Pressure ulcers – prevention of pressure related tissue damage

Technical report

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Joanna Briggs Institute Evidence Based Publications

The Joanna Briggs Institute is involved in the development and dissemination of a number of publications that inform health professionals about clinical practice and specifically what constitutes best practice in health care. These serials include the International Journal of Evidence Based Healthcare (formerly JBI Reports) published by Blackwell Publishing and available online at http://www.blackwell-synergy.com. Systematic reviews conducted by Collaborating Centres of the Joanna Briggs Institute are published in the International Journal of Evidence Based Healthcare. These systematic review reports are further abstracted and published by Blackwell Publishing as the series Best Practice Information Sheets for Health Professionals. All Best Practice Information Sheets are derived from systematic reviews of health care research literature either conducted by the Joanna Briggs Institute Collaborating Centres or in some cases by an external source.

Aims and scope of the Technical Report

The conduct of systematic reviews and the development of Best Practice Information Sheets involve rigorous, standardised methods to ensure that all information provided to health professionals is of the highest standard and constitutes best practice. The conduct of a systematic review and development of the corresponding Best Practice issue are two parts of a staged process. All aspects of the conduct of the systematic review and the development of the accompanying Best Practice issue are documented so that these methods may be scrutinised. The processes involved in conducting Joanna Briggs Institute systematic reviews, including review methods are documented within the systematic review report. The format of Best Practice precludes it from including detailed information regarding the abstraction of evidence and development of recommendations embodied in the publication. For this reason JBI Best Practice Technical Reports are provided as a complementary publication to document all aspects of the development of Best Practice Information Sheets. In determining the quality of the Joanna Briggs Institute Best Practice Information Sheets the information provided in the Technical Report and the Systematic Review Report should also be considered.

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Disclaimer

“The procedures described in Best Practice must only be used by people who have appropriate expertise in the field to which the procedure relates. The applicability of any information must be established before relying on it. While care has been taken to ensure that this edition of Best Practice summarises available research and expert consensus, any loss, damage, cost, expense or liability suffered or incurred as a result of reliance on these procedures (whether arising in contract, negligence or otherwise) is, to the extent permitted by law, excluded”.

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Pressure ulcers - prevention of pressure related tissue damage: Technical report

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Introduction
The aim of Joanna Briggs Institute evidence publications is to provide the best available evidence relating to clinical questions that are important to health professionals and consumers. Although the publications relate to the same clinical question/s and are therefore complementary they serve different purposes and so are of a different scope and format. The Best Practice Information Sheets are targeted to base level health professionals and are restricted to a six-page format, recognising the time constraints on today’s clinicians. This prevents details of the development process being presented in the Best Practice Information Sheets. The Best Practice Information Sheet Technical Report provides this detail to allow scrutiny of the development process. The development of these publications is essentially a stepped process involving first the identification and synthesis of the evidence (Systematic Review) and then the abstraction of the evidence and development of recommendations for practice (Best Practice Information Sheets). In examining the methods and processes that ultimately produce practice recommendations the reader should consider the information available in the both the Systematic Review Report and the Best Practice Information Sheet Technical Report for a given information sheet.

This technical report details the development process for the following Best Practice Information sheet:


Best Practice Information Sheets development methods
All Joanna Briggs Best Practice Information Sheets are developed by staff of the Joanna Briggs Institute in collaboration with staff from one of the Joanna Briggs Collaborating Centres with the assistance of an advisory panel of clinicians and other experts.

Acknowledgements

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Identification and synthesis of the evidence

All Best Practice Information Sheets are derived from systematic reviews of the best available evidence. This information sheet is based on four systematic reviews, which are as follows:


Executive summary

Background
Pressure ulcers or pressure sores, bedsores, decubiti or decubitus ulcers, are areas of localised damage or trauma to the skin and underlying tissue, caused by pressure, friction or shear. They generally occur over bony prominences, for example the base of the spine, heels and hips and are most common in people with impaired mobility, spinal cord injuries, severe acute illness (patients in ICU) and the elderly. The most effective method of confronting the issue is prevention and the quality of nursing care is considered the key factor in managing pressure ulcers. The actual extent to they are preventable, however, is unclear. Prevention measures are commonly divided into several areas: identification of those individuals deemed to be most at risk of developing pressure ulcers, repositioning and use of pressure-reducing support surfaces, and nutrition.

