The Role of Support Surfaces in Pressure Ulcer Prevention and Treatment

A Clinical Resource

- Pressure ulcers occur as a result of tissue being exposed to prolonged pressure or pressure associated with shear. They may be superficial injuries affecting the epidermis and dermis or they can extend into the subcutaneous tissues and involve muscle, tendon and bone.
- Pressure ulcers typically occur over bony prominences with the lower trunk (sacrum, coccyx, trochanter and ischial tuberosities) and heels being the two most common anatomical locations.
- Up to one in five acute care patients presents with a pressure ulcer and the cost of pressure ulcers on healthcare budgets at a national level runs into billions of dollars, pounds or euros.
- The dominant risk factor for pressure ulcer development is immobility. In simplistic terms, and with the exception of certain specific patient cohorts, the majority of patients are unlikely to develop pressure ulcers if they are mobile.
- The use of active (alternating) and reactive (constant lower pressure) support surfaces can help manage the pressure applied to the patient and depending upon the individual needs of the patient these support surfaces can in some instances help reduce the frequency of manual repositioning.
- Talley offer a comprehensive range of both active and reactive support surfaces for bed and chair. These surfaces incorporate unique design features that deliver efficient pressure relief/redistribution while addressing other essential clinical needs such as patient comfort and microclimate management.
- The quality, reliability and efficacy offered by Talley products is supported by clinical papers and customer testimonials.

Talley

Welcome to the clinical world of Talley

Dear Reader

Since our origin in 1953 there have been many significant changes in the global healthcare industry however, the application of pressure, with or without shear, remains the principal cause of pressure ulcers.

Effectively managing the pressure applied to patients forms the cornerstone of pressure ulcer prevention and treatment care protocols and this requirement continues to drive the research and development of the comprehensive range of patient support surfaces that we manufacture today.

This clinical resource is written to help educate and inform anyone with an interest in the world of tissue viability and who wants learn more about patient support surfaces and the role they play in pressure ulcer prevention and treatment. The aim is for the reader to gain a greater understanding of how the design principles of Talley mattresses and cushions relate to individual clinical goals and patient needs.

Whether you are new to the field of tissue viability or an experienced wound care specialists this resource is designed to improve your knowledge and understanding of this key clinical area with the ultimate aim being to help you understand how Talley products can help you and your patients achieve optimal clinical outcomes.

We hope you find this resource useful and would be very happy to have one of our clinical specialists answer any questions you may have.

Please feel free to contact us through your local representative or via email at www.talleygroup.com

Chris Evans and John Evans
Directors

An introduction to pressure ulcers

What is a pressure ulcer?

Pressure ulcers are commonly encountered injuries that develop when tissue is subjected to prolonged pressure or pressure associated with shear.[1] Pressure ulcers are categorised by their severity and may be limited to the superficial tissues of the epidermis and dermis, or extend to deeper tissue exposing and/or involving muscle, tendon and bone (see Figure 1). They are often located over a bony prominence.

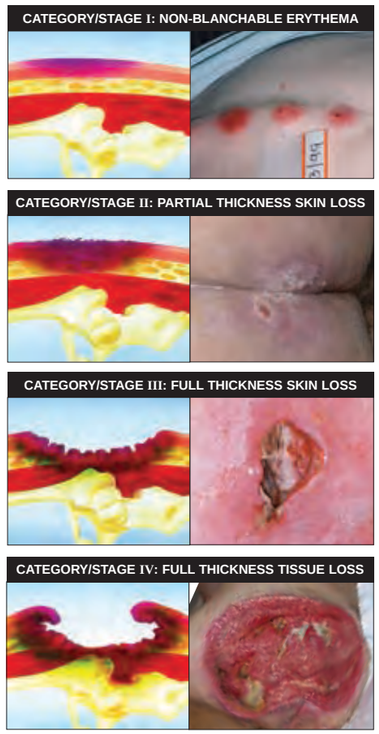


FIGURE 1.
An adaptation of the globally recognised pressure ulcer classification scale published by the EPUAP / NPUAP [1]

Pressure ulcer severity is not always immediately apparent, for example some pressure ulcers may originate within the deep tissue beneath intact skin (deep tissue injury). For others, the wound bed may be obscured from view by slough, eschar or undermining of the wound; these wounds are reported as unstageable until such time as the wound bed becomes visible.[1]

While staging or categorising pressure ulcers is not always straightforward it is important when communicating the status of a wound, measuring and reporting the quality of treatment interventions and, ultimately, calculating the probable treatment cost. Figure 1 represents an adaptation of the globally recognised pressure ulcer classification scale published by the EPUAP / NPUAP in 2009.[1]

Which anatomical locations are most frequently affected?

The most common anatomical location for a pressure ulcer is over the bony structures of the lower trunk which includes the sacrum, coccyx, trochanter and ischial tuberosities (see Figure 2). The heel is the second most prevalent site and accounts for some of the most severe injuries. Heel ulcers are often complicated by underlying vascular disease of the limb.[2] Almost half of all deep tissue injuries can be found on the heel [3] and the rate of subsequent amputation may be as high as 42%.[4] Although numbers vary by clinical speciality, these two anatomical locations typically account for the majority of pressure ulcers and therefore represent an important focus for preventative care.

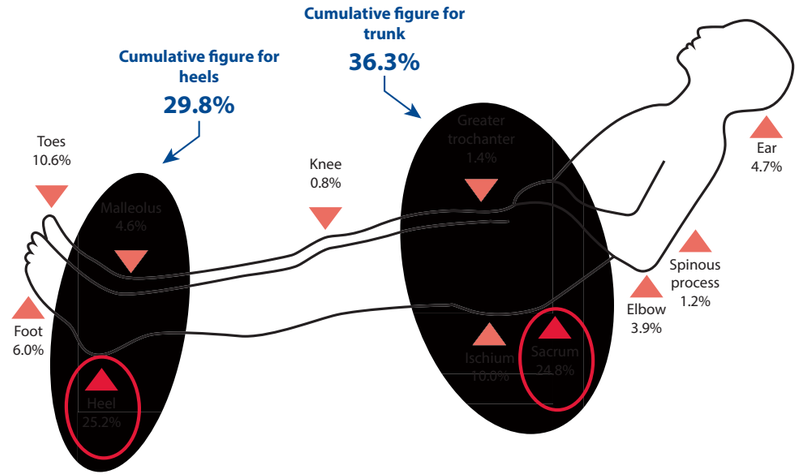


FIGURE 2.
Illustration of the key anatomical locations associated with the development of pressure ulcers

Tissue damage can occur in virtually any anatomical location exposed to prolonged periods of pressure and the risk of pressure ulceration is no respecter of age, gender or ethnicity as these wounds can affect anyone from the very young or temporarily incapacitated to the very old and infirm.

In addition to the risk posed to patients when lying or sitting, clinicians are increasingly aware of the pressure ulcer risk associated with medical equipment such as splints, traction, respiratory support [5] and anti-embolic stockings.[6] Current literature estimates that patients with a supplementary medical device may be up to 2.4 times more likely to develop a pressure related injury than those without.[7]

Prevalence

While there is a clear definition for pressure ulcer prevalence, differences in the way it is measured and reported make meaningful comparisons between regions or countries impossible.[8] In spite of this variation in pressure ulcer prevalence methodology the data from unrelated studies undertaken across acute and community healthcare environments in the last decade clearly show that prevalence frequently runs into double figures, with up to one in every five acute care patients presenting with a pressure ulcer.[3, 9, 10, 11, 12] See Figure 3.

Prevalence:
The percentage of people in a given population with a pressure ulcer at any one moment in time.

Incidence:
The number of persons who develop a new pressure ulcer, within a particular time period in a particular population.

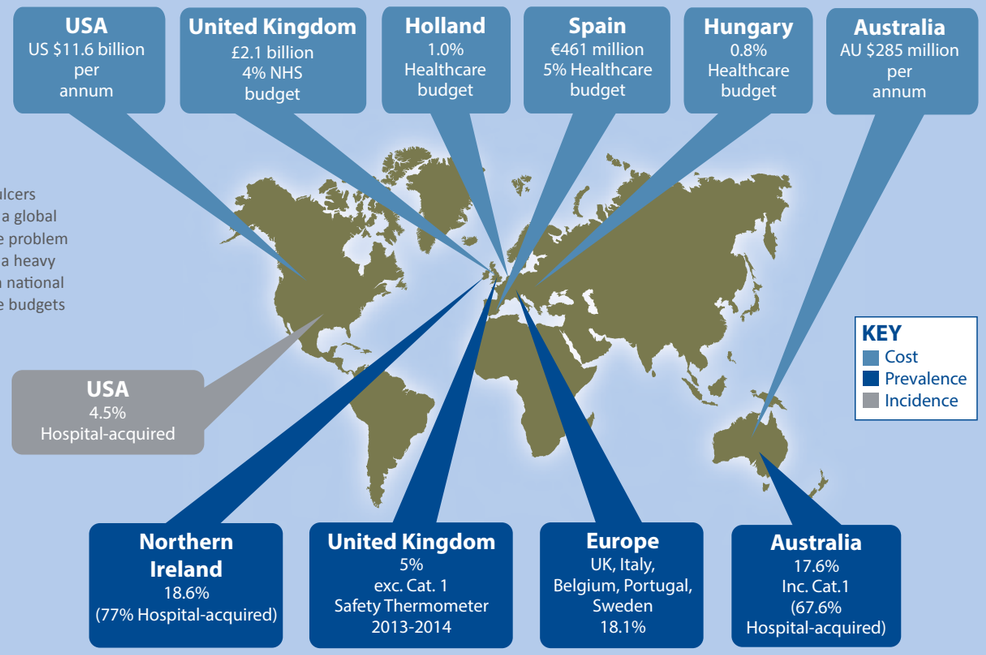


FIGURE 3.
Pressure ulcers represent a global healthcare problem and place a heavy burden on national healthcare budgets

Healthcare-acquired pressure ulcers

A measurable proportion of all pressure ulcers encountered will develop under clinical supervision and these are referred to as healthcare-acquired pressure ulcers.[13, 14, 15] A high proportion of these may be considered to be an unwelcome adverse event or 'medical error' that, in more than 90% of cases, could probably be avoided with reasonable care.[16] Unfortunately, investigations reveal that care frequently falls below a minimum standard.[11, 14, 17] For example, one study across five European countries showed less than 10% of patients received a complete care package, while an examination of more than 400,000 legal cases in the USA determined that 90% of nosocomial pressure ulcers might have been avoided.[16] In some parts of Australia, more than two-thirds of all ulcers occur during an episode of care, despite more than 6-years of focussed effort.[18]

The UK faces similar challenges to other countries, with self-reported pressure ulcer data from the NHS Safety Thermometer (2013-2014) showing that, on average across the year, 30,500 patients (5%) suffered pressure ulcers (category 2-4) with 25% of these occurring more than 72 hours after admission.

