WUWHS

WORLD UNION OF WOUND HEALING SOCIETIES

CONSENSUS DOCUMENT

# Role of dressings in pressure ulcer prevention

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a division of Omnia-Med Ltd
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This consensus document was produced by Wounds International, an Omnia-Med Ltd company, and launched at the 5th World Union of Wound Healing Societies Congress 2016 in Florence, Italy

To cite this document
World Union of Wound Healing Societies (WUWHS) Consensus Document. Role of dressings in pressure ulcer prevention. Wounds International, 2016

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The views expressed in this publication are those of the authors and do not necessarily reflect those of Molnlycke Health Care

Supported by an educational grant
from Mölnlycke Health Care

## FOREWORD

Recognition of the huge economic, health-related and social burden of pressure ulcers has resulted in considerable efforts to reduce their occurrence. Despite this, pressure ulcers still occur. In recent years, evidence has been building that some types of dressings typically used to treat open wounds have the potential to supplement standard pressure ulcer prevention measures and further reduce incidence[1,2].

In September 2015, an international group of experts met to discuss the challenges involved in reducing pressure ulcer occurrence and to define the role of dressings in pressure ulcer prevention. The group considered the current evidence to propose a protocol for dressing use within pressure ulcer prevention and to identify research needs.

This final consensus document was produced following extensive review of an initial draft by the core working group and further review by a wider group. The document aims to help clinicians and healthcare budget holders to understand which dressings may protect against pressure ulcer development and from which patients may benefit.

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## DRESSINGS FOR PRESSURE ULCER PREVENTION

There are indications from the literature that implementation of pressure ulcer (PU) prevention strategies may result in reduction of PU occurrence in acute and long-term settings[3-8]. However, PUs (Box 1) continue to occur and to result in considerable morbidity and mortality, and social and economic burden[9,10].

**'Evidence that some dressings provide added benefits in preventing PUs when used in addition to standard PU prevention strategies is starting to accumulate[1,2]'**

Recommendations for the use of specific dressings in PU prevention have been published and have also appeared in guidelines[12-14]. Applying a dressing that was designed to treat open wounds to intact skin to prevent PU development may be counterintuitive, but has a rational basis (page 9). Box 2 contains some myths about the use of dressings for PU prevention.

### Box 1 | Definition and alternative terms for 'pressure ulcer'

*Definition:* A pressure ulcer is localised injury to the skin and/or underlying tissue over a bony prominence, as a result of pressure, or pressure in combination with shear[11].

*Alternative terms*

- Bedsore
- Decubitus
- Decubitus ulcer
- Pressure damage
- Pressure injury
- Pressure lesion
- Pressure sore

### Box 2 | Possible myths about the use of dressings for PU prevention

Myth 1: Dressings indicated for open wounds are not suitable for use in PU prevention

A number of different dressings, including foams, films and hydrocolloids that are typically used for the management of open wounds, have been investigated and are used for the prevention of PUs in a variety of clinical settings[1,2,15] (Table 3, page 15).

Myth 2: When a dressing is used for PU prevention, no other PU preventive measures are required

The appropriate use of dressings for PU prevention is intended to augment existing measures. Standard PU prevention measures must be implemented and continued even when a dressing is also being used, and often once the dressing has been discontinued. The use of dressings to prevent PUs should not replace standard prevention protocols[13].

Myth 3: Dressings are too thin to have an impact on the factors that cause PUs

The full range of actions of dressings in PU prevention is not fully understood. However, a number of *in vitro*, animal, clinical and computer modelling studies have demonstrated that some dressings reduce friction and redistribute pressure and shear, and may reduce the likelihood of skin weakening through over-hydration[16-21]. A low friction outer surface, multiple layers, sufficient size to cover the area at risk and a margin beyond, and ability to remove excessive skin moisture are dressing properties associated with reductions in extrinsic factors.

Myth 4: All patients at risk of PUs should have a dressing applied

The use of dressings to prevent PUs has not been evaluated in all patient groups. Published studies indicating that some types of dressings may reduce PU incidence have investigated dressing use in patients in acute care settings, e.g. emergency departments or intensive care units, operating rooms, spinal surgery, neurosurgery and elderly care[1,13,14] (Table 3, page 15). Total or relative immobility, loss of sensation, reduced spontaneous movement, atypical movement, medical device placement and scarring due to previous PUs are indicators for the use of PU prevention dressings (Table 2, page 12).

Myth 5: Once a dressing is in place for PU prevention it should be left undisturbed until the time for change

When used for PU prevention, a dressing may be used continuously for several days. However, it is essential that the skin covered by the dressing is inspected regularly to ensure there are no signs of damage. The frequency of inspection should be according to risk status, local protocol for skin assessment and the manufacturer's instructions, whichever is the most frequent. The dressing should be peeled back to allow for assessment of all of the skin and any bony prominence covered (Box 6, page 13). Particularly in patients with darker skin tones, assessment may include evaluation of skin temperature, and for the presence of oedema and differences in tissue consistency or firmness in comparison to surrounding tissue[12]. In view of the need for regular inspections, only dressings that can be peeled back without causing skin trauma and pain, and without loss of integrity and ability to adhere to the skin, should be used.

### Evolving terminology

The terminology around pressure ulcers is evolving to reflect that pressure damage does not always manifest as an open wound, and to emphasise preventability. The term 'pressure injury' has been in use by the Pan Pacific Pressure Injury Alliance (PPPIA) and has recently been adopted by the National Pressure Ulcer Advisory Panel (NPUAP)

## CURRENT CHALLENGES IN PU PREVENTION

Efforts to reduce PU occurrence face a number of significant challenges. Some challenges relate to healthcare system funding, or incentives to avoid PUs. Others relate to difficulties in assessing risk of PU development, identifying PUs and measuring occurrence. Lack of knowledge may result in inappropriate or under-use of preventive strategies, which may increase the risk of litigation (Box 3, below).

### Box 3 | Current challenges in PU prevention

**Healthcare system funding**

- PU prevention may be low priority and/or implemented inconsistently
- Penalties or requirements relating to PU prevention may produce unintended negative consequences, e.g. the presence of a PU may be omitted from an inpatient discharge summary, which may then cause later difficulties with claiming for clinic or homecare costs and medical equipment
- Fragmented budget structures may hinder implementation of PU prevention. Departments with their own budgets that care for patients for only short periods may find that any investment in PU prevention may not result in any recognition for preventing occurrence

**Litigation**

- In the US, 17,000 lawsuits are filed annually for PUs[22], and about 87% of cases are settled in favour of the patient[23]. In England, PUs are a common feature of litigation associated with intensive care treatment[24]. Between 2010 and 2015, £23.4m was paid in damages for claims related to pressure ulcers against the National Health Service[25]
- The prospect of large settlements and negative effects on institutional reputation continue to be drivers of PU prevention

**Education**

- The concepts involved in PU aetiology and underpinning prevention are complicated. As a result, misunderstandings or lack of knowledge, coupled with the time lag of up to 20 years associated with the translation of research into clinical practice[26], may result in under-use or inappropriate use of preventive strategies

**Risk assessment**

- Identifying which patients are at risk is often achieved through the use of skin assessment and PU risk assessment tools such as the Braden, Norton or Waterlow scales[27-29]. However, such tools tend to have low predictive values [30,31]
- A systematic review concluded that using a structured risk assessment tool instead of clinical judgement alone did not reduce the incidence of PUs[32]

