



Clinical Practice Guidelines

for the Prediction and Prevention of
Pressure Ulcers

**Australian Wound
Management
Association**



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(August 2001)

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Foreword

A great deal has been written about pressure ulcers in the literature over the last few decades. Despite a general consensus that pressure ulcers are preventable adverse events, they continue to remain a problem in all health care settings and extract a considerable fiscal and social cost.

In 1997, Young¹ estimated the cost of managing a *Stage 4* (*Stage 5 Torrance* classification) pressure ulcer at \$A61,230. Davenport² estimated the cost of treating a *Stage 2* pressure ulcer at an additional \$A586 per month. In the United Kingdom, the cost of treating a *Stage 4* ulcer is estimated as high as £40,000³.

In addition to the financial costs the social cost must also be considered in terms of pain, discomfort, decreased mobility, loss of independence and even social isolation. As health care professionals these are all factors that warrant our concern.

The aim of these guidelines is to present current research on the prediction and prevention of pressure ulcers in adults in an Australian context. These guidelines have been written by a national multidisciplinary team for all health care professionals across all health care settings. Recent systematic reviews from Australia, United States of America and the United Kingdom have been evaluated to provide a comprehensive approach to the prevention of pressure ulcers. Further details and updates of these guidelines will be available from the Australian Wound Management Association website, <www.awma.com.au>.

It is pertinent to acknowledge the serious gap in the evidential basis for pressure ulcer prevention. In most instances, there is limited research to support the recommendations listed. We hope that this review highlights the need for, and encourages, further research in all areas of pressure ulcer prevention and management.

This document is a general guide to appropriate practice, to be followed only subject to medical/health practitioner's judgement in each individual case.

The guidelines are designed to provide information to assist decision making and are based on the best information available at the date of publication.

1.0 Introduction

Clinical Practice Guidelines are designed to assist health care professionals and consumers in making appropriate clinical decisions. Guidelines are systematically developed statements about care for specific clinical conditions and are based on best available scientific evidence⁴. Guidelines are not intended to be prescriptive, but offer a framework within which to apply clinical judgement and consider individual patient needs.

The Clinical Practice Guidelines for the Prediction and Prevention of Pressure Ulcers have been developed by the Australian Wound Management Association (AWMA), Pressure Ulcer Interest Subcommittee (PUISC). This is a national body which is comprised of health care professionals from a range of disciplines and settings (see Appendix A: PUISC membership and terms of reference). The purpose of this subcommittee was to develop national clinical guidelines to identify adults 'at risk' of developing pressure ulcers and outline interventions for prevention. (The term 'adult' includes young adults (adolescents) from 14 years and over). The guidelines include a discussion on aetiology of pressure ulcer development and a selection of pressure ulcer risk assessment tools.

Further objectives of the subcommittee were: to collate national data on the incidence and prevalence of pressure ulcers in Australia; produce an inventory of pressure reducing and pressure relieving equipment; disseminate and update the guidelines.

The guidelines are not intended as a basis for care of infants and children. Nor do these guidelines describe wound management for pre-existing pressure ulcers. However, the broader principles of risk assessment and risk management are applicable to the management of individuals with pre-existing pressure ulcers. These principles include: identifying individuals 'at risk' and associated risk factors; implementing strategies aimed at eliminating risk factors and protecting the individual from potential further risk, as well as continually evaluating the effectiveness of the care delivered.

The guidelines offer recommendations to help health care professionals provide quality care across a range of health care settings, such as acute care, post acute care, extended care facilities, nursing homes and home settings. The recommendations have been developed by a multidisciplinary team and are intended for all clinicians and carers who examine and treat persons at risk of developing pressure ulcers. This includes: the family; doctors; nurses; dietitians; physiotherapists and occupational therapists. The recommendations are generic. Discipline specific responsibilities must be decided according to professional qualifications and institutional policy.

2.0 Methodology

Committee members were nominated by AWMA State Representatives and ratified by the national body. States nominated representatives who were considered experts in pressure ulcer prevention or management. The committee consisted of professionals from: medicine, nursing and allied health. A wide range of health care settings were represented. These include: medical and surgical acute care; rehabilitation; aged care; community care; education; wound management; stomal therapy; infection control, pharmacy and quality management.

Much work has been done in relation to guidelines for pressure ulcer prevention and management. In the United States of America (USA) the Agency for Health Care Policy and Research has published guidelines for the prediction, prevention and treatment of pressure ulcers^{5, 6}. The aim of the PUISC was not to reproduce other work, but to research recent (since 1992), and particularly Australian, scientific evidence to add to this current body of knowledge.

Research was retrieved from published and presented papers using the following methods:

- MEDLINE, CINAHL searches;
- Hand searches of journals not referenced in computer data;
- Reference lists from review articles;
- Personal files from committee members, and
- Recommendations from peers.

Committee representatives were allocated responsibility for reviewing designated sections of the pressure ulcer research. The following areas were covered: prevalence and incidence of pressure ulcers; staging; aetiology and risk factors; risk assessment tools; strategies for skin care and early treatment; interventions for reducing mechanical loading and support surfaces, and implementation of a risk management program.

The level of evidence to support pressure ulcer risk factors and the recommendations for prevention strategies were evaluated according to the quality and quantity of available scientific data using the designation of levels of evidence as recommended by the National Health and Medical Research Council (Table 1, page 3). However, there are many methodological barriers in pressure ulcer studies which reduce the ability to generalise or draw conclusions. These limitations or barriers include: inconsistencies in the definition of a pressure ulcer, and pressure ulcer staging; the exclusion of *Stage 1* pressure ulcers; the

variety and methods of data collection, ranging from direct observation to retrospective retrieval of data; biased or small sample sizes; difficulties in comparing diverse clinical situations; and the use of animal models in physiological and bioengineering experiments. The levels of evidence for the risk factors for pressure ulcers are relatively low because of the difficulty of performing randomised controlled trials in this area. Most studies are cohort studies, single arm studies or case series.

In the absence of adequate research to support risk factor identification or recommendations for prevention, expert opinion or professional judgement was sought from review articles, published guidelines and from PUIISC members and peer review. On these occasions the committee developed consensus-based statements that indicate the lack of clear evidence but which acknowledge consensus. These are referred to in the guidelines as consensus statements.

The guidelines were circulated to over seventy health care associations throughout Australia for peer review prior to publication. These associations include nursing, medical and allied health professional organisations, consumer organisations, health departments, clinical and home care facilities as well as educational institutions and special interest groups that have a particular focus on pressure ulcer prevention. Over thirty associations responded with great enthusiasm and support for the guidelines. Many of their suggested amendments have been incorporated into the guidelines. The AWMA would like to sincerely thank those organisations that contributed time and effort in providing this valuable feedback.

Table 1. Strength of supporting evidence.

I	Evidence obtained from a systematic review of all relevant randomised controlled trials.
II	Evidence obtained from at least one properly designed randomised controlled trial.
III-1	Evidence obtained from well-designed pseudo-randomised controlled trials (alternate allocation or some other method).
III-2	Evidence obtained from comparative studies with concurrent controls and allocation not randomised (cohort studies), case controlled studies, or interrupted time series with a control group.
III-3	Evidence obtained from comparative studies with historical control, two or more single-arm studies, or interrupted time series without a parallel control group.
IV	Evidence obtained from case series, either post-test or pre-test and post-test.

3.0 Incidence and prevalence of pressure ulcers

There are many terms used to describe pressure ulcers: pressure sores, decubitus ulcers, bed sores, pressure necrosis or ischaemic ulcers. Essentially they all describe *any lesion caused by unrelieved pressure resulting in damage of underlying tissue*⁵.

Pressure ulcers have been recognised for hundreds of years; their presence has even been documented in Egyptian mummified bodies⁷. Since the late 1960s, pressure ulcers have had a high profile in health professional journals. Despite the plethora of research and acquired knowledge, the occurrence of pressure ulcers remains a problem in today's health care setting.

The reported incidence and prevalence (see Table 2) of pressure ulcers varies widely according to population, clinical setting and methodology. The American National Pressure Ulcer Advisory Panel⁹ highlighted the following methodological barriers which limit interpretation and comparison of incidence and prevalence studies:

- Difficulty comparing various populations – data collected in tertiary care hospitals are not likely to reflect community hospital populations;
- Data sources – ranging from direct observation of individuals by trained research personnel to retrieval of data from individual records;
- Study methods – confuse incidence and prevalence and may include or exclude *Stage 1* ulcers and segments of the institutional populations (paediatrics, psychiatry, midwifery).

In Australia there are few reported studies in the literature. The majority of these studies are limited to the acute care hospital setting and report pressure ulcer prevalence ranging from 5.4 to 15.6 per cent¹⁰⁻¹⁴. Pressure ulcer prevalence in hospitals in the United Kingdom (UK) have been reported from 5.3 per cent¹⁵ to as high as 22.8 per cent¹⁶.

In the USA a recently published national survey reported a pressure ulcer prevalence 10.1 per cent across 265 acute care hospitals (39,874 inpatients)¹⁷. The pressure ulcer prevalence of each hospital ranged from 1.4 per cent to 36.4 per cent. However, the aggregate prevalence was consistent with previous surveys: 11.7 per cent in 1993¹⁸ and 9.2 per cent in 1989¹⁹.

Pressure ulcer prevalence higher than those cited above have been reported in subpopulations of individuals: 60 per cent in hospitalised quadriplegics²⁰; 66 per cent in elderly individuals

Table 2. Incidence and prevalence⁸.

Incidence	– the number of new cases of a disease or event in a population during a specific period of time.
Prevalence	– the number of existing cases of a particular disease or condition in a given population at a designated time.

admitted with a fractured femur²¹, and 41 per cent in critical care units²². In an Australian critical care setting* an incidence rate of 5.4 per cent was reported from data collected over a 40 week period in a 14 bed intensive care unit.

In an USA national study of intraoperative pressure ulcers, Arnovitch²³, reported a prevalence of 8.5 per cent across 104 clinical facilities (1128 inpatients). Forty percent of those who developed pressure ulcers underwent surgery lasting more than three hours and 33 per cent underwent surgery lasting more than five hours.

In nursing home-type facilities, one study reported a pressure ulcer prevalence of 3.4 per cent from 117 residents²⁴. An Australian survey of 30 nursing homes reported an overall pressure ulcer prevalence of less than 5 per cent**. In a review of the literature from 1980 to 1994 on pressure ulcer prevalence in nursing homes, Smith²⁵ reported that 17 to 35 per cent of patients have pressure ulcers at the time of admission to a nursing home. Smith²⁵ also reported a pressure ulcer prevalence that ranged from 7 to 23 per cent from five published surveys. Brandeis *et al.*²⁶ conducted a national survey of 78 National HealthCorp nursing homes across the USA and reported a 21 month incidence rate that varied from 6.5 to 19.3 per cent from a population of 4,232 residents. The highly variable nature of casemix within nursing home facilities as well as staffing skill and numbers make any comparison or generalisation of these data difficult⁵.

Published Australian data on the prevalence of pressure ulcers among persons who are cared for in the home setting with supervision or assistance from professionals are not available. In the USA, Ramundo²⁷ reported an incident rate of 17 per cent in the home care setting. In a large scale survey of 1,711 non-hospice community-based adults receiving home health care Bergquist and Frantz²⁸, reported a 14 month incidence rate of 3.2 per cent. This incidence rate reflects only *Stage 2 to Stage 4* ulcers and the sample was limited to patients 60 years and above. The magnitude of the problem in home care settings will become increasingly important as health care continues to move from the acute care setting into the community.

The great variation in reported incidence or prevalence of pressure ulcers reflects inconsistencies in data acquisition and how pressure ulcers are defined and classified. Nevertheless, the occurrence of pressure ulcers remains clinically significant and warrants concern. Reliable data on the incidence and prevalence of pressure ulcers by stage, type of health care facility, diagnosis and risk factors will permit better planning for allocation of resources to at risk populations⁵.

* Tobias T, Breakwell C. Predictors of Pressure Sore Development in an Intensive Care Unit. 20th Australian and New Zealand Scientific Meeting on Intensive Care. Brisbane: CACCN & ANZICS, 1995.

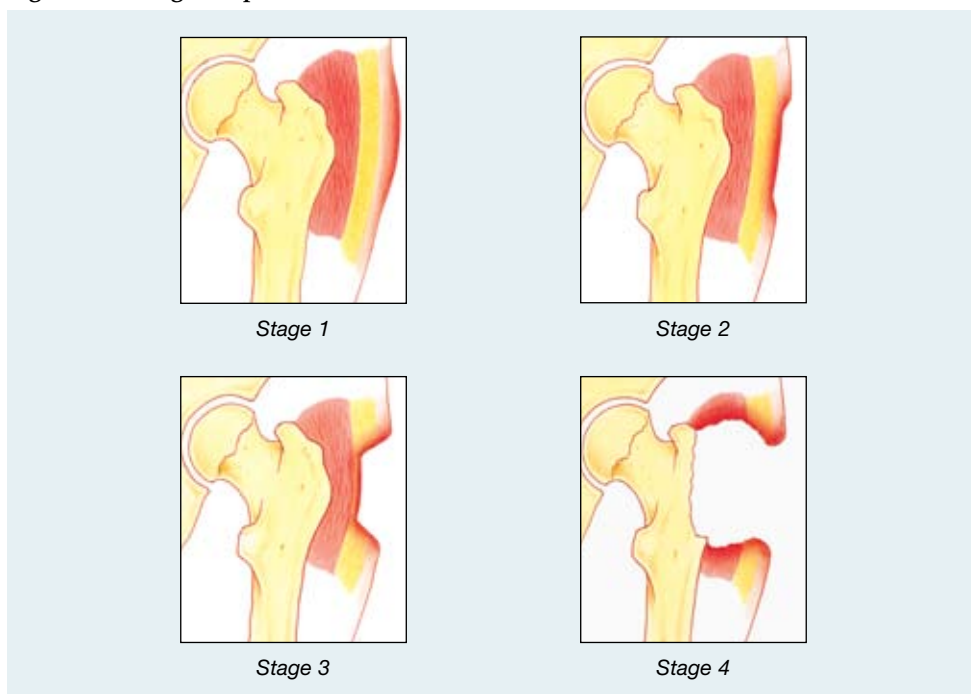
** Rice J Where are the pressure ulcers? (Poster Presentation). Breaking Down the Barriers, Australian Wound Management Association, Sydney: AWMA, 1996.