Unfortunately, pressure ulcers continue to be a challenge and represent a significant economic and humanitarian burden globally (Figure 3), not only affecting healthcare providers and patients, but also impacting wider society.

The economic impact of pressure ulcers

Relatively few economic studies have been published in the past decade, leaving healthcare systems, particularly those that operate within budgetary 'silos', unable to determine an absolute cost of caring for a patient with a pressure ulcer. As an injured patient will typically cross several departmental boundaries during the course of treatment, and frequently move from primary to secondary care or vice versa, it is difficult to track expenditure on a macro level. However, it is clear that patients with pressure ulcers are more likely to be admitted or readmitted to hospital, remain as an inpatient for longer [19, 20] and are more likely to die.[21]

Given the lack of robust data, financial planning tends to be tackled by calculating the cost of treating an individual wound type, followed by extrapolation to factor in the population density of people affected and the probability of healing. By 2004, the UK was believed to be spending up to 4% of the National Health Service budget on pressure ulcers.[22] A second review, in 2012, predicts that this will increase further as the population ages and more advanced treatments become available with a mid-sized facility (NHS Trust) spending up to £3.6 million per annum.[20]

Aside from the 'hospital bed' and 'lost opportunity' costs, the financial burden is largely attributed to providing nursing interventions along with both the diagnosis and treatment of wound complications.[20] A severe pressure ulcer with complications can cost more than £40,000 in the UK [20] (see Table 1) and almost US$130,000 in the USA.[23]

Surprisingly, the cost of pressure-redistributing support surfaces and equipment, antibiotics and dressings for prevention and treatment accounts for just 3.3% of the overall cost, [20] a finding that supports investment in prevention as the basis of a sound economic model.

As healthcare demand increasingly outstrips funding, many countries have a renewed interest in tackling pressure ulcers and have prevention high on the quality agenda. In the UK for example, the implementation of effective prevention strategies, which lead to improved outcomes, are rewarded and reinforced by financial incentives through the Committee for Quality and Innovation (CQUIN) programme.[24] Investment has also been directed towards updating national (NICE) and international (EPUAP-NPUAP) best practice guidelines during 2014.

TABLE 1.
The economic impact of pressure ulcers

PRESSURE ULCER CATEGORY / STAGE	LOWEST COST PER EPISODE	HIGHEST COST PER EPISODE	MEAN COST PER PATIENT
	Normal healing	Additional complications (infection; cellulitis; osteomyelitis)	All costs based on probability of complications occurring (costs are ± 10%)
Category / Stage I	£1,214	N/A	£1,335
Category / Stage II	£4,399	£35,850	£5,766
Category / Stage III	£7,233	£38,684	£9,945
Category / Stage IV	£8,783	£38,684	£15,519

The patient and their family

Pressure ulcers also have a considerable impact on the patient and their family, not least the indirect costs of providing informal care and support.[25] Even in their mildest form, pressure ulcers cause clear anxiety and distress, [26] with almost half of patients reporting pain as a notable symptom even where the skin remains intact.[27]

As pressure ulcer severity increases a patient's quality of life falls [28] and they may experience social isolation, prolonged ill health and endure repeated hospital admissions. In the worst case, patients may lose a limb [29] or succumb to overwhelming sepsis or organ failure and die as a result. Pressure ulcer associated deaths affect many patients and their families each year with the US reporting several thousand patients dying annually in this way.[30]

Sadly pressure ulcers are still frequently encountered and despite a clear understanding of aetiology and greater access to effective prevention strategies, pressure ulcers remain a major cause of morbidity and mortality.[31] Whilst this is particularly true for people with impaired sensation, prolonged immobility, or advanced age it is important to remember that these injuries can happen to anyone. Babies, children and new mothers can suffer pressure ulcers, as can patients with few risk factors but subject to prolonged pressure from a medical device such as an anti-embolic stocking, [6] traction device or splint.

Pathophysiology of pressure ulcers

Pressure ulcers occur as a result of living tissue being exposed to an applied 'force' or pressure for a prolonged period of time. In addition to pressure, shear forces may or may not be present. Historically friction was believed to play a direct part in pressure ulcer development and while still important for tissue integrity, friction is no longer considered part of the primary pathology of pressure ulcers.[1]

The accepted model for pressure ulcer development recognises the importance of two interdependent pathways [1] (see Figure 4). One pathway considers 'mechanical loading' which, in essence, relates to the amount, duration and direction of pressure applied to the tissues; the other pathway relates to factors that influence 'tissue tolerance' or the ability to withstand the applied load.

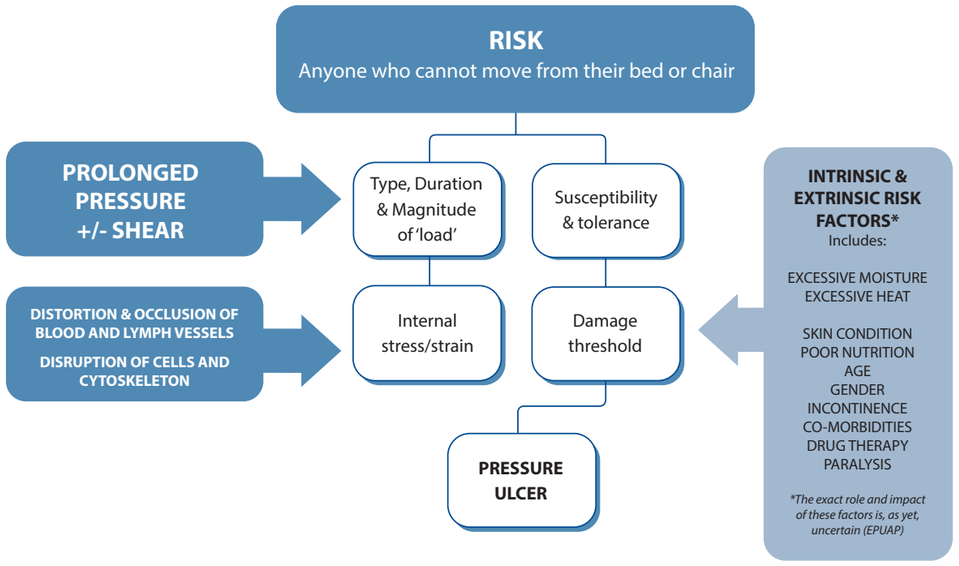


FIGURE 4.
An illustration of the two interdependent pathways involved in pressure ulcer development (adapted from EPUAP)

The pathway related to mechanical loading is where patient support surfaces can have the greatest impact on outcomes.

The impact of pressure and shear

Pressure can theoretically be an entirely perpendicular force however, due to skeletal anatomy and the inherent flexibility of soft tissues, there is almost always an element of lateral displacement creating additional shear forces in the tissues overlying bony prominences. The effects of shear may be most noticeable during postural change when skin is held in close contact with a surface that has a high friction coefficient. Factors such as a high backrest elevation, lack of an appropriate knee break or incorrect chair height, causes weight to shift forward, displacing internal structures in relation to the outer surface of the skin (see Figure 5 for a diagrammatic representation of this).

As pressure is applied to the skin surface (for example as a patient sits on a cushion or lies in bed), tissue lying directly between the body structures and external surface will be squeezed (compression stress), while adjacent structures will be distorted (shear stress) and stretched (tensile stress) (see Figure 6). This combination of compression (pressure), distortion (shear) and stretching reduces fluid flow in the blood and lymph vessels. This reduction in blood flow reduces the oxygen and nutrients being delivered into the tissue whilst simultaneously reducing the removal of metabolic waste products from the tissues. A reduction in lymph flow slows the removal of excess interstitial fluid and proteins from the tissues.

When shear factors predominate, the pressure required to occlude the circulation can be up to 50% lower than the force required with lower levels of shear [32] hence the importance of managing both pressure and shear forces when considering pressure ulcer prevention.

In addition to the impact on circulation, high levels of shear can also have a direct and destructive effect on individual cells and their cytoskeleton.[33] The degree of tissue distortion may be most noticeable where a steep gradient occurs between adjacent areas of high and low pressure. This is most likely to occur when sitting or lying on an unyielding surface that does not conform to, or envelop, the body for example where the sacrum or heels rest on tightly stretched sheets.[34, 35]

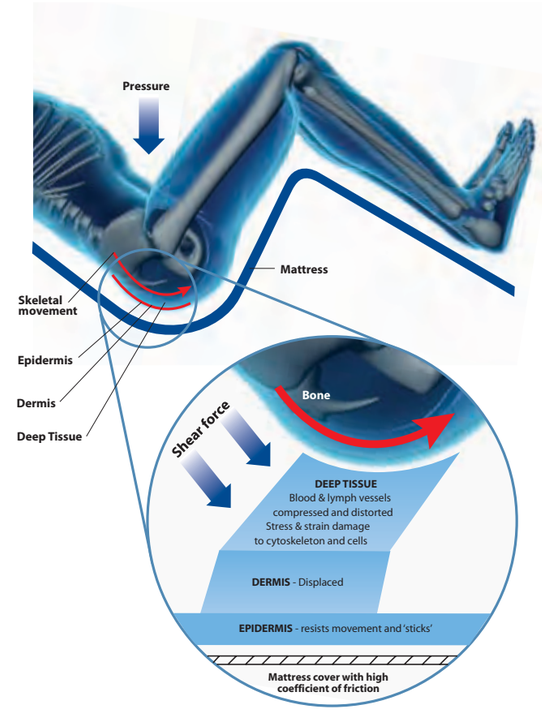


FIGURE 5.
A schematic diagram to illustrate how shear forces occur in deeper tissues

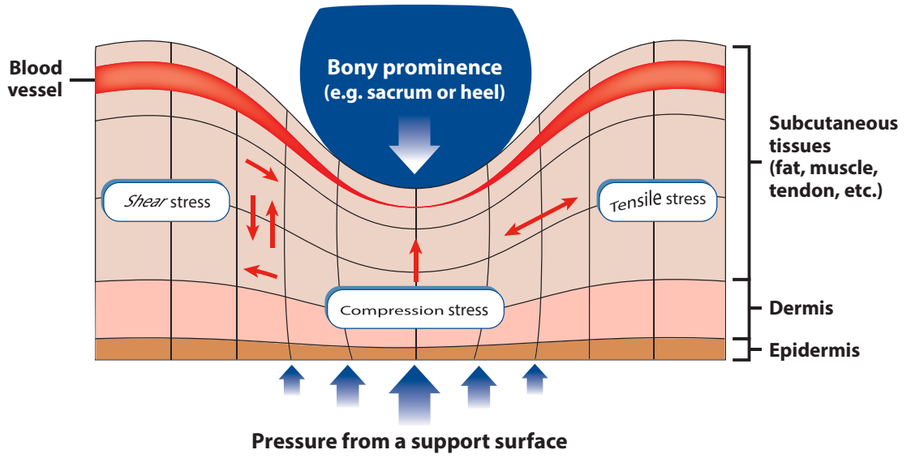


FIGURE 6.
A schematic illustration to highlight how pressure applied over a bony prominence can result in multiple stresses within the tissue which can compromise the local blood supply