**Classification and diagnosis**

- Difficulties in distinguishing superficial PUs from moisture lesions (e.g. incontinence-associated dermatitis) or dressing/tape damage may result in misdiagnosis or undertreatment[33,34]
- The National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel and Pan Pacific Pressure Injury Alliance[12] scheme for classifying PUs is widely adopted. The numbered categories the scheme uses were not devised to describe how PUs develop or how they heal. However, the scheme is sometimes misinterpreted as an explanation of PU development or is used to monitor healing ('reverse staging')[35]

**Unavoidability**

- There is increasing recognition that PUs may be unavoidable in certain patients despite evaluation of PU risk and implementation of preventive care[36-39]
- In healthcare facilities where penalties or non-payments occur for PUs, being able to distinguish between avoidable and unavoidable PUs is particularly important

**Monitoring and surveillance**

- To determine the effectiveness of PU prevention strategies, including the use of dressings for PU prevention, occurrence of PUs needs to be measured so that changes can be tracked over time
- Comparing changes in PU occurrence over time requires great care to ensure that the numbers calculated use the same criteria and measures, and so are comparable and a close reflection of any changes observed[12,40,41] (Appendix 1, page 19)

## AETIOLOGY OF PUs

The cause of PUs is complex, with pressure on a patient's skin and subcutaneous tissues playing a major role. However, other extrinsic factors such as shear and friction, and increased skin temperature and humidity (adverse microclimate) may also be involved[12,42].

Even so, not all patients develop PUs when their skin and soft tissues are subjected to these extrinsic factors. This may be because the factors have not been applied for long enough or at a high enough level to cause problems, or because the patient is able to withstand the stresses applied without developing any tissue damage.

Although pressure, shear, friction and microclimate are the most important factors in PU development, a number of factors intrinsic to patients, e.g. poor perfusion, reduced sensation and inadequate nutrition, may be associated with PU development[12,43] (Appendix 2, page 19).

These increase the likelihood of PU development by raising susceptibility to the potentially tissue-damaging effects of the extrinsic factors[43]. PU prevention focuses on decreasing the risk of PU development by reducing the level of the extrinsic factors, e.g. by using pressure-redistributing support surfaces and repositioning, managing incontinence etc... and by improving patient tolerance.

**How do pressure, shear, friction and microclimate cause PUs?**
Understanding how factors such as pressure, shear, friction and microclimate may contribute to PU occurrence continues to develop.

*Pressure*
When a force is applied perpendicular (i.e. at right angles) to the surface of the skin, pressure occurs on the skin and subcutaneous tissues. The pressure compresses the tissues and can distort or deform skin and soft tissues such as subcutaneous fat and muscle. Deformation of soft tissues is greater when pressure is applied over a bony prominence[42].

**'PUs may occur both with short durations of high levels of pressure, and with long durations of lower levels of pressure'**

*Friction and shear*
The occurrences of friction, shear and pressure are interlinked. Friction is the force that occurs when two objects that are touching are encouraged to move relative to each other, e.g. friction is present between the skin and a support surface when gravity encourages a patient to slip down the bed. Friction cannot occur without some element of pressure.

The amount of friction produced will depend on the interaction of the skin and support surface, i.e. how easily they can move across each other, and how much pressure is applied. Coefficient of friction is a measure of the amount of friction that may occur between two surfaces[42].

**'Tissue deformation causes shear, e.g. when a patient slides down a bed, and when uneven pressure distribution occurs over a bony prominence'**

Shear may result from the application of a tangential force, i.e. a force that is parallel to the surface of the skin (Figure 1, page 7). When there is a high level of friction between the skin and a support surface and a tangential force occurs, the skin will tend to stay in place against the support surface while the layers of underlying tissues are deformed as they move with the patient[44].

**Figure 1 | Friction and shear — effects on body tissues[42]**

When a patient in contact with a support surface moves, the friction between the skin and the surface tends to hold the skin in place and a shear force occurs that displaces and deforms the deeper tissues, and may distort and compress blood vessels. If friction between the skin and support surface is reduced, the amount of shear generated will also reduce

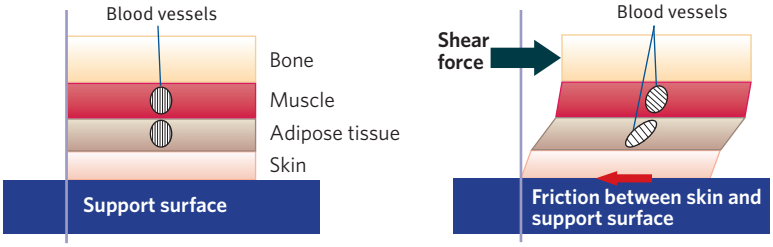
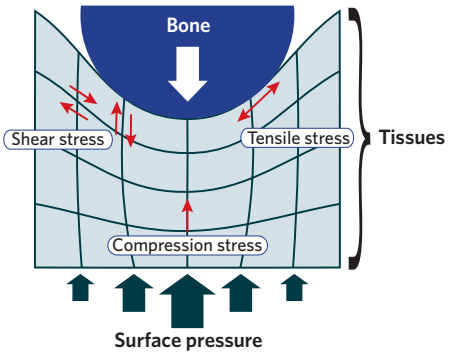



**Figure 2 | Pressure can produce shear deep in soft tissues over a bony prominence[42]**

Pressure applied to the skin over a bony prominence causes compression, deformation and distortion of the underlying soft tissues and produces shear within and between tissue layers




Shear may also occur in and between layers of deeper tissues as a result of the tissue deformation caused by pressure over a bony prominence (Figure 2, above). Muscle is particularly prone to damage by shear[44].

*Microclimate*

Microclimate refers to the conditions, usually of temperature and moisture, at the skin–support surface interface. The concept was developed when increased tissue temperature and skin moisture were recognised as risk factors for PU development[42,45,46].

Increased skin temperature has a number of metabolic and physical effects that may heighten the risk of skin damage from external influences[18,42]. Raised skin temperature has been associated with increased risk of PU development in an animal study[47] and in patients undergoing surgery in the park-bench (side lying) position[48].

High moisture levels at the skin–support surface interface may have a number of causes, e.g. perspiration, incontinence, wound/fistula drainage. They may contribute to the development of PUs by weakening skin and increasing the amount of friction between the skin and a support surface[34,49,50]. In this way, high moisture levels increase shear and increase the likelihood of tissue damage.

