 (16.2%) patients in the mattress group developed a pressure ulcer during the study period.</p> <p>This indicated a significantly lower risk of pressure ulcer development when patients were nursed on pressure-reducing mattresses.</p>
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<p>Moore Z., Cowman S. &amp; Conroy R.M. (2011) A randomised controlled trial of repositioning, using the 30° tilt, for the prevention of pressure ulcers. <i>Journal of Clinical Nursing</i> <b>20</b>(17-18), 2633-2644.</p>	<p>To compare the incidence of pressure ulcers among older persons nursed using two different repositioning regimens.</p>	<p>Pragmatic, multi-centre, open label, cluster-randomised controlled trial.</p>	<p>213 patients from 12 long-term care of the older person hospitals in Ireland.</p>	<p>Staff recorded each time the patient was repositioned on a data collection sheet.</p> <p>A skin assessment was conducted each time a patient was repositioned and this was also recorded on the data collection sheet.</p>	<p>SPSS version 13 on an intention to treat (ITT) basis.</p>	<p>Three (3%) patients in the experimental group and 13 (11%) patients in the control group developed a pressure ulcer during the study period.</p> <p>94% of pressure ulcers were located on the sacrum.</p>
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<p>Moore Z., Johansen E., van Etten M., Strapp H., Solbakken T., Eskerud Smith B. &amp; Faulstich J. (2015) Pressure ulcer prevalence and prevention practices: a cross-sectional comparative survey in Norway and Ireland. <i>Journal of Wound Care</i> <b>24</b>(8), 333-339.</p>	<p>To explore whether the risk assessment method, structured versus clinical judgment, influences pressure ulcer prevalence or prevention strategies.</p>	<p>A cross-sectional comparative survey.</p>	<p>180 patients in total – 59 patients from a hospital in Norway and 121 patients from a hospital in Ireland.</p>	<p>The pressure ulcer prevention checklist (O'Brien &amp; Cowman 2011) was employed for data collection.</p> <p>Risk assessment was carried out using the Braden assessment tool.</p> <p>Pressure ulcers were assessed using the European Pressure Ulcer Advisory Panel pressure ulcer grading system.</p>	<p>SPSS version 21.</p>	<p><u>Risk Assessment:</u> 103 Irish patients (85%) and 5 Norwegian patients (8%) underwent a risk assessment on admission to hospital.</p> <p><u>Pressure-reducing devices:</u> 27 pressure-reducing mattresses in use in the Irish site, none in the Norwegian site.</p> <p><u>Repositioning:</u> 25 Irish patients (56%) and 5 Norwegian patients (15%) who were deemed at risk had a repositioning care plan.</p>
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<p>O'Brien J. &amp; Cowman S. (2011) An exploration of nursing documentation of pressure ulcer care in an acute setting in Ireland. <i>Journal of Wound Care</i> <b>20</b>(5), 197-205.</p>	<p>To explore the nature and quality of documented care planning for pressure ulcers.</p>	<p>A mixed method design – a descriptive survey and a focus group.</p>	<p><u>Quantitative data:</u> 85 nursing notes.</p> <p><u>Qualitative data:</u> A focus group of 13 nurses in a university hospital in Ireland.</p>	<p><u>Quantitative data – Nursing Records:</u> The EPUAP pressure ulcer minimum data set formulated a checklist for reviewing nursing documentation. The risk assessment tool used and recommended interventions were also included.</p> <p><u>Qualitative Data – Focus Groups:</u> A research assistant took notes, observed and reported any bias during each focus group session.</p>	<p>SPSS version15.</p>	<p><u>Quantitative data:</u> 52 patients (61%) had a weekly risk assessment, 21 patients (25%) had only one follow-up risk assessment; 45% of charts showed evidence of care planning, and of these, 53% had no evidence that care plan was implemented.</p> <p><u>Qualitative Data:</u> Nurses reported current documentation could be improved, and that risk assessment was often overlooked during admission.</p>
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<p>Pancorbo-Hidalgo P.L., Garcia-Fernandez F.P., Lopez-Medina I.M. &amp; López-Ortega J. (2007) Pressure ulcer care in Spain: nurses' knowledge and clinical practice. <i>Journal of Advanced Nursing</i> <b>58</b>(4), 327-338.</p>	<p><u>To determine:</u></p> <p>(i) Nurses' level of knowledge of existing guidelines for pressure ulcer prevention and treatment.</p> <p>(ii) The level of implementation of this knowledge to clinical practice.</p> <p>(iii) The professional and educational factors that influence knowledge and practice.</p>	<p>A questionnaire survey design.</p>	<p>740 nurses from acute care settings in Spain.</p>	<p>A contact person was appointed at each chosen hospital to receive, distribute and deliver the questionnaires to nursing staff. Questionnaires were sent back via post within 2 weeks.</p>	<p>SPSS version 11.0.</p> <p>T-tests, Pearson's test.</p>	<p><u>Pressure Ulcer Prevention</u></p> <p>Knowledge index for recommendations found in clinical guidelines was high – 78%. Additional effort needed to improve dissemination.</p>
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<p>Peterson M.J., Gravenstein N., Schwab W.K., van Oostrom J.H. &amp; Caruso L.J. (2013) Patient repositioning and pressure ulcer risk – Monitoring interface pressures of at-risk patients. <i>Journal of Rehabilitation Research &amp; Development</i> <b>50</b>(4), 477-488.</p>	<p>To assess the effectiveness of routine repositioning in relieving at-risk tissue of the perisacral area using interface pressure mapping.</p>	<p>A descriptive, observational study.</p>	<p>23 patients from the intensive care unit (<math>n=20</math>) and an intermediate care unit (<math>n=3</math>) in a university hospital Florida, U.S.A.</p>	<p>Interface pressure measurements were recorded every 30 seconds as the patient lay in bed using a pressure mapping system.</p>	<p>MATLAB and Excel.</p>	<p>Bedbound, at-risk patients have substantial areas of skin that are not relieved despite 2 hourly repositioning.</p> <p>This suggests that the current standard of care may not be sufficient to prevent pressure ulcer formation in bedbound patients.</p>
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<p>Rich S.E., Margolis D., Shardell M., Hawkes W.G., Miller R.R., Amr S. &amp; Baumgarten M. (2011) Frequent manual repositioning and incidence of pressure ulcers among bed-bound elderly hip fracture patients. <i>Wound Repair and Regeneration</i> <b>19</b>(1), 10-18.</p>	<p>To examine the association between repositioning and pressure ulcer incidence.</p>	<p>A prospective cohort study.</p>	<p>269 patients from nine hospitals in Maryland and Pennsylvania, U.S.A.</p>	<p>Data was collected from nursing flow-sheets, which indicated the frequency of patient turning by nursing staff.</p> <p>A skin assessment and pressure ulcer status was undertaken at the beginning of the study period, and on alternating days thereafter.</p>	<p><u>Categorical variables:</u> p-values obtained by Chi-square test.</p> <p><u>Continuous variables:</u> Two-sample <i>t</i>-test.</p>	<p>22 (12%) patients who were repositioned every 2 hours and 16 (10%) patients who were repositioned less frequently developed a pressure ulcer during the study period – suggesting manual repositioning 2 hourly may not effectively prevent pressure ulcers.</p>