FIGURE 7.
A schematic graph to demonstrate the original theory of the interplay between pressure and time (Reswick and Rogers) and the current theory based on more recent work

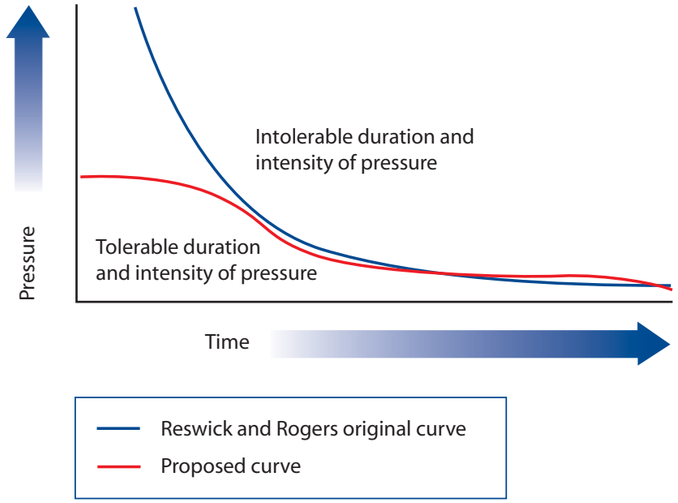
Steep pressure gradients can also be more noticeable to the patient. In addition to being uncomfortable some early mattresses with relatively high inflation pressures and rapid inflation-deflation pressure profiles were believed to increase the incidence of reflex spasm in susceptible patients and cause visible ridges in oedematous skin.[36] The use of different cell configurations, such as supporting the patient across three lower-pressure, partly immersible cells, whilst the fourth cell deflates, is thought to be advantageous. The benefit of increased support is to reduce lateral shear, improve comfort, [36] and lower the risk of spasm-induced friction damage.

Although not an absolute diagnostic indicator, a pressure ulcer that has developed under significant pressure and shear components may show clear signs of tissue displacement in the direction of travel and resultant undermining of the wound cavity.[37] This can provide relevant information for future care planning.

The importance of time in pressure ulcer development

Since both pressure and shear occlude essential blood and lymph vessels, time (i.e. duration of occlusion) becomes a critical factor in pressure ulcer development. The combined effect of hypoxia and the retention of toxic metabolites within the cell environment can cause irreversible damage. The application of constant, unrelieved pressure on the body can result in cell death and tissue necrosis in as little as 1 to 2 hours.[38, 39]

In addition, the very act of reperfusion after prolonged vessel occlusion may result in cellular damage. This is referred to as a 'reperfusion injury', however it is important to note that this effect relates to prolonged ischemia, which is typically in excess of 2 hours.[40] Therefore the relatively rapid cycle times of active patient support surfaces fall well within this accepted timespan and therefore pose no risk of reperfusion injury to patients.



Unfortunately, it is not possible to determine an absolute time threshold beyond which a patient will definitely develop or avoid a pressure related injury. The speed and severity of the onset of pressure ulceration varies between individuals and depends on a wide range of intrinsic and extrinsic risk factors (see Figure 4), many of which cannot be easily mitigated. However, the established principle is that tissue can withstand higher pressures for a short period of time and lower pressures for a longer period of time (Figure 7).[41] This interplay between pressure and time underpins the design characteristics of active (alternating) and reactive (constant lower pressure) support surfaces.

The impact of temperature and humidity

While the relative impact of many risk factors is uncertain, tissue 'microclimate' (temperature and humidity) is emerging as an important consideration in the avoidance of pressure ulcers.[1] A small, 1°C increase in temperature will raise the metabolic rate of cells [42] and is likely to induce a sweat response [43] at a time when blood supply may be limited by vessel occlusion. Excessive moisture can have a negative impact on tissue structure and function and render it more prone to damage from pressure, shear and friction.[44]

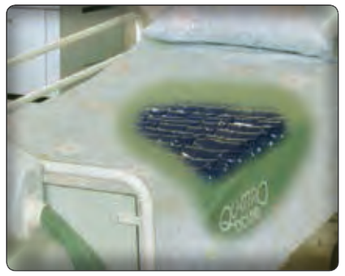
Conversely, hypothermia, when the core body temperature drops below 36°C, [45] provokes a systemic protective response that reduces blood flow to the skin. This reaction is particularly problematic for surgical patients where perioperative hypothermia leads to almost double the number of pressure ulcers [46] along with an associated delay in both the speed and quality of post-operative healing.[47] Maintaining core and local normothermia along with the provision of appropriate pressure area care are important clinical goals for the surgical patient.

Patient immobility and support surfaces

While additional risk factors such as skin condition, nutrition, incontinence, age, gender, comorbidities etc. are important, the dominant risk factor for pressure ulcer development is immobility. In simplistic terms patients do not develop pressure ulcers if they are mobile, irrespective of how many other risk factors they may exhibit. Being rendered immobile or insensate through disease, trauma, sedation or paralysis, diminishes the body's inherent protective mechanism of spontaneous movement and it is this lack of spontaneous movement which exposes the patient to the significant risk of pressure ulceration.

Lack of spontaneous movement means that the areas of the body in contact with a support surface will experience prolonged periods of unrelieved pressure (with or without shear). It is this prolonged exposure to unrelieved pressure which is a primary predictor of risk for all patients where mobility is limited or compromised for whatever reason.

The use of active (alternating) and reactive (constant lower pressure) support surfaces helps with the management of the pressure applied to the patient and may mean that in some instances it is possible to reduce the frequency of manual repositioning for patients with limited or compromised mobility.



Pressure ulcer prevention and treatment and the role of therapeutic support surfaces

When considering pressure ulcer prevention and treatment it is important to understand that while some risk factors, such as age, gender, incontinence and nutrition, may correlate with pressure ulcer development they are not necessarily causal and therefore they are likely to be less time critical for the patient. The most successful prevention and treatment protocols will be ones that address the primary pathology of pressure ulcers (pressure and shear) as rapidly as possible.[43]

The first step in pressure ulcer prevention and treatment is to reduce the patient's exposure to prolonged pressure and shear (see Figure 8). Once these key risk factors have been addressed, other aspects such as keeping the skin cool and dry, together with more complex risk factors such as nutrition, incontinence and perfusion, can be dealt with.

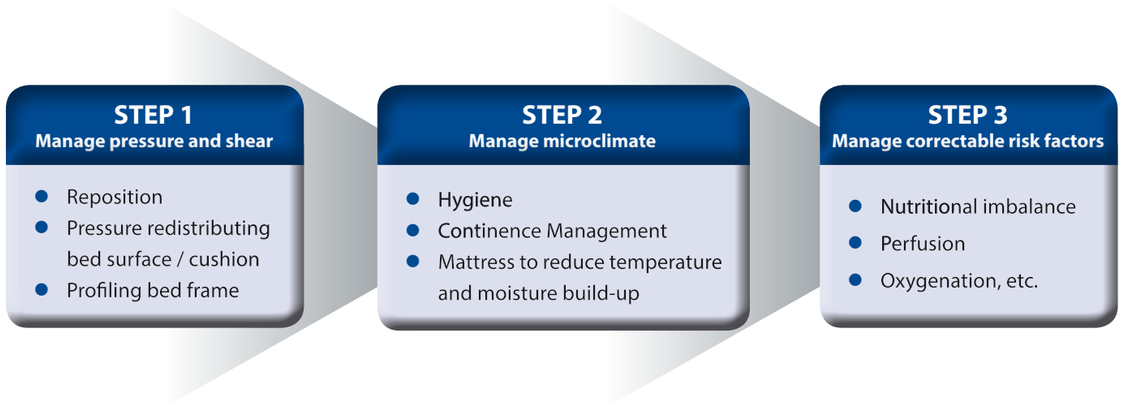


FIGURE 8.
A simplified three step approach to managing patients at an elevated risk of pressure related tissue damage. Step one addresses the primary pathology of pressure ulcers

How patients are protected from the effects of prolonged pressure will vary depending upon their level of mobility and any specific individual needs or requirements they may have. For semi-dependent patients with some mobility this is typically achieved by encouraging and supporting natural movement. Where patients are fully dependent they will be repositioned according to their assessed need and at a frequency which enables them to maintain their tissue integrity and remain free from pressure related damage. For most patients at an elevated risk of pressure damage a repositioning schedule based around 2-hourly intervals is a reasonable starting point.[34]

Repositioning needs to take into account the safety of the caregiver, the comfort and dignity of the patient and also the impact on the skin. Where possible appropriate aids should be used to avoid drag and shear forces.[1]

The role of therapeutic support surfaces

To enhance comfort, sleep and quality of life, repositioning intervals can often be extended by the use of specialised pressure-redistributing support surfaces.[48] These specialist support surfaces are primarily designed to provide an environment that enhances tissue perfusion.[1] In addition, some support surfaces can also assist in the management of microclimate at the interface between the patients skin and the support surface.

Support surfaces often play an essential role in modern day pressure ulcer prevention and treatment protocols around the world. However, whilst effective pressure redistribution is a key component of successful pressure ulcer prevention and treatment, using these products in isolation will neither prevent nor treat pressure ulcers. Support surfaces therefore represent just one part of an overall care package which must be implemented in order to reduce the risk of pressure associated tissue damage to patients. Important areas such as nutrition, continence and supplementary therapies fall beyond the scope of this clinical brochure and are comprehensively covered in numerous national and international guideline documents and consensus statements (e.g. NICE, EPUAP, NPUAP).

Understanding the differences between the various support surfaces and their differing modes of action is an important skill and enables you to provide the most appropriate support surface for your patients thereby meeting their clinical needs in terms of pressure area care.

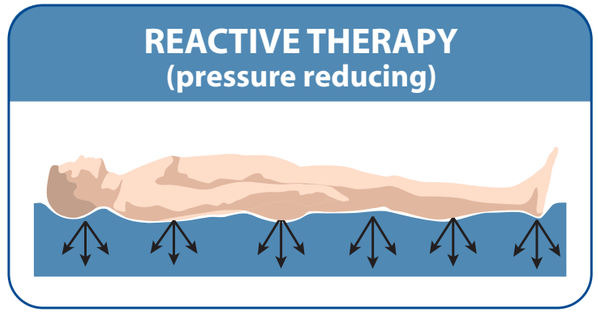
Support surface definitions

Since 2007, therapeutic support surfaces have been described as *'specialised devices designed for the management of tissue loads [pressure], microclimate and/or any other therapeutic function'*.[49] This definition applies to mattress replacements, mattress overlays and seat cushions.

Each of these support surfaces can be further defined by their primary mode of action into either 'active' (alternating) or 'reactive' (constant lower pressure) support surfaces.[49] Figure 9 illustrates how these surfaces work in principle with a more detailed explanation given over the page.