Objectives
The objectives of the four systematic reviews included in this information sheet were as follows:

- Effectiveness of risk assessment scales
- Repositioning
- Support surfaces (including pressure-relieving cushions, beds, mattress overlays, and mattress replacements)
- Nutritional supplements (including enteral and parenteral nutrition)

Search strategy
Cullum et al. (2004) searched the Specialised Trials Register of the Cochrane Wounds Group, which is a compilation of databases such as MEDLINE, CINAHL, EMBASE, and
handsearching results of specialist journals and conference proceedings) up to January 2004. Issue 4, 2003 of the Cochrane Central Register of Controlled Trials was also searched.

Langer et al. (2003) also searched the Specialised Trials Register of the Cochrane Wounds Group and Cochrane Central Register of Controlled Trials in September 2002. Furthermore, their search included PubMed and CINAHL, handsearching conference proceedings and journals, relevant articles’ bibliographies, contacting manufacturers and experts in the field.

Pancorbo-Hidalgo et al. (2006) conducted a search of 14 databases for the period 1966-2003: DARE; CINAHL; MEDLINE; Current Contents; Indice médico espaéol (IME, Spanish Medical Index); Cochrane Library; EBSCO; ScienceDirect; Springer; InterScience; ProQuest; Pascal; Cuiden; and LILACS (Latin-American and Caribbean Information Centre for Health Sciences).

Reddy et al. (2006) searched MEDLINE and CINAHL from inception to June 2006 and Cochrane databases (through Issue 1, 2006), Proquest Digital Dissertations, ISI Web of Science, and Cambridge Scientific Abstracts. Bibliographies of articles were also reviewed.

Selection criteria
The following selection criteria were applicable to Cullum et al (2004):

- RCTs, published and unpublished, assessing the effectiveness of beds, mattresses, mattress overlays, and seating cushions to prevent pressure ulcers for any patient group in any setting
- RCTs included if they reported an objective, clinical outcome measure
- Studies with proxy measure outcomes were excluded.

The following selection criteria were applicable to Langer et al (2003):

- RCTs evaluating the effectiveness of enteral and parenteral nutrition in the prevention and treatment of pressure ulcers via measurement of new ulcers, ulcer healing or changes in pressure ulcer severity
- No restrictions on patients, setting, date, publication status or language.

The following selection criteria were applicable to Pancorbo-Hidalgo et al (2006):

- Controlled clinical trials and prospective cohort studies
- Percentage of patients followed up was over 75%
- Studies offering data on the predictive validity of the scales or the raw data necessary to do the calculations

The following selection criteria were applicable to Reddy et al (2006):

- RCTs that reported objective, clinically relevant outcomes, for example incidence of pressure ulcers
- No restrictions on language, publication date, or setting.

Data collection and analysis
In Cullum et al. (2004) trial data were extracted by one researcher and checked by a second. Each study’s results were presented as a relative risk for dichotomous variables. Similar studies were pooled into a meta-analysis where it was deemed appropriate.

In Langer et al. (2003) abstracts were independently inspected and full articles obtained of potentially relevant studies. In case of disagreement advice was sought from a third person. The three reviewers extracted data and assessed the quality of the studies independently.