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<p>Saleh M., Anthony D. &amp; Parboteeah S. (2009) The impact of pressure ulcer risk assessment on patient outcomes among hospitalized patients. <i>Journal of Clinical Nursing</i> 18(13), 1923-1929.</p>	<p>To determine whether use of a risk assessment scale reduces hospital-acquired pressure ulcers.</p>	<p>A pretest-posttest comparison.</p>	<p><u>Nurses:</u></p> <ol style="list-style-type: none"> <li>1. Group A – The Braden scale group – received a wound care study day, PU prevention training, training on use of Braden scale.</li> <li>2. Group B – The training group – received wound care study day, PU prevention training, not required to implement a risk assessment scale.</li> <li>3. Group C – The CJ group – received wound care management study day.</li> </ol> <p><u>Patients:</u> Sample not disclosed.</p>	<p>Patients followed up for 8 weeks, and were monitored for protective measures: Use of pressure-reducing mattresses; creams and skin barriers; vitamin supplements/nutritional formulas; planned repositioning.</p> <p>Data collected by a Tissue Viability Nurse Specialist and two staff nurses.</p>	<p>Chi-squared analysis.</p> <p>ANOVA.</p>	<p>No significant differences in pressure ulcer incidence between three nurse groups.</p> <p>Only one of the six sub-scores in the Braden scale was found to be significant – sensory perception.</p>
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Samuriwo R. (2010) Effects of education and experience on nurses' value of ulcer prevention. <i>British Journal of Nursing</i> <b>19</b> (20), 8-18.	To determine the value that nurse's place on pressure ulcer prevention.	Qualitative design.	16 nurses from hospitals in Wales, UK.	Semi-structured interviews.	Straussian grounded theory.	Nurse's gained more experience from the practical element of nursing patients with pressure ulcers, in comparison to learning about pressure ulcers in the classroom.
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<p>Sving E., Gunningberg L., Högman M. &amp; Mamhidir A.G. (2012) Registered nurses' attention to and perceptions of pressure ulcer prevention in hospital settings. <i>Journal of Clinical Nursing</i> <b>21</b>(9-10), 1293-1303.</p>	<p>To describe how nurses perform, document and reflect on pressure ulcer prevention in a specific nurse-patient care situation, as well as generally, on hospital wards.</p>	<p>A multi-methods descriptive design.</p>	<p>9 nurses from three wards in an acute care setting in Sweden.</p>	<p>1. The first author performed risk assessment, and nursing care aimed at PU prevention was observed for patients at risk of PU's. All nurse activities were noted in the field-observation protocol together with field notes.</p> <p>2. Nurse interviews performed after step 1.</p> <p>3. Retrospective reviews of patient records were made following step 1.</p>	<p>SPSS version 19.0.</p> <p>Manifest analysis.</p>	<p>Barriers to providing preventive care were discussed during interviews. Despite the knowledge of their importance, these included high workloads (felt pressure relief was not a priority) and patients not co-operating.</p> <p>Nurses in this study also felt that clinical judgement is more important than the use of a RAS.</p>
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<p>Vanderwee K., Grypdonck M.H.F., De Bacquer D. &amp; Defloor T. (2007) Effectiveness of turning with unequal time intervals on the incidence of pressure ulcer lesions. <i>Journal of Advanced Nursing</i> 57(1), 59-68.</p>	<p>To investigate whether repositioning patients lying on a pressure-reducing mattress alternately for 2 hours in a lateral position and 4 hours in a supine position reduces the incidence of pressure ulcers in comparison with repositioning every 4 hours.</p>	<p>A two-arm randomised controlled trial.</p>	<p>235 patients from long term care of the older person hospitals in Belgium.</p>	<p>Baseline characteristics of patients determined through nursing notes and through interviewing nursing staff.</p> <p>A skin assessment was conducted each morning by nursing staff.</p>	<p>SPSS version 12.</p>	<p>20 (16.4%) patients in the experimental group and 24 (21.2%) patients in the control group developed a pressure ulcer during the study period.</p> <p>There was no significant difference in incidence between the two groups.</p>
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<p>Vanderwee K., Grypdonck M. &amp; Defloor T. (2005) Effectiveness of an alternating pressure air mattress for the prevention of pressure ulcers. <i>Age and Ageing</i> <b>34</b>(3), 261-267.</p>	<p>To evaluate whether an alternating pressure air mattress is more or equally effective as the standard prevention.</p>	<p>A randomised controlled trial.</p>	<p>447 patients from seven hospitals in Belgium.</p>	<p>A skin assessment was carried out daily by staff nurses.</p> <p>A random sample of patients was observed at random intervals by the researcher and the data nurse.</p> <p>A 4cm x 4cm transparent pressure disk was used to standardize distinguishing between blanchable and non-blanchable erythema.</p> <p>Braden score calculated every 3 days for each patient.</p>	<p><u>Allocation to experimental/control groups and all statistical analyses:</u> SPSS 10 software package.</p> <p><u>Continuous variables:</u> Mann-Whitney U test.</p> <p><u>Categorical variables:</u> Fisher's exact test; X2 test.</p>	<p>34 (15.3%) patients in the experimental group and 35 (15.6%) patients in the control group developed a pressure ulcer during the study period.</p>
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<p>Wilborn D., Halfens R.J. &amp; Dassen T. (2009) Evidence-based education and nursing pressure ulcer prevention textbooks: Does it match?</p> <p><i>Worldviews on Evidence-Based Nursing</i> <b>6</b>(3), 167-172.</p>	<p>To investigate the extent to which textbooks were evidence-based regarding preventing pressure ulcers.</p>	<p>Telephone interviews; comparing information in textbooks to the German Expert Standard of Pressure Ulcer Prevention.</p>	<p>44 books were analysed.</p>	<p>Telephone conversations.</p> <p>Entering book titles into Excel tables.</p>	<p>Not disclosed.</p>	<p>Only one book fully complied with national guidelines.</p> <p>Recommendation that new forms of 'textbooks', such as CD ROMs, should be considered.</p>
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**Appendix 2: Summary Table for Literature Reviews and Systematic Reviews Included in the Literature Review**