4.0 Staging of pressure ulcers

Pressure ulcers are classified by the depth of tissue damage. The staging of pressure ulcers recommended for use by this subcommittee is consistent with the recommendations of the National Pressure Ulcer Advisory Panel (NPUAP)⁹. These recommendations were derived from previous staging systems proposed by Shea²⁹ and the International Association for Enterostomal Therapy (IAET)³⁰. *Stage 1* has recently been updated by the NPUAP to include criteria for individuals with darkly pigmented skin³¹

The staging is as follows:

Figure 1. Stages of pressure ulcers.



Stage 1: Observable pressure-related alteration(s) of intact skin whose indicators as compared to the adjacent or opposite area on the body may include changes in one or more of the following: skin temperature (warmth or coolness), tissue consistency (firm or boggy feel) and/or sensation (pain, itching).

The ulcer appears as a defined area of persistent redness in lightly pigmented skin, whereas in darker skin tones, the ulcer may appear with persistent red, blue or purple hues.

- Stage 2:* Partial thickness skin loss involving epidermis and/or dermis. The ulcer is superficial and presents clinically as an abrasion, blister, or shallow crater.
- Stage 3:* Full thickness skin loss involving damage or necrosis of subcutaneous tissue that may extend down to, but not through, underlying fascia. The ulcer presents clinically as a deep crater with or without undermining of adjacent tissue.
- Stage 4:* Full thickness skin loss with extensive destruction, tissue necrosis or damage to muscle, bone, or supporting structures (for example, tendon or joint capsule). Undermining and sinus tracts may also be associated with *Stage 4* pressure ulcers.

There are limitations to any staging system and the following points should be noted:

1. Reactive hyperaemia may easily be confused with a *Stage 1* pressure ulcer. Reactive hyperaemia is a normal compensatory mechanism following an episode of reduced perfusion from localised pressure. Relief of this pressure results in a large and sudden increase in blood flow to the affected tissue⁵. When a *Stage 1* pressure ulcer is detected during prevalence or incidence survey the individual should be repositioned and re-evaluated after 30 minutes.
2. Identification of *Stage 1* pressure ulcers may be difficult in individuals with darkly pigmented skin.
3. When necrotic tissue (eschar or slough) is present the true extent of tissue damage is masked. Accurate staging of the pressure ulcer is not possible until the necrotic tissue has sloughed or the wound has been debrided. Pressure ulcer staging systems should be used to document the deepest anatomy involved in the ulcer after necrotic tissue has been removed.
4. Staging of healing pressure ulcers (reverse staging) remains controversial (as the healing of a *Stage 4* pressure ulcer is not equivalent to a *Stage 2* pressure ulcer) but a system may need to be developed for use in management protocols³².
5. The NPUAP recommend that the progress of a healing pressure ulcer be documented by objective parameters such as: size, depth, amount of necrotic tissue, amount of exudate, and presence of granulation and epithelial tissue³².
6. The staging system depends on visual observation of tissue involvement only. Health care professionals involved in individual care should also note the following factors: location; dimensions or surface area of the wound; nature/description of the wound bed, wound edges and surrounding skin; the amount of exudate; severity of pain; and other factors which may impede wound healing³³.

5.0 Aetiology of pressure ulcers

Pressure ulcers occur when soft tissue is compressed between a bony prominence and an external surface for a prolonged period of time⁹. Pressure ulcers may involve any of the following tissue: epidermis, dermis, subcutaneous fat, muscle and bone^{34, 35}.

Pressure can be defined as a perpendicular load or force exerted on a unit of area³⁶. When prolonged pressure is applied to a localised area of tissue (point pressure), the result can be occlusion of blood flow causing tissue ischaemia and reperfusion injury. Both ischaemia and reperfusion injury ultimately contribute to cell destruction and tissue death³⁷. Pressure can also force fluid out of the interstitial space, causing cell to cell contact. This results in membrane rupture and the release of toxic intracellular material. The removal of toxic substances is hampered by the destruction of local lymphatic vessels, contributing to tissue necrosis³⁸.

The critical determinants of pressure ulcer development are:

1. The intensity and duration of pressure, and
2. The tolerance of the skin and its supporting structures for pressure³⁹.

Capillaries have little resistance to direct external pressure. A threshold of 32 mmHg is widely quoted⁴⁰⁻⁴³ as the point at which intracapillary pressure is overcome, resulting in capillary collapse. An absolute value for capillary closing pressure has been disputed. Factors such as collagen content of the dermis and autoregulation mechanisms of microcirculation have been hypothesised as factors which influence the threshold for capillary collapse^{34, 36, 44}.

Collagen plays an important role in preventing disruption to the microcirculation. In response to pressure, collagen maintains the hydrostatic and oncotic pressures, buffering the interstitial fluid from the external force and preventing cellular destruction⁴⁵. However, the collagen content of the dermis alters with disease, age, spinal cord injury and the use of steroids, affecting the capacity of the dermis to buffer external pressure^{38, 46, 47}.

External pressures below capillary closing pressure may also cause damage to the deep tissues closer to bony prominences where pressures have been demonstrated to be three to five times greater than at the skin surface⁴⁸. Damage to deeper structures may be more extensive than damage to underlying skin. In addition, while lower pressures may not close capillaries they may reduce blood flow by obstructing the venous capillaries which have a pressure of 6 – 12 mmHg. This may also contribute to tissue ischaemia and necrosis.

In response to pressure, local autoregulation of the microcirculation preserves tissue blood flow in healthy subjects^{36,49}. This compensatory response fails when the external pressure exceeds the diastolic pressure⁴⁴; capillary closing pressure may be as high as 60 mmHg or more. In the elderly, severely ill³⁶, and following spinal cord injury⁵⁰ where the autoregulatory mechanism is not apparent, external pressures of less than 20 mmHg have been reported to cause capillary collapse³⁶.

The manner in which pressure is applied is another important factor which must also be considered. Pressure applied in a uniform manner has little, if any, long term impact on tissue. Deep sea divers, for example, can tolerate high levels of pressure without any detrimental effects, as pressure is applied evenly³⁴. Tissue damage occurs with point or local pressure to the skin.

Studies which have explored the relationship between intensity and duration of pressure generally conclude that imposed external pressure of low intensity and long duration is as capable of producing tissue injury as high pressure of shorter duration^{41,51}. Others^{40,52} concluded that low pressure maintained for long periods appeared to induce more tissue damage than high pressure for short periods. However, variations in technique, reporting and the fact that these were animal studies made drawing conclusions difficult.

The intensity and duration of pressure has great individual variability and is interrelated with many other factors that influence the individual's capacity to tolerate pressure. Such factors include: age, diet, physiological and psychological stressors, poor oxygen saturation, and exposure to shear and friction or moisture.

6.0 Risk factors

Any factor which exposes the skin to excessive pressure, or diminishes its tolerance to pressure, is considered a 'risk factor'. Many risk factors are mentioned in the literature but few have been rigorously evaluated. The most thorough evaluation would be that a proposed factor is repeatedly demonstrated as an independent risk factor in prospective, longitudinal studies. Subsequent evaluation would then demonstrate that elimination or modification of that risk factor reduces the incidence of pressure ulcer development.

Using the framework described by Braden and Bergstrom (Figure 2, page 11)³⁹ an attempt has been made to evaluate the strength of evidence supporting or discounting each risk factor (refer Table 1, page 3). The level of evidence has been highlighted against specific risk factors in this section of the guidelines. In subsequent sections the same classification system for level of evidence is used to support the recommendations made by the AWMA Inc. and

is highlighted with each recommendation listed at the end of each section. Risk factors not shown in this model, for which evidence exists, have also been included, for example, dry skin. Evidence has been gathered largely from primary sources, however, several reviews have also been cited^{5, 34, 39}.

6.1 Intensity and duration of pressure

Risk factors which contribute to prolonged and intense pressure can be classified as factors which impede mobility, activity and sensory perception. Both immobility and diminished activity are considered primary risk factors in the development of pressure ulcers⁵.

Impaired mobility refers to the degree to which the individual is unable to independently change body position. There are numerous reasons an individual will suffer loss of mobility, ranging from a diminished conscious state induced by trauma, disease or anaesthetics, to hemiplegia, para/quadruplegia, trauma to the lower limbs (especially fractured hips), obesity, pain or burns. Diminished activity describes individuals who are able to control their body position but cannot avoid intense or prolonged periods of pressure, for example, individuals who are bed ridden, wheelchair bound or chairfast⁵³.

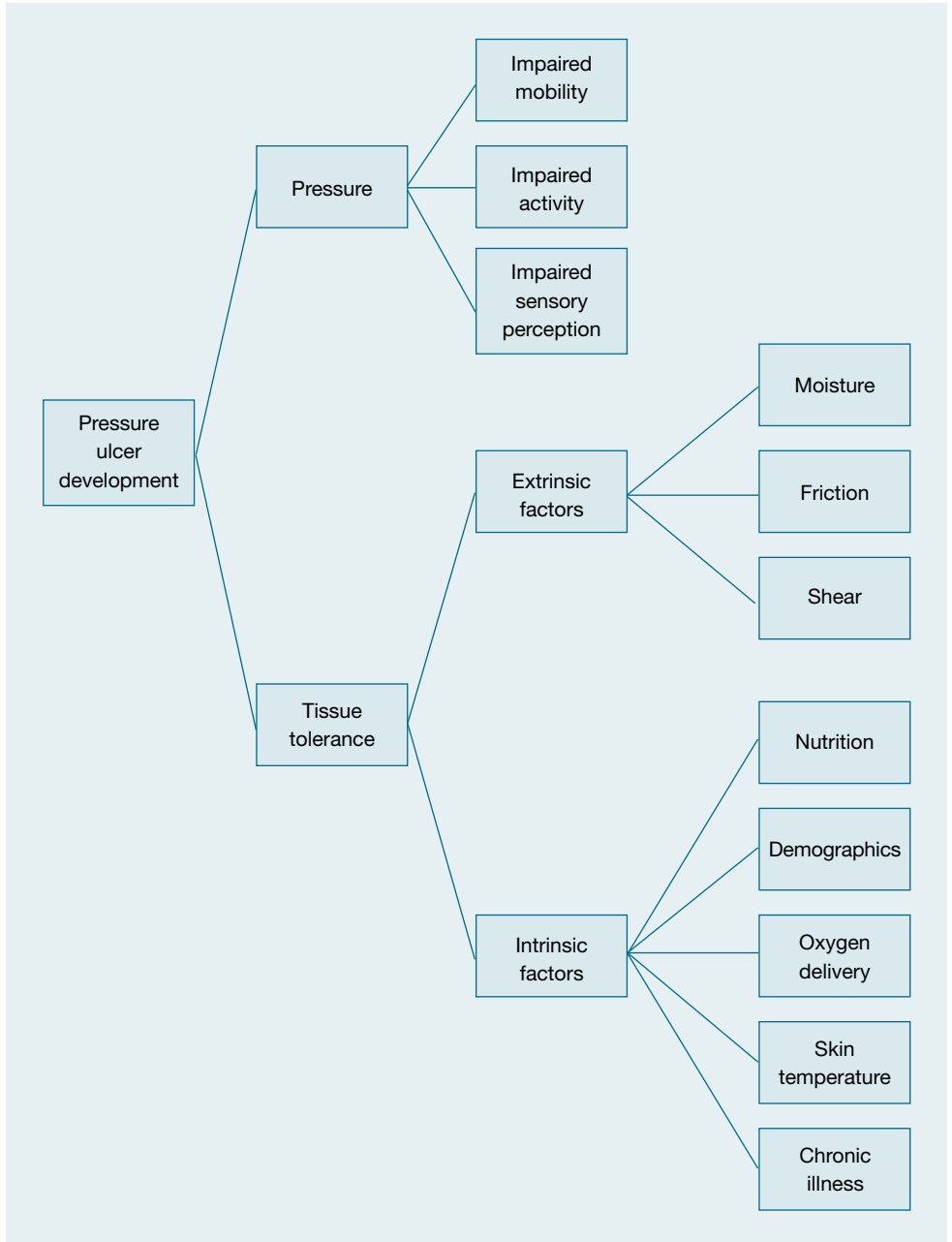
Immobility and diminished activity were the most commonly identified risk factors in both prospective and retrospective studies^{11, 13, 26, 54-59}. Pase⁵⁹ demonstrated that the more mobile or active the individual, the lower the incidence of pressure ulcers (*level of evidence III-2*).

Impaired sensation or a reduced ability to respond to discomfort or pain predisposes the individual to prolonged and intense pressure³⁹. Risk factors related to this include spinal injury, an impaired cognitive state, or an altered level of consciousness.

Studies on sensory loss were largely associated with spinal injury. Total loss of sensory and motor function, and complete paralysis with some sensation below the level of the lesion, have been demonstrated as significant risk factors for pressure ulceration^{60, 61} (*level of evidence III-2*). Impaired cognitive state or an altered level of consciousness, have also been identified as risk factors^{55, 57, 62} (*level of evidence III-2*).

Surgery may also be classified as a risk factor under this category. The individual is immobilised for prolonged periods, as well as being anaesthetised and unable to respond to the stimulus of prolonged, intense, localised pressure. Intraoperative time exceeding three hours is a predisposing factor for pressure ulceration^{23, 63-65}. Other studies support this when induction time (total anaesthetic time) is taken into consideration, along with other factors such as age and use of an extracorporeal circuit^{66, 67} (*level of evidence III-2*).

Figure 2. Pressure ulcer development model based on Braden and Bergstrom's conceptual schema for the study of the aetiology of pressure ulcers³⁹.