*Mechanisms of tissue damage*

The tissue damage that precedes development of a PU is due mainly to:

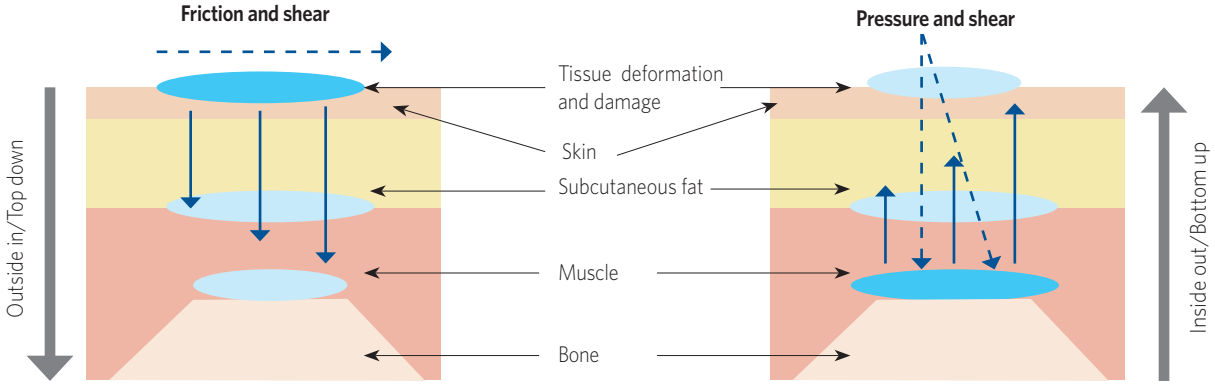
- Ischaemia — compression or distortion of blood vessels by pressure and/or shear may halt or reduce blood flow to tissues. This results in tissue hypoxia, build up of metabolic waste products and, eventually, tissue damage[43,51,52].
- Tissue deformation — animal and computer modelling studies have found that compression and large degrees of tissue deformation can cause direct tissue damage and cell death very quickly, and much faster than hypoxia[43,51,52].

For further information, see: *International review. Pressure ulcer prevention: pressure, shear, friction and microclimate in context. A consensus document.* London: Wounds International, 2010. Available from www.woundsinternational.com

**Figure 3 | Possible differences in the development of superficial and deep PUs**

**Outside in/Top down**
Friction and shear at the surface of the skin, or other superficial skin damage such as irritant dermatitis, may cause superficial damage which changes the physical characteristics of the skin, increasing shear and pressure in deeper tissues and causing progression to deeper damage

**Inside out/Bottom up**
Pressure and shear cause deep tissue damage near a bony prominence, which then extends up towards the surface of the skin




Repeated exposure to stresses such as pressure may result in increasingly severe tissue damage[53].

**'Superficial' and 'deep' PUs**

Emerging thought on the development of PUs has suggested that 'superficial' PUs (i.e. Category/Stage I and II) and 'deep' PUs (i.e. Category/Stage III and IV, and deep tissue injury) may result from different mechanisms[54]. However, these concepts continue to be debated.

Friction and shear forces applied to the skin, and other superficial skin damage (such as irritant dermatitis), are thought to be important contributors to superficial PUs[34,55-57]. The damage at the skin surface may progress to affect deep tissues, i.e. superficial PUs develop 'outside in', 'top down' or in a manner similar to a pothole in a road (Figure 3, above). However, clinically it may be difficult to determine the cause of superficial skin injuries, and there is debate around whether and which superficial skin injuries are PUs. Superficial skin injuries solely due to friction should not be classified or treated as PUs[57].

**'Friction and resulting superficial shear forces are thought to play important roles in the development of superficial PUs'**

In contrast, deep PUs and deep tissue injury are thought to be due mainly to deformation of deeper tissues resulting from pressure and shear. The damage occurs initially at the muscle/bone interface, and skin breakdown occurs late in the process. Deep PUs may therefore develop 'inside out', 'bottom up' or like a geological sinkhole[34,54,58-60] (Figure 3). It is important to recognise that, at the time of assessment, some PUs may be continuing to develop and the full extent of the damage may not be clear. An apparent deterioration in a PU may therefore be an unavoidable consequence of tissue damage that occurred prior to assessment.

**Box 4 | Definition of medical device-related PU[14]**

Medical device-related PUs are 'pressure injuries associated with the use of devices applied for diagnostic or therapeutic purposes wherein the PU that develops has the same configuration as the device.'

**'Additional research is required to clarify if and how the development mechanisms of superficial and deep PUs differ, and to what extent the mechanisms may co-exist'**

### Anatomical sites at risk of PUs

PUs are generally most common at anatomical sites that overlay a bony prominence. In adults, the most common locations are the sacrum and the heel. These sites account for about half of all PUs. Other sites commonly affected include the ischium, ankle, elbow and hip[61,62].

In children and neonates, the skin over the occiput is most commonly affected by PUs[63]. However, medical device-related PUs are of increasing concern in these patients[12,64].

### Medical device-related PUs

PUs associated with medical devices (Box 4) may account for up to around one-third of PUs in hospitalised adult patients[31,65] and more than half of PUs in hospitalised children[64]. PUs may occur on any tissue beneath a medical device, including skin and mucous membranes[14].

PUs have been associated with a wide range of medical devices including nasogastric tubes, ventilation masks, oxygen saturation probes, tracheostomy tubes and immobilisation splints[66]. The rigid materials used in these devices may abrade skin, create pressure on soft tissues or retain moisture against the skin surface. In addition, fixation methods, such as adhesive tapes, may irritate or damage skin[67,68].

## DRESSINGS FOR PU PREVENTION

In recent years, there has been increasing interest in and accumulating evidence for the use of wound dressings as an addition to standard PU prevention protocols[13]. The effect on PU occurrence of several different dressing types has been investigated at various anatomical locations and under medical devices[1,2,14]. Many of the dressings investigated are also used in the management of open wounds.

### How do dressings prevent PUs?

Laboratory, animal, computer modelling and clinical studies have investigated the physical effects of dressings. These have shown that a variety of dressing materials may reduce friction, shear and pressure, and reduce the likelihood of altering skin moisture to a point where the skin may be weakened[16-18,20,21,69]. Further research is required to clarify the mode of action of dressings in PU prevention.

**'The extent of the physical effects of a particular dressing varies with the properties of the materials it comprises, and also with the way that the dressing is constructed (Table 1)[19]'**

Friction and superficial shear forces have been shown to be reduced by a low friction outer dressing surface[16]. The reduction in shear and compression forces seen with multilayer dressings may be due in part at least to the horizontal displacement of the different dressing layers relative to each other, and to a cushioning effect[19,20].

**'In a study using computer modelling, a multilayer foam dressing applied to the heel dissipated internal shear to a greater extent than did a single layer foam dressing[20]'**

Other aspects of dressings found to affect shear reduction are the type of adhesive and the size of the dressing. An elastic adhesive allows absorption of shear forces, and a sufficiently large dressing allows transmission of shear to a wider area and away from the critical area[19].

**Table 1 | Modifying pressure, shear, friction and microclimate using dressing properties[19,20]**

| Factor | Property of dressing that may modify factor | Examples |
|---|---|---|
| **Pressure** | High loft (thickness or 'padding' which contains air) that cushions<br>Large load bearing area, i.e. to redistribute pressure | Thicker dressings, e.g. those with multiple layers (which may include foam)<br>Sufficiently large to extend beyond the area at risk |
| **Shear** | Ability to absorb and redistribute shear forces through good adhesion to the skin, high loft and lateral movement of dressing layers | Multilayer dressings that contain a material(s) with high loft, e.g. a foam<br>Elastic adhesive to allow absorption of shear forces<br>Sufficiently large to cover area at risk with overlap onto unaffected skin to redistribute shear from area at risk |
| **Friction** | Outer surface with low coefficient of friction* to reduce the generation of shear | Film<br>Dressings with a low friction outer surface |
| **Microclimate** (moisture)** | Absorbent so able to keep perspiration away from skin<br><br>High moisture vapour transmission rate (MVTR) to allow moisture to be released from the outer aspect of the dressing<br><br>Impermeable to liquids, e.g. urine | Foam, hydrocolloid<br><br>Outer layer with a high MVTR<br><br>Water-resistant outer layer, dressing is adhesive and protects the local microenvironment and excludes external factors |

*N.B. A dressing with a very low coefficient of friction may make it difficult for a patient to maintain position if applied to the sacrum for example

***In vitro* research has suggested that, although some dressings may increase skin temperature slightly, the increase is not sufficient to cause tissue damage[18]

Dressings were originally designed to absorb wound drainage and so can influence the level of moisture at the skin surface. They may therefore have additional impact on PU risk through effects on microclimate. *In vitro* research found that although dressings increase skin surface temperature slightly, the increase detected was unlikely to be sufficient to cause tissue damage[18]. Skin loses water and dressings with low absorption and/or low moisture vapour transmission may hold moisture against the skin surface to weaken the skin[18].