<b>Author(s) &amp; Title</b>	<b>Research Question/ Purpose</b>	<b>Search Strategy/ Inclusion/ Exclusion Criteria</b>	<b>Search Terms</b>	<b>Detail of Literature/ Study Selection</b>	<b>Quality Assessment (where applicable)</b>	<b>Data Synthesis (where applicable)</b>	<b>Findings/ Conclusions Relevant to the Review</b>
Vanderwee K., Grypdonck M. & Defloor T. (2008) Alternating pressure air mattresses as prevention for pressure ulcers: A literature review. <i>International Journal of Nursing Studies</i> 45(5), 784-801.	To examine the literature on alternating pressure air mattresses (APAMS) as a preventive measure for pressure ulcers.	<p><u>5 databases:</u> PubMed; CINAHL; Central; Embase; Medline.</p> <p><u>Time period:</u> 1980-2006.</p> <p><u>Languages:</u> English; German; French; Dutch.</p> <p><u>Inclusion:</u> Original studies investigating APAMS for the prevention of pressure ulcers.</p>	Not disclosed.	<p>83 articles retrieved from database search – 31 complied with inclusion criteria.</p> <p>2 additional publications identified in CINAHL/ Central.</p> <p>6 found in reference citations.</p> <p>Total of 35 articles.</p>	Not disclosed.	Not disclosed.	A significantly lower pressure ulcer incidence when patients are nursed on an APAM.