In Pancorbo-Hidalgo et al. (2006) the data from each selected study were transferred to a data extraction sheet. Two researchers independently extracted the data from each study and to minimize bias, a list was made of operational definitions of the variables considered. Whenever possible, the authors re-calculated the validity indicator scores (sensitivity, specificity, positive prediction value, negative prediction value, effectiveness and area under the ROC curve) in order to check them against the raw data offered by each author.
In Reddy et al. (2006) 59 RCTs were selected. Interventions assessed in these studies were grouped into 3 categories, i.e., those addressing impairments in mobility, nutrition, or skin health. Methodological quality for the RCTs varied and was generally suboptimal. Effective strategies that looked at impaired mobility included the use of support surfaces, mattress overlays on operating tables, and specialized foam and specialized sheepskin overlays. While repositioning is a mainstay in most pressure ulcer prevention protocols, there is insufficient evidence to recommend specific turning regimens for patients with impaired mobility. In patients with nutritional impairments, dietary supplements may be beneficial. Incremental benefit of specific topical agents over simple moisturizers for patients with impaired skin health is unclear.

**Main results**

Cullum et al. (2004) found that from an evaluation of 41 RCTs, foam alternatives to the standard hospital foam mattress can reduce the incidence of pressure ulcers in people at risk. The relative merits of alternating and constant low pressure devices, and of the different alternating pressure devices for pressure ulcer prevention are unclear. Pressure-relieving overlays on the operating table can reduce post-operative pressure ulcer incidence, although one study indicated that an overlay resulted in adverse skin changes. One trial indicated that Australian standard medical sheepskins prevented pressure ulcers. Evidence is insufficient to make conclusions on the value of seat cushions, limb protectors and various constant low pressure devices as pressure ulcer prevention strategies. A study of Accident & Emergency trolley overlays did not identify a reduction in pressure ulcer incidence. It can be suggested that foot waffle heel elevators, a particular low air loss hydrotherapy mattress and an operating theatre overlay are harmful.

Langer et al (2003) found that most of the 8 trials included are small and of poor methodological quality. Regarding prevention, 4 studies compared a combination of nutritional supplements, consisting of a minimum of energy and protein in different dosages, for the prevention of pressure ulcers. The largest study found that nutritional supplements reduced the number of new pressure ulcers. The three smaller studies lacked power. For treatment, 4 studies evaluated the effects of nutritional supplements on existing pressure ulcers: one trial examined mixed nutritional supplements, one trial examined zinc, another the effect of proteins, and two studies compared ascorbic acid. The trials included are heterogeneous with regard to participants, interventions and outcomes. It was therefore considered inappropriate to perform a meta-analysis.

Pancorbo-Hidalgo et al (2006) discovered that no decrease in pressure ulcer incidence was found which might be attributed to using an assessment scale. However, the use of scales increases the intensity and effectiveness of prevention interventions. The Braden Scale shows optimal validation and the best sensitivity/specificity balance; its score is a good pressure ulcer risk predictor. The Norton Scale has reasonable scores for sensitivity, specificity and risk prediction. The Waterlow Scale offers a high sensitivity score but low specificity; with a good risk prediction score. Nurses’ clinical judgement (in three studies) provided moderate scores for sensitivity and specificity, but is not a good pressure ulcer risk predictor.

Reddy et al (2006) identified 59 RCTs evaluating interventions to prevent pressure ulcers. Our review suggests that the methodology for pressure ulcer prevention trials is suboptimal overall, although more recent studies have shown improvements in methodological quality. In pressure ulcer prevention trials, it is sometimes not feasible to ensure that participants are blinded, and other aspects of these trials may be difficult to standardize. To address these issues, we used the CLEAR NPT quality-rating guidelines developed specifically for non-pharmacological interventions. Only 3 of the 58 RCTs in this review fulfilled all of the criteria we selected from the CLEAR NPT checklist. The trials reviewed were generally short, but follow-up ranged from 1 to 224 days. Although pressure ulcers can develop within 2-6 hours, the incidence of pressure ulcers has been found to rise with increasing duration of stay in LTC, and continues to rise for at least 2 years. While days or weeks of follow-up may be adequate for patients with reversible risk factors (e.g., relatively healthy patients in...
perioperative settings), patients with indefinite immobility (eg, paraplegia) may require longer follow-up.

