Pressure Management Guide

Understanding the role of support surfaces and wheelchair systems

permobil

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Common abbreviations

CPG - Clinical Practice Guideline
GPS - Good Practice Statements
ITs - Ischial tuberosity
LEs - Lower extremities
PI - Pressure injury
ROM - Range of motion
STBA - Seat-to-back angle

Purpose of this guide

What is the purpose of the pressure management guide?

Our goal is to create a resource for all healthcare professionals and consumers to:

- foster a more holistic approach to the management and prevention of pressure injuries (PI) by simultaneously treating supine and seated postures
- review and adopt the Clinical Practice Guideline (CPG) as set forth by the Pan Pacific Pressure Injury Alliance (PPPIA)
- support members of the healthcare team to prescribe appropriate wheelchair support surfaces in the management of PIs
- adopt key recommendations from the PPPIA's CPG when considering support surfaces for the supine and seated posture for the prevention and treatment of PI among wheelchair users
- understand the critical role wheelchair configuration and equipment choices play in the prevention and treatment of pressure injuries
- introduce the role of international standardised testing

Look for these info boxes throughout the guide. They include quick tips or takeaways for that section.

Pressure injury: definition and etiology

What is a pressure injury?

PPPIA defines a pressure injury as "localised damage to the skin and/or underlying tissue, as a result of pressure or pressure in combination with shear. Pressure injuries usually occur over a bony prominence, but may also be related to a medical device or other object. Tolerance may be affected by microclimate, perfusion, age, health status, co-morbidities, and conditions of the soft tissue."

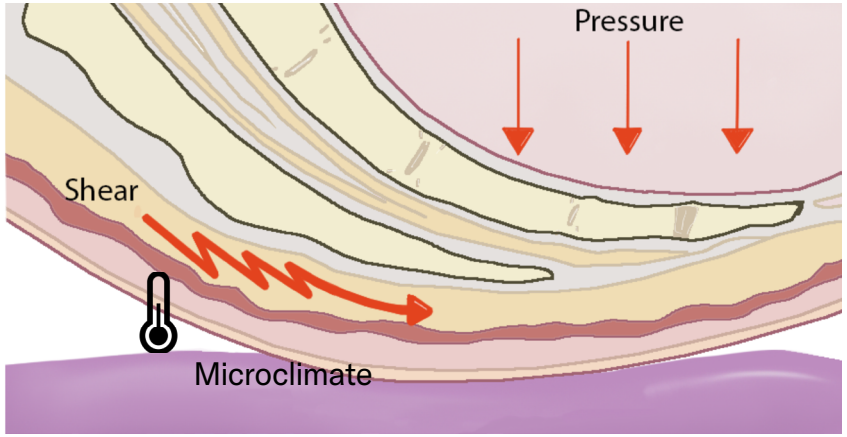


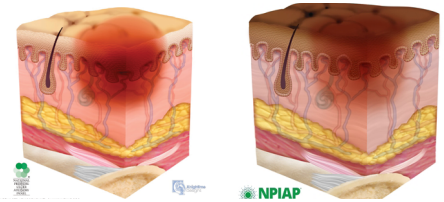
Image from the NPIAP

The PPPIA was formally established in late 2012 with the terminology change from pressure ulcer to pressure injury already in place and widely used in countries such as Australia. The NPUAP made the change in April of 2016.

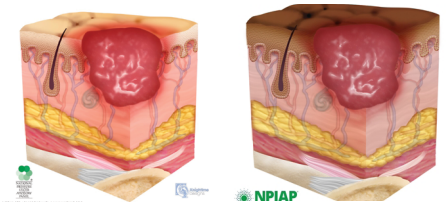
What are the categories/stages of a pressure injury?

Category / Stage 1

Intact skin with a localised area of non-blanchable superficial reddening of the skin, which may appear differently in darkly pigmented skin. Presence of blanchable erythema or changes in sensation, temperature, or firmness may precede visual changes.



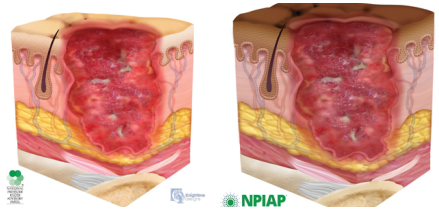
Category / Stage 2



Partial-thickness skin loss or blister. The wound bed is viable, pink or red, and moist. These injuries commonly result from adverse microclimate and shear in the skin over the pelvis and shear in the heel.

Category / Stage 3

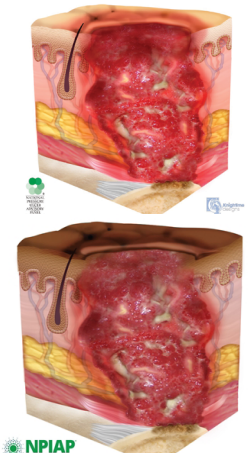
Full-thickness skin loss, in which adipose (fat) is visible in the ulcer and granulation tissue and epibole (rolled wound edges) are often present. Slough and/or eschar may be visible. Undermining and tunneling may occur.



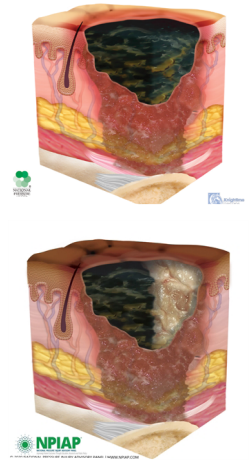
Category / Stage 4

Full-thickness skin and tissue loss with exposed or directly palpable fascia, muscle, tendon, ligament, cartilage, or bone in the ulcer. Slough and/or eschar may be visible. Epibole (rolled edges), undermining, and/or tunneling often occur.

Stage 4 Pressure Injury



Unstageable Pressure Injury - Dark Eschar

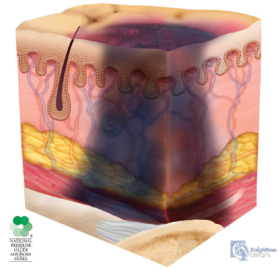


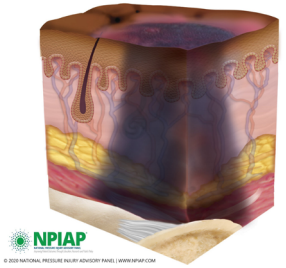
Unstageable

Full-thickness skin and tissue loss in which the extent of tissue damage within the ulcer cannot be confirmed because it is obscured by slough or eschar. If slough or eschar is removed, a stage 3 or stage 4 pressure injury will be revealed.