**'High absorbency or high moisture vapour transmission rate are preferable properties of a dressing used for PU prevention to prevent potentially detrimental accumulation of moisture on the skin surface'**

Dressing composition and construction have a marked impact on the effect of a dressing on pressure, shear, friction and microclimate. Different anatomical sites vary in skin properties, shape of underlying bony prominence, and thickness and types of subcutaneous tissue present, e.g. muscle is not present over the calcaneus, and over the sacrum the skin may have a higher moisture content. As a result, different dressing constructions may be required for different anatomical sites to optimise PU prevention.

**'Although some studies have shown that the use of certain dressings reduces the occurrence of PUs (Table 3, page 15), the optimal dressing construction to maximise the potential of dressings to prevent PUs remains to be determined'**

Understanding how dressing materials and construction affect pressure, shear, friction and microclimate helps to establish the ideal properties of a dressing for PU prevention. Box 5 (page 11) lists the properties that currently exist, as well as aspirational properties that are not yet available.

**Box 5 | Ideal properties of a dressing used for PU prevention**

- Reduces friction forces transmitted to the patient's skin — e.g. has an outer surface made from a low friction material
- Reduces shear forces transmitted to the patient's tissues — e.g. comprises several layers that can move relative to each other
- Reduces pressure transmitted to the patient's tissues — e.g. has high loft/thickness and contains padding that allows a degree of cushioning of bony prominences
- Reduces humidity at the skin/dressing interface — i.e. is absorbent and/or allows moisture to evaporate readily (e.g. has a high moisture vapour transmission rate [MVTR])
- Large enough to cover the area at risk, plus a margin of skin that is not at risk, to ensure that the area at risk is protected and that forces are transmitted away from it
- Sufficiently adherent to skin so that the dressing stays in place, but is easy to remove without causing trauma
- Conformable to variations in anatomy
- Does not interfere with the function of medical devices
- Can be used for several days — i.e. maintains adherence with repeated removal and reapplication to allow for skin inspection, or is transparent
- Impervious to external moisture — e.g. from showering and incontinence
- Available in a variety of sizes and shapes suitable for different anatomical locations
- Can be written on — e.g. to enhance communication between clinicians about dates of change, times of skin inspection and state of underlying skin*
- Contains an indicator to show when the structural integrity of the dressing is compromised and its ability to withstand shear, friction and pressure has reduced*
- Comfortable to wear
- Poses a low risk of skin irritation and skin stripping, and is hypoallergenic
- Quick and easy for clinical staff to apply
- Cost effective
- Acceptable to the patient and carer(s)

*N.B. Some properties listed here are aspirational and are not features of currently available dressings

## USING DRESSINGS FOR PU PREVENTION

Dressings for PU prevention should be used only after skin assessment and PU risk assessment have identified that the patient is at risk of developing a PU. Risk assessment should be structured, take place as soon as possible after (and within eight hours of) admission to a healthcare facility or at the time of the first visit to a home[12].

Published studies indicating that some types of dressings may reduce PU occurrence have investigated dressing use in patients in acute care settings, e.g. emergency departments or intensive care units, operating rooms, spinal surgery and neurosurgery and elderly care[1,13,14] (Table 3, page 15).

Immobility is the major factor in an 'at risk' patient to indicate that a dressing to prevent PUs should be considered (Table 2, page 12). Immobility may be the result of disease, severe illness or frailty, or sedation, paralysis or anaesthesia for surgery, investigations or treatments.

Length of surgery is known to be positively correlated with the risk of developing a PU[46,70]. A study of patients undergoing surgery for four hours or more found that for every 30 minutes of surgery beyond four hours the risk of developing a PU increased by about one-third[71]. Other studies have shown increased risk with surgery durations greater than 2.5 or 3 hours[72,73]. A review concluded that combined evidence from clinical

studies, animal models and *in vitro* studies indicates that PUs occur between the first hour and 4–6 hours after sustained loading[74]. As a result, an anticipated time of surgery or planned immobility of 2–3 hours or more, depending on level of individual patient risk for pressure ulceration, is suggested as the criterion for dressing use.

Restricted or atypical movement, loss of sensation, the use of medical devices and scarring due to previous PUs may also prompt consideration of a dressing for PU prevention (Table 2, below).

**Dressings for PU prevention: protect to prevent**

Dressings used for PU prevention should be used alongside standard PU prevention protocols. e.g. a SSKIN bundle (pressure-redistributing support surface, regular skin inspection, keep moving [repositioning], management of incontinence/moisture and optimised nutrition; see nhs.stopthepressure.co.uk) (Figure 4, page 14).

Body sites on which dressings for PU prevention have been investigated include the sacrum, heels and trochanters. However, application of a suitable dressing to other anatomical sites at risk of pressure damage may be considered.

Strategies to minimise friction and shear should be continued when a dressing for PU prevention is in place, e.g. moving and handling techniques and transfer aids that minimise drag between the patient and support surfaces should be used and the patient should be nursed with no more than 30˚of head elevation. Box 6 (page 13) details tips on selecting and using dressings for PU prevention. It is important to note that not all dressings are able to mitigate the effects of the extrinsic factors involved in PU

**Table 2 | Indications for dressings for PU prevention**

| Indication | Example(s) |
|---|---|
| **Immobility** | Patient is immobile, e.g. because of severe illness, neurological disease, frailty, sedation, or is positioned prone |
| **Planned immobility** | Patient is undergoing a procedure that requires immobility, sedation, general anaesthesia or local anaesthesia (e.g. spinal), that will last ≥2–3 hours (depending on individual patient risk) |
| **Loss of sensation that reduces spontaneous movement** | Patient is undergoing a procedure that results in loss of sensation, that will last ≥2–3 hours (depending on individual patient risk) (see text on pages 10-11 about length of surgery) and will impair spontaneous movement in response to pressure, e.g. epidural anaesthesia during childbirth<br>Patient has peripheral neuropathy, e.g. due to diabetes, or loss of sensation due to spinal cord injury or stroke |
| **Reduced or restricted mobility, or atypical movement** | Patient is weak or has limb contractures or spasticity so that self-repositioning or transfers between bed and chair involve dragging limbs and/or trunk across the support surface<br>Patient tends to move from a position in which they have been placed, e.g. the patient slips in the bed or feet move off pillows being used to elevate heels<br>Patient tends to rub their heels or another body part on the support surface, e.g. because of agitation due to physical or mental illness, pain or dementia |
| **Medical devices and securements** | When use is prolonged<br>When use of the device or securements increases pressure or moisture on the skin<br>When the device cannot be lifted or repositioned easily<br>When there is localised oedema |
| **Scarring due to previous PU** | Scar tissue has much lower strength than normal skin and is relatively avascular, and so is more vulnerable to external stresses |

development. A dressing should be selected that has been proven to have beneficial effects *in vitro* and *in vivo* at the intended anatomical site of use. It is essential that a process of regular monitoring and assessment of the dressing and the patient's PU risk takes place (Figure 4, page 14).