6.2 Tissue tolerance for pressure

Tissue tolerance is the ability of both the skin and its supporting structures to endure the effects of pressure without adverse sequelae. In other words, tolerance is how well the tissue acts as a cushioning factor, transferring pressure loads from the skin surface to the skeleton below^{38,39}. Tissue tolerance is affected by both extrinsic and intrinsic factors (see Figure 2). *It is important to note that these factors in the absence of pressure will not cause pressure ulceration.*

6.2.1 Extrinsic factors

Extrinsic factors influence tissue tolerance by impinging on the skin surface and reflect the degree to which the skin is exposed to shear, friction and moisture³⁹.

Shear is created by a parallel load forcing the skeleton to slide against resistance which develops between the skin and its contact surface. The epidermis and dermis remain relatively anchored to the contact surface while the deep fascia moves with the skeleton. The blood vessels between the dermis and deep fascia may be distorted, resulting in thrombosis and capillary occlusion⁶⁸⁻⁷².

When relatively high levels of shear are present, the amount of pressure required to produce vascular occlusion is only about half the amount when shear is not present^{36, 73, 74}. In the formation of pressure ulcers the primary force in generating mechanical occlusion is pressure, but shear also plays a significant contributory role (**consensus statement**).

Friction is the force related to two surfaces moving across one another⁷⁵. Friction works in conjunction with gravity to cause shear by creating that resistance between the skin and the contact surface. Friction is not a primary factor in pressure ulcer development but has been demonstrated to increase the skin's susceptibility to pressure^{72,76} and may cause the initial break in the skin (**consensus statement**).

Moisture is thought to alter the resilience of the epidermis to external forces. Exposure to moisture for prolonged periods of time causes maceration of the epidermis, making it more friable and susceptible to injury. Moisture may be in the form of urine, faeces, perspiration, and drainage from fistulae or wounds³⁹.

Although urinary and faecal incontinence are widely cited as risk factors for pressure ulcer formation, there is conflicting evidence in the literature. Urinary incontinence has been cited as a significant risk factor in some studies^{60, 77-82} (**level of evidence III-2**).

Other studies suggest that faecal incontinence is more important than urinary incontinence in pressure ulcer formation^{26, 57, 83-85}. In addition to maceration, faecal incontinence exposes the skin to bacteria and toxins which act as major irritants⁸⁶ (**level of evidence III-2**).

It is important to also note that, urinary and faecal incontinence have also been cited as non-significant risk factors in studies^{55, 59, 87}.

6.2.2 *Intrinsic factors*

Intrinsic factors are those that influence the skin's supporting structures and/or the vascular and lymphatic system (see Figure 2)³⁹.

Individual characteristics of age (>65years)^{54, 66, 67, 88} (*level of evidence III-2*), male gender^{26, 88}, and Caucasians⁸⁸ have been implicated as predisposing factors for pressure ulceration (*level of evidence III-2*).

Chronic illnesses which have been identified as risk factors are: diabetes^{26, 57, 67} and metastatic carcinoma⁵⁷ (*level of evidence III-2*). Other chronic illnesses which have been identified as predisposing factors with little evidence are: lymphoedema⁵⁴, and renal failure or renal impairment⁸⁹.

Numerous studies have indicated that poor nutrition plays a significant role in the development of pressure ulcers. Identification of critical nutrients that directly contribute to pressure ulceration however has not yet been achieved⁹⁰⁻⁹². Risk factors such as malnutrition^{54, 57, 90, 93, 94}, inadequate protein/ hypoalbuminaemia or poor energy intake^{55, 94, 95}, and recent weight loss⁹⁴ have been identified in prospective and retrospective studies as independent risk factors (*level of evidence III-2*).

Other factors such as vitamin C deficiency^{52, 96, 97} (*level of evidence III-2*) and inability to feed oneself²⁶ have been identified in some studies as possible risk factors. Mineral deficiencies of zinc and other trace elements have been implicated as contributors to tissue breakdown⁹⁸. However, the above deficiencies are also observed in hospitalised elderly individuals who are free of pressure ulcers⁹⁶.

Factors which impair the delivery of oxygen to the tissues have been implicated in predisposing to pressure ulceration. Such factors are: anaemia^{55, 58, 90-92, 99-101}; low systolic or diastolic blood pressures^{38, 43, 102-106}; circulatory abnormalities^{57, 104, 106}; tobacco smoking^{99, 107, 108}, and autonomic dysfunction from spinal cord injury resulting in lower than normal transcutaneous oxygen tensions⁵⁰ (*level of evidence III-2*).

Skin temperature elevation was associated with pressure ulcer development in several studies^{83, 109-111}. The association has not been fully explained however, it may be related to an increasing oxygen demand in tissue already deprived of oxygen. With each degree

centigrade rise in temperature, there is an increase in tissue metabolism and oxygen demand by 10 per cent¹¹² (*consensus statement*).

Dry skin has been identified as a sign associated with pressure ulceration^{13, 54} (*level of evidence III-2*). However, excessive skin washing has not been identified as a risk factor in any studies, despite it being a theoretical risk factor.

Many of the above risk factors are not independent of each other – for instance, nutritional status may be referred to as malnutrition, inadequate protein/energy intake, hypoalbuminaemia, (recent) weight loss or unable to feed one's self. Malnutrition may also be associated with old age, and/or chronic illness. Old age is associated with increased risk of hospitalisation, chronic illness, poor peripheral perfusion and loss of peripheral sensation. The above risk factors have a sound theoretical basis but little prospective randomised controlled interventional evaluation has occurred. The multifactorial nature of pressure ulcers limits researchers ability to independently evaluate individual risk factors and controlled trials are often limited to animal models that diminish the relevance of results.

7.0 Risk assessment tools

The purpose of a risk assessment tool is to identify individuals 'at risk' of developing pressure ulcers. A systematic assessment for pressure ulcer risk factors should be incorporated into the assessment of all individuals in any health care setting. The presence of any condition that reduces mobility or diminishes activity to the point where the individual is unable to independently move or change positions to relieve pressure, should automatically place the individual in the 'at risk' category 5,^{55, 57-59}. Additional risk factors contributing to pressure ulcer formation should be considered as they may place the individual at higher risk.

The aim of any risk management strategy is to shift the focus from crisis intervention and blame, to preventative management. In the prevention of pressure ulcers, health care professionals may use professional judgement, a risk assessment tool or a combination of both¹¹³. There are numerous risk assessment tools for pressure ulcers used in the UK and the USA, but their use appears to be sporadic and limited in Australia.

Risk assessment tools are based on risk factors known to predispose an individual to pressure ulcers (see Risk factors chapter 6). Most risk assessment tools utilise a numerical scoring system to weight the severity of risk into the categories of: no risk, low, medium, or high risk. These tools assist health care professionals to gather information systematically

and identify individuals 'at risk'. Risk assessment tools are not designed to replace clinical judgement but rather to assist in decision making in order to channel resources appropriately¹¹⁴.

Selection of a pressure ulcer risk assessment tool is often a matter of personal preference^{115, 116}. Any tool should be 'user-friendly' and have clearly defined, commonly understood assessment categories, which have a proven relationship to the development of pressure ulcers¹¹⁶. A good risk assessment tool should also meet basic requirements of validity and reliability (see Tables 3 and 4)¹¹⁷. The tool must identify those persons it claims to identify (validity) and must identify the same person regardless of who uses the tool (reliability)¹¹⁸.

Few pressure ulcer risk assessment tools described in the literature have been rigorously tested for reliability, sensitivity, specificity or predictive value¹¹⁹. The most frequently scrutinised tools are the Norton Risk Assessment Score, The Waterlow Pressure Sore Prevention/Treatment Policy and the Braden Scale.

The Norton Risk Assessment Score (see Table 5, page 16) is a widely used risk assessment tool in Australia. Although simple, it has been criticised for under-prediction and has only been validated using elderly patients in hospital settings^{5, 116}. The Waterlow Pressure Sore Prevention/Treatment Policy (see Table 6) is a comprehensive tool which is widely distributed as a laminated pocket sized card, for quick reference. However, it is criticised for its complexity and overprediction^{117, 120}. The Braden Scale for prediction of pressure sore risk (see Table 7, page 18) is widely used in the USA. It has proven reliable when used by a

Table 3. Measures of validity¹¹⁷.

Sensitivity – the accuracy in predicting those who develop a pressure ulcer.

Specificity – the accuracy in predicting those who do not develop a pressure ulcer.

The predictive value of positive tests – percentage of those 'at risk' of pressure ulcer development who actually develop a pressure ulcer.

The predictive value of negative tests – the percentage of those not 'at risk' of developing a pressure ulcer who do not develop a pressure ulcer.

Table 4. Measures of reliability^{117, 118}.

Percentage agreement – the percentage of occasions in which different people using the same instrument obtain the same results.

Correlation – can be used to quantify the magnitude and direction of a relation. Scores range from -1.00 to +1.00. The closer to -1.00 or +1.00 the better the reliability of the tool.

Table 5. Norton Risk Assessment Score.

Norton was the first to develop a risk assessment tool (see Appendix B). The Norton Score was based on the care of geriatric patients. It is simple in evaluation, hence its popularity^{117, 123}. Many argue it is too simplistic and not valid outside the geriatric area and is especially not valid for young people^{117, 124-126}.

The Norton Score is based on five distinct areas: physical condition, level of consciousness, activity, mobility, and incontinence. Optimal conditions score 4, poor conditions score 1, therefore a patient least at risk scores 20 and a patient most 'at risk' scores 5. Norton originally classed a patient 'at risk' at a total score of 14 or less. She reviewed this later following heavy criticism of over and under prediction of patients, and increased the threshold to 16¹²⁷.

Initial testing of the tool found a linear relationship between the initial score on admission to hospital and the incidence of pressure ulcers (defined as a break in the skin surface). However, retrospective validity measures indicate poor validity with a sensitivity of 63 per cent, specificity of 70 per cent, a predictive value positive test of 39 per cent and a predictive value negative test of 86 per cent. No conclusions on reliability could be drawn as all data was collected by a single observer¹¹⁷.

Subsequent studies which have tried to validate the use of the Norton Score^{125, 128-130} have demonstrated under-prediction ranging from 7-100 per cent or over-prediction ranging from 47-100 per cent. Few studies have explored the reliability of the tool¹¹⁷. Major criticisms have been the lack of operational definitions which created difficulty interpreting the rating between subscales such as 'fair' and 'poor' or 'limited' and 'slightly limited'¹²⁸. Modifications of the Norton Score have subsequently included operational definitions¹³¹.

There have been many adaptations of the Norton Score: for example by Gosnell, Goldstone, Warner, and Hall¹¹⁸. Modifications to the Norton Score have included the addition of nutritional status, the removal of physical condition, and inversion of scores. Despite the criticism and the modified variations, the Norton Risk Assessment Score is still one of the most widely used assessment tools^{117, 118}.

registered nurse and validity appears to compare favourably with the Norton and Waterlow tools^{117, 118, 121, 122}.

It is difficult to recommend any one risk assessment tool over the other as there is great variability in reported validity and reliability¹¹⁹. This probably reflects differences in study settings, populations and outcome measures (prevalence or incidence rates). Not all studies include *Stage I* ulcers as an outcome and there are inconsistent definitions of these lesions. The degree to which preventative interventions have been implemented in response to the findings of the risk assessments may have also contributed to the variability in their reported performance. There is no firm evidence to recommend adoption of any assessment tool or the assessment of any single risk factor, or combination of risk factors as better predictors of risk^{5, 119}.

To demonstrate value, a pressure ulcer risk assessment tool should be linked to intervention. However, there are few studies which demonstrate that use of a risk assessment tool promoted early intervention of patients considered at 'high risk'. Salvadalena *et al.*¹³⁴ found that intervention measures were used only 27 per cent of the time after the identification of individuals 'at risk'. Abruzzese¹³⁸ also found that nurses using an assessment scale did not specify any more nursing intervention for preventing pressure ulcers than nurses who did not use a scale.

Risk assessment is not only part of the admission process, but part of the ongoing preventative management of each individual. A pressure ulcer risk assessment should be performed:

- on admission to the health care facility or home care service;
- regularly throughout the length of stay;
- following a change in the individuals condition which places that person 'at risk', for example a sudden deterioration in condition; or
- prior to, during and following prolonged procedures which involve reduced mobility and hardened surfaces^{5, 139}.

Individuals identified 'at risk' of developing pressure ulcers should have a comprehensive management plan instituted in order to protect the individual against forces of pressure, shear and friction and to reduce the risk of pressure ulcers¹⁴⁰⁻¹⁴⁶.

Table 6. Waterlow Pressure Sore Prevention/Treatment Policy.

The Waterlow Pressure Sore Prevention/Treatment Policy was designed as a comprehensive tool which not only outlines a risk assessment scale but also includes preventative aids and treatments (see Appendix C for risk assessment scale only). The risk assessment scale is based on the following variables: weight and build, continence, skin type, mobility, gender and age, and appetite. There is also a special section which incorporates: tissue malnutrition; neurological deficits; surgery/trauma and special medication. These categories enable the carer to make a detailed assessment of the patient and award several scores in each category to reflect the patient's risk status accurately. With a score >10 the patient is considered at risk; >15 at high risk and >20 at very high risk. The minimum possible score is 1 and the maximum score is 64¹²⁶.

In her initial study Waterlow did not publish data on validity or reliability¹³². Independent assessment of the Waterlow tool demonstrated sensitivity of 98-100 per cent^{120, 133} but specificity was as low as 14 per cent for both studies indicating gross over-prediction. Reliability measures are difficult to interpret. Waterlow performed the majority of assessments herself suggesting an element of bias¹¹⁷. In another study student nurses were used to compare reliability between Norton and Waterlow scores with Norton achieving percentage agreement of 70 per cent reliability and Waterlow achieving 60 per cent¹³³. The Waterlow tool is also criticised for its lack of operational definitions and the large number of items on the tool which increase the potential for poor reliability¹¹⁷.

Table 7. Braden Scale for Predicting Pressure Sore Risk.

The Braden Scale was developed in the USA in 1986 and is based on the Braden and Bergstrom Conceptual Schema for the Study of the Etiology of Pressure Sores³⁹. The Braden Scale is composed of six subscales (see Appendix D): mobility, activity, sensory perception, skin moisture, nutritional status, and friction. Each subscale has its own operational definitions and they rate from 1, (least favourable) to 3 or 4, (most favourable). The scores range from 6 to 23 and the cut off point at which a patient is considered 'at risk' is 16 points or less.