Deep tissue pressure injury (DTI)

Intact or non-intact skin with localised area of persistent non-blanchable deep red, maroon, or purple discoloration, or epidermal separation revealing a dark wound bed or blood filled blister. Pain and temperature change often precede skin color changes. Discoloration may appear differently in darkly pigmented skin. This injury results from intense and/or prolonged pressure and shear forces at the bone-muscle interface. The wound may evolve rapidly to reveal the actual extent of tissue injury, or may resolve without tissue loss.

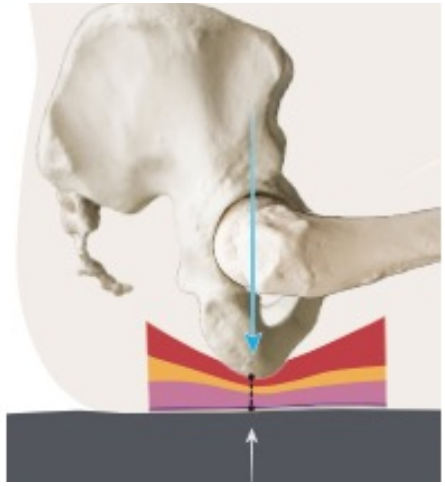




Above images provided by NPIAP show pressure injuries on both fair and darkly pigmented skin for reference.

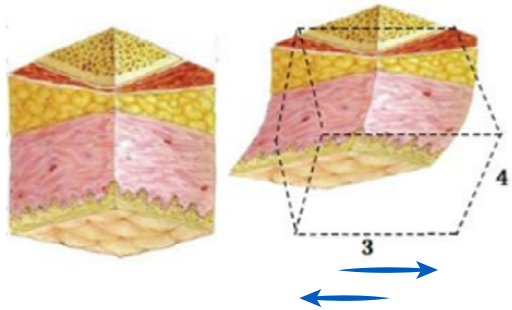
How does a pressure injury happen?

There are multiple forces acting on the body that change the shape of the skin and soft tissue between the support surface and the bony prominences.



Sustained loading compressed layers of tissue

Superficial skin and deeper tissues are distorted and damaged. Death at the cellular and tissue level occurs, resulting in a pressure injury.



Non-distorted tissue vs. distorted tissue

Do cells of the skin and soft tissue die because they are deprived of oxygen (ischaemia) or because they are deformed (deformation)? Or both?

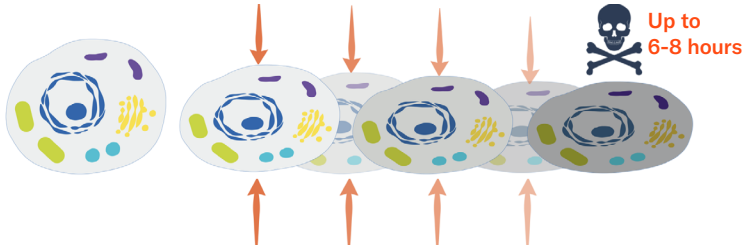
In the past, we thought pressure injuries were caused by ischaemia alone, as a result of external forces.

Ischaemia	Deformation
Occlusion of blood	Deformation of cells
Reduce oxygen	Cell membrane failure
Change in metabolism	Cell permeability increases
Accumulation of waste products	Disruption of the cytoskeleton
Decrease in pH	Decrease in pH
Cell death	Cell death

Tissue ischaemia is a decreased level of oxygen deliverability by the bloodstream that results in cell hypoxia.

From the seated posture, this occurs as a result of prolonged compression of the tissue.

High tissue deformations result in cell damage on a microscopic level within just a few minutes, although it may take hours of sustained loading for the damage to become clinically visible.



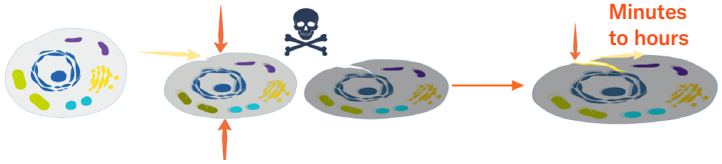
Ischaemia is only one component of tissue death

It's not just the blood flow we are worried about anymore!

Studies have shown that when ischaemia was taken out of the equation and the cellular structure was placed under direct deformation only, the cells died within MINUTES, which means... **deformation is the culprit!** It kills cells and tissues in multiple ways.

Cellular deformation is the process of permanently changing the shape or distorting the cellular structure.

In the seated posture this happens from compression, shear stress, and strain.



Why?

- The cellular membrane was stretched out and pulled too much
- The cytoskeleton was stretched too much
- Cells thin out and die off

Why are patients susceptible to pressure injuries in a seated posture?

The effects of intrinsic and extrinsic factors of a pressure injury.

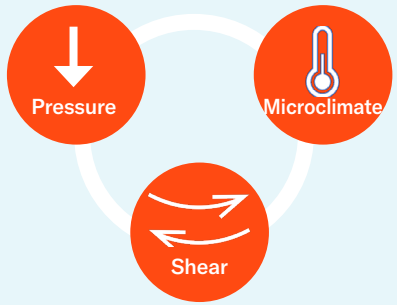
What are intrinsic factors?

Factors stemming from **within the body** that make an individual more susceptible to a pressure injury include:

- limited mobility
- impaired sensation
- age-related skin changes
- postural deformities
- poor nutrition and dehydration
- urinary and faecal incontinence
- obesity
- being underweight
- limited alertness
- muscle spasms
- smoking
- medical conditions affecting blood flow

What are extrinsic factors?

Factors that stem from the **outside environment and/or seating surface. Pressure, shear, and microclimate** are the extrinsic factors of a pressure injury. These are also factors we have greater control of.



Therapists can prevent the harmful effects of extrinsic factors through proper wheelchair positioning and equipment choices.