In addition to being 'active' or 'reactive' some surfaces also have other therapeutic functions such as 'low-air-loss', where air is intentionally circulated beneath the mattress cover or the patient to introduce cool dry air to the local tissue environment. The benefits of a low air loss support surface are detailed on pages 14 and 20.

FIGURE 9.
Differentiating between the mechanism of action for reactive and active support surfaces



REACTIVE THERAPY (pressure reducing)

The primary modes of action for a REACTIVE therapy support surface are immersion and envelopment (see Figure 10). The body immerses (or sinks) into the support surface and is enveloped (or surrounded) by the supporting material. This results in an increase in the total surface area over which the body weight is distributed. Distributing the body weight over a larger surface area reduces contact pressures.

While this process avoids the creation of high pressure gradients associated with highly resistant surfaces the pressure applied to the skin and subcutaneous tissues is continuous unless the patient moves or is repositioned. Even in the highest specification device, the pressures experienced by the patient may be sufficient to occlude the circulation.

A reactive therapy surface can be achieved in several ways including pressure-redistributing foam, such as the POLYFLOAT™ range, through to sophisticated powered bed systems. Reactive surfaces may be full mattress replacements, mattress overlays or seat cushions and may also be powered or non-powered.

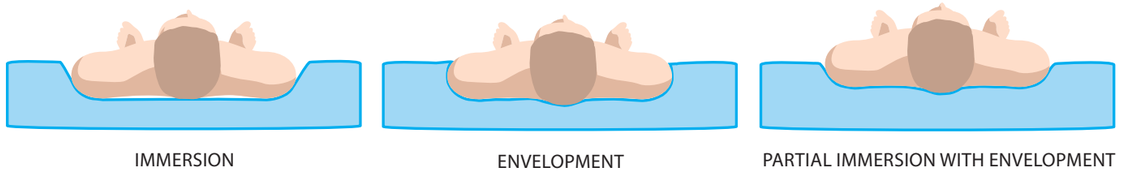


FIGURE 10.
An illustration of the differences between immersion and envelopment with regard to reactive therapy support surfaces

ACTIVE THERAPY (pressure relieving)

ACTIVE therapy support surfaces have previously been referred to as 'alternating pressure' support surfaces. The mode of action for active therapy support surfaces is the periodic redistribution of pressure beneath the body (Figure 9). This is typically achieved through the inflation and deflation of a series of air cells activated and controlled by a specialist mains powered pump unit.

This modality perhaps best targets the primary pathology of pressure ulcers by mimicking natural spontaneous movement which is a protective mechanism that ensures effective tissue off-loading several times each hour, even during sleep. [50] Active surfaces can differ significantly in their design with some deflating every second, third or fourth cell in sequence. All active support surfaces provide a period of off-loading at least twice and, more usually, four to six times each hour. Table 2 details the key mechanical characteristics of active support surfaces.

Active support surfaces (examples of which include the Talley QUATTRO® and PULSAIR® CHOICE product ranges) are associated with the following physical and physiological benefits:

- Enhanced tissue perfusion and rapid removal of toxic metabolites, through the stimulation of reactive hyperaemia (vessel dilatation and increased blood flow) [54]

TERM	DEFINITION	CLINICAL RELEVANCE
Cycle frequency	Usually continuous	Cycles may be interrupted for nursing procedures or when assessing patients suitability for transfer to a non-powered (reactive) support surface
Cycle duration	Range from 7.5 minutes to 30 minutes	Some patients may benefit from a longer cycle time – increased comfort and longer reperfusion interval; an important consideration for those patients with spinal injury [51] or vascular disease and longer oxygen recovery index [52, 53]
Amplitude	The difference between the highest and lowest inflation pressures at each cycle	Amplitude has to be sufficient to lift the patient clear of the deflating cell in order to achieve therapeutic off-loading. High amplitude may also increase the pressure gradient in skin over the adjacent cell
Rate of change	Speed at which pressure is applied or removed	Rapid inflation-deflation, particularly combined with a high-amplitude cycle, may disturb some patients

TABLE 2.
Key design characteristics of active surfaces [49]

- Increased skin blood flow in response to alternation compared to constant pressure [54]
- Enhanced lymphatic drainage [55]
- The 'peristaltic' action of the cells helps to prevent the patient slipping towards the foot of the bed [36]
- I-in-4 cycle provides off-loading, comfort and support [56]
- Suitable for both pressure ulcer prevention and healing [57, 58]

The defining characteristic for an active surface, and one with obvious clinical relevance, is that pressure is redistributed several times each hour even if the patient does not or cannot move. This makes active support surfaces the therapy of choice for patients who, for a variety of reasons, cannot be regularly repositioned.[1] The EPUAP recommend active therapy for a wide range of patients at risk of pressure ulceration and who cannot be regularly repositioned. This includes;

- Respiratory distress
- Medically unstable
- Trauma and traction
- Bariatric
- Uncontrolled pain
- End of life care

DUAL-MODALITY

Many surfaces will fall into a specific category and can be easily classified as either active or reactive. One example of this is the PULSAIR® CHOICE range which offers active support surfaces. However, more advanced surfaces, for example the products within the QUATTRO® range, may be switched between to the two modes and/or have specific design characteristics, such as the unique TISSUEgard™ air cells, that incorporate both active and reactive processes simultaneously into a single support surface.

The products within the QUATTRO® range offer all of the pressure relieving qualities of an active support surface while at the same time reducing the pressure exerted on the patients skin and subcutaneous tissue by allowing the patient to immerse into the support surface and become enveloped in the inflated air cells.

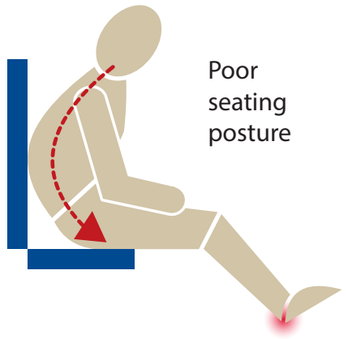
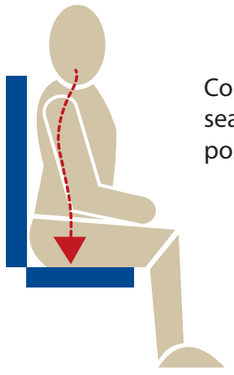


FIGURE 11.
The correct posture when seated can help reduce the risk of pressure and shear related tissue damage in patients



MANAGING MICROCLIMATE

Several methods are available to reduce heat and moisture build up at the mattress-skin interface. The simplest and most natural method of maintaining normothermia is to reposition the patient, however, this is seldom practical and microclimate is increasingly managed by the support surface.

Low air loss is the primary method of control, whereby ambient air is circulated beneath the mattress cover to create a temperature and moisture gradient across the cover i.e. high moisture and temperature above the cover (at the skin/ mattress cover interface) and low moisture and temperature below the cover. Moisture-vapour permeable covers allow heat and moisture to dissipate through the cover (from high to low concentration) and it is this movement of heat and moisture which helps to maintain a healthy microclimate at the skin / support surface interface.

Active surfaces have the additional benefit of every few minutes, individual cells loose contact with the body and allow dry, cool air to circulate above the cells.[53] Studies indicate that the alternation process itself can help to maintain a healthy local skin environment.[59]

The importance of seating

Pressure ulcer risk management is an ongoing, 24-hour a day problem. Irrespective of whether a patient remains in bed or sat out on a seat, the provision of appropriate pressure area care should be considered a priority for all patients at an elevated risk of pressure related tissue damage.

For at risk patients sat out of bed, sitting time should be limited to 2 hours or less, however this has to be balanced with the physical, psychological and social benefit of leaving the bed and some patients are unable or unwilling to limit sitting time.

When sitting, care should be taken to ensure that the chair height and dimensions are suitable for the patient, particularly after the addition of a pressure-redistributing cushion. Incorrect posture can have a significant impact on both pressure and shear over the vulnerable ischial tuberosities, sacro-coccygeal area and thighs. Less obviously, the heels may also be exposed to risk from poorly adjusted seating, as the patient uses their feet to try to stabilise their posture and may weight bear on the back of the heel rather than the sole foot (Figure 11).

Both reactive and active cushions, are indicated for pressure ulcer prevention and treatment. Active cushions (such as the B.A.S.E.™ SEQUENTIAL cushion), have been shown to stimulate similar or superior blood flow to 20 minute physical off-loading (push up/forward lean) [60] and so may be particularly indicated for patients unable or unlikely to reposition themselves on a regular basis when seated. Active cushions are also indicated for pressure ulcer healing when used with care [1] and so might be helpful where patients have developed wounds on reactive (foam, gel or static air) support surfaces.

When providing additional seating to patients important safety considerations include seat height and patient stability. Some cushions are unsuitable for patients with particular conditions and, where possible, longer term seating needs should be referred to a specialist team. Detailed information is given in dedicated seating guidelines.[61]

Selecting a patient support surface

The selection of a patient support surface will depend on several factors and should not be determined solely by a risk assessment score or category of wound.[1] The trigger for assessing need is whether or not the patient can move himself or herself, followed by whether or not they can be regularly repositioned (Figure 12). The choice of an active or reactive support surface will depend on the environment, the support of caregivers and the therapy goals.

Evidence from a large outcomes study in more than 2,500 subjects concluded that an active mattress replacement would be the preferred option for preventing pressure ulcers in the most vulnerable patients and for healing existing wounds.[62]

A randomised controlled clinical trial concerned only with active support surfaces compared full mattress replacements with mattress overlays in approximately 2,000 subjects and came to similar conclusions.[63] The key findings from this work were;

- Pressure ulcers occurred almost 11 days sooner in the overlay group
- There is an 80% probability that an overlay will cost more
- Overlays were significantly less well tolerated by patients (p=<0.02) in terms of comfort and device related issues

Although it is counterintuitive, research evidence from larger scale clinical outcome studies demonstrates that there is a higher probability that an active mattress replacement will cost less than an active overlay, despite a higher acquisition cost. This is due to a substantial delay in the development of tissue injury and lower treatment costs.[64]

Important considerations when using mattress overlays are;

1) Overlay performance is dependent on the support provided by the underlying base mattress, therefore the quality / condition of the base mattress must be sufficient for overlay to work appropriately.
2) Patient safety must be considered when combining the height of an overlay with the base mattress.

Talley offer a comprehensive range of both reactive and active support surfaces. The following section highlights how these products work and how the key design features they offer can help you provide the most appropriate support surface to your patient.

