Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline
INTRODUCTION

Foreword

This Clinical Practice Guideline presents recommendations and summarizes the supporting evidence for pressure ulcer prevention and treatment. The first edition was developed as a four year collaboration between the National Pressure Ulcer Advisory Panel (NPUAP) and the European Pressure Ulcer Advisory Panel (EPUAP). In this second edition of the guideline, the Pan Pacific Pressure Injury Alliance (PPPIA) has joined the NPUAP and EPUAP. This edition of the guideline has been developed over a two year period to provide an updated review of the research literature, extend the scope of the guideline and produce recommendations that reflect the most recent evidence. It provides a detailed analysis and discussion of available research, critical evaluation of the assumptions and knowledge in the field, recommendations for clinical practice, a description of the methodology used to develop the guideline and acknowledgements of the 112 experts formally involved in the development process.

A Quick Reference Guide version that contains excerpts from the Clinical Practice Guideline is also available. The quick reference guide is intended for busy health professionals who require a quick reference in caring for individuals in the clinical setting. Users should not rely on excerpts from the Quick Reference Guide alone.

The goal of this international collaboration was to develop evidence-based recommendations for the prevention and treatment of pressure ulcers that could be used by health professionals throughout the world. An explicit scientific methodology was used to identify and critically appraise all available research. In the absence of definitive evidence, expert opinion (often supported by indirect evidence and other guidelines) was used to make recommendations. Drafts of the recommendations and supporting evidence were made available to 986 invited stakeholders (individuals and organizations) around the world. The final guideline is based on available research and the accumulated wisdom of the NPUAP, EPUAP, PPPIA and international stakeholders. In this edition of the guideline, a consensus voting process (GRADE) was used to assign a strength to each recommendation. The strength of recommendation identifies the importance of the recommendation statement based on potential to improve patient outcomes. It provides an indication to the health professional of the confidence one can have that the recommendation will do more good than harm, and can be used to assist in prioritizing pressure ulcer related interventions.

Printed copies of the English version of the Clinical Practice Guideline are available through links provided on the following websites:

NPUAP website: www.npuap.org
EPUAP website: www.epuap.org
Australian Wound Management Association (AWMA) website: www.awma.com.au
Hong Kong Enterostomal Therapist Society website: www.etnurse.com.hk
New Zealand Wound Care Society (NZWCS) website: www.nzwcs.org.nz
Wound Healing Society Singapore website: www.woundhealingsociety.org.sg
International Pressure Ulcer Guideline website: www.internationalguideline.com

Suggested Citation

The NPUAP, EPUAP and PPPIA welcome the use and adaptation of this guideline at an international, national and local level. We request citation as the source, using the following format:

## Strengths of Evidence and Strengths of Recommendations

Full explanation of the methodology is available in Appendix 1: Guideline Methodology. Individual studies were assigned a 'level of evidence' based on study design and quality. The body of evidence supporting each recommendation was given a 'strength of evidence'. A consensus voting process (GRADE) involving all the experts formally engaged in the guideline development was used to assign a 'strength of recommendation' that indicates the confidence the health professional can have that the recommended practice will improve patient outcomes (i.e., do more good than harm). The overall aim of the 'strength of recommendation' is to help health professionals to prioritize interventions.

### Strengths of Evidence

| A | The recommendation is supported by direct scientific evidence from properly designed and implemented controlled trials on pressure ulcers in humans (or humans at risk for pressure ulcers), providing statistical results that consistently support the recommendation (Level 1 studies required). |
| B | The recommendation is supported by direct scientific evidence from properly designed and implemented clinical series on pressure ulcers in humans (or humans at risk for pressure ulcers) providing statistical results that consistently support the recommendation. (Level 2, 3, 4, 5 studies) |
| C | The recommendation is supported by indirect evidence (e.g., studies in healthy humans, humans with other types of chronic wounds, animal models) and/or expert opinion |

### Strengths of Recommendation

| Strong positive recommendation: do it |
| Weak positive recommendation: probably do it |
| No specific recommendation |
| Weak negative recommendation: probably don't do it |
| Strong negative recommendation: definitely don't do it |

### Guideline Website

http://www.internationalguideline.com

The guideline website will remain accessible during the interim period until the next guideline revision. The Quick Reference Guide, sponsor acknowledgement, and supportive documents to the guideline are available from the website.
EMERGING THERAPIES FOR PREVENTION OF PRESSURE ULCERS

Introduction

The comprehensive literature review conducted for the guideline revision revealed a body of evidence on new and emerging therapies for preventing pressure ulcers. This section of the guideline presents the evidence on these new and emerging therapies, including microclimate manipulation; fabrics designed to reduce shear and friction; prophylactic dressings and electrical stimulation of muscles in individuals with spinal cord injury.