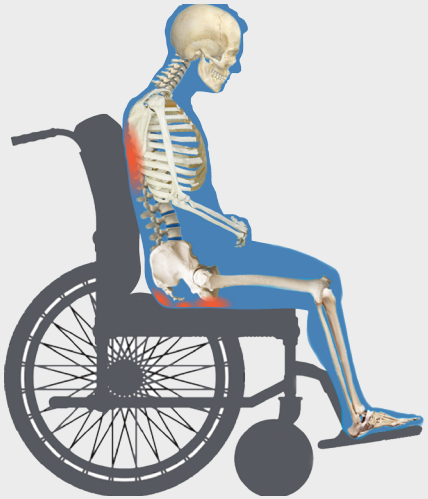
Pressure

What is pressure?

Pressure results when force is applied on or against an object by making contact. In seating, equipment such as the seat and/or back support surface are in contact with the body, creating pressure.

What are peak pressures?

Peak pressures are high pressure directly under or against the bony prominences. Without proper pressure redistribution through appropriate cushion and back choices, a pressure injury can result.

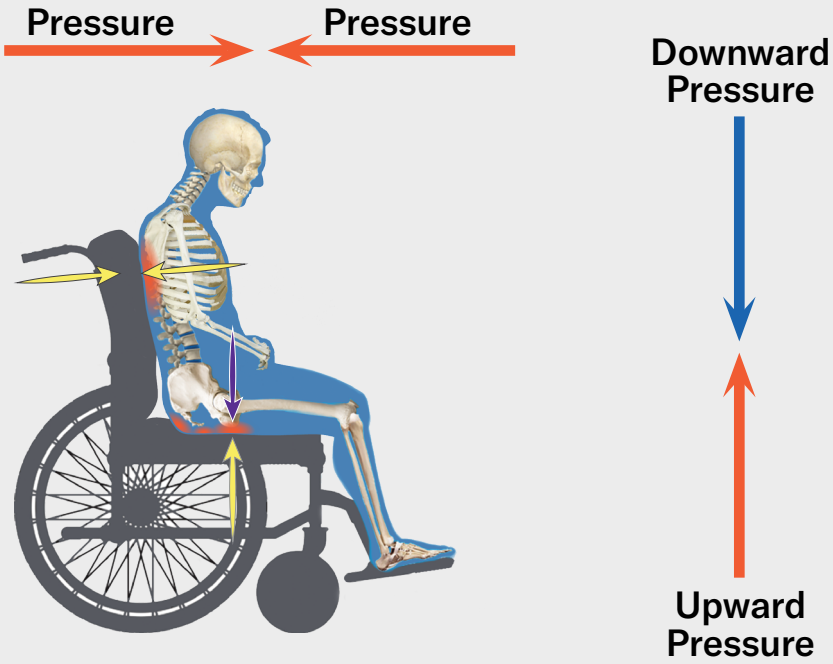


Peak pressures are commonly found at the ITs, sacrum, coccyx, and on the spinous process, injuring the skin and underlying tissue, muscle, and in extreme cases bone.

Where is there pressure on the seated body?

Everywhere it touches the seating system. Pressure from a seated posture comes from:

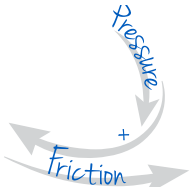
- downward force from gravity
- reactive force upward from the seat surface
- reactive force horizontally from the back support
- reactive force from every surface in contact with the **body**



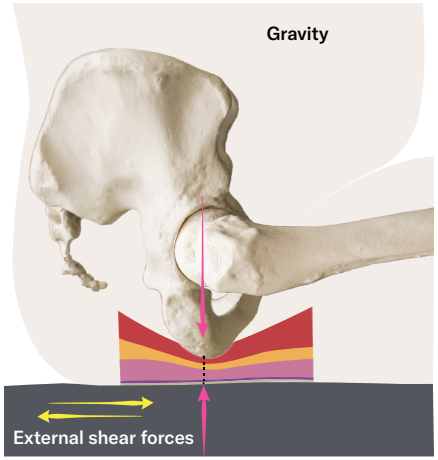
Make sure to look at the entire person and how they are positioned in the wheelchair and seating system, as pressure can occur in many locations.

Shear

What is shear? “Shear” is a commonly used clinical term that occurs in combination with pressure. It has multiple components.



External forces



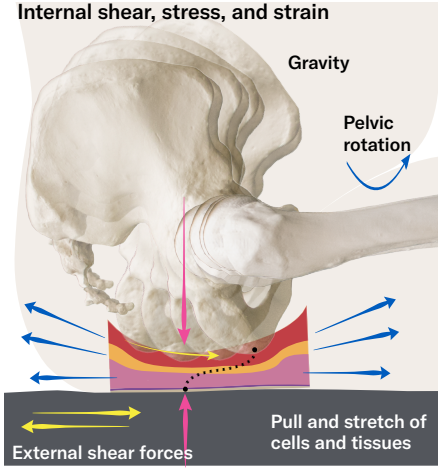
External to the body: shear forces act

- Between the body and the support surface. This can be thought of as the sliding/gripping between the body and support surface.

Internal to the body: shear, stress, and strain

- Result from external shear forces that pull and stretch the cells and tissues in multiple directions.
- This distortion leads to deformation induced cell and tissue death.
- Between the bony prominence and soft tissues, as gravity is pressing the skeleton downward and tissues are resisting

Internal shear, stress, and strain



Bottom line:
We want to minimise the external shear forces acting on the body, with our support surfaces and wheelchair configuration. This will help protect internal tissues and cells from deformation, which can cause pressure injuries.

When does shear commonly occur in the wheelchair system?

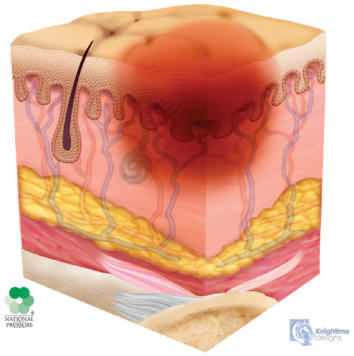
- While the patient is sliding into an abnormal posture **due to an ill-fitting wheelchair system.**
- When there is unwanted movement in a wheelchair **due to a lack of pelvic and/or trunk stability.**
- **With patients** that may be agitated and constantly shifting, repositioning, and reaching while in the wheelchair system.
- **During transfers** in and out of the wheelchair.
- When **repositioning a patient multiple times** in the wheelchair system by **dragging their pelvis** into a “better” position.