In testing the tool initial studies concentrated on reliability. Percentage agreement of up to 88 per cent was achieved⁵³ and correlational measures of reliability were excellent when used by a registered nurse ($r = 0.99$). However, reliability proved to be less favourable when the tool was used by less qualified staff. Conclusions drawn indicated that literacy and staff knowledge of the patient influenced the reliability of the tool. Bergstrom and Braden recommended that the tool should be used by registered nurses⁵³.

In testing validity, initial studies demonstrated a sensitivity at 100 per cent and specificity at 68-90 per cent⁵³. Subsequent studies did not reproduce such high results and in an acute medical unit the Braden Scale was less sensitive than the established method of nurse judgement of pressure ulcer risk¹³⁴. Bergstrom *et al.*¹³⁵ recommend that each clinical setting conduct their own study to determine the sensitivity and specificity to establish appropriate cut off points for each institution's population.

Recent studies which adjusted the threshold cut off point have obtained improved validity ratings in acute care settings. Vanden Bosch *et al.*¹³⁶ compared nurses perception against the Braden Scale with the cut off point for 'at risk' raised to 17 and reported the Braden Scale to be highly significant in prediction of pressure ulcer positive and negative groups. Capobianco and McDonald¹³⁷ raised the cut off point to 18 and reported sensitivity of 71 per cent, specificity of 83 per cent, and 63 per cent predictive value of a positive test and 88 per cent predictive value of a negative test. A study from the home care setting however was able to achieve a 100 per cent sensitivity with a cut off

Consensus statements:

1. *Risk assessment should be performed on admission to any health care facility or home care service, following a change of health status and at appropriate intervals throughout the continuum of care.*
2. *The 'at risk' status and risk factors should be documented regularly or following a change in the individual's condition.*

Recommendation:

1. *The presence of any condition which reduces mobility or diminishes activity to the point where the individual is unable to independently move or change positions to relieve pressure, should automatically place the individual in the 'at risk' category^{55, 57-59} (level of evidence III-2).*

Individuals identified 'at risk' of developing pressure ulcers should have a comprehensive preventative management plan instigated which aims to maintain tissue tolerance to pressure and protect the individual against the forces of pressure, shear and friction ¹⁴⁰⁻¹⁴⁶ (level of evidence II).

8.0 Skin care

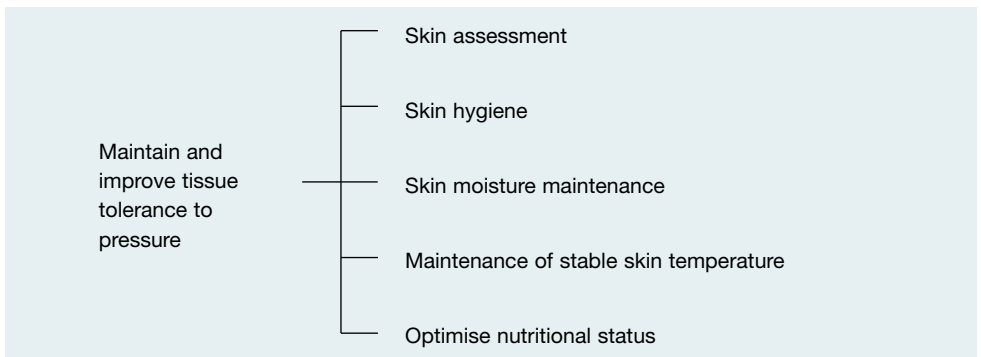
All individuals identified as 'at risk' of developing pressure ulcers should have a management plan that aims at aspects of care: skin assessment; optimal skin hygiene and skin moisture maintenance, and maintenance of a stable skin temperature. In addition to this the 'at risk' individual's nutritional status should be monitored and reassessed regularly (Figure 3).

8.1 Skin assessment

Skin assessment is fundamental to the early identification of skin damage and provides a baseline for the planning and evaluation of interventions. Individuals 'at risk' of developing pressure ulcers should have a comprehensive skin inspection at least daily for signs of impaired skin integrity ^{5, 147}.

Localised skin checks should occur with each repositioning or turn. Attention should be paid to skin overlying bony prominences, for example the sacral area, the heels, and greater trochanters. These bony prominences are not designed to support external pressure. They are close to the body surface, have less subcutaneous fat and muscle and are subsequently stressed when exposed to high concentrations of body weight over a relatively small surface area ¹⁴⁷.

Figure 3. Skin care.



In instances where a pre-existing pressure ulcer is present this should be noted in the clinical record in terms of location and severity with a description of the pressure ulcer and surrounding skin (see chapter 10, Documentation). In addition to this, a photograph or sketch will aid reassessment and evaluation of management.

8.2 Skin hygiene

The normal pH of the skin is between 4 and 6.8 and is referred to as the acid mantle. Maintenance of a stable skin pH discourages colonisation of bacteria and reduces the risk of opportunistic infection^{148, 149}.

In order to maintain skin integrity, all potentially irritating substances should be eliminated or minimised¹⁵⁰. Skin should be kept clean and dry, without excessive dryness. Skin cleansing regimens should be personalised according to individual need and preference. All skin care products should be evaluated for their pH value and dermatological safety¹⁵⁰. Alkaline soaps should be avoided as they alter the acid mantle of the skin. Excessive washing or the use of soap and detergents may not only result in chemical and physical irritation but may also compromise the water-holding capacity of the skin and interfere with bacterial resistance^{149, 150}.

8.3 Skin moisture maintenance

Skin hygiene is fundamental to promoting dignity, comfort and skin integrity. Elimination or containment of intrinsic and extrinsic factors that result in dryness or maceration of the skin aids the skin's ability to resist trauma^{81, 151}.

Dryness and reduced tissue turgor diminish the tissue's resistance to mechanical forces such as pressure, shear and friction¹⁵². Dry, flaky or scaling skin should be treated with a topical moisturiser⁵.

Skin which is exposed to excessive or sustained contact with bodily fluids such as: saliva, perspiration, urine, faeces or wound drainage can result in maceration, reducing the tensile strength of the skin^{148, 155}. Irritating substances such as urine and faeces not only increase the risk of maceration but provide a favourable environment for bacterial growth. Wound dressings and clothing items that occlude the skin elevate the skin's pH and in the presence of faeces, increase the activity of faecal enzymes^{148, 153}. In the presence of urine the irritant effect of faeces on skin is accentuated¹⁴⁸.

Measures to promote continence, such as continence training, regular toileting, the use of continence pads, garments or protective bed or chair sheets that present a quick-drying surface to the skin should be employed⁵. Protective plastic bed surfaces can prolong exposure

to moisture and should be avoided where possible. Moisture barrier ointments, creams and skin barrier films provide skin protection from moisture and chemical irritants¹⁵⁴.

8.4 Maintenance of a stable skin temperature.

Overheating of the skin predisposes the individual to a greater risk of pressure ulcer development^{110, 112}. Increased skin and body temperature also contributes to increased perspiration and compromises moisture maintenance. Maintenance of a stable skin and body temperature is important in reducing the metabolic and oxygen demands of the skin.

Contact surfaces that interfere with conduction and convection of heat, such as plastic surfaces covering mattresses and pillows, should be avoided where possible¹¹². The intraoperative and postoperative use of warming blankets have been demonstrated to significantly increase skin and core temperature. Removal of such warming devices from beneath patients once core temperature has been normalised and is stable, is recommended^{67, 155}.

The length of time between turning intervals has a significant effect on skin surface temperature. Knox *et al.*¹¹² demonstrated a significant increase in skin surface temperature with two hourly turns when compared to turning schedules shorter than two hours.

8.5 Influence of nutrition on the skin.

A balanced diet should be encouraged to provide adequate caloric requirements for the maintenance of an appropriate Body Mass Index (BMI) and for tissue maintenance and repair⁹⁰. It is important to assess the individual's dietary intake regularly, particularly in an acute care setting where interruptions to diet due to diagnostic tests, treatments or surgical procedures are frequent occurrences. Food and fluid intake should be assessed along with other simple indices of nutritional state, for example: muscle wasting, body weight <85 per cent of ideal, or any signs of vitamin or mineral deficiencies. What may normally be considered an adequate dietary intake may actually be inadequate in the context of the underlying illness¹⁵⁶. A dietitian should be consulted, and oral, enteral or parenteral supplementary nutrition should be considered when obvious deficits compromise tissue integrity^{59, 157}.

Consensus statements:

- 1. Individuals 'at risk' of developing pressure ulcers should have a comprehensive skin inspection at least daily for signs of impaired skin integrity.***

2. *The skin should be kept clean and free from all potentially irritating substances or those that substantially alter the skin pH.*
3. *All intrinsic and extrinsic factors that result in dryness or maceration of the skin should be eliminated or minimised by: a) treating dry, flaky or scaling skin with a topical moisturiser; b) avoiding sustained or excessive contact with body fluids, and/or c) encouraging continence by employing interventions such as continence training or the use of continence aids.*
4. *Maintain a balanced diet in individuals 'at risk'. They should be assessed regularly and referred to a dietitian if their diet is inadequate.*
5. *Avoid extremes in skin temperature by avoiding skin contact with plastic support surfaces and ensuring that turning schedules do not exceed two hourly intervals for patients on basic mattresses.*

Recommendation:

1. *Avoid high skin temperature by removing warming blankets from beneath patients once core temperature has been normalised and is stable 155 (level of evidence IV).*

9.0 Mechanical loading and support surfaces.

To protect the skin from external forces of pressure, shear and friction requires a management plan that incorporates the following: an appropriate turning schedule; elimination of shear and friction; reduction or elimination of heel pressure; promotion of mobility and activity and the use of an appropriate support surface (see Figure 4).

9.1 Positioning and repositioning*

Any individual who is assessed to be 'at risk' of developing pressure ulcers should be repositioned as frequently as their skin's tolerance to pressure dictates^{5, 159}. There is very little evidence to demonstrate the optimal frequency of manual repositioning^{119, 160}. The most frequently recommended repositioning regimen or turning schedule is two hourly. However, repositioning needs may vary between individuals from less than one hourly to greater than two hourly. Skin inspection with each turn is the key to determining effectiveness of any turning schedule¹⁴⁷.

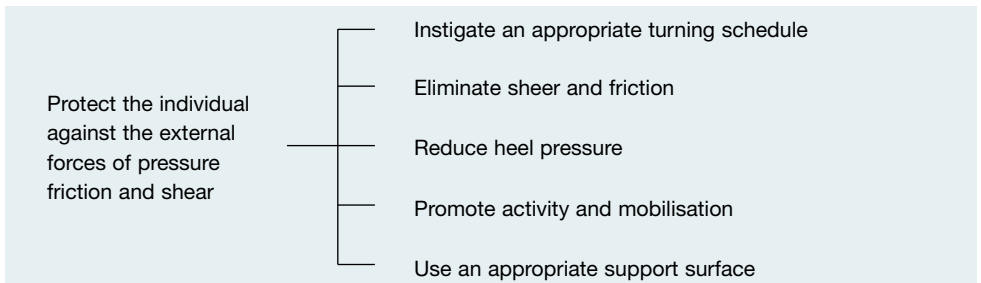
Pillows and foam wedges can be used when repositioning to assist in maintaining body

* All health care professionals and carers are advised to note the manual handling policy of their clinical facility, home care service or that of their respective professional association. Where possible manual handling should be minimised and mechanical lifting aids and other handling equipment should be employed¹⁵⁸.

alignment and avoiding direct contact between bony prominences. Correct body alignment when lying or sitting ensures the even distribution of body weight, reducing point pressure¹⁴⁷. Where possible, direct positioning on the greater trochanter should be avoided⁵.

Any person 'at risk' of developing pressure ulcers should avoid uninterrupted sitting in a chair or wheelchair. Repositioning or shifting of pressure points should occur as frequently as every 15 minutes and at least every hour⁵. When sitting out of bed, foot placement should be below the level of the hips. Feet positioned higher than the hips will transfer weight from the posterior thighs to the ischial tuberosities (buttocks)¹⁴⁷.

Figure 4. Mechanical loading and support surfaces.



9.2 Eliminating shear and friction

Immobile and inactive individuals are often exposed to the forces of shear and friction as a result of clinical practices such as lifting, turning, positioning and massaging over bony prominences. Friction is commonly experienced when the individual cannot be sufficiently lifted during repositioning and is dragged over the rough surface of the bed linen. Shear is often encountered when the individual cannot support their own body weight, maintain postural alignment or move independently¹⁴⁷.

To avoid friction, proper lifting and manual handling techniques should be employed when repositioning or transferring the individual. There are many devices available to assist carers with lifting and transferring, for example hoists, turning devices, slide sheets and slide boards.

Skin that is constantly exposed to friction should be protected with padding or protective dressings, for example hydrocolloids or transparent films⁵. Sheepskins play a questionable role in pressure relief, but can guard against friction and provide comfort¹⁶¹.

Massage over bony prominences was traditionally taught to care providers in the belief that rubbing stimulated blood flow to the affected area and consequently increased oxygenation

and nutrition to the affected tissue. There is no established scientific evidence to support this practice and there is the suggestion that in 'at risk' individuals massage may lead to deeper tissue trauma through the forces of friction and shear^{5, 157, 162}.

When an individual is unable to support their own body weight or move independently, the force of shear can be reduced by elevating the foot of the bed by 10 to 20 degrees. This helps to prevent sliding when sitting or semi-recumbent¹⁶³. The head of the bed should also be maintained at the lowest possible elevation consistent with the individuals medical condition and comfort. If the individual is constantly exposed to sliding when sitting up in bed or in a chair, time in this position should be limited⁵.

9.3 Reducing heel pressure.

Heels are particularly vulnerable to pressure as the calcaneum (heel bone) exerts pressure on a small surface area that has only minimal protection from a thin covering of subcutaneous fat¹⁶⁴. Individuals who are bed-bound or have immobilised lower extremities are at greatest risk of developing pressure ulcers on their heels. Care should be aimed at providing total relief of pressure from the heels. Constriction of the foot by tight or heavy bed linen can be prevented by the use of a bed cradle. Pillows or foam under the *full* length of the lower leg, suspending the heels, will also assist in relieving pressure from the heels⁵. However, this can be difficult if the individual experiences knee pain, is confused or agitated.