The dressing should be changed in accordance with the manufacturer's instructions. It should also be changed if it is no longer able to adhere fully or is compromised in some other way, e.g. is fully saturated, soiled or creased.

**Protecting the skin under medical devices**

Dressings for use under medical devices require careful selection and should be used in combination with correct positioning and care of the equipment[67]. The dressing should not compromise the action of the device and should avoid adding too much thickness below the

**Box 6 | Tips for selecting and using dressings for PU prevention**

**Dressing selection**

- Select a dressing proven to reduce PU occurrence in the patient group/clinical setting and position of use, e.g. at the anatomical location or under the medical device in question
- Select a dressing that is suitably shaped for the anatomical location
- Select a dressing that is large enough to cover the area at risk with a margin of overlap on to the surrounding skin of at least 2cm
- Consider a dressing constructed of several layers
- When used to protect the skin under a medical device, select a dressing that will:
  - not interfere with the function of the device
  - not increase pressure under the device, i.e. is not too thick
  - absorb excess moisture and/or transfer moisture to the environment (i.e. has a high moisture vapour transmission rate)

**Dressing application**

- Where possible, ensure the patient and carer(s) consent to dressing application and understand why a dressing is being applied
- Follow manufacturer's instructions for application – the skin will usually need to be clean and dry; creams and lotions should be avoided
- Ensure the dressing:
  - fits and conforms closely to the anatomical location
  - is properly adherent over its entire area and will not roll at the edges
  - extends beyond the area at risk (in some cases it may be possible to use several dressings that abut side by side to ensure adequate coverage of large areas at risk)
  - does not impede mobility
- In a patient who is perspiring heavily (diaphoretic), only use a dressing after drying the skin and if confident that it will adhere
- If used under a medical device, ensure the dressing fits under the device without leaving gaps and does not cause additional pressure or interfere with the functioning of the device
- Where possible, medical devices should continue to be lifted and repositioned regularly when a dressing is used to allow skin examination and pressure relief

**Monitoring**

- Inspect the dressing itself at least once daily
- Use risk status, local protocol and manufacturer's instructions to determine frequency of skin assessment*: skin assessment should fully visualise all of the skin at risk including the skin over any bony prominences. For non-transparent dressings this may require the dressing to be peeled back
- The skin underneath dressings applied beneath medical devices should be assessed* when and if the device can be moved or removed
- Document findings of skin assessments and be specific, e.g. state whether or not erythema, blistering, skin denudation or breakdown, or bruising are visible, and whether or not any erythema is blanchable
- Cleanse the skin covered by the dressing at each dressing change
- Change the dressing earlier than planned if it is no longer fully adherent, is dislodged, rolled at the edges, wrinkled, creased or damaged, soiled, saturated or compromised in some other way
- Do not leave the dressing in place for longer than stated in the manufacturer's instructions
- Document dressing selected, skin inspections, dressing changes, and timing and reason for discontinuation

**Discontinuation**

- Consider discontinuing a dressing that is being used for PU prevention once no longer indicated or the risk of PU has reduced, e.g. the patient is walking and/or moving purposefully when in a bed or a chair. N.B. Increased, but not full, mobility may result in increased shear and friction, e.g. when a totally immobile patient starts to move but cannot lift themselves clear of a support surface when changing position

**Transfer or discharge**

- When the patient is moved or discharged from the department or healthcare setting that implemented the dressing, ensure documentation and clear communication regarding whether and how continued use of the dressing should occur accompanies the patient

**Stepping up care**

- If pressure damage occurs, reassess the patient and skin, and manage according to local PU treatment protocol

**Contraindications/precautions**

- Do not use a dressing that contains components to which the patient is sensitive or allergic

* Particularly in patients with darker skin tones, assessment may include skin temperature, the presence of oedema and differences in tissue consistency in relation to surrounding tissue[12]. The role of diagnostic devices (such as a device to measure subepidermal moisture) as ways of detecting early PU damage is currently under investigation[74].

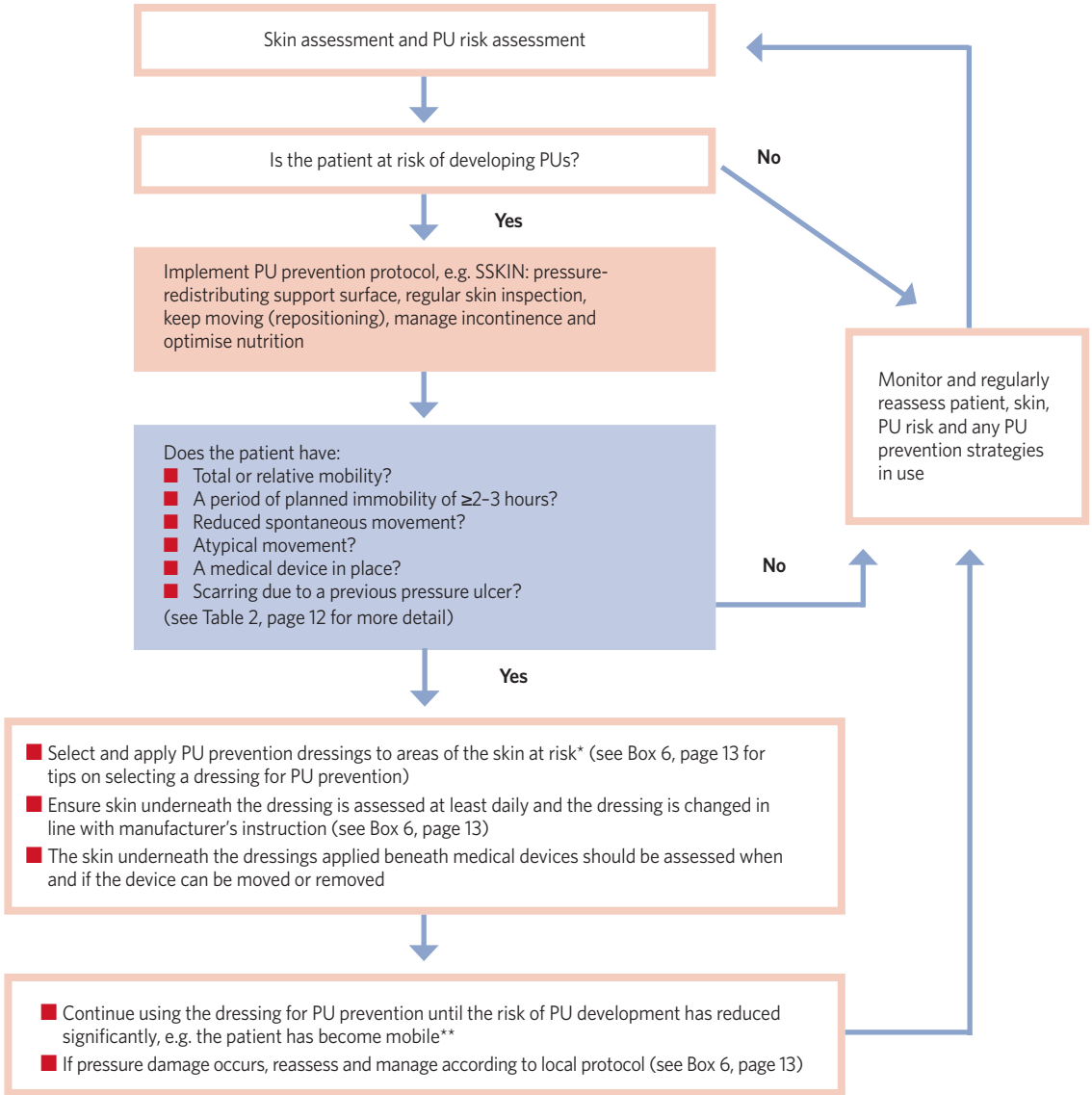
device and increasing pressure on the skin below. Film dressings may be useful when friction is a particular problem[68]; foam dressings may reduce pressure and absorb moisture[14].

