

Pan Pacific Clinical Practice Guideline for the Prevention and Management of Pressure Injury



AWMA
Australian Wound
Management Association Inc.
National



Pan Pacific Guideline for the Prevention and Management of Pressure Injury (2012)

Published by the Australian Wound Management Association in collaboration with the New Zealand Wound Care Society, Hong Kong Enterostomal Therapists Association and the Wound Healing Society (Singapore).

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This guideline was developed by the Australian Wound Management Association in collaboration with the New Zealand Wound Care Society, New Zealand Wound Care Society, Nursing Service, Hong Kong Enterostomal Therapists Association and the Wound Healing Society (Singapore).

The guideline presents a comprehensive review of the assessment, diagnosis, management and prevention of pressure injuries within the Australian, New Zealand, Hong Kong and Singapore healthcare context, based on the best evidence available up to August 2011. The guideline is designed to provide information to assist in decision-making and is based on the best information available at the date of compilation. This document is a general guide to appropriate practice, to be implemented by a qualified health professional subject to his or her clinical judgment of each individual case and in consideration of the patient's personal preferences. The guideline should be implemented in a culturally safe and respectful manner in accordance with the principles of protection, participation and partnership.

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1 INTRODUCTION

Despite a general consensus that pressure injuries (PIs) are preventable adverse events, they continue to remain a problem in all health care settings. In addition to the significant financial costs (to health services and patients), PIs are associated with significant social cost in terms of increased morbidity and mortality, pain, discomfort, decreased mobility, loss of independence, social isolation and lost work time. As health care professionals, these are factors that warrant our concern.¹

The Australian Wound Management Association (AWMA) together with partners in New Zealand, Singapore and Hong Kong aims to optimise the prevention, assessment and management of PIs via the dissemination of this guideline that represents best available evidence, and simplify clinical decision-making processes for health care professionals. This guideline, developed by a multidisciplinary international team of experts, presents a comprehensive review of the prevention, assessment and management of PIs within the Australian, New Zealand, Hong Kong, Singapore and Pan Pacific region healthcare context, based on the best evidence available up to August 2011. The guidelines offer recommendations to help health care professionals provide quality care for patients of all ages and across a range of health care settings, such as acute care, post-acute care, community settings and long term care. The guideline is designed to provide information to assist in decision-making and is based on the best information available at the date of compilation. The guideline is not intended to have a regulatory effect.

Management of PI requires a multidisciplinary approach. This document is a general guide to appropriate practice, to be implemented by qualified health professionals subject to their clinical judgment of each individual case and in consideration of the patient's personal preferences and available resources. The guideline should be implemented in a culturally safe and respectful manner in accordance with the principles of protection, participation and partnership.

1.1 Acknowledgements

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1.2 Commonly used abbreviations

ABPI	Ankle brachial pressure index
AWMA	Australian Wound Management Association
AGREE	Appraisal of Guidelines for Research and Evaluation
AS	Australian Standard
BWAT	Bates-Jensen Wound Assessment Tool
BMI	Body mass index
BPUSRAS	Burn Pressure Ulcer Skin Risk Assessment Scale
CRP	C reactive protein
CALD	Culturally and linguistically diverse
CBR	Consensus based recommendation
CI	Confidence interval
CRIES scale	Crying; Requires oxygen for saturation >95%; Increasing vital signs; Expression; Sleepless scale
DAA	Dietitians Association of Australia
EMLA	Eutectic mixture of local anesthetic
EPUAP	European Pressure Ulcer Advisory Panel
ETF	Enteral tube feeding
FLACC	Face, Legs, Activity, Cry, Consolability
FRS	Wong-Baker FACES Pain Rating Scale
GIT	Gastrointestinal tract
GM-CSF	Granulocyte-macrophage colony-stimulating factor
HBOT	Hyperbaric oxygen therapy
HRQOL	Health related quality of life
IFD	Indentation force deflection
ITT	Intention to treat
Kcal	Kilocalorie
Kg	Kilograms
LLLT	Low level laser therapy
m ³	Metres cube
MNA-SF	Mini Nutritional Assessment Short Form
N	Number (of participants)
Nb	Note well
MHz	Megahertz
NHMRC	The National Health and Medical Research Council
MPQ	McGill Pain Questionnaire
NNT	Number needed to treat
NPUAP	National Pressure Ulcer Advisory Panel
NSRAS	Neonatal Skin Risk Assessment Scale
NS	Not statistically significant
NZ	New Zealand
OR	Odds ratio
PI / PIs	Pressure injury / Pressure injuries
PEMT	Pulsed electromagnetic therapy
PUSH Tool	Pressure Ulcer Scale for Healing
P value (p)	Probability value
pps	Pulses per second
PPV	Positive predictive value
QALYs	Quality adjusted life years

QI	Quality improvement
QOL	Quality of life
r	Sample correlation
RCT	Randomised controlled trial
RNAO	Registered Nurses Association Ontario
RR	Relative risk
RRR	Relative risk reduction
SCI	Spinal cord injury
SIGN	Scottish Intercollegiate Guidelines Network
SR	Systematic review
TBPI	Toe brachial pressure index
VAS	Visual analogue scale
WBP	Wound bed preparation
WHO	World Health Organisation
WMD	Weighted mean difference
WOCN	Wound Ostomy Continence Nurses Society

1.3 Glossary

Active support surface	A powered support surface that produces alternating pressure through mechanical means, thereby providing the capacity to change its load distribution properties with or without an applied load. This generally occurs through alternation of air pressure in air cells on a programmed cycle time. Also called an alternating pressure support surface or a dynamic support surface.
Air fluidised surface	A reactive (constant low pressure) support surface where a gentle flow of temperature controlled air is projected upward through numerous tiny openings called ceramic microspheres. e.g. a Cliniflon™ bed.
Alternating pressure support surface	A powered support surface that produces alternating pressure through mechanical means, thereby providing the capacity to change its load distribution properties with or without an applied load. This generally occurs through alternation of air pressure in air cells on a programmed cycle. Also called an active support surface or a dynamic support surface.
Antibiotic	Substance or compound administered systemically or applied topically that acts selectively against bacteria. ²
Antimicrobial	A term used to encompass antibiotics, antiseptics and disinfectants. A substance that inhibits the growth of, or eradicates micro-organisms. ²
Autolytic debridement	The selective process whereby the body releases endogenous proteolytic enzymes and phagocytes that gradually degrade non-viable tissue. ²
Blanching erythema	Reddened skin that blanches white under light pressure. May be difficult to visualise in darker skin tones.
Bioengineered skin substitutes	Manufactured skin substitutes derived from biological (human or animal cells) or synthetic products.
Bony prominence	An anatomical bony projection.
Bottoming out	When the deepest point of the patient's immersion in a reactive or an active support surface provides insufficient support to adequately redistribute pressure so the patient presents as sitting or lying on the underlying structure of the bed or chair.
Clinical infection	Multiplication of bacteria that overwhelm host defences, resulting in disruption of healing and damage to the wound. Wound infection can result in local and systemic host responses. ³
Conservative sharp wound debridement	Entails the removal of loose avascular tissue without pain or bleeding using a scalpel, scissors or other sharp, sterile instrument. ²
Constant low pressure support surface	A support surface which, in response to applied pressure, distributes interface pressure over a wider body area through immersing and enveloping the patient. May be referred to as reactive support surface or a static support surface.
Debridement	The removal of non-viable or infected tissue from or adjacent to a wound. ²
Deep tissue injury	Purple or maroon localised area or discoloured, intact skin or blood-filled blister due to damage of underlying soft tissue. Full description in section 7.3. ⁴
Density related to foam	Density is the weight of the foam in kilograms per cubic metre kg/m ³ .

Dressing selection	A structured approach to choosing the most appropriate dressing for a wound
Dynamic surface	A powered support surface that produce alternating pressure through mechanical means, thereby providing the capacity to change its load distribution properties with or without an applied load. This generally occurs through alternation of air pressure in air cells on a programmed cycle. Also called an active support surface or an alternating pressure support surface.
Electrotherapy	Electrotherapy is the application of electrical stimulation to the body to promote wound healing or relieve pain.
Enteral nutrition	The provision of nutrients through the gastrointestinal tract via a tube, when the patient cannot ingest food and fluids normally. ⁵
Envelopment	Refers to how well a support surface moulds to body contours and accommodates irregular areas (such as folds in clothing or bedding).
Enzymatic debridement	The use of products containing proteolytic enzymes designed to enhance naturally occurring wound debridement. ²
Erythema	Redness of the skin caused by dilatation and congestion of the capillaries, often a sign of inflammation or infection. May be difficult to visualise in darker skin tones. ¹
Eschar	Leathery brown or black necrotic tissue.
Extrinsic factors	Originating outside of the body
Friction	Friction is a mechanical force that occurs when two surfaces move across one another, creating resistance between the skin and contact surface. ^{1, 4, 6}
Growth factors	Growth factors are naturally occurring proteins or hormones that stimulate cell growth.
Hardness related to foam	Hardness is the ability of foam to 'push back' and carry weight, defined as the amount of force (in Newtons) required to indent a sample of the foam by a specific percentage of the original thickness.
High specification foam mattress	A type of mattress exhibiting density-hardness, support factor and depth characteristics superior to a "standard" mattress. Classified as Type H or HR according to Australian Standards (AS2281-1993).
Hydrocolloid	An adhesive waterproof wound dressing comprised of gel-forming sodium carboxymethylcellulose (NaCMC) and possibly gelatin and or pectin.
Hyperbaric oxygen therapy	Therapy requiring the patient to inhale 100% oxygen at pressures above normal atmospheric pressure.
Immersion	Refers to the ability of a support surface to allow a patient to sink into it.
Incidence	The proportion of at-risk patients who develop a new pressure injury over a specific period.
Indigenous	Original inhabitants such as people from an Aboriginal background, Torres Strait Island background or Maori background.
Infrared therapy	Low-energy laser that uses light in the infrared spectrum.
Intrinsic factors	Originating within the body
Interface pressure	The pressure between the patient's body and the support surface in use.
Laser therapy	A device that emits light (electromagnetic radiation) through a process of optical amplification based on the stimulated emission of photons. The term laser originated as an acronym for Light Amplification by Stimulated Emission of Radiation.
Larval debridement	Involves the application of sterile, green bottle fly (<i>Lucilia sericata</i>) maggots to the wound.
Likert scale	An interval-based multiple-choice style question frequently used in questionnaires.
Low air loss	A support surface that allows air to escape from air cells to manage skin heat and humidity. Available as overlays, replacement mattresses or within a whole bed system.
Malnutrition	Malnutrition is a broad term that refers to under-nutrition but technically it also refers to over-nutrition. People are malnourished if their diet does not provide adequate calories and specific nutrients for growth and maintenance or if they are unable to fully utilize the food they eat due to illness. They are also malnourished if they consume too many calories (over-nutrition). ⁵
Mechanical debridement	A process that removes tissue and debris via mechanical means including low frequency ultrasound, high pressure irrigation, hydrotherapy (whirlpool) and wet-to-dry dressings.

Medical grade honey	Honey that is filtered, gamma irradiated and produced under exacting standards of hygiene.
Medical grade sheepskin	A sheepskin that complies with the internationally recognised Australian Standard AS4480.1-1998.
Microclimate	The temperature of the skin or the soft tissues and humidity or skin surface moisture at the interface between the skin and the support surface. ¹
Moisture	Moisture alters resilience of the epidermis to external forces by causing maceration, particularly when the skin is exposed for prolonged periods. Moisture can occur due to spilt fluids, incontinence, wound exudate and perspiration. ¹
Necrosis	Devitalised or dead tissue.
Negative pressure wound therapy	The use of controlled negative pressure to assist and accelerate wound healing. Also known as vacuum assisted wound healing or topical negative pressure.
Non-blanching erythema	Erythema that remains reddened when pressure is applied and removed. ¹
Nutritional assessment	General assessment of nutritional status
Offload	To remove pressure from a skin surface.
Oral nutritional supplement	A commercial or other prepared food or beverage that supplements nutrient and caloric intake.
Overlay	A support surface placed onto a constant low pressure support surface or a 'standard' mattress. Overlays may be reactive (static) or active (dynamic) devices.
Pain	In the context of this guideline pain refers to an unpleasant sensory and emotional experience associated with a pressure injury. Patients may use varying words to describe pain including discomfort, distress and agony.
Patient	For the purpose of this guideline, any individual receiving health assessment, care or treatment in any setting.
pH	A measure on a scale from 0 to 14 of the acidity or alkalinity of a solution, with 7 being neutral, greater than 7 is more alkaline and less than 7 is more acidic.
Period prevalence	Total number of a given population with pressure injuries at any time during a specified period (rather than at one point in time).
Point prevalence	Total number of a given population with pressure injuries at a specific time.
Positioning	Position of normal body alignment to promote comfort, safety and relaxation, prevent deformities and reduce the effects of tissue strain on skin. ⁴
Pressure injury	A localised injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, shear and/or friction, or a combination of these factors. ⁴
Pressure injury healing assessment scale	Formal tool to assess and monitor condition of PIs.
Pressure ulcer	See pressure injury.
Pressure redistribution	The ability of a support surface on which the patient is placed to reduce the pressure load on bony prominences in contact with the surface by enabling either immersion or envelopment into the surface.
Prevalence	Total number of a given population with pressure injuries.
Pulsed electromagnetic therapy	Pulsed electromagnetic therapy (PEMT) exposes the patient to a magnetic field effect, usually in a pulsed fashion.
Psychosocial assessment	Assessment of an individual's mental, physical, social, emotional, environmental and cultural influences and wellbeing.
Reactive hyperaemia	A reddening of the skin in response to blood reperfusing hypoxic or ischaemic tissues when pressure is eliminated.
Reactive support surface	A support surface which, in response to applied pressure, distributes interface pressure over a wider body area through immersing and enveloping the patient. May be referred to as constant low pressure support surface or a static support surface.
Reliability	Measure of reproducibility of a measure
Repositioning	Changing a patient's body position to redistribute the pressure on the bony points that were in contact with the surface supporting the body. The frequency is determined by skin response, support surface in use and patient's general condition.
Risk assessment scale	Formal scale or score used to help determine the degree of pressure injury risk.
Risk assessment tool	See risk assessment scale.

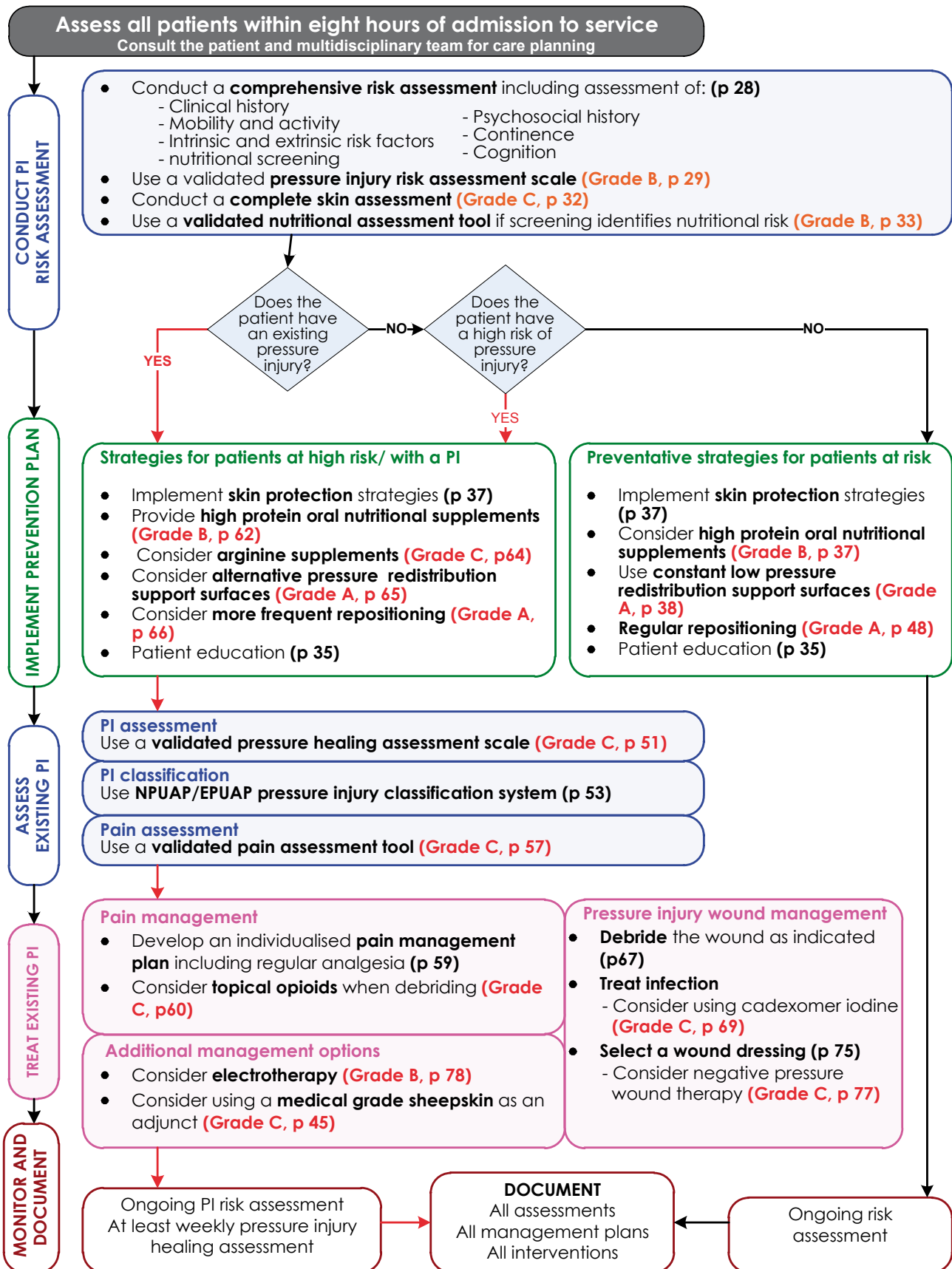
Seating cushion	Static (reactive) or dynamic (active) cushions on a chair for pressure redistribution purposes.
Skin assessment	General examination of the skin.
Shear	Shear is a mechanical force created from a parallel (tangential) load that causes the body to slide against resistance between the skin and a contact surface. The outer layers of the skin (the epidermis and dermis) remain stationary while deep fascia moves with the skeleton, creating distortion in the blood vessels and lymphatic system between the dermis and deep fascia. This leads to thrombosis and capillary occlusion. ^{1, 6, 7}
Sinus tract	A blind ended tract into the tissues from the skin and/or wound opening as a result of tissue destruction.
Slough	Moist soft necrotic tissue.
Specialty beds	Powered beds and replacement mattresses that function as a system for redistributing pressure and repositioning (i.e. the bed and mattress work together).
Stage I pressure injury	Pressure injury presenting as intact skin with non-blanchable redness of a localised area usually over a bony prominence. Full description in section 7.3. ⁴
Stage II pressure injury	Partial thickness loss of dermis presenting as a shallow, open wound with a red-pink wound bed, without slough Full description in section 7.3. ⁴
Stage III pressure injury	Pressure injury presenting as full thickness tissue loss in which subcutaneous fat may be visible but bone, tendon or muscle are not exposed. Full description in section 7.3. ⁴
Stage IV pressure injury	Pressure injury presenting as full thickness tissue loss with exposed bone, tendon or muscle. Full description in section 7.3. ⁴
Standard care	A term used to describe usual care, most often in research studies. Standard care varies according to the setting and historical context. Within the context of the guideline, a description of the standard care used in research studies has been provided when available.
“Standard” mattress	The definition of a “standard” mattress is variable, and may change between facilities and over time. Classified as Type N according to Australian Standards (AS2281-1993).
Static support surface	A support surface which, in response to applied pressure, distributes interface pressure over a wider body area through immersing and enveloping the patient. May be referred to as reactive support surface or a constant low pressure support surface.
Support surface	A surface on which the patient is placed to manage pressure load by distributing body weight pressure more effectively over the support surface. Support surfaces are classified as reactive (constant low pressure) or active (alternating pressure) surfaces. Includes bed, trolley and operating table mattresses and overlays; integrated bed systems; and seat cushions and overlays. ⁴
Surgical debridement	Rapid removal of necrotic or infected tissue performed under local or general anaesthetic.
Suspected deep tissue injury	Purple or maroon localised area of discoloured, intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. Deep tissue injury may be preceded by tissue that is painful, firm, mushy, boggy, or warmer or cooler than adjacent tissue. Deep tissue injury may be difficult to detect in individuals with dark skin tones. Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar. Evolution to a stage 3 or 4 PI may be rapid exposing additional layers of tissue with or without interventions. ⁴
Therapeutic ultrasound	Ultrasound therapy delivers acoustic vibrations in either a continuous or a pulsed manner.
Topical antibiotics	Antibiotics that are applied directly to a wound to reduce bacterial levels. ²
Topical biological agents	Topical agents that are applied directly to a wound to promote healing. ²
Tissue tolerance	The ability of skin and underlying tissues to endure pressure without experiencing any adverse effects.
Topical opioids	Topical application of morphine and its metabolites to skin ulcers to provide local relief from pain.
Topical silver	Application of a dressing product containing silver to a wound to manage wound bio-burden.
Ultraviolet light therapy	Ultraviolet light C is a wavelength of ultraviolet light that has been theorised to have a role in wound healing through cell proliferation stimulation, enhancing cutaneous blood flow and inhibiting bacterial growth.

Undermined edge/ undermining	An area of tissue destruction that extends under intact skin parallel to the wound edges. ²
Unstageable pressure injury	Pressure injury presenting as full thickness tissue loss in which the base of the PI is covered by slough or necrosis that prevents the determination of the true depth, and therefore the stage. Full description in section 7.3.
Validity	How well a tool measures the concept it claims to measure.
Viscoelastic foam	<p>Open cell flexible polyurethane foam with additional chemicals to increase its density and viscosity. It is often referred to as memory, slow recovery, or low resilience foam.</p> <p>Body heat , ambient temperature and humidity affect viscoelastic foam firmness, support and height recovery rate.</p> <p>Comparative laboratory testing must match ambient testing conditions for accurate comparisons and replicability of test results.</p>
Whirlpool	Hydrotherapy or the use of agitated water or saline used to cleanse or debride necrotic tissue.

1.4 Quick reference flow chart

FLOW CHART FOR PREVENTION AND MANAGEMENT OF PRESSURE INJURY

The Pan Pacific Clinical Practice Guideline for the Prevention and Management of Pressure Injury



2 SUMMARY OF RECOMMENDATIONS

Recommendation grades²	
Evidence based recommendations	
A	Excellent evidence - body of evidence can be trusted to guide practice
B	Good evidence - body of evidence can be trusted to guide practice in most situations
C	Some evidence - body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Weak evidence - body of evidence is weak and recommendation must be applied with caution
Consensus based recommendations (CBR)	
CBR	Consensus evidence – a graded recommendation could not be made due to a lack of evidence from SRs. Consensus recommendations are generally supported by international consensus from existing PI guidelines. The CBRs are supported by all members of Guideline Development Steering Committee.

PRESSURE INJURY RISK ASSESSMENT		Grade
1	Conduct a comprehensive assessment for <u>all</u> patients to identify pressure injury risk factors. A comprehensive assessment should include: <ul style="list-style-type: none"> • clinical history, • pressure injury risk scale, • skin assessment, • mobility and activity assessment, • nutritional assessment, • continence assessment, • cognitive assessment, • assessment of extrinsic risk factors. 	CBR
2	Use a pressure injury risk assessment scale in conjunction with a comprehensive risk assessment to determine the patient's risk of pressure injury and to inform the development of a prevention plan.	CBR
3	The Braden Scale, Norton Scale or Waterlow Score are validated and reliable scales for assessing pressure injury risk in adults.	B
4	Use a paediatric risk assessment scale in conjunction with a comprehensive risk assessment to determine a risk of pressure injury and to inform the development of a prevention plan for children.	CBR
5	Inspect the skin of all patients on admission and at each repositioning to identify indications of pressure injury including: <ul style="list-style-type: none"> • erythema, • blanching response, • localised heat, • oedema, • induration, and • skin breakdown. 	C
6	Conduct nutritional screening and assessment using validated screening and assessment tools appropriate to the population and clinical setting.	B
7	Conduct a psychosocial history to identify factors that impact on pressure injury prevention and management.	C
8	Provide patients with education on the prevention and management of pressure injuries.	CBR
PREVENTION OF PRESSURE INJURIES		Grade
9	Implement preventative strategies to protect the patient's skin.	CBR
10	Provide high protein oral nutritional supplements in addition to a regular diet for patients at a high risk of pressure injury.	B
11	Use a high specification reactive (constant low pressure) support foam mattress on beds and trolleys for patients at risk of pressure injuries.	A
12	No one specific high specification reactive (constant low pressure) support foam mattress is better than any other.	A

13	Active (alternating pressure) support mattresses could be used as an alternative in patients at high risk of pressure injuries.	A
14	Only consider using a medical grade sheepskin as an adjunct or when high specification reactive (constant low pressure) or active (alternating pressure) support surface is unavailable/not tolerated.	C
15	Any device used to prevent heel pressure injuries should be selected and fitted appropriately to ensure pressure is adequately offloaded.	CBR
16	Use a support cushion for patients at risk of pressure injury when seated in a chair or wheelchair.	C
17	Reposition patients to reduce duration and magnitude of pressure over vulnerable areas, including bony prominences and heels.	A
18	Frequency of repositioning should consider the patient's risk of pressure injury development, skin response, comfort, functional level, medical condition, and the support surface used.	CBR
19	Position patients using 30° lateral inclination alternating from side to side or a 30° inclined recumbent position. Use the prone position if the patient's medical condition precludes other options.	C
20	When repositioning the patient in any position always check the positioning of heels and other bony prominences.	CBR
21	Limit the time a patient spends in seated positions without pressure relief.	CBR
22	Use a high specification reactive (constant low pressure) foam mattress or an active (alternating pressure) mattress on operating theatre tables for patients at risk of pressure injuries.	B
23	Position the patient with heels elevated, knees flexed and the weight of the leg distributed along the calf to reduce the risk of pressure injuries in the operating theatre.	CBR
ASSESSMENT AND MONITORING OF PRESSURE INJURIES		Grade
24	Assess and monitor pressure injuries using a validated pressure injury healing assessment scale.	C
25	Consider using the NPUAP/EPUAP 2009 pressure injury classification system to identify and communicate the severity of pressure injuries.	CBR
ADDRESSING PAIN ASSOCIATED WITH PRESSURE INJURIES		Grade
26	All patients with pressure injuries should be regularly and routinely assessed for presence of pain.	C
27	Use a validated pain assessment tool to assist in assessing pain associated with a pressure injury.	C
28	Holistic management of a patient with pressure injuries includes development of an individualised pain management plan.	CBR
29	Consider using topical opioids to reduce pain associated with stage II to IV pressure injuries.	C
INTERVENTIONS FOR THE TREATMENT OF PRESSURE INJURIES		Grade
30	Provide high protein oral nutritional supplements in addition to a regular diet for patients with a pressure injury.	B
31	Consider multivitamin supplements in patients with a pressure injury who are identified as having nutritional deficits.	D
32	Consider arginine containing supplements in patients with a stage II or greater pressure injuries.	C
33	Manage patients with existing pressure injuries on a high specification reactive (constant low pressure) or active (alternating pressure) support surface on beds and trolleys and seating surfaces.	A
34	Continue repositioning patients with existing pressure injuries with consideration to: <ul style="list-style-type: none"> • the patient's risk for further pressure injury development, • comfort, • functional level, • medical and general condition, and • the support surface used. 	CBR

35	When debridement is indicated, select the method of debridement with consideration to: <ul style="list-style-type: none"> the patient's condition (including pain, vascular condition, and bleeding risk), comfort, type, quantity and location of non-viable tissue; goals of care; patient preferences; health professional training and experience; and availability of resources. 	CBR
36	Cleanse the peri-wound skin and pressure injury when wound dressings are changed.	CBR
37	Cadexomer iodine could be used to promote healing in pressure injuries when there is a known increased microbial burden.	C
38	Consider using topical medical grade honey to promote healing in pressure injuries.	D
39	Consider using topical silver to promote healing in pressure injuries.	CBR
40	Toxic topical antiseptic agents should not be used in the standard care of pressure injuries. Antiseptic solutions with no demonstrated toxicity should be considered in the treatment of pressure injuries with clinical evidence of infection or critical colonisation.	CBR
41	Topical antibiotics are best avoided in the management of pressure injuries as there is a concern that their use is associated with antibiotic resistance and sensitivities.	CBR
42	Use systemic antibiotics when the patient with a pressure injury has clinical evidence of spreading and/or systemic infection.	CBR
43	Consider using a hydrocolloid dressing to promote healing in non-infected stage II pressure injuries.	C
44	Select wound dressings based on: <ul style="list-style-type: none"> comprehensive ongoing clinical assessment, management of pain, malodour, exudate and infection, wound size and location, cost and availability, and patient preference. 	CBR
45	Consider negative pressure wound therapy as an adjunct for treating stage III or IV pressure injuries.	C
46	Consider using electrotherapy as an adjunct for promoting healing in pressure injuries.	B
47	Pulsed electromagnetic therapy could be considered as an adjunct for promoting healing in pressure injuries.	D
48	Ultraviolet light C therapy could be considered as an adjunct for promoting healing in pressure injuries.	D
49	There is insufficient evidence to make a recommendation on the use of ultraviolet light C therapy for reducing bacterial burden in pressure injuries.	CBR
50	Education in the prevention, assessment and management of pressure injury should be provided to all health professionals.	C
51	Patients with stage III or IV pressure injuries that are non-responsive to contemporary management strategies should be evaluated for surgical intervention.	CBR
52	Therapeutic ultrasound does not improve healing in stage I or II pressure injuries.	A
53	The effectiveness of therapeutic ultrasound in treating stage III or IV pressure injuries is unknown.	CBR
54	There is insufficient evidence to make a recommendation on the use of the following interventions for treating pressure injuries: <ul style="list-style-type: none"> hyperbaric oxygen infrared therapy laser therapy miscellaneous topical agents 	

3 BACKGROUND

A pressure injury (PI) is a “localised injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear and/or friction.”^{14 p.16} Other contributing or confounding factors are associated with PIs; however, the role and significance of these factors requires further research. Previous terms that have been used to describe pressure injuries include pressure ulcers, pressure sores, decubitus ulcers, sores, pressure necrosis and ischaemic ulcers.¹

International studies indicate a wide range in PI prevalence, related to the care setting and types of patients. In Australia, one estimate of PI prevalence in acute and sub-acute health care facilities ranged from range 5.6% to 48.4% (mean 25.5%)⁹ and estimates in acute care facilities range from 4.5% to 36.7%.^{10, 11} Hospital acquired PIs accounted for 67.6% of PIs identified,⁹ with most PIs being stage I or II and located over the sacro-coccygeal region, heels, elbows or malleoli.¹² The prevalence of PIs in Australian long term care facilities was estimated to be 26% in 2004.¹³ The variations in prevalence rates appear primarily related to study methods.¹² Despite being a largely preventable health problem, PIs remain prevalent and extract a considerable fiscal and social cost.¹

The most recent estimates of the prevalence of PI in New Zealand were reported in 2003 and 2005. In 2003, prevalence of PI in an acute care facility was identified at 29% and in 2005, prevalence of PI in an intensive care unit in a major teaching hospital (determined from patient record audits) was reported at 38.5%.¹²

In South East Asia, PI prevalence data dates to the 1990s. In 1998 the Ministry of Health Nursing Department reported PI prevalence in Singaporean acute and rehabilitation settings ranged from 9 to 14%.¹² A 1991 published report on PI prevalence in a Hong Kong rehabilitation setting provided an estimate of 21%.¹²

One 2005 Australian study¹⁴ predicted the number of cases of PI in adults, the bed days lost, and the economic value of these losses at public hospitals. The authors reported a median of 95,695 cases of PIs in Australian public hospitals, with a median of 398,432 bed days lost. The median opportunity costs were AU\$285 million nationally with greatest cost attributed to New South Wales and the lowest in Australian Capital Territory.¹⁴

The significant impact of PIs on health related quality of life (HRQOL) has been investigated extensively.¹⁵ Patients with PIs report negative impact of symptoms associated with PIs such as pain, infection, delayed healing and wound characteristics (e.g. exudate and odour). These factors impact upon the general health of patients, are related to physical limitations and sleep deprivation, and can have a psychological effect. Patients reported negative emotions and mood alterations, and issues related to body image, coping and acceptance. Patient perception of the aetiology of PIs was often associated with anger and blame, particularly when the PI was acquired in a health care facility. These factors all contributed to personal suffering and impacted on relationships with others, including their carers.¹⁵

Management of PIs further impacts upon patient HRQOL, particularly when their preferences are not considered in management planning. Repositioning regimens were reported as impacting upon sleep and activities, wound dressing choices were an area of conflict between patients and health professionals, and hospitalisation or regular attendance at health care services had social and financial implications.¹⁵

It is evident that PIs represent a serious clinical and economic problem, and their prevention and appropriate management is an imperative to promoting patient health outcomes and improving international health budget efficiency.

3.1 Aim of the guideline

The aim of the guideline is to increase awareness of PIs amongst health care professionals. The primary objectives are to promote the prevention and optimal care of patients at risk of, or with, PIs. The guideline specifically seeks to assist health professionals to:

- identify patients at risk of PI,
- identify strategies to assess PIs and factors related to their risk,
- prevent or delay complications associated with PIs,
- optimise management of PIs, and
- optimise quality of life.

The guideline may also be used as an educational source and for use by policy developers in developing local practice policies and procedures.

3.2 Scope and target population

The guideline is intended for use by health professionals including but not limited to medical and surgical specialists, general practitioners, allied health professionals, nurse practitioners, nurses, pharmacists, rural health workers and Indigenous health workers. The guidelines could also be used as an informative source for consumers and unlicensed carers.

The guideline is intended for use in all health care settings in metropolitan, regional, rural and remote areas of Australia, New Zealand, Singapore, Hong Kong and other regions in the Pan Pacific and refers to people of all ages.

3.3 Focus of the guideline

The guideline focus is pressure injuries, excluding those of the mucosa.

The staging system for PI of the skin cannot be used to stage mucosal PIs. The reasons for this is that nonblanchable erythema cannot be seen in mucous membranes, as shallow open ulcers indicating superficial tissue loss of the non-keratinized epithelium are so shallow that they are visually indistinguishable from deeper, full thickness ulcers. Soft coagulum seen in mucosal PIs, which resembles slough in Stage III PIs, is actually soft blood clot. Exposed muscle would seldom be seen and bone is not present in mucosa.¹⁶ Although it is agreed that mucosal injuries may be PIs, anatomically analogous tissue comparisons cannot be made. Therefore, in keeping with the NPUAP Position Statement,¹⁶ the Guideline Development Steering Committee concur that PIs on mucous membranes be labelled as mucosal PIs without a stage identified. It is highly recommended that research into mucosal injuries be conducted.

3.3.1 Clinical questions

Assessment of patients and their risk of pressure injury

What strategies or tools for assessing the risk of PI have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these strategies or tools provide a reliable and valid method of assessing PIs?

Prevention of pressure injuries

What interventions for preventing PIs have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these interventions are effective in reducing the risk of PI development?

Assessment of pressure injuries

What strategies or tools for assessing PIs have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these strategies or tools provide a reliable and valid method of assessing PIs?

Addressing pain associated with pressure injury

What strategies or tools for assessing pain associated with PIs have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these strategies or tools provide a reliable and valid method of assessing pain associated with PIs?

What interventions for managing pain associated with PIs have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these interventions are effective in managing pain associated with PIs?

Management of pressure injury

What interventions for treating PIs have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these interventions are effective in promoting healing in PIs?

4 GUIDELINE DEVELOPMENT PROCESS

This section outlines the process used for the development of the evidence-based the *Pan Pacific Clinical Practice Guideline for the Prevention and Management of Pressure Injury*. The process consisted of the following major phases.

- Formation of an international, multidisciplinary Guideline Development Steering Committee (see Appendix A)
- Formation of smaller international, multidisciplinary Guideline Development Groups (see Appendix A) to review each area of care
- Identification and appraisal of relevant existing clinical guidelines, leading to the selection of existing guidelines for use as primary references
- Systematic literature searches to identify the most recent level I evidence
- Synthesis of new evidence and evidence from the primary reference guidelines into clinical recommendations and algorithms
- Grading of recommendations using a matrix developed by the NHMRC
- Public consultation and consensus process to determine the terms used in this guideline to describe PI staging classification
- Development of consensus guidelines and practice points using a peer consensus process
- Peer review and appraisal through a public consultation process
- Response to feedback and completion of final guideline

4.1 Identification, appraisal & selection of existing clinical guidelines

Due to extensive research that has been published on the prevention, assessment and management of PIs it was not feasible for the Guideline Development Steering Committee to conduct appraisals and a review of all the relevant research within the time and budget constraints of this project.