<p>Pancorbo-Hidalgo P.L., Garcia-Fernandez F.P., Lopez-Medina I.M. &amp; Alvarez-Nieto C. (2006) Risk assessment scales for pressure ulcer prevention: a systematic review. <i>Journal of Advanced Nursing</i> <b>54</b>(1), 94-110.</p>	<p>To determine the effectiveness of the use of risk assessment scales for pressure ulcer prevention in clinical practice, degree of validation and risk assessment scales, and effectiveness of risk assessment scales as indicators of risk of developing a pressure ulcer.</p>	<p><u>14 databases:</u> DARE; CINAHL; Medline; Current contents; IME; Cuiden; LILACS; Cochrane Library; EBSCO; ScienceDirect; Springer; InterSciencia; ProQuest; Pascal.</p> <p><u>Time Period:</u> 1966-2003.</p> <p><u>Languages:</u> Spanish, English, French, Portuguese.</p>	<p>“Pressure ulcers” (or “pressure sores” or “decubitus ulcer”), and “risk assessment”.</p>	<p><u>Retrieved Searches:</u> 491 bibliographical references found.</p> <p><u>After critical analysis of abstracts:</u> 33 found to be valid.</p>	<p><u>Clinical Trials:</u> CASP Guide (Critical Appraisal Skills Programme 2002).</p> <p><u>Prospective Cohort Studies:</u> The critical assessment guide developed for the clinical practice guide for PU assessment and prevention.</p>	<p>Tables were included in the study with the analysis and conclusions from the selected studies.</p>	<p><u>Braden scale:</u> Found to have optimal validation.</p> <p><u>Norton scale:</u> Found to have high inter-rater reliability.</p> <p><u>Waterlow scale:</u> Found to have high reliability values.</p>
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### Appendix 3: Pressure Ulcer Risk Assessment Scales