**EVIDENCE**

Several types of dressing for PU prevention have been evaluated in a range of different types of clinical studies (Table 3, page 15). Studies have evaluated the impact of dressings on the occurrence of PUs at a range of anatomical sites, and others have examined the impact on medical device-related PUs.

Many of the studies have been conducted in critically ill patients in emergency departments or intensive care units (ICUs). Dressing types that have been evaluated include foams, hydrocolloids and polyurethane films[1,2]. The sacrum and heels have been the sites most commonly investigated.

**Figure 4 | Algorithm for the use of dressings for PU prevention**




*Body sites on which dressings for PU prevention have been investigated include sacrum, heels and trochanters. However, application of a suitable dressing to another anatomical site at risk of pressure damage may be considered

**N.B According to patient risk and local protocol, other PU prevention strategies should be continued when the dressing is discontinued

## Table 3 | Clinical studies of dressings in PU prevention

| Healthcare setting | Dressing(s) | Anatomical site | Reference | Study design | Key outcomes |
|---|---|---|---|---|---|
| **Randomised controlled trials** | | | | | |
| ED/ICU | Soft silicone foam* | Sacrum<br>Heels | Santamaria et al, 2015[15] | RCT (n=440): dressing to sacrum and heels plus standard PU prevention vs standard PU prevention | Overall, fewer patients developed a PU in the dressing group: 3.1% vs 13.1%; (p=0.001)<br>Number needed to treat =10<br>Fewer heel (3.1% vs 12.5%; p=0.002) and sacral (1.2% vs 5.2%; p=0.05) PUs developed in the foam dressing group |
| ICU, CCU, medical ward | Hydrocolloid or polyurethane film | Sacrum and trochanters | Dutra et al, 2015[77] | RCT (n=160): hydrocolloid vs film | Incidence of PUs was significantly lower in the film group (8.7%) than in the hydrocolloid group (15%) (p=0.038) |
| ICU | Soft silicone foam* | Sacrum | Kalowes et al, 2012[76] | RCT (n=367): dressing plus standard PU prevention vs standard PU prevention | PU incidence was significantly lower in the group that received the dressing: 1/184 vs 7/183; p=0.001 |
| Surgical ICU | Soft silicone foam or hydrocolloid | Sacrococcygeal area | Tsao et al, 2013[78] | RCT (n=90): hydrocolloid vs foam vs standard care | Incidence of PUs was lowest in the foam group (0%): hydrocolloid group 13.3%; standard care 23.3% |
| OR | Composite polyurethane film/ foam | Areas at risk during posterior spinal surgery | Han et al, 2011[79] | RCT (n=100): dressing versus standard care | At endpoint (72 hours) significantly fewer patients in the dressing group had developed a PU vs the standard care group (p=0.05) |
| Acute care | Soft silicone foam with or without border* | Sacrum, hip and heels | Qiuli & Qiongyu, 2010[80] | RCT (n=52): dressing plus standard PU prevention vs standard PU prevention | Incidence of PUs was lower in dressing group: 0% (0/26) vs 11.5% (3/26) |
| Nursing homes and primary care | Hydrocellular or gauze dressing | Heels | Torra i Bou et al, 2009[81] | RCT (n=130): dressing was applied randomly to one trochanter; the other was the control | Incidence of PUs was lower in the hydrocellular group (3% vs 44%; p<0.001) |
| Geriatric hospital | Composite hydrocolloid/ film/ nylon fibre | Trochanter | Nakagami et al, 2007[82] | RCT (n=37): dressing was applied randomly to one trochanter; the other trochanter was the control | Incidence of persistent erythema was significantly lower on the dressing side (p=0.007); no PUs occurred on either side |
| **Non-randomised trials** | | | | | |
| ICU | Soft silicone foam* | Heels | Santamaria et al, 2015[83] | Non-randomised (n=191): dressing vs historical control of standard PU preventive care | Incidence of PUs was significantly lower in the dressing group: 0% vs 9.2% (p<0.001) |
| ICU | Soft silicone foam* | Sacrum | Park, 2014[84] | Non-randomised (n=102): dressing plus standard care vs standard care | Incidence of PUs was significantly lower in dressing group: 6% vs 46% (p<0.001) |
| ED/ICU | Soft silicone foam* | Sacrum | Brindle & Wegelin, 2012[85] | Non-randomised (n=100); dressing plus standard PU prevention vs standard PU prevention | Fewer PUs developed in the dressing group than did in the control group: 2% vs 11.4% (p=0.058) |
| ICU | Soft silicone foam* | Sacrum | Chaiken, 2012[86] | Non-randomised (n=273): dressing vs historical control of previous care (n=291) | Sacral PU prevalence before study: 12.3%<br>PU incidence during study: 1.8% |
| ICU | Soft silicone foam* | Sacrum | Walsh et al, 2012[87] | Non-randomised (n=62): dressing vs historical control of previous care | PU incidence was lower after introduction of the dressing: 12.5% vs 4.8% |
| ED/medical ward | Soft silicone foam* | Sacrum | Cubit et al, 2012[88] | Non-randomised (n=109): dressing vs historical control of previous care | PU incidence was lower in dressing group (1/51 vs 6/58); the historical controls were 5.4 times more likely to develop a PU than the dressing group |
| Medical and surgical ICUs/other units | Soft silicone foam* | Sacrococcygeal region | Koerner et al, 2011[89] | Non-randomised prospective (n=not stated): phase I in ICUs; phase II following patients in rest of hospital | Phase I 0% incidence of PUs; previously 20% surgical ICU and 40% medical ICU |
| Cardiovascular ICU/ Critical Care unit | Soft silicone foam* | Sacrum | Cano et al, 2011[90] | Non-randomised (n=166) | Only one patient developed a sacral PU. This was reduction compared with PU rates prior to the study |
| ICU | Soft silicone foam* | Sacrum | Brindle, 2009[91] | Non-randomised (n=93): dressing plus standard PU prevention vs standard PU prevention | PU incidence was lower in dressing group (0% vs 6%) |
| *Mepilex Border Sacrum (5 layer) or Mepilex Heel (3 layer) as appropriate for anatomical site | | | | | |
| **Medical devices** | | | | | |
| Paediatric hospital | Foam dressing (Mepilex Ag) | Tracheostomy sites | Kuo et al, 2013[92] | Retrospective study (n=134): dressing vs no dressing | No skin breakdown occurred in the dressing group (0/41) vs 11/93 (11.8%) in the control group (p=0.02) |
| Paediatric ICU | Thin foam dressing (Mepilex Lite) | Tracheostomy sites | Boesch et al, 2012[93] | Non-randomised with historical controls (n=834) | PU incidence was lower after introduction of a PU prevention bundle that included the foam dressing: 0.3% vs 8.1% |
| Respiratory ward | Soft silicone foam dressing (Mepilex) or hydrocolloid | Face | Hsu et al, 2011[94] | Non-randomised (n=30): standard care plus foam or hydrocolloid vs standard care alone | PU incidence was lowest in the foam dressing group: 0/13 foam dressing; 2/11 control group; 4/6 hydrocolloid group |
| Not stated | Soft silicone foam (Mepilex) plus standard PU preventive measures | Face under non-invasive positive pressure ventilator masks | Hsu et al, 2010[95] | Non-randomised (n= not stated): foam vs previous care (hydrocolloid) | PU incidence was lower in foam group vs historical group: 0.9% vs 5.9% |
| OR | Soft liner with hydrocolloid | Nose – nasotracheal intubation | Huang et al, 2009[96] | Non-randomised (n=18): dressings vs no dressings | 40% of patients in the dressing group did not develop a PU; all of the patients in the control group developed a PU |
| Medical and cardiac ICUs | Hydrocolloid or polyurethane film | Face – non-invasive positive pressure ventilation masks | Weng, 2008[97] | Non-randomised (n=90): hydrocolloid vs film vs standard care | PU incidence was significantly lower in the hydrocolloid and film groups than in the control group (p<0.01) |