**Reviewers’ conclusions**

Cullum et al. (2004) concluded that in people at high risk of pressure ulcer development, consideration should be given to using higher specification foam mattresses rather than standard hospital foam mattresses. The relative merits of higher-tech constant low pressure and alternating pressure for prevention are unclear. Healthcare organisations might consider using pressure relief for high risk patients in the operating theatre, as this is linked to reduced post-operative incidence of pressure ulcers. Seat cushions and overlays designed for use in Accident & Emergency settings have not been adequately evaluated.

Langer et al. (2003) concluded that firm conclusions could not be made regarding the effect of enteral and parenteral nutrition on the prevention and treatment of pressure ulcers. More trials with high methodological rigour are required.

Pancorbo-Hidalgo et al. (2006) concluded that there is not enough evidence to claim that use of a risk assessment scale (RAS) in clinical practice decreases pressure ulcer incidence. The use of a validated RAS, the Norton Scale, as a criterion for prevention intervention (pressure-reducing support surfaces) increases both its effectiveness and the application of a greater number of early prevention interventions. The Braden and Norton Scales were better risk prediction tools than nurses’ clinical judgement. The weighted analysis and meta-analysis of the validation studies suggested the Braden Scale as offering the best sensitivity/specificity balance and the highest prediction capacity. There is presently no evidence that nurses’ clinical judgement on its own can predict pressure ulcer development risk in patients.

Reddy et al. (2006) concluded that given current evidence, using support surfaces, repositioning the patient, optimizing nutritional status, and moisturizing sacral skin are good strategies to prevent pressure ulcers. While a number of RCTs have evaluated preventive strategies for pressure ulcers, many had important methodological limitations. There is a need for well-designed RCTs that follow standard criteria for reporting non-pharmacological interventions and that provide data on cost-effectiveness for these interventions.

**Key Words:** pressure ulcers, pressure sores, decubitis, tissue load, skin assessment, risk assessment scale, nutrition, tissue damage, skin changes

**Abstraction of the evidence and development of practice recommendations**

All Joanna Briggs Institute *Best Practice* Information Sheets are a standardised format that includes a background to the clinical question, a summary of the evidence from the systematic review, recommendations and/or implications for practice (graded using the Joanna Briggs Institute Feasibility, Appropriateness, Meaningfulness and Effectiveness scale). The recommendations arising from the evidence in the systematic review and embodied in the *Best Practice* Information Sheets are developed by the *Best Practice* Information Sheets developers with the assistance of the expert advisory panel. Essentially the recommendations for *Best Practice* Information Sheets are where possible evidence based. The developers and the advisory panel consider the evidence and the context in which the evidence may be used and then develop recommendations for practice. Where no evidence is identified in the systematic review the developers and the expert panel develop consensus statements to inform practice. At this point the *Best Practice* Information Sheet is subjected to an extensive review process external to the developers and advisory panel.

**Peer review**

All Joanna Briggs Institute evidence publications are subjected to a rigorous peer review process. This process begins with the submission of the protocol for the systematic review to the Joanna Briggs Institute Collaboration Support Unit. The protocol is peer reviewed by members of the Support Unit not involved in the review itself. When the systematic review is
at draft report stage it is peer reviewed the Joanna Briggs Institute Collaboration Support Unit staff who appraised the protocol initially. In addition the systematic review report is subjected to additional external blinded peer review before publication in the JBI Library of Systematic Reviews.

The Collaboration Support Unit along with members of the Best Practice review panel and other staff of the Joanna Briggs Institute also review the draft Best Practice information sheet. The Best Practice information sheet is then distributed to all other Joanna Briggs Collaborating Centres for comment with regard to cultural, professional and organisational issues that may impact on the implementation of the Best Practice information sheet recommendations/implications within their constituency.