Numerous relevant clinical guidelines have been developed in the past. It was determined that the most feasible methodology would be to base the guideline of level I evidence⁸ and use appropriate existing guidelines as primary references for the guideline, particularly in clinical areas for which no level I evidence⁸ was available .

Existing PI guidelines were identified through a search of the National Guidelines Clearing House, those identified in the literature searches and those known to the Guideline Development Steering Committee. Guidelines were selected for appraisal if they were evidence-based, addressed the focus of the current project and were published since January 2005. Identified guidelines that were excluded from the appraisal process are listed in Appendix B. Selected guidelines were appraised using the Appraisal of Guidelines for Research and Evaluation (AGREE) instrument (<http://www.agreecollaboration.org/>). The AGREE instrument includes 21 questions (each assessed on a 4-point Likert scale) organised into six quality domains:

- scope and purpose,
- stakeholder involvement,
- rigour of development,
- clarity and presentation,
- applicability, and
- editorial independence.

Each guideline was assessed by two reviewers and an overall percentage for each domain was calculated using the formula outlined in the AGREE tool. The identified guidelines assessed using the AGREE tool and the results are presented in *Table 4.1*.

Table 4.1 – AGREE scores of appraised existing pressure injury guidelines (guidelines shaded white are those selected for use in the development of this guideline)

Guideline	Domain 1. Scope & purpose	Domain 2. Stakeholder involvement	Domain 3. Rigour of development	Domain 4. Clarity & presentation	Domain 5. Applicability	Domain 6. Editorial independence
NPUAP/EPUAP, 2009 ⁴	75%	81%	66%	88%	25%	63%
Queensland Health, 2008 ¹⁷	29%	56%	28%	25%	25%	25%
Whitney et al, 2006 ¹⁸	63%	44%	25%	81%	25%	44%
ICSI, 2010 ¹⁹	63%	63%	46%	26%	81%	88%
RNAO, 2007 ²⁰	100%	91%	96%	100%	92%	63%
Stechmiller et al, 2008 ²¹	33%	38%	39%	50%	25%	25%
Stockton et al, 2009 ²²	75%	38%	57%	44%	25%	88%
Pace et al, 2007 ²³ and the TTDWCG 2011 update ^{5, 23}	100%	38%	86%	100%	92%	100%
WOCNS, 2010 ⁶	50%	44%	64%	100%	25%	88%

The following guidelines were selected as primary sources of information for the following reasons:

- The National Pressure Ulcer Advisory Panel and European Pressure Ulcer Advisory Panel (NPUAP/EUPAP) guideline⁴ was developed using a satisfactory level of rigour, was clearly presented and had strong stakeholder involvement. The guideline included recommendations graded level A (based on large RCTs with clear results), level B (based on clinical series evidence) or level C (indirect evidence or consensus opinion).
- The Registered Nurses' Association of Ontario (RNAO) guideline²⁰ was developed using a very high level of rigour, strong stakeholder involvement and was highly applicable. The guideline included recommendations graded Ia (evidence from SRs of RCTs), Ib (at least one RCT), IIa (non-randomised trials), IIb (non-randomised quasi-experiments), III (descriptive studies) and IV (consensus opinion).
- The Trans Tasman Dietetic Wound Care Group (TTDWCG) guideline⁵ (early edition by Pace et al²³) was developed using a high level of rigour, was clearly presented and was highly applicable. It provided guidance in areas where there was less evidence available from systematic reviews. The guideline included recommendations graded using the NHMRC grading system.
- The Wound Ostomy and Continence Nurses Society (WOCNS)⁶ guideline had a satisfactory level of rigour, was clearly presented and included appropriate tools, and was the most recently published relevant guideline. The guideline included recommendations graded level A (based on two or more RCTs or higher level evidence), level B (non-randomised trials or controlled trials) and level C (case series or expert opinion).

The graded recommendations from these guidelines and the evidence underpinning them are presented in the evidence summaries throughout this guideline and were considered in the grading of the recommendations. The consensus recommendations from these guidelines were considered in the development of the practice points.

4.2 Identification, appraisal and synthesis of new evidence

4.2.1 Search strategy

Searches were conducted for systematic reviews (SRs) that provided Level I evidence⁸ on the prevention, assessment and management of PIs. The search was performed in OVID Medline, OVID Embase, OVID CINAHL, the Cochrane library, the Australian Wound Management Association journal, and reference lists of included reviews for English language publications from January 1980 to March 2011. The database search of MEDLINE, EMBASE and CINAHL combined search terms describing PIs using filters for systematic reviews to limit the identified evidence to that of a high level. Relevant SRs published between March 2011 and August 2011 was identified on an ad-hoc basis by members of the Guideline Development Steering Committee. The search strategies are provided in full in Appendix C.

4.2.2 Inclusion/exclusion criteria

Types of studies

Studies that provide Level I evidence on the NHMRC Levels of evidence scale⁸ (see Table 4.2) were considered for inclusion.

Types of participants

The review included research conducted in participants with PIs and participants considered at risk of developing PIs. There were no age restrictions or restrictions to specific clinical settings; however participants with mucosal PIs were excluded.

Table 4.2 – NHMRC levels of evidence⁸

Level	Intervention	Diagnosis
I	Evidence obtained from a systematic review of all relevant randomised, controlled trials	A systematic review of level II studies
II	Evidence obtained from at least one properly designed, randomised, controlled trial	A study of test accuracy with independent blinded comparison with a valid reference standard, among consecutive patients with a defined clinical presentation
III –1	Evidence obtained from well-designed, pseudo-randomised, controlled trials (alternate allocation or some other method)	A study of test accuracy with independent blinded comparison with a valid reference standard, among non-consecutive patients with a defined clinical presentation
III –2	Evidence obtained from comparative studies with concurrent controls and allocation not randomised (cohort studies), case-control studies, or interrupted time series with a control group	A comparison with reference standard that does not meet the criteria for Level II or Level III-1 evidence
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	Diagnostic case–control evidence
IV	Evidence obtained from case series, either post-test or pre-test and post-test	Study of diagnostic yield (no reference standard)

Types of interventions

Evidence defined as falling within, but not limited to, the following categories was considered for inclusion:

- Interventions: positioning, support surfaces, nutrition, education, health professional training and competency, pharmacological management, complementary and/or alternative treatments, wound management products, hyperbaric oxygen, psychosocial interventions, education and pain management strategies.

- Diagnosis and assessment: risk assessment, PI assessment tools, pain assessment, health professional education and competency, PI staging scales.

Types of outcomes

Outcome measures of interest included:

- Outcomes assessing wound response to the intervention: time to complete wound healing, change in wound size, proportion of PIs healed, prevention of recurrence (e.g. number of new PIs developed in trial period).
- Other outcomes related to the intervention: quality of life and global assessments, functional outcomes, pain, compliance with therapy.
- Adverse events.

4.2.3 Critical appraisal

All SRs were critically appraised by two reviewers. A third reviewer appraised all papers to ensure consistency in appraisal between reviewers. Discrepancy in appraisal was resolved through discussion between the three reviewers until a consensus was reached. Critical appraisal tools developed by the Scottish Intercollegiate Guidelines Network (SIGN) (www.sign.ac.uk/methodology/checklists.html) were used to appraise all the research. The SIGN tool allows assessment against key indicators of quality including:

- a well-defined clinical objective,
- description of methodology, including description of appropriate inclusion, criteria, systematic data extraction and multiple reviewers,
- thorough and transparent search strategy,
- validity of included studies is appraised and reproducible,
- appropriate strategies are used for pooling and analysing results, and
- potential conflicts of interest are clearly reported.

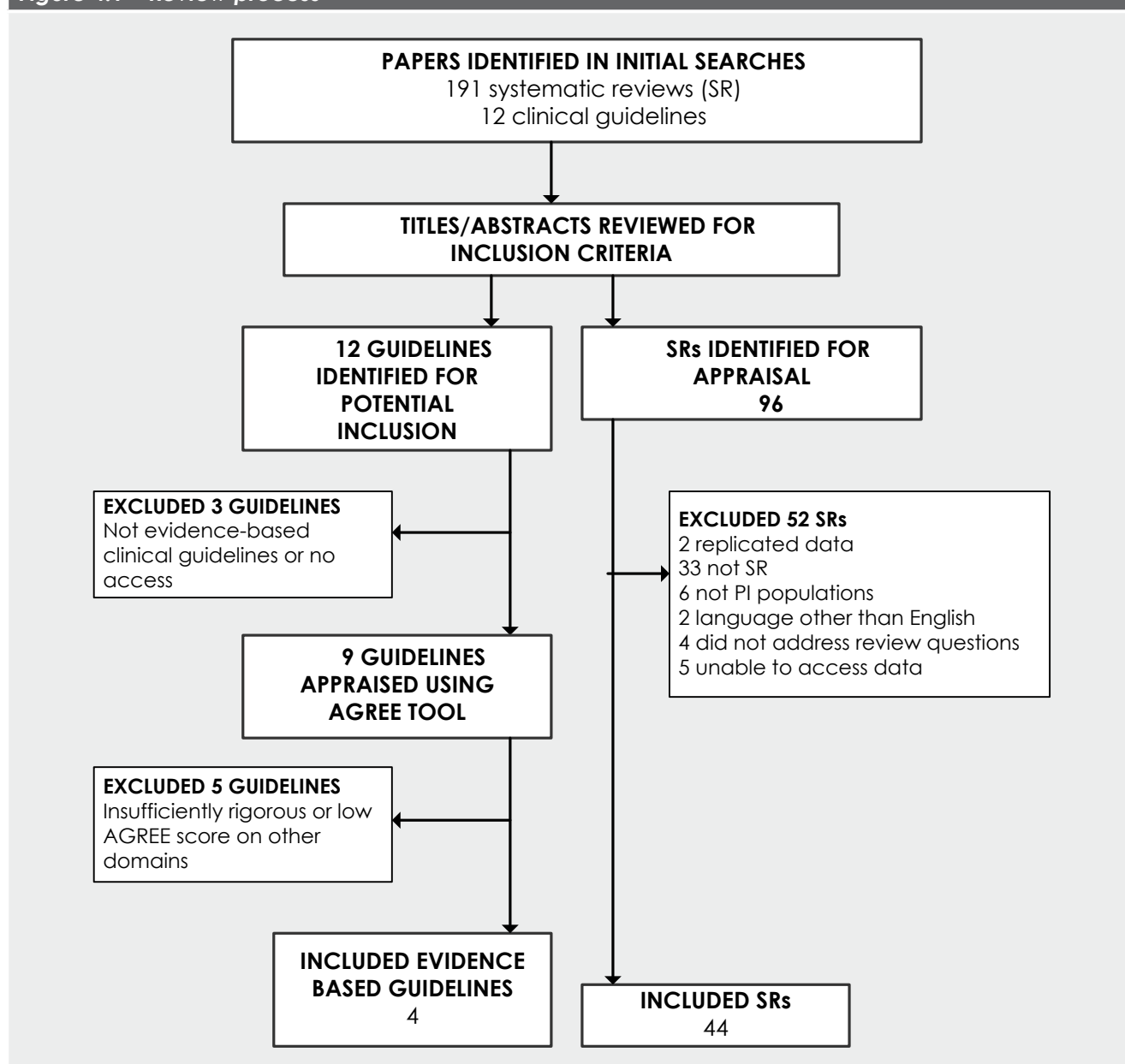
Appendix D outlines the results of the critical appraisals and a summary of the volume, type and quality of research included in each SR.

4.2.4 Data extraction

One reviewer systematically extracted the data from all studies using a data extraction tool that combined NHMRC data extraction⁸ suggestions with information collected using the SIGN checklist tools. Data from included studies was presented in evidence summaries.

4.2.5 Identified research

Over 200 relevant reviews and guidelines were identified in the initial searches. Papers were initially selected for inclusion based on the title and/or the abstract by one reviewer and overseen by the Chair of the Guideline Development Steering Committee. As shown in Figure 4.1, a total of 108 papers and guidelines were identified for retrieval. Research subsequently excluded following initial identification is presented in Appendix B.

Figure 4.1 – Review process

4.3 Development and grading of recommendations

The Guideline Development Steering Committee and Guideline Development Groups used the best available evidence from SRs and existing clinical guidelines, together with their expert opinion to develop recommendation statements relevant to health care practice within Australia, New Zealand, Singapore, Hong Kong and other Pan Pacific countries.

The evidence from SRs and clinical guidelines was collated into evidence summaries, presented throughout the guideline. A body of evidence assessment matrix outlined in *NHMRC levels of evidence and grades for recommendations for developers of guidelines*⁸ (Table 4.3) was used to assess the volume and consistency of evidence supporting each recommendation; as well as the clinical impact, generalisability and applicability.

The body of evidence supporting each recommendation was given a final grading (Table 4.4) representing its overall strength. The grades reflect the confidence and trust health professionals can have when implementing recommendations in clinical practice.

Table 4.3 - Body of evidence assessment matrix⁸

Component [#]	A	B	C	D
	Excellent	Good	Satisfactory	Poor
Evidence base	Several level I or level II studies with low risk of bias	One or two level II studies with low risk of bias or a SR of multiple level III studies with low risk of bias	Level III studies with low risk of bias or level II studies with moderate risk of bias	Level IV studies or level I to III studies with high risk of bias
Consistency	All studies consistent	Most studies consistent and inconsistencies may be explained	Some inconsistency reflecting genuine uncertainty around clinical question	Evidence is inconsistent
Clinical Impact	Very large	Substantial	Moderate	Slight or restricted
Generalis-ability	Population/s studied in body of evidence are the same as the target population for the guideline	Population/s studied in the body of evidence are similar to the target population for the guideline	Population/s studied in the body of evidence different to the target population for the guideline but it is clinically sensible to apply this evidence to the target population (e.g. results in adults that are clinically sensible to apply to children)	Population/s studied in the body of evidence different to the target population for the guideline and hard to judge whether it is sensible to generalise to the target population
Applicability*	Directly applicable to Australian healthcare context	Applicable to Australian healthcare context with few caveats	Probably applicable to Australian healthcare context with some caveats	Not applicable to Australian healthcare context

[#] Where the component was unable to be graded, U (unknown) was recorded.

*Applicability to the context in other Pan-Pacific countries was also considered.

Table 4.4: Recommendation grades⁸

Evidence based recommendations	
A	Excellent evidence - body of evidence can be trusted to guide practice
B	Good evidence - body of evidence can be trusted to guide practice in most situations
C	Some evidence - body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Weak evidence - body of evidence is weak and recommendation must be applied with caution
Consensus based recommendations (CBR)	
CBR	Consensus evidence – a graded recommendation could not be made due to a lack of evidence from SRs. Consensus recommendations are generally supported by international consensus from existing PI guidelines. The CBRs are supported by all members of Guideline Development Steering Committee.

The overall grade was reached through discussion within Guideline Development Groups until majority consensus was reached. The Guideline Development Steering Committee reviewed all recommendations and grading and added further consensus. Unequivocal consensus was reached on the inclusion and grading of all the recommendation statements.

Each grading is based on a summation of the grading of individual components represented in the body of evidence assessment matrix. In reaching an overall grade, recommendations were not graded A or B unless the volume and consistency of evidence components were both graded either A or B.⁸ The wording of recommendation statements was designed to reflect their message and the grade of evidence supporting the recommendation statement.

Evidence based graded recommendations are shaded in red throughout the guideline.

4.3.1 Process for consensus based recommendations

Consensus based recommendations have been made for areas in which no high level research conducted in populations with PIs was identified in the literature search. These recommendations address topics considered important by the Expert Working Committee and/or identified in the evidence-based guidelines used as primary resources.

The NHMRC grading system does not recognise non-analytical studies, discussion, case studies or opinion of experts, therefore fields for which this is the best available evidence fall outside the grading system. A full search for these lower levels of evidence was not conducted; however, consensus based recommendations in the evidence-based guidelines used as primary resources and evidence-based guidelines conducted in similar populations (e.g. patients with chronic wounds) have been used to support the expert opinion recommendations.

After conducting the full literature searches and failing to locate SRs, the expert opinion recommendations were developed through group discussion and email. Discussion continued until consensus was reached regarding topics appropriate to include and the content of each recommendation.

Consensus based recommendations are shaded in blue throughout the guideline.

4.3.2 Development of practice points

Most recommendations are accompanied by practice points to assist clinicians to implement the recommendation. The practice points were developed by the Expert Working Committee and reflect their considerable experience in assessing and managing PIs in a range of clinical settings. A full search of the literature was not conducted for each practice point. Practice points are supported by:

- studies and evidence-based guidelines included in the review,
- manufacturer product information, and
- evidence beyond the scope of the literature review (e.g. guidelines referring to general management of chronic wounds).

4.4 Limitations of the guideline

4.4.1 Topical preparations and wound dressings

The literature search was not designed to retrieve safety trials for wound care therapies including dressings, antimicrobials and other topical preparations. The guideline does not seek to provide full safety and usage information; however commonly available safety and usage tips have been included. Adverse events reported in the research included in the review have been reported in the evidence summaries and caution statements. The Guideline Development Steering Committee recommends consulting the National Prescribing Service (www.nps.org.au), Australian Therapeutic Guidelines (www.tg.org.au) or New Zealand Medicines and Medical Devices Safety Authority (www.medfsafe.govt.nz) for detailed product information. All products should be used according to manufacturer's directions.

4.4.2 Search date and strategy

The guideline is based on SRs published from January 1980 to March 2011. The guideline is also based on international evidence-based guidelines published from January 2005 scoring highly on the AGREE tool. Evidence published before and after these dates has not been reviewed or considered for the guideline.

The search was limited to NHMRC level I evidence (SRs) and existing evidence-based guidelines. The Guideline Development Steering Committee acknowledges that other evidence may exist (e.g. RCTs or cohort studies not reported in the included SRs); however the evidence-based recommendations in the guideline are based on recent, well conducted SRs that report a comprehensive overview of the available evidence.

4.4.3 Outcome measures

The outcome measure most frequently reported in the evidence was "healing of PIs". The Guideline Development Steering Committee acknowledges that some products or interventions may have other beneficial outcomes (e.g. preparing the wound bed for other treatments) that have not been investigated or reported in the research. The Guideline Development Steering Committee has attempted to address this in the practice points.

4.4.4 Lack of evidence

For some interventions there was limited evidence from which to draw conclusions on potential effectiveness. These interventions have received a lower grade due an insufficient body of evidence at this stage. The Guideline Development Steering Committee considered a single low quality trial to be insufficient evidence on which to make a recommendation.

Some interventions may provide benefit for outcomes that have not been addressed in the research (e.g. patient well-being). The Guideline Development Steering Committee acknowledges that **lack of evidence is not evidence of lack of effect**.

Some interventions were not supported, or received a lower grade, because research indicated there was a lack of effect. The Guideline Development Steering Committee acknowledges that this refers to **lack of evidence of effect over placebo or standard therapy**. That is: patients may receive beneficial outcomes from the intervention; however, these outcomes do not exceed beneficial effects that can be expected from a placebo therapy or standard care.

4.5 Consultation

A draft version of the *Pan Pacific Clinical Practice Guideline for the Prevention and Management of Pressure Injury* was presented to the AWMA General Committee and nominated membership for comment and feedback. Similar processes were followed by New Zealand, Singapore and Hong Kong partners. These groups consist of professionals representing all major fields of health care including general practice, specialist medical and surgical fields, nursing, nutrition, occupational therapy, physiotherapy, podiatry, education and wound care.

In October 2011 the draft version of the *Pan Pacific Clinical Practice Guideline for the Prevention and Management of Pressure Injury* was presented at a public forum in Canberra and placed on the AWMA website. The public was informed of the draft guideline and the consultation period was announced at the forum, in The Australian newspaper and on the website. Known stakeholders and peak body groups representing health professionals were sent invitations to review the material. Feedback was collated and the AWMA Guideline Development Steering Committee made appropriate changes to the guideline based on the comments received and related available evidence.

The Guideline Development Steering Committee would like to thank all the all respondents who provided feedback during the consultation phase including:

- Dietitians Association of Australia Malnutrition Guideline Steering Committee
- College of Nurses Aotearoa (NZ) Inc
- Mary Potter Hospice Team
- RBWH PUP Committee
- ArjoHuntleigh
- Queensland Pressure Injury Collaborative
- Alana Baker, Clinical Dietitian, Auckland, NZ
- Andrea Mears
- Anna Campbell, Wound Care Waikato DHB
- Associate Professor Andrew Jull, School of Nursing University of Auckland

Brenda Sando

Colleen O'Brien-Malone, Occupational Therapist, WA

Catherine Hammond, Clinical Nurse Specialist Wound Care, Christchurch, NZ

Annette Findlay, Quality and Risk Coordinator and Maori Cultural Advisor, Christchurch, NZ

Adrian Te Patu, Maori Cultural Advisor, Christchurch, NZ
Catherine Sharp, Consultant

Dr David Huber, Chief of the Department of Vascular Surgery, Illawarra Health Area Service

Dr Robert Carter

Mr Anthony Warr

Julie Betts, NP Wound Care, Waikato DHB New Zealand

Kathy Lynch

Mandy Pagan

Margaret Gosnell, Nurse Educator, Whanganui District Health Board

Marianne Mackenzie

Michael Nestmann

Pip Rutherford

Sally Sutherland-Fraser, Clinical Nurse Consultant, Victoria

Suzanne Kapp, RN, Victoria

Suzanne Jackson

Wendy White

Jane Edwards

M. Smith

Diane Hishon, Wound Care Advisor; Ambulatory Nurse Educator; RN

Sue Templeton, Nurse Practitioner (Wound Mgt)

4.6 Dissemination

The final version of the 2012 edition of the *Pan Pacific Clinical Practice Guideline for the Prevention and Management of Pressure Injury* has been made publicly available on the following websites:

- AWMA website (free access), <http://www.awma.com.au/>
- New Zealand Wound Care Society website (free access), www.nzwcs.org.nz/
- Wound Healing Society (Singapore) www.woundhealingsociety.org.sg.

An abridged version and a consumer version of the guideline are planned for development and dissemination.

5 PRESSURE INJURY RISK ASSESSMENT

5.1 Clinical questions

What strategies or tools for assessing the risk of PIs have been reported in systematic reviews and evidence-based clinical guidelines?

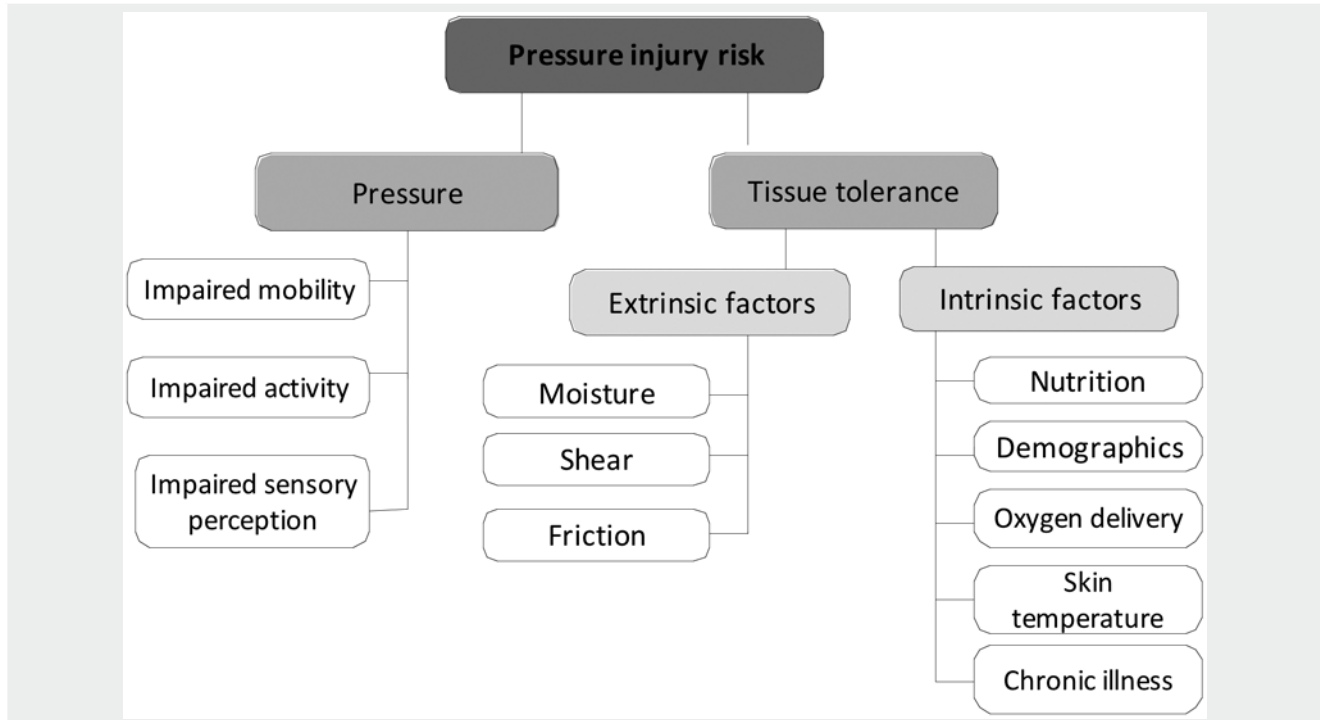
Which of these strategies or tools provide a reliable and valid method of assessing PI risk?

5.2 Factors associated with an increased risk of pressure injury

An imperative in the prevention of PIs is the assessment and identification of patients at risk and implementation of an individualised prevention plan. Risk assessment includes consideration of both patient and environmental factors that are associated with the development of PIs.

A risk factor is any factor that either contributes to increased exposure of the skin to excessive pressure or diminishes the skin's tolerance to pressure (see Figure 5.1). The literature search was not designed to retrieve research on factors associated with PI risk; however one SR provided evidence related to patients with spinal cord injury (SCI). Risk factors were presented in previously published guidelines.

Figure 5.1 Factors associated with increased risk of pressure injury²⁴



5.2.1 Increased exposure to pressure

Risk factors that increase exposure of the skin to pressure are related to impaired mobility, activity or sensory perception, all of which reduce the patient's ability to change their body position in order to reduce pressure. Numerous prospective and retrospective studies have identified specific factors that fall into these categories including, but not limited to:^{1, 6}

- spinal cord injury (SCI),
- stroke,
- multiple sclerosis,
- trauma (e.g. fracture),
- obesity,
- diabetes,
- cognitive impairment,
- medication use (e.g. sedatives, hypnotics and analgesics), and
- surgery.

5.2.2 Reduction in tissue tolerance

Tissue tolerance is the ability of the skin and its supporting structures to tolerate the effects of pressure by acting as a cushioning and transferring pressure loads from the skin surface to the skeleton. In the presence of pressure, both extrinsic and intrinsic factors influence tissue tolerance.¹

Extrinsic factors

Shear, friction and moisture all impact on the ability of skin to tolerate pressure. Shear is a mechanical force created from a parallel (tangential) load that causes the body to slide against resistance between the skin and a contact surface. The outer layers of the skin (the epidermis and dermis) remain stationary while deep fascia moves with the skeleton, creating distortion in the blood vessels and lymphatic system between the dermis and deep fascia. This leads to thrombosis and capillary occlusion. Shear is a mechanical force created from parallel loads that cause the body to slide against resistance between the skin and a contact surface. The outer layers of the skin (the epidermis and dermis) remain stationary while deep fascia moves with the skeleton, creating distortion in the blood vessels between the dermis and deep fascia. This leads to thrombosis and capillary occlusion.^{1, 6, 7}

Friction is a mechanical force that occurs when two surfaces move across one another, creating resistance between the skin and contact surface that leads to shear.^{1, 4, 6}

Moisture alters resilience of the epidermis to external forces by causing maceration, particularly when the skin is exposed for prolonged periods. Moisture can occur due to incontinence, wound exudate and perspiration. Some forms of moisture, particularly faecal incontinence, create added risks by exposing the skin to bacteria and enzymes that raise the skin pH.^{1, 4, 6}

Intrinsic factors

Intrinsic factors reduce the skin's tolerance through impacting its supporting structures, vascular and lymphatic system.

Advancing age is the demographic characteristic most associated with an increased risk of PI. Patients aged over 65 years are at a greater risk, and the risk increases in those aged over 75 years.^{1, 4, 6} While some studies have identified men and Caucasians at increased risk,¹ there is no consensus on the role of these demographic characteristics.^{4, 25} In a SR on risk factors in patients with SCI, males were more likely to develop PI in the chronic phase of SCI (eight studies, odds ratio [OR] 1.3, 95% CI 1.1 to 1.7). Age and ethnicity appeared unrelated to PI risk in this population.^{26, 27}

Chronic illnesses that influence tissue perfusion, the lymphatic system and sensation also increase PI risk. In addition, illness and conditions that impair oxygen delivery to the tissues are also associated with an increased PI risk. In patients in the chronic phase of SCI, past history of deep vein thrombosis, lower limb fracture and pneumonia were all identified as risk factors for PI.²⁷ Chronic illnesses and conditions that impair oxygen delivery, tissue perfusion, sensation and/or lymphatic function identified as increasing PI risk include, but are not limited to:^{1, 6}

- diabetes mellitus,
- carcinoma,
- peripheral arterial disease,
- cardiopulmonary disease,
- lymphoedema,
- renal impairment or failure,
- low blood pressure,
- circulatory abnormalities,
- anaemia and
- smoking.

Elevation in skin temperature has also been associated with increased PI risk, although the mechanism is not understood. It may relate to an increased oxygen demand in already compromised tissue.¹

Impaired nutritional status and dehydration are both intrinsic factors that increase the risk of PI. This includes factors such as recent weight loss, malnutrition and inadequate protein or energy intake.^{1, 4, 6} Poor nutrition and hydration are also related to dry skin and decreased skin turgor, which increase PI risk.

5.3 Identifying patients at risk of pressure injury

Patients exhibiting the above risk factors have an increased risk of PI. These risk factors are not independent, and presence of multiple risk factors increases risk. Identification of risk factors is essential in order to develop a comprehensive PI prevention plan.

Assessment should be conducted and documented by an experienced health professional. Assessment should include a clinical and psychosocial history, a focused physical assessment for factors that affect healing, nutritional assessment.^{4, 20}

Evidence summary

The WOCNS guideline⁶ included level C recommendations that a PI risk assessment include an assessment of intrinsic and extrinsic factors associated with PI risk including clinical history, past history, immobility, continence, nutritional status and factors that may impede healing. (*Consensus*)

The NPUAP/EPUAP guideline⁴ included an ungraded recommendation to consider nutrition, factors that influence perfusion and oxygenation, skin moisture, age, friction and shear, sensory perception, body temperature and general health status when performing a PI risk assessment. (*Consensus*)

The RNAO guideline²⁰ provided a level IV recommendation to conduct a history and focused physical assessment of patients presenting with a PI. (*Consensus*)

Recommendation 1

<p>Conduct a comprehensive assessment for <u>all</u> patients to identify pressure injury risk factors. A comprehensive assessment should include:</p> <ul style="list-style-type: none"> • clinical history, • pressure injury risk scale, • skin assessment, • mobility and activity assessment, • nutritional assessment, • continence assessment, • cognitive assessment, • assessment of extrinsic risk factors. 	CBR
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Practice points for risk assessment

- Assessment of extrinsic factors should include the impact of environmental factors on pressure, shear and microclimate (e.g. local heating, air-conditioning, electric blankets).^{4, 6}
- Findings of a comprehensive assessment should be used to inform development of a PI prevention plan.
- Risk assessments should be conducted as soon as possible after admission and within a minimum of eight hours of admission (or on initial home or clinic visit for patients seen in the community). Risk assessments should be repeated whenever there is a change in the patient's condition and on the patient's discharge.²⁸
- Patients presenting with an extremity PI (particularly on the lower limb) should have a vascular assessment to identify co-morbidities. This could include:^{4, 29}
 - Doppler ultrasound measurement of ankle brachial pressure index (ABPI),
 - Toe brachial pressure index (TBPI), and/or
 - Pulse oximetry.

- Consider the following patients to be at risk of PIs:^{1, 4}
 - Patients with reduction in mobility or activity that prevents independent movement or position change to relieve pressure (e.g. patients with SCI or CVA).^{1, 4, 6}
 - Patients with alterations to intact skin.^{1, 4}
 - Neonates and young children, particularly in the occipital region.⁶
 - Patients using equipment or devices that come in close contact with the skin (e.g. orthotics, casts, intravenous devices, continuous positive airway pressure equipment).⁶
 - Adults aged over 65 years, particularly those with restricted mobility.⁶

Documentation

- Document all risk assessments, including risk factors and at risk status as soon as possible after admission and within a minimum of eight hours (or on initial home or clinic visit for patients seen in the community), and whenever there is a change in the patient's condition.^{1, 4}
- Include the date and time the risk assessment was conducted.

5.4 Risk assessment scales

Although used frequently in practice, there is minimal-to-no evidence on the effectiveness of PI risk assessment scales (also referred to as risk assessment tools) in reducing PI incidence. Indirect evidence suggests that implementing preventative management interventions reduces PI incidence. As most preventative interventions are initiated as a result of a risk assessment (either formal or the health professional's clinical judgement), indirect evidence suggests that use of a PI risk assessment tool reduces the risk of PI development. The most commonly used assessments tools for adults include the:

- Braden Scale for Predicting Pressure Sore Risk© (Braden Scale),³⁰
- Norton Scale©,³¹ and
- Waterlow Score©.³²

Additional scales are also available for specific adult populations, including the Glasgow Scale and Cubbin and Jackson Scale, both for patients in the intensive care unit. Appendix E contains a list of population-specific PI risk assessment scales.

5.4.1 Braden Scale

The Braden Scale (see Appendix F) includes a 3- or 4-point Likert scale for assessment of each of six clinical risk factors for PIs: sensory perception, moisture, activity, mobility, nutrition, friction and shear. A cumulative score is used to qualify the patient's PI risk as low, moderate or high.³⁰ The Braden Scale includes descriptive operators for each Likert point, which may relate to its higher inter-rater reliability.³³

5.4.2 Norton Scale

The Norton Scale (see Appendix G) includes 4-point Likert scales for each of five clinical factors for PI risk: physical condition, mental condition, activity, mobility and incontinence. A cumulative score is calculated and patients scoring above 14 are considered to be at risk of PIs.³¹ The scale includes single word qualifiers for each Likert point, reducing clarity factors to consider when assessing each clinical factor.

5.4.3 Waterlow Score

Revised in 2005, the Waterlow Score (see Appendix H) includes nine clinical categories, some of which include a two-step assessment (e.g. malnutrition). Each category includes specific scores for each descriptor (i.e. not on a Likert scale). Clinical categories include height and build for weight, skin type of visual risk areas, gender and age, malnutrition screening, continence, mobility, tissue malnutrition, neurological deficit and major surgery or trauma. Each category includes options with brief descriptors, fully described in a training manual. A cumulative score is used to identify patients as at risk, at high risk or at very high risk of PIs.³²

5.4.4 Reliability and validity of pressure injury risk assessment scales for adults

Evidence is available on the reliability and validity of specific risk assessment scales as presented detail in the evidence summary below. Findings from a meta-analysis indicated that the Braden Scale had the strongest reliability and clinical judgement had the lowest reliability (Table 5.1). However, fewer studies investigated clinical judgement, and studies have shown that health professionals who use clinical judgement as a sole assessment of risk are more likely to incorporate a holistic assessment of the patient, considering up to 35 clinical factors not included on formal assessment scales.

Table 5.1 Reliability and validity of pressure injury risk assessment tools for adults³³

Scales	Sensitivity	Specificity	PPV	Odds ratio	95% CI
Braden	57.1*	67.5*	22.9*	4.8*	2.56 to 6.48
Norton	46.8 [†]	61.1 [†]	8.4 [†]	2.16 [#]	1.03 to 4.54
Waterlow	82.4 ^{&}	27.4 ^{&}	16.0 ^{&}	2.05 [§]	1.11 to 3.76
Clinical judgement	50.6 [#]	60.1 [#]	32.9 [#]	1.69 [#]	0.76 to 3.75

*20 studies, n=6643
[†]16 studies, n=5847
[&]6 studies, n=2246
[§]5 studies, n=200
[#]3 studies, n=302

5.4.5 Reliability and validity of pressure injury risk assessment scales for children

One review³⁴ reported 12 paediatric PI risk assessment scales, including modifications of the Braden Scale³³ and adaptations of the Waterlow Scale.³² Other scales had been developed using the Delphi technique, consensus opinion or findings from literature reviews. Of the presented instruments, only three had been tested for diagnostic accuracy, and five had been tested for inter-rater reliability and validity (see Table 5.2). Scales that had received some form of performance testing included the:

- Neonatal Skin Risk Assessment Scale for Predicting Skin Break down (NSRAS),
- Braden Q,
- Burn Pressure Ulcer Skin Risk Assessment Scale (BPUSRAS),
- Starkid Skin Scale, and
- Glamorgan Scale.