#### 1. The Norton Scale

(i) Physical Condition

- Good = 4
- Fair = 3
- Poor = 2
- Very bad = 1

(ii) Mental Condition

- Alert = 4
- Apathetic = 3
- Confused = 2
- Stupor = 1

(iii) Activity

- Ambulant = 4
- Walks with help = 3
- Chair bound = 2
- Bed bound = 1

(iv) Mobility

- Full = 4
- Slightly impaired = 3
- Very limited = 2
- Immobile = 1

(v) Incontinent

- Not = 4
- Occasionally = 3
- Usually/Urine = 2
- Double = 1

\* Sum all scores from (i) – (v). A score < 14 indicates a high risk of pressure ulcers \*

Source: Norton D., McLaren R. & Exton-Smith A.N. (1962) *An Investigation of Geriatric Nursing Problems in Hospital*. National Corporation for the Care of Old People, London.

## 2. The Waterlow Scale

### (i) Sex

- Male = 1
- Female = 2

### (ii) Age

- 14-49 years = 1
- 50-64 years = 2
- 65-74 years = 3
- 75-80 years = 4
- 81+ years = 5

### (iii) Build/Weight for Height (BMI)

- Average – BMI 20-24.9 = 0
- Above average – BMI 25-29.9 = 1
- Obese – BMI > 30 = 2
- Below average – BMI < 20 = 3

### (iv) Continence

- Complete/catheterised = 0
- Incontinent – urine = 1
- Incontinent – faeces = 2
- Doubly incontinent = 3

### (v) Skin Type – Visual Risks Area

- Healthy = 0
- Tissue paper (thin/fragile) = 1
- Dry (appears flaky) = 1
- Oedematous (puffy) = 1
- Clammy (moist to touch)/pyrexia = 1
- Discoloured (bruising/mottled) = 2
- Broken (established ulcer) = 3

### (vi) Mobility

- Fully mobile = 0
- Restless/fidgety = 1
- Apathetic (sedated/depressed/reluctant to move) = 2
- Restricted (by severe pain/disease) = 3
- Bedbound (unconscious/unable to change position/traction) = 4
- Chair bound (unable to leave chair without assistance) = 5

(vii) Nutritional Element

- Unplanned weight loss in past 3-6 months:
  - < 5% = 0
  - 5-10% = 1
  - > 10% = 2
- BMI score:
  - > 20 = 0
  - 18.5-20 = 1
  - < 18.5 = 2
- Patient acutely ill/no nutritional intake > 5 days = 2

(viii) Special Risks – Tissue Malnutrition

- Multiple organ failure/terminal cachexia = 8
- Single organ failure e.g. cardiac, renal, respiratory = 5
- Peripheral vascular disease = 5
- Anaemia – Hb < 8 = 2
- Smoker = 1

(ix) Special Risks – Neurological Deficit

- Diabetes/MS/CVA/Motor/Sensory/Paraplegia = 4-6 (max. 6)

(x) Special Risks – Surgery/Trauma

- On table > 6 hours = 8
- Orthopaedic/below waist/spinal (up to 48 hours post op) = 5

(xi) Special Risks = Medication

- Cytotoxic/anti-inflammatory/long term or high dose steroid = 4 (max. 4)



\* Sum all scores from (i) – (xi). Score of 10+ = 'At Risk'; Score of 15+ = 'High Risk'; Score of 20+ = 'Very high risk'. \*

Source: Healthcare Improvement Scotland. (2014) *Adapted Waterlow Pressure Area Risk Assessment Chart*. Retrieved from [www.healthcareimprovementscotland.org](http://www.healthcareimprovementscotland.org) on 22<sup>nd</sup> March 2016.