**Best Practice Information Sheets ongoing review/update**

All Joanna Briggs Institute evidence publications are based on the best available evidence at the time of publication. When using the publications to inform practice the reader should consider the date of publication and the possibility that recent research may have implications about the strength or direction of recommendations. All Joanna Briggs Institute systematic reviews on which the Best Practice Information Sheets are based are assessed for update at five years post publication and at this time the relevant Best Practice Information Sheets is also reviewed.

**Funding**

Although the majority of Joanna Briggs Institute systematic reviews and Best Practice Information Sheets are funded by corporate membership funds and/or by the Joanna Briggs Collaborating Centres, external funding is occasionally used. In these cases the internal and external peer review processes ensure that editorial independence from the funding body is maintained.

**Conflict of interest**

Any conflict of interest by Joanna Briggs Collaborating Centre staff and/or advisory panel members is declared in a statement within the systematic review report.
Appendix 1 – Grades of Recommendation and Implications for Practice

It is the policy of the Joanna Briggs Institute that all Best Practice Information Sheets will utilise the Joanna Briggs Institute Grades of Recommendation with the specific hierarchy corresponding to the implication for practice provided. See recommendation tables below.

<table>
<thead>
<tr>
<th>Implications for Practice</th>
<th>Feasibility</th>
<th>Appropriateness</th>
<th>Meaningfulness</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Strong support that merits application</td>
<td>Strong support that merits application</td>
<td>Strong support that merits application</td>
<td>Strong support that merits application</td>
</tr>
<tr>
<td>B</td>
<td>Moderate support that warrants consideration of application</td>
<td>Moderate support that warrants consideration of application</td>
<td>Moderate support that warrants consideration of application</td>
<td>Moderate support that warrants consideration of application</td>
</tr>
<tr>
<td>C</td>
<td>Not supported</td>
<td>Not supported</td>
<td>Not supported</td>
<td>Not supported</td>
</tr>
</tbody>
</table>

The following implications for this Best Practice Information Sheet are based on the JBI developed Grades of Effectiveness (column far right above):

- Positioning and repositioning should aim to avoid direct pressure on bony prominences or surfaces of the body (Grade B)

- Risk assessment with a validated tool should be performed on admission to hospital and at least daily and include an assessment of nutrition (Grade B)

- The administration of 2 oral nutritional supplements daily may benefit elderly people recovering from acute illness in reducing the incidence of pressure ulcers (Grade B)

- The Braden Scale indicates optimal validation in pressure ulcer risk prediction (Grade B)

- Foam mattresses may reduce the incidence of pressure ulcers in people at risk compared to standard hospital mattresses (Grade B)
### Appendix 2 – Tables of included studies