The goal of support surfaces in pressure injury management is to help the tissue keep its shape and minimise deformation.

Why do we refer to shear as the “silent” extrinsic factor?

Generally, as healthcare providers, we are more familiar with pressure injuries starting superficially at the epidermis and then moving deeper through the layers of skin as it progresses.

Deep tissue pressure injury (DTPI) is very prevalent, due to the higher stress and strain values experienced directly under the bony prominences, deep in the tissues.

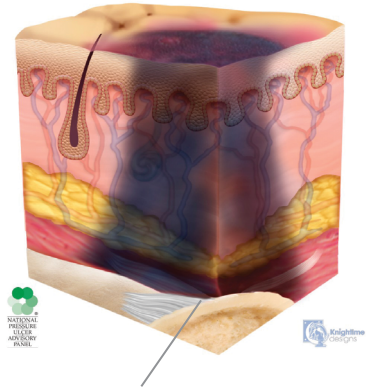


We begin treatment when we notice the telltale visual signs of:

- reddening of the skin
- temperature change

However a pressure injury caused by shear is “silent” because it:

- begins in the deeper layers of the skin at the bone-tissue interface
- **forms from the inside and expands** outward to the surface of the skin
- goes undetected longer since the pressure injury gives no telltale visual signs to begin intervention early



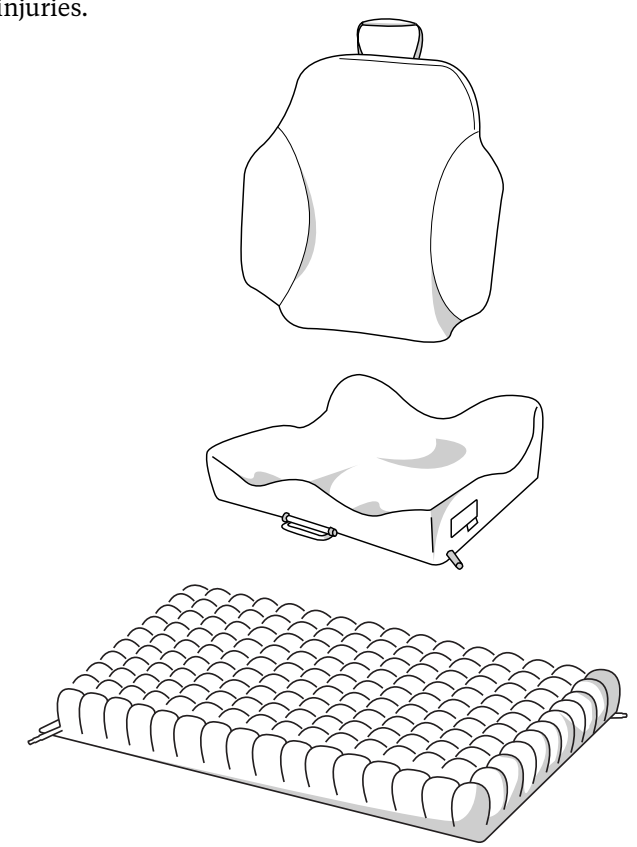
Bone-tissue interface

By the time a pressure injury caused from shear forces is visible, it usually is already at a very advanced stage.

What part of shear can I impact?

The CPG is clear that minimising pressure and shear loads at the interface between the body and the support surface (cushion, back support, mattress, wheelchair) is imperative.

By selecting the appropriate skin protection and support surfaces, we can help to reduce shear strain and minimise deformation in the management and prevention of pressure injuries.



Teaching a pressure relief routine is not enough! We need to provide a surface that will help the person maintain their tissue shape and reduce deformation.

Microclimate

What is microclimate?

Microclimate refers to the temperature, humidity, and airflow next to the skin surface. The CPG notes that an increasing body of evidence suggests that the microclimate between skin and the supporting surface play a role in the development of pressure injuries.

How is microclimate created?

Increased body temperature at the skin surface, increased tissue temperature, **and/or** increased moisture at the skin surface due to:

- sweat
- urinary or faecal incontinence
- drainage from wounds
- sitting on a non-breathable seat surface preventing ventilation
- contact with a non-breathable support surface

How does microclimate increase the effects of pressure and shear?

Raised skin temperature and excessive moisture weaken the outermost layer of skin, making the superficial and deeper layers, tissue, muscle, and bone more susceptible to pressure and shear forces.

Elevated body temperature:

- increases metabolic rate, in turn increasing the demand of O2 to be delivered to the tissues
- pressure and shear cut off O2 supply
- as demand increases but supply decreases, ischaemia occurs more quickly than when the body temperature is normal

Excessive moisture:

- increases the skin's coefficient of friction, making the skin and deeper tissues "stick" more easily to the seat surface when shear forces are applied
- weakens the collagen fibre connections between the dermis and the epidermis and increases the risk of maceration
- increases the risk of maceration, which:
    1. weakens the collagen fibre connections between the dermis and epidermis, and increases the risk of maceration and damage from stress and strain
    2. makes blood vessels more susceptible to tearing and damage from stress and strain

Global experts

Are there leaders in pressure injury management that can guide me in prevention and treatment considerations?

There are global leaders that collaborate to provide state-of-the-art recommendations for best practice based upon literature review, research, and product test standards.

These leaders include:

- Pan Pacific Pressure Injury Alliance (PPPIA)
- National Pressure Injury Advisory Panel (NPIAP)
- European Pressure Ulcer Advisory Panel (EPUAP)
- International Organisation for Standardization (ISO)
- Rehabilitation Engineering and Assistive Technology Society of North America (RESNA)
- American Nation Standards Institute (ANSI)

Who are the NPIAP, EPUAP, and PPPIA and what is the Clinical Practice Guideline (CPG)?

The NPIAP, EPUAP, and PPPIA are independent not-for-profit professional organisations composed of leading experts from different healthcare disciplines, who share a commitment to the prevention and management of pressure injuries.

These international authorities performed a comprehensive literature review, critically appraised the research, and published the CPG as a global consensus reference. These guidelines assist health professionals, consumers, and informal caregivers to make evidence-based decisions in the prevention and treatment of pressure injuries.