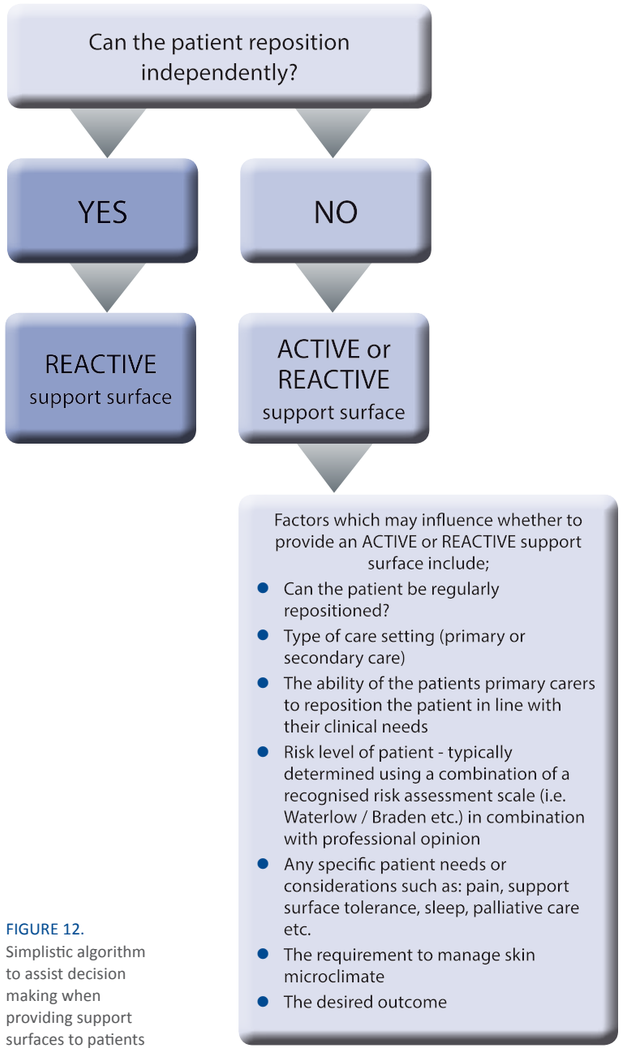


FIGURE 12.
Simplistic algorithm to assist decision making when providing support surfaces to patients

Understanding how Talley support surfaces meet patients clinical needs

For over 60 years Talley have been meeting the needs of patients and clinicians with support surfaces that have a reputation for efficacy, reliability and quality. The modern range of Talley support surfaces consists of both active (alternating) and reactive (foam) surfaces for bed and chair. These surfaces incorporate unique design features that deliver efficient pressure redistribution while addressing other essential clinical needs, such as patient comfort and microclimate management (see Table 3).

TABLE 3.
At a glance comparison of key features and the comprehensive range of Talley support surfaces

	QUATTRO® AUTOCURA MR	QUATTRO® ACUTE MR	QUATTRO® PAEDIATRIC MR	QUATTRO® PLUS MR	QUATTRO® OVERLAY	PULSAIR® CHOICE MR	PULSAIR® CHOICE OVERLAY	FUSION® MR	POLYFLOAT® SUPREMA MR	POLYFLOAT® DORMIRA MR
	QUATTRO®					PULSAIR® CHOICE		POLYFLOAT®		
Cycle: 1-in-4	●	●	●	●	●	●		Foam / air hybrid		
Cycle: 1-in-2							●			
Cycle duration: mins	Variable (16-30)	Variable (16-30)	Variable (16-30)	16	16	16	8			
Reactive mode	●	●	●	●	●			●	Foam	Foam
DEEP CELL THERAPY™	●	●								
TISSUEgard™		●	●	●		●				
AUTOzone™	●									
ODS™		●	●	●	●	●	●			
AUTOsupport™		●	●	●	●	●	●	●		
Maximum inflation	●	●	●	●	●			●		
Comfort control	●	●	●	●	●	●	●	●		
Low Air Loss	●	●	●	●	●	●	●			
Entire mattress machine washable	●	●	●	●	●					
SEATING										
Active seat cushion available				●	●	●	●			

Talley offer three established product ranges as follows:

- QUATTRO®: powered products offering either ‘active’ or ‘reactive’ therapy
- PULSAIR® CHOICE: powered products offering ‘active’ therapy
- POLYFLOAT® foam products offering ‘reactive’ therapy

Table 3 details a features comparison table for each of these support surfaces, along with the new FUSION mattress (a foam/air hybrid).

Key features of the QUATTRO® products

Some of the following features are present in all products in the QUATTRO® range, others are specific to certain QUATTRO® products. Please refer to Table 3 for clarification of which features apply to which products.

ACTIVE 1-IN-4 (ALTERNATING) THERAPY

QUATTRO® THERAPY utilises an active 1-in-4 cell alternating cycle which enables 75% of the patient’s body to be comfortably supported across three inflated cells, whilst the fourth cell deflates sufficiently to encourage tissue reperfusion.[36] In additon to optimal pressure relief patient benefits of a 1-in-4 cycle include enhanced comfort, reduced awareness of support surface movement [56] and the reduction of stimulus-related complications such as muscle spasm.[36]

An additional consideration is the inflation and deflation sequence of an active surface, which has been described as a slow peristaltic effect which when moving from the foot to the head end of the support surface can counteract the tendency of a patient to slide to the foot end of the bed.[36]

Depending upon the product, when operating as an active support surface QUATTRO® products will either have a fixed 16 minute cycle time OR they will have a variable cycle duration which ranges from 16 to 30 minutes (see Table 3 for full details).

REACTIVE THERAPY MODE (CONTINUOUS LOW PRESSURE THERAPY)

At the touch of a button support surfaces within QUATTRO® range can convert from an active (alternating) support surface to a reactive **(continuous low-pressure)** support surface which can be adjusted to suit individual patient requirements. This is achieved by allowing the internal air pressure within the cells to be equalised throughout the mattress, allowing patients to be immersed and enveloped within the support surface.

Using the mattress in this way can be most useful for patients who are unable to tolerate a moving surface. This may include patients with neuromuscular conditions who suffer muscle spasm, or patients with difficult pain control. Some patients simply prefer the enveloping environment of a reactive mattress. However, it is important to note that while the surface pressure is lowered it remains constant and therefore this modality is not ideal for patients who cannot be regularly repositioned.

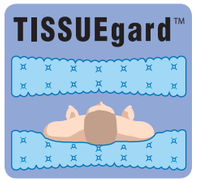
“ Benefits of a 1-in-4 cell cycle include;

- *75% of the body supported at any point in time*
- *Lower cell inflation pressure compared with other cell configurations (i.e. 2:1)*
- *Sufficient time for tissue reperfusion*
- *Greater patient comfort*
- *Less stimulation-induced muscle spasm*
- *Less fluid displacement on oedematous skin*
- *Suitable for a wide range of patients ”*

(Peter Lowthian, Freelance Clinical Nursing Specialist/ Lecturer)

CELL DESIGN

The design of mattress air cells plays an important part in mattress performance as it can influence inflation pressure and the way in which the patients skin and subcutaneous tissue is subjected to both pressure and shear forces. Air cell features such as DEEP CELL THERAPY™ and TISSUEgard™ technology offer different patient benefits as described below.



Each air cell featuring **TISSUEgard™** has additional fabric pleats at the cell apex. When subjected to a load (i.e. a patient) these pleats flatten out under the patient, giving an additional surface area of up to 15%. This increase in surface area facilitates partial immersion and envelopment of the patient into the support surfaces (properties not dissimilar to that seen in reactive systems). This results in reduced pressure being applied to the patients skin and subcutaneous tissues during the support phase of the cycle. This approach to active therapy reduces the pressure differential at the boundary between the inflated and deflated cells, avoiding an undesirable environment linked to increased tissue strain [34, 35] and associated shearing forces.

The construction of air cells featuring **DEEP CELL THERAPY™** allows them to run at lower internal cell pressures. This in turn has the benefit of reducing the pressure applied to patient skin and subcutaneous tissue and subsequently this reduces the pressure gradient between tissues supported on inflated air cells and tissue where the air cell has deflated during active therapy.

Laboratory studies of mattresses featuring DEEP CELL THERAPY™ demonstrate that these support surfaces are capable of delivering pressures at the mattress-body interface of less than 30mmHg for the entire cycle (Figure 13). While this cannot be generalised across the spectrum of patient morphologies, nor directly translated into a predicted clinical outcome, it is indicative of performance and clearly demonstrates the off-loading capability of these mattresses.

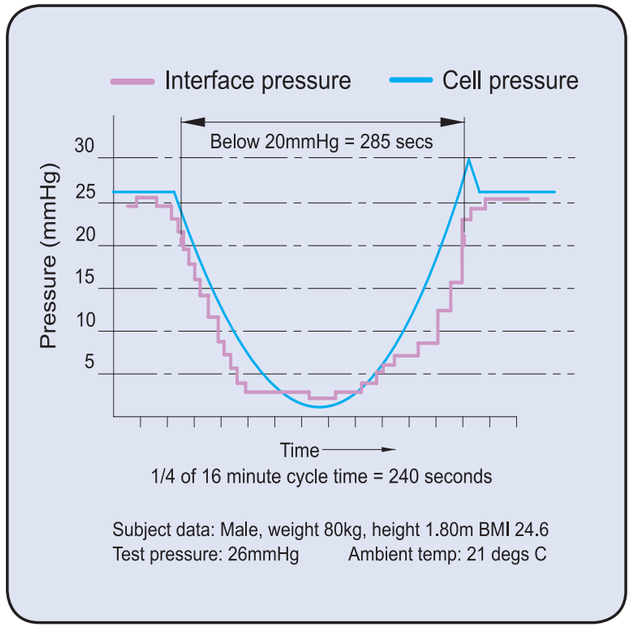


FIGURE 13.
An illustration of the low interface pressures that can be achieved when supporting a subject on an active support surface with DEEP CELL THERAPY™

OPTIMISING PATIENT SUPPORT

The Talley QUATTRO® product range uses one or more of the following features to ensure optimal patient support and pressure redistribution irrespective of patient weight or position (see Table 3 to identify the features relevant to each support surface).

AUTOzone™ Technology
Pressure is independently controlled across six individual zones optimising the pressure in response to individual body mass distribution. Cell pressures are continuously monitored throughout the cycle, automatically adjusting to patient movement or change in posture i.e. from lying to sitting.

Ortho-differential Support™ (ODS)
Cells are wider at the edge of the mattress than in the centre. This enables smaller lighter patients to be supported on the softer central area of the mattress, giving them a feeling of additional security, [56] while larger heavier patients are supported on the firmer outer edges of the mattress. The firmer edges of the mattress also aid both patients and staff when transferring patients on and off of the mattress.

AUTOsupport™
In response to patient weight, movement and position cell pressures are equalised throughout the cycle to ensure the optimal balance between patient support and patient therapy.

> *"(Ortho-Differential Support) provides optimum cell pressure for different body shapes, matching the requirements of patients at high risk of pressure ulcer development."*
>
> *(Sylvie Hampton Tissue Viability Consultant)*

"The low air loss feature helps reduce moisture build-up, helping to maintain the patient's skin at an ambient temperature and lower humidity level..."