<table>
<thead>
<tr>
<th>Study</th>
<th>Type of Study</th>
<th>Patients</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
</table>
| Andersen 1982 | RCT with 10 day follow-up         | Acute setting at high risk of pressure ulcer development and no existing ulcers | 1. Standard hospital mattress  
2. Alternating air mattress  
3. Water filled mattress                                                                 | Incidence of pressure ulcers; Grade 2 or greater ulcers; alternating mattress; water mattress; standard mattress |
| Aronovitch 1999 | Prevention trial; 7 days follow-up | 18 years old, undergoing elective surgery of at least 3 hours; no significant baseline differences | 1. AP system intra and postop  
2. Conventional management comprised use of a gel pad in the operating room and replacement mattress post-op | Micropulse system 1%; Conventional management (7 patients developed 11 ulcers)                     |
| Bourdel 2000  | Multicentre, RCT                  | 672 patients > 65 in acute phase of illness                               | 1. Nutrition  
2. Control group                                                                                                                                   | Pressure ulcers recorded each using 4 grades                                                       |
| Collier 1996  | Prevention trial; RCT             | Patients on general medical ward                                          | Comparison of 8 different kinds of foam mattresses                                                                                          | Incidence of pressure ulcers and assessed weekly throughout hospital stay; no patient developed any grade of pressure ulcer |
| Conine 1993   | Prevention trial with 3 mth. follow-up | Extended care patients > 60 years                                    | 1. Alternating pressure overlay  
2. Silicore overlay                                                                                                                                  | 1. Jay Cushion (25%)  
2. Foam Cushion (41%)                                                                                                                               |
| Conine 1994   | Prevention trial; RCT with 3 mth. follow-up | Elderly patients average age 82 in extended care hospital                 | 1. Jay cushion  
2. Foam cushion                                                                                                                                  | Unable to present incidence data re number of patients affected by Grade 2 or above pressure ulcers |
| Cooper 1998   | Prevention trial; RCT with 7 day follow-up | 100 patients over 65 years with no pressure ulcers                       | 1. Dry flotation mattress (Roho)  
2. Dry flotation mattress (Sofflex)                                                                                                              | Grade 2 ulcer and above; Grade 1 ulcer                                                          |
| Daechsel 1985 | Prevention trial; RCT with 3 mth. follow-up | 32 patients with chronic neurological conditions in long-term care hospital | 1. Alternating pressure mattress  
2. Spenco overlay                                                                                                                                  | Grade 1 ulcers; alternating overlay (25%); Spenco overlay (25%)                                   |
| Delmi 1990    | RCT                               | 59 elderly patients > 60 in orthopaedic unit                             | 1. Standard hospital diet with oral nutrition supps.  
2. Standard hospital diet                                                                                                                       | Frequency of complications (eg. death, pressure ulcer, severe anaemia)                             |
| Ewing 1964    | Prevention and treatment trial; RCT with 6 mth. follow-up | Elderly patients, average age 72.5 years                                 | 1. Adjusting sheepskins to support legs on woolly fleece  
2. Control without sheepskins                                                                                                                   | Study too small to detect any difference                                                           |
| Goldstone 1982 | Prevention trial                 | Participants >60 with femur fracture                                    | 1. Beaufort bead bed system  
2. Standard supports in A&E                                                                                                                     | Grading of ulcers not given; Beaufort bed (16%); standard surface (49%)                           |
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Participants</th>
<th>Interventions</th>
<th>Findings</th>
</tr>
</thead>
</table>
| Gray & Campbell 1994          | Prevention trial; RCT with 10 day follow-up | Patients from orthopaedic trauma, vascular and medical oncology units | 1. Softfoam mattress  
2. Standard 130 mm NHS foam mattress | Grade 2 or greater: Softfoam (7%); Standard (34%) |
2. Standard hospital diet | Development and severity of pressure sores |
| Houwing 2003                  | Double-blind, randomised, placebo-controlled trial | Patients with femoral-neck fracture | 1. Cubed foam mattress  
2. Standard hospital mattress | Incidence of pressure ulcers of Grade 2 or more at 2 weeks |
| Laurent 1997                  | Prevention trial; RCT with factorial design | 103 hip fracture patients | 1. Nutrition suppl.  
2. Placebo | Presence and stage of pressure ulcers assessed daily for 28 days |
| Lazzara 1991                  | Prevention and Treatment trial; RCT | Nursing home residents at risk of pressure ulcers | 1. Air-filled overlay  
2. Gel mattress | Grade 2 or greater ulcers: air overlay (16%); gel mattress (15%) |
| Lim 1988                      | Prevention trial; RCT with 5 month follow-up | 62 residents of an extended care facility, 60 or older | 1. Foam slab cushion  
2. Contoured foam | Included Grade 1 ulcers: slab foam (73%); contoured foam (69%) |
| McGowan et al 2000            | Prevention trial              | Orthopaedic inpatients 60 or older | 1. Standard hospital mattress with Aust. sheepskin overlay  
2. Standard hospital mattress with low tech constant pressure devices | Sheepskin group: ulcers developed, no more severe than stage 1; Control group: more ulcers developed |
| Nixon et al 1998              | Prevention trial; RCT with 8 day follow-up | Patients 55 years and older for elective major surgery | 1. Dry visco-elastic polymer pad on operating table  
2. Standard operating theatre table mattress | Visco-elastic polymer (11%); Standard mattress |
| Russell 2000                  | Prevention trial; RCT with 7 day follow-up | Patients at least 18 years got cardiothoracic surgery | 1. MicroPulse system  
2. Conventional care | Micropulse System (2%); Conventional management (7%) |
| Russell 2002                  | Median days presented by group in hospital; central allocation of trials office | Elderly acute, orthopaedic and rehab wards, > 65 years | 1. Visco-polymer energy absorbing foam mattress  
2. Standard mattress/cushion combination | Development of non-blanching erythema or worse |
| Santy 1994                    | Prevention trial; RCT with 14 day follow-up | Patients aged >55 with hip fracture | 1. Clinifloat  
2. NHS contract  
3. Vaperm  
4. Therarest  
5. Transfoam | Ulcers of Stage 2 ulcers (6) reported in experimental group; 3 Stage 2 ulcers reported in control group |
| Schultz 1999                  | Follow-up 6 days              | Patients for surgery lasting at least 2 hours | 1. Experimental mattress overlay  
2. Usual care | Ulcers of Stage 2 ulcers (6) reported in experimental group; 3 Stage 2 ulcers reported in control group |
<table>
<thead>
<tr>
<th>Study</th>
<th>RAS</th>
<th>Setting</th>
<th>Sampling</th>
<th>Sample size</th>
<th>Average Years</th>
<th>Pressure Ulcer Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sideranko 1992</td>
<td>Prevention trial; RCT with 9.4 days mean follow-up</td>
<td>Adult, surgical ICU patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stapleton 1986</td>
<td>Prevention trial</td>
<td>Female elderly patients with fractured neck of femur</td>
<td></td>
<td></td>
<td></td>
<td>Ulcers of Grade 2 and Grade 3 greater</td>
</tr>
<tr>
<td>Takala 1996</td>
<td>Prevention trial; RCT with 14 day follow-up</td>
<td>Non-trauma patients in ICU to stay &gt; 5 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tymec 1997</td>
<td>Prevention trial</td>
<td>52 patients in a large hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pancorbo-Hidalgo et al review**