### **3. The Braden Scale**

#### **(i) Sensory Perception**

- Completely limited (unresponsive to painful stimuli/limited ability to feel pain) = 1
- Very limited (only responds to painful stimuli/sensory impairment) = 2
- Slightly limited (responds to verbal commands, cannot communicate discomfort/has some sensory impairment) = 3
- No impairment (responds to verbal commands/no sensory deficit) = 4

#### **(ii) Moisture**

- Constantly moist (perspiration/incontinence) = 1
- Very moist (often but not always) = 2
- Occasionally moist (may require extra linen change once per day) = 3
- Rarely moist (skin usually dry) = 4

#### **(iii) Activity**

- Bedfast (confined) = 1
- Chairfast (mobility severely limited) = 2
- Walks occasionally (short distances) = 3
- Walks frequently (walks at least once every 2 hours) = 4

#### **(iv) Mobility**

- Completely immobile (not even slight changes in body position without assistance) = 1
- Very limited (occasional slight position changes) = 2
- Slightly limited (frequent though slight position changes) = 3

- No limitation (major and frequent position changes) = 4

(v) Nutrition

- Very poor (never eats complete meal/NPO) = 1
- Probably inadequate (rarely finishes a meal/receives less than optimum amount of liquid diet/tube feeding) = 2
- Adequate (eats more than half of most meals/receiving tube feeding or TPN) = 3
- Excellent (eats most of every meal/no supplementation required) = 4

(vi) Friction & Shear

- Problem (requires maximum assistance to move) = 1
- Potential problem (requires minimal assistance to move) = 2
- No apparent problem (moves in bed/chair independently) = 3

\* Sum all scores from (i) – (vi). Score of > 19 – patient is low risk/score of < 18 – patient is high risk. \*

Source: Braden B. & Bergstrom N (1988) *Braden Scale for Predicting Pressure Sore Risk*.

Retrieved from [www.healthcare.uiowa.edu/igec/tools/pressureulcers/bradenscale.pdf](http://www.healthcare.uiowa.edu/igec/tools/pressureulcers/bradenscale.pdf) on 22nd March 2016.

## Appendix 4: Glossary of Terms

### 1. Alternating Pressure Air Device

Alternating pressure air devices reduce pressure for short periods of time by continuous inflation and deflation of air-filled cells. These devices are available as mattresses (APAM's) or overlays (APAO's) to be placed over a regular hospital mattress.

Source: Manzano F., Pérez A., Colmenero M., Aguilar M., Sánchez-Cantalejo E., Reche A., Talavera J., López F., Frías-Del Barco S. & Fernández-Mondejar E. (2013) Comparison of alternating pressure mattresses and overlays for prevention of pressure ulcers in ventilated intensive care patients: a quasi-experimental study. *Journal of Advanced Nursing* **69**(9), 2099-2106.

### 2. Grades of Pressure Ulcers

#### (i) Category/Stage One – Non-blanchable erythema:

- Skin is still intact
- Non-blanchable redness in an area
- Often occurs over a bony prominence
- Patient may feel pain
- May be warmer or cooler when compared with adjacent tissue

#### (ii) Category/Stage Two – Partial thickness:

- Loss of dermis layer of skin
- Shallow open ulcer – red or pink in colour – no slough

#### (iii) Category/Stage Three – Full thickness skin loss:

- Full thickness tissue loss
- Subcutaneous tissue may be visible
- Bone/tendons/muscle are not visible
- May be presence of slough
- Depth varies depending on location

#### (iv) Category/Stage Four – Full thickness tissue loss:

- Full thickness tissue loss
- Bone/tendons/muscle exposed
- Slough may be present
- Often includes undermining and tunneling
- Depth varies depending on location
- Osteomyelitis/osteitis likely to occur

Source: National Pressure Ulcer Advisory Panel (2007) *NPUAP Pressure Ulcer Stages/Categories*. Retrieved from [www.npuap.org](http://www.npuap.org) on 22<sup>nd</sup> March 2016