Abbreviations ED: emergency department; CCU: coronary care unit; ICU: intensive care unit; OR: operating room; RCT: randomised controlled trial

Two systematic reviews of the use of dressings for PU prevention have been published[1,2]. The analysis in the first review, published in 2013, found that in comparison with no dressing, dressings applied over bony prominences reduced pressure ulcer incidence ($p<0.001$). However, concerns over the quality of the studies that were included in the analysis prompted the authors to highlight the need for further well-designed trials[1]. A subsequent review published in 2014, concluded that the introduction of a dressing as part of PU prevention may help to reduce PU incidence associated with medical devices and in immobile ICU patients[2].

The largest randomised controlled trial to date (n=440) concluded that multi-layered soft silicone foam dressings significantly reduced the incidence of sacral and heel PUs when they were applied to critically ill or trauma patients on arrival in the emergency department and were continued on transfer to the intensive care unit[15] (Table 3, page 15).

Few clinical studies have compared directly the effectiveness of dressings of different compositions and constructions for PU prevention, and there is no clear evidence of greater effectiveness of one particular dressing over another[2]. The largest randomised controlled trials of the use of dressings in prevention showed a significant reduction in PU incidence with the use of a multilayered soft silicone foam dressing on the sacrum and heels[15,76] (Table 3, page 15).

## COST EFFECTIVENESS

Analysis of the cost benefits of a healthcare intervention is complicated because of the extensive range of costs and benefits that may be included and the wide variety of different types of analysis that can be performed[98].

As yet, few publications explore the cost implications of PU prevention with dressings. A study of the use of a hydrocellular dressing in comparison with a protective bandage in the prevention of heel PUs in community settings calculated the costs of nursing time. The study found that the hydrocellular dressing was more effective in preventing PUs (PU incidence 3.3% vs 44%; $p<0.001$) and was associated with lower costs for dressing changes in comparison with the protective bandage (Can$12.24 vs Can$86.77)[81].

**'An alternative approach to cost arguments in making the case for the implementation of dressings for PU prevention may be using reductions in PU occurrence to uphold the reputation of a healthcare institution, e.g. by avoiding litigation for PUs and achieving high standing in healthcare standards league tables'**

A three-month study in 58 patients of the use of a soft silicone dressing to prevent sacral PUs in critical care units and operating rooms, had a zero incidence of sacral PUs. The authors calculated that the total cost of implementing the dressing during that time was US$21,590, approximately half of the cost of treating one PU[99].

Similarly, a study of the use of a soft silicone dressing to prevent sacral PUs predicted that the statistically significant reduction in PU incidence seen would translate to a saving of $325,000 for the investigators' hospital system[100].

Another cost analysis has been conducted using the results of a large randomised controlled trial in Australia of a multilayered soft silicone foam in critically ill and trauma patients in the emergency department and ICU. The dressing produced a significant reduction in the incidence of sacral and heel PUs[101].

Cost analysis using an intention-to-treat approach found that the dressing was associated with cost savings in the hospital (average cost of using the dressing and using standard PU prevention alone: Au$70.82 vs Au$144.56)[101].

Further analysis using the results of the study concluded that use of a multilayered soft silicone dressing could produce an annual saving to the Australian healthcare system of Au$34.8 million[102]. However, the compartmentalisation of healthcare budgets may limit the impact of cost savings as an argument for adoption of a new clinical practice such as the use of dressings for the prevention of PUs.

### Box 7 | Using change management for the inclusion of dressings in a PU prevention protocol

**Creating the climate for change**

- Form a **multidisciplinary lead team** to drive inclusion of appropriate dressings for PU prevention into local PU protocols
- Collect **baseline data** to establish a clear understanding of prevalence and incidence of PUs at the facility and within individual departments
- Use these data to estimate **costs**
- If not in place, devise and institute a system for **ongoing data** collection using clearly defined outcomes
- Conduct a root cause analysis* to determine where and when PUs are starting
- Achieve **'buy in'** and engagement by and collaboration with key administrators and key members of departments involved, e.g. emergency departments, operating rooms, intensive care units, acute medical wards, by **communicating** the:
  - Local problem with PUs — scale and cost
  - Evidence for the use of dressings to prevent PUs
  - Place of dressings in the prevention of PUs in local PU prevention protocols
  - Expected clinical and financial benefits of implementing the suggested changes
- **Adapt** local PU prevention protocols to include dressings for PU prevention as appropriate
- Ensure **availability** of dressings at potential points of use

**Engaging and enabling**

- Devise and deliver **education/training** for healthcare payers, clinicians, and patients and families/carers to ensure **engagement** at all levels, e.g. as appropriate: face-to-face sessions, information leaflets, educational posters, practical training on dressing use and application, online resources

**Implementing and sustaining**

- **Implement** new protocol
- Collect **data** on adherence to protocol and prevalence/incidence of PUs, and conduct a root cause analysis:
  - Report results regularly, e.g. monthly, to administrators and clinical departments/clinicians
  - Compare results with baseline data to establish what changes have occurred
- Collect **feedback**
- Implement **changes** as necessary

**Tools**

http://www.nice.org.uk/guidance/cg179/resources
http://www.ihi.org/resources/Pages/Tools/default.aspx

*Root cause analysis — a technique used to investigate why an event has occurred, e.g. to determine what contributed to the development of an individual PU by examining the events preceding PU development[108,109]

## IMPLEMENTATION AND CHANGING PRACTICE

Successful integration of a new intervention, such as the use of a dressing for prevention of PUs, into clinical practice is dependent on a wide variety of factors. These include organisational, educational, behavioural and logistical factors that will be individual to each healthcare setting. Even so, there are a number of key principles involved in successful implementation of a new intervention.

Many of these key principles have been identified in models of change management (Appendix 3, page 20) and can be divided into three broad categories:

- Creating the climate for change
- Engaging and enabling
- Implementing and sustaining.