<table>
<thead>
<tr>
<th>Study</th>
<th>RAS</th>
<th>Setting</th>
<th>Sampling</th>
<th>Sample size</th>
<th>Average Years</th>
<th>Pressure Ulcer Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andersen et al 1982</td>
<td>Andersen ≥ 2</td>
<td>Hospital (acute observation)</td>
<td>Systematic</td>
<td>3398</td>
<td>ND</td>
<td>ND</td>
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<tr>
<td>Bergstrom et al 1987a</td>
<td>Braden ≤ 16</td>
<td>Hospital (medical surgical units)</td>
<td>Systematic</td>
<td>100</td>
<td>50.5</td>
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<td>Hospital (medical surgical units)</td>
<td>Systematic</td>
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<td>57.2</td>
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<tr>
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<td>Braden ≤ 16</td>
<td>Hospital (ICU)</td>
<td>Systematic</td>
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<tr>
<td>Stotts 1988</td>
<td>Norton ≤ 14</td>
<td>Hospital (cardiovascular surgery and neurosurgery)</td>
<td>Systematic</td>
<td>387</td>
<td>53.1</td>
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</tr>
<tr>
<td>Towey and Erland 1988</td>
<td>Knoll 12</td>
<td>Long-term care facility</td>
<td>Convenience</td>
<td>60</td>
<td>81.3</td>
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<tr>
<td>Smith 1989</td>
<td>Norton ≤ 16; Waterlow ≥ 2; Clinical judgement</td>
<td>Hospital (orthopaedic surgery)</td>
<td>Random</td>
<td>100</td>
<td>ND</td>
<td>ND</td>
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<tr>
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<td>Systematic</td>
<td>1244</td>
<td>ND</td>
<td>ND</td>
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<td>Langemo et al 1991</td>
<td>Braden ≤ 16</td>
<td>Hospital (medical-surgical and orthopaedics unit)</td>
<td>Convenience</td>
<td>74</td>
<td>66</td>
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<tr>
<td>Langemo et al 1991</td>
<td>Braden ≤ 18</td>
<td>Home care, Hospice</td>
<td>Convenience</td>
<td>25</td>
<td>66</td>
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<td>Braden ≤ 16; Clinical judgement</td>
<td>Hospital (acute care medical unit)</td>
<td>Convenience</td>
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<td>72</td>
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<td>Barnes and Payton 1993</td>
<td>Braden ≤ 16</td>
<td>Hospital (medical and cardiovascular)</td>
<td>Systematic</td>
<td>361</td>
<td>68.4</td>
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<tr>
<td>Braden and Bergstrom 1994</td>
<td>Braden ≤ 18</td>
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<td>McDonald (1996)</td>
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<td>VandeBosch et al 1996</td>
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<td>Goodridge et al 1998</td>
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<td>Bergstrom et al 1998</td>
<td>≤ 18</td>
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<td>18; Waterlow ≥ 16;</td>
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<td>Wai-Han et al 1997</td>
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<td>Hasigawa &amp; Barbenel 1999</td>
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<td>Feuntelsaz Gallego 2001</td>
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<td>Lindgren et al 2002</td>
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<td>Perneger et al 2002</td>
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<td>Seongsook et al 2004</td>
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<td>≤ 24; Douglas ≤ 18</td>
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### Reddy et al review