Table 5.2 Reliability and validity of pressure injury risk assessment tools for children³⁴

Scales	Population	Sensitivity	Specificity	PPV	Inter-rater reliability
NSRAS	Neonate	0.83	0.81	0.50	r= -0.27 to 1.00 across items
Braden Q	Paediatric intensive care	0.88	0.58	0.15	—
BPUSRAS	Paediatric intensive care (burns)	0.54	0.95	0.80	ICC=0.99
Starkid Skin scale	Paediatric	—	—	—	r=0.85 for total score
Glamorgan scale	Paediatric	—	—	—	100% agreement

r = Pearson's r

ICC = intraclass correlation

Evidence summary

One Cochrane review³⁵ investigated whether the use of a structured risk assessment scale was associated with a decreased incidence of PIs (in any health care setting). Only one low quality RCT met the inclusion criteria. The study compared the effectiveness of staff training and use of the Braden Scale compared to staff training and an unstructured risk assessment. The trial was conducted in a military hospital in Saudi Arabia (n=256) over an eight week period and found no significant difference in the incidence of PIs between patients randomly assigned to each assessment technique (RR 0.97, 95% CI 0.53 to 1.77, p=not reported). The review concluded there is no good quality evidence showing that a structured risk assessment scale is associated with a lower incidence of PIs than an unstructured assessment, if staff have appropriate training.³⁵ (Level II evidence)

Braden Scale

The validity and reliability of the Braden Scale has been reported extensively. One SR³³ included 22 validation studies. The majority of validation studies were conducted in in-patient hospital settings, with a few conducted in home care environments. The scale is reported to have a high inter-rater reliability ($r=0.83$ to 0.99), which the review authors proposed as being related to strong operational definitions included in the tool. Sensitivity of the Braden Scale ranged from 38.9% to 100% and specificity ranged from 26% and 100%. Positive predictive value (PPV) ranged from 4.5% to 100%. Meta-analysis of the findings indicated that the Braden Scale is the most reliable structured risk assessment scale (see table 5.1). (Level III evidence)

Norton Scale

One SR³³ included two studies that reported on the reliability and validity of the Norton Scale, both conducted in hospital settings. Both trials reported a high inter-rater reliability. Sensitivity of the scale ranged from 16% to 81% and specificity ranged from 31% to 94%. Positive predictive value ranged from 7.1% to 98.3%. (Level III evidence)

Waterlow Scale

One SR³⁶ investigated the rater reliability of the Waterlow Score. The review included eight studies (three described as good quality) that investigated inter or intrarater reliability of either individual items on the Waterlow Score, or reliability of the overall score. Across the studies raters included registered nurses, enrolled nurses, student nurses, trained raters and research personnel. Four of the studies were conducted in clinical practice settings. The study found that there was often disagreement between raters; however, when differences of only one or two points were considered acceptable, concordance was between 11% and 86%. The largest discrepancies were apparent on the items for mobility, nutrition and skin type, possibly due to the poor operational definition provided with the tool. The researchers suggested that rater reliability could be higher in raters who had received training in use of the scale; however this hypothesis was not analysed in the review. The SR raised the important issue of rater reliability and its influence on overall scoring on the Waterlow Score. It was noted that depending upon individual scores, a rater difference of only one point could achieve a different classification of risk for an item. Comparatively, it was possible for raters to differ by three to four points but achieve the same classification. This raised limitations of relying on a risk assessment classification to make clinical decisions on PI management.³⁶ (Level III evidence)

Pancorbo-Hidalgo et al.³³ included seven validation studies of the Waterlow Score. The studies were conducted in a wide range of settings including hospitals, geriatric facilities, rehabilitation and home care. Only two of the studies reported inter-rater reliability, both indicating a high correlation. Sensitivity of the score ranged from 75.8% to 100% and specificity ranged from 10.8% to 38%. Positive predictive value was reported as 33.3%. The low specificity reduces the usefulness of the scale in clinical practice due to over-identification of patients as at-risk. (Level III evidence)

Clinical judgement

Pancorbo-Hidalgo et al.³³ reported results from three studies that investigated nurses' clinical judgement as the assessment for PI risk, none of which reported inter-rater reliability. Nurses were working hospital or geriatric settings. Sensitivity and specificity were both moderate and the PPV was high. Meta-analysis of findings indicated clinical judgement is a poor predictor of PI risk; however the experience and training of the nurses in these studies was not reported. Other studies have shown that health professionals using clinical judgement alone consider more factors when assessing PI risk. (Level III evidence)

Risk assessment scales for children

One SR³⁴ focused on PI risk assessment scales for use in child populations. Fifteen papers that appeared to be of moderate quality and reporting diagnostic accuracy, reliability and/or validity of paediatric PI risk assessment scales were included. Although 12 risk assessment instruments were identified, only three were the subject of validation trials—BPUSRAS, Glamorgan scale and Braden Q. Although four scales had been subjected to inter-rater reliability, two papers used Pearson's r , an inappropriate statistic for the study design. The findings are reported in Table 5.2. The reviewers concluded that no specific paediatric PI risk assessment scale could be recommended over others.³⁴ (Level III evidence)

The WOCNS guideline⁶ included a grade B recommendation supporting the use of risk assessment scales, underpinned by the evidence presented in the Pancorbo-Hidalgo et al.³³ review. The NPUAP/EPUAP⁴ also provides a moderate grade recommendation in favour of validated risk assessment scales based on the evidence presented above. (Level III evidence)

NHMRC grading matrix		
Evidence base	One MA including 36 level III studies	C
Consistency	Trials had consistency and inconsistencies could be explained by populations and staff experience	B
Clinical impact	Clinical impact of using a scale is unknown	U
Generalisability	Trials in populations with high risk of PI	A
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 2		
Use a pressure injury risk assessment scale in conjunction with a comprehensive risk assessment to determine the patient's risk of pressure injury and to inform the development of a prevention plan.		CBR
Recommendation 3		
The Braden Scale, Norton Scale or Waterlow Score are validated and reliable scales for assessing pressure injury risk in adults.		B
Recommendation 4		
Use a paediatric risk assessment scale in conjunction with a comprehensive risk assessment to determine a risk of pressure injury and to inform the development of a prevention plan for children.		CBR

Practice points for using risk assessment scales

- Development of a PI prevention plan should be based on a risk assessment scale in conjunction with a comprehensive risk assessment (see section 5.3).
- A risk assessment scale offers a structured approach to assessment, but does not replace a comprehensive risk assessment.^{4, 6}
- Use a risk assessment scale that is appropriate to the population (see Appendix E). Validated risk assessment scales are included in the guideline appendices (see Appendix F, G and H).
- Risk assessments should be conducted as soon as possible following admission and within a minimum of eight hours. Risk assessments should be repeated whenever there is a change in the patient's condition and on the patient's discharge.²⁸

Documentation

- Document all risk assessments, including risk factors and 'at risk' status as soon as possible following admission and within a minimum of eight hours (or on initial home or clinic visit for patients seen in the community). Document a new risk assessment whenever there is a change in the patient's condition.^{1, 4}
- Document the date and time the risk assessment was conducted.

5.5 Skin assessment

Skin status is the most significant early indicator of the skin's response to pressure exposure and the ongoing risk of PI. As shown in Figure 5.1, numerous factors impact upon the skin and its underlying structures to tolerate pressure exposure.

Evidence summary

The literature search did not identify any SRs reporting on the effectiveness of skin assessment strategies for identifying PI risk.

The NPUA/EPUAP guideline⁴ reported prospective and retrospective cohort studies and non-randomised trials related to skin assessment. One prospective cohort trial (n=109) conducted in an acute care setting identified non-blanching erythema as an independent risk factor for PI. One prevalence study identified skin tone as a factor associated PI development, with patients exhibiting darker skin tones significantly more likely to develop stage II to IV PIs (0.56 per person year versus 0.35 per person year in light skin tones). Another prevalence trial found stage I PIs were less likely to be identified in patients with darker skin tones compared to those with light skin tones (13% versus 38%). Under-identification of early PI may be associated with the ease at which the skin can be visually assessed for early signs. The NPUAP/EPUAP guideline provided a grade B recommendation that inspecting the skin for signs of erythema, blanching response, localised heat and induration be conducted regularly. (*Level III evidence*)

The WOCNS guideline⁶ included a level C recommendation to conduct a head to toe skin assessment on the patient's admission to the service, with particular attention to bony prominences and high risk areas. (*Consensus*)

NHMRC grading matrix		
Evidence base	One evidence based guideline reporting level III studies of unknown quality	C
Consistency	The evidence was consistent that PIs increased when visual skin inspection was more difficult.	A
Clinical impact	Clinical impact of using a scale is unknown	U
Generalisability	Trials in populations with high risk of PI	A
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	

Recommendation 5

Inspect the skin of all patients on admission and at each repositioning to identify indications of pressure injury including:	C
<ul style="list-style-type: none"> • erythema, • blanching response, • localised heat, • oedema, • induration, and • skin breakdown. 	

Practice points for skin assessment

- Conduct a head-to-toe skin assessment.
- Focus particular attention to skin overlying bony prominences including the sacral region, heels, ischial tuberosities and greater trochanters.^{1, 4, 6}
- Darker skin tones may be more difficult to assess visually. Pay particular attention to localised heat, oedema and induration in patients with darker skin tones.^{4, 6}
- Observe the skin for pressure damage related to medical devices (e.g. braces, splints, harnesses, cervical collars, hip protectors). Where possible these devices should be removed to allow a comprehensive skin assessment at least daily or more frequently in high risk patients.^{1, 6}
- Ask the patient to identify areas of discomfort or pain associated with pressure and pay particular attention to assessment of these areas.⁴

Documentation

- Document all skin assessments as soon as possible following admission and within a minimum of eight hours (or on initial home or clinic visit for patients seen in the community), on a daily basis and whenever there is a change in the patient's condition.^{1, 4}

5.6 Nutritional screening and assessment

Malnutrition significantly impacts healing and is a factor related to both the development of and impaired healing of PIs. Nutritional screening promotes early identification of patients with or at risk of malnutrition. The Mini Nutritional Assessment Short Form (MNA-SF) has been validated for nutritional screening in populations with PIs.⁵ In addition, a range of nutritional screening tools (see Appendix E) have been validated for use in different clinical settings.³⁷

Patients who are identified as having malnutrition or being at risk of malnutrition should receive a comprehensive nutritional assessment using a validated assessment tool³⁷ (see Appendix E). These tools usually include assessment of:

- weight, height and BMI,^{5, 6, 23}
- history of unintended weight loss or gain,⁶
- food intake history,^{5, 6, 23}
- dental and oral health,⁶
- swallowing difficulties,⁶
- drug/nutrient interactions,⁶
- ability to acquire and prepare food,
- cultural influences,⁶ and
- biochemistry investigations.^{5, 6, 23}

The TTDWCG evidence-based guideline^{5, 23} suggested appropriate biochemical investigations to support a nutritional assessment in patients with or at risk of PI include:^{5, 23}

- electrolytes,
- creatinine,
- urea,
- albumin and/or pre-albumin,
- C reactive protein (CRP),
- total protein,
- transferrin,
- cholesterol,
- haemoglobin,
- vitamin B12,
- iron, and
- folate.

Evidence summary

The literature search did not identify any reviews reporting on nutritional assessment of patients with PIs.

The WOCNS guideline⁶ reported a cross-sectional study conducted at 1,087 international health facilities (including acute, long term and home care). Facilities with existing nutritional guidelines were more likely to conduct nutritional screening ($p < 0.001$). The guideline included a consensus recommendation to use a validated tool such as the Mini Nutritional Assessment (MNA) to assess the nutritional status of all patients on admission to a service. (*Level III evidence*)

The TTDWCG evidence-based guideline^{5, 23} provided Grade B recommendations that nutritional screening and assessment of patients with a PI should be conducted using validated nutritional screening and assessment tools appropriate to the clinical setting. The guideline reported that the Mini Nutritional Assessment Short Form (MNA-SF) has been validated for screening patients with PIs. Other nutritional screening tools have been validated for use in a range of clinical settings. The guideline recommended that a nutritional assessment include weight, BMI, anthropometry, biochemistry and food intake. (*Level III evidence*)

NHMRC grading matrix		
Evidence base	Level I, II and III studies reported in an evidence-based guideline NHMRC grade B recommendation from an evidence-based guideline for screening tools. NHMRC Level C recommendation from an evidence based guideline for assessment tools.	B
Consistency	Findings were consistent	A
Clinical impact	Clinical impact is unknown but likely to be high	U
Generalisability	Validation trials were conducted in populations with existing PIs.	A
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 6		
Conduct nutritional screening and assessment using validated screening and assessment tools appropriate to the population and clinical setting.		B

Practice points for nutritional assessment

- Consider referring patients to a dietitian for nutritional screening and assessment.
- Consider consulting a dietitian on selection of appropriate nutritional screening and assessment tools (see Appendix E).

Documentation

- Document all nutritional assessments, including referrals.

5.7 Psychosocial assessment

A psychosocial history identifies factors that influence the patient's disease experience, personal preferences, concordance with management and overall response to care.²⁰

A comprehensive psychosocial assessment should include:^{4, 15, 20}

- mental status,
- psychological symptoms including depression,
- patient preferences,
- goals of care,
- social support,
- culture and ethnicity,
- quality of life,
- financial support; and
- educational requirements.

5.7.1 Goals of care

Goals of care should be established by the multidisciplinary team including the patient and their caregivers. Particularly in patients receiving palliative care, appropriate goals should be established and incorporated into the patient's management plan. Multiple risk factors and overall poor health significantly increase the risk of PIs in palliative care patients and prevention or healing of PIs may not be a realistic goal of care. Palliative care may have a stronger focus on managing symptoms, comfort and quality of life.^{4, 6} Re-assessment of the management plan and care goals should be conducted with the patient and their caregiver on a regular basis, guided by the patient's progress.

5.7.2 Education

Education of the patient and their significant others is a vital component in achieving input into a PI prevention plan and attaining cooperation in preventative strategies. Patients and their care givers should have a clear understanding of the impact of PI and the importance of its prevention, risk factors for PI and strategies that assist in reducing or eliminating the risk. This is of particular importance when the patient is in a home care environment or being discharged from the service.¹

Evidence summary*Psychosocial impact of pressure injury*

One SR¹⁵ reported research on the impact of PIs and PI interventions on health related quality of life (HRQOL) derived from ten good quality qualitative studies and an additional 21 quantitative trials (mainly cross-over designs).¹⁵ The review identified the significant impact PIs have on all aspects of the patients life including overall health, functional ability; socialisation and relationships with others; sleep; finances and knowledge. The review highlighted the importance of investigating the impact of PIs and incorporating interventions into the management plan that address arising issues. (Level IV evidence)

Patient education

One SR²⁷ of cross-sectional studies conducted in patients with SCI presented evidence on factors associated with the development of PI. Five studies provided a moderate evidence base indicating that a low education level was associated with an increased risk of PI in patients in the chronic stage of SCI. (Level IV evidence)

The WOCNS guideline⁶ included a consensus recommendation that patients and their caregivers receive education about PI risk factors, wound staging and healing, nutrition, skin care and inspection, wound care, support surface use and preventative strategies. (Consensus)

The RNAO guideline²⁰ included consensus recommendations that patients and their caregivers receive a structured education program aimed at an appropriate level including the same content as identified in the WOCNS guideline. (Consensus)

No evidence was available on the effectiveness of patient education programs in reducing PI

NHMRC grading matrix		
Evidence base	Level IV studies on psychosocial assessment	D
Consistency	Findings were consistent	A
Clinical impact	Clinical impact is unknown	U
Generalisability	Studies were conducted in populations with existing PIs.	A
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations, Pacific Island populations or Asian populations.	
Recommendation 7		
Conduct a psychosocial history to identify factors that impact on pressure injury prevention and management.		C
Recommendation 8		
Provide patients with education on the prevention and management of pressure injuries.		CBR

Practice points for psychosocial assessment

- Consider the cognitive ability of the patient and their care givers when planning and delivering education on PI treatment and prevention.

Documentation

- Document all psychosocial assessments.
- Document patient education sessions, including the content of education provided to the patient and their caregivers.

6 PREVENTION OF PRESSURE INJURIES

6.1 Clinical questions

What interventions for preventing PIs have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these interventions are effective in reducing the risk of PI development?

6.2 Skin protection

Skin protection is paramount to the prevention of skin breakdown and PI. Protection of the skin includes management of both intrinsic and extrinsic risk factors. Elimination of shear, friction and moisture are primary considerations in protection of the skin.

Evidence summary

The WOCNS guideline⁶ includes a consensus recommendation to implement measures to reduce PI risk. (*Consensus*)

The NPUAP/EPUAP evidence based guideline⁴ includes consensus recommendations to reduce the risk to skin from extrinsic factors, particularly moisture, shear and friction. The guideline recommends protecting the skin from moisture through continence management and skin emollients and minimising shear and friction through appropriate manual handling. ⁴ (*Consensus*)

Recommendation 9

Implement preventative strategies to protect the patient's skin.

CBR

Practice points for skin protection

- Appropriate positioning (see section 6.5) and use of appropriate support surfaces (see section 6.4) help reduce shear and friction.^{4, 6, 20}
- Employ appropriate manual handling techniques in line with occupational health and safety guidelines when repositioning and transferring patients.
- Provide transfer assistance devices (e.g. overhead handle) to promote independent patient transferring and reduce shear forces and friction.⁴
- Do not vigorously rub the patient's skin.⁴
- Develop and implement an individualised continence management plan.^{4, 6}
- Use a pH appropriate skin cleanser and dry thoroughly to protect the skin from excess moisture.²
- Use water-based skin emollients to maintain skin hydration.⁴

6.3 Oral nutrition

There is no research on the general role of the patient's regular diet in preventing PIs. The research has focused on additional nutritional support (e.g. vitamin supplements).

Evidence summary

Three SRs³⁸⁻⁴⁰ reported on oral nutritional support (ONS) and enteral tube feeding (ETF) for prevention of PIs. One SR⁴⁰ included 15 trials (eight RCTs, one controlled trial, one before/after trial and five cohort trials), the second SR³⁸ included only RCTs (n=8) and the third SR³⁹ included 5 RCTs. The reviews all included the same RCTs. The trials were reported to be of low quality.³⁸⁻⁴⁰

Four RCTs (total n=1224) investigated the effect of oral nutritional support compared to standard care (no nutritional support) or placebo as a preventative measure in older adults in acute or long term care with no PI at baseline. Oral nutritional support interventions in these studies generally consisted of a high protein diet delivered in addition to the standard diet for durations ranging from 14 days up to 26 weeks.^{39, 40} The largest trial (n=672) found a significant reduction (control group RR 1.57, 95% CI 1.30 to 2.38, p=0.04)³⁹ in PIs related to the intervention after adjusting for baseline incomparability (e.g. level of dependence, PI risk using Norton Scale).³⁸ The other three trials were too small to detect

significant differences.^{38, 39} A pooling of the studies was not heterogeneous and the results showed significantly lower incidence of PIs associated with ONS (odds ratio [OR] 0.75, 95% CI 0.62 to 0.89, p=not reported).⁴⁰ An additional trial investigated using ETF (standard formula delivering 1500 k/cal daily) in addition to a standard hospital diet. This was compared to a routine hospital diet. Adding this trial to the meta-analysis for prevention of PI using ONS maintained the homogeneity. Pooled results from the five studies (n=1325) showed an OR of 0.74 (95% CI 0.62 to 0.88, p=not reported), which translated to a numbers needed to treat (NNT) of 19.25 (i.e. 19.25 patients need to be treated with ONS to prevent one PI).⁴⁰ However, acceptability of the ETF intervention was questionable, as only 40% of the intervention population agreed to have ETF in the first week of the trial, and by the second week this had reduced to 16%.³⁸ The results from these low quality trials indicate that high protein ONS given twice daily may reduce the risk of developing PIs in adults at risk of PIs.^{38, 40} (*Level I evidence*)

The NPUAP/EPUAP evidence based guideline⁴ included a grade A recommendation supporting the use of high protein oral nutrition support on the same trials reported above. (*Level I evidence*)

The WOCNS guideline⁶ included a consensus based recommendation supporting the use of high protein oral nutrition support based on the recommendation included in the NPUAP/EPUAP guideline. (*Consensus*)

NHMRC grading matrix		
Evidence base	Two SRs and one MA	A
Consistency	Small trials did not find any significant effects	B
Clinical impact	Small clinical impact	C
Generalisability	Trials in populations with high risk of PI	A
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations, Pacific Island populations or Asian populations.	
Recommendation 10		
Provide high protein oral nutritional supplements in addition to a regular diet for patients at a high risk of pressure injury.		B

Practice points for nutrition

- To reduce the risk of PI, patients who have been identified as being malnourished or at nutritional risk require:⁴
 - a minimum of 30 to 35 kcal per kg body weight per day
 - 1.25 to 1.5 g per kg body weight daily of protein
 - 1 ml of fluid intake per kcal per day
- Patients with SCI have reduced energy needs due to decreased activity and muscle atrophy. These patients require:⁴¹
 - Paraplegic patients: 29.8 ± 1.2 kcal/kg body weight per day
 - Tetraplegic patients: 24.3 ± 1.1 kcal/kg body weight per day
- When determining dietary intake requirements, consider concurrent diagnoses.⁴¹
- Refer to appropriate national clinical guidelines for strategies to improve oral dietary intake.
- When the decision to use enteral feeding in a person at risk of PIs has been made, practice should be guided by relevant evidence based guidelines.
- Consider referring patients with identified nutritional deficits or high risk of PI to a dietitian.⁶

6.4 Support surfaces

A support surface is a surface on which the patient is placed to manage pressure load, shear, friction and microclimate. This includes bed, trolley and operating table mattresses; integrated bed systems; and seat cushions. Support surfaces are designed to reduce interface pressure through increasing the

body surface area or alternating the area of the body in contact with the support surface (i.e. pressure reduction and pressure relief).⁴

Interface pressure, or the pressure between the patient's body and the support surface, is assumed to be related to the development of PIs. One SR⁴² reported seven moderate to good quality trials that investigated the predictive and prognostic value of interface pressure for PI development. The types of patients, measurement of pressure and outcome measures were heterogeneous and the reviewers were unable to pool results or develop a standardised quantitative predictor for PI development based on interface pressure. Populations included at-risk older adults (although method of risk assignment was not defined), patients with existing PIs and surgical patients. Follow-up ranged from 48 hours to 12 months. Measurement of pressure interface was conducted with a variety of pressure measurement devices including single cell pressure transducers and pressure mapping mats. These were used in varying locations (e.g. sacrum, heels) and patient positions (e.g. sitting, lying). Two of the trials identified high interface pressure being related to a higher incidence of PIs. One study identified that PIs on the feet develop sooner with a higher interface pressure and another study determined that a lower interface pressure was associated with faster PI healing. The review concluded that a qualitative relationship exists between interface pressure and the development and healing of PIs; however the concurrent influence of other factors including friction, internal pressure, patient health status and mobility prevent the identification of a clinical threshold for interface pressure.⁴²

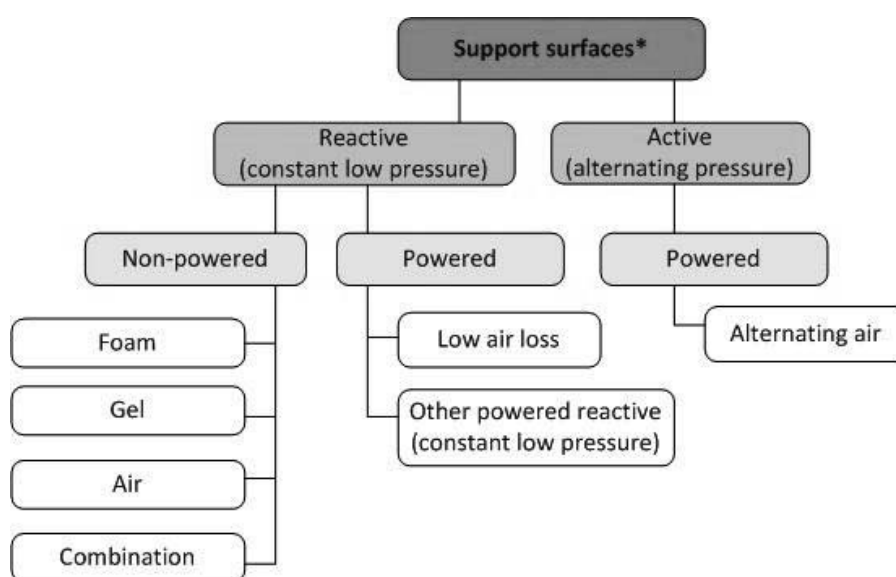
6.4.1 Types of support surfaces

The two primary sorts of support surfaces are reactive (constant low pressure) support surfaces and active (alternating pressure) support surfaces.

A reactive (constant low pressure) support surface can be powered or non-powered and has the ability to change its load distribution properties in response to a pressure load. A reactive (constant low pressure) support surface molds to the patient's shape (immersion and envelopment) in order to redistribute body weight over a larger contact area. The interface pressure remains constant while the patient remains in the one position, but is redistributed over a wider surface area. 4, 43, 44

Active (alternating pressure) support surfaces produce an alternating pressure through mechanical means regardless of the pressure load. This is usually achieved through alternation of air pressure in support surface air cells on a programmed cycle time. This mechanism continually changes the part of the body supporting higher pressure loads.^{4, 43, 44}

Table 6.1 outlines types of support surfaces and their characteristics.



* Not a hierarchy

Nb: suppliers may use a combination of these technologies in some products to produce a hybrid product.

Table 6.1 Types of support surfaces^{4, 44}

	Name	Definition	Benefits	Problems
Reactive (constant low pressure)	High specification foam	Foam mattress made to high specifications as outlined in Table 6.2.	<ul style="list-style-type: none"> • Light weight • Easily customisable • Minimum maintenance 	<ul style="list-style-type: none"> • Fast compression • Increases insulation and temperature
	Gel	Support surface made from gel filled cells.	<ul style="list-style-type: none"> • Allows posture control • Heat conductor 	<ul style="list-style-type: none"> • Heavy in weight • Requires maintenance • Can experience leaks • Increase skin moisture • Minimal immersion
	Air	Support surface made from air filled cells.	<ul style="list-style-type: none"> • High level pressure redistribution • Light • Customisable inflation properties 	<ul style="list-style-type: none"> • High cost • Requires staff training • Reduced posture control • Can experience leaks • Can be difficult to transfer in and out of bed • Low air loss pump noise may be problematic • Low air loss may cause dehydration • Requires access to electricity
	Low air loss and other powered reactive	<p>A powered, air filled surface that allows air to escape from air cells.</p> <p>Not all powered reactive (constant low pressure) support surfaces are low air loss (e.g. continuous air flow)</p>		
Active (alternating pressure)	Support surface that produces alternating pressure through mechanical means, generally involving alternating air pressure in air cells on a programmed cycle time.	<ul style="list-style-type: none"> • Cyclic pressure potentially offloading to a PI site • Customisable inflation properties 	<ul style="list-style-type: none"> • Pump noise may be problematic • Can experience leaks • Can be difficult to transfer in and out of bed • Some patients experience symptoms similar to sea sickness • High cost • Overlays can result in bottoming out • Requires access to electricity 	

6.4.2 Reactive (constant low pressure) support surfaces

Research on support surfaces has primarily focused on investigating the effectiveness of reactive (constant low pressure) or active (alternating pressure) support surfaces compared to “standard” hospital mattresses; although the specifications of a “standard” hospital mattress are rarely reported. The definition of a “standard” hospital mattress is variable, and may change between facilities and over time, confounding the results from these analyses.

The research in this field suggests that high specification foam mattresses are most effective in reducing risk of PIs.⁴³ With the evolution of more affordable high specification foam mattresses the use of most types of mattress overlay (e.g. egg crate foam) is not recommended in most settings.

The research on high specification mattresses reports a wide variety of products and their specific specifications were generally not provided. The guideline development group has developed table 6.2 to provide an overview of characteristics considered to meet the requirement of a high specification mattress.

Table 6.2 Consensus on minimum recommendations for high specification foam mattresses⁴⁵

Characteristics	Explanation	High specification mattress
Classification	Classification according to the Australian Standards (AS2281-1993). ⁴⁶	Type H/HR ⁴⁶ H - conventional resilience, heavy duty HR - high resilience LR - Low resilience
Multi-layering	<i>Multi-layering</i> of various grades / types of foam alters design features. Different density-hardness layers produce a harder base that increases upper weight limit. <i>Slow recovery foam</i> increases the surface area contact, redistributes pressure, reduces peak pressures and allows immersion of bony prominences. Has potential to increase skin surface temperature.	Common feature
Density – hardness in single layer mattresses	<i>Density</i> is the weight of the foam in kilograms per cubic metre kg/m ³ . <i>Hardness</i> is the ability of foam to 'push back' and carry weight. <i>Hardness</i> is defined as the amount of force (in Newtons) required to indent a sample of the foam by a specific percentage of the original thickness. This is known as the indentation force deflection (IFD). In Australia and Europe hardness is measured at 40% IFD. <i>Density/hardness</i> defines the grade of foam and is stated with density followed by hardness.	35-130 kg/m ³ (minimum for single layer foam mattress) Variance in the hardness exists in top and middle layers of multilayer designs. ⁴⁶
Support factor	An indicator of foam comfort that is calculated as a ratio: $\frac{\text{IFD at 65\%}}{\text{IFD at 25\%}} = \text{support factor}$ A higher value usually indicates a softer feel and good base support.	IFD: 1.6 to 2.6 ⁴⁶
Depth	Consider depth of the mattress alongside density/hardness. Different foam grades require different depth to manage upper body weight and prevent bottoming out	150 mm ⁴⁷ Mattress depth needs to be increased to support bariatric load. ⁴⁸
Mattress cover	<i>Vapour permeability</i> : the relevant measurement is moisture vapour transmission rate (MVTR). Increasing the MVTR potentially allows the trans-epidermal water loss (TEWL) of intact skin to transpire through the cover. ⁴⁹ Decreasing the MVTR of the cover protects the foam from moisture degradation. Changing the MVTR becomes a compromise between managing local climatic conditions and the patient's TEWL. <i>Allows for partial immersion in foam</i> <i>Wrinkling</i> : may add additional pressure at skin surface <i>Shear resistance</i> : can be reduced with a low friction fabric. ⁵⁰ <i>Infection control</i> : <ul style="list-style-type: none"> • water proofing – prevents contamination of foam • welded seams prevent ingress of fluids • waterfall flap cover over zips • cleaning according to facility protocol and manufacturers guidelines <i>Fire retardant properties</i> : material must meet local standards	MVTR: minimum 150-200 g/m ² / 24 hrs ⁵¹ (equivalent to normal patient TEWL) ⁴⁹ Often 2 way stretch

Table 6.2 Consensus on minimum recommendations for high specification foam mattresses⁴⁵

Characteristics	Explanation	High specification mattress
Other considerations	<p><i>Castellated foam</i>: partial thickness cuts made in a regular block pattern on the top section of the foam increases surface contact area potentially reducing friction and shear.⁵²</p> <p><i>Side walls</i>: a border or stiffener along the edge increases firmness and assists mobility and transfers</p> <p><i>Safety sides (concave shape)</i>: may reduce risk of falls but may also reduce bed mobility, need to consider facility restraint policy</p> <p><i>Hinging system</i>: wedges removed on the inner border to allow for folding or bending of mattress to accommodate back rest and upper and lower leg sections to conform to profiling beds</p>	Common features

Evidence summary

One Cochrane SR⁴³ investigated support surfaces for reducing risk of PIs. The reviewers identified 52 RCTs, primarily of medium to low quality. The review updated a previous SR that included an analysis of bed surfaces,⁵³ as well as a previous Cochrane review.⁵⁴ In the majority of trials the participants were restricted to adults over 16 or 18 years of age considered at risk of PIs, and in 15 trials participants were adults aged over 60 years.⁴³

In this review, eight RCTs compared the effectiveness of “standard” mattresses with various other reactive (constant low pressure) support surfaces, including static air-filled surfaces, water-filled surfaces, contoured foam and bead-filled supports.⁴³ Five RCTs compared high specification (alternative foams) mattresses to “standard” hospital mattresses. Interventions shown to be more effective than a “standard” hospital mattress were a Soffform® mattress (RR 0.20, 95% CI 0.09 to 0.45, p=not reported) and Comfortex® DeCube mattress (RR 0.34, 95% CI 0.14 to 0.85, p=not reported, appears to no longer be marketed under this name). One RCT found a significant reduction in grade I (but not grade II or higher) PIs associated with a high specification mattress (RR 0.78, 95% CI 0.55 to 1.11, p=0.0004). An unpublished RCT found a significantly reduced risk of PIs for three high specification foam mattresses compared to a “standard” hospital mattress used by UK NHS in 1994 (RR 0.36, 85% CI 0.22 to 0.59). In the fifth RCT, no PIs occurred in either group. These trials were primarily conducted in older adults at high risk of PI, particularly orthopaedic patients in accident and emergency wards. Pooled results for high specification foam mattresses compared to a “standard” hospital mattress favoured high specification foam mattresses, with a 60% reduction in PI risk (RR 0.40, 95% CI 0.21 to 0.74, p=0.0039).⁴³ (Level I evidence)

Two RCTs investigated effectiveness of a low air loss bed in reducing risk of PIs. The review did not define a low air loss bed; however one of the trials involved a KinAir™ bed that is described by the manufacturer as having four zones of air suspension to create air flotation that redistributes pressure. In one trial the comparator support surface was a “standard” mattress used in an intensive care unit and in the other trial the comparator was an undefined reactive (constant low pressure) mattress overlay. Although the pooled results favoured the low air loss bed (RR 0.33, 95% CI 0.16 to 0.67, p=0.0020) the trials were of low quality with poor reporting.⁴³ (Level I evidence)

Other reactive (constant low pressure) support surfaces that were effective in reducing risk of PIs compared to a “standard” hospital mattress included a water-filled overlay (RR 0.35, 95% CI 0.15 to 0.79, p=not reported), a bead-filled mattress (RR 0.32, 95% CI 0.14 to 0.76, p=not reported) and the Optima®

air mattress (RR 0.06, 95% CI 0 to 0.99). Trials comparing different reactive (constant low pressure) support surfaces to each other found no difference in risk of PIs between surfaces; however these trials were not sufficiently powered to establish significant differences.⁴³ (Level II evidence)

These findings indicated that reactive (constant low pressure) support surfaces, particularly high specification foam mattresses, are more effective than a "standard" hospital mattress (as noted above, a "standard" mattress was generally not defined in the trials). The current evidence suggests there is no significant differences in the effectiveness of different types of high specification reactive (constant low pressure) support mattresses in reducing risk of PI.⁴³ (Level I evidence)

There is insufficient evidence to make recommendations on high specification reactive (constant low pressure) support overlays; however with the evolution of affordable high specification foam mattresses their use is generally not recommended.

The NPUAP/EPUAP evidence-based guideline⁴ presented evidence from some of the trials reported above to make a high grade recommendation that high specification foam mattresses be used in preference to a "standard" hospital mattress in patients at risk of PIs.⁴ (Level II evidence)

NHMRC grading matrix		
Evidence base	Meta-analysis at low risk of bias including 52 RCTs Additional RCTs at medium to high risk of bias High graded recommendation from an evidence based guideline	A
Consistency	Findings were consistent	A
Clinical impact	Moderate clinical impact	B
Generalisability	Trials in populations with high risk of PI.	A
Applicability	Applicable to all health care settings; however different facilities may use different standard foam mattresses	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori or Pacific Islander populations. It is unknown if Asian populations were included in trials.	
Recommendation 11		
Use a high specification reactive (constant low pressure) support foam mattress on beds and trolleys for patients at risk of pressure injuries.		A
Recommendation 12		
No one specific high specification reactive (constant low pressure) support foam mattress is better than any other.		A

6.4.3 Active (alternating pressure) support surfaces

High level research on active (alternating pressure) support surfaces is limited to alternating air devices and has focused on comparing their effectiveness to either "standard" mattresses or high specification foam mattresses.