Standard heel protectors such as gel or cushioned booties provide modest pressure reducing qualities; they largely help to reduce the forces of shear and friction. Devices which offer the best heel protection feature clearance of the heel from any surface contact by elevating the entire lower leg. These devices can be difficult to apply and require several adjustments to ensure proper positioning. Heel protectors can cause reduced ventilation and, if fitted too tightly, may increase the surface-interface pressure¹⁶⁴.

9.4 Activity and mobilisation

Mobilisation and activity alter pressure on weight bearing areas, relieving stressed or damaged tissue of pressure and improving circulation¹⁴⁷. Individuals should be encouraged to maximise activity and mobilisation consistent with their medical condition, ability and energy level⁵⁸. Particular attention should be paid to early mobilisation following surgery, stroke or other major illnesses. The health care team should assess the need for devices that assist individuals with activity and mobilisation, for example: trapeze, cotsides, cane, walker or handrails⁵⁹. Where appropriate the individual should be referred to a physiotherapist or occupational therapist.

9.5 Support surfaces

The optimal support surface relieves pressure, shear and friction and maintains a stable skin temperature (see page 21). Such a support surface ideally distributes total bodyweight over the largest possible surface, or totally removes pressure from the body surface, thereby reducing point pressure and tissue damage. The support surface should be dense enough or high enough that bony prominences do not 'bottom out' on the mattress base¹⁶⁵.

There are a multitude of support surfaces on the market that offer a variety of features and varying degrees of pressure relief. Support surfaces may be categorised according to a number of different criteria, some of which relate directly to their effect on the patient (clinical classification) and others which relate to their physical characteristics. The most useful clinical classification for devices is that of *constant low pressure devices and alternating pressure devices*. These categories are commonly found in the UK literature and are used in the Cochrane Collaboration systematic review on pressure ulcers¹⁶⁶. The method of classification of devices created much debate in the committee and was flagged as a section to be critically reviewed when the guidelines undergo their first revision.

Clinical classification

Constant low pressure

Constant low pressure devices conform closely to the body contours and aim to redistribute the body weight over a wider area thereby reducing tissue interface pressure. These devices may be foam or fibre-filled mattresses and overlays, water beds, gel pads, air overlays and mattresses both static/constant air or low air loss devices. These devices may also be powered, mechanical devices or non-powered, non-mechanical devices. Air fluidised beds achieve the lowest interface pressures in this product group.

As stated in section 5.0, pressures applied to the skin surface which are below capillary closing pressure can still cause tissue ischaemia and necrosis. A constant low pressure device must therefore be combined with a turning regimen, relating to the individual's degree of risk and the skin's tolerance to pressure¹⁶⁷, as it is imperative that pressure is completely eliminated at frequent intervals to allow blood to circulate to ischaemic tissues.

Alternating pressure devices

Alternating pressure devices generate alternating high and low pressures between the body and the support surface in a manner similar to that employed in the healthy individual who continually changes position in response to pressure pain. This is universally achieved by cyclically inflating and deflating groups of air filled cells placed transversely across the

mattress surface. The inflated cells support the body while the deflated ones reduce contact pressure to a greater or lesser degree. These devices are available as overlays, and single or multi-layered mattress replacements.

Classification of physical characteristics

These classifications are found in the literature and relate to the physical characteristics of support surfaces, however they have little relevance to the clinical application of these devices.

- Pressure reducing or pressure relieving qualities

This categorisation is found predominantly in the American literature. Pressure reducing support surfaces have been defined as reducing pressure at the surface interface below that found with the standard hospital mattress. Pressure relieving support surfaces are defined as maintaining a tissue interface pressure consistently below the capillary closing pressure found in healthy individuals (32 mmHg) (see Table 8). As stated in section 5.0, pressures at the skin surface that are below capillary closing pressure, which may vary from patient to patient, but that are applied for prolonged periods are still capable of causing tissue ischaemia and necrosis. These categories provide an indication of the interface pressure only at the skin surface.

- Static or dynamic components

Static devices are non-mechanical, support surfaces that remain motionless except in response to patient movement, for example foam, fibre, air or water-filled overlays^{165, 167}.

Table 8. Capillary closing pressure and tissue interface pressure¹⁶⁸.

Capillary closing pressure (CCP) – the point at which external pressure on the capillary exceeds internal pressure and the structural strength of the vessel and causes capillary collapse. Generally quoted as 32 mmHg in healthy individuals.

Tissue interface pressure (TIP) – the pressure applied to the epidermis by the surface that is supporting it.

TIP = Patient Weight/Surface Area Supported

TIP does not equal CCP, there is no conversion constant as it is not directly proportional. Both measurements are influenced by multiple variables such as: amount of fatty tissue, relative location of bony prominences, vertical and horizontal shearing forces, vascular circulation, systemic blood pressure, general health.

The general rule of thumb is: the lower the tissue interface pressure, the lower the pressure on the capillary.

Dynamic devices have moving parts and require an electrical power source. Dynamic devices offer such features as constant regulated air flow (low and high air loss devices), alternating air flow or flotation support¹⁶⁵.

- Adjunct to or replacement of the basic mattress or bed

Overlays rest on top of the basic mattress, trolley, operating table or chair. Overlays vary in size and thickness and may provide either a static or dynamic surface.

Replacement mattresses are substituted for the basic mattress. Again they may provide either a static or a dynamic surface.

Specialty beds have the support surface integrated into a bed frame and replace the entire bed.

9.5.1 Basic hospital mattresses

Basic hospital mattresses, emergency department trolleys, and radiology and operating room tables offer very little in the way of pressure relief. They usually consist of a single piece of polyurethane foam confined by a non-stretch plastic/nylon cover. They have a relatively short life expectancy (around two to three years) and should be regularly assessed for 'core fatigue'. This occurs when the foam mattress softens under the area of maximal weight and the patient sinks into the foam and 'bottoms out' onto the underlying bed base. A simple test for foam quality can be performed by spreading the hands in the middle of the mattress and pushing down with full body weight; the base of the bed should not be felt¹⁶⁹.

Tight mattress covers or bed linen which aim to be wrinkle-free produce a 'hammocking' effect which increases the hardness of the mattress or any support surface and reduces its ability to mould around the body, effectively undermining the pressure reducing qualities of the support surface^{169,170}.

9.5.2 Foam pressure reducing devices

Foam has been used for many years as an inexpensive and convenient support surface. Foam is available in a variety of sizes, and thickness for use as overlays on beds, trolleys and operating tables, or as cushions for chairs. Foam is easily shaped for specific bony prominences, such as heels and heads. Newer formulations of foam have increased its resiliency and fire-retardant characteristics making it safer and improving its durability and compressibility¹⁶⁵.

Ten centimetre thick foam overlays have demonstrated improved pressure reducing capabilities when compared with five centimetre thick foam overlays or the basic hospital

mattress. Ten centimetre thick foam overlays are suited to those individuals at low or moderate risk of developing pressure ulcers¹⁷¹.

Pressure reducing foam replacement mattresses are a more recent addition to pressure reducing devices. These mattresses consist of foam layers of varying densities, or sections or cubes of foam that can be temporarily removed or altered to provide greater pressure relief to specific areas. Foam replacement mattresses may also be a combination of materials such as foam and gel, or foam with air filled chambers.

Pressure reducing foam mattresses are used as permanent replacements for basic hospital mattresses¹⁶⁵. Studies demonstrate that foam replacement mattresses are more effective in preventing pressure ulcers in individuals at low to moderate risk than basic hospital mattress or foam overlays^{171, 172}.

The major advantages of foam as a pressure reducing device include: ease of transport and installation, minimal maintenance and resistance to puncture by sharp objects. Foam's disadvantage is its limited life expectancy; two to three years for an overlay and around five years for a replacement mattress. Foam also traps perspiration, absorbs body heat, stains easily, retains odour and may be difficult to clean¹⁶⁵.

9.5.3 Sheepskins, fibre-filled overlays and gel pads

Sheepskins, fibre filled overlays and gel pads are other forms of pressure reducing static devices that cover existing hospital mattresses, trolleys, operating tables or chairs. These devices are also available in a wide range of accessories such as heel and elbow protectors. They are easy to use, easy to transport and easy to clean. However, research is limited on their effectiveness to reduce pressure below that of the basic hospital mattress. Their use should be limited to individuals at low risk of developing pressure ulcers¹⁷³.

Sheepskin is well recognised by the general community as a pressure ulcer preventative device. However, there are only a few published studies, albeit poorly designed and inconclusive, that cite any benefit of sheepskin¹¹⁹. Generally a natural fleece sheepskin is considered a comfort measure that may potentially reduce friction and improve vapour loss¹⁷⁴. These physical properties are impaired when the sheepskin is overlaid by sheets or clothing, or if matting occurs due to poor laundering¹⁶¹.

Gel filled pads or dry visco-elastic polymer-flotation pads have been reported to be effective in protecting the sacral area and to work well with obese patients^{161, 175}. They are frequently used on operating theatre tables as overlays or for protecting the head, heels or ankles. They are easy to clean, extremely durable, can be reused and are easy to repair. Gel pads,

however, can be heavy to handle and lack airflow – reducing moisture control. The gel can migrate downward into folds and crease when the patient is semi-recumbent or sitting up¹⁶⁵.

Fibre filled overlays consist of synthetic fibres within a series of connected cushions. The fibres may be coated with silicone or formed in very small discrete balls to reduce shear and friction. Depending on the properties of the covering fabric, air may be able to circulate around the fibres thereby minimising the accumulation of moisture and maintaining an even temperature environment around the patient's skin. Fibre-filled overlays may be useful in reducing shear and friction, and providing comfort. A variety of these overlays are available with differing properties relating to stain resistance, water resistance, multiple or single use and ability to clean.

9.5.4 Static air mattresses and overlays

Static air mattress and overlays are designed with interconnected chambers that allow air exchange between compartments when compressed. Studies have repeatedly demonstrated that the pressure reducing capabilities of static air overlays are superior to the basic hospital mattress when the overlay is correctly inflated¹⁷¹.

Static air overlays are suitable for individuals at moderate risk of developing pressure ulcers. They are economical, easy to clean and low in maintenance. They are however, easily damaged by sharp objects and air is lost with use. They must be regularly checked and adjusted to the individuals body weight as over or under-inflation of static air overlays can increase the interface pressure^{165, 175}.

9.5.5 Alternating pressure devices

Alternating pressure devices work on the principle of cyclic inflation and deflation of air cells over a short period of time. The continual alternation of inflating and deflating cells changes interface pressure temporarily, thus relieving sections of the body from pressure and creating a pressure gradient that enhances blood flow^{165, 171}.

Alternating pressure devices are available as overlays for beds and chairs or as replacement mattresses. Overlays can be small 'bubble cell' overlays with diameters of 3-5 cm or large cell overlays with cell diameters of 10 cm or more. Alternating pressure devices are also available as mattress replacement systems that are more sophisticated and can adjust to patient weight and change of position.

Studies demonstrate that alternating pressure devices significantly lower tissue interface pressure when compared with a basic hospital mattress and reduce the incidence of pressure

ulcers when cell diameter is greater than 10 cm. These devices are suitable for moderate to high risk individuals^{119, 173}.

These types of overlays and mattresses are easy to clean and are durable. However, they are also easy to puncture, require mechanical components to operate, have tubing that may kink, can be noisy and the constant alternating pressure may bother some individuals¹⁶⁵. The alternating pressure effect can also be impeded by the use of multiple layers of bed-clothing between the support surface and the patient. Plastic sheets, draw sheets, cellulose incontinence sheets (blueys) and sheepskins reduce the pressure relieving qualities of the alternating pressure device to that of a static support surface so the benefits of a reduced turning regimen are negated.

9.5.6 Low air loss devices

Low air loss devices provide a continuous flow of air from the entire surface of the mattress; this is achieved by using a microporous material for the transverse air cells that constitute the support surface. A powerful fan maintains air cell inflation at the lowest possible level despite constant air loss. This level of inflation provides adequate patient support and body alignment.

Low air loss devices are available as an overlay, a replacement mattress or a specialty bed. The cells within the overlay and replacement mattress are interconnected. In the specialty bed they are separated so that inflation can be varied in each air cell and very low interface pressures can be achieved¹⁶¹. The overlay and mattress are suitable for moderate to high risk patients while the specialty beds cater for high risk individuals¹⁷³.

9.5.7 High air loss or air fluidised beds

High air loss or air fluidised beds are designed for the high risk individual who can not tolerate any pressure. Sand-like grains or beads are contained in a tank that is covered with an air permeable fabric¹⁷³. Warmed high flow air is passed through the beads creating a 'dry flotation' system. Two thirds of the body is submerged within this support surface significantly reducing interface pressure. The warmed air creates a dry environment decreasing the effects of perspiration, incontinence and copious wound drainage. The support surface can be stabilised if required for some procedures by turning off the air flow¹⁶⁵.

Air fluidised beds can be costly and the floating properties make handling the patient difficult. The high air loss 'dry flotation' system can potentially have a dehydrating effect on the individual.

9.5.8 Turning beds

There are a variety of beds or devices that assist in turning the patient. They may be manual or mechanically controlled and may provide intermittent or continuous movement¹⁷⁵. Studies have not demonstrated any benefit in the reduction of pressure ulcers^{119, 175}.

9.5.9 Evaluating support surfaces

There have been few randomised controlled trials (RCTs) on pressure relieving support surfaces. The UK National Health Service Centre for Reviews and Dissemination¹¹⁹ reviewed all RCTs identified in the literature (30 in total) for effectiveness of pressure relieving interventions. They found most studies were poorly designed with inadequate sample sizes. In their findings they reported

... the standard hospital mattress is less effective at preventing sores than some low pressure foam mattresses. There is some evidence which suggests that large celled (diameter > 10cm) alternating pressure mattresses and certain low-air loss and air fluidised beds are more effective than foam and silicone-based surfaces in preventing and healing sores (p.6).