Why should I consider what the CPG says about pressure injury management?

The CPG includes a critical assessment of over 3,500 peer-reviewed articles, by over 100 global recognised experts, and achieved international consensus.

This latest revision in 2019 includes recommendations regarding bed surfaces and wheelchair seating surfaces (cushions and back supports). The CPG is shining a light on the importance of consistently applying best practice when choosing all support surfaces, in any setting across the continuum of care. This is a shared partnership between:

- doctors
- nurses
- therapists
- clinical nurse consultants and specialists
- consumers

"The CPG guide is intended to apply to all clinical settings, including acute care, rehabilitation care, long term care, assisted living at home, and unless specifically stated, can be considered appropriate for all individuals with or at risk of pressure injuries." *-Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline, 2019*

What other evidence can be considered when making decisions about pressure injury management?

Standardised tests that quantify performance characteristics of support surfaces have been developed to assess support surface capabilities, which can be connected to user's needs.

Who develops these standardised tests, and what are they?

Authorities that develop standardised testing are:

- International Organisation for Standardization (ISO)
- Rehabilitation Engineering and Assistive Technology Society of North America (RESNA)
- American Nation Standards Institute (ANSI)

These multi-disciplinary volunteer organisations have published standard test methods for quantifying characteristics for mattresses and cushions. Measurements include:

- immersion
- envelopment
- heat and water vapor dissipation
- horizontal force
- and more...

These test methods objectively compare the properties of cushions and mattresses.

At-risk clients

Who is at risk for pressure injury?

There are both intrinsic (stemming from within the body) and extrinsic (stemming from the environment) factors that increase a person's risk for a pressure injury.

The CPG lists a number of contributing or compounding intrinsic factors associated with pressure injuries:

- impaired mobility
- limited activity
- previous/current pressure injury
- alterations to skin status over pressure points
- diabetes melitus
- perfusion and circulation deficits
- oxygenation deficits
- impaired nutrition
- moist skin
- increased body temperature
- older age
- impaired sensory perception

The CPG identified impaired mobility as the number one risk factor. This affects every person using a wheelchair as a primary mobility device.

Why are patients susceptible to pressure injuries in a seated posture?

While seated, our patients are more susceptible to the extrinsic factors of a pressure injury due to:

- 40-90% more stress going directly through the spine than when standing
- 75% of weight going through the pelvis

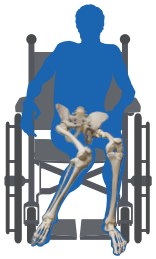
This makes it **imperative** that we position our patients with the **appropriate seating system** to prevent them from sliding into one of the five postural asymmetries shown below, when coupled with skin changes and exposure to the extrinsic factors, place them at even greater risk for a pressure injury.

These are the five most common postural asymmetries caused by inappropriate wheeled mobility systems in a seated posture:

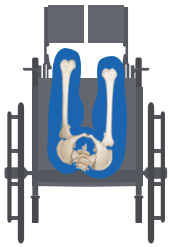
Posterior pelvic tilt with kyphosis

Pelvic obliquity with scoliosis

Anterior pelvic tilt with lordosis



Windswept deformity



Pelvic rotation with spinal rotation

Why is a wheelchair user's skin more susceptible to a pressure injury?

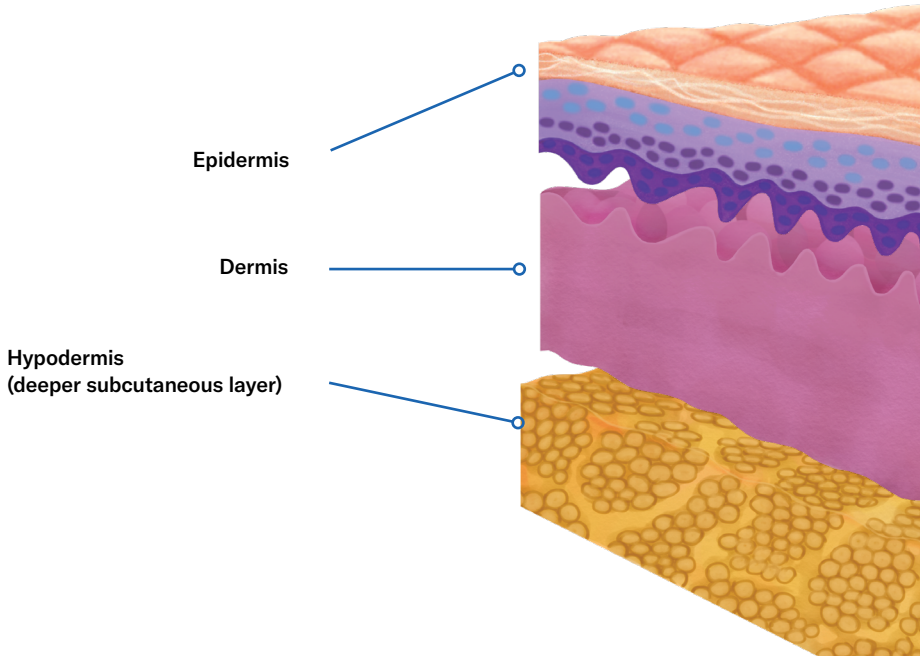
Recall that the CPG states that the primary factor associated with the risk of a pressure injury is immobility, making a wheelchair user automatically at higher risk for the development of a pressure injury.

Other factors alter skin integrity, making a wheelchair user's risk even higher such as:

- disease processes known to directly affect skin integrity such as Insulin-Dependent Diabetes Mellitus (IDDM), vascular insufficiencies, etc.
- the natural progression of aging

What layers of skin become compromised with disease and/or aging?

Since changes occur at each layer of the skin through disease processes and/or natural aging, ALL the layers are compromised and make an individual more susceptible to a pressure injury.