Active (alternating pressure) air support surfaces vary by the depth of air cells, cell cycle time and mechanical robustness. The ideal frequency, duration, amplitude and rate of inflation and deflation have not been determined. However, this information is important in defining active (alternating pressure) support surfaces and determining the potential to offer cyclic offloading to different parts of the body.

Evidence summary

One Cochrane SR⁴³ reported 16 RCTs investigated active (alternating pressure) support surfaces. Equipment was poorly described in these RCTs.

Two low quality RCTs compared active (alternating pressure) mattress overlays (single and double air cell overlays) to "standard" hospital mattresses. Results from the trials were pooled using a fixed effects model and showed a significant reduction (70%) in PI risk (RR 0.31, 95% CI 0.17 to 0.58, p=0.0022) associated with the active (alternating pressure) support surfaces.

Ten RCTs compared active (alternating pressure) support surfaces to reactive (constant low pressure) support surfaces. One RCT found active (alternating pressure) mattress devices to be superior (RR 0.38, 95% CI 0.22 to 0.66); however due to methodological shortcomings this trial provided insufficient evidence to support an overall class effect for active (alternating pressure) support surfaces. The additional nine RCTs individually found no significant differences between reactive (constant low pressure) and active (alternating pressure) support surfaces. Pooling of trials based on type of active support surface (e.g. air filled compared to water filled) also showed no significant differences. Pooled results (12 RCTs) for all active (alternating pressure) support surfaces compared to all reactive (constant low pressure) support surfaces showed no significant difference in risk of PI (RR 0.85, 95% CI 0.64 to 1.13, $p=0.28$).⁴³ The poor description of the specific active (alternating pressure) support surfaces used in these trials and the large variability in function of active (alternating pressure) support surfaces is likely to have influenced the finding that active (alternating pressure) support surfaces provide no additional benefits over reactive (constant low pressure) support surfaces. *(Level I evidence)*

The NPUAP/EPUAP evidence-based guideline⁴ presented evidence from some of the trials reported above to make a high grade recommendation that active (alternating pressure) support surfaces be used in patients at higher risk of PIs when regular repositioning is not possible. *(Level II evidence)*

NHMRC grading matrix		
Evidence base	Meta-analysis at low risk of bias including 10 RCTs Additional RCTs at medium to high risk of bias High graded recommendation from an evidence based guideline	A
Consistency	Findings were consistent	A
Clinical impact	Moderate clinical impact	B
Generalisability	Trials in populations with high risk of PI.	A
Applicability	Applicable to all health care settings, not applicable to spinal injury patients	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori or Pacific Islander populations. It is unknown if Asian populations were included in trials.	
Recommendation 13		
Active (alternating pressure) support mattresses could be used as an alternative in patients at high risk of pressure injuries.		A

6.4.4 Selecting a support surface

The evidence provides little guidance to selection of the most appropriate high specification support surface for various patients. Table 6.3 outlines factors to consider when selecting a support surface.

Table 6.3 Considerations in selecting a support surface¹

Patient factors	<ul style="list-style-type: none"> ▪ Risk factors - See section 5.2 ▪ Risk and skin assessment ▪ Weight, height and BMI ▪ Age ▪ Incontinence needs ▪ Cognitive ability 	<ul style="list-style-type: none"> ▪ Mobility ▪ Clinical condition ▪ Comfort ▪ Personal preference
Environmental factors	<ul style="list-style-type: none"> ▪ Shear ▪ Friction ▪ Pressure 	<ul style="list-style-type: none"> ▪ Moisture ▪ Temperature
Equipment characteristics	<ul style="list-style-type: none"> ▪ Durability ▪ Ability to conform to bony prominences without resistance ▪ Allows immersion without "bottoming out" ▪ Ability to offload body parts ▪ Ability to manage microclimate at the skin's surface ▪ Impermeable to fluid and bacteria ▪ Fire retardant properties ▪ Maximum weight, weight and width limits 	<ul style="list-style-type: none"> ▪ Ease of use ▪ Ease of transferring ▪ Ease of transport ▪ Ability to stabilise ▪ Cleaning and maintenance ▪ Availability ▪ Cost
Service provider factors	<ul style="list-style-type: none"> ▪ Funding provisions ▪ Ability to provide cleaning and maintenance 	<ul style="list-style-type: none"> ▪ Care setting (e.g. home, residential aged care, hospital)

6.4.5 Sheepskins

A medical grade sheepskin is one that complies with the internationally recognised Australian Standard. The Australia Standard for medical sheepskins defines the minimum quality of leather, wool type, wool density and length. In Australia, medical grade sheepskins are required to be labeled with:⁵⁵

- the manufacturer's identification,
- laundering requirements (e.g. temperature),
- designated size of the sheepskin and
- designation for urine resistance.

Evidence summary

A Cochrane SR⁴³ reported four RCTs that investigated medical grade sheepskins (two trials specified natural Australian sheepskin and the other two trials did not define the type of sheepskin) for preventing PIs. One of the trials was too small to detect any differences between sheepskins and a standard hospital mattress. The other three trials were conducted in an orthopaedic population, a mixed inpatient population and a predominantly rehabilitation setting. All trials compared use of sheepskins to standard care (repositioning and other low technology pressure relieving devices). All trials found the sheepskin to be more effective. Pooled results showed a statistically significant reduction in risk (approximately 50%) of any PI associated with using sheepskins (RR 0.48, 95% CI 0.31 to 0.74, $p=0.00077$). Additionally, risk of PIs of grade II or higher also favoured sheepskins (RR 0.56, 95% CI 0.32 to 0.97, $p=0.037$). This finding suggested that medical grade sheepskins are an effective intervention to reduce risk of PI in at-risk populations.⁴³ (*Level I evidence*)

The NPUAP/EPUAP evidence-based guideline⁴ considered the same trials and recommended that medical grade sheepskins may have a role in reducing risk of PIs.

NHMRC grading matrix		
Evidence base	Three RCTs at moderate risk of bias Additional RCTs at moderate to high risk of bias Moderate grade recommendation from an evidence based guideline	C
Consistency	Findings were inconsistent relating to size of trials	B
Clinical impact	Moderate clinical impact	B
Generalisability	Trials in populations with high risk of PI	A
Applicability	Applicable to all health care settings; however different facilities may use different standard foam mattresses	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori or Pacific Islander populations. It is unknown if Asian populations were included in trials.	
Recommendation 14		
Only consider using a medical grade sheepskin as an adjunct or when a high specification reactive (constant low pressure) or active (alternating pressure) support surface is unavailable/ not tolerated.		C

6.4.6 Protecting the patient's heels in bed

Evidence summary

One SR⁵⁶ investigated strategies to prevent heel PIs, with a focus on support surfaces and heel protection devices. One RCT and one cohort trial were reported. No critical appraisal process was reported and the quality of these studies is unclear. The RCT included 447 patients in acute care. One group received an active (alternating pressure) air overlay and an air cushion when seated with no repositioning. The second group received or a reactive (constant low pressure) visco-elastic foam mattress and an air cushion, with four hour repositioning. Overall incidence of PIs did not differ between the groups; however there was statistically significantly fewer heel PIs in patients managed on the active (alternating pressure) surface ($p=0.006$). The study was not powered to measure this effect.

The cohort trial included 235 patients from long term care facilities who were managed with a wedge-shaped visco-elastic foam cushion (2cm at one end, 10cm at other end) that extended the width of the bed. Data from subjects deemed to be at high risk of PIs ($n=162$) was compared to a cohort of acute care patients managed with standard foam pillows. Analysis indicated a significantly lower incidence of heel PIs ($p=0.03$) associated with the heel wedge pillow. Although these two trials present some evidence that support surfaces may help reduce the incidence of heel PIs, both trials had methodological shortcomings.⁵⁶ (*Level II evidence*)

Two moderate quality trials on heel devices were reported in the above SR⁵⁶ and a Cochrane SR.⁴³ The first trial compared a foot elevation device (Foot Waffle®) consisting of a vinyl boot with a built in foot cradle to elevation of feet on a hospital pillow and found no statistically significant difference in PI risk. The second trial compared three devices—a Bunny Boot (fleece high cushion heel protector), an egg-crate foam heel lifter and an air cushion. No significant differences were found between the devices in reducing risk of heel PIs. The Foot Waffle® was found to triple the incidence of PIs, although the difference was not significant.^{43, 56} Both SRs^{43, 56} reached similar conclusions regarding effectiveness; that is, that there is insufficient evidence available on devices specifically used to prevent heel PIs. (*Level II evidence*)

Recommendation 15

Any device used to prevent heel pressure injuries should be selected and fitted appropriately to ensure pressure is adequately offloaded.	CBR
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6.4.7 Seating support cushions

There is a large variety of seating cushions available, ranging from low-end foam slabs to air-filled cushions. There is currently minimal research on the effectiveness of support cushions. Most trials have focused on comparisons of different cushion types; however these trials are small and of low quality and provide insufficient evidence to recommend specific types of support cushions.

Evidence summary

One Cochrane SR⁴³ reported on four RCTs that compared different seating cushions. In one RCT a slab foam cushion was compared to a bespoke contoured foam cushion and showed no significant difference in incidence of PIs. The second RCT compared a Jay® J-gel cushion to a foam wheelchair cushion and although the incidence of PIs was lower (RR 0.61, 95% CI 0.37 to 1.00) the difference was not statistically significant. One RCT compared a bevelled slab foam cushion to a contoured foam cushion with a posterior cut-out and found no significant differences; the final RCT compared a standard egg crate foam cushion to a pressure reducing cushion for wheelchair users and also found no statistically significant difference.⁴³ (Level II evidence)

The NPUAP/EPUAP evidence-based guideline⁴ presented evidence from one RCT and one non-randomised trial, both conducted in older adults, investigating support cushions to no use of cushions. In the small RCT (n=32) there was no significant difference between the groups in overall rate of PIs, but a significant reduction (p<0.005) in ischial PIs in patients on the pressure redistribution cushion. In the non-randomised trial, patients using support cushions experienced less PIs (p<0.0001).⁴ (Level II and level III evidence)

NHMRC grading matrix		
Evidence base	Six RCTs at high risk of bias	D
Consistency	Findings were consistent for an effect in reducing PIs	A
Clinical impact	Moderate clinical impact	B
Generalisability	Trials in populations with high risk of PI	A
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori or Pacific Islander populations. It is unknown if Asian populations were included in trials.	

Recommendation 16

Use a support cushion for patients at risk of pressure injury when seated in a chair or wheelchair. C

Practice points for support surfaces

- Selection of a support surface should not be based solely on the results of risk assessment scores or interface pressure measurements.⁵⁷ Consider the additional factors listed in Table 6.3.
- Regardless of the support surface used, regularly reposition the patient at appropriate intervals guided by regular skin assessment.⁴
- To check for bottoming out:
 - Reactive (constant low pressure) mattress: place the hand palm down between the support surface and the patient's lowest bony prominence (e.g. ischial tuberosity or sacrum) and determine how far the patient indents the mattress. There should be at least 5cm between the lowest bony prominence and the bed base when the patient is in a sitting and/or supine position.⁴⁵
 - Active (alternating pressure) mattress: slide the hand between the deflated air cell directly under the patient. If there is sufficient support minimal contact should be felt.
- Avoid excess linen between the support surface and the patient's skin.
- Consider and monitor the skin's microclimate when selecting support surfaces. This especially applicable in enclosed heel protection devices.
- Avoid use of synthetic sheepskins, cut outs/rings/donut devices and fluid filled gloves/bags.⁴
- A sheepskin or non-stretch fabric impedes the function of a high specification mattress and may be best utilised when the primary risk factor for pressure injury is moisture and friction.
- Choose positioning devices and incontinence pads that are compatible with the surface and avoid excess padding on the bed or chair.⁴ Where possible avoid plastic products as they

increase heat and moisture retention on the skin.⁴⁴

- Do not leave the patient on a bedpan, commode or transferring devices longer than required.⁴

Lower limbs:

- Pillows will only be effective in offloading heel pressure when placed lengthwise under the lower limb so heels are elevated and offloaded.⁴
- Heel protection devices should elevate the heel completely and distribute the weight of the leg along the calf without placing undue pressure on the Achilles tendon. The knee should be in slight flexion.⁴ When seated in a chair, any foot stool that is used should comply with the same principles.
- Foam, fibre-filled, sheepskin and air filled boots that secure to the heel should be used selectively. They may be effective in reducing friction and shear but are ineffective if they dislodge. Use with caution in restless patients.
- Consider pressure applied to toes and lower limbs from bedding, medical devices and surgical stockings (e.g. anti-embolic stockings).

Critically ill patients:

- Select an alternating pressure support surface that optimises pressure offloading for patients with poor local and/or systemic oxygenation and perfusion and in patients who cannot be repositioned for medical reasons.⁴
- There should be special consideration to microclimate in this group.
- Consult a medical practitioner before positioning a patient with a recent SCI or pelvic fracture on an active (alternating pressure) support surface.

Equipment:

- Check all support surfaces are functioning and correctly positioned every time a patient is repositioned or transported.
- Any support surface should be used and maintained according to manufacturer instructions. Annual safety audits to ensure the integrity devices are recommended.
- Support surface cushions need to be fitted to the person and the chair/wheelchair in which they are seated (wheelchair, bedside chair). Seek advice from a seating therapist (e.g. occupational therapist, physiotherapist) for chair-bound patients or those with limited mobility.⁴
- Do not use small cell (less than diameter of 10 cm) alternating pressure mattresses or overlays as they cannot be sufficiently inflated to ensure adequate pressure redistribution.^{1, 4}
- All equipment should be used with an appropriately sized, specified cover as determined by the manufacturer.
- Electrical devices require electrical certification and regular electrical safety inspections.
- Where possible, beds should be sufficiently wide that the patient does not reach the side of bed (or rails) when turned from side-to-side.⁴
- Ensure the support surface and bed are appropriate for use together (e.g. there are no excessive gaps for entrapment) and appropriate for the patient.
- Mattress overlays must be used on top of a mattress. Overlays should never be placed directly onto the bed base. Be aware that overlays will change the height of the bed and potentially reduce the effectiveness of bed rails. Overlays can increase the risk of falls.

Documentation

- Documentation of interventions relating to the support surface, evaluations of effectiveness and changes to the patient's management plan is required.⁵⁸
- Document annual equipment audits.

6.5 Patient positioning

Sustained pressure to areas of the body causes soft tissue injury leading to ischaemia. In normal circumstances, pain resulting from sustained injury prompts a person to change position. In patients who are unable to reposition themselves due to physical limitations, and in patients with reduced sensory perception and impaired ability to detect pain, failure to reposition is a significant risk factor for PIs. Regular repositioning is an essential component of PI prevention.⁴ Repositioning also contributes to the patient's comfort, dignity and functional ability.⁴ In addition, repositioning provides an opportunity to interact with the patient, perform close observation of general skin condition and offer food and fluids — basic nursing care is usually performed at these intervention periods.

Evidence summary

One SR⁵⁹ investigated the effectiveness of repositioning in reducing the development of PIs, but only included research reporting the overall incidence of PI development as an outcome measure. The researchers identified two prior SRs and three RCTs that met inclusion criteria.⁵⁹ A second SR³⁹ reported two of the same RCTs, and appraised them as being of moderate to good quality.

The two SRs reported in the first SR⁵⁹ came to conflicting conclusions regarding the effectiveness of repositioning for preventing PIs. Whilst one concluded that repositioning was effective when used with other preventative strategies, the second found little evidence to support routine repositioning and called for further research on appropriate positions rather than comparisons of repositioning schedules.⁵⁹

The first RCT compared a two hour repositioning regimen to four hour repositioning, both implemented in conjunction with support surfaces. Participants were residents in long term care (mean age 87 years) and the primary outcome measure was development of PIs after a mean follow up of 15 days. There was no statistically significant difference in the rate of stage II PIs (16.4% in the two hour group compared to 21.2% in the four hour group). Thirty-four per cent of patients in the trial spontaneously repositioned themselves from a 30° lateral position to a supine position in between assisted repositioning.⁵⁹ In the second RCT 838 long term care residents (mean age 84.4 years) were repositioning using four different regimens (two, three, four or six hour repositioning between a 30° lateral position and a 30° semi-Fowler's positioning). The control group received care based on the clinician's judgment (including alternating pressure mattresses, sheepskins and gel cushions). Participants with longer durations between repositioning also received a visco-elastic foam mattress. There was no significant difference between groups in incidence of stage one PIs;^{39, 59} however, patients repositioned every four hours and receiving a visco-elastic foam mattress had a statistically significant reduction in rate of PIs of grade two or higher (3% versus 14.3% to 24.1%, $p=0.002$).⁵⁹ The use of different support surfaces between the groups may have contributed to the findings. In the third RCT a 30° pelvic tilt positioning regimen was compared to a 90° side-lying position regimen, with both groups repositioned as required for regular care (in both groups, every two to three hours). Participants were long term care residents (mean age 70 years). There was no significant difference in incidence of stage I PIs in the follow up period (one night).^{39, 59} The two SRs^{39, 59} came to different conclusions on the findings of these trials. Whilst one concluded that repositioning more frequently than every four hours achieved no additional reduction in incidence of PIs;⁵⁹ the second SR concludes that a standard two hour turning regimen is the most appropriate management strategy.³⁹ (*Level II evidence*)

The NPUAP/EPUAP evidence-based guideline⁴ presented evidence from RCTs to support a recommendation that patients be repositioned to reduce exposure to and magnitude of pressure to vulnerable body areas. (*Level II evidence*) Evidence from a small cross over trial ($n=57$) that compared seating regimens of more than and less than two hours. Patients seated for more than two hours at a time were more likely to develop PIs (7% versus 63%, $p<0.001$). The guideline makes a moderate grade recommendation to limit time spent in a chair without pressure relief. (*Level III evidence in related populations*) The guideline further recommends that frequency of repositioning be determined by the patient's risk, mobility, overall treatment aims (*Consensus*) and the support surface on which the patient is managed. (*Level II evidence*)

The RNAO evidence-based guideline²⁰ uses one study to support a recommendation that patients at risk of PIs be repositioned despite the use of any pressure management devices, but no guidance on position or frequency of repositioning is provided. (*Level II evidence*)

The WOCNS guideline⁶ also presented the evidence above. The guideline included a grade B recommendation that patients be repositioned. (*Level II studies*) The guideline recommended that as there is no evidence on the optimal time frame for routine repositioning, repositioning frequency should be determined by the individual patient's medical condition, mobility and individual preferences.

NHMRC grading matrix		
Evidence base	For any repositioning – Three RCTs at low risk of bias	A
	High grade recommendation in an evidence based guideline For routine repositioning – Two RCTs (unknown level of bias)	C
Consistency	There is consistency for individualised repositioning.	A
	Findings for routine repositioning are inconsistent and may be related to concurrent support surfaces.	B
Clinical impact	Clinical impact of repositioning is high, but using impact of using a routine regimen is not reported and remains unknown	A
Generalisability	Trials conducted in populations with high risk of PI.	A
Applicability	Applicable to all health care settings and appears to be applicable regardless of pressure surface on which patient managed.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations, Pacific Island populations or Asian populations.	
Recommendation 17		
Reposition patients to reduce duration and magnitude of pressure over vulnerable areas, including bony prominences and heels.		A
Recommendation 18		
Frequency of repositioning should consider the patient's risk of pressure injury development, skin response, comfort, functional level, medical condition, and the support surface used.		CBR

6.5.1 Positioning the patient in bed

Evidence summary

One SR⁵⁹ reported two RCTs that found patients repositioned themselves spontaneously, particularly when placed in a 30° supine position, suggesting further investigation of this position for pressure relief may be warranted. These patients (all older adults in long term care) were managed on a range of support surfaces described as visco-elastic foam mattresses, static foam mattresses, low air loss beds and alternating pressure mattresses.⁵⁹ (*Level II evidence*)

The NPUAP/EPUAP evidence-based guideline⁴ provided evidence from a laboratory study on healthy volunteers that found interface pressure to be significantly lower when patients were managed in a 30° laterally inclined position and the prone position. Highest interface pressures were found with the 90° side-lying position. The guideline recommended patients be repositioned using the 30° side laterally inclined position alternating from right side, back and left side; or in the prone position if the patient's medical condition precluded other options. (*Level II evidence in related populations*)

NHMRC grading matrix		
Evidence base	Two RCTs (unknown level of bias) in an SR	C
	Low graded recommendation from an evidence based guideline	
Consistency	Findings were consistent	A
Clinical impact	Clinical impact not reported and remains unknown	U
Generalisability	One trial in healthy volunteers in a laboratory setting, two trials in populations with high risk of PI.	A
Applicability	Applicable to all health care settings and appears to be applicable regardless of pressure surface on which patient managed.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations, Pacific Island populations or Asian populations.	
Recommendation 19		
Position patients using 30° lateral inclination alternating from side to side or a 30° inclined recumbent position. Use the prone position if the patient's medical condition precludes other options.		C

Recommendation 20

When repositioning the patient in any position always check the positioning of heels and other bony prominences. CBR

6.5.2 Positioning the seated patient**Evidence summary**

One SR⁶⁰ investigated posterior or anterior tilted seating (either compared to an upright position or comparisons of tilt angle) for people with neurological impairment who were non-ambulant. Nineteen small, low quality studies (randomised and non-randomised trials, primarily cross over studies with a maximum sample size of 20 participants) were included. Ten studies were in juvenile populations primarily with cerebral palsy and nine trials were conducted in adults primarily with spinal cord injury. Primary outcome measures were indirect measures of PI development measured over short time frames (maximum 20 minutes) and included pressure loading at the sacrum and ischial tuberosities. A meta-analysis using a random effects model was conducted on five studies comparing tilted and upright seating effect on mean interface pressure. The analysis showed a reduction in pressure under ischial tuberosities of between 24 mmHg (95% CI 4.19 to 43.80, $p=0.02$) and 24.80 mmHg (95% CI 7.16 to 42.44, $p=0.006$). All the studies included in the analysis individually showed a reduction in pressure; however, the results were not significant in more than half. The pooled analysis included studies in adults and children, various tilting orientations and various additional interventions (e.g. pressurised cushions).⁶⁰ This heterogeneity reduced confidence in the appropriateness of the meta-analysis and its findings. This review⁶⁰ provided some evidence that posterior tilted seating of at least 20° may reduce pressure load at ischial tuberosities; however a direct effect in reducing development of PIs was not demonstrated. ⁶⁰ (Level I evidence)

Recommendation 21

Limit the time a patient spends in seated positions without pressure relief.

CBR**Practice points for patient positioning**

- Repositioning should be performed regardless of the support surface on which the patient is managed.
- Whenever the patient is repositioned assess the patient's skin condition and general comfort and reconsider frequency and method of positioning if the patient is not responding as expected.⁴
- When repositioning the patient reduce friction and shear forces through use of repositioning or transfer aids.⁴
- Where possible, avoid positioning the patient on bony prominences (including heels) with existing erythema.⁴
- Ensure heels are free of the bed surface⁴ and inspect the skin of heels frequently.
- If sitting when head-of-bed elevation is required, use aids such as pillows that support the upper body to reduce additional pressure on the sacrum and coccyx.
- Before raising the head-of-bed, move the patient up the bed and raise the knees. This assists in avoiding shear from the patient slipping down the bed.
- Consider more frequent, smaller shifts in position for patients who cannot tolerate frequent and/or major changes in body position.⁴

Seating in chairs/wheelchairs:

- Position a seated patient in a posture that minimises pressure, friction and shear forces and maintains their usual range of activity.⁴
- When seated in non-reclining chairs ensure the patient's lower limbs are supported in optimal alignment (e.g. 90° at hip, knee and foot) within the patient's range of movement.
- To minimise pressure under ischial tuberosities, avoid positioning hips at greater than 90° when seated.

- Consider adjusting the seat height and depth to improve supported body positioning. All patients should have appropriate seat to floor height to reduce potential for shear and friction.

Documentation

- Document repositioning regimens, including frequency, position and evaluation of the outcome of repositioning.⁴

6.6 Support surfaces and positioning in the operating theatre

Time spent in the operating theatre can have a significant impact on the development of PIs as the patient remains immobile for extended periods and is unable to respond to pain stimulus related to shear and pressure forces.⁴

Factors that influence the risk of PI development during surgery include:⁴

- Length of time spent in the operating theatre
- Increased intraoperative hypotensive episodes
- Decreased intraoperative core temperature
- Decreased mobility in the 24 hours following surgery

6.6.1 Support surfaces in the operating theatre

Evidence summary

One Cochrane SR⁴³ reported four low quality RCTs on support surfaces in the operating theatre.

In one trial a high specification visco-elastic polymer pad significantly reduced the risk of PI in patients undergoing surgical procedures of at least 1.5 hours duration compared with a "standard" operating table mattress (RR 0.53; 95% CI 0.33 to 0.85, p=0.0083).⁴³

In a second trial an experimental group received a reactive (constant low pressure) thermo-active visco-elastic foam overlay over a water-filled mattress and the control group received only the water-filled mattress. The trial was terminated early due to an increase in stage one PIs associated with the overlay (17.6% vs 11.1%, p=0.22).

Two trials compared a Micropulse® Inc. active (alternating pressure) multi-segmented air filled support mattress used both during and after surgery to a reactive (constant low pressure) gel pad overlay used in the theatre and a "standard" mattress following surgery. Surgery duration was at least four hours. The pooled findings showed the Micropulse® Inc. active (alternating pressure) mattress to be superior in reducing PI risk (RR 0.21, 95% CI 0.06 to 0.70, p=0.011); however, the reviewers were not confident that this effect was achieved during time spent in the operating room.⁴³ (*Level I evidence*)

The NPUAP/EPUAP guideline⁴ reports the above studies and two additional non-randomised lab-based studies into interface pressure in operating theatres. The studies, conducted in healthy volunteers, indicated that interface pressure is reduced with high-specification constant low pressure foam mattresses compared to "Standard" operating theatre mattresses and gel mattresses.⁴

NHMRC grading matrix		
Evidence base	Four RCTs at moderate-high risk of bias Consensus recommendation from an evidence based guideline	B
Consistency	Findings were consistent for mattresses but not overlays	A
Clinical impact	Moderate clinical impact	B
Generalisability	Trials in populations with high risk of PI.	A
Applicability	Applicable to operating rooms	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori or Pacific Island populations. It is unknown if Asian populations were included in trials.	

Recommendation 22

Use a high specification reactive (constant low pressure) foam mattress or an active (alternating pressure) mattress on operating theatre tables for patients at risk of pressure injuries.

B**Practice points for operating theatre support surfaces**

- Check all support surfaces are functioning and correctly positioned every time a patient is repositioned or transported.
- Any support surface should be used and maintained according to manufacturer instructions. Annual safety audits to ensure the integrity devices are recommended.
- Supports will only be effective in offloading heel pressure when placed lengthwise under the lower limb so heels are elevated and offloaded.⁴
- Heel protection devices should elevate the heel completely and distribute the weight of the leg along the calf without placing undue pressure on the Achilles tendon. The knee should be in slight flexion.⁴

Documentation

- Document any support surfaces and devices used during the surgical procedure.⁴

6.6.2 Positioning the patient for surgery**Evidence summary**

The NPUAP/EPUAP guideline⁴ provides consensus recommendations on positioning patients in the operating room. The recommendations are supported by a study conducted in a laboratory with healthy volunteers that found that of all surgical positions, supine position offers the lowest interface pressure. Another study supporting the consensus recommendations found that when the patient's knees are extended popliteal vein compression increases, increasing the risk of deep vein thrombosis.⁴

Recommendation 23

Position the patient with heels elevated, knees flexed and the weight of the leg distributed along the calf to reduce the risk of pressure injuries in the operating theatre.

CBR**Practice points for patient positioning in the operating theatre**

- Consider using padding to protect bony prominences.⁴
- When positioning the patient reduce friction and shear forces through use of repositioning or transfer aids.⁴

Documentation

- Document position the patient was placed in during the surgical procedure.⁴

7. ASSESSMENT AND MONITORING OF PRESSURE INJURIES

7.1 Clinical questions

What strategies or tools for assessing PIs have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these strategies or tools provide a reliable and valid method of assessing PIs?

7.2 Pressure injury assessment and monitoring

A comprehensive assessment of the PI assists in developing the most appropriate management plan and ongoing monitoring of wound healing.

The Guideline Development Steering Committee concurs with other expert groups that ongoing wound assessment is crucial to the appropriate management of PIs. Pressure injuries should be assessed on admission to the service's care and formally assessed at least weekly or when change in healing status indicates.⁴ Ongoing observation should be conducted with each dressing change.⁴ Pressure injury assessment includes:^{2, 4, 61}

- location of PI,
- measurement of the wound size and depth,
- amount and type of exudate,
- appearance of the wound bed,
- condition of the wound edges,
- signs of clinical infection,
- appearance of peri-wound skin,
- undermining, sinus tracts and tunnelling,
- wound odour, and
- level of pain and discomfort,

7.2.1 Microbiology and histopathology

Microbiology assists in the identification of causative organisms and sensitivity testing determines appropriate therapy when clinical infection is present. Histopathology can identify malignant or other aetiologies. Investigations may include:

- bacterial wound swab or wound tissue biopsy for bacteriological analysis.^{2, 20}
- wound tissue biopsy if malignancy or other aetiology is suspected.²

7.2.2 Pressure injury healing assessment scales

Using a validated PI healing assessment scale promotes comprehensive and consistent assessment. The following PI healing assessment scales have been validated for use:⁶¹

- Pressure Ulcer Scale for Healing (PUSH®).
- Bates-Jensen Wound Assessment Tool (BWAT).
- Sessing Scale.

7.2.3 Expectations of healing

Studies investigating healing time for PIs have had inconsistent findings, likely related to contextual variations including types of patients. Evidence is consistent that stage II PIs take less time to heal than stage III and IV PIs, with the latter generally taking about twice as long to heal. Healing times reported for stage II PIs were 50 to 60 days, and 140-150 days for stage III and IV PIs, although the age and nutritional status of the long term care patients in which these studies were conducted likely influenced healing rates.⁴

With optimal care, improvement in the PI condition should be evidenced within one to two weeks for partial thickness PIs^{4, 6} and two to four weeks for full thickness PIs.⁶ Large, deep, infected wounds with higher levels of exudate and/or covered in slough or eschar may not heal within five or six months.⁶

Evidence summary

Validated pressure injury healing assessment scales

One SR⁶¹ reported on the feasibility, validity, reliability and cost effectiveness of various PI healing assessment scales for clinical use. Three scales were reported —the Pressure Sore Status Tool (PSST), PUSH© and Sessing Scale. The PSST (now known as the BWAT) and PUSH© were also reported in the NPUAP/EPUAP evidence-based guideline⁴ that recommended their use as validated scales for assessing PI healing.

The BWAT is reported to take about 30 minutes of training and 10 to 15 minutes to use,⁶¹ has good intra-rater reliability (0.89)⁴ but only partial inter-rater reliability (0.70 to 0.80). Responsiveness and validation have not been reported.^{4, 61} The BWAT includes 15 items that assess wound characteristics (size, depth, edges, undermining, necrosis, exudate, skin colour, oedema, granulation and epithelialisation) on Likert scales.^{4, 6}

The PUSH Scale has good validity, strong interrater and intrarater reliability ($r > 0.90$, $p < 0.01$)⁶² and acceptable responsiveness (between two and four weeks). The tool takes between one and five minutes to administer and clinicians require about 50 minutes of training to use the tool. It was developed as a tool for monitoring wound deterioration or healing over time.^{4, 61}

The Sessing Scale has good validity and reliability, takes about one minute to use and clinicians require about 30 minutes of training. Its responsiveness was not reported. However, time to calculate patient scores on the Sessing Scale was reported to be extensive, possibly reducing practicality.⁶¹ (Level III evidence)

Wound volume

The SR by van Lis et al.⁶¹ reported three methods for assessing wound volume— filling the cavity with warm sterile normal saline (0.9%), filling with alginate or measuring length, width and depth using a ruler. Intrarater reliability for saline filling was rated as good (defined as Kappa or Pearson's r above 0.80); however interrater reliability was low (< 0.70). Reliability was not reported for the other measures. Time to implement the assessment was only reported for saline filling (less than 15 minutes) and training time was only reported for ruler measurement (15 to 30 minutes). Ruler measurement was reported to have the best responsiveness, with statistically significant differences in results apparent at three weeks. All three methods were reported to have strong correlation (in this review defined as correlation coefficients > 0.60).⁶¹ (Level III evidence)

Wound surface area

Five strategies for assessment of wound surface area were reported in the SR by van Lis et al.⁶¹ Measuring length and width with a ruler showed good inter- and intra-rater reliability and good responsiveness, with statistically significant results evident after two weeks. Tracings using either grid paper or planimetry were also reported to have good inter- and intra-rater reliability, and the later had also been tested for responsiveness (significant results achieved at two weeks). Tracing with a grid sheet was reported to take five to seven minutes. Tracing with a digital stylus or with a computer pointed device both had good intra-rater reliability, but inter-rater reliability and responsiveness have not been reported.⁶¹

The SR authors⁶¹ considered the ruler method was the most acceptable strategy for measuring the wound size (volume and/or surface area) of PIs. This method is simple and relatively fast and has good validity, reliability and responsiveness to change in wounds. This method also requires the least clinician training and is likely to be the most cost effective.⁶¹ (Level III evidence)

NHMRC grading matrix		
Evidence base	Level III studies reported in SRs and guidelines Moderate graded recommendation from an evidence based guideline	C
Consistency	Findings were consistent	A
Clinical impact	Clinical impact is unknown but likely to be high	B
Generalisability	Validation trials were conducted in populations with existing PIs.	A
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 24		
Assess and monitor pressure injuries using a validated pressure injury healing assessment scale. C		

Practice points for assessing PIs

- Validated PI healing assessment scales include:
 - PUSH@.
 - BWAT.
 - Sessing Scale.
- Measurement of the wound should include length, width and depth.^{4, 61}
- Tracing the wound margins provides a reliable indication of the progress of wound healing. Other techniques for measuring wound size include using a disposable ruler or photography including a calibrated measure.^{4, 61}
- Computerised calculation (planimetry) of the wound area from wound tracings or digital photography could be considered if resources are available.^{2, 4}
- The patient's position should be replicated as closely as possible when re-measuring the wound to increase the accuracy of results.^{2, 4}
- When ongoing assessment indicates that the PI is not healing at an optimal rate (improvement evident within two to four weeks depending on initial condition of the wound^{4, 6}) the wound dressing choice and overall management should be reviewed.

7.3 Pressure injury classification

Pressure injury classification systems provide a consistent and accurate means by which the severity of a PI can be communicated and documented. These classification systems are used in PI research as well as in the clinical field to provide a description of the severity of the PI under discussion.

The first PI classification system was developed in 1975 by Shea.⁶³ This classification system has been modified since its original inception and it is cited as one of the most commonly used classification systems. Also widely used, the NPUAP⁶⁴ and the EPUAP⁶⁵ classification systems have been modified a number of times and most recently presented in the NPUAP/EPUAP 2009 evidence-based guideline. In Australia, the previous classification system presented by AWMA in 2001¹ is widely used.

Evidence summary

One SR⁶⁶ reported on 10 studies investigating inter-rater reliability of PI classification systems. The EPUAP 1998 classification system⁶⁵ was investigated in two studies, both including nurse raters with specific training who assessed patients in a range of clinical settings. Coefficients indicated ranged from kappa 0.97 (95% CI 0.92 to 1.00) to kappa 0.31. Three studies reporting on the NPUAP system⁶⁴ also showed wide variation in inter-rater reliability (58% to 100% agreement). The adapted Shea classification system had moderate inter-rater reliability (Kappa 0.42, 95% CI 0.10 to 0.74). Methodological issues in the studies prevented meaningful synthesis of the data and the reviewers determined there was insufficient evidence to recommend one specific PI classification system.⁶⁶ (*Descriptive studies*)

One SR⁶⁷ reported on review papers that described PI classification systems. The review included 94 papers and the search was designed to include papers by leading experts in the field. The review found that there was large variability in descriptions of stage I PIs, terms used to describe PIs and opinion on when staging should be conducted. Although experienced health professionals recognised the occurrence of deep tissue injury, the staging systems most often used and cited (Shea⁶³, NPUAP1989⁶⁴ and AHCPR⁶⁸) did not identify this form of PI. The review appeared to be a precursor to the consideration of the updated NPUAP staging system.⁴ (*Consensus*)

In consideration of the lack of evidence to recommend a specific PI classification system as being a more reliable tool for classifying PIs, the AWMA takes the position that a consistent terminology be adopted. Opinion was sought from AWMA members and canvassed from international health professionals via an online survey made available on the AWMA website in the first half of 2011. The majority opinion of over 400 health professionals from Australia, New Zealand, Singapore and Hong Kong was that the most recently published NPUAP/EPUAP classification system⁴ be used. Adoption of the NPUAP/EPUAP classification system within the Pan Pacific region seeks to achieve international consensus on terminology used to describe PIs.