In a more recent report for the Cochrane Collaboration, Cullum *et al.*¹⁶⁶ reviewed 29 RCTs on pressure relieving support surfaces. In this review some previous studies used in the 1995 report¹¹⁹ were discarded on the basis of non-randomised allocation of support surfaces. However, the findings were similar. Cullum *et al.*¹⁶⁶ concluded that in the prevention of pressure ulcers, some high specification foam mattresses were more effective than 'standard' hospital foam mattresses in moderate to high risk patients. The application of this conclusion to clinical practice is hampered by the poor description of a 'standard' hospital mattress in most studies. Low air loss beds appear effective in preventing pressure ulcers compared with foam mattresses. In addition to this, Cullum *et al.*¹⁶⁶ suggest that pressure relieving overlays on the operating table are of benefit in reducing the incidence of pressure ulcers.

Figure 5 (page 34-35) provides an overview of the categories, types of support surfaces and recommended use according to degree of risk.

9.5.10 Selecting a support surface

The following criteria should be considered when selecting a pressure relieving or pressure reducing support surface¹⁷⁵⁻¹⁷⁷:

- Durability;
- Comfort of the individual;

- Support surface conforms to bony prominences without resistance;
- Support surface allows patient immersion without 'bottoming out';
- Support surface cover is impermeable to fluid or bacteria but also has properties that reduce shear, friction, moisture and temperature;
- Fire retardant properties;
- Temperature at the interface is controlled;
- Maximum weight limit the device will support;
- Access to the patient and ease of repositioning;
- Ease of transferring from bed to chair, or bed to trolley;
- Ease of transport;
- Ability to stabilise the surface to perform emergency and other procedures;
- Multiple parts required e.g. air compressor, power source, tubing;
- Cleaning and maintenance;
- Appropriateness for clinical setting;
- Size and weight of the device;
- Availability, and
- Cost to purchase or hire.

Consensus statements:

1. *The most effective pressure relieving support surface such as a sophisticated alternating pressure device should be chosen for those individuals who are unable to tolerate a turning regimen or where a consistent turning regimen (24 hours a day) cannot be guaranteed.*
2. *Support surfaces should be used in conjunction with a comprehensive prevention strategy based on frequent observation and assessment, individualised turning regimen and measures to increase the tissues tolerance to pressure.*
3. *Pillows and foam wedges can be used to avoid direct contact between bony prominences.*
4. *Avoid prolonged uninterrupted sitting in a chair or wheelchair. Repositioning or shifting of pressure points should occur as frequently as 15 minutely to hourly depending on the tissues tolerance to pressure.*

5. *Exposure to shear and friction should be reduced by: a) employing correct lifting and manual handling techniques; b) protecting skin constantly exposed to friction with protective dressings or padding or sheepskin; c) elevating the foot of the bed to 20 degrees when sitting to prevent sliding, and d) maintaining the head of the bed at the lowest possible elevation consistent with the individuals medical condition and comfort.*
6. *Individuals who are bed bound or have immobilised lower extremities should have total relief of pressure from their heels.*
7. *Individuals should be encouraged to maximise their activity and mobilisation consistent with their medical condition, ability and energy level.*

Recommendations:

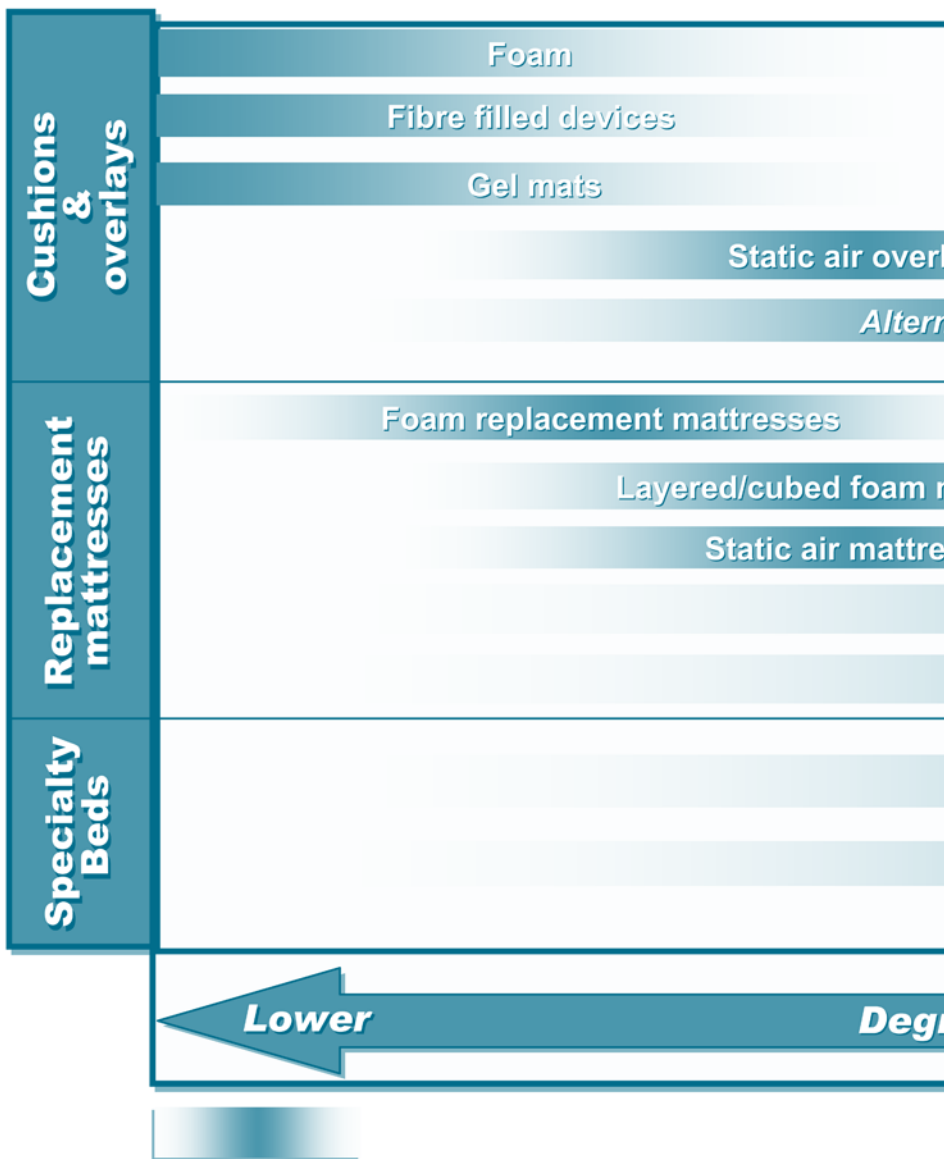
1. *Any individual who is assessed to be 'at risk' for developing pressure ulcers should be repositioned as frequently as their skin's tolerance to pressure dictates¹⁵⁹ (level of evidence IV).*
2. *Replacement mattresses or beds should be used in place of standard hospital mattresses in patients who are assessed as being at high risk of developing a pressure ulcer^{119, 166} (level of evidence I).*

10.0 Documentation

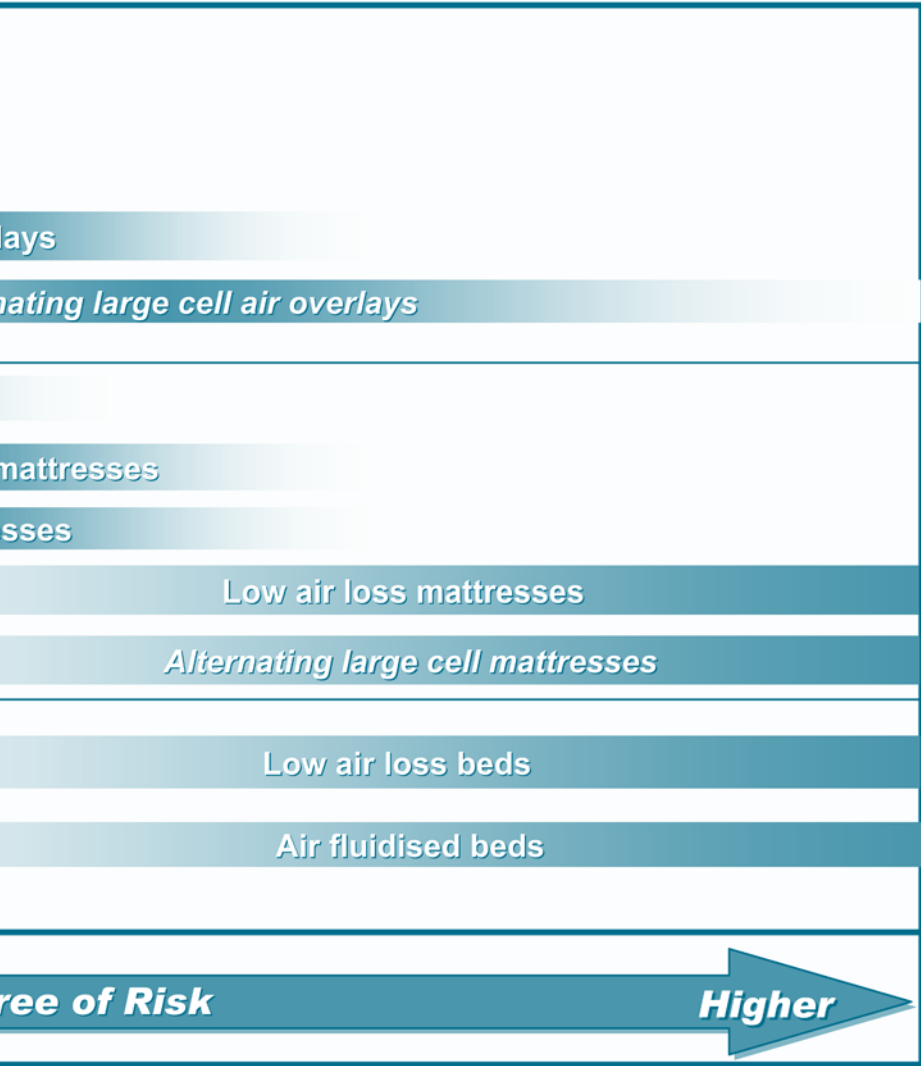
The primary aim of documentation in the patient record or management plan is to facilitate communication and continuity of care between health care professionals and across health care settings. The patient record should provide a complete picture of care from admission to discharge and should include evidence of clinical assessment, interventions and outcomes. It may be called upon in the future and may be subpoenaed for litigation purposes^{178, 179}.

All individuals identified 'at risk' of pressure ulcers should have their risk assessment status and risk factors clearly documented and readily accessible for all health care providers. The individual's risk status should be updated as the individual's condition changes. If a pressure ulcer is present then the following should also be included in the patient record: location and severity (*Stage*) of the ulcer; dimensions or surface area of the wound; nature/description of the wound bed, wound edges and surrounding skin; the amount of exudate; severity of pain; and other factors which may impede wound healing. In addition to this a sketch with measurements or a photograph with a scale of the pressure ulcer will aid reassessment and evaluation of treatment.

Figure 5. Recommended use of support surfaces according to degree of risk.



Indicates recommended range of use according to degree of risk.
 (Devices not in italics are constant low pressure devices)



Note: Support surfaces should be used in conjunction with an appropriate turning schedule. The above classification and recommendations are based on consensus using the best available evidence for their usage.

The individual's risk status and risk factors provide the foundation for the patient management plan for prevention and treatment of pressure ulcers. The management plan should provide specific details of what care is required, who is responsible for that care, frequency of turning, equipment needed, referrals and expected outcomes⁵.

Clinical interventions, outcomes of care and adjustments to the pressure ulcer prevention/management plan should be regularly monitored and documented. The frequency of assessment will be determined by the clinical setting and the policies of the respective clinical facility or home care agency. For instance in an acute care setting, documentation of outcomes of care should be documented at least daily.

Critical pathways or care maps are useful tools to assist in coordinating and documenting care within a multidisciplinary team. These tools also provide valuable data on the outcomes of care and the effectiveness of preventative strategies through variance analysis¹⁸⁰.

Consensus statement:

- 1. All individuals 'at risk' of developing pressure ulcers should have the following details recorded in the patient record on a regular, ongoing basis: risk assessment status (low, moderate or high); identified risk factors; management plan which includes interventions used such as, turning schedules, support surface, referrals and the individual's response to treatment.*

11.0 Risk management system for the prevention of pressure ulcers

Pressure ulcers are adverse events which can occur in any health care setting and home environment. A continuous quality improvement approach provides a systematic framework for continuously monitoring and evaluating the impact of any preventative risk management strategy.

11.1 Risk management process

The introduction of a risk management system aimed at preventing and reducing the occurrence of pressure ulcers should always be based on quantifiable baseline information. If any benefit or outcome is to be measured, each health care agency must be able to demonstrate the size of the health burden, cost, variations in practice, and the resources available⁴.

The occurrence of pressure ulcers can be measured by two rate-based indicators: prevalence or incidence (refer to Table 2, page 4). Pressure ulcer point prevalence survey provides a 'snapshot' of a given population at a given time. It is relatively easy to measure and is therefore the most commonly used. However, its limitations lie in that it only measures subjects with existing pressure ulcers and does not provide any data on subjects 'at risk'.

Pressure ulcer incidence rates provide information on the development of new pressure ulcers over a given time. Incidence surveys can provide information regarding factors which predispose to pressure ulcer development¹⁸¹ and are preferred quality indicators if subjects 'at risk' are taken into account¹¹⁹.

In conjunction with the collection of baseline data on incidence or prevalence, the following data will also assist in determining the most appropriate risk assessment tool suited to the particular health care setting:

- age and basic patient demographics;
- disease processes, and
- risk factors.

Collecting data on the site and severity of pressure ulcers provides information regarding the appropriateness of available pressure relieving equipment. Monitoring of severity of pressure ulcers also provides a means of identifying subtle improvements or deteriorations in the overall occurrence of pressure ulcers. For example the total incidence of pressure ulcers may remain relatively unchanged, but the incidence of *Stage 3 or 4* pressure ulcers may have altered significantly.