Microclimate Control

There is a growing appreciation of the effects of microclimate in pressure ulcer formation and healing. Microclimate is the term used to describe the local tissue temperature and moisture (relative humidity) at the body/support surface interface. One study conducted in older adults (n = 20) suggested that positioning may influence microclimate, due to the influence on skin temperature of alterations in superficial blood flow associated with changes in body positioning. Pressure alone may also lead to increases in skin temperature.2

Elevated temperature increases metabolic rate3 in tissue and promotes fibroblast growth and scarring.4,6 Thus, hospitalized individuals with elevated skin temperatures and perspiration are at possible increased risk of pressure ulcers.7 One study has demonstrated that elevating the sacral skin temperature is associated with statistically significant (p < 0.017) increase in hyperemia in response to applied pressure at the sacrum in both healthy volunteers and individuals with spinal cord injury (SCI). Conversely, the same study demonstrated that cooling the skin by approximately 10°C was associated with reduced hyperemia in response to pressure for individuals with and without SCI (indirect evidence). However, some individuals with SCI may have alterations in their ability to modulate temperature. Animal studies (using incremental tissue loading levels) have also showed a direct dose response to heat in formation of both deep and superficial ulceration.8,9

Elderly individuals have been shown to have reduced ability to dissipate excess heat via the vascular system, resulting in additional skin warming for a given stimulus.11 High levels of moisture on the skin surface (e.g., due to incontinence, drainage and/or perspiration) reduce skin tensile strength, and intracellular cohesion of the stratum corneum, and increase the skin coefficient of friction. These cellular changes result in skin maceration.12

In a cohort study set in Indonesia, Yusuf et al. (2013)13 took regular hourly skin temperature and moisture readings at the sacral region of hospitalized participants (n = 86 recruited, n = 71 completed the study) considered to be at risk of pressure ulcers (Braden score less than 19). Daily skin assessments were conducted to identify pressure ulcers and superficial skin changes, which occurred in 28% of participants. The physical environment had a high humidity and an average room temperature of 30°C, with the study conducted in the Indonesian dry season. Although there was no significant difference in sacral skin temperature between participants who did and did not develop pressure ulcers, the results bordered on significant (p = 0.07). In addition, participants who developed pressure ulcers had significantly lower overall Braden scores (odds ratio [OR] = 0.347, 95% confidence interval [CI] 0.206 to 0.585, p = 0.00), including significantly lower scores on the moisture subscale (p=0.00). The study was hampered by high room humidity that decreased the reliability of skin temperature measurement, and skin temperature was not measured overnight (Level 3 study).

Management of microclimate can provide an environment conducive to prevention and tissue repair.

1. **Consider the need for additional features such as ability to control moisture and temperature when selecting a support surface.** *(Strength of Evidence = C; Strength of Recommendation = B)*

This recommendation is based primarily on expert opinion. The use of specialized surfaces that come into contact with the skin may be able to alter the microclimate by changing the rate of evaporation of moisture and the rate at which heat dissipates from the skin.14 Specialized support surfaces that aid active management of microclimate by allowing air to flow through their surfaces,14 for example low air loss features or air fluidized beds, are available. The constant air flow helps to cool the skin and promote evaporation of moisture from the skin surface.14 Low air loss support surfaces are designed to assist with microclimate management, but in the absence of evidence outlining optimal levels of skin temperature and moisture levels, clinical judgment is required for effective and safe use of these devices.14
every three days, or earlier if soiled or dislodged\textsuperscript{17, 20, 21} and net stockings were used to protect prophylactic dressings applied to heels.\textsuperscript{19, 20}

**Fabrics and Textiles**

1. Consider using silk-like fabrics rather than cotton or cotton-blend fabrics to reduce shear and friction. (Strength of Evidence = B; Strength of Recommendation = ∆)

Four studies reviewed the effectiveness of utilizing lower friction coefficient textiles to reduce friction force and shear stresses.