Recommendation 25

Consider using the NPUAP/EPUAP 2009 pressure injury classification system to identify and communicate the severity of pressure injuries.

CBR

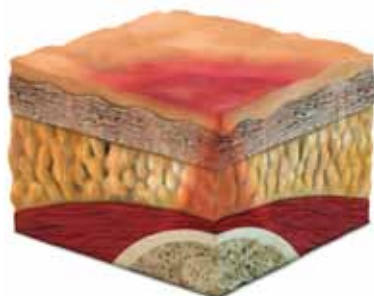
Table 7.1 NPUAP/EPUAP pressure injury classification system⁴

Normal skin

3D graphics designed by Jarrad Gittos, Gear Interactive, <http://www.gearinteractive.com.au>

Stage I pressure injury: non-blanchable erythema

- Intact skin with non-blanchable redness of a localised area usually over a bony prominence.
- Darkly pigmented skin may not have visible blanching; its colour may differ from the surrounding area.
- The area may be painful, firm, soft, warmer or cooler compared to adjacent tissue.
- May be difficult to detect in individuals with dark skin tones.
- May indicate “at risk” persons (a heralding sign of risk).



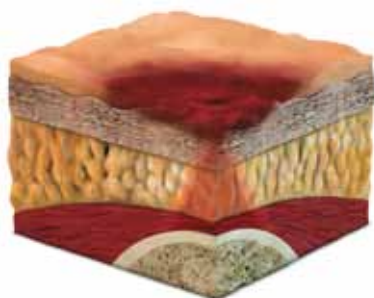
3D graphics designed by Jarrad Gittos, Gear Interactive, <http://www.gearinteractive.com.au>



Photo courtesy CY, Launceston General Hospital. Used with permission.

Stage II pressure injury: partial thickness skin loss

- Partial thickness loss of dermis presenting as a shallow, open wound with a red-pink wound bed, without slough.
- May also present as an intact or open/ruptured serum-filled blister.
- Presents as a shiny or dry, shallow ulcer without slough or bruising (NB bruising indicates suspected deep tissue injury).
- Stage II PI should not be used to describe skin tears, tape burns, perineal dermatitis, maceration or excoriation.



3D graphics designed by Jarrad Gittos, Gear Interactive, <http://www.gearinteractive.com.au>

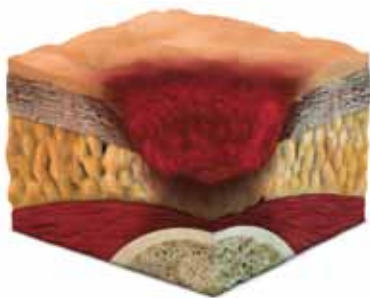


Photo courtesy KC, Silver Chain Nursing Assoc. Used with permission.

Table 7.1 NPUAP/EPUAP pressure injury classification system⁴

Stage III pressure injury: full thickness skin loss

- Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunnelling.
- The depth of a stage III PI varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have subcutaneous tissue and stage III PIs can be shallow. In contrast, areas of significant adiposity can develop extremely deep stage III PIs. Bone or tendon is not visible or directly palpable.



3D graphics designed by Jarrad Gittos, Gear Interactive, <http://www.gearinteractive.com.au>



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Stage IV pressure injury: full thickness tissue loss

- Full thickness tissue loss with exposed bone, tendon or muscle. Slough or eschar may be present on some parts of the wound bed.
- The depth of a stage IV pressure injury varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have subcutaneous tissue and these PIs can be shallow. Stage IV PIs can extend into muscle and/or supporting structures (e.g. fascia, tendon or joint capsule) making osteomyelitis possible. Exposed bone or tendon is visible or directly palpable.



Table 7.1 NPUAP/EPUAP pressure injury classification system⁴

3D graphics designed by Jarrad Gittos, Gear Interactive, <http://www.gearinteractive.com.au>

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Unstageable pressure injury: depth unknown

- Full thickness tissue loss in which the base of the PI is covered by slough (yellow, tan, grey, green or brown) and/or eschar (tan, brown or black) in the PI bed.
- Until enough slough/eschar is removed to expose the base of the PI, the true depth, and therefore the stage, cannot be determined. Stable (dry, adherent, intact without erythema or fluctuance) eschar on the heels serves as the body's natural biological cover and should not be removed.

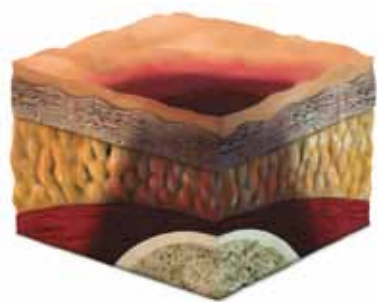


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Suspected deep tissue injury: depth unknown

- Purple or maroon localised area or discoloured, intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler as compared to adjacent tissue.
- Deep tissue injury may be difficult to detect in individuals with dark skin tone.
- Evolution may include a thin blister over a dark wound bed. The PI may further involve and become covered by thin eschar. Evolution may be rapid, exposing additional layers of tissue even with optimal treatment.



3D graphics designed by Jarrad Gittos, Gear Interactive, <http://www.gearinteractive.com.au>

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8. ADDRESSING PAIN ASSOCIATED WITH PRESSURE INJURIES

8.1 Clinical questions

What strategies or tools for assessing pain associated with PIs have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these strategies or tools provide a reliable and valid method of assessing pain associated with PIs?

What interventions for managing pain associated with PIs have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these interventions are effective in managing pain associated with PIs?

8.2 The experience of pressure injury pain

Two SRs^{69, 70} focused on the patient's experience of pain associated with PIs in adults. Both reviews included both qualitative (descriptive) and quantitative (primarily cross-sectional designs) studies. The first review⁶⁹ identified 26 studies and the second SR⁷⁰ presented data from ten studies, about half of which were also reported by Girouard et al.⁶⁹

8.2.1 Pain prevalence

Incidence of PI associated pain was not reported in any study. In three studies with more than 100 participants, prevalence of PI associated pain ranged from 37% to 66%. Studies using validated assessment tools reported higher PI pain prevalence than those using non-validated assessment tools.⁶⁹ Gorecki et al⁷⁰ reported that the majority of patients experience pain at least some of the time.

8.2.2 Pain duration and timing

Girouard et al⁶⁹ reported that time of PI associated pain occurrence was assessed in six studies, although three of these studies only reported pain at one point in time. One large cross-sectional study found 12% of participants to have constant pain and 54% had occasional or treatment-related pain. Another study indicated that 20% of patients had pain for less than one hour daily and 55% experienced pain at rest.⁶⁹ Gorecki et al⁷⁰ reported similar variations, concurring that pain could be experienced for various durations (patient descriptors included constant, comes and goes, persistent, intermittent) and may be related to the time of day, activities (e.g. dressing changes, contact of the PI with bed clothes) or occur at rest. There appeared to be no common pattern to pain duration or when it occurs.⁷⁰

8.2.3 Factors associated with pain

Severity or stage of the patient's PIs appeared to be related to the experience of pain, with increasing pain as PI severity increased.⁶⁹ Gorecki et al's review⁷⁰ reported that there was consistency across relevant studies that patients with more severe PIs (stages III and IV) were more likely to report pain, and the descriptors used suggested the pain was more frequent and intense.⁷⁰

Although increasing pain levels were not consistently related to dressing changes,⁶⁹ experience of pain at these times was reported most commonly.⁷⁰ Patients reported pain to be related to the tenderness of the wound, the techniques used to clean the wound and dressing application or removal.⁷⁰ Table 8.1 includes other factors associated with pain reported in the literature.

Table 8.1 Factors associated with pressure injury pain^{69, 71}

Stage or severity of the pressure injury	Increasing stage or severity associated with greater pain levels
Wound dressings	Attendance of the wound associated with greater pain than at rest
Dressing types	Hydrocolloid dressings associated with lower pain levels than any other dressing types including transparent films and wet-to-dry dressings
Ethnic origin	Different ethnic background (particularly non-English speaking) associated with greater pain levels
Patient age	Increasing age associated with greater pain levels
Medication	Patients taking analgesia report greater pain levels
Support surface	Low air loss beds associated with lower pain levels than other surfaces

8.2.4 Pain descriptions

Gorecki et al⁷⁰ focused on descriptions and communication of pain by the patient. Studies included in the review identified that the experience of pain and its qualities were difficult to describe and patients regularly use metaphors or similes (e.g. "it hurts like the devil"^{70p.7}, "feel as if the skin is being pulled backwards on it"^{70p.7}, a burning, throbbing sensation"^{70p.7}) to convey their pain experience. A wide range of descriptors were reported, with increasing variety in descriptors noted as the severity of PIs increased. Although more than forty words or descriptions were reported across ten studies included in Gorecki et al's⁷⁰ review, the most commonly used pain descriptors included:

- tender,
- sharp,
- throbbing,
- aching,
- hot burning,
- stabbing,
- heavy, and
- shooting.

Girouard et al⁶⁹ reported that pain was most often described as burning and that 7% to 18% patients rated their pain as severe or excruciating.

8.3 Pain assessment

It is vital to conduct an initial assessment of wound related pain and frequently reassess. A pain assessment should include:^{4, 20, 62, 69, 70, 72}

- location of the wound-related pain,
- frequency, quantity and severity of the pain,
- quality or characteristics of the pain,
- when pain occurs (e.g. at dressing changes, background pain),
- triggers and relievers,
- impact of the pain on QOL.

8.3.1 Pain assessment tools

Using a validated pain assessment tool is associated with greater accuracy in identifying the presence and severity of pain. Findings from the evidence suggested that patients may have preferences for types of pain assessment tools (e.g. numerical versus pictorial scales) and where possible a choice should be offered.⁶⁹ Not all validated pain assessment tools assess other characteristics of pain (e.g. quality).

The following pain assessment tools have been validated for use in adult populations with PIs:^{4, 62, 69}

- Visual analogue scale (VAS)

- Wong-Baker FACES Pain Rating Scale (FRS)⁷³
- McGill Pain Questionnaire (MPQ)⁷⁴

The following pain assessment tools have been validated in child populations (not with PIs) and could be considered appropriate for assessing PI associated pain in children:^{4,72}

- 0 to 10 pain rating scale
- Wong-Baker FRS⁷³
- Face, Legs, Activity, Cry, Consolability (FLACC) scale⁷⁵
- Revised-FLACC⁷⁶
- Crying; Requires O₂ for Saturation >95%; Increasing vital signs; Expression; Sleepless (CRIES) scale⁷⁷

Evidence summary

Three SRs^{62, 69, 72} reported on pain scales that have been used in PI associated pain assessment. The review by Girouard et al.⁶⁹ was based on 26 studies of various design that addressed pain assessment, prevalence, incidence and management. Pieper et al.⁷² identified three pain assessment scales that have been used in PI assessment in adults, as well as numerous tools appropriate for assessing PI pain in children. The third SR⁶² focused on assessment and management of pain, odour and exudate associated with PIs and included 13 studies of different design (Level II, III and IV evidence).⁶²

Girouard et al.⁶⁹ reported on pain assessment from 26 studies and concluded that prevalence of PI associated pain was higher in studies that used a validated assessment tool compared to those using non-validated assessment tools. Findings from the evidence suggested that patients may have preferences for types of pain assessment tools (e.g. numerical versus pictorial scales) and accuracy of pain assessment may be increased if the patient is offered a choice.^{69,70} (*Descriptive studies*)

Visual analogue scale

A standard visual analogue scale (VAS) was reported as a suitable tool for measuring pain intensity associated with PIs. One trial reported a moderate correlation between VAS and wound stage ($r=0.37$, $p<0.01$), a moderate correlation between VAS and generalised pain ($r=0.59$) and a strong correlation between the VAS and Wong-Baker FRS ($r=0.90$).^{4, 62, 69} Girouard et al.⁶⁹ reported a second trial found that there is significant variability in VAS ratings when pain is rated at the end of the FRS scale.⁷³ (Level III evidence)

Faces Pain Rating Scales

One cross-sectional trial conducted in 44 participants (not cognitively impaired) with PIs in an acute care setting found a strong correlation ($r=0.92$, $p<0.01$) between the Wong-Baker FRS and VAS, and that was confirmed in a secondary analysis of the trial.^{62, 69} The Wong-Baker FRS was also reported to be reliable in cognitively impaired adults.⁶⁹ Girouard et al.⁶⁹ included a trial that reported on the validity of the Revised Faces Ratings Scale, a pain scale developed by the International Association for the Study of Pain and generally referred to as the Faces Pain Scale-Revised (FPS-R).⁷⁸ The trial reported statistically significant and high correlation ($r=0.90$) between pain intensity and FPS-R rating.⁶⁹ (Level III evidence)

McGill Pain Questionnaire

Trials on the McGill Pain Questionnaire (MPQ)⁷⁴ have focused on the different descriptors and ratings of pain given by patients with PIs. Reliability and validity of the scale for measuring PI associated pain was established in a trial of 47 patients with stage II to IV PIs. There was a strong correlation between MPQ and FRD ($r=0.90$).⁴ Studies on general pain have also provided evidence of the tool's internal consistency, construct validity and sensitivity.⁶² One trial found the MPQ to be a time consuming tool for clinical use.⁶⁹ Use of the Present Pain Intensity subscale of the MPQ by cognitively impaired adults was suggested.⁶⁹ (Level III evidence)

Pain assessment in children

A number of pain assessment tools for use in children were reported; however, none have been specifically validated for assessing PI associated pain. The FLACC scale⁷⁵ was reported to have high inter-rater reliability [$r=0.9$] when used to assess post-operative pain in children.^{4, 72} The CRIES scale⁷⁷ was reported to be highly reliable in children up to 6 months in age.^{4, 72} The revised-FLACC⁷⁶ was reported to have medium to high intra-class correlation coefficients (range 0.76 to 0.90).⁷² (Level III evidence)

The RNAO evidence-based guideline²⁰ provided a consensus recommendation that patients be assessed for pain. The guideline suggests that pain be assessed routinely and regularly using the same validated tool. The MPQ, VAS, Wong-Baker FRS and modified Functional Independence Measure (FIM) are proposed as assessment tool options. (*Consensus*)

The NPUAP/EPUAP evidence-based guideline⁴ reported validation of the Wong-Baker FRS, MPQ and VAS and provided a moderate grade recommendation supporting the use of validated pain assessment tools.

The guideline provided consensus recommendation on tools appropriate for assessing PI associated pain in children. (Consensus)

NHMRC grading matrix		
Evidence base	Five Level II studies reported in SRs Moderate graded recommendation from an evidence based guideline	C
Consistency	Findings were consistent	A
Clinical impact	Clinical impact is unknown but likely to be high	B
Generalisability	Validation trials were conducted in populations with existing PIs.	A
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials included Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations; however, there are validated Asian versions of some pain assessment tools.	
Recommendation 26		
All patients with pressure injuries should be regularly and routinely assessed for presence of pain.		C
Recommendation 27		
Use a validated pain assessment tool to assist in assessing pain associated with a pressure injury.		C

Practice points for assessing pain

- Select a validated pain assessment tool that is appropriate for the patient population (see Appendix E).
- Offering patients a choice of pain assessment tools may increase accuracy of assessment.⁶⁹ Some patients may have preferences between numerical, textual and graphics based tools.
- Use the same pain assessment tool for ongoing pain assessment²⁰ and reassess pain regularly.
- Pain assessment should include observation of body language and nonverbal cues (particularly in cognitively impaired patients and children).⁴

Documentation

- All pain assessments, including the tool used and the assessment findings, should be documented.

8.4 Managing pain associated with pressure injury

A pain management plan should be developed and regularly reviewed. The patient should be prescribed adequate analgesia and pain management strategies and be referred to a pain specialist when pain is not managed effectively.⁴

One SR⁷² reported a number of descriptive studies that indicated patients experience increased pain when dressings are attended. The review suggests using principles developed from consensus by the World Union of Wound Healing Societies:²⁵

- be aware of current wound pain,
- avoid unnecessary manipulation of the wound,
- explore patient-controlled techniques to minimise wound pain,
- assess the skin and surrounding tissue for infection and necrosis,
- consider the temperature of wound care products,
- avoid excessive pressure to the wound from dressing materials, and
- regularly evaluate the patient's management plan.

One SR⁷² reported that no research was available on the use of systemic analgesia for managing pain associated with PIs. The review suggested using the World Health Organisation's (WHO) Analgesic Dosing Ladder⁷⁹, proposed for use in patients with cancer-related pain, but this has not been investigated as

a strategy for managing PI associated pain specifically. The WHO recommends a three-step approach to analgesia:⁸⁰

- commence with non-opioid medications with or without an adjuvant,
- if pain persists or increases, use an opioid for mild to moderate pain +/- a non-opioid adjuvant,
- if pain persists or increases, use an opioid for moderate to severe pain +/- a non-opioid adjuvant,
- when a drug is ineffective, do not switch to a drug with similar efficacy, switch to a drug that is stronger.

Recommendation 28

Holistic management of a patient with pressure injuries includes development of an individualised pain management plan.

CBR

8.4.1 Topical opioids

Opioid receptors have been found on peripheral nerves and inflamed tissue, providing some support for the theory that topically applied opioids may provide relief of PI associated pain.

Evidence summary

Two SRs^{62, 72} reported trials investigating topical morphine gels. In one double-blind cross over RCT (n=5) the effect of morphine sulfate 10 mg injection in 8 g of IntraSite™ gel applied topically to PIs assessed as being stage II or III (scale not reported). The intervention was compared with a water injection applied to IntraSite™ gel, covered with a standard dressing and used in addition to regular analgesia (not reported). Pain scores measured on a VAS were significantly lower ($p < 0.01$) in the morphine group; however the clinical significance was not reported. No systemic side effects occurred. The quality of the trial was not reported but the sample size appears to be too small to measure significant results. The second double-blind cross over RCT (n=13) investigated the effectiveness of diamorphine gel compared with ordinary gel for pain associated with stage II or III PIs. Pain scores on a five point scale were reported to be significantly lower between one and 12 hours after administration ($p = \text{not reported}$).^{62, 72} (Level II evidence)

The NPUAP/EPUAP evidence-evidence based⁴ guideline provided a stage B recommendation that topical opioids (e.g. diamorphine) be considered for reducing pain. The recommendation was based on two additional small trials to those reported above, and evidence derived from patients with skin ulcers. The guideline reported one placebo-controlled cross-over trial including seven participants with stage II to IV PIs that found significant improvement in pain scores following debriding after one hour ($p < 0.003$) and 12 hours ($p = 0.005$) associated with diamorphine-IntraSite™ gel. A retrospective trial in 15 patients with stage II to IV PIs reported a reduction of four points on a VAS associated with diamorphine-IntraSite™ gel.⁴ (Level II and III evidence)

NHMRC grading matrix

Evidence base	Three RCTs at high risk of bias and a retrospective trial reported in SRs and guidelines Moderate graded recommendation from an evidence based guideline	D
Consistency	Findings were consistent	A
Clinical impact	Moderate clinical impact	B
Generalisability	Populations with existing stage II to IV PIs.	A
Applicability	Applicable to all health care settings, but access may be limited.	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations, Pacific Island populations or Asian populations.	

Recommendation 29

Consider using topical opioids to reduce pain associated with stage II to IV pressure injuries.

C

Caution

The small trials reported in the literature reported that no systemic effects occurred when treating patients with PIs with topical opioids.^{62, 72} Topically applied opioids may be associated with increased systemic side effects in patients taking systemic opioids.⁸¹ Local itching and irritation has been reported, but not more frequently than when a placebo gel is applied.⁸¹

Practice points for managing pain

- Refer patients with chronic pain associated with pressure injuries to a pain specialist or service.
- Individualised non-pharmacological interventions and patient preferences should be included in a holistic pain management plan.
- Using morphine topically is off license use and requires prescription from a medical professional.
- Topical opioids could be considered prior to debriding the wound.
- Address factors associated with pain (e.g. positioning, support surfaces, incontinence and increased muscle tone).
- If a patient is experiencing moderate to severe pain, the wound and its management, and the patient's pain management plan should be reviewed.
- Consultation with a pharmacist is advised before preparing a topical morphine preparation.

Documentation

- An individualised pain management plan and interventions implemented to manage pain should be documented.
- Prescription for analgesia should be documented by an authorised health professional and all administration should be recorded.

9. INTERVENTIONS FOR THE TREATMENT OF PRESSURE INJURIES

9.1 Clinical questions

What interventions for treating PIs have been reported in systematic reviews and evidence-based clinical guidelines?

Which of these interventions are effective in promoting healing in PIs?

9.2 Nutrition

Ensuring the patient receives an adequate regular diet is an imperative in promoting PI healing. Energy is essential for wound healing and promotes anabolism, nitrogen and collagen synthesis. A deficit in energy does not allow protein to be used in healing. Protein is an essential dietary component for wound healing, and consensus opinion suggests that protein requirements are higher in patients with PIs.^{23, 41, 82} Hydration is also important, affecting both the healing process and skin turgor.

Oral nutrition support (ONS) includes supplements taken orally in addition to the patient's regular diet. The most common forms of ONS considered for patients with PIs include:

- high protein supplements,
- disease-specific supplements,
- vitamin or multi-vitamin supplements, and
- arginine containing supplements.

9.2.1 High protein and disease-specific supplements

Evidence summary

One SR⁴⁰ investigated the effect of oral nutritional support in promoting PI healing. The studies investigating PI treatment were heterogeneous and all of low quality. In one RCT, hospitalised patients (n=425) receiving a normal diet plus a standard supplement (400kcal/day, primarily carbohydrate) for up to 26 weeks showed greater rates of total healing (41.8% of PIs compared to 30.3%) and greater rates of PI improvement (51.3% compared to 43.9%) than patients on the standard diet alone (2200 kcal/day). These results were not significantly different.^{40, 82} A second RCT compared three diets over two weeks. Six patients received a disease-specific supplement (500kcal/day, high protein, zinc and arginine). Five patients received a standard supplement (500kcal/day, high protein) and five patients received a routine hospital diet. The authors reported that patients receiving supplements achieved faster PI improvement; however, specific findings were not reported in the SR. One cohort trial (n=39) also reported improved healing with a disease-specific supplement (up to 750 kcal/day, high protein, multivitamins) taken for three weeks; however, comparison to a control group was not methodological sound.⁴⁰ (*Level I evidence*)

A better quality trial was reported in the review by Reddy et al.⁸² In this trial, 89 patients in long term care settings and with PIs above stage I in severity received either a collagen protein supplement or placebo for eight weeks. There was a statistically significant association ($p < 0.05$) between the supplement and improved wound healing assessed using the PUSH@.⁸² The trials reported in these reviews indicated a trend toward improved healing with ONS but they were generally of low quality and conducted in small populations, and both reviews concluded there was insufficient evidence on the role of specific oral nutritional supplements.^{40, 82} (*Level I evidence*)

The TTDWCG evidence-based guideline^{23, 41} reported evidence from Level III studies conducted in patients with PIs that investigated nutritional requirements. Seven trials supported the recommendation that energy requirements be calculated as 30 to 35kcal/kg/day (125 to 145kJ/kg/day), adjusted according to the patient's weight loss or gain or level of obesity. Eight studies supported the recommendation that protein requirements be calculated at 1.25 to 1.5g/kg/day to prevent/minimise muscle wastage. Eight studies supported the recommendation that fluid requirements be calculated as 30-35ml/kg/day or 1ml/kcal/day, with additional fluids in patients at risk of dehydration. Energy requirements for patients with SCI presented in the TTDWCG guideline are based on consensus. (*Level III studies*)

NHMRC grading matrix		
Evidence base	Two SRs and one MA	A
Consistency	Small trials did not find any significant effects	B
Clinical impact	Small clinical impact	C
Generalisability	Trials in populations with high risk of PI	A
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 30		
Provide high protein oral nutritional supplements in addition to a regular diet for patients with a pressure injury.		B

Practice points for nutrition

- Patients with a PI require:^{4, 23, 41}
 - a minimum of 30 to 35 kcal per kg body weight per day
 - 1.25 to 1.5 g per kg body weight daily of protein
 - 1 ml of fluid intake per kcal per day
- Patients with SCI have reduced energy needs due to decreased activity and muscle atrophy. These patients require:⁴¹
 - Paraplegic patients: 29.8 ± 1.2 kcal/kg body weight per day
 - Tetraplegic patients: 24.3 ± 1.1 kcal/kg body weight per day
- When determining dietary intake requirements, consider concurrent diagnoses.⁴¹
- Refer to appropriate national clinical guidelines for strategies to improve oral dietary intake.
- Consider referring patients with a PI to a dietitian.⁶
- When the decision to use enteral feeding in a person with PIs has been made, practice should be guided by relevant national evidence based guidelines, or in their absence, local policy.

Documentation

- Document the patient's oral/enteral food intake and nutritional interventions, including implementation and acceptance or tolerance of oral nutrition supplements.

9.2.2 Vitamin or multivitamin supplements

Patients with chronic wounds such as PIs often have general vitamin and mineral deficiencies, often associated with overall malnutrition. Some evidence suggests patients with PI have low serum zinc and vitamin C; and research to date investigating nutritional interventions has primarily focussed on these deficits.

Evidence summary

One SR⁸³ sought to investigate the role of supplementation with multivitamins, vitamin A and/or vitamin E in healing PIs. After a comprehensive search the reviewers were unable to identify any RCTs or quasi-experimental studies.

Three SRs^{38, 82, 84} reported on effectiveness of vitamin C supplementation for increasing the healing of PIs. All three SRs identified the same two RCTs, appraised in one SR⁸² as being of good and medium quality. In the medium quality double blinded RCT participants, who appeared to be hospitalised people with PIs, were randomly assigned to receive either 500mg vitamin C in the form of ascorbic acid or a placebo on a twice daily basis. Participants (n=20) were cared for on a standard hospital mattress, had similar local wound care and received no other dietary manipulations for the duration of the four week study. Wound healing was assessed on a weekly basis for 4 weeks using wound tracings and a qualitative assessment of healing. After four weeks participants who received vitamin C had statistically

significantly greater wound healing than those receiving placebo (84% versus 42.7% reduction in wound size, $p < 0.005$).^{38, 82, 85} In the good quality double blind trial ($n=88$) participants received twice daily doses of either 500 mg or 20 mg vitamin C in the form of ascorbic acid (they were also randomised to receive either high frequency ultrasound or sham ultrasound). Participants, who were in both acute and long term care facilities, were cared for on water beds and/or flotation pads and received daily wound care (debridement, saline wash and dressing with paraffin or regular gauze). After 12 weeks there was no significant difference between the two vitamin C groups for rate of wound healing (0.21cm²/week versus 0.27cm²/week) or healing on a 10-point global scale. It was unclear if participants in these trials had vitamin C deficiency at commencement of the trial, but in the first RCT supplementation was associated with a significant increase in leukocyte vitamin C levels. The inconsistent results in these two trials may relate to baseline levels of serum vitamin C.^{38, 82, 85} (Level I evidence)

Three SRs^{38, 82, 86} reported on the effectiveness of oral zinc supplementation for healing PIs. One review⁸⁶ identified five experimental and quasi-experimental trials however, three were later excluded due to unreported methodological concerns. The Langer et al³⁸ review only reported one RCT, and the Reddy et al⁸² review reported two RCTs, both of which were included in either of the other two SRs.^{82, 86} One RCT^{82, 86} compared the effect of zinc sulfate 220 mg daily for ten weeks to placebo. Participants were 29 males in long term care. The primary outcome measure was change in PI area measured using serial photography and wound tracings. The baseline serum zinc status of participants was unclear, and management interventions for PIs were not reported. The results showed no statistically or clinically significant difference in reduction in PI area between the two groups.^{82, 86} A double blinded, cross-over RCT conducted in 14 long term care patients over 24 weeks compared 600 mg zinc sulphate daily to daily placebo. There was no significant effect of zinc on PI volume, and only 21% of the participants completed the trial.^{38, 39} A third trial (it was unclear if this was randomised)⁸⁶ compared zinc sulfate 220 mg daily to placebo in 14 participants over 12 weeks. The review did not report demographics or other interventions for managing PIs. Zinc supplementation was shown to have no statistically or clinically significant effects on PI healing.⁸⁶ (Level I evidence)

Studies investigating the effectiveness of vitamin and mineral supplementation were of low quality and found no significant impact of the interventions on PI healing. In some of these trials participants had known nutritional deficits that improved as a result of the intervention, and it is possible trials were of insufficient duration to determine effects on wound healing.^{38, 82, 86} (Level I evidence)

The TTDWCG evidence-based guideline^{23, 41} provided evidence from Level III studies that multivitamins could be considered in patients at high risk of malnutrition who were not receiving adequate dietary micronutrient intake. (Level III evidence) The guideline suggested that micronutrients may only be required where a deficit was present or suspected, and supplementation should be to levels recommended by the Nutrient Reference Values for Australia and New Zealand. (Consensus)

NHMRC grading matrix		
Evidence base	RCTs at high risk of bias	D
Consistency	Small trials did not find any significant effects	A
Clinical impact	Small improvements in nutritional profile where a deficit existed at baseline.	D
Generalisability	Trials in populations with PIs of various severities; however most participants did not have identified nutritional deficits.	
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 31		
Consider multivitamin supplements in patients with a pressure injury who are identified as having nutritional deficits.		D

Caution

High levels of zinc supplementation are associated with nausea, vomiting, diarrhoea, compromised wound healing and copper deficiency.⁸⁶ High levels of vitamin c supplementation are associated with diarrhoea.

Practice points for oral supplements

- Multivitamin supplementation should be to levels recommended by the Nutrient Reference Values for Australia and New Zealand.

9.2.3 Arginine containing supplements

Arginine is an amino acid that plays a role in collagen growth and protein accumulation at the wound site. Although it does not appear to have an essential role in normal growth, arginine influences tissue repair following trauma. Arginine is used by macrophages and endothelial cells to produce nitric oxide that is used in the process of wound healing.⁴¹

Evidence summary

The TTDWCG evidence-based guideline⁴¹ reported that two RCTs and three cohort trials conducted in patients with PI indicated that arginine supplementation for a minimum of two weeks may promote healing in stage II PIs more effectively than high protein or high calorie diets or standard diets. The statistical significance of findings in these trials was not consistent and the trials had methodological shortcomings. The guideline included a grade C recommendation that arginine supplementation be considered for patients with stage II or greater PIs. (*Level II and III evidence*)

NHMRC grading matrix		
Evidence base	Two RCTs at moderate risk of bias reported in an evidence based guideline	C
Consistency	Findings were inconsistent	C
Clinical impact	Clinical impact was not reported.	U
Generalisability	Trials in populations with stage II or greater PIs.	A
Applicability	Applicable to all health care settings, although access may be limited.	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations, Pacific Island populations or Asian populations.	
Recommendation 32		
Consider arginine containing supplements for patients with a stage II or greater pressure injuries.		C

Caution

Arginine containing supplements are generally well tolerated. As nitric oxide may be involved in development of sepsis and inflammation, caution is recommended in patients at risk of infection or sepsis.⁴¹

Practice points for arginine

- With appropriate concurrent management strategies, improvements in wound healing should be evident after two to three weeks of arginine supplementation.⁴¹
- Consider arginine supplementation with medical or dietetic consultation.

9.3 Support surfaces

As discussed in section 6.4 support surfaces are designed to reduce relieve and redistribute pressure. The majority of the research in this field has been conducted in patients without existing PIs who are at high risk and has investigated the contribution of various types of support surfaces in reducing the development of a PI. Patients with existing PIs remain at risk of further PI development and should be managed accordingly.

The evidence indicated that patients with existing PIs should be managed on a high specification support surfaces. There was insufficient evidence on specific high specification support surfaces to reach conclusions on their comparative effectiveness.

Evidence summary

Reactive (constant low pressure) support surfaces

One SR⁸² reported on one lower quality RCT that compared a high specification foam mattress to a water mattress

in a long term care setting (n=120) for a duration of two to four weeks and found no significant difference in total wound healing (45% versus 48.3%, p=not significant but not reported).⁸²

Six primarily additional RCTs that compared powered reactive (constant low pressure) support surfaces (described as low air loss) to non-powered reactive (constant low pressure) support surfaces (described as high specification foam mattresses or "standard" foam mattresses). Participants were adults in either acute or long term care with PIs (generally patients with stage I PIs were excluded). Trials ranged in duration from three to 104 weeks. Four of the RCTs compared the effect on reducing wound surface area, one reported on complete PI closure and one reported on improvement in PI staging (scale unknown). The two higher quality trials found no significant differences in PI healing between powered and non-powered reactive support surfaces. Three of the other studies favoured powered reactive support surfaces (low air loss), and the fourth found no significant differences.⁸²

Alternating pressure replacement mattresses and mattress overlays

An additional five RCTs investigated different types of active (alternating pressure) surfaces. The majority of these trials did not find any specific powered active (alternating pressure) support surface to be superior. One trial comparing an air fluidised mattress to an active (alternating pressure) mattress covered with foam found the air fluidised mattress was associated with a significantly greater reduction in median wound size (median changes, -1.2 versus 0.5 cm², 95% CI -9.2 to -0.6 cm², p=0.01). Overall, the findings on active (alternating pressure) support surfaces were inconsistent and the reviewers concluded there was insufficient evidence to determine if these products are more effective for promoting healing of PIs above grade I in severity.⁸² (Level II evidence)

Patients with existing PIs are considered to be at high risk of further PI development.⁴ The research presented in the Prevention section of this guideline is therefore applicable to this population.

The RNO evidence based guideline²⁰ includes a grade A recommendation that patients with existing PIs be cared for on a high specification support surface (as they remain at high risk of further PIs). This recommendation is supported by evidence on the effectiveness of high specification support surfaces in patients without existing PIs.

NHMRC grading matrix

Evidence base	Meta-analysis of 5 RCTs (see Prevention section) High graded recommendation from an evidence based guideline	A
Consistency	Findings were consistent for an effect for high specification surfaces	A
Clinical impact	Moderate clinical impact	B
Generalisability	Trials in populations with high risk of PI.	A
Applicability	Applicable to all health care settings; however different facilities may use different standard foam mattresses	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	

Recommendation 33

Manage patients with existing pressure injuries on a high specification reactive (constant low pressure) or active (alternating pressure) support surface on beds and trolleys and when seated.	A
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Practice points for support surfaces

- The recommendations and practice points outlined in section 6.4 should be followed when managing a patient with an existing PI.
- The use of a support surface does not negate the repositioning requirements of a patient with a PI.
- Select an appropriate support surface for the severity of the PI and the patient's general condition.
- The effectiveness of the support surface should be regularly reassessed and reconsidered if the patient's skin condition is deteriorating and/or showing no signs of improvement.

Documentation

- Documentation of interventions relating to the support surface, evaluations of effectiveness and changes to the patient's management plan is required.⁵⁸

9.4 Patient positioning

As discussed in section 6.5, regular repositioning is an essential component of pressure care.⁴ Not only does it contribute to redistribution of interface pressure, but repositioning also promotes the patient's comfort, dignity and functional ability;⁴ allows opportunity to perform basic nursing care; and enables regular skin assessment. Despite the recognised importance of repositioning, there is no high level evidence on its use as an intervention for patients with existing PIs.

Evidence summary

One Cochrane review⁸⁷ provided a detailed search for RCTs and CCTs investigating the effectiveness of repositioning for treating PIs. The review was unable to identify any studies meeting inclusion criteria.

The NPUAP/EPUAP guideline⁴ also found no high level evidence to support recommendations on positioning patients with existing PIs. The guideline includes recommendations based on consensus opinion on the positioning of patients with PIs.

The Guideline Development Group reached consensus that continued repositioning is an essential component of holistic management of a patient with an existing PI.

Recommendation 34

Continue repositioning patients with existing pressure injuries with consideration to:	CBR
<ul style="list-style-type: none"> • the patient's risk for further pressure injury development, • comfort, • functional level, • medical and general condition, and • the support surface used. 	

Practice points for patient positioning

- The recommendations and practice points presented in section 6.5 for preventing PIs should be applied to patients with an existing PI.
- Where possible patients should not be positioned directly on an existing PI or body surface that remains damaged or erythematous from a previous episode of pressure loading.⁴
- Increase activity as rapidly as the patient with a PI can tolerate.⁴
- Implement a schedule for progressive sitting that details frequency and duration according to tolerance and wound response.⁴
- Avoid seating a patient with an ischial PI in a fully upright position.⁴
- Select a seating cushion that effectively distributes pressure away from existing PIs.⁴
- Use alternating pressure seating devices with caution in patients with existing PIs, with consideration to benefits of offloading compared to the risk of shear forces.⁴

Documentation

- Repositioning interventions (e.g. when and how) and the response to repositioning (e.g. skin assessment) should be documented.