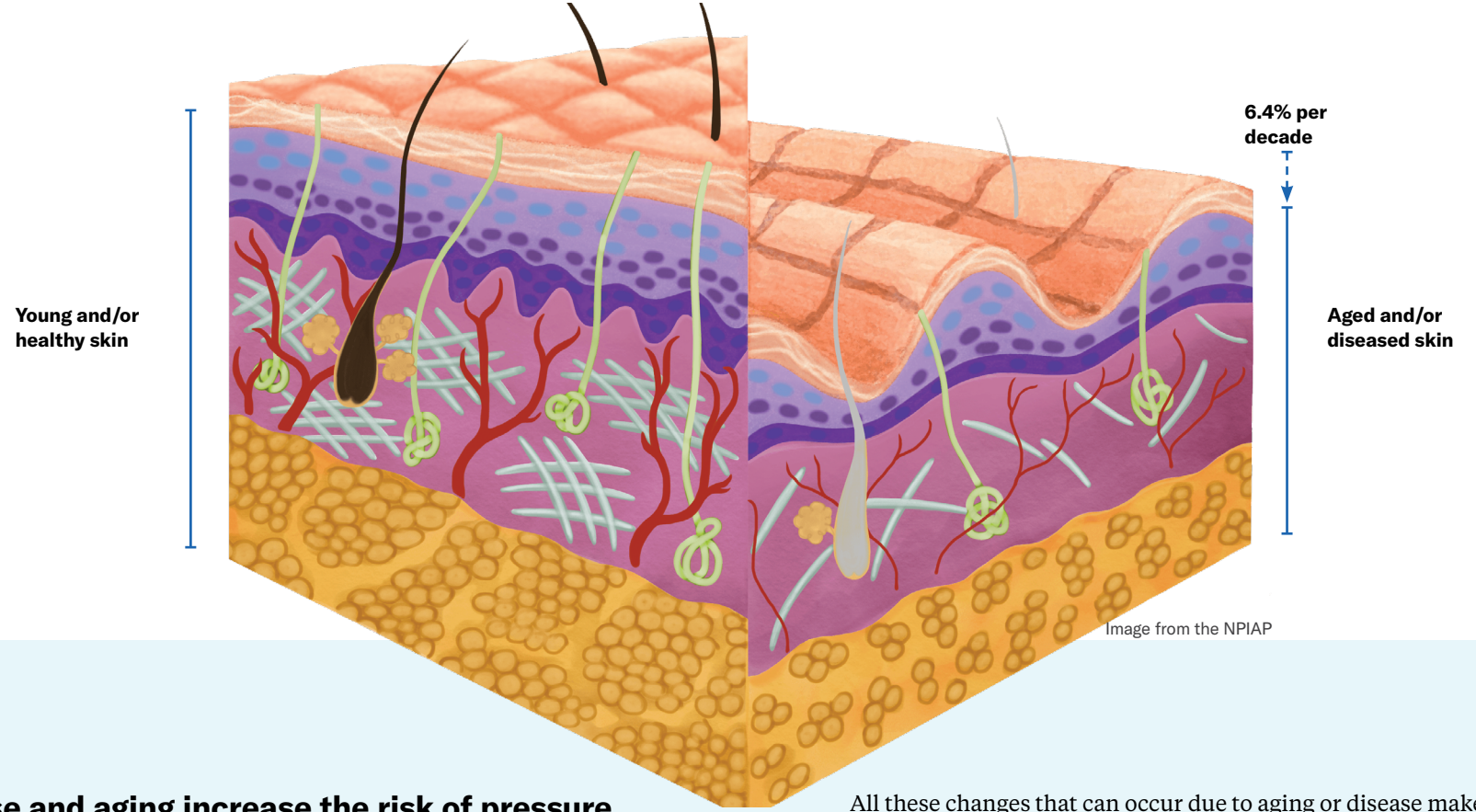


Image from the NPIAP

Why do disease and aging increase the risk of pressure injury development?

Chronic disease and age cause:

- decreased overall skin thickness
- decreased number of sebaceous glands and sweat glands
- decreased vasularisation
- reduction and disorganisation of collagen and elastin fibres
- loss of Langerhans cells
- flattening of the dermal-epidermal junction
- loss in effectiveness of the nerve endings
- redistribution of fat cells
- loss of connective tissue of the hypodermis

All these changes that can occur due to aging or disease make the skin more susceptible to pressure injuries. The skin balance and function are compromised when:

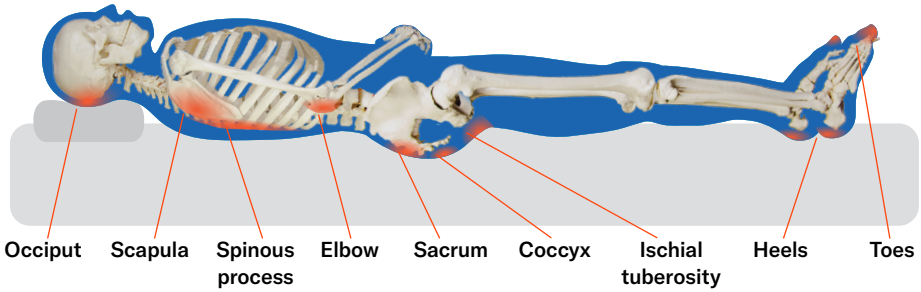
- oxygen and nutrients are not transported as easily
- skin is thinner, drier, and more brittle
- protective barriers are minimised
- resiliency is lost
- thermal regulation is impaired
- pain sensors/reactions are dulled

With all these changes, skin is more easily damaged by pressure, shear, and microclimate. Once a pressure injury occurs, it is more difficult to heal compromised skin.

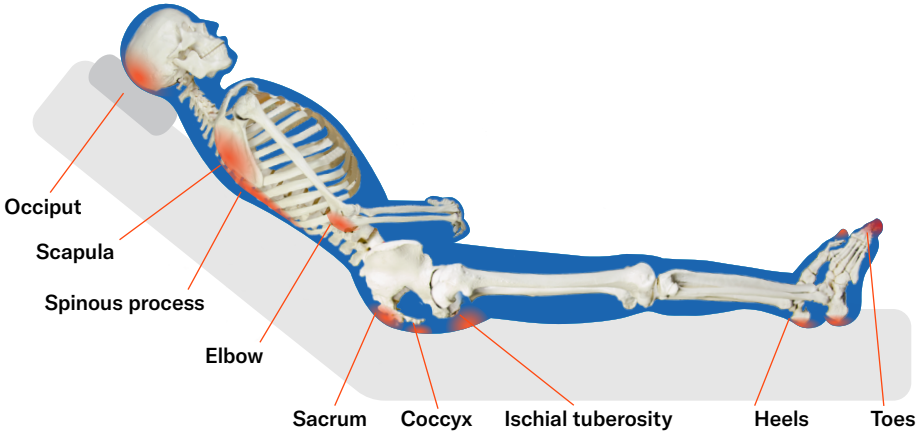
Where do pressure injuries most commonly occur?