(Sylvie Hampton Tissue Viability Consultant)

"...the covers' two-way stretch material reduces the potential forces of shearing and friction – an important consideration in reducing pressure ulcer incidence...

- *Easily cleaned & fully launderable*
- *Waterproof*
- *Vapour-permeable*
- *Welded seams to prevent ingress of liquids & bacteria"*

(Professor David Gray)

MICROCLIMATE MANAGEMENT

All mattress covers are water-vapour permeable. Combining these covers with the low air loss function which circulates ambient (cool, dry) air beneath the cover throughout the cycle, results in a temperature and humidity gradient between the patient and the cells. The resulting microclimate is important for skin integrity [65] as excess heat at the skin-mattress interface is naturally drawn towards the cooler sub-cover air and, at the same time, any perspired moisture is drawn through the cover membrane toward the less humid air beneath. Both processes help to maintain a microclimate that protects the skin and can help to avoid maceration, which can raise the risk of friction related injuries.

COVERS

All active support surface covers are two-way stretch and loosely fitted. This reduces the likelihood of interference with off-loading during cell deflation. The covers are waterproof with welded seams, to prevent ingress of body fluids and contaminants, and all covers are fully launderable.

The surface of the fabric also has a relatively low coefficient of friction which is useful for avoiding local shear stress and strain on the skin during patient movement and manual repositioning.

Lower friction surfaces have also been linked to caregiver safety, particularly during repositioning. One study demonstrating that the load borne by the lower back was most greatly influenced by the type of sheet rather than the patient's weight or disability, [66] making it an important safety consideration.

COMFORT AND SLEEP

Although pressure-redistribution is the primary focus when providing patients with a specialist support surface, it should not be at the expense of comfort because any therapy will only be effective if it is well tolerated by the patient. Patient comfort and sleep are key considerations when providing support surfaces as they have significant impacts on both mental and physical wellbeing.

The combination of a 1-in-4 cell cycle coupled with the unique air cell design features found in the QUATTRO® range has clear benefits in terms of comfort, pain and sleep. When compared with two of the most widely used mattress replacements in the United Kingdom (1-in-2 and 1-in-3 cell configuration), the QUATTRO® ACUTE mattress proved superior with respect to patient comfort, sleep and pain reduction (see Table 4).[67]

The PULSAIR® CHOICE product range

Several of the key features present in the QUATTRO® product range are also present in the PULSAIR® CHOICE product range. Features such as Ortho-Differential Support, AUTOsupport™ and 'low air loss' are common across both product ranges, therefore to prevent repetition please refer to Table 3 to identify specific PULSAIR® CHOICE product features and see the above explanations for more detailed information.

The two key differences between the QUATTRO® products and the PULSAIR® CHOICE products occur in the PULSAIR® CHOICE overlay which has a 1-in-2, eight minute alternating cycle. This exception to the active portfolio delivers efficient pressure redistribution and shares familiar characteristics with some of the most widely used 1-in-2 alternating support surfaces currently available.

Additional considerations - infection prevention

Support surfaces are almost always intended for multi-patient use, therefore it is important that they are designed to minimise the risk of cross-infection / cross-contamination when in use and that they can be cleaned and decontaminated quickly and effectively between patients.

All cover seams on both the QUATTRO® and PULSAIR® CHOICE systems are fully welded to prevent fluid ingress into the mattress core during use. To assist cleaning and decontamination between patients the entire mattress for each of the products in the QUATTRO® range is fully launderable. The mattress covers of the PULSAIR® CHOICE range can also be laundered.

"...the mattress was comfortable and in fact two patients asked if they could purchase their own once they had been discharged..."

(Heather Newton, Tissue Viability Nurse Consultant; Julie Dean Tissue Viability Equipment Coordinator)

"...clinical effectiveness, acceptability and cost effectiveness are important but we feel that comfort and preservation of the integrity of sleep are paramount..."

(J Pring, Deputy Superintendent Physiotherapist; P Millman Senior Nurse Manager)

Clinical evaluation and professional opinion of Talley support surfaces

Clinicians have reviewed and evaluated products from within the active surface range and conclude that they are suitable for prevention and treatment of a wide range of patients including those at the highest risk or pressure related tissue damage.[65]

TABLE 4.
Summary of studies and clinical testimonials offering clear evidence of product performance and user acceptance

Title and Authors	Setting and Methodology	Outcomes	Conclusion
Monitoring the effectiveness of the Talley **QUATTRO® ACUTE** mattress replacement system. *Newton H & Dean J* [57]	**Acute Hospital Trust** • Acute elderly care • Vascular surgery • Rheumatology Nine mattresses provided for general evaluation over a 7 month period in very high-risk patients.	67 subjects completed • 54% (n=36) had existing PU • Mean use = 17.5 days (range 1-79) • 1 patient developed a new PU (1.5%) Category II - cause could not be determined due to the patient's terminal condition • No PU deteriorated • Just 3 patients rated the mattress as below average comfort • Patient satisfaction and overall impression was good.	The **QUATTRO® ACUTE** mattress is suitable for patients at the highest level of risk. With a low level of faults and noise, plus both patient and clinician satisfaction, the **QUATTRO® ACUTE** is suitable for very busy clinical environments.
Evaluating pressure-relieving mattresses. *Pring J & Millman P* [67]	**Regional Rehabilitation Centre** • 40 high risk subjects with intact skin • Random allocation to one of three support surfaces for one-week:- (A) 1-in2 cycle (B) 1-in-3 cycle (C) 1-in-4 cycle (Talley **QUATTRO®**) • Patient & staff questionnaire • Skin assessment.	39 subjects completed (1 withdrew on clinical grounds) • A high proportion of subjects rejected mattresses A (10%) & B (51%) on the grounds of discomfort. • **QUATTRO®** mattress was significantly more comfortable than mattresses A & B (p=<0.01) • **QUATTRO®** mattress caused less pain than mattress B (P=<0.01). • **QUATTRO®** mattress caused less sleep disturbance than either A (p=<0.05) or B (P=<0.01). • **QUATTRO®** mattress caused less awareness of movement than A (p=<0.01) .	**QUATTRO®** overall is the most comfortable of the three mattresses and created least sleep disturbance. Nurse found all mattresses to be easy to set up and manage and none complicated patient handling.
Clinical evaluation of an electronic pressure-relieving mattress. *Knowles C & Horsey I* [68]	**Surgical and trauma unit** **QUATTRO®** Deepcell mattress allocated to high risk individuals who required a therapeutic support surface.	35 subjects completed • 17 subjects (49%) had at least one PU at commencement • 2 subjects (6%) developed new tissue damage:- 1 subject developed category I damage 1 subject developed additional category II damage • Half of PU present at the outset healed during the evaluation • All except 2 nurses rated the mattress positively and, for those two, it was uncertainty about whether the softer mattress was effective – the patient's skin in both cases remained intact.	There appears to be a significant positive effect from the use of the mattress. **QUATTRO®** Deepcell is useful in preventing and managing pressure ulcers in very-high risk patients and is a valuable addition to the pool of equipment.
Treatment of pressure ulcers in a rehabilitation ward *Cook S* [58]	Rehabilitation Unit **QUATTRO® ACUTE** and active cushion used to treat a complex series of wounds in a patient for whom repositioning was difficult.	Single subject case study demonstrating the value of a multi-disciplinary and holistic approach to wound care and prevention of further injury. The patients overall condition and his wounds improved in response to effective pressure management, advanced wound care, addressing nutritional needs and the use of lift equipment to reposition when fatigued. Access to an active cushion had great emotional and physical benefit in terms of healing and quality of life.	

NB. While some product brand names have changed over time the core design principles remain the same.

Title and Authors	Aims and Objectives	Outcomes / Evidence of Improvement	Conclusion
Evaluation and adoption of the **QUATTRO® PLUS** into an acute care setting for the prevention and treatment of pressure ulcers *Sutherland L* [69]	1) To simplify support surfaces allocation to patients at risk of pressure damage by reducing the variety of products available to staff. 2) To replace ageing, worn, unreliable existing support surfaces with new, clinically effective, easy to use, reliable support surfaces.	After an extensive evaluation process October 2013 saw West Suffolk Hospital NHS Foundation Trust purchase 20 **QUATTRO® PLUS** dynamic mattress replacement systems (see Figure 1) for use across the 400 bedded hospital. In addition a smaller number (n=9) of **QUATTRO® ACUTE** systems from Talley were also purchased with the majority of these being used in ITU. The combination of clinical performance, ease of use, product reliability and positive feedback from patients, clinical and EBME staff have resulted in a further 40 **QUATTRO® PLUS** systems being ordered in May 2014.	The **QUATTRO®** mattress replacement systems do everything they are required to do from a clinical perspective and they continue to play an essential role in the pressure area care needs of all high and very high risk patients who are cared for within the Trust.
Effective use of the **QUATTRO® PLUS** mattress replacement system for the treatment of pressure ulcers and to help produce a significant Trust wide reduction in pressure ulcer incidence *Harrison K* [70]	To formally identify, evaluate and adopt a more cost effective support surface whilst maintaining or improving patient safety and the patient experience, clinical outcomes and the staff experience.	The **QUATTRO® PLUS** has been used as part of a care bundle which has resulted in PU incidence reductions of over 65%. Staff feedback on the **QUATTRO® PLUS** mattress replacement system identified the following benefits over the existing (1-in-2 cell cycle) support surfaces. • Patient comfort significantly improved as a result of the 1-in-4 cell cycle • The **QUATTRO® PLUS** was significantly easier to use (requiring less user input to set the system up correctly) • Staff concordance with the allocation and use of dynamic mattress replacements improved as a result of the improved ease of use for the Talley system • Medical equipment library technicians reported ease of decontamination and service / maintenance	The **QUATTRO® PLUS** offers excellent levels of clinical and cost effectiveness. It is straightforward to set up and use and it is very well liked by both staff and patients. When used appropriately as part of a comprehensive pressure ulcer care bundle it can play a major role in significantly reducing Trust wide pressure ulcer incidence.
Using the **QUATTRO® PLUS** mattress as part of a comprehensive care package to help reduce pressure ulcer incidence *Bullough L* [71]	The aim of the tissue viability team was to reduce the incidence of hospital acquired pressure ulcers. This would benefit patients whilst simultaneously realising a cost saving for the Trust.	In 2008 the Trust set a target to reduce hospital acquired pressure ulcers by 90% over 5 years. From 2008/9 onwards the Trust used 25 **QUATTRO® ACUTE** and 250 **QUATTRO® PLUS** systems. As a direct result of the initiatives implemented by the tissue viability team there was an 84% reduction in pressure ulcer incidence over a 3 year period. This translated into an annual cost saving of £408K.	When used as part of an overall care package the **QUATTRO® PLUS** and **QUATTRO® ACUTE** dynamic mattress replacement systems can help reduce pressure ulcer incidence in the acute care setting. This not only benefits patients but also offers significant cost savings for the Trust.
Clinical experiences of using the **QUATTRO® PLUS** mattress replacement system in a busy NHS Foundation Trust over a six year period *Young L* [72]	The Trust wanted to identify and adopt clinically effective support surfaces that were simple to use and intuitive to set up and operate. The aim was to simplify dynamic support surface allocation for patients at risk of pressure ulcers.	Colchester Hospital University NHS Foundation Trust opted for a fully managed service from Talley with in excess of 200 dynamic mattresses consisting of both the **QUATTRO® PLUS** (60%) and **QUATTRO® ACUTE** systems (40%). From 2011 to 2014 the Trust has recorded a 61.5% reduction in the incidence of hospital acquired pressure ulcers.	Adopting the **QUATTRO®** systems into the Trust has simplified the choice of support surfaces for nursing staff. The systems are easy to set up and use and minimise the opportunity for user error. When used as an integral part of a holistic care package the **QUATTRO®** systems can help reduce pressure ulcer incidence in at risk individuals.