Clinical practices can be surveyed by conducting criteria audits which identify evidence of risk assessment, problem identification, planning, intervention and evaluation of care. Using both clinical observation and documentation sources of evidence, information can be collected regarding the knowledge and risk management strategies of staff caring for individuals 'at risk'^{182, 183}.

Inventories of equipment available and audits of clinical use and appropriateness of use will provide information on resource allocation and staff knowledge.

11.2 Develop a policy and protocol

A pressure ulcer policy should reflect the commitment of the health care agency to preventative management. The policy should clearly identify the role and responsibilities

of all health care professionals. Pressure ulcer prevention is more than mechanical redistribution of body weight. Prevention includes treatment of the underlying illness, restoration of metabolic balance, maintenance of adequate nutrition and promotion of mobility and activity. Pressure ulcer prevention requires a multidisciplinary approach¹⁸².

Surveys of clinical practice in pressure ulcer prevention highlight the variety of products and procedures employed to manage individuals 'at risk'. Many of these practices are not supported by well conducted research^{184, 185}. Pressure ulcer protocols that are formulated within a multidisciplinary framework and based on current evidence offer a consistent approach to pressure ulcer prevention based on the best available research. Protocols should provide information which is relevant and easy to access, while being comprehensive and useful as a reference source¹⁸³.

11.3 Education

Education is crucial in the implementation and maintenance of any pressure ulcer prevention program. Education and training workshops, inservice programs and bedside teaching are important to address knowledge deficits, and increase or maintain staff competency by keeping staff abreast of new developments in pressure ulcer prevention¹⁸².

Education should be directed at all levels of clinicians and carers and should include information on the following items:

- Aetiology and risk factors for pressure ulcers;
- Risk assessment tools and their application;
- Skin assessment;
- Selection and/or use of support surfaces;
- Development and implementation of an individualised program of skin care;
- Repositioning to decrease risk of tissue breakdown, and
- Instruction on accurate documentation of the pertinent data⁵.

11.4 Consumer awareness

A vital component of any successful preventative regimen is the education and involvement of the individual 'at risk', carers and significant family members. Both consumer and significant family members should have a clear understanding of risk factors and the strategies employed to reduce or eliminate the risk of pressure ulcer development. The individual should be instructed to alert carers to discomfort, or when assistance is required

for repositioning, or other activities that will help reduce the occurrence of a pressure ulcer. Education of the individual and significant family members is a vital component in gaining co-operation and in preparing for discharge if the individual remains 'at risk' following discharge.

11.5 Evaluation

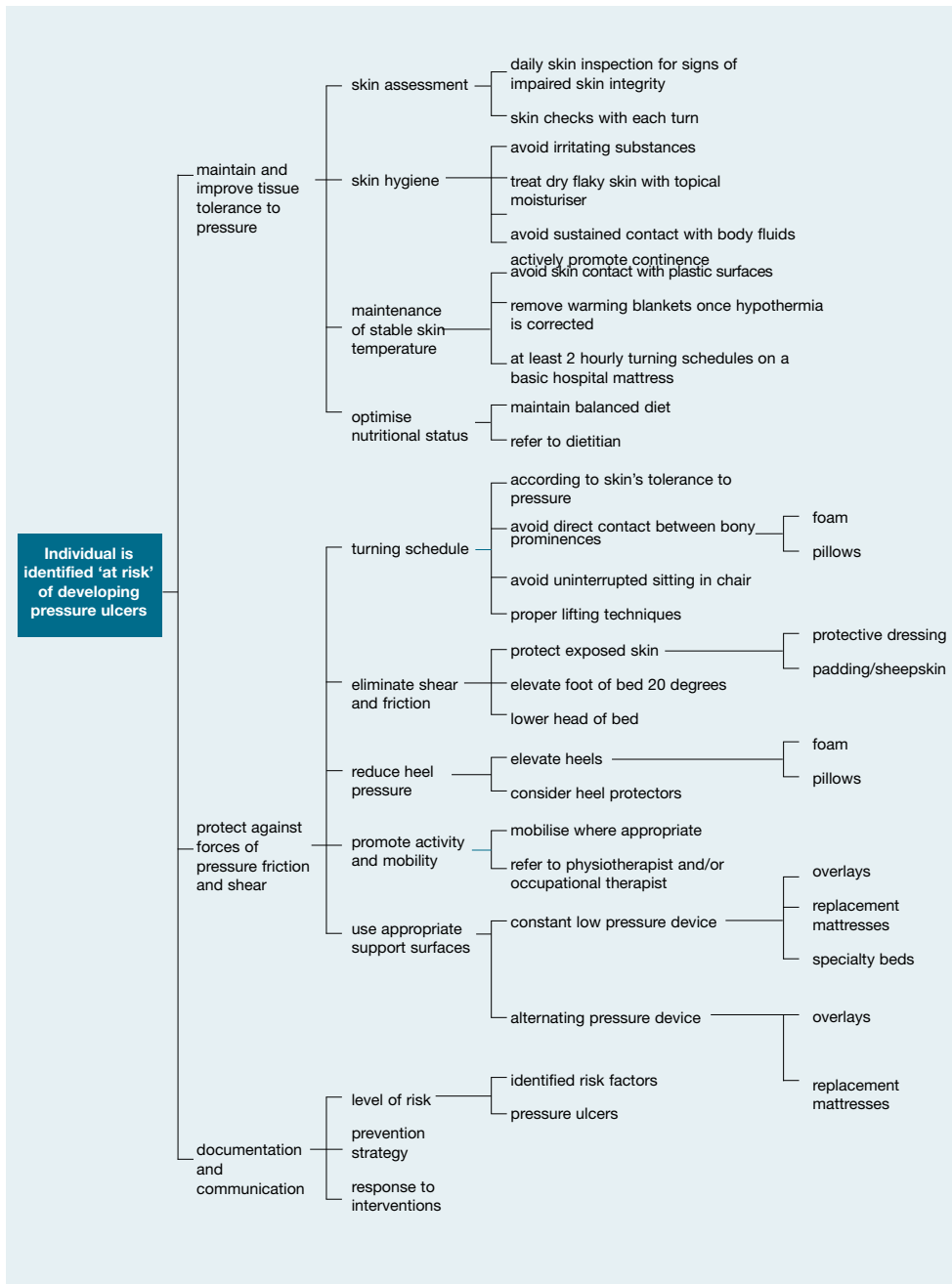
Regular evaluation of any pressure ulcer prevention program is essential to determine the effectiveness of an implemented policy and protocol. The aims of any evaluation program should be to highlight strengths and problem areas which require modification, further education and/or additional resources¹⁸⁶.

Evaluation is part of an ongoing process of monitoring, assessing and intervention. Success can only be determined by tracking trends of both outcome and process indicators over time and where possible benchmarking results with agencies recognised for 'best practice' in pressure ulcer prevention¹⁸⁶.

Consensus statements:

- 1. Any pressure ulcer risk management program should be based on a demonstrable need, relevant to the health care setting and supported by a policy and protocol based on the best available research.*
- 2. All pressure ulcer risk management programs should include the individual 'at risk' and significant family members. The individual should be considered an active participant in the management plan and should be informed of the relevant risk factors and the strategies employed to minimise or eliminate the risk of pressure ulcer development.*
- 3. A pressure ulcer risk management program should be supported by a continuing educational program and a multidisciplinary continuous improvement process that is able to monitor and compare the impact of interventions over time.*

12.0 Summary of pressure ulcer preventative strategies.



Appendix A

AWMA pressure ulcer interest subcommittee

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Appendix A

AWMA Pressure ulcer interest subcommittee terms of reference

Mission / Purpose

To develop and maintain clinical practice guidelines for the prevention and management of pressure ulcers in Australia.

Objectives

Major

1. To develop guidelines for the prediction and prevention of pressure ulcers.
2. To develop guidelines for the management of pressure ulcers.
3. To facilitate implementation of the guidelines.

Minor

1. To collate data on the incidence and prevalence of pressure ulcers in Australia.
2. To summarise advantages, disadvantages and possible indications for the use of different risk assessment tools used to identify patients at risk of the development of pressure ulcers.
3. To categorise and produce an inventory of pressure relieving equipment available in Australia.
4. To prepare a summary of resolutions as an educational package for clinicians, institutions, Health Departments etc. and to determine a process for updating and dissemination of this information.
5. To reach a consensus on a method for staging pressure ulcers.

Function of the committee:

This is a subcommittee of the Australian Wound Management Association Inc. which will act as a forum for health professionals with an interest in pressure ulcers to develop and maintain clinical practice guidelines for the prevention and management of pressure ulcers in Australia.

To meet at regular intervals to update the guidelines and associated information, based on up to date knowledge.

To disseminate information as an educational package for clinicians, institutions and Health Authorities.

Representation

The committee will consist of:

- President of Australian Wound Management Association Inc.
- Two to four representatives from each state (representatives may rotate).
- Representation from the following groups – nursing, medical, allied health.
- Other organisations or individuals may be invited to attend particular meetings where that person is able to provide specialist advice on particular issues of interest to the committee.

Conduct of meetings

Meetings will be chaired by the president of the AWMAInc (or a representative nominated by the president). Final resolution proposed by the meeting will be recorded and distributed to all members for comment prior to the compilation of an information package by the committee of AWMAInc. Background and relevant papers will be circulated in advance of the meeting and may be contributed to by the nominated coordinator or by any member of the committee.

Appendix B

Norton Risk Assessment Guidelines

Physical condition

Encompasses current medical condition and physical health (consider nutritional status, tissue integrity, muscle bulk and condition of skin).

Good	stable medical condition, appears healthy, well nourished
Fair	generally stable medical condition, appears fairly healthy
Poor	unstable medical condition, appears healthy
Very bad	critical medical condition, appears acutely ill

Mental condition

Encompasses level of consciousness and orientation.

Alert	orientated x 3, aware of surroundings
Apathetic passive	orientated x 2-3, dull affect,
Confused	orientated x 1-2, conversation inappropriate at times
Stuporose	generally unresponsive, lethargic

Activity

Degree to which subject is ambulatory.

Ambulant	able to walk independently, includes cane/walker
Walks with help	unable to walk without human assistance
Chair-bound	walks only to chair, limited to chair by condition and/or physician's orders
Bed-bound	confined to bed due to condition and/or physician's orders

Mobility

Degree to which subject controls and moves extremities.

Full	moves and controls all extremities at will, independent in moving
Slightly	able to control and move extremities, but some degree of limitation, needs assistance to change position
Very limited	unable to change position without help, offers minimal assistance with moving, paralysis, contractures
Immobile	no ability to move, unable to change position

Incontinence

Degree to which subject has control of bowel/bladder.

Not	total control of bowel and bladder (exceptions: with diagnostic test), has Foley catheter and no bowel incontinence
Occasionally	has had one to two episodes of urine/faeces incontinence in 24 hours (not related to laxatives/enemas), has condom catheter, has Foley catheter but has continent stools
Usually urine	has had three to six episodes of urinary incontinence or diarrhoea stools in past 24 hours
Doubly	never able to control bowel and bladder function, has seven to 10 episodes in 24 hours

The Norton Risk Assessment Score

Physical condition		Mental condition		Activity		Mobility		Incontinence	
Good	4	Alert	4	Ambulant	4	Full	4	Not	4
Fair	3	Apathetic	3	Walks with help	3	Slightly limited	3	Occasionally	3
Poor	2	Confused	2	Chair-bound	2	Very limited	2	Usually of urine	2
Bad	1	Stuporose	1	Bed-bound	1	Immobile	1	Doubly	1

Patient 'at risk' with score of 16 or less

Appendix C

Waterlow Pressure Sore Prevention/Treatment Policy

Build/weight for height	Mobility	Special risks	
0 Average	0 Fully	<i>Tissue malnutrition</i>	
1 Above average	1 Restless/fidgety	8 Terminal cachexia	
2 Obese	2 Apathetic	5 Cardiac failure	
3 Below average	3 Restricted	5 Peripheral vascular disease	
	4 Traction	2 Anaemia	
	5 Chairbound	1 Smoking	
Contenance			
0 Complete/catheter			
1 Occasional incontinence	Sex and age	<i>Neurological deficit</i>	4-6
2 Cath/incontinence. faeces Doubly incontinent	1 Male	Diabetes	
	2 Female	M S	
	1 14-49	C V A	
	2 50-64	Motor/sensory paraplegia	
	3 65-74		
Skin type and visual risk areas	4 75-80		
0 Healthy	5 >81	<i>Major surgery/trauma</i>	5
1 Tissue paper		Orthopaedic	
1 Dry		Below waist spinal	
1 Oedematous	Appetite	OR > 2 hours	
1 Clammy	0 Average		
2 Discoloured	1 Poor		
3 Broken	2 NG tube or fluids only	<i>Medication</i>	4
	3 N B M/Anorexia	Steroids	
		Cytotoxics	
		High dose anti-inflammatories	

Score: >10 At risk >15 High risk >20 Very high risk

Waterlow Pressure Sore Prevention/Treatment Policy reproduced with permission, June 2000