9.5 Wound bed preparation

9.5.1 Debridement

Debridement is commonly performed on wounds to remove non-viable or infected tissue and debris in order to prepare the wound bed to receive therapeutic healing products (wound bed preparation). The aim is to maximise the healing process. Non-viable tissue can prolong the healing process by increasing inflammation, levels of bacteria and toxins, and inhibiting re-epithelialisation.^{20, 88} Non-viable tissue generally presents as moist, yellow, green or grey in colour and over time becomes dry black or brown eschar.⁴

The most commonly used methods of debridement are:²⁰

- surgical sharp,
- conservative sharp,
- autolytic,
- enzymatic,
- larval, and
- mechanical.

Surgical debridement, which is beyond the scope of this guideline, is rapid, although it requires either general or topical anaesthetic and can be painful. Removal of necrotic or infected tissue is rapid, therefore is preferable for prompt management of cellulitis or sepsis.^{88, 89} Its use is confined to specialist inpatient centres where there is the ability to maintain strict asepsis and control bleeding.

Conservative sharp wound debridement is the removal of loose avascular tissue with minimal pain or bleeding using a scalpel, scissors or other sharp, sterile instrument.²⁰

Autolytic debridement is a selective process whereby the body releases endogenous proteolytic enzymes and phagocytes that gradually degrade non-viable tissue.^{20, 88, 89} Although this process occurs naturally in wounds, dressings with a semi-occlusive outer layer facilitate autolytic debridement.

Enzymatic debridement requires the use of products containing proteolytic enzymes designed to enhance naturally occurring wound debridement. It is a slower debridement method, therefore not recommended for prompt removal of infected tissue.^{20, 88-90}

Larval debridement is a therapy that involves the application of sterile, green bottle fly (*Lucilia sericata*) maggots to the wound. There is limited research on the effectiveness of this method for debriding chronic wounds, and none conducted in patients with PIs.²⁰

Mechanical debridement is a debridement process that removes tissue and debris via mechanical means including ultrasound, high pressure irrigation, hydrotherapy (whirlpool) and wet-to-dry dressings. It can be used alone, or as a preparation for conservative sharp wound debridement. Some methods (e.g. wet-to-dry dressings) pose additional risk to viable tissue as this method of debridement is non-selective.²⁰

Evidence summary

One SR⁹¹ reported on methods of cleansing PIs. The review included one low quality RCT that compared whirlpool treatment (20 minutes daily at 35.5 to 36.5°C) to no whirlpool. Participants (n=18) had stage III or IV PIs. Pressure injuries in both groups were irrigated with saline and dressed with saline-soaked gauze twice daily. After 14 days there was no significant difference in PI healing (RR 2.10, 95% CI 0.93 to 4.76, p=not significant).⁹¹ One RCT at high risk of bias was insufficient evidence on which to make a specific recommendation on this method of debriding.

Neither the RNAO evidence-based guideline²⁰ or the NPUAP/EPUAP evidence based guideline⁴ identified research on debridement conducted in patients with PIs. Both guidelines provided consensus recommendations for the general use of debridement in preparing the wound bed, and the NPUAP/EPUAP guideline⁴ presented supportive evidence from research conducted in other types of chronic wounds. These guidelines both recommend that selection of debridement method is based on individual patient and wound characteristics, the experience of the health professional and safety considerations.^{4, 20}

Recommendation 35

When debridement is indicated, select the method of debridement with consideration to: **CBR**

- **the patient's condition (including pain, vascular condition, and bleeding risk),**
- **comfort,**
- **type, quantity and location of non-viable tissue;**
- **goals of care;**
- **patient preferences;**
- **health professional training and experience; and**
- **availability of resources.**

Caution

Use surgical and/or conservative sharp wound debridement with caution in patients with impaired immunity, compromised vascular supply, with bleeding disorders or taking antiplatelet and anticoagulant therapy.⁴

Practice points for debridement

- Debridement is often a painful intervention. Conduct a pain assessment and provide appropriate pain relief before debriding a wound.^{4, 20}
- A vascular assessment should be conducted prior to debriding lower extremity PIs.^{4, 20}
- Surgical debridement is appropriate when there is an urgent need to remove non-viable tissue (e.g. advancing cellulitis, sepsis, pain, exudate or malodour).^{4, 20}
- Conservative sharp wound debridement should only be performed by health professionals with appropriate training.^{4, 20}

9.5.2 Skin and wound hygiene

Skin and wound hygiene is important in maintaining overall skin integrity. Regular cleansing of the ulcer removes exudate and topical product residue that may aggravate peri-ulcer skin. Routine wound cleansing should be performed in a way that minimises trauma to health, granulating wound tissue and achieves a clean wound bed.^{4, 20}

Evidence summary

One SR⁹¹ investigated the effectiveness of different cleansing agents for PIs. The review did not identify any trials comparing cleansing to no cleansing. One low quality RCT compared cleansing with saline compared to tap water cleansing. The participants (n=35 in analysis) were older adults (mean age 71 years) being treated outside of the hospital environment and who had stage II or III PIs (described as having partial or full thickness skin loss down to the fascia). Wounds were cleansed with either tap water or saline delivered at room temperature via a syringe and cannula and a variety of dressings (including hydrocolloids and gels) were applied. After six weeks, more wounds cleansed with tap water had healed (RR 3.00, 95% CI 0.21 to 41.89); however the sample size was too small to draw conclusions,⁹¹ and the non-equivalent baseline size of wounds may have influenced the healing. A second low quality RCT reported in the SR⁹¹ compared a saline spray containing aloe vera, silver chloride and decyl glucoside (Vulnopur™) to isotonic saline. Participants (n=133) had stage I PIs. Method of application and adjunct treatment was not reported. Ulcers were assessed using the Pressure Sore Status Tool that uses Likert scales to assess 13 items relating to ulcer condition. After 14 days the PIs treated with the saline spray product showed significantly greater improvement (p<0.025).⁹¹ These small low quality RCTs were insufficient evidence on which to make specific recommendations. (Level II evidence)

The NPUAP/EPUAP evidence-based guideline⁴ provided consensus recommendations that PIs be cleansed regularly with saline or potable water, with minimal agitation to clean wound beds. The guideline recommended cleansing agents with surfactants or antimicrobials only be used in PIs containing debris or suspected to have clinical infection. (Consensus)

The RNAO evidence-based guideline²⁰ recommended that skin cleansers or antiseptics not be used for cleansing ulcers. The guideline suggested that normal saline, Ringer's solution, sterile water or non-cytotoxic wound cleansers are used for ulcer cleansing and that solutions be at room temperature. One recommendation based on a non-randomised trial suggested that safe and effective irrigation pressure ranged from 4 to a 15 psi and this could be achieved using a single use 100 ml squeeze bottle or a 35 ml syringe with a 18 gauge angiocath.²⁰ (Consensus)

Recommendation 36

Cleanse the peri-wound skin and pressure injury when wound dressings are changed.	CBR
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Practice points for skin and wound hygieneSkin hygiene

- Cleanse peri-wound skin with a pH neutral appropriate skin cleanser. To obtain optimal ulcer and

wound pH avoid the use of alkaline soaps and cleansers.²

- Applying a moisturiser contributes to the maintenance of the healthy skin.
- Consider applying a topical barrier preparation to the peri-wound skin to protect it from exudate.

Wound care

- Cleanse the wound in a manner that prevents damage of healthy granulation tissue.^{2, 4, 20}
- Aseptic wound management techniques should be used when the person, the wound and/or the environment is compromised.²
- Clean wound management technique (using room temperature potable water) can be used when there is no compromise of the patient, the wound and the environment.⁴

9.6 Treating clinical infection

Antimicrobial therapy includes topical agents such as cadexomer iodine, silver, honey and other topical antiseptics, as well as systemic antibiotics. **All products should be used following comprehensive assessment and in accordance with the licensing authority endorsement and the manufacturers' directions.**

Although all chronic wounds are contaminated or colonised, not all are infected. Signs of local infection in a pressure injury include:³

- new wound breakdown/increased wound size,
- erythema localised to the peri-ulcer tissue,
- increased amount of exudate,
- increase in viscosity or purulence of exudate,
- increased or unexplained pain,
- oedema of peri-ulcer tissue,
- increased peri-ulcer tissue temperature,
- malodour; and
- tracking, bridging or pocketing within the tissue or probing to the bone.

9.6.1 Cadexomer iodine

Evidence summary

One SR⁹² reported three RCTs conducted in patients with chronic PIs (severity not reported). One of the RCTs was conducted in 40 patients (age range 16 to 102 years) and compared povidone-iodine (n=7 patients, 11 PIs) to both silver sulfadiazine (n =15 patients, 15 PIs) and normal saline solution (n =15 patients, 15 PIs) for reducing bacterial count and promoting PI healing (reduction in wound surface) over 21 days. The trial was likely underpowered and groups analysis is confounded by unequal groups (per number of patients). The second RCT included 38 hospitalised patients (mean age over 70 years) who were treated with either cadexomer iodine or a control treatment (saline dressings, debriding agents and a non-adhesive dressing). This was a partial cross-over trial conducted over three weeks and the outcome measures include reduction in wound area, pain, pus and amount of debris. The trial appeared to be of moderate quality and included an a priori power calculation. The third RCT was conducted in 27 patients with SCI (mean age 30 in iodine group and 35 in control group). Patients received either povidone-iodine gauze or a hydrogel dressing, and the trial continued until complete healing occurred, with the primary outcome measure being healing rate. All three of the RCTs reported iodine products had a statistically significant greater effect in wound healing demonstrated by reduction in wound surface using different measures. There was no significant difference in complete wound healing rates in the single study that reported this measure. The two trials that reported on bacterial load found that the control treatments (silver sulfadiazine, normal saline solution) were more effective in reducing infection than iodine. Rates of erosion, ulceration, erythema and allergic dermatitis were significantly greater in PIs treated with iodine in one study. The findings from these low and moderate quality trials suggested that iodine may have a role in promoting wound healing and its role in managing bacterial burden requires further investigation. These findings appeared to be supported by trials conducted in patients with different types of chronic wounds included in the review.⁹² (Level II evidence)

A second SR reported the results of two of the same RCTs and concluded that although the role of

antiseptics such as iodine-based products remains controversial, the products are inexpensive and non-RCT evidence provided some support for their use in preventing wound deterioration.⁸² (*Opinion*)

The NPUAP/EPUAP evidence-based guideline⁴ provided consensus recommendations suggesting cadexomer iodine is appropriate to use in heavily exudating PIs that are not large-cavities requiring frequent dressing changes. The guideline reported one non-RCT to support the recommendation. (*Consensus*)

The RAO evidence-based guideline²⁰ did not include a specific recommendation on the use of cadexomer iodine; however the guideline discussion suggested it could be used in clean PIs with ongoing (after two to four weeks) exudate. (*Consensus*)

NHMRC grading matrix		
Evidence base	Three RCTs on iodine at moderate risk of bias Consensus recommendation in an evidence based guideline	C
Consistency	There is consistency for an effect in promotion of wound healing. There was consistency that bacterial burden is not reduced.	A
Clinical impact	Positive clinical impact on wound healing, effect size not reported. No effect on bacterial burden.	U
Generalisability	Trials conducted in populations with PIs, although severity not reported.	B
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 37		
Cadexomer iodine could be used to promote healing in pressure injuries when there is a known increased microbial burden.		
		C

Caution

Cadexomer iodine ointments and impregnated dressings should not be used in patients with iodine sensitivity, taking lithium, history of Hashimoto's thyroiditis, Graves disease, non-toxic nodular goitre or thyroid disorders, or impaired renal function, in children or in pregnant or lactating women. Risk of systemic absorption increases when cadexomer iodine products are used on larger or deeper wounds or for prolonged periods.^{4, 93}

Practice points for iodine products

- Cadexomer iodine should not be used for longer than three months continuously.⁹³
- Cadexomer iodine should not be covered with povidone-iodine soaked gauze/tulle gras as this practice results in the increased release of iodine, increasing toxicity.

9.6.2 Topical medical grade honey

Honey is a supersaturated sugar solution containing glucose, fructose, sucrose and water. Honey has been used for treating wounds for centuries.⁹⁴ Honey is thought to aid in wound healing through an osmotic effect that draws fluid from the wound to the wound tissue surface, through the promotion of a moist healing environment and through the lowering of wound pH, all of which aid in autolysis.⁹⁵ More recently it has been proposed for use due to potential antibacterial properties.⁹⁴

Evidence summary

Two SRs^{82, 94} reported trials investigating the effectiveness of honey for treating PIs. A Cochrane review⁹⁴ identified only one low quality RCT that met inclusion criteria. Participants were 40 hospitalised orthopaedic patients with uninfected grade I (irregular partial thickness PI confined to epidermis and dermis) or II (full thickness) PIs of at least 2 cm in diameter who were restricted to a bed or wheelchair. Participants were randomised to receive either a honey dressing or a saline soaked dressing, both applied daily for ten days. At three month follow up, mean time to complete healing was 8.20 (SD 1.44) days for the honey treated group and 9.93 (SD 0.27) days in the control group. This favoured the honey group (mean difference -1.73 days, 95% CI -2.73 to -1.09, p=not reported).⁹⁴ In a second review a different low quality trial that investigated honey compared to ethoxydiaminoacridine and

nitrofurazone was reported. The trial was conducted over up to 13 weeks with adult participants (n=26) in acute care who had PIs classified as stage II or III in severity. The results indicated that honey was associated with a statistically significant greater improvement in PI severity ($p < 0.001$).⁸² Neither trial reported on antimicrobial outcomes or adverse events.^{82, 94} (Level II evidence)

The NPUAP/EPUAP evidence-based guideline⁴ presented results from a second RCT above to support a consensus recommendation that medical-grade honey be considered for treating stage II and III PIs. (Consensus)

NHMRC grading matrix		
Evidence base	Two RCTs at high risk of bias Consensus recommendation in an evidence based guideline	D
Consistency	There is consistency for an effect in promotion of wound healing. There was no evidence on effect on bacterial burden.	A
Clinical impact	Small clinical impact on wound healing. No effect on bacterial burden.	D
Generalisability	Trials conducted in populations with grade II and III PIs.	A
Applicability	Applicable to all health care settings, although access may be limited.	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 38		
Consider using topical medical grade honey to promote healing in pressure injuries.		D

Caution

Treating PIs with honey has been reported to lead to pain, deterioration of the wound and an increase in wound exudate.⁹⁶ A SR found that adverse events (e.g. pain, deterioration and increased exudate) were more likely to occur in other types of chronic wounds treated with honey compared with those treated with hydrogel or standard dressings and there was no difference in infection rates.⁹⁶

Practice points for honey

- The honey should be specifically indicated for application to wounds (i.e. medical grade). Manuka honey should be rated UMF (Unique Manuka Factor) +12 or above for topical dressing products. Use gamma irradiated honey as other sterilising processes will destroy the UMF in the honey.

9.6.3 Topical silver

Evidence summary

The literature search did not identify any SRs investigating the role of topical silver preparations for treating PIs.

The NPUAP/EPUAP evidence-based guideline⁴ discussed research conducted in other wound types (e.g. burns, leg ulcers) and identified the lack of research in patients with PIs. The guideline provided a consensus recommendation that topical silver be considered for use in PIs with known microbial burden, particularly when infected with multiple organisms. (Consensus)

The RNAO evidence-based guideline²⁰ did not provide a specific recommendation on the use of silver, but suggested that its broad spectrum properties could be considered useful in treating known microbial burden. (Consensus)

Recommendation 39	
Consider using topical silver to promote healing in pressure injuries.	CBR

Caution

Potential renal toxicity should be considered when using topical silver agents for extended periods (e.g. greater than 4 weeks) on large wound beds. The risk appears to be low but caution is warranted. As with other anti-microbial therapies there is a risk of bacterial resistance with extended use of silver products.⁹⁷

9.6.4 Topical antiseptic solutions

Topical antiseptics are used either as an irrigation agent or designed to remain in contact with the wound for longer periods (e.g. until the next time the dressing is changed). Most products come in a range of forms or concentrations and are promoted as facilitating healing through the reduction in or eradication of bacteria in the wound.⁹⁸ As many have toxic effects to skin cells, these products should be avoided or used prudently in the treatment of infected PI. Antiseptic solutions include:^{4, 20}

- chlorhexidine,
- hydrogen peroxide,
- sodium hypochlorite,
- polyhexanide and betaine,
- povidone-iodine and
- acetic acid.

Evidence summary

The literature search did not identify any SRs investigating the role of topical antimicrobials in promoting healing of PIs.

The RNAO evidence-based guideline²⁰ recommended that the use of topical antimicrobial agents should be avoided. Although the recommendation is based on non-experimental descriptive studies, correlation studies and case studies, the evidence from these sources is not presented and the population characteristics are unknown. (*Consensus*)

In contrast, the NPUAP/EPUAP evidence-based guideline⁴ provided a consensus recommendation that properly diluted topical antiseptics are appropriate for short term use to reduce bacterial burden and inflammation. The guideline also recommended use in PIs that are critically colonised and have a poor prognosis. (*Consensus*)

Recommendation 40

Toxic topical antiseptic agents should not be used in the standard care of pressure injuries. Antiseptic solutions with no demonstrated toxicity should be considered in the treatment of pressure injuries with clinical evidence of infection or critical colonisation.	CBR
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Caution

The Guideline Development Group does not recommend the use of hydrogen peroxide in wound management. Deaths have been reported as a result of irrigation of closed cavity wounds with hydrogen peroxide.^{99, 100}

Toxic effects of most antiseptic solutions on fibroblasts and macrophages in vitro are well documented.¹⁰¹⁻¹⁰³

Acetic acid at concentrations greater than 3% has been associated with pain at the wound site and skin irritation. There is a risk of acidosis when used for extended periods over very large wound surfaces.¹⁰⁴ It has been demonstrated that there is no dilution of acetic acid that is toxic to bacteria without being toxic to fibroblasts.¹⁰²

9.6.5 Topical antibiotics

Topical antibiotics are also designed to remain in contact with the wound for longer periods (e.g. until the next time the dressing is changed). The overuse of topical antibiotics has contributed to the development of antibiotic resistant bacteria.

Evidence summary

The literature search did not identify any SRs investigating the role of topical antibiotics in promoting healing of PIs.

The RNAO evidence-based guideline²⁰ recommended that the use of topical antibiotics may be required for medical management of PIs that are not healing or continue to exudate heavily after two to four weeks of optimal wound care, with the recommendation supported by in-vitro studies. The guideline recommended topical antibiotics be effective against gram-positive, gram-negative and anaerobic organisms.²⁰ (*In-vitro studies*)

The NPUAP/EPUAP evidence-based guideline⁴ provided a consensus recommendation that use of topical antibiotics be limited. Suggested appropriate use included wounds with a bacterial burden of $\geq 10^5$ CFU/g or those infected with beta haemolytic streptococci. The guideline highlighted that selection of topical antibiotics should be guided by culture results and microbial sensitivities. (*Consensus*)

Recommendation 41

Topical antibiotics are best avoided in the management of pressure injuries as there is a concern that their use is associated with antibiotic resistance and sensitivities. CBR

9.6.6 Systemic antibiotics

Systemic antibiotics include penicillins, cephalosporins, aminoglycosides, quinolones, clindamycin, metronidazole, and trimethoprim. Cephalosporins and penicillin based antibiotics interfere with formation of bacterial cell walls. Aminoglycosides interfere with normal protein synthesis, whilst quinolones prevent cell nucleus DNA synthesis.⁹⁸

Antibiotic resistance is a significant concern due to the over use or inappropriate use of antibiotic therapy.^{4, 98, 105} Selection of antibiotics should generally be made after wound swabs and sensitivity testing to determine the bacteria against which treatment should be directed.

Clinical indications that the patient has spreading infection (e.g. cellulitis) include:³

- signs of advanced local infection,
- spreading erythema,
- fever,
- oedema of regional tissues, and
- general malaise

Clinical indications that the patient has systemic infection (e.g. bacteraemia, sepsis) include:³

- high fever,
- hypothermia,
- lymphangitis and regional lymphadenopathy,
- delirium,
- multiple compromise or organ failure, and
- circulatory shock (hypotension, tachypnoea, tachycardia).

Evidence summary

The literature search did not identify any SRs investigating the role of systemic antibiotics in promoting the healing of PIs.

The RNAO evidence-based guideline²⁰ recommended that systemic antibiotics may be required for medical management of PIs in patients with bacteraemia, sepsis, advancing cellulitis or osteomyelitis.²⁰ (*In-vitro studies*)

The NPUAP/EPUAP evidence-based guideline⁴ provided a consensus recommendation that systemic antibiotics were appropriate when there is clinical evidence that the patient has systemic infection. (*Consensus*)

Recommendation 42

Use systemic antibiotics when the patient with a pressure injury has clinical evidence of spreading and/or systemic infection. CBR

Caution

Adverse effects for systemic antibiotics were not reported in the trials. Side effects include GIT signs and symptoms and signs of allergic reaction (e.g. skin rash, itching and rarely, difficulty breathing). Interactions with other medications are common.¹⁰⁵ The development of antibiotic resistance due to overuse of antibiotics is also of major concern.

The Guideline Development Group recommends consulting specific product information, national licensing authorities and therapeutic guidelines before prescribing systemic antibiotics.

Practice points for antibiotics

- All PIs should be assessed regularly for indicators of infection.^{2,3}
- For complex, unresponsive, recalcitrant or recurrent infection, consider consulting a microbiologist or infectious disease specialist.^{2,3}
- Patients should be advised to complete their antibiotic therapy as prescribed to reduce the risk of antibiotic resistance.

9.7 Wound dressing selection

Wound dressings or devices are applied to a wound in order to protect the wound from contamination and trauma, to absorb exudate, to fill dead space deficits, reduce oedema and to promote an optimal healing environment.²⁰ Wound healing is based on the principles of moist wound healing, which is optimised through dressings that donate fluid to the wound or the application of occlusive or semi-occlusive dressings, and wound bed preparation.^{4,106} **All products should be used in accordance with the manufacturer's directions.**

Trials investigating the effectiveness of primary dressings were generally conducted in populations without clinically infected wounds, severe cellulitis or erythema on admission to the trial. Some of the trials were conducted in populations with heavily exuding wounds.

Evidence summary

The vast majority of wound dressing trials in PI have consisted of comparisons of hydrocolloid dressings to other dressing types.^{82,107-109} These trials, which included various outcome measures as indicators for healing, were reported to be of low to moderate quality.^{82,109}

Hydrocolloids compared to saline soaked gauze

Four SRs^{82,107-109} reported on five RCTs comparing hydrocolloid dressings (Comfeel® and DuoDerm®, which is known as Granuflex® in some countries) to traditional treatments (saline soaked gauze or wet-to-dry dressings and Dakin's solution). The studies ranged in duration from 42 to 91 days, were primarily conducted in acute care settings and ranged in size from 39 to 70 participants. When severity was reported, participants were described as having PIs of stage II to IV (generally using Shea's classification system⁶³) that ranged in size between studies from 2cm² to 15cm².^{82,107-109}

One meta-analysis¹⁰⁸ using a fixed effects model of the results favoured hydrocolloid dressings (OR 2.57, 95% CI 1.58 to 4.18, p=not reported). The results of this meta-analysis showed that a hydrocolloid dressing was related to a significantly improved rate of PI healing compared to a traditional treatment.¹⁰⁸ A second meta-analysis¹⁰⁷ also showed significantly improved healing rates associated with hydrocolloids, with a number need to treat (NNT) of seven (95% CI 4 to 16, p=not reported). In this analysis, an additional trial was included that compared a hydrocolloid to povidone-iodine dressings and there was a high degree of heterogeneity. (*Level I evidence*)

One of the reviews reported that dressing changes were significantly faster when a hydrocolloid was used. One study found that a hydrocolloid dressing had greater absorptive capacity and one study reported less pain on dressing changes for patients treated with a hydrocolloid. One study reported significantly less side effects with a hydrocolloid dressing compared to saline gauze.¹⁰⁹ (*Level II evidence*)

The findings of the meta-analyses,^{107,108} although significant, are unlikely to have major implications to current practice, where gauze-based dressings are no longer used with great frequency.

Hydrocolloid compared to other dressings

Four SRs^{82, 107-109} reported on four RCTs that compared a hydrocolloid dressing to a polyurethane foam dressing. The trials ranged in size from 32 to 99 participants and were conducted for between 30 and 56 days. Participants were recruited from a range of settings including home care, wound clinics and hospital.¹⁰⁹ Where reported, participants were described as having PIs of stage II to III using either the Stirling Classification System¹¹⁰ or the classification system devised by NPUAP.¹¹¹ In one of the reviews, the results from these trials were pooled using a fixed effects model and the findings for wound healing were not statistically significant for either type of dressing (OR 0.80, 95% CI 0.44 to 1.44).¹⁰⁸ (Level I evidence)

One of the trials reported polyurethane foam was more easily applied and removed allowing for quicker dressing changes. One trial reported that polyurethane foam has greater absorptive capabilities.¹⁰⁹ (Level II evidence)

Three RCTs compared a hydrocolloid dressing to a hydrogel dressing for between 56 and 102 days in rehabilitation, hospital and home care settings. No significant findings were established for either wound healing or dressing change outcome measures.^{82, 109} Single trials were identified comparing a hydrocolloid to other advanced dressing types. In most of these trials hydrocolloid dressings were either inferior for wound healing outcomes to other products (e.g. radiant heat therapy, biosynthetic dressing, topical enzyme) or there was no significant differences. The findings from these small low quality trials are insufficient to draw conclusions on use.^{82, 109} (Level II evidence)

Other dressing types

Two SRs^{82, 108} reported five RCTs that compared topical agents to dressings. The findings reported in one SR were insufficient to determine whether topical agents or dressing products have a greater effect in promoting PI healing.¹⁰⁸ The second review reported most of these trials in narrative summary and reached similar conclusions regarding the insufficient volume and quality of evidence.⁸² (Level II evidence)

Two SRs^{82, 107} reported a number of single RCTs that investigated polyurethane foam, radiant heat dressings, an undefined transparent moisture-permeable dressing, occlusive polyurethane, soft silicone, hydropolymer, and collagen dressings to either moist saline gauze or undefined standard care. Although some of these dressings were found to be related to superior healing outcome measures the trials were all low quality, generally had a small number of participants and were considered insufficient evidence to recommend particular dressing types.⁸² (Level II evidence)

Dressings for managing exudate

One review⁶² reported on interventions to manage PI exudate. Six RCTs have compared the ability of various dressing products to absorb exudate, with only one trial finding a significant difference in the performance of dressings. In this trial involving 99 patients with PIs living in the community found a hydropolymer dressing associated with less exudate leakage than a hydrocolloid dressing; however the reviewers reported that the clinical impact was minimal.⁶²

Both Bouza et al¹⁰⁷ and Reddy et al⁸² concluded that there is insufficient good quality evidence to suggest a particular dressing type is superior to others.⁸² Reddy et al⁸² recommended selecting dressings based on: (Opinion)

- local guidelines for wound care,
- cost,
- ease of use,
- goals of care, and
- patient comfort.

The NPUAP/EPUAP evidence-based guideline⁴ included consensus recommendations on selection of a dressing that suggested ability to keep the wound bed moist was a significant consideration. The guideline included recommendations supporting the use of hydrocolloid dressings based on the research reported above. The NPUAP/EPUAP also provides a recommendation for using alginate or foam dressings for heavily exuding wounds, based on the low quality evidence above.⁴

NHMRC grading matrix		
Evidence base	Nine RCTs at moderate to high risk of bias Recommendation in an evidence based guideline	C
Consistency	There is consistency for an effect in promotion of wound healing.	A
Clinical impact	Small clinical impact on wound healing.	D
Generalisability	Trials conducted in populations with grade II and III PIs.	A
Applicability	Applicable to all health care settings.	A
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 43		
Consider using a hydrocolloid dressing to promote healing in non-infected stage II pressure injuries.		C
Recommendation 44		
Select wound dressings based on:		CBR
<ul style="list-style-type: none"> • comprehensive ongoing clinical assessment, • management of pain, malodour, exudate and infection, • wound size and location, • cost and availability, and • patient preference. 		

Practice points for wound dressings

- Other characteristics that are likely to influence wound dressing selection may include:
 - condition of surrounding skin,
 - ease of application and removal,
 - ability to maintain moisture balance,
 - ability to absorb exudate and odour,
 - pain experienced on dressing changes,
 - infection control and ability to maintain bacterial balance,
 - cosmetic effect,
 - skill and knowledge of the health professional,
 - accessibility and cost effectiveness,
 - suitability of dressing location to wound location, and
 - comfort.
- Continually moist gauze should be used only when other moisture retentive dressings are not available.⁴

9.7.1 Negative pressure wound therapy

Negative pressure wound therapy (NPWT) is a wound management technique that involves application of suction to the wound using a vacuum dressing. It is reported to improve nutritional and oxygen delivery to the wound through reduction of oedema; to remove wound exudate; to promote tissue granulation; and to remove wound inhibitory factors. The therapy is primarily used to reduce wound volume and may be used to prepare the wound bed for flap closure surgery.⁴

A foam or gauze cavity filling dressing is used to fill the wound defect and sealed with a transparent film secondary dressing, through which a drainage tube connected to vacuum is inserted.⁴ All studies presented in the literature used commercially produced NPWT systems that comply with nationally endorsed licensing protocols.

Evidence summary

In 2008, two SRs^{112, 113} reported the same two RCTs as providing the best available evidence on the use of NPWT for treating PIs. The first trial, (n=28 patients) described as being of moderate to low quality, compared NPWT (VAC® system) changed three times weekly (n=20 PIs) to various gel dressings (Accuzyme®, Idoasorb® and Panafil®) changed one to two times daily (n=15 PIs) in promoting total healing and reducing PI size over ten months. Patients had a mean age of 41.7 to 54.4 years and had full thickness PIs of at least four weeks' duration. The study found no statistically significant difference between NPWT and gel dressings for either outcome measure after a mean

treatment period of six weeks. The second trial (n=22 patients), also described as being of moderate to low quality, reported the effect of NPWT (VAC® system) changed every two to seven days in halving the volume of PIs. The comparator treatment (n=11 PIs) was gauze dressings (wet-to-wet/wet-to-dry) soaked in Ringer's solution and changed one to three times daily. Participants were paraplegic or quadriplegic patients with deep pelvic PIs.^{112, 113} At follow up (0.7 to 1.7 months) there was no significant difference (=0.9)¹¹⁴ between the two groups in healing rates.^{112, 113} One of the SRs reported safety data based on the findings from eight RCTs (all primarily poor quality) that included trials conducted in other types of chronic wounds. Adverse events included infection, skin irritation and pain on dressing change; however, none of these events occurred significantly more often than in control populations. The reviewers concluded that, based on a small volume of poor quality trials, NPWT is as effective as traditional wound management strategies.¹¹³ (*Level II evidence*)

A 2010 SR¹¹⁴ identified three RCTs ranging from low to moderate quality that evaluated NPWT. The studies involved 68 patients with 93 PIs. In the first low quality RCT (n=22) 43% of PIs were complicated by osteomyelitis. There was no significant difference between groups in the percentage of PIs that achieved complete healing by 6 weeks and a non-statistically significant difference in the per cent change in wound volume (NPWT -52%, control -42%, p=0.46). The second low quality RCT was conducted in 22 patients with quadriplegia and was reported in greater detail in the review by Vikatmaa et al.¹¹³ as reported above. The third RCT was reported to be of medium quality and participants (n=24) had chronic wounds, 79% of which were PIs. The results showed a significant positive effect for NPWT on both per cent change in wound volume (78% versus 30%, p=0.038) and per cent change in wound depth (-66% versus -20%, p<0.001). Study lengths were not reported. The SR raised concerns regarding publication bias and conflict of interest and concluded that although the evidence for NPWT in the treatment of PIs was promising, conflicting findings necessitated more research.¹¹⁴ (*Level II evidence*)

A fourth SR¹¹⁵ also identified only three RCTs including participants primarily with PIs. These three studies were the same ones identified by Xie et al.¹¹⁴ and reported above. The SR reached the same conclusion as Xie et al.,¹¹⁴ suggesting that the qualitative shortcomings of the trials prevented any confident recommendations on the use of NPWT in treating PIs.¹¹⁵ (*Level II evidence*)

The NPUAP/EPUAP evidence-based guideline⁴ recommended the use of NPWT for early management of stage III or IV PIs, based on the evidence presented above. (*Level II evidence*)

The RNAO guideline²⁰ included a consensus recommendation in support of NPWT. The guideline reported that evidence is inconsistent and no specific regimen could be identified as most effective. The guideline suggested NPWT was most appropriate for managing wound moisture and may have some effect on reducing infection.²⁰ (*Consensus*)

NHMRC grading matrix

Evidence base	Three RCTs at low to moderate to high risk of bias	D
Consistency	Results were inconsistent but may have been explained by bias	B
Clinical impact	Small clinical impact	D
Generalisability	Trials in populations with stage III or IV PIs	A
Applicability	Applicable to all health care settings, although access may be restricted	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	

Recommendation 45

Consider negative pressure wound therapy as an adjunct for treating stage III or IV pressure injuries. **C**

Caution

One SR¹¹³ reported adverse events including infection, skin irritation and pain on dressing change occurred with the use of NPWT; however, none of these events occurred significantly more often than in control populations.¹¹³ Negative pressure wound therapy is not recommended in inadequately debrided, necrotic or malignant wounds; where vital organs are exposed; in wounds with no exudate; or in patients with untreated coagulopathy, osteomyelitis or local or systemic clinical infection. Cautious

use of NPWT is recommended for patients on anticoagulant therapy, in actively bleeding wounds or where the wound is in close proximity to major blood vessels.^{4, 116}

Practice points for NPWT

- Debride necrotic tissue prior to applying NPWT.⁴
- Evaluate the wound and effectiveness of therapy with each dressing change.⁴
- Comply with the health provider's policies and protocols and the manufacturer's instructions for the application, maintenance and removal of NPWT.

9.8 Other interventions

9.8.1 Electrotherapy

Electrotherapy is the application of electrical stimulation to the body to promote wound healing or relieve pain. The trials reported in the literature used a range of different therapies, including transcutaneous electrical nerve stimulation (TENS), low intensity direct current, high voltage pulsed current and alternating current. Specific frequencies and voltages were not reported. Therapy regimens ranged from 2.9 to eight weeks, with electrotherapy applied twice daily (duration not specified).⁵³

Because various cell types respond differently to electrotherapy throughout the wound healing process, there may be a role for application of different current types at different stages of wound healing. It is suggested that in the initial inflammatory stages of wound healing mast cells are reduced by negative polarity and in proliferative wound stages, fibroblasts migrate to negative polarity.¹¹⁷ Wound moisture is also considered to play a role in the effectiveness of electrotherapy.^{53, 118} However, the research conducted in patients with PIs has not investigated these potential differences.