> *"...sitting out of bed while receiving dynamic treatment improved state of mind, speeded healing and enabled family socialisation..."*
>
> *(Stephen Cook, Tissue Viability Nurse)*

> *"...any seated patient with the provision of a pressure-relieving air mattress should automatically be provided with an equivalent pressure-relieving air cushion for seating..."*
>
> *(Professor David Gray)*

Therapeutic seating

A range of active and reactive chair cushions are available to enable patients to be cared for 24-hours a day. For some patients who would otherwise be restricted to bed rest appropriate seating provides an opportunity to spend short periods of time in a chair which can have clear physical and emotional benefits.[58]

Active seating is indicated for both prevention of pressure ulcers in the most vulnerable patients and for the treatment of pressure ulcers when used with care.[1] The B.A.S.E.™ SEQUENTIAL cushion is powered by the ATTIVO™ pump and operates on a 1-in-4 cycle. It can also operate alongside the QUATTRO® OVERLAY or PLUS bed surfaces, sharing the same pump. The PULSAIR® CHOICE cushion (1-in-2 cycle) is operated by the same pump as the PULSAIR® CHOICE bed surfaces.

For patients with some independent mobility and for whom an active seat cushion is not indicated, the POLYFLOAT® cushion with a 'cross-cut' visco-elastic top surface is ideal. This cushion has been designed to provide support, pressure redistribution and comfort for patients at risk of pressure ulcers.

Non-powered, reactive surfaces (foam mattresses)

The POLYFLOAT® range of non-powered, reactive surfaces is composed of two foam mattresses the SUPREMA™ (visco-elastic) and the DORMIRA™ (high quality pressure redistributing foam). They are designed to allow the body to partially immerse into and be enveloped by the foam. As the degree of immersion and envelopment increases, so to, does the surface area. Distributing the same weight over a larger surface area leads to a reciprocal drop in interface pressure (i.e. the larger the surface area the greater the reduction in pressure). For additional information on these products please refer to the appropriate product brochures.

Strategic approach to prevention

Pressure ulcers represent a significant financial burden to society and can be life changing or life limiting for the patient (see Figure 14). However, despite years of effort the absolute number of patients suffering pressure injury has proven remarkably resistant to change. This is not necessarily due to a lack of effective solutions but, in many cases, because interventions are not provided in time or just not provided at all.[11, 14, 16, 17]

This clinical resource provides an insight into how Talley support surfaces can reduce the risk that pressure ulcers pose to both patients and providers. The combination of support surface design and product performance makes our range of mattress replacements, overlays and cushions highly versatile and offers healthcare providers and patients clear clinical benefits with regard to pressure ulcer prevention and treatment, even in the highest risk, immobile patients.[65]

Whilst support surfaces are just one aspect of patient care they play an essential role in the prevention and treatment of pressure ulcers. These interventions work best when used as an integral part of a facility-wide leadership project, with accountability from the boardroom to the bedside.

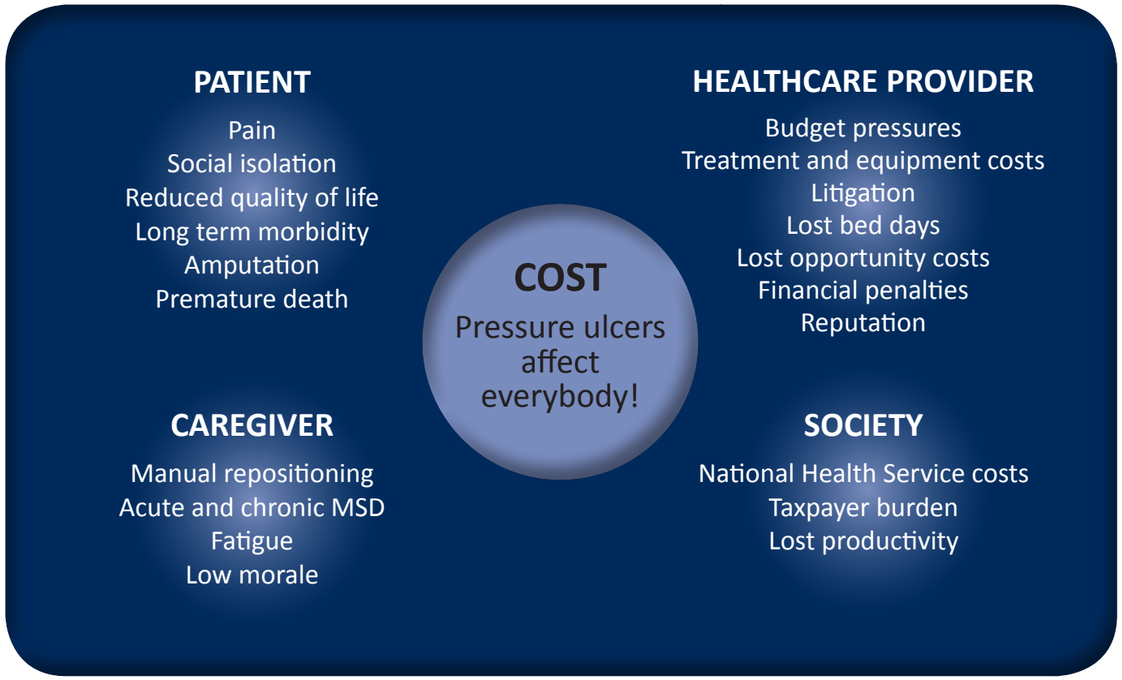


FIGURE 14.
The numerous different ways in which pressure ulcers can impact on patients, caregivers, healthcare providers and society

As seen in the clinical testimonials summarised in Table 4, when prescribed alongside other important interventions for individuals at risk of pressure ulceration, the appropriate use of Talley support surfaces can contribute towards positive patient outcomes. This is often seen as a reduction in pressure ulcer incidence and this can benefit the healthcare provider in terms of significant annual cost savings.[71]

Summary

Since our inception, in 1953, we have combined decades of clinical and engineering expertise to deliver a current product portfolio that represents quality, efficacy and value for money. All Talley mattresses, mattress overlays and cushions are based on sound clinical principles and designed specifically to address the most important factors related to pressure ulcer pathology (pressure with or without shear) whilst also successfully managing microclimate and patient comfort.

Thank you for taking the time look through this document and we hope you have found it a useful resource. If you require further information or have any questions then please don't hesitate to contact us.