Appendix D

The Braden Scale for Predicting Pressure Sore Risk

The Braden Scale for Predicting Pressure Sore Risk.		Evaluator's name _____	Date of assessment _____
<p>Patient's name _____</p> <p>SENSORY PERCEPTION ability to respond meaningfully to pressure-related discomfort.</p>	<p>1. Completely limited Unresponsive (does not moan, flinch, or grasp) to painful stimuli, due to diminished level of consciousness or sedation OR limited ability to feel pain over most of body.</p> <p>1. Constantly moist Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned.</p> <p>1. Bedfast Confined to bed.</p>	<p>2. Very limited Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness OR has a sensory impairment which limits the ability to feel pain or discomfort over 1/2 of body.</p> <p>2. Very moist Skin is often, but not always moist. Linen must be changed at least once a shift.</p> <p>2. Chairfast Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.</p> <p>2. Very limited Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.</p> <p>2. Probably inadequate Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only three servings of meat or dairy products per day. Occasionally will take a dietary supplement OR receives less than optimum amount of liquid diet or tube feeding.</p> <p>2. Potential problem Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.</p>	<p>3. Slightly limited Responds to verbal commands, but cannot always communicate discomfort or the need to be turned OR has some sensory impairment which limits ability to feel pain or discomfort in 1 or 2 extremities.</p> <p>3. Occasionally moist Skin is occasionally moist, requiring an extra linen change approximately once a day.</p> <p>3. Walks occasionally Walks occasionally during day, but for very short distances, with or without assistance. Spends majority of each shift in bed or chair.</p> <p>3. Slightly limited Makes frequent though slight changes in body or extremity position independently.</p> <p>3. Adequate Eats over half of most meals. Eats a total of four servings of protein (meat, dairy products per day. Occasionally will refuse a meal, but will usually take a supplement when offered OR is on a tube feeding or TPN regimen which probably meets most of nutritional needs.</p> <p>3. No apparent problem Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair.</p>
<p>MOISTURE Degree to which skin is exposed to moisture.</p>	<p>1. Bedfast Confined to bed.</p> <p>1. Completely immobile Does not make even slight changes in body or extremity position without assistance.</p>	<p>2. Very moist Skin is often, but not always moist. Linen must be changed at least once a shift.</p> <p>2. Chairfast Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.</p> <p>2. Very limited Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.</p> <p>2. Probably inadequate Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only three servings of meat or dairy products per day. Occasionally will take a dietary supplement OR receives less than optimum amount of liquid diet or tube feeding.</p> <p>2. Potential problem Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.</p>	<p>4. No impairment Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.</p> <p>4. Rarely moist Skin is usually dry, linen only requires changing at routine intervals.</p> <p>4. Walks frequently Walks outside room at least twice a day and inside room at least once every two hours during waking hours.</p> <p>4. No limitation Makes major and frequent changes in position without assistance.</p> <p>4. Excellent Eats most of every meal. Never refuses a meal. Usually eats a total of four or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.</p>
<p>ACTIVITY Degree of physical activity.</p>	<p>1. Bedfast Confined to bed.</p> <p>1. Completely immobile Does not make even slight changes in body or extremity position without assistance.</p>	<p>2. Very moist Skin is often, but not always moist. Linen must be changed at least once a shift.</p> <p>2. Chairfast Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.</p> <p>2. Very limited Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.</p> <p>2. Probably inadequate Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only three servings of meat or dairy products per day. Occasionally will take a dietary supplement OR receives less than optimum amount of liquid diet or tube feeding.</p> <p>2. Potential problem Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.</p>	<p>4. No impairment Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.</p> <p>4. Rarely moist Skin is usually dry, linen only requires changing at routine intervals.</p> <p>4. Walks frequently Walks outside room at least twice a day and inside room at least once every two hours during waking hours.</p> <p>4. No limitation Makes major and frequent changes in position without assistance.</p> <p>4. Excellent Eats most of every meal. Never refuses a meal. Usually eats a total of four or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.</p>
<p>MOBILITY Ability to change and control body position.</p>	<p>1. Bedfast Confined to bed.</p> <p>1. Completely immobile Does not make even slight changes in body or extremity position without assistance.</p>	<p>2. Very moist Skin is often, but not always moist. Linen must be changed at least once a shift.</p> <p>2. Chairfast Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.</p> <p>2. Very limited Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.</p> <p>2. Probably inadequate Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only three servings of meat or dairy products per day. Occasionally will take a dietary supplement OR receives less than optimum amount of liquid diet or tube feeding.</p> <p>2. Potential problem Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.</p>	<p>4. No impairment Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.</p> <p>4. Rarely moist Skin is usually dry, linen only requires changing at routine intervals.</p> <p>4. Walks frequently Walks outside room at least twice a day and inside room at least once every two hours during waking hours.</p> <p>4. No limitation Makes major and frequent changes in position without assistance.</p> <p>4. Excellent Eats most of every meal. Never refuses a meal. Usually eats a total of four or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.</p>
<p>NUTRITION Usual food intake pattern.</p>	<p>1. Very poor Never eat a complete meal. Rarely eats more than 1/2 of any food offered. Eats two servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement OR is NPO and/or maintained on clear liquids or IV's for more than five days.</p>	<p>2. Very moist Skin is often, but not always moist. Linen must be changed at least once a shift.</p> <p>2. Chairfast Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.</p> <p>2. Very limited Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.</p> <p>2. Probably inadequate Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only three servings of meat or dairy products per day. Occasionally will take a dietary supplement OR receives less than optimum amount of liquid diet or tube feeding.</p> <p>2. Potential problem Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.</p>	<p>4. No impairment Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.</p> <p>4. Rarely moist Skin is usually dry, linen only requires changing at routine intervals.</p> <p>4. Walks frequently Walks outside room at least twice a day and inside room at least once every two hours during waking hours.</p> <p>4. No limitation Makes major and frequent changes in position without assistance.</p> <p>4. Excellent Eats most of every meal. Never refuses a meal. Usually eats a total of four or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.</p>
<p>FRICITION AND SHEAR</p>	<p>1. Problem Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. Frequently slides down in bed or chair, requiring frequent repositioning with maximum assistance. Spasticity, contractures or agitation leads to almost constant friction.</p>	<p>2. Very moist Skin is often, but not always moist. Linen must be changed at least once a shift.</p> <p>2. Chairfast Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.</p> <p>2. Very limited Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.</p> <p>2. Probably inadequate Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only three servings of meat or dairy products per day. Occasionally will take a dietary supplement OR receives less than optimum amount of liquid diet or tube feeding.</p> <p>2. Potential problem Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.</p>	<p>4. No impairment Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.</p> <p>4. Rarely moist Skin is usually dry, linen only requires changing at routine intervals.</p> <p>4. Walks frequently Walks outside room at least twice a day and inside room at least once every two hours during waking hours.</p> <p>4. No limitation Makes major and frequent changes in position without assistance.</p> <p>4. Excellent Eats most of every meal. Never refuses a meal. Usually eats a total of four or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.</p>
			Total score

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Appendix E

Pressure relieving devices available in Australia

Note: For the most current list of pressure relieving devices check the AWMA Inc website at: <http://www.awma.com.au>

Cushions	Overlays	Replacement	Mattress	Specialty beds	Supplier
Foam			TheraRest		KCI Medical Aust.
	Aerofil Standard Aerofil foam base Aerofil wedge	Aerofil			Starwell Aust
	Check pad	Check pad	Transfoam Wave TF5, Transfoam Wave TF6		Vernon-Carus
	Basix	Improtec Improtec Trolley/OT pad Basix	Improtec Standard Improtec HR Pro 2000		Mac Med Healthcare (Spenco)
	Vaperm		Vaperm		Huntleigh Healthcare
		Egg shell foam			Dunlop
	Maxifloat VE Pommel Maxifloat Tri Laminare Pommel Maxifloat wedge Maxifloat Die Cut Ultra foam		Maxifloat 'RX' series Maxifloat 'D' series		Sexton Textiles
	Foam Rest	Comfort Plus Foam Rest Foam Air Foam Air Plus	Comfort Plus Foam Rest Foam Air Foam Air Plus		Bosshard Medical
			Comfortline Comfortline Ultimate Clinifloat		Hill Rom Acute Care Systems Aust. Agents
	Confor-Med Medifoam	Confor-Med Medifoam	Confor-Med Medifoam		Joyce Healthcare (Australia)
	Trinity	Ripple overlay			Talley Medical
		Bodyform	Bodyform Plus Bodyform		Elite Medical (QLD)
	Techno Foam: Basic/Standard/Deluxe	Techno Foam: Convolutd Foam	Techno Foam: Basic/Standard/Deluxe		Pegasus (Wooltec)
Pin Dot				Invacare	
Fibre filled	Silicore chair seat Silicore full chair Intagrest chair seat Intagrest full chair	Silicore: Combi bed pad Hospital bed pad Stretcher pad Compact Integral Operating table pad			Mac Med Healthcare (Spenco)
	Unidown seat pad	Unidown Extra			Huntleigh Healthcare
		Supersoft			Pegasus (Wooltec)
		Ultradown			Elite Medical (QLD)
		Starfil			Starwell
	Transoft Silicone Fibre	Transoft Silicone Fibre			Vernon-Carus
Gel	Action Pilot Action Professional				Elite Medical (QLD)
			RIK Theatre Table (Fluid Therapy)		KCI Medical Aust.
	Trinity				Talley Medical
	Flo-Tech Range				Medical Support Systems
	Gelpot				Bosshard Medical

Cushions	Overlays	Replacement	Mattress	Specialty Beds	Supplier
	Omega 5000 (polymer)				Mac Med Healthcare (Spenco)
	Jay				Sunrise Medical
Foam - gel	Transflo				Vernon-Carus
	Maxifloat gel Maxifloat Geri gel Maxifloat Theramax				Sexton Textiles
	Action Centurion Action Xact				Elite Medical
	Intagrest 2000				Mac Med Healthcare (Spenco)
	Otto Bock Cloud Otto Bock Advantage Otto Bock Z-Flow				ETS
Static air	Adapt II	Adapt II			Purmark P/L
	Accumax WC14		Accumax		Sexton Textiles
	Roho	Roho			Seating Dynamic
	Kineris	Kineris			Bosshard Medical
Low air loss		First Step Plus Q2Plus	Therakair	Kinair III TheraPulse BioDyne II TriADyne	KCI Medical Aust.
		Alphacare			Huntleigh Healthcare
			Convertible II		Pegasus (Wooltec)
		Acucair	Flexicair Eclipse Unit V-Cue Dynamic Air Unit		Hill Rom Acute Care Systems
Alternating air cell			Duo Mattress		Hill Rom Acute Care Systems
	Base Sytem Trinity HR	Micro System Quattro 2 System Quattro Duo Care	Quattro Deep Cell 2000 Quattro Deep Cell 1000		Talley Medical
	Transcell Aura	Alpha Bed AlphaXcell Alpha Trancell Autoexcel	Nimbus II Floatation System.		Huntleigh Healthcare
	Transair 500	Transair/PPS 1000	Transair/PPS 2000		Vernon-Carus
	Airworks Care Chair	Airworks Super Airworks Sure	Airworks Success		KCI Medical Aust
	Pro-Active 2	Overture (Viaclin)	Bi-Wave Plus Cairwave Therapy System Trinova		Pegasus (Wooltec)
Air fluidised bed				Clinitron Dual Cooled Clinitron Rite Hite	Hill Rom Acute Care System
				FluidAir Elite	KCI Medical Aust.
Turning beds			Pulmonex Dynamic Air V-Cue Dynamic Air		Hill Rom Acute Care System
				Rotorest	KCI Medical Aust.

Appendix F

Glossary of Terms

Blanching hyperaemia – blanching of the skin in response to light finger point pressure being applied to an area of reactive hyperaemia, indicating that the microcirculation is intact¹⁸⁷.

Capillary closing pressure – the point at which pressure on the capillary exceeds blood pressure and the structural strength of the vessel and causes capillary collapse¹⁶⁸.

Clinical practice guidelines – systematically developed statements about care for specific clinical conditions that are based on the best available scientific evidence⁴.

Erythema – non-specific redness of the skin which may be localised or general in nature. It may be associated with cellulitis, infection, prolonged pressure or reactive hyperaemia¹⁸⁷.

Friction – a force created by two contact surfaces moving across one another⁷⁶.

Incidence – the number of new cases of a disease or event in a population during a specific period of time⁸.

Non-blanching hyperaemia – persistent redness when light finger point pressure is applied to an area of reactive hyperaemia, indicating a disruption to the microcirculation¹⁸⁷. In lightly pigment

individuals this would be classified as a *Stage 1* pressure ulcer⁵.

Oncotic pressure (colloid osmotic pressure) – the force created by non-permeating protein molecules within plasma that results in osmosis of water molecules from interstitial fluid into the capillary. Under normal circumstances colloid osmotic pressure is equivalent to the capillary hydrostatic pressure which forces fluid out of the capillaries; thereby creating a balance of fluid movement between plasma and the interstitial space¹⁸⁸.

Pressure – a perpendicular load or force exerted on a unit of area³⁶.

Pressure reducing support surfaces – support surfaces that reduce pressure at the surface interface below that found with the basic hospital mattress¹⁶⁷.

Pressure ulcer – any lesion caused by unrelieved pressure resulting in damage of underlying tissue⁵.

Prevalence – the number of existing cases of a particular disease or condition in a given population at a designated time⁸.

Period prevalence – the number of people with a disease or condition in a given population within a defined time period¹⁸⁹.

Point prevalence – the number of people with a disease or condition in a given population at a specific point in time ¹⁸⁹.

Reactive hyperaemia – a normal compensatory mechanism following an episode of reduced perfusion from localised pressure. Relief of this pressure results in a sudden increase in blood flow to the affected tissue ⁵.

Reliability – the degree to which results obtained by a measurement procedure can be replicated ⁸.

Measures of reliability:

Percentage agreement – percentage of occasions in which different people using the same instrument obtain the same result ¹⁸⁹.

Correlation – can be used to quantify the magnitude and direction of a relation. Scores range from -1.00 to +1.00. The closer to -1.00 or +1.00 the greater the reliability of the tool ¹¹⁸.

Risk factors – an aspect of a person's condition, lifestyle or environment which increases the probability of occurrence of a disease ⁸. In this case any factor which exposes the skin to excessive pressure, or diminishes its tolerance to pressure.

Shear – a parallel load forcing the skeleton to slide forward against a resistance created between the skin and its contact surface. The epidermis and dermis remain relatively

anchored to the contact surface while the deep fascia moves with the skeleton. The blood vessels between the dermis and deep fascia may be distorted resulting in thrombosis and capillary occlusion ⁷³.

Validity – the degree to which a result (of a measurement or study) is likely to be true and free of bias (systematic errors) ⁸.

Measures of validity:

Sensitivity – the accuracy in predicting those who develop the condition ¹⁸⁹.

Specificity – the accuracy in predicting those who do not develop the condition ¹⁸⁹.

Predictive value of positive tests – percentage of those at risk who actually develop the condition ¹⁸⁹.

Predictive value of negative tests – percentage of those not at risk who do not develop the condition ¹⁸⁹.

Tissue interface pressure – the pressure applied to the epidermis by the surface that is supporting it ¹⁶⁸.

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