Most patients who develop a pressure injury spend the majority of their time in bed or in a wheelchair, placing the skin and tissue under the bony prominences at risk. These “at risk” areas are almost identical in bed and in the wheelchair, making it imperative to simultaneously prevent and treat pressure injuries from the supine and seated postures.

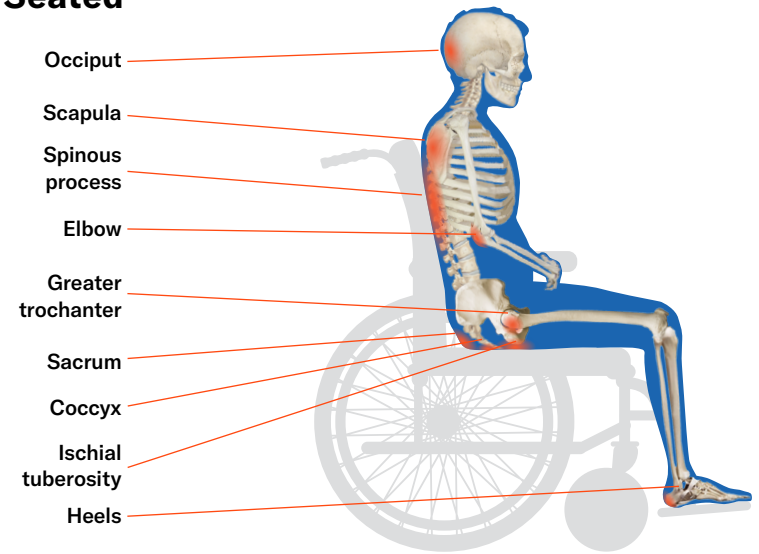
Supine



Semi-recumbent



Seated



What can I do to minimise the risk of or to treat pressure injuries in these areas?

The use of skin protection support surfaces is necessary as part of your pressure injury management program. Unlike a basic or general use product, skin protection support surfaces are constructed with properties to maximise pressure redistribution and stability.

Support surfaces

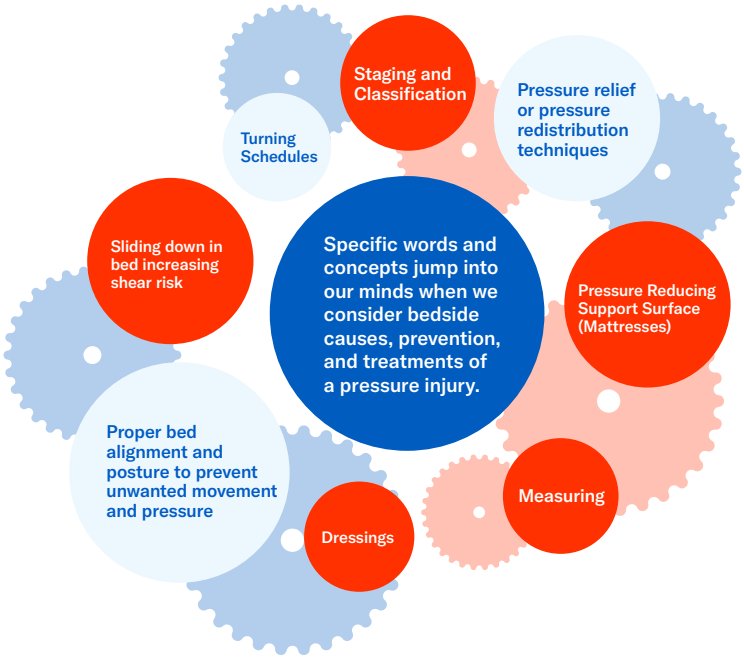
What are "support surfaces"?

Support surfaces are any surface supporting the body for optimal posture and function.

What are we missing in the treatment of a pressure injury?

As healthcare providers—especially doctors, nurses, and specialised therapists in wound care—we understand **bedside treatment** well. We search for the most appropriate support surfaces and stay up-to-date with the most innovative techniques to promote healing and prevention of new pressure injuries.

However, too often we forget a critical piece of the puzzle in the fight against pressure injuries: **prevention and treatment at the wheelchair level!**



The words and concepts above jump to mind when discussing pressure injuries and they are just as critical to understand from the seated posture as they are in supine.

What support surfaces should I be thinking about with a person who is at risk?

Every surface in daily use needs to be taken into consideration:

- mattress and mattress overlays
- wheelchair cushions and back supports
- commodes/toilets
- shower bench
- travel seats and recreational seating

This guide will focus primarily on considerations for mattresses, wheelchair cushions, and wheelchair back supports.

Will any support surface protect my at-risk client?

Skin protection support surfaces, unlike basic or general use products, are constructed with properties to maximise pressure redistribution and stability for optimal posture and function. These help to minimise PI risk when any of the above risk factors are identified.

Specialty support surfaces, as defined by the CPG are, “specialised devices for pressure redistribution designed for **management of tissue loads, microclimate, and/or other therapeutic functions** (i.e. a mattress, integrated bed system, mattress replacement, overlay, or seat cushion, or seat cushion overlay).

Support surfaces alone neither prevent nor heal pressure injuries, but support surfaces play a **significant** role in an individualised comprehensive management plan **for pressure injury prevention and treatment**.

All at-risk clients should be utilising specialised skin protection support surfaces both in bed AND in their wheelchair.

What are the CPG recommendations for support surfaces?

Support surfaces are an important element in pressure injury prevention and treatment because they **can prevent damaging tissue deformation and provide an environment that enhances perfusion of at-risk or injured tissue**.