Evidence summary

One SR¹¹⁸ investigated the effect in reducing quantitative measures of wound healing through the application of electrical stimulation (electrotherapy). The SR included 28 studies (RCTs, non-randomised trials and descriptive studies) which were not appraised for quality. The trials were conducted in patients with chronic wounds, about half of which were entirely patients with PIs and others of which included patients with PIs. Due to insufficient reporting on effect sizes of treatment compared to controls in many of the included trials the reviewers used a non-standard meta-analysis technique in which the per cent healing per week was averaged across studies and weighting was applied according to sample size. A net difference in rate of healing between of electrotherapy treatment and control groups was calculated. The SR did not report the reliability and validity of outcome measurement strategies used in the trials. Control treatments varied between trials (e.g. placebo electrotherapy, whirlpool treatment, standard dressings) and the electrotherapy systems also varied (e.g. TENS, pulsed direct current, continuous direct current). Data was reported by study type and no difference in findings was ascertained between an analysis combining RCTs to one combining non-RCTs. Across the 28 included studies mean age of participants was 58.8 years, mean follow up period was six weeks and mean size of wounds at baseline was 8.8cm² (SD 6.8) for of electrotherapy groups and 9.2cm² (SD 6.4) for control groups (unclear if this difference was significant). In the trials in which participants had PIs there was a net difference in healing rates between electrotherapy (n=130) compared to control (n=86) of 13.30% in per cent healing per week, translating to a 403% increase in healing compared to the control rate. This SR provided evidence that electrotherapy is an effective treatment for healing PIs. No guidance was provided on the type of system (e.g. TENS, pulsed direct current, continuous direct current) or regimen (e.g. sessions per week or duration of therapy).¹¹⁸ (Level I evidence)

In a second SR⁵³ the reviewers identified three RCTs investigating the effectiveness of electrotherapy for treating PIs. All three of these trials were included in the review reported by Gardner et al.¹¹⁸ The first trial was a moderate quality RCT (n=49) conducted in participants with PIs of stage II to IV and a mean age of approximately 63 years. The treatment group received electrotherapy twice daily for four weeks and outcomes were compared to a group receiving sham electrotherapy. Pressure injuries in both groups were treated with normal saline and an unspecified dressing. At four-week follow up the electrotherapy group achieved statistically significant greater reduction in mean percentage of PI area healed (49.8% versus 23.4%, p=0.042). The second trial was a moderate quality, double-blind RCT (n=76) conducted

in older adults (mean age approximately 75 years) with chronic PIs. Participants were randomised to receive either electrotherapy or sham therapy, both in conjunction with whirlpool baths and moist dressings. The groups were not equivalent at baseline, with the PIs in intervention group being larger. At eight weeks the treatment group had greater healing (58% versus 3%, RR 18.02, 95% CI 2.58 to 126.01, p=not reported). The third trial was a small low quality RCT (n=17) conducted in young people with SCI. The mean age of participants in the intervention group was 32.5 years and mean age in the placebo group was 26 years. Participants were randomised to receive either electrotherapy or sham therapy, both in conjunction with wound cleansing and an unspecified dressing regimen. At follow up (mean of 2.9 weeks) the intervention group had more healed PIs (37.5% versus 22%, RR 1.69, 95% CI 0.37 to 7.67, p=not reported).^{53, 118} The results from the second two trials were pooled in a meta-analysis that showed electrotherapy was superior to sham therapy (RR 7.92, CI 2.39 to 26.31, p=not reported).⁵³ (Level I evidence)

The NPUAP/EPUAP⁴ guideline provided a high grade recommendation supporting the use of electrotherapy for treating PIs. This guideline recommended use of direct current electrical stimulation, basing the recommendation on the research reported in the SR by Gardner et al.¹¹⁸

NHMRC grading matrix

Evidence base	One meta-analysis at low risk of bias including 28 trials One evidence based clinical guideline reporting the same research	A
Consistency	Findings were consistent	A
Clinical impact	Small clinical effect	D
Generalisability	Trials conducted in populations with stage II to IV PIs	A
Applicability	The trial findings appear relevant to all health care settings; however access may be limited.	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	

Recommendation 46

Consider using electrotherapy as an adjunct for promoting healing in pressure injuries. B

Caution

No major adverse effects of electrotherapy were reported in the research included in this review. Electrotherapy is contraindicated in patients with electrical implants (e.g. pacemakers), epilepsy, malignancy or who are pregnant. Electrotherapy should be used with caution in patients with impaired circulation.¹¹⁹

9.8.2 Pulsed electromagnetic therapy

Pulsed electromagnetic therapy (PEMT) exposes the patient to a magnetic field effect, usually in a pulsed fashion. It includes pulsed short wave diathermy, pulsed electromagnetic field therapy and diapulse.^{120, 121} These therapies use different radio frequencies, energy frequencies, pulse lengths and energy powers. Their effect is theorised to be an energy boost to the wound through a calculated disruption to the ions, molecules, membranes and cells that can have physiological effects that promote healing. It is purported that electromagnetic therapy increases white cells and fibroblasts within a wound, stimulates osteogenesis and enhances blood flow.¹²⁰

The PEMT interventions for treating PIs reported in the literature were conducted for 20 to 30 minutes using 27.12 MHz frequency, a pulse duration of between 80 and 600 pulses per second (pps) and peak power of between 290 and 975 W. Treatment duration was for between four and 12 weeks.^{120, 122}

Evidence summary

One Cochrane SR¹²² investigated the effectiveness of PEMT for treating PIs. This review updated a previous review conducted by the same research team.⁵³ Two RCTs assessed as having an unclear risk of bias were included in the SR. The two trials had different treatment durations (eight weeks and one week) preventing pooling of the results in a meta-analysis. In the first RCT, 30 participants from a geriatric unit who had stage II or stage III PIs (scale not reported) were randomised to one of three groups. The

treatment group (n=20) received electromagnetic therapy (Diapulse®) locally at a frequency of 600 pps at 117 V (27.12 MHz) twice daily for 30 minutes followed by hepatic application (400 pps, 117 V, 27.12 MHz) for 20 minutes daily (only after first daily local treatment) plus conventional local wound treatment. The second group (n=5) received sham PEMT therapy plus conventional local wound treatment and the third group (n=5) received only conventional local wound treatment.¹²² The conventional local wound treatment for all groups consisted of hydrogen peroxide cleansing and talcum powder, methylene blue in solution and tetracycline ointment;¹²² however this standard therapy would be considered questionable. At five weeks, 80% of the treatment group had achieved complete wound healing compared with 0% in both the control groups; however, the treatment group had smaller PIs at baseline. No adverse events occurred. In the second RCT 30 participants with SCI and either stage II or stage III PIs received electromagnetic therapy (80 to 600 pps, 27.12 MHz) delivered locally twice daily for 30 minutes or sham electromagnetic therapy. Both groups received local wound treatment consisting of a moist saline gauze dressing. After 12 weeks, 30% of the stage II PIs and 60% of stage III PIs in the treatment group had completely healed compared to no PIs in the control group. Time to complete healing for stage II PIs was significantly shorter in the treatment group (13 days versus 31.5 days, $p < 0.001$). No adverse events occurred. This result should be interpreted with caution as this is a small study and the finding may be due to chance. Additionally, the outcome, percentage reduction in wound area, is less clinically meaningful than complete healing.¹²² (Level II evidence)

A second SR¹²⁰ reported four RCTs, only one of which was described as being of high quality. The high quality trial and one of the low quality trials were reported in the Cochrane review by Aziz et al.¹²² The four RCTs (n=100) compared PEMT to either sham PEMT therapy or varying PEMT regimens with conventional therapy (moist saline gauze). The PEMT intervention was conducted for 20 to 30 minutes using 27.12 MHz frequency, a pulse duration of between 80 and 600 pps and peak power of between 290 and 975 W. Treatment duration was for between four and 12 weeks. Where reported, patients had stage II or III PIs. The good quality trial reported statistically significant healing (percentage of wound healed at one week, median wound size at one week and median days to complete healing, all $p < 0.05$). One trial found significant improvements in healing at one week and in median days to heal for stage II PIs. The other two trials found no significant differences in healing. No adverse events were reported. This review concluded that there is moderate evidence that PEMT is effective in combination with regular care; however this conclusion is primarily based on the findings of one good quality trial with only 30 participants which only showed statistical improvements on some outcome measures.¹²⁰ (Level II evidence)

The NPUAP/EPUAP⁴ guideline provided a consensus recommendation for considering use of PEMT for stage II to IV PIs. The recommendation is based on earlier SRs conducted in patients with chronic wounds. (Consensus)

NHMRC grading matrix		
Evidence base	Four RCTs, only one considered to be at low risk of bias One evidence based clinical guideline based on RCTs at high risk of bias or in similar populations	D
Consistency	Findings were inconsistent	C
Clinical impact	Moderate clinical effect	B
Generalisability	Trials conducted in populations with stage II to IV PIs	A
Applicability	The trial findings appear relevant to all health care settings; however access may be limited in some settings	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 47		
Pulsed electromagnetic therapy could be considered as an adjunct for promoting healing in pressure injuries.		D

Caution

No major adverse effects of electromagnetic therapy were reported in the research included in this review. Manufacturers of devices used to administer electromagnetic therapy do not recommend their use in patients with pacemakers or other implanted devices, diabetes, cancer, epilepsy, cardiac infarction less than 2 months ago, congenital pathology of central nervous system or kidney disease or in pregnant women.^{123, 124}

9.8.3 Ultraviolet light therapy

Ultraviolet light C is a wavelength of ultraviolet light that has been theorised to have a role in wound healing through cell proliferation stimulation, enhancing cutaneous blood flow and inhibiting bacterial growth.^{4, 20}

In the one RCT reported in detail in the literature, ultraviolet light C was administered for 12 weeks for five days per week; however administration was alternated daily with ultrasound therapy (five days per week over 12 weeks).¹²⁵ The effect of ultraviolet light therapy is unknown due to the combination of therapies used.

Evidence summary

One Cochrane SR¹²⁵ reported results from an RCT at high risk of bias that investigated ultraviolet light therapy in combination with ultrasound therapy to promote healing in PIs (described as 'skin wounds'). The trial was small (n=18) and participants (all of whom had SCI) received either laser (820nm laser diode), ultrasound and ultraviolet light treatment alternating for five days per week or standard wound care (cleansing, Jelonet™ dressing and pressure care). At 12 weeks there was no significant difference in number of PIs healed between the therapy groups and the standard wound care group. Relative risk of healing with ultrasound and ultraviolet light therapy compared to standard therapy was 1.18 (95% CI 0.76 to 1.83, p=0.43). The effect of ultraviolet light therapy is unknown due to the combination of therapies used. (*Level II evidence*)

The NPUAP/EPUAP⁴ guideline provided a consensus recommendation for considering short term use of ultraviolet light C for stage II to IV PIs; however duration of therapy is not clearly defined. The recommendation is based on the RCT reported above, and an additional small RCT at high risk of bias conducted in an unknown population that found an effect (p<0.02) for ultraviolet light C therapy compared to placebo therapy.⁴ In addition, one RCT at high risk of bias is cited in support of a consensus recommendation that ultraviolet light C therapy could be used to reduce bacterial burden in PIs. (*Consensus*)

The RNAO guideline²⁰ reported the same trials to support a recommendation that ultraviolet light C therapy could be considered for treating PIs. Although it is not specific, the context suggests the therapy is recommended for healing and reducing bacterial burden.

NHMRC grading matrix		
Evidence base	Two RCTs considered to be at high risk of bias reported in evidence based guidelines	D
Consistency	Findings were inconsistent	C
Clinical impact	Not reported	U
Generalisability	Trials conducted in populations with superficial PIs and in undescribed populations	B
Applicability	The trial findings appear relevant to all health care settings; however access may be limited in some settings	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 48		
Ultraviolet light C therapy could be considered as an adjunct for promoting healing in pressure injuries.		D
Recommendation 49		
There is insufficient evidence to make a recommendation on the use of ultraviolet light C therapy for reducing bacterial burden in pressure injuries.		CBR

9.9 Health professional education

Given the complex nature of the PI risk assessment and the prevention of PIs, and assessment and management of PIs, education and training is considered essential for achieving positive patient outcomes.

Evidence summary

One SR¹²⁶ reported on studies (n=39) investigating quality improvement (QI) interventions aimed at reducing PI incidence in hospitals (including acute care, geriatric acute care and rehabilitation settings). Twenty-eight of the studies incorporated nurse education into the QI intervention. In this review, nurse education included written, didactic and other strategies to improve health professional (primarily nurses) understanding of PI prevention. Education was frequently specifically associated with a new product (e.g. support surfaces) or tool (e.g. introduction of a risk assessment scale). The studies, which ranged from six to 36 months in duration, were primarily before-after trials appraised as having moderate to good methodology. Ten of the trials in which education was included in the intervention reported PI incidence as an outcome measure. All of these trials showed a reduction in PI incidence associated with the QI intervention; however, precise differences in PI incidence were unclear due to the graphical nature of the report. The effectiveness of health professional is difficult to extrapolate from these trials due to the concurrent use of other QI initiatives in the interventions of interest. However, three additional trials that did not include an element of staff education in the QI initiative failed to demonstrate a reduction in incidence associated with the intervention.¹²⁶ This suggests that QI initiatives aimed at reducing PI incidence may be more effective if health professional education is incorporated into the initiative. This interpretation should be considered in light of the low level of evidence these studies provided and the indirect evidence they offer on effectiveness of education programs. (Level III evidence)

The RNAO guideline²⁰ included consensus recommendations that education programs be designed and targeted to appropriate health professionals and knowledge be updated on a regular basis. The guideline suggested a range of information that should be included in education programs including:

- aetiology and risk factors for PI,
- assessment of PI risk,
- pressure injury prevention planning,
- accurate and timely documentation of assessments, management plans and interventions for preventing and managing PI risk,
- manual handling techniques and facility policies,
- selection, use and maintenance of support surfaces,
- pressure injury assessment and staging,
- principles of wound management including selection of topical products and wound dressings, and
- principles of providing patient education.

The guideline specifies that healthcare organisations have a role in the development and implementation of appropriate education programs. (Consensus)

The NPUAP/EPUAP guideline⁴ included consensus recommendations throughout related to educational needs of health professionals. (Consensus)

NHMRC grading matrix		
Evidence base	Ten before after trials of moderate to good quality Consensus from two evidence based guidelines	C
Consistency	Findings were consistent for a reduction in PI incidence when QI initiatives included staff education	A
Clinical impact	Small clinical impact	D
Generalisability	Trials conducted in health professionals caring for patients with PIs	A
Applicability	The trial findings appear relevant to all health care settings; however access may be limited in some settings and the full nature of the interventions under investigation were unclear.	C
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	

Recommendation 50

Education in the prevention, assessment and management of pressure injury should be provided to all health professionals.

C

Practice points for education

- Health professionals require appropriate education and training before performing conservative sharp wound debridement.^{4, 20}
- Health professionals should receive appropriate education when the service introduces new PI protocols or equipment/products.¹²⁶
- An accredited or endorsed program should be sought as such programs promote sound education and practice advice.

9.10 Surgery

Surgical repair of stage III and IV PIs, including flap reconstruction, direct wound closure or skin grafting, may be considered to be a management option to promote more rapid healing.²⁰ Stage III and IV PIs generally take a considerable period of time to heal due to the large amount of skin, soft tissue, subcutaneous fat and muscle loss. Recurrence rate is high. Where bone is exposed, there is a higher risk of osteomyelitis that should be excluded through appropriate diagnosis prior to surgery. Surgical closure of the PI may reduce risk of osteomyelitis.⁴ In patients for whom traditional management strategies have been ineffective, evaluation of the appropriateness of surgical intervention by the multidisciplinary team could be considered.^{4, 20}

Evidence summary

The literature search did not identify any SRs investigating the effectiveness of surgical repair of PIs.

Recommendations on surgery for PIs presented in the NPUAP/EPUAP evidence-based guideline⁴ focus on supporting the patient throughout the pre, intra and post-operative phases, but do not provide guidance on the effectiveness of surgical interventions. The recommendations, which are based on consensus opinion, highlight the importance of an appropriate pre-operative evaluation of the PI and the patient's condition, pre-operative optimisation of the patient's physical condition (e.g. promotion of nutritional status and control of local infection) and ensuring appropriate psychosocial support is in place to promote recovery. The NPUAP/EPUAP recommendations for the intra-operative phase highlight the importance of appropriate interface pressure management, positioning and transferring of the patient and provide guidance on surgical process. Recommendations for the post-operative phase focus on ongoing care and evaluation of the wound, use of positioning and transferring strategies to prevent wound breakdown related to interface pressure and trauma from repositioning and psychosocial support.⁴

The RNAO evidence-based guideline²⁰ also included a consensus recommendation that patients who are medically and nutritionally stable and able to tolerate surgical blood loss and post-operative immobility could be considered as candidates for surgical closure of PIs.²⁰ (*Consensus*)

Recommendation 51

Patients with stage III or IV pressure injuries that are non-responsive to contemporary CBR management strategies should be evaluated for surgical intervention.

Practice points for surgery

- Evaluation for surgical interventions should include multidisciplinary collaboration including the patient and consider his or her preferences.^{4, 20}
- In evaluating appropriateness for surgery consider the patient's:^{4, 20}
 - medical stability,
 - nutritional status,
 - capacity for recovery and rehabilitation, and
 - likelihood of improvement in overall wellbeing and QOL.
- Following surgery, protect the wound from pressure, shear forces and friction using the recommendations and practice tips outlined throughout this guideline.^{4, 20}

10 ORGANISATIONAL AND COST IMPLICATIONS

10.1 Introducing pressure injury reduction initiatives in the organisation

One SR¹²⁶ reported on research identifying QI interventions aimed at improving PI management in acute care settings. Thirty-nine studies (primarily before/after designs) investigating a range of QI interventions were reported. These interventions included protocol and/or guideline development and implementation, staff education, use of risk assessment scales, performance monitoring, team care management planning, use of new support surfaces, use of management feedback to care staff and resource nurse roles. Many studies included multiple QI interventions. Studies primarily used PI incidence (defined variably between studies) as an outcome measure. The reviewers pooled the findings from studies reporting PI incidence (n=16) and found a statistically significant decrease in PI incidence (risk difference -0.07, 95% CI -0.1 to -0.04, p<0.0001); however, there was significant heterogeneity across the studies. The reviewers concluded that the use of QI interventions is associated with a decrease in PI incidence, particularly when more than one organisational change is implemented.¹²⁶

This review¹²⁶ highlighted that introduction of QI initiatives for reducing PI incidence should be consistent with QI methodology. Quality improvement processes are more likely to have a demonstrable effect on PI incidence when the full Plan, See, Action Do (PDSA) QI cycle is implemented and performance monitoring and feedback are incorporated into the change process. Findings from the review also indicated that adequate health professional education may be associated with more successful PI reduction QI initiatives.

10.2 Implications of a new classification system

In 2011 the AWMA conducted a survey in the Pan Pacific region to gauge clinician preferences for terminology to refer to PIs. This was promoted by the release of the NPUAP/EPUAP international PI guideline including the classification system adopted in this guideline. The proposal to adopt the NPUAP/EPUAP classification system in the Pan Pacific regions and work towards an international consensus on PI terminology received overwhelming support from over 400 respondents.

The survey offered a timely opportunity to canvass opinion on the adoption of the term pressure injury as a replacement for pressure ulcer. In 2009, Dunk and Arbon¹²⁷ argued for Australian adoption of terminology that referred to condition causation (injury) to replace a range of often inaccurate terms (e.g. pressure sore, pressure ulcer). The change in terminology is intended to more accurately reflect cause and effects, and highlight the preventable nature of most pressure injuries. Respondents to the 2011 provided overwhelming support for this change.

The recommendation to consider using the NPUAP/EPUAP PI classification system may require organisational changes for services using other classification systems. Health professional education should be concurrent to any change in classification systems.

This recommendation has implication for national health coding systems. Current ICD-10-AM coding conventions dictate how pressure injuries are defined and coded. The Guideline Development Steering Committee recognise that until codes and definitions are changed there will be an anomaly between clinicians documented descriptions of pressure injuries and what the coder can generate. The AWMA is working with appropriate bodies to attain changes to the ICD-10-AM coding that reflect the NPUAP/EPUAP PI classification system.

10.3 Cost implications of the recommendations

10.3.1 Support surfaces

The vast majority of economic modelling related to support surfaces has been conducted in the UK. Two SRs^{128, 129} reported on these papers and concurred that the reduction in PI incidence associated with high specification support surfaces was associated with an overall reduction in health care costs.

One SR¹²⁸ reported on the cost-effectiveness of various support surfaces. The paper used a previously published review⁵³ that reported on the effectiveness of different support surfaces as the basis for

development of a decision model for cost effective pressure management. An additional study¹³⁰ was used to provide estimates of reduction on pressure risk. The pressure reduction estimates provided in this study were established in a large population (n=2507) in UK acute care settings. Cost estimates of support surfaces were made through contact with device manufacturers, and the paper provided cost comparisons in UK dollars. Based on the review by Cullum et al.⁵³ that established effectiveness of alternating pressure mattress replacements and alternating pressure overlays, the cost of these devices was compared to high-specification foam mattress. The analysis considered costs, PI free days and quality adjusted life years (QALYs) for each device for one week, four weeks and 12 weeks of use.¹²⁸

The SR¹²⁸ concluded that alternating pressure mattress overlays appear to be cost effective for preventing PIs (about a 45% probability of reducing costs over 12 weeks) and alternating pressure mattress replacements appear to be cost effective for treating existing PIs (about a 60% probability of reducing costs over 12 weeks). The "standard care" for cost comparison was a high specification foam mattress,¹²⁸ which is likely to be used in most acute care settings, but may not be used in other care settings. Costs were relevant to the UK setting in 2005, and but are likely to represent the cost of these treatments in other international settings.

A second SR¹²⁹ presents an economic analysis of support surfaces for preventing PIs. Where there was sufficient evidence on the comparative clinical effectiveness between alternative pressure redistribution devices, economic modelling was undertaken to assess comparative cost effectiveness. The review, which included three economic modelling papers, showed that managing patients at high risk of PIs on high specification mattresses significantly reduced their risk of developing a PI compared to management on a standard hospital mattress. The pooled estimate of the four studies yielded a relative risk of 0.29 (95% CI 0.19–0.43), or a relative reduction in PI incidence of 71% (95% CI 57–81%). Cost effectiveness modelling indicated that, because of savings accrued through the treatment of fewer PIs, high specification foam mattresses are likely to cost less overall. The studies were all conducted in the UK; however, the financial benefits reported in this SR are likely to be relevant to other first world countries.¹²⁹

10.3.2 Wound dressings

One SR¹⁰⁹ on the use of hydrocolloids in managing PIs also reported a cost analysis for the dressings. Three comparing hydrocolloids to saline gauze found that hydrocolloids were a more cost effective alternative when considering the cost of materials, cost of staffing and frequency and time taken for dressing changes. Studies were conducted in a hospital and nursing home settings more than ten years ago. Hydrocolloids were also related to statistically significant greater wound healing than saline gauze dressings. Currency and brands of product was not reported.¹⁰⁹

11 INTERVENTIONS NOT CURRENTLY RECOMMENDED

11.1 Therapeutic ultrasound

Ultrasound therapy delivers acoustic vibrations at either low (20 to 50 kilohertz [kHz]) or high (0.5 to 3.0 megahertz [MHz]) frequencies⁴ in either a continuous or a pulsed manner to the area under treatment.^{125, 131, 132} Usually a water or gel based coupling agent is used between the wound area and the ultrasound applicator. The benefits of ultrasound are achieved from both thermal effects and non-thermal effects. Thermal effects, generally achieved through continuous ultrasound, are hypothesised to increase blood flow to the area. Non-thermal effects, such as acoustic streaming and cavitation are achieved through pulsed ultrasound.^{131, 132} These are variously theorised to contribute to wound healing through enzymatic fibrinolysis; stimulation of protein synthesis; and an increase in cell proliferation that stimulates inflammation and promotes angiogenesis. However, there is insufficient research in this area to determine the validity of these theories. These non-thermal effects are distinguished from the use of ultrasound for debridement.

Evidence summary

One Cochrane SR¹²⁵ investigated the effectiveness of therapeutic ultrasound for healing PIs. The review updated a previous SR⁵³ conducted by the same research team. The SR reported three RCTs meeting the inclusion criteria, only one of which was described as being of good quality. Two of the trials compared ultrasound therapy at a frequency of 3 MHz to sham ultrasound. In the first, described as being of good quality, 88 patients with at least partial thickness PIs were treated with ultrasound at a frequency of 3.28 MHz with pulse duration of 2ms and pulse repetition of 100Hz five times per week for 12 weeks or until complete healing. There was no significant difference in complete healing compared to patients receiving sham ultrasound (40% versus 44% of PIs, $p=0.61$). The relative risk (RR) of healing at 12 weeks was not significant (RR 0.91, 95% CI 0.55 to 1.48, $p=0.69$). The second RCT included 40 participants with superficial PIs. Ultrasound at a frequency of 3 MHz was applied for a minimum of five minutes to PIs up to 3 cm² in size, with an additional one minute for each additional 0.5cm² to a maximum of ten minutes. The therapy was delivered three times per week and the control group received placebo ultrasound on the same regimen. The number of PIs healed was not significantly different between groups (48% compared to 42%, p =not reported). Relative risk of healing (mean treatment time of 34 days) was not significant (RR 1.13, 95% CI 0.57 to 2.26, $p=0.73$). The findings from these trials were pooled in meta-analysis and the RR for number of PIs healed was not significant (RR 0.97, 95% CI 0.65 to 1.45, $p=0.89$). In the third RCT 18 participants with SCI and PIs described as 'skin wounds' received either laser (820nm laser diode), ultrasound and ultraviolet light treatment alternating for five days per week or standard wound care (cleansing, Jelonet™ dressing and pressure care). At 12 weeks there was no significant difference in number of PIs healed between the therapy groups and the standard wound care group. Relative risk of healing with ultrasound and ultraviolet light therapy compared to standard therapy was 1.18 (95% CI 0.76 to 1.83, $p=0.43$). Findings from this review suggested there is no benefit of using ultrasound therapy to heal PIs.¹²⁵ (Level I evidence)

The NPUAP/EPUAP⁴ guideline provided consensus based recommendations on the use of therapeutic ultrasound. The guideline suggests that low frequency (40 kHz) ultrasound be considered for treating stage III and IV PIs, providing support for the consensus opinion from a small RCT of unknown quality and two small, non-randomised trials. Use of ultrasound is suggested for treating infected PIs,⁴ based on findings of one of the moderate quality trials reported in the Cochrane review.¹²⁵ (Level II evidence)

NHMRC grading matrix		
Evidence base	One meta-analysis at low risk of bias including 3 RCTs at low risk of bias	A
Consistency	Findings were consistent for no effect	A
Clinical impact	Low	D
Generalisability	Trials conducted in populations with stage I and II PIs	B
Applicability	The trial findings appear relevant to all health care settings; however access may be limited.	B
Other factors	None of the trials were conducted in Australian Indigenous populations, New Zealand Maori populations or Pacific Island populations. It was unclear if trials included Asian populations.	
Recommendation 52		
Therapeutic ultrasound does not improve healing in stage I or II pressure injuries.		A
Recommendation 53		
The effectiveness of therapeutic ultrasound in treating stage III or IV pressure injuries is unknown.		CBR

12 INTERVENTIONS FOR WHICH THERE IS INSUFFICIENT EVIDENCE

The Guideline Development Steering Committee considered one low quality study to be insufficient evidence on which to make a graded recommendation on the effectiveness of an intervention.

There was insufficient evidence to make recommendations on the use of:

- hyperbaric oxygen therapy (HBOT),
- infrared therapy,
- laser therapy, and
- miscellaneous topical agents.

Hyperbaric oxygen therapy (HBOT) is therapy requiring the patient to inhale 100% oxygen at pressures above normal atmospheric pressure. It has been proposed as a therapy for wound healing due to its ability to increase blood oxygenation that may potentially increase oxygen delivered to tissue during healing. Treatment is delivered in 1.5 to two hour sessions on a daily basis.^{4, 84} There is insufficient evidence conducted in patients with PIs to make a recommendation on the therapy's use.

Infrared is low-energy laser that uses light in the infrared spectrum. The therapy has been suggested for use in increasing circulation and promoting healing in chronic wounds.

Laser therapy has been used as an intervention for treating chronic wounds including PIs. It is theorised that laser therapy stimulates microcirculation and tissue oxygenation, thereby promoting healing.¹³³ There is currently little evidence that laser therapy has these effects and it has not yet been shown to promote superior healing outcomes.

Miscellaneous topical agents for which evidence was identified included ketanserin, barley extract, dialysate and topical insulin. The trials on these products were very small and had inconclusive findings.

Evidence summary

Hyperbaric oxygen therapy

One SR⁸⁴ reported on the use of HBOT for managing PIs. The reviewer identified only one RCT for inclusion for which no quality appraisal was apparent. The RCT included 18 patients (38 PIs) who were treated with HBOT for a mean of 37 treatments commencing at 1.5 hours duration and increasing to two hours. Results were compared to those in three randomly selected control patients with six PIs. In the HBOT treatment group 58% of PIs healed completely and 13% of PIs achieved a reduction in size of at least 50%. None of the PIs in the control group healed or reduced in size by at least 50%. This trial appears to be of a low quality and patient demographics were not reported.⁸⁴

Although the RNAO guideline²⁰ provided a low graded recommendation for the use of HBOT, the evidence is based on trials conducted in patients with diabetic ulcers.

The NPUAP/EPUAP⁴ guideline reported the same RCT reported in the SR by Gray et al.⁸⁴ and concludes that this trial provides insufficient evidence on which to make a recommendation on the use of HBOT for treating PIs.

Infrared therapy

The literature search did not identify any SRs reporting on infrared therapy. The NPUAP/EPUAP⁴ guideline reported that small studies have been conducted on infrared therapy with and without heat but that there was insufficient evidence to make a recommendation on its use.

Laser therapy

The literature search did not identify any SRs reporting on laser therapy. The NPUAP/EPUAP⁴ guideline reported that evidence on laser therapy was confined to animal studies and healing in other wound types and concluded there is insufficient evidence to make a recommendation on its use.

Miscellaneous topical agents

Two SRs^{82, 108} reported a small number of low quality RCTs that compared topical agents (ketanserin, barley extract, dialysate and topical insulin) to a placebo or standard care (undefined).^{82, 108} Two trials reporting on topical insulin had conflicting findings. One found that ten units of regular insulin applied topically twice daily for five days was superior for both healing rate and number of days treatment ($p=0.05$ for both) in nursing home participants with PIs between 1 cm and 7 cm of at least 14 days.^{82, 108} However, a second RCT in a similar population found no significant difference for the outcome measure of wound surface area ($p=0.42$) over two weeks.⁸² Both trials were small and of low quality.^{82, 108} Trials investigating the other topical products were small, of low quality and had findings on which recommendations could not be based. (Level II evidence)

Recommendation 54

There is insufficient evidence to make a recommendation on the use of the following interventions for treating pressure injuries:

- **hyperbaric oxygen**
- **infrared therapy**
- **laser therapy**
- **miscellaneous topical agents**

13 EMERGING INTERVENTIONS

13.1 Topical biological agents

Growth factors are naturally occurring proteins or hormones that stimulate cell growth. Keratinocyte growth factor stimulates epithelialisation.¹³⁴ Granulocyte-macrophage colony-stimulating factor (GM-CSF) reportedly stimulates neutrophils, macrophages and keratinocytes, all of which promote wound healing.^{135, 136} Protein-derived growth factors are topical biological agents containing proteins that are reported to play a role in blood vessel formation in the wound base. The products generally contain an extracellular matrix that provides a framework within the wound onto which cells can attach during healing.¹³⁷ Tissue plasminogen activator is a topical product containing proteins that assist in the breakdown of blood clots.¹³⁸

The vast majority of these products are not available in Australia, New Zealand, Singapore or Hong Kong, therefore it was inappropriate to make a recommendation on the use of these emerging therapies.

Evidence summary

Bradley et al¹⁰⁸ reported on four small RCTs that investigated biological agents compared to placebo or standard care and concluded there was insufficient evidence on their use. Reddy et al⁸² included nine moderate quality trials reporting various topical biological agents including recombinant platelet-derived growth factor, nerve growth factor, a protease-modulating matrix, transforming growth factor beta3, granulocyte-macrophage/colony stimulating factor and basic fibroblast growth factor. The trials were conducted in a range of settings and included adults with PIs ranging from stage I to stage IV in severity. The trials reported wound surface area or total wound healing as outcome measures. Of these trials, six reported significant findings in support of the biological agents and the reviewers concluded that there was preliminary evidence supporting human platelet-derived growth factor and nerve growth factor dressings.⁸² (*Level II evidence*)

13.2 Support surfaces

Support surface technology continues to advance and an increasing variety of reactive (constant low pressure) and active (alternating pressure) support surfaces are available. However, these newer support surfaces have no high level evidence and minimal low level evidence in support of their effectiveness in preventing or treating PIs.

Some of the systems have benefits beyond PI management (e.g. occupational health and safety advantages). In particular, systems that incorporate lateral rotation or seating position features, and bed systems that are able to be lowered or raised to facilitate patient transfers reduce the need for manual repositioning, but as yet there is no clear evidence as to their overall effectiveness in reducing PI's.

14 IMPLICATIONS FOR FURTHER RESEARCH

The development of these guidelines highlighted the paucity of research at low risk of bias investigating the management of PIs. Much of the research appraised in this guideline was at a moderate to high risk of bias. The Guideline Development Steering Committee recommends that future research related to PIs focus on:

- Implementation of study designs and processes that are at low risk of bias
- Research specific to Aboriginal and Torres Strait Island populations, New Zealand Maori populations, Pacific Island populations and Asian populations
- Research on the cost effectiveness of interventions to manage PIs in the Pan Pacific region
- Further research into areas with limited existing consistent, good quality evidence including:
 - The validity and reliability of non-numerical pressure injury risk assessment scales or algorithms.
 - The most effective repositioning regimens.
 - The most effective and cost effective support surfaces, including bed systems and lateral rotation devices.
 - The role of multivitamin and arginine supplementation in PI healing.
 - The role of HBOT in PI healing.
 - The effectiveness of infrared therapy, ultraviolet light therapy and laser therapy.
 - The effectiveness of patient and health professional education programs in preventing the development of PI.
 - The most effective and cost effective wound dressings for promoting healing of PIs.
 - The role of topical agents, particularly silver, cadexomer iodine and honey in managing PIs.
 - The role of traditional treatments such as Chinese traditional medicine in healing PIs.
 - The most effective strategies and analgesic regimens to manage pain associated with PIs.
 - The importance of extrinsic factors such as moisture to the assessment and management of PIs.
- Further discussion on the avoidable/unavoidable nature of PIs in some patients is warranted. Following recent publication by the NPUAP of a consensus statement¹³⁹ that most PIs are avoidable and not all PIs are unavoidable, a Pan Pacific survey or consensus conference to provide guidance on concerns over the potentially unavoidable nature of some PIs is strongly recommended.
- Development of standardised approaches to measuring and reporting PI prevalence and incidence to facilitate national and international benchmarking. A standardised approach should include:^{11, 140}
 - common use of a validated tool for PI prevalence or incidence data collection on which all definitions and data fields are the same;
 - a common tool to educate and test surveyors' proficiency in classifying PIs in order that PIs are recorded correctly; and
 - consistent use of a PI classification system and definitions (we recommend the NPUAP/EPUAPs classification system).

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APPENDIX A GUIDELINE DEVELOPMENT STEERING COMMITTEE AND GUIDELINE DEVELOPMENT GROUPS

A.1 Guideline Development Steering Committee and Guideline Development Groups

The Guideline Development Steering Committee and Guideline Development Groups who have overseen the development of the guideline consisted of a geriatrician, nurse practitioners, registered nurses, consumer representatives, dietitians, occupational therapists, academics and a research consultant. The Guideline Development Steering Committee and Guideline Development Groups is outlined in table A.1.