The first study\textsuperscript{26} was a RCT that compared two groups. Cohort one participants wore regular hospital garments (n = 204) and cohort two were assigned low friction fabric undergarments or bootees (n = 165). The incidence of facility-acquired pressure ulcers was significantly lower in the second cohort (25% versus 41%, p = 0.02). There was a lower rate of wound deterioration for participants admitted with an existing pressure ulcer in the second cohort (6% versus 25%, p = 0.001).\textsuperscript{26} The study concluded that the use of low friction garments was associated with a reduced incidence of pressure ulcers amongst those assessed as being at high risk. In individuals who did acquire a pressure ulcer, the lower friction undergarments were associated with reduced deterioration of pressure ulcers.\textsuperscript{26} While these results suggested that the use of low friction coefficient material reduced pressure ulcers, the methodological flaws were numerous (Level 2 study).

A non-blinded, controlled trial by Coladonato et al. (2012)\textsuperscript{27} was conducted over eight weeks. During the control period all participants were positioned on cotton-blend linen. The control period was repeated after the intervention period. During the intervention period silk-like linen was used. The study identified that silk-like linen was associated with a lower incidence of pressure ulcers among individuals in a medical/surgical setting as compared to cotton-blend linen. In the medical unit, the average length of stay was shorter for the silk-like linen cohort (5.31 versus 5.97 days, p = 0.07) and the incidence of new pressure ulcers was lower (4.6% versus 12.3%, p = 0.01). The surgical ICU showed similar results with a decrease in pressure ulcer incidence (0% versus 7.5%, p = 0.01), though the average length of stay did not show a statistically significant difference (p = 0.33) (Level 3 study).

A cohort study conducted by Yusuf et al. (2013)\textsuperscript{13} included an analysis of the influence of sheet selection in development of pressure ulcers. In a multivariate analysis, type of sheeting was one of two significant factors (the other being Braden scale score). Participants (n = 86, 71 completed study) who received 100% cotton sheeting were more likely to develop a pressure ulcer than those who had a synthetic fiber sheeting (OR = 0.11, 95% CI 0.012 to 1.032, p = 0.00). However, the confidence interval spans the null value, suggesting caution in considering the results (Level 3 study).

A retrospective record analysis (n = 1,427) conducted by Smith et al. (2013)\textsuperscript{28} explored the association between pressure ulcer incidence and silk-like linen compared to a cotton-blend fabric. In this study the historical control participants experienced significantly more facility-acquired Category/Stage I pressure ulcers than the intervention group (5.6% versus 2.3%, p < 0.001). The silk-like sheets were also associated with a significantly lower rate of Category/Stage II pressure ulcers (5.95 versus 0.8%, p < 0.001). Participants in the intervention group discharged during the three month intervention period were significantly less likely to have a pressure ulcer at the time of discharge compared to the control group (13.45% versus 6.8%, p < 0.001). Retrospective analysis for the control group spanned the holiday period, and the potential influence of more casual nursing staff members on pressure ulcer incidence was not discussed (Level 4 study).

**Electrical Stimulation of the Muscles for Prevention of Pressure Ulcers**

There is emerging evidence that electrical stimulation (ES) induces intermittent tetanic muscle contractions and reduces the risk of pressure ulcer development in at risk body parts, especially in individuals with spinal cord injury (SCI). Electrical stimulation may decrease tissue atrophy by increasing muscle mass, improving blood flow and tissue oxygenation. The periodic muscle contractions redistribute the loading and stiffness of the deformed soft tissues. This method appears practical in daily life and is well tolerated.\textsuperscript{29, 30}

1. Consider the use of electrical stimulation for anatomical locations at risk of pressure ulcer development in spinal cord injury patients. (Strength of Evidence = C; Strength of Recommendation = ∆)

   This recommendation is based on indirect evidence and expert opinion. Two clinical experiments, one a moderate quality comparative study\textsuperscript{30} and one a low quality cross-over RCT,\textsuperscript{29} investigated the effect of ES induced activation