References

1. National Pressure Ulcer Advisory Panel and European Pressure Ulcer Advisory Panel. Prevention and treatment of pressure ulcers: a clinical practice guideline. 2009. NPUAP Washington DC. www.epuap.org accessed August 2014
2. Meaume S, Faucher N. Heel pressure ulcers on the increase? Epidemiological change or ineffective prevention strategies? J Tissue Viability. 2008 Feb;17(1):30-3.
3. Vangilder C, Macfarlane GD, Meyer S. Results of nine international pressure ulcer prevalence surveys: 1989 to 2005. Ostomy Wound Manage 2008 Feb;54(2):40-54.
4. Han PY, Ezquerro R. Surgical treatment of pressure ulcers of the heel in skilled nursing facilities: a 12-year retrospective study of 57 patients. J Am Podiatr Med Assoc 2011 Mar-Apr;101(2):167-75.
5. Apold J, Rydrych D. Preventing device-related pressure ulcers. Using data to guide statewide change. J Nurs Care Qual. 2012 Jan-Mar;27(1):28–34.
6. CLOTS Trials Collaboration, Dennis M, Sandercock PA, Reid J, Graham C, Murray G, Venables G et al. Effectiveness of thigh-length graduated compression stockings to reduce the risk of deep vein thrombosis after stroke (CLOTS trial 1): a multicentre, randomised controlled trial. Lancet. 2009 Jun 6;373(9679):1958-65.
7. Black JM, Cuddigan JE, Walko MA, Didier LA, Lander MJ, Kelpe MR. Medical device related pressure ulcers in hospitalized patients. Int Wound J 2010 Oct;7(5):358-65.
8. Phillips L, Clark M. Can meaningful quality benchmarks be derived from pressure ulcer prevalence data? J Tissue Viability. 2010 Feb;19(1):28-32.
9. Schoonhoven L, Bousema MT, Buskens E; prePURSE-study group. The prevalence and incidence of pressure ulcers in hospitalised patients in the Netherlands: a prospective inception cohort study. Int J Nurs Stud. 2007 Aug;44(6):927-35.
10. Woodbury MG, Houghton PE. Prevalence of pressure ulcers in Canadian healthcare settings. Ostomy Wound Manage. 2004 Oct;50(10):22-4, 26, 28, 30, 32, 34, 36-8.
11. Vanderwee K, Clark M, Dealey C, Gunningberg L, Defloor T. Pressure ulcer prevalence in Europe: a pilot study. J Eval Clin Pract. 2007 Apr;13(2):227-35.
12. Gallagher P, Barry P, Hartigan I, McCluskey P, O'Connor K, O'Connor M. Prevalence of pressure ulcers in three university teaching hospitals in Ireland. J Tissue Viability. 2008 Nov;17(4):103-9.
13. Posnett J, Gottrup F, Lundgren H, Saal G. The resource impact of wounds on health-care providers in Europe. J Wound Care. 2009 Apr;18(4):154-61.
14. Buttery J, Phillips L. Pressure ulcer audit highlights important gaps in the delivery of preventative care in England and Wales 2005–2008. EWMA Journal 2009;9(3):27–31.
15. PUPPS 3 - Pressure ulcer point prevalence survey. Quality and Safety Branch, Victorian Government Department of Human Services, Melbourne, Victoria, Australia.
16. Shreve J, Van den Bos J, Grey T et al. The economic measurement of medical errors. Society of Actuaries. Available online at: http://www.soa.org/research/research-projects/health/research-econ-measurement.aspx.
17. O'Brien J. An exploration of current practice in nursing documentation of pressure ulcer prevention and management. EWMA Journal. 2009;9(3):20.
18. Mulligan S, Scott L, Prentice J, Elmes R, Carville K, Santamaria N. WoundsWest Wound Prevalence Survey 2009 State-wide Report. Ambulatory Care Services, Department of Health 2009: Perth, Western Australia.
19. Graves N, Birrell F, Whitby M. Effect of pressure ulcers on length of hospital stay. Infect Control Hosp Epidemiol 2005 Mar;26(3):293-7.
20. Dealey C, Posnett J, Walker A. The cost of pressure ulcers in the United Kingdom. J Wound Care 2012 Jun;21(6):261-2, 264, 266.
21. Lyder CH, Wang Y, Metersky M, Curry M, Kliman R, Verzier NR, Hunt DR. Hospital-acquired pressure ulcers: results from the national Medicare Patient Safety Monitoring System study. J Am Geriatr Soc. 2012 Sep;60(9):1603-8.
22. Bennett G, Dealey C, Posnett J. The cost of pressure ulcers in the UK. Age Aging. 2004 May;33(3):230-5..
23. Brem H, Maggi J, Nierman D, Rolnitzky L, Bell D, Rennert R, et al. High cost of stage IV pressure ulcers. Am J Surg. 2010 Oct;200(4):473-7.
24. NHS England. (21013) Commissioning for Quality and Innovation (CQUIN): 2014/15 guidance. http://www.england.nhs.uk/wp-content/uploads/2013/12/cquin-guid-1415.pdf accessed August 2014.
25. Franks P. The cost of pressure ulceration. EWMA Journal. 2007;7(2):15-17.
26. Gorecki C, Closs SJ, Nixon J, Briggs M. Patient-reported pressure ulcer pain: a mixed-methods systematic review. J Pain Symptom Manage. 2011 Sep;42(3):443-59.
27. Briggs M, Collinson M, Wilson L, Rivers C, McGinnis E, Dealey C, et al. The prevalence of pain at pressure areas and pressure ulcers in hospitalised patients. BMC Nurs. 2013 Jul 31;12(1):19.
28. Gorecki C, Brown JM, Nelson EA, Briggs M, Schoonhoven L, Dealey C, et al; European Quality of Life Pressure Ulcer Project group. Impact of pressure ulcers on quality of life in older patients: a systematic review. J Am Geriatr Soc. 2009 Jul;57(7):1175-83.
29. Black J. Preventing pressure ulcers on the heel. Wounds International. 2012;3(3):1-4.
30. Redelings MD, Lee NE, Sorvillo F. Pressure ulcers: more lethal than we thought? Adv Skin Wound Care. 2005;18(7):367-72.
31. Salcido R, Popescu A, Potter PJ et al. Pressure Ulcers and Wound Care. Medscape online. 2012 http://emedicine.medscape.com/article/319284-overview#aw2aab6b2
32. Bennett L, Kavner D, Lee BK, Trainor FA. Shear vs pressure as causative factors in skin blood flow occlusion. Arch Phys Med Rehabil. 1979 Jul;60(7):309-14.
33. Ceelen KK, Stekelenburg A, Loerakker S, Strijkers GJ, Bader DL, Nicolay K, et al. Compression-induced damage and internal tissue strains are related. J Biomech. 2008 Dec 5;41(16):3399-404.
34. International Review. Pressure ulcer prevention: pressure, shear, friction and microclimate in context. A consensus document. London: Wounds International. 2010
35. Swain ID, Bader DL. The measurement of interface pressure and its role in soft tissue breakdown. J Tissue Viability. 2002 Oct;12(4):132-4, 136-7, 140-6.
36. Lowthian P. Alternating-pressure air mattresses: the Quattro range. Br J Nurs. 1997 Jul 24-Aug 13;6(14):827-33.
37. Ohura T, Ohura N. Pathogenic mechanisms and classification of undermining in pressure ulcers - elucidation of relationship with deep tissue injury. Wounds 2006;18(12):329-39.
38. Gefen A. How much time does it take to get a pressure ulcer? Integrated evidence from human, animal, and in vitro studies. Ostomy Wound Manage. 2008 Oct;54(10):26-8, 30-5.
39. Bansal C, Scott R, Stewart D, Cockerell CJ. Decubitus ulcers: a review of the literature. Int J Dermatol. 2005 Oct;44(10):805-10.
40. Tsuji S, Ichioka S, Sekiya N, Nakatsuka T. Analysis of ischemia-reperfusion injury in a microcirculatory model of pressure ulcers. Wound Repair Regen. 2005 Mar-Apr;13(2):209-15.
41. Linder-Ganz E, Engelberg S, Scheinowitz M, Gefen A. Pressure-time cell death threshold for albino rat skeletal muscles as related to pressure sore biomechanics. J Biomech. 2006;39(14):2725-32.
42. Lachenbruch C, Tzen YT, Brienza DM, Karg PE, Lachenbruch PA. The relative contributions of interface pressure, shear stress, and temperature on tissue ischemia: a cross-sectional pilot study. Ostomy Wound Manage. 2013 Mar;59(3):25-34.
43. Phillips L. Support surfaces: taking the pressure out of pressure ulcers. Br J Nurs. 2014; suppl.
44. Reger SI, Ranganathan VK, Sahgal V. Support surface interface pressure, microenvironment and the prevalence of pressure ulcers: an analysis of the literature. Ostomy Wound Manage. 2007 Oct; 53(10): 50-8.
45. National Institute for Health and Clinical Excellence. The management of inadvertent peri-operative hypothermia. Clinical guideline 65. 2008; www.nice.org Accessed August 2014.
46. Scott EM, Leaper DJ, Clark M, and Kelly PJ. Effects of warming therapy on pressure ulcers -- a randomized trial, AORN J. 2001 May; 73(5): 921-7, 929-33, 936-8.
47. Leaper D. Perfusion, oxygenation and warming. Int Wound J. 2007 Sep;4 Suppl 3:4-8.
48. Defloor T, De Bacquer D, Grypdonck MH. The effect of various combinations of turning and pressure reducing devices on the incidence of pressure ulcers. Int J Nurs Stud 2005 Jan;42(1):37-46.
49. National Pressure Ulcer Advisory Panel. Terms and definitions of support surfaces. 2007. http://www.npuap.org/wp-content/uploads/2012/03/NPUAP_S3I_TD.pdf Accessed August 2014.
50. Giganti F, Ficca G, Gori S, Salzarulo P. Body movements during night sleep and their relationship with sleep stages are further modified in very old subjects. Brain Res Bull, 2008 Jan 31;75(1):66-9.
51. Makhsous M, Priebe M, Bankard J, Rowles D, Zeigler M, Chen D, et al. Measuring tissue perfusion during pressure relief maneuvers: insights into preventing pressure ulcers. J Spinal Cord Med. 2007;30(5):497-507.
52. Masaki N, Sugama J, Okuwa M, Inagaki M, Matsuo J, Nakatani T, et al. Heel blood flow during loading and off-loading in bedridden older adults with low and normal ankle-brachial pressure index: a quasi-experimental study. Biol Res Nurs. 2013 Jul;15(3):285-91.
53. Hampton S. The QUATTRO ACUTE mattress and pressure ulcer prevention. Br J Nurs. 2003 Jun 12-25;12(11):697-8, 700-1.
54. Jan YK, Brienza DM, Geyer MJ, Karg P. Wavelet-based spectrum analysis of sacral skin blood flow response to alternating pressure. Arch Phys Med Rehabil. 2008 Jan;89(1):137-45.
55. Gunther RA, Clark M. The effect of a dynamic pressure-redistributing bed support surface upon systemic lymph flow and composition. J Tissue Viability. 2000 Jul;10(3 su):10-5.
56. Gray D. The new QUATTRO PLUS mattress replacement system. Br J Nurs. 2000 Oct 26-Nov 8;9(19):2100-3.
57. Newton H, Dean J. Monitoring the effectiveness of the Talley Quattro Acute mattress replacement system. Wounds UK 2008;4(32):63-6.
58. Cook SL. Treatment of pressure ulcers in a rehabilitation ward. Br J Nurs. 2001 Mar;10(6 Suppl):S32, S34, S36 passim.
59. Goossens RH, Phillips L. effect of support surface design on skin temperature. World Union Wound Healing Societies. 2012
60. Stockton L, Rithalia S. Is dynamic seating a modality worth considering in the prevention of pressure ulcers? J Tissue Viability. 2008 Feb;17(1):15-21.
61. Stockton L, Gebhardt KS, Clark M. Seating and pressure ulcers: clinical practice guideline. J Tissue Viability. 2009 Nov;18(4):98-108.
62. Clark M. Models of pressure ulcer care: costs and outcomes. British Journal Healthcare Management. 2001;7(10):412-6.
63. Nixon J, Cranny G, Iglesias C, Nelson EA, Hawkins K, Phillips A, et al. Randomised, controlled trial of alternating pressure mattresses compared with alternating pressure overlays for the prevention of pressure ulcers: PRESSURE (pressure relieving support surfaces) trial. BMJ. 2006 Jun 17;332(7555):1413..
64. Iglesias C, Nixon J, Cranny G, Nelson EA, Hawkins K, Phillips A, et al; PRESSURE Trial Group. Pressure relieving support surfaces (PRESSURE) trial: cost effectiveness analysis. BMJ. 2006 Jun 17;332(7555):1416.
65. Gray D. Deep Cell Prime: preventing and healing pressure ulcers. Br J Nurs. 2002 Nov;11(20 Suppl):S44, S46-S48..
66. Skotte J, Fallentin N. Low back injury risk during repositioning of patients in bed: the influence of handling technique, patient weight and disability. Ergonomics. 2008 Jul;51(7):1042-52.
67. Pring J, Millman P. Evaluating pressure-relieving mattresses. J Wound Care. 1998 Apr;7(4):177-9.
68. Knowles C, Horsey I. Clinical evaluation of an electronic pressure-relieving mattress. Br J Nurs. 1999 Nov 11-24;8(20):1392-5.
69. Sutherland L. Evaluation and adoption of the QUATTRO PLUS into an acute care setting for the prevention and treatment of pressure ulcers. 2014. Data on File. Talley Group. Romsey.
70. Harrison K. Effective use of the QUATTRO® PLUS mattress replacement system for the treatment of pressure ulcers and to help produce a significant Trust wide reduction in pressure ulcer incidence. 2014. Data on File. Talley Group. Romsey.
71. Bullough L. Using the QUATTRO PLUS mattress as part of a comprehensive care package to help reduce pressure ulcer incidence. 2014. Data on File. Talley Group. Romsey.
72. Young L. Clinical experiences of using the QUATTRO PLUS mattress replacement system in a busy NHS Foundation Trust over a six year period. 2014. Data on File. Talley Group. Romsey.

Talley Group Limited
Premier Way, Abbey Park Industrial Estate
Romsey, Hampshire, SO51 9DQ England
TEL: +44(0)1794 503500
FAX: +44(0)1794 503555
EMAIL: sales@talleygroup.com

www.talleygroup.com

11/2014