<table>
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<th>Study</th>
<th>Setting</th>
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<th>Intervention</th>
<th>Incidence reduced?</th>
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<td>Bourdel-Marchasson et al 2000</td>
<td>Acute care</td>
<td>672 (351)</td>
<td>Standard hospital diet with daily oral nutritional supplement vs. standard hospital diet</td>
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<td>Defloor et al 2005</td>
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<td>838 (761)</td>
<td>Repositioning 1. Turning q2h on standard hospital mattress 2. Turning q3h on standard hospital mattress 3. Turning q4h on specialized foam mattress 4. Turning q6h on specialized foam mattress 5. Standard care (based on clinical judgment)</td>
<td>Yes; turning q4h on specialized foam mattress</td>
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<td>Delmi et al 1990</td>
<td>Acute care (elderly orthopaedic)</td>
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<td>Ek et al 1991</td>
<td>Long-term care</td>
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<td>Standard hospital diet and daily oral nutritional supplement vs standard hospital diet</td>
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<td>Hartgrink et al 1998</td>
<td>Acute care (orthopaedic with nasogastric tube feeding)</td>
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<td>Standard hospital diet and overnight nasogastric feeding pump vs standard hospital diet</td>
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<td>Houwing et al 2003</td>
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<td>Nutritional supplement vs non-caloric placebo</td>
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<td>Young 2004</td>
<td>Acute care</td>
<td>46 (43)</td>
<td>Tilt vs 90 degree side-lying</td>
<td>No</td>
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</tbody>
</table>
Appendix 3 - References

These include references from the systematic reviews and additional references used in the development of this Best Practice information sheet.


CrossRef, Medline, CSA


Lazzara DJ, Buschmann MBT. Prevention of pressure ulcers in elderly nursing home residents: are special support surfaces the answer? *Decubitus* 1991;4: 42-46.


Research Dissemination Core Prevention of Pressure Sore. Gerontological Nursing Interventions Research Center, University of Iowa, 2002.


Santy JE, Butler MK, Whyman JD. A comparison study of 6 types of hospital mattress to determine which most effectively reduces the incidence of pressure sores in elderly patients with hip fractures in a District General Hospital. Report to Northern & Yorkshire Regional Health Authority 1994.


Stotts N.A. Predicting pressure ulcer development in surgical patients. *Heart and Lung* 1988; 17: 641–647.