Table A.1 Membership of Steering Committee and Development Groups

Committee member	Speciality and qualifications	Location and setting of clinical practice	Types of populations	Participation in guideline development
Margo Asimus	Nurse Practitioner (Wound Mmt)	Newcastle, NSW • Community	• Rural	• Guideline Development Groups • Literature appraisal
Elizabeth Abraham	Occupational Therapist	Sydney, NSW • Hospital setting	• Urban	• Guideline Development Groups
Judith Barker	Nurse Practitioner (Wound Mmt); RN; STN; MN(NP) BHthSc (Nurs);	ACT • Community care • Outpatient clinics • Residential care	• Urban • Multicultural populations	• Guideline Development Steering Committee • Literature appraisal
Jennifer Byrnes	Nurse Practitioner (Wound Mmt); RN; NP; STN; MN(NP); DipHthSc (Nurs);	Darwin, NT • Hospital setting	• Urban • Rural • Indigenous populations	• Guideline Development Groups
Keryn Carville (Chair)	Adj. Professor RN; PhD; STN(Cred);	Perth, WA • Community care • Education • Research • Telehealth • Residential care	• Urban • Rural • Remote • Australian Indigenous communities	• Chair, Guideline Development Steering Committee • Guideline Development Groups • Literature appraisal
Kerrie Coleman	Nurse Practitioner Complex Wound Mmt; RN; MNclinical (Wound Mmt),MN(Chronic Disease) DipApSc, BNsc	Brisbane, Qld • Hospital setting	• Urban	• Guideline Development Groups • Literature appraisal
Monique Covey	Clinical Dietitian; APD; BSc(Nutrition) Hons	Sydney, NSW • Hospital setting • Outpatient clinics	• Urban • Rural • Multicultural populations	• Guideline Development Groups
Jenny Davenport	Clinical Nurse Educator; RN; STN(Cred); Cert. Advanced Wound Management; Cert IV in Training & Assessment	Victoria • Education	N/A	• Guideline Development Groups • Literature appraisal
Sandy Dean	Nurse Consultant, RN; RM; MWOundCare; FAWMA	Werribee, Vic • Hospital setting • Community care • Residential care • Education	• Urban • Rural • Multicultural populations	• Literature appraisal • Guideline Development Groups
Ann Marie Dunk	Clinical Nurse Consultant (Wound Mmt); RN; BHthSc(Nurs)	Canberra, ACT • Hospital setting • Education • Research	• Urban • Multicultural	• Guideline Development Groups • Literature appraisal
Sean Fitzgerald	Consumer representative	N/A	N/A	• Guideline Development Steering Committee

Anne Gardner	Professor of Nursing; RN; PhD	Canberra, ACT • Education	N/A	<ul style="list-style-type: none"> Guideline Development Groups
Susie Goh	RN, STN, PGrad Cert. Tissue Viability			<ul style="list-style-type: none"> Guideline Development Steering Committee
Emily Haester	Methodologist, Academic Researcher BN, PGradDip (AdvNsg)	Canberra, ACT	N/A	<ul style="list-style-type: none"> Project Officer Guideline Development Steering Committee Guideline Development Groups Literature appraisal
Debra Harcourt	Clinical Nurse (Wound Management) MHlthSci	Brisbane, QLD	<ul style="list-style-type: none"> Urban Multicultural populations 	<ul style="list-style-type: none"> Guideline Development Groups Literature appraisal
Susan Law	Advanced Practice Nurse (Wound Mgmt); RN; RM; MSCN; BScN; ET.	Hong Kong • Hospital setting • Outpatient clinics	<ul style="list-style-type: none"> Urban Minor ethnic group (e.g. Indonesia, Pakistan, Philippines, Thailand) 	<ul style="list-style-type: none"> Guideline Development Steering Committee
Judith Manning	Clinical Nurse (Wound Management) RN; MA; BEd.	Adelaide, SA • Residential care • Education	<ul style="list-style-type: none"> Urban Multicultural populations 	<ul style="list-style-type: none"> Project administration Guideline Development Steering Committee Guideline Development Groups Literature appraisal
Bill McGuinness	AWMA President; Assoc. Professor RN; PhD; MNS; BN; DipT.	Melbourne, Vic • Hospital setting • Community care • Residential care • Tertiary education	<ul style="list-style-type: none"> Urban Multicultural populations 	<ul style="list-style-type: none"> Guideline Development Steering Committee Literature appraisal
Bernadette McNally	Clinical Nurse Consultant (Wound Mgmt and Quality Coordination) RN; MEd&Wk, MNurs (Advanced Practice) BN; Grad Dip Nursing (Comm. Nurs) Dip Hsc.	ACT • Hospital setting	<ul style="list-style-type: none"> Urban Multicultural populations 	<ul style="list-style-type: none"> Literature appraisal Guideline Development Groups
Pam Mitchell	Clinical Nurse Consultant (Wound Mgmt); RN; MN; PGDip WHTR (Wales); Dip N;	Christchurch, New Zealand • Hospital setting	<ul style="list-style-type: none"> Urban 	<ul style="list-style-type: none"> Guideline Development Steering Committee Guideline Development Groups Literature appraisal
Pamela Morey	Nurse Practitioner; RN; STN; MN (NP); MRCNA	Perth, WA • Hospital setting • Education • Remote consultation	<ul style="list-style-type: none"> Urban Rural Remote Indigenous communities 	<ul style="list-style-type: none"> Guideline Development Groups
Wayne Naylor	Senior Analyst Palliative Care Council New Zealand; President NZWCC	N/A	N/A	<ul style="list-style-type: none"> Guideline Development Groups
Tracy Nowicki	Clinical Nurse Consultant; RN	Brisbane Qld • Hospital setting	<ul style="list-style-type: none"> Urban Adult Multicultural 	<ul style="list-style-type: none"> Guideline Development Steering Committee Literature appraisal

Katrina Pace	New Zealand Registered Dietitian NZRD Bsc (hons)	NZ	<ul style="list-style-type: none"> • Adult • Education 	<ul style="list-style-type: none"> • Urban • Multicultural (Maori, NZ, European, Pacific Islander, Asian) 	<ul style="list-style-type: none"> • Guideline Development Groups
Jenny Prentice	RN; PhD	Perth WA	<ul style="list-style-type: none"> • Education 	N/A	<ul style="list-style-type: none"> • Guideline Development Steering Committee
Rosalind Probert	Clinical Nurse Consultant (Stomal Therapy Wound Mmt); RN	Brisbane Qld.	<ul style="list-style-type: none"> • Hospital setting, • Outpatient clinics 	<ul style="list-style-type: none"> • Urban • Adult, multicultural, indigenous populations 	<ul style="list-style-type: none"> • Guideline Development Groups
Robyn Rayner	Clinical Nurse (Wound Mmt) RN; M Wound Care; PGrad Health Admin; BSci (Nursing)	Bunbury, WA Perth, WA	<ul style="list-style-type: none"> • Community care • Education 	<ul style="list-style-type: none"> • Urban • Rural • Remote • Indigenous communities 	<ul style="list-style-type: none"> • Guideline Development Steering Committee • Guideline Development Groups • Literature appraisal
Jan Rice	Clinical Nurse Educator; RN; M Wound Care; Cert. Plastic & Reconstructive Surgery; MRCNA; FAWMA	Melbourne, Vic	<ul style="list-style-type: none"> • Community care • Outpatient clinics • Residential care • Education 	<ul style="list-style-type: none"> • Urban • Rural • Remote • Indigenous communities • 3rd world countries 	<ul style="list-style-type: none"> • Guideline Development Steering Committee • Guideline Development Groups • Literature appraisal
Kerri Roberts	Supervisory OT (Neurology & Rehab); MOT; BAppSc(OT); DipBusMmt.	Tasmania	<ul style="list-style-type: none"> • Hospital setting • Community care 	<ul style="list-style-type: none"> • Rural 	<ul style="list-style-type: none"> • Guideline Development Groups
Emil Schmidt	RN, BN Hon. PG cert. WCNS, MCNA (NZ)	Dunedin, New Zealand	<ul style="list-style-type: none"> • Hospital setting 	<ul style="list-style-type: none"> • Urban • Rural • Indigenous populations 	<ul style="list-style-type: none"> • Guideline Development Steering Committee • Guideline Development Groups • Literature appraisal
Maria Schollum	Clinical Nurse Specialist Wound Care, RN BN PG Dip Health Science, Adv Nurs	Hamilton, NZ	<ul style="list-style-type: none"> • Hospital setting 	<ul style="list-style-type: none"> • Urban 	<ul style="list-style-type: none"> • Guideline Development Groups • Literature appraisal
Michael Woodward	Assoc. Professor MB; BS; MD; FRACP	Melbourne, Vic	<ul style="list-style-type: none"> • Hospital setting • Outpatient clinics 	<ul style="list-style-type: none"> • Urban • Multicultural populations 	<ul style="list-style-type: none"> • Guideline Development Steering Committee • Guideline Development Groups • Literature appraisal
Jan Wright	Clinical Nurse Consultant (Wound Mmt); RN	Perth, WA	<ul style="list-style-type: none"> • Hospital setting 	<ul style="list-style-type: none"> • Urban • Multicultural populations 	<ul style="list-style-type: none"> • Guideline Development Groups • Literature appraisal
Catherine Young	Occupational Therapist; Wheelchair Seating Consultant; BAppSci (OT); Cert Family Dynamics PU Prevention.	Melbourne, Vic	<ul style="list-style-type: none"> • Outpatient clinics • Community care • Residential care • Education 	<ul style="list-style-type: none"> • Urban • Multicultural populations 	<ul style="list-style-type: none"> • Guideline Development Steering Committee • Guideline Development Groups • Literature appraisal
Clarissa Young	Clinical Nurse Consultant (Wound Mmt); RN; MCN; MNS (NP); BN;	Launceston, Tas	<ul style="list-style-type: none"> • Hospital setting 	<ul style="list-style-type: none"> • Urban 	<ul style="list-style-type: none"> • Guideline Development Steering Committee • Guideline Development Groups • Literature appraisal
Seok Yee Toh	Clinical Dietitian; APD; MSC Nutrition and Dietetics.	Launceston, Tasmania	<ul style="list-style-type: none"> • Hospital setting 	<ul style="list-style-type: none"> • Regional 	<ul style="list-style-type: none"> • Guideline Development Groups

A.2 Conflicts of Interest

Members of the Guideline Development Steering Committee and Guideline Development Groups and experts involved in literature appraisal completed an AWMA declaration of conflict of interest and confidentiality statement annually throughout the project. Conflicts of interest were raised at every meeting. Although the majority of members had no conflicts of interest to declare those who did made their conflicts of interest known, and refrained from participating in discussion where these conflicts were relevant. Full details are outlined within the AWMA Declaration of Conflict of Interest and Confidentiality Statement available on request from the AWMA. Declared conflicts of interest are outlined in Table A.2.

Table A.2 Conflict of interest declarations

Member	Declared conflicts of interest
Margo Asimus	No conflicts of interest
Elizabeth Abraham	No conflicts of interest
Judith Barker	No conflicts of interest
Debbie Blanchfield	Presentations for Convatec, Astra Zenica and Australian Pharmacy Association
Jennifer Byrnes	No conflicts of interest
Keryln Carville (Chair)	Sponsored to attend Smith & Nephew and ConvaTec Forums
Kerrie Coleman	No conflicts of interest
Monique Covey	No conflicts of interest
Jenny Davenport	No conflicts of interest
Sandy Dean	No conflicts of interest
Ann Marie Dunk	No conflicts of interest
Jane Edwards	No conflicts of interest
Sean Fitzgerald	No conflicts of interest
Anne Gardner	No conflicts of interest
Susie Goh	No conflicts of interest
Emily Haesler	No conflicts of interest
Debra Harcourt	No conflicts of interest
Diane Hishon	No conflicts of interest
Susan Law	No conflicts of interest
Judith Manning	No conflicts of interest
Bill McGuiness	Sponsored to attend Hartmann forum
Bernadette McNally	No conflicts of interest
Pam Mitchell	Sponsored to attend forums by both Smith & Nephew and KCI/Intermed. on negative pressure wound therapy
Pamela Morey	No conflicts of interest
Wayne Naylor	No conflicts of interest
Tracy Nowicki	No conflicts of interest
Katrina Pace	No conflicts of interest
Jenny Prentice	No conflicts of interest
Rosalind Probert	No conflicts of interest
Robyn Rayner	No conflicts of interest
Jan Rice	No conflicts of interest
Kerri Roberts	No conflicts of interest
Emil Schmidt	No conflicts of interest
Maria Schollum	No conflicts of interest

Carol Tweed	Reimbursement from Molnlyche Health Care (UK), ArjoHuntleigh NZ to prepare and present educational material relating to wound care including PI. Sponsorship from ArjoHuntleigh UK and NZ to attend national and international wound care and PI conferences.
Sue Templeton	Sponsorship from manufacturers/distributors of wound management products to: <ul style="list-style-type: none">• attend educational programs;• prepare and deliver unrestricted education material at conferences;• provide editorial comment of a general nature for promotional wound management material.
Michael Woodward	Membership of scientific advisory committee and advisor to Phoenix Eagle Previous paid presenter for Coloplast, 3M and Nestle Consultancy fees for chairing Board of Aged Care Wound Care for Hartmann Australia
Jan Wright	No conflicts of interest
Catherine Young	No conflicts of interest
Clarissa Young	No conflicts of interest
Seok Yee	No conflicts of interest

APPENDIX B EXCLUDED LITERATURE

Table B.1 Excluded guidelines and literature

Reasons for exclusion

- | | |
|--|---|
| 1. Not a systematic review | 4. Library could not retrieve trial |
| 2. Not in English | 5. Participants did not primarily have Pls |
| 3. Old review that has been updated (new version included) | 6. Does not address objectives of the guideline |
| | 7. Guideline not sufficiently evidence-based |

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Bradley M, Cullum N, Sheldon T. The debridement of chronic wounds: a systematic review. <i>Health Technology Assessment</i> 1999; 3(17 Part 1): 1-78.	5
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Chan D, Fong D, Leung J, Patil N, Leung G. Maggot debridement therapy in chronic wound care. <i>Hong Kong Medical Journal</i> , 2007; 13(5):382-6.	5
Chen H, Cai D, Shen W, Liu P. Bibliometric analysis of pressure ulcer research: 1990-2009. <i>Journal of Wound, Ostomy & Continence Nursing</i> , 2010; 37(6): 627-32.	1
Cuddigan J, Frantz R. Pressure ulcer research: pressure ulcer treatment. A monograph from the National Pressure Ulcer Advisory Panel. <i>Advances in Wound Care</i> , 1998; 11(6):294-300.	1
Cullum N, Deeks J, Sheldon T, Song F, Fletcher A. Beds, mattresses and cushions for pressure sore prevention and treatment. <i>Cochrane Database of Systematic Reviews</i> ; 2000; (2):CD001735.	3
Dealey C. Review: support surfaces, nutritional supplements, and topical agents help prevent pressure ulcers. <i>Evidence-Based Nursing</i> , 2007; 10 (2): 54.	1
Duimel-Peeters I, Halfens R, Berger M, Snoeckx L. The effects of massage as a method to prevent pressure ulcers. A review of the literature. <i>Ostomy Wound Management</i> , 2005 Apr; 51 (4): 70-80.	1
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Hawkins D, Hourelid N, Abrahamse H. Low level laser therapy (LLLT) as an effective therapeutic modality for delayed wound healing. <i>Annals—New York Academy of Science</i> , 2005; 1056:486-493.	1
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Holm B, Mesch L, Ove H. Importance of nutrition for elderly persons with pressure ulcers or a vulnerability for pressure ulcers: a systematic literature review. <i>Australian Journal of Advanced Nursing</i> , 2007; 25(1):77-84	6
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Joanna Briggs Institute. Pressure ulcers—prevention of pressure related damage. <i>Best Practice</i> , 2008; 12 (2): 1-4.	1
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Keller B, Wille J, van Ramshorst B, van der Werken C. Pressure ulcers in intensive care patients: a review of risks and prevention. <i>Intensive Care Medicine</i> , 2002. 28(10):1379-88.	1
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Mortenson W, Miller W & Team. S. A review of scales for assessing the risk of developing a pressure ulcer in individuals with SCI. <i>Spinal Cord</i> . 2008;46(3):168-75.	1
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Sung Y, Park K. Factors affecting the healing of pressure ulcers in a Korean acute care hospital. <i>Journal of Wound, Ostomy & Continence Nursing</i> , 2011; 38 (1): 38-45	1
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APPENDIX C PRIMARY SEARCH STRATEGY

Search strategy for systematic reviews and practice guidelines

- 1 exp "Review"/ or exp Guideline/ or exp Practice Guideline/
- 2 (medline or medlars or embase or pubmed).tw,sh,ab.
- 3 (scisearch or psychlit or psyclit).ti,ab,sh.
- 4 cinahl.ti,ab,sh.
- 5 ((hand adj2 search\$) or (manual\$ adj search\$)).tw.
- 6 ((electronic adj database\$) or (bibliographic adj database\$)).tw.
- 7 ((pooled adj analys\$) or pooling).tw.
- 8 (peto or dersimonian or (fixed adj effect) or mantel haenszel).tw.
- 9 (psycinfo or psychinfo).ti,ab,sh.
- 10 exp meta analysis/
- 11 meta analys\$.tw,sh.
- 12 (systematic\$ adj5 review\$).tw,sh.
- 13 (quantitativ\$ adj5 review\$).tw,sh.
- 14 (methodologic\$ adj5 review\$).tw,sh.
- 15 (quantitativ\$ adj5 synthesi\$).tw,sh.
- 16 10 or 11 or 12 or 13 or 14 or 15
- 17 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
- 18 1 and 17
- 19 pressure ulcer.mp. or decubitus ulcer.mp or exp Pressure Ulcer/
- 20 pressure injury.mp.
- 21 19 or 20
- 22 16 or 18
- 23 19 or 20
- 24 22 and 23
- 25 limit 24 to (English language and humans)

APPENDIX D CRITICAL APPRAISALS AND QUALITY OF RESEARCH

All SRs were critically appraised by two reviewers. A third reviewer appraised all papers to ensure consistency in appraisal between reviewers. Discrepancy in appraisal was resolved through discussion between the reviewers until a consensus was reached. Critical appraisal tools developed by the Scottish Intercollegiate Guidelines Network (SIGN) (www.sign.ac.uk/methodology/checklists.html) were used to appraise all the research. Table AD.1 outlines the critical appraisal scores of include SRs. Table AD.2 outlines the type, volume and quality of evidence included in each of the included SRs.

Table D.1: Critical appraisal of included SRs

	Focused review question	Description of review methodology	Rigorous literature search	Critical appraisal	Appropriate pooling	Conflict of interest and funding reported
++ well covered						
+ adequately addressed						
- Poorly or not addressed/ not reported						
N/A not applicable						
Akbari et al, 2006 ¹²⁵	++	++	++	++	++	++
Ankrom et al, 2005 ⁶⁷	+	+	++	-	-	-
Aziz et al, 2010 ¹²²	++	++	++	++	++	++
Bouza et al, 2005 ¹⁰⁷	++	++	+	+	++	+
Bradley et al, 1999 ¹⁰⁸	+	++	++	++	++	++
Cullum et al, 2001 ⁵³	++	++	++	++	++	++
de Laat et al, 2005 ⁶²	+	+	+	-	-	+
Gardner et al, 1999 ¹¹⁸	++	+	+	-	+	+
Gelis et al, 2009 ^{26, 27}	++	+	+	+	++	++
Girouard et al 2008 ⁶⁹	++	++	++	+	++	-
Gorecki et al, 2009 ¹⁵	++	++	++	++	++	++
Gorecki et al, 2011 ⁷⁰	++	++	++	+	++	++
Gray and Whitney, 2003 ⁸⁵	++	+	++	-	-	-
Gray, 2003 ⁸³	++	+	++	N/A	N/A	-
Gray, 2003 ⁸⁶	++	-	++	+	-	-
Gray et al, 2006 ⁸⁴	++	-	+	-	N/A	-
Heyneman et al, 2008 ¹⁰⁹	+	++	++	+	++	+
Jull et al, 2008 ⁹⁴	++	++	++	++	++	++
Junkin and Gray, 2009 ⁵⁶	++	+	+	-	+	++
Kottner et al, 2009 ³⁶	+	++	++	+	+	++
Kottner et al, 2009 ⁶⁶	++	++	++	++	++	-
Kottner et al, 2011 ³⁴	++	++	+	++	++	++
Krapfl and Gray, 2008 ⁵⁹	++	++	++	+	++	-
Langer et al, 2003 ³⁸	++	++	++	+	-	++
Legood and McInnes, 2005 ¹²⁹	++	++	++	+	+	++
McGaughey et al, 2009 ¹²⁰	++	++	+	++	+	-
McInnes et al, 2010 ⁴³	++	++	++	++	++	++
Michael et al 2007 ⁶⁰	+	++	++	+	-	++
Moore and Cowman, 2009 ⁸⁷	++	++	++	N/A	N/A	++
Moore and Cowman, 2008 ³⁵	++	++	++	++	N/A	++
Moore and Cowman, 2008 ⁹¹	++	++	++	++	++	+
Pancorbo-Hidalgo et al, 2006 ³³	++	+	++	++	++	+
Pieper et al, 2009 ⁷²	+	-	-	-	+	+
Reddy et al, 2008 ⁸²	++	++	++	++	++	++
Reddy et al, 2006 ³⁹	+	++	+	++	+	++
Reenalda et al, 2009 ⁴²	++	++	+	++	++	-
Soban et al, 2011 ¹²⁶	+	++	++	++	-	+
Stratton et al, 2005 ⁴⁰	++	++	++	+	++	+
Ubbink et al, 2008 ¹¹²	++	++	++	++	++	-
van den Boogaard et al, 2008 ¹¹⁵	++	+	+	++	+	-
van Lis et al, 2009 ⁶¹	+	+	-	-	++	+
Vermeulen et al, 2010 ⁹²	++	++	+	++	++	++
Vikatmaa et al, 2008 ¹¹³	+	++	++	++	+	++
Xie et al, 2010 ¹¹⁴	++	++	++	+	-	++

Table D.2: Quality of research included in SRs

	Primary clinical topic	Type of papers included	Number of papers included	Quality of studies included in the review
Akbari et al, 2006 ¹²⁵	Therapeutic ultrasound	RCTs	3	1 Good 2 Low
Ankrom et al, 2005 ⁶⁷	Pressure ulcer staging	Consensus and descriptive	94	Unclear
Aziz et al, 2010 ¹²²	Electromagnetic therapy	RCTs	2	Low
Bouza et al, 2005 ¹⁰⁷	Wound care: topical agents and dressings	RCTs	21	Low to medium
Bradley et al, 1999 ¹⁰⁸	Wound care: topical agents and dressings	RCTs	28	Low
Cullum et al, 2001 ⁵³	Electrotherapy	RCTs	3	Low to medium
de Laat et al, 2005 ⁶²	Pain, wound exudate	RCTs, cross sectional studies and descriptive	13	Unclear
Gardner et al, 1999 ¹¹⁸	Electrical stimulation	RCTs, non-RCTs and descriptive	28	Unclear
Gelis et al, 2009 ^{26, 27}	Risk factors	Cohort and cross-sectional	12	Low to good
Girouard et al 2008 ⁶⁹	Pain assessment	Cross-sectional and descriptive	26	Unclear
Gorecki et al, 2009 ¹⁵	QOL	Phenomenological studies and cross over designs	31	Good for qualitative Poor for quantitative
Gorecki et al, 2011 ⁷⁰	Pain	Qualitative and quantitative	6 qualitative 4 quantitative	Unclear
Gray and Whitney, 2003 ⁸⁵	Nutrition	RCTs	2	Low
Gray, 2003 ⁸³	Nutrition	None	0	N/A
Gray, 2003 ⁸⁶	Nutrition	RCTs	2	Unclear
Gray et al, 2006 ⁸⁴	HBOT	RCTs	1	Low
Heyneman et al, 2008 ¹⁰⁹	Wound care: hydrocolloid dressings	RCTs	29	Low to medium
Jull et al, 2008 ⁹⁴	Wound care: honey	RCTs	1	Low
Junkin and Gray, 2009 ⁵⁶	Pressure redistribution surfaces	RCTs and cohort	4 RCTs 1 cohort study	Unclear
Kottner et al, 2009 ³⁶	Risk assessment	Validation and reliability studies	8	3 good quality 5 low to medium quality
Kottner et al, 2009 ⁶⁶	PI classification scales	Validation and reliability studies	10	Medium to good
Kottner et al, 2011 ³⁴	Risk assessment	Validation and reliability studies	15	Medium
Krapfl and Gray, 2008 ⁵⁹	Repositioning	Systematic reviews and RCTs	2 SRs 3 RCTs	Unclear
Langer et al, 2003 ³⁸	Nutrition	RCTs	8	Low to medium
Legood and McInnes, 2005 ¹²⁹	Cost effectiveness	RCTs	3 economic evaluations	Unclear
McGaughey et al, 2009 ¹²⁰	PEMT	RCTs	4	1 good 3 low
McInnes et al, 2010 ⁴³	Pressure redistribution surfaces	RCTs	52	Primarily low to medium
Michael et al 2007 ⁶⁰	Seating	RCTs and non-randomised trials	19	Primarily low
Moore and Cowman, 2009 ⁸⁷	Pressure redistribution surfaces	RCTs and controlled clinical trials	0	N/A
Moore and Cowman, 2008 ³⁵	Risk assessment	RCTs	1	Low

Table D.2: Quality of research included in SRs

	Primary clinical topic	Type of papers included	Number of papers included	Quality of studies included in the review
Moore and Cowman, 2008 ⁹¹	Wound cleansing	RCTs	3	Low
Pancorbo-Hidalgo et al, 2006 ³³	Risk assessment	Validation and reliability studies	33	Ranged from low to high
Pieper et al, 2009 ⁷²	Pain	Primarily descriptive	15	Unclear
Reddy et al, 2008 ⁸²	Support surfaces, wound care, adjunctive therapies	RCTs	103	Primarily low to medium
Reddy et al, 2006 ³⁹	Prevention interventions	RCTs	59	Primarily low to medium
Reenalda et al, 2009 ⁴²	Interface pressure	RCTs, controlled clinical trials	7	Good to medium
Soban et al, 2011 ¹²⁶	QI initiatives	Before/after designs	39	Good to medium
Stratton et al, 2005 ⁴⁰	Nutrition	RCTs, controlled clinical trials, cohort trials	8 RCTs 7 additional trials	Low
Ubbink et al, 2008 ¹¹²	NPWT	RCTs	2	Low to medium
van den Boogaard et al, 2008 ¹¹⁵	NPWT	RCTs	3	Low to medium
van Lis et al, 2009 ⁶¹	Assessment	Cohort trials	22 (or more)	Unclear
Vermeulen et al, 2010 ⁹²	Wound care: iodine	RCTs	3	Low to medium
Vikatmaa et al, 2008 ¹¹³	NPWT	RCTs	2	Low to medium
Xie et al, 2010 ¹¹⁴	NPWT	RCTs	3	Low to medium

APPENDIX E VALIDATED ASSESSMENT TOOLS

Table E.1 Validated assessment tools

Nutritional screening tools	
Acute care settings ³⁷	Mini Nutritional Assessment-Short Form (MNA-SF) (for older adults) Malnutrition Universal Screening Tool (MUST) Simplified Nutritional Appetite Questionnaire (SNAQ) Malnutrition Screening Tool Nutritional Risk Screening
Residential care ³⁷	MNA-SF (for older adults) MUST SNAQ Simple Nutrition Screening Tool
Rehabilitation settings ³⁷	MNA-SF Rapid Screen
Community settings ³⁷	MNA-SF (for older adults) MUST SNAQ Seniors in the Community: Risk Evaluation for Eating and Nutrition Short Nutritional Appetite Questionnaire
Nutritional assessment tools	
Acute care settings ³⁷	MNA-SF (for older adults) Subjective Global Assessment (SGA) Patient Generated Subjective Global Assessment
Residential care ³⁷	SGA Mini Nutritional Assessment (MNA)
Rehabilitation settings ³⁷	SGA MNA
Community settings ³⁷	SGA MNA
Pressure injury risk assessment scales	
Adult populations ³³	Braden Scale for Predicting Pressure Sore Risk (Braden Scale) Norton Scale Waterlow Score
Intensive care unit	Glasgow Scale Cubbin and Jackson Scale
Paediatric populations ³⁴	Neonatal Skin Risk Assessment Scale for Predicting Skin Break down (NSRAS) Braden Q Burn Pressure Ulcer Skin Risk Assessment Scale (BPUSRAS) Starkid Skin Scale Glamorgan Scale
Pressure injury healing assessment scales	
All populations ^{4, 61}	Pressure Ulcer Scale for Healing (PUSH) Bates-Jensen Wound Assessment Tool (BWAT) Sessing Scale
Pain assessment tools	
Adults with PI ^{4, 62, 69}	Visual analogue scale (VAS) Wong-Baker FACES Pain Rating Scale (FRS) McGill Pain Questionnaire (MPQ)
Paediatric populations ^{4, 72}	0 to 10 pain rating scale Wong-Baker FRS Face, Legs, Activity, Cry, Consolability (FLACC) scale Revised-FLACC Crying; Requires O ₂ for Saturation >95%; Increasing vital signs; Expression; Sleepless (CRIES) scale
Cognitively impaired adults ¹⁴¹	MPQ Assessment of Discomfort in Dementia (ADD) protocol Abbey Pain Scale Pain Assessment Checklist for Seniors with Limited Ability to Communicate Proxy Pain Questionnaire Pain Assessment in Advanced Dementia

APPENDIX F BRADEN SCALE FOR PREDICTING PRESSURE SORE RISK

BRADEN SCALE FOR PREDICTING PRESSURE SORE RISK

Patient's Name _____		Evaluator's Name _____		Date of Assessment _____	
SENSORY PERCEPTION ability to respond meaningfully to pressure-related discomfort	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	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.	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.	4. No Impairment Responds to verbal commands. Has no sensory deficit which would limit ability to feel or voice pain or discomfort.	
MOISTURE degree to which skin is exposed to moisture	1. Constantly Moist Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned.	2. Very Moist Skin is often, but not always moist. Linen must be changed at least once a shift.	3. Occasionally Moist: Skin is occasionally moist, requiring an extra linen change approximately once a day.	4. Rarely Moist Skin is usually dry, linen only requires changing at routine intervals.	
ACTIVITY degree of physical activity	1. Bedfast Confined to bed.	2. Chairfast Ability to walk severely limited or non-existent. Cannot bear own weight and/or must be assisted into chair or wheelchair.	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	4. Walks Frequently Walks outside room at least twice a day and inside room at least once every two hours during waking hours	
MOBILITY ability to change and control body position	1. Completely Immobile Does not make even slight changes in body or extremity position without assistance	2. Very Limited Makes occasional slight changes in body or extremity position but unable to make frequent or significant changes independently.	3. Slightly Limited Makes frequent though slight changes in body or extremity position independently.	4. No Limitation Makes major and frequent changes in position without assistance.	
NUTRITION usual food intake pattern	1. Very Poor Never eats a complete meal. Rarely eats more than 1/2 of any food offered. Eats 2 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 5 days.	2. Probably Inadequate Rarely eats a complete meal and generally eats only about 1/2 of any food offered. Protein intake includes only 3 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	3. Adequate Eats over half of most meals. Eats a total of 4 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	4. Excellent Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.	
FRICTION & SHEAR	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	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.	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.		
Total Score					

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APPENDIX G NORTON SCALE

The Norton Scale

NOTE: Scores of 14 or less rate the patient as "at risk"

	Physical Condition	Mental Condition	Activity	Mobility	Incontinence	Total Score
	4 Good 3 Fair 2 Poor 1 Bad	4 Alert 3 Apathetic 2 Confused 1 Stupor	4 Ambulant 3 Walk/help 2 Chairbound 1 Bedridden	4 Full 3 Slightly Limited 2 Very Limited 1 Immobile	4 Not 3 Occasional 2 Usually-urine 1 Doubly	
Name:						
Date:						
Name:						
Date:						
Name:						
Date:						
Name:						
Date:						
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Source: Doreen Norton, Rhoda McLaren, and A.N. Exton-Smith. An Investigation of Geriatric Nursing Problems in the Hospital. London. National Corporation for the Care of Old People (now the Centre for Policy on Ageing); 1962. Adapted with permission of the publisher.

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APPENDIX H WATERLOW SCORE

WATERLOW PRESSURE ULCER PREVENTION/TREATMENT POLICY
RING SCORES IN TABLE, ADD TOTAL. MORE THAN 1 SCORE/CATEGORY CAN BE USED

BUILD/WEIGHT FOR HEIGHT	SKIN TYPE VISUAL RISK AREAS	SEX AGE	MALNUTRITION SCREENING TOOL (MST) (Nutrition Vol.15, No.6 1999 - Australia)		
AVERAGE BMI = 20-24.9	HEALTHY	MALE	A - HAS PATIENT LOST WEIGHT RECENTLY		B - WEIGHT LOSS SCORE
ABOVE AVERAGE BMI = 25-29.9	TISSUE PAPER	FEMALE	YES - GO TO B	NO - GO TO C	0.5 - 5kg = 1
OBESE BMI > 30	DRY	14 - 49	UNSURE - GO TO C AND SCORE 2		5 - 10kg = 2
BELOW AVERAGE BMI < 20	OEDEMATOUS	50 - 64			10 - 15kg = 3
BMI = Wt(Kg)/Ht (m) ²	CLAMMY, PYREXIA	65 - 74			> 15kg = 4
	DISCOLOURED GRADE 1	75 - 80	C - PATIENT EATING POORLY OR LACK OF APPETITE		unsure = 2
	BROKEN/SPOTS GRADE 2-4	81 +	'NO' = 0; 'YES' SCORE = 1		NUTRITION SCORE If > 2 refer for nutrition assessment / intervention
CONTINENCE	MOBILITY	SPECIAL RISKS			
COMPLETE/ CATHETERISED	FULLY	TISSUE MALNUTRITION	NEUROLOGICAL DEFICIT		
URINE INCONT.	RESTLESS/FIDGETY	8	DIABETES, MS, CVA		
FAECAL INCONT.	APATHETIC	8	MOTOR/SENSORY		
URINARY + FAECAL INCONTINENCE	RESTRICTED	5	PARAPLEGIA (MAX OF 6)		
	BEDBOUND	5	MAJOR SURGERY or TRAUMA		
	e.g. TRACTION	5	ORTHOPAEDIC/SPINAL		
	CHAIRBOUND	2	ON TABLE > 2 HR#		
	e.g. WHEELCHAIR	1	ON TABLE > 6 HR#		
		1	MEDICATION - CYTOTOXICS, LONG TERM/HIGH DOSE STEROIDS, ANTI-INFLAMMATORY MAX OF 4		

SCORE
10+ AT RISK
15+ HIGH RISK
20+ VERY HIGH RISK

Scores can be discounted after 48 hours provided patient is recovering normally

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* The 2005 revision incorporates the research undertaken by Queensland Health.

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APPENDIX I BRADEN Q SCALE

BRADEN Q SCALE

Intensity and Duration of Pressure		Score		
Mobility – Ability to change & control body position	<p>1. Completely Immobility Does not make even slight changes in body or extremity position without assistance</p> <p>1. Bedfast Confined to bed</p> <p>1. Completely Limited Unresponsive to painful stimuli due to diminished level of consciousness or sedation OR limited ability to feel pain over most of body surface</p>	<p>2. Very Limited Makes occasional slight changes in body or extremity to completely turn self independently</p> <p>2. Chair Fast Ability to walk severely limited or non-existent. Cannot bear own weight &/or must be assisted into chair</p> <p>2. Very Limited Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness OR has sensory impairment which limits the ability to feel pain or discomfort over half of body</p>	<p>3. Slightly Limited Makes frequent though slight changes in body or extremity position independently</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 Responds to verbal commands but cannot always communicate discomfort or need to be turned OR has sensory impairment which limits the ability to feel pain or discomfort in 1 or 2 extremities</p>	<p>4. No Limitation Makes major and frequent changes in position without assistance</p> <p>4. All patients too young to ambulate OR walks frequently Walks outside the room at least twice daily and inside room at least once every 2 hours during waking hours</p> <p>4. No Impairment Responds to verbal commands. Has no sensory deficit, which limits ability to feel or communicate pain or discomfort</p>
Sensory Perception – The ability to respond in a developmentally appropriate way to pressure related discomfort	<p>Tolerance of the Skin and Supporting Structure</p> <p>1. Constantly Moist Skin is kept moist almost constantly by perspiration, urine, drainage, etc. Dampness is detected every time patient is moved or turned</p> <p>1. Significant Problem Spasticity, contracture, itching or agitation leads to almost constant thrashing and friction</p> <p>1. Very Poor NBM &/or maintained on clear fluids, or IV's for more than 5 days OR albumin < 25mg/l</p> <p>1. Extremely Compromised Hypotensive (MAP < 50mmHg; < 40mmHg newborn) OR the patient does not physiologically tolerate position changes</p>			
Moisture – Degree to which skin is exposed to moisture	<p>2. Very Moist Skin is often, but not always moist. Linen must be changed at least every 8 hours</p> <p>2. 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.</p> <p>2. Inadequate Is on liquid diet or tube feedings/TPN which provide inadequate calories and minerals for age OR albumin < 30mg/l</p> <p>2. Compromised Normotensive; Oxygen saturation may be < 95% OR haemoglobin may be < 100mg/l OR capillary refill may be > 2 seconds; Serum pH is < 7.40</p>			
Friction – Shear Friction – occurs when skin moves against support surfaces. Shear – occurs when skin and adjacent bony surface slide across one another.	<p>3. Potentially Problem Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints, or other devices. Maintains relative good position in chair or bed most of the time but occasionally slides down.</p> <p>3. Adequate Is on tube feedings or TPN which provide adequate calories and minerals for age</p> <p>3. Adequate Normotensive; Oxygen saturation may be < 95% OR haemoglobin may be < 100mg/l OR capillary refill may be > 2 seconds; Serum pH is normal</p>			
Nutrition	<p>4. Rarely Moist Skin is usually dry, routine nappy changes, linen only requires changing every 24 hours.</p> <p>4. No Apparent Problem Able to completely lift patient during a position change. Moves in bed and chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair at all times.</p> <p>4. Excellent Is on a normal diet providing adequate calories for age. Does not require supplementation</p> <p>4. Excellent Normotensive; Oxygen saturation >95%; normal haemoglobin; & capillary refill < 2 seconds</p>			
Tissue Perfusion and Oxygenation	<p>Very High Risk 16 - 23</p> <p>Moderate Risk 13 – 15</p> <p>High Risk 10 - 12</p>			


Patient 'At Risk' / Mild Risk	'Very High Risk'
16 - 23	9 or below

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Australian Wound Management Association
New Zealand Wound Care Society
Hong Kong Enterostomal Therapists Association
Wound Healing Society (Singapore)