The Institute for Health Improvement (IHI) has developed a specific model for change for healthcare organisations (Appendix 3, page 20). The model involves collaboration between different healthcare settings and using a series of testing cycles employing the PDSA (plan, do, study (check), act) process to refine the planned changes[103].

Box 7 (page 17) describes steps that could be taken to implement changes to local protocols to incorporate the use of dressings for PU prevention. It includes links to tools available online to help. A multidisciplinary approach is important in gaining support for changes and in ensuring effective implementation[104].

**'An important message to convey to everyone involved is that the use of dressings for PU prevention does not replace existing PU protocols: when indicated, dressings are used in addition to standard PU prevention measures[105]'**

## FUTURE RESEARCH NEEDS

Evaluation of changes made to practice in PU prevention is essential for ongoing refinement and development of PU prevention protocols, and requires ongoing data collection to measure clearly defined outcomes[104,106,107].

Research into the effects of dressings used for PU prevention is ongoing. Box 8 lists some particular research needs, including the development of international standards for laboratory tests and reporting, and development of methods and instruments which detect early changes in the skin and soft tissues.

**Box 8 | Future research**

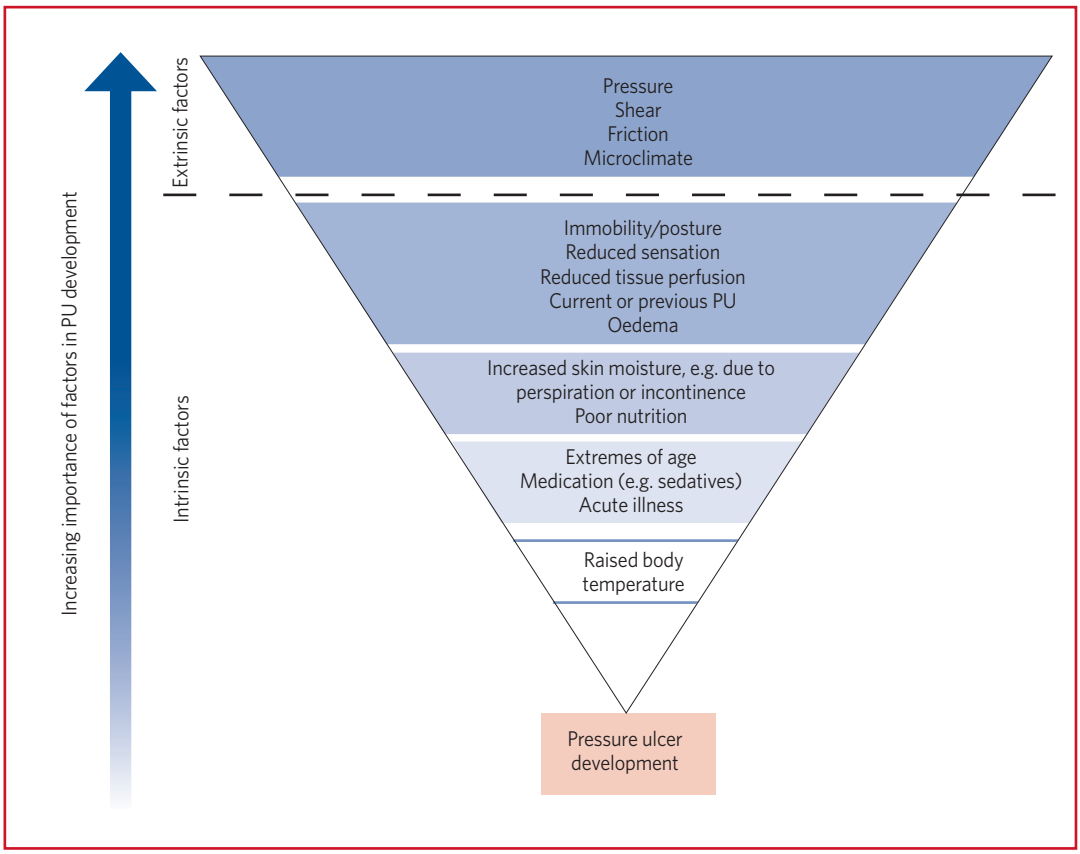
- Effect of different dressing materials and constructions on pressure, shear, friction and microclimate
- Impact of different types of dressing used for PU prevention on occurrence of PUs in different healthcare settings, patient populations and anatomical locations, e.g. comparison of heel dressings and heel offloading devices
- Development of international standards for laboratory tests and reporting for the effects of dressings used for PU prevention on pressure, shear, friction and microclimate
- Development of methods and instruments which detect early changes in the skin and soft tissues that indicate pressure damage is likely to occur.

## APPENDIX 1 Examples of potential contributors to variations in PU prevalence and incidence[12,40,41]

When comparing prevalence and incidence of PUs, a number of factors other than true differences should be considered as potential contributors to apparent variations in occurrence. For example:

- **Study population:**
  - Are the healthcare setting and patient characteristics (such as patient types, inclusion/exclusion criteria, comorbidities, PU risk) comparable?
- **Terminology:**
  - What terminology was used around PUs (Box 1, page 4)?
  - Might variations in terminology have hindered identification of all occurrences?
- **Definitions and classification of PUs:**
  - What definition/classification system was used?
  - Were 'non-blanchable erythema' (Category/Stage I PU), deep tissue injuries or 'unstageable' PUs included or excluded?
  - Were medical device-related PUs included or excluded?
- **Methods used to identify the presence of a PU:**
  - Were data collected by trained clinical assessors for the purpose of the study or as part of routine care by clinicians working in the setting, or were they extracted by non-clinicians from medical records or administrative databases?
  - Extraction from medical records may result in underestimation of occurrence if PUs were not recorded in or identifiable from medical records
- **Accuracy of identification of PUs:**
  - Were Category/Stage I/II PUs accurately distinguished from lesions such as incontinence-associated dermatitis?
- **Methods used to calculate the rate:**
  - Were existing and/or newly occurring PUs counted? What was the time period of the data collection?

## APPENDIX 2 Extrinsic and intrinsic factors in PU development (adapted from[12,43,56])



## APPENDIX 3 Some models of change management

| Lewin[110] | Kotter[111] | FOCUS PDC(S)A[112] | IHI Collaborative Model[103] |
|---|---|---|---|
| **Creating the climate for change** | | | |
| Unfreeze<br>■ What is the current state? | ■ Create a sense of urgency<br>■ Build a guiding coalition<br>■ Form a strategic vision and initiatives | ■ Find an opportunity<br>■ Organise a team<br>■ Clarify current knowledge<br>■ Understand causes of variation<br>■ Select the strategy | ■ Topic selection by leaders<br>■ Recruit experts<br>■ Enrol organisations and teams<br>■ Learning sessions involving several organisations — including vision/ change package/feedback |
| **Engaging and enabling** | | | |
| Change<br>■ What do we need to do to improve? | ■ Enlist (communicate the vision)<br>■ Enable action by removing barriers<br>■ Generate short-term wins | ■ **Plan** the improvement | ■ Testing cycles x 3 (between learning sessions) — test changes and collect data; build collaboration between organisations |
| **Implementing and sustaining** | | | |
| Refreeze<br>■ How can action and improvement be embedded and sustained? | ■ Sustain acceleration<br>■ Institute change | ■ **Do**<br>- Implement<br>■ **Check** (Study)<br>– Collect data for process improvement<br>■ **Act**<br>– To hold gain and continue improvement | ■ Refine and apply changes<br>■ Collect data |

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NOTES

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