The CPG recommends the following Good Practice Statements (GPS) for an at-risk client:
Select a support surface that meets the individual's need for pressure redistribution based on the following factors:

- level of immobility and inactivity
- need to influence microclimate and shear reduction
- size and weight of the individual
- number, severity, and location of existing PIs
- risk for developing new PIs *7.1*

- For individual's with obesity, select a support surface with enhanced pressure redistribution, shear reduction, and microclimate features. *7.3*
- For individuals with a PI, consider changing to a specialty support surface when the individual:
  - cannot be positioned off the existing PI
  - has PIs on two or more turning surfaces that limit repositioning options
  - has a PI that fails to heal or the PI deteriorates despite appropriate comprehensive care
  - is at high risk for additional PI
  - has undergone flap or graft surgery
  - is uncomfortable
  - "bottoms out" on their current support surface *7.9*
- Select a wheelchair seat and seating system support surface that meets the individual's need for pressure redistribution with consideration to:
  - body size and configuration
  - effects of posture and deformity on pressure distribution
  - mobility and lifestyle needs *7.11*
- Use a pressure redistribution cushion for preventing pressure injuries in people at high risk who are seated in a chair/wheelchair for prolonged periods, particularly if the wheelchair is unable to perform pressure-relieving manoeuvres. *7.12*
- Use a bariatric pressure redistribution cushion designed for individuals with obesity on seated surfaces. *7.14*
- For individuals with, or at risk for, a pressure injury, consider using a pressure redistributing support surface during transit.

The CPG recommends the following for mattresses:

- Ensure that the bed surface area is sufficiently wide to allow turning of the individual without contact with the bed rails. *7.2*
- Use a high specification reactive single layer foam mattress or overlay in preference to a foam mattress without high specification qualities for individuals at risk of developing pressure injuries. *7.4*
- Consider using a reactive air surface or overlay for individuals at risk for developing pressure injuries. *7.6*
- Assess the relative benefits of using an alternating pressure therapy (APT) air surface. *7.7*
- Use a pressure redistribution support surface on the operating table for all individuals with, or at risk of, pressure injuries who are undergoing surgery. *7.8*
- Consider using continuous bedside pressure mapping as a visual cue to guide repositioning. *5.7*

What is the role of specialty support surfaces?

When immobility is a key issue, the seat support surface should redistribute pressure away from high risk areas through the methods of pressure redistribution.

Pressure distribution methods

How do I redistribute pressure away from high-risk areas?

The risk for pressure injury increases when force is concentrated over a small surface area creating high pressures (Figure 1). By using the pressure redistribution methods of immersion, envelopment, and/or offloading, we are able to spread that same force over a greater surface area, thereby reducing pressure and the risk of pressure injury development.

Cushion construction achieves pressure redistribution in one of two methods: immersion/envelopment, or redirection/off-loading (CPG – 10 Support Surfaces)

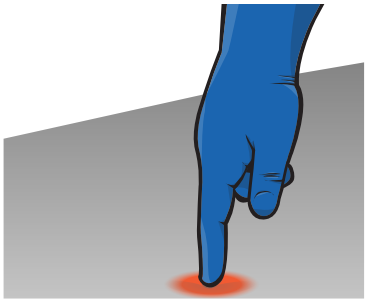


Figure 1

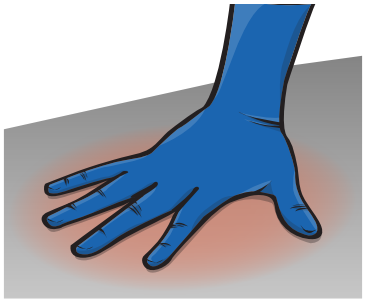


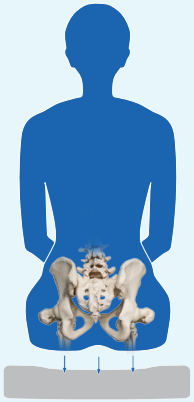
Figure 2

Force, when concentrated in a small surface area, creates high peak pressures (see Figure 1). When the force is spread over a greater surface area, the peak pressure is reduced (see Figure 2).

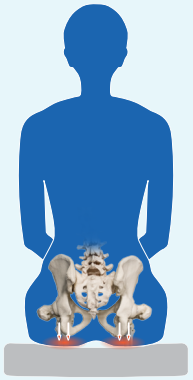
According to the CPG, when immobility is a key issue, the seat support surface should redistribute pressure away from high risk areas. The method we choose should be based on the individualised needs of the client.

What is offloading?

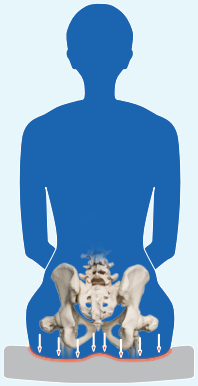
The principle of **taking pressure off a small surface area** and **loading it onto a greater surface area** that can withstand more pressure, preventing unwanted skin breakdown.



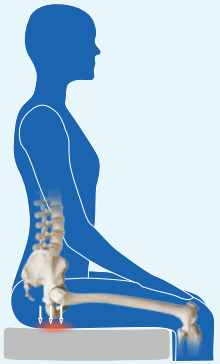
Before loading



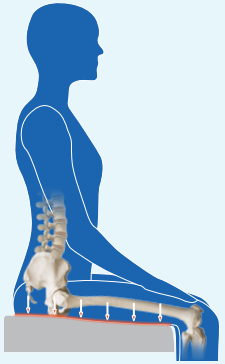
Without offloading
Peak pressures
under the ITs



With offloading
Loading the
trochanters



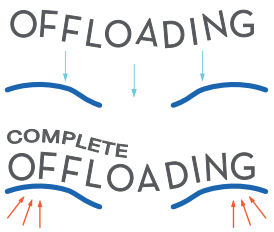
Without offloading
Peak pressures
under the ITs

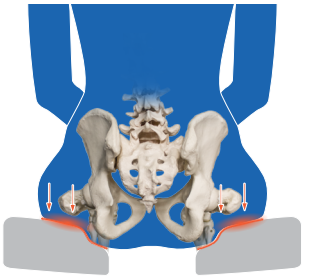


With offloading
Loading the trochanters
and femur

Complete and partial offloading

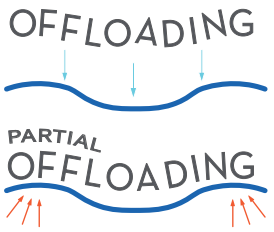
Complete offloading is the principle in which pressure is completely removed from a small, vulnerable surface area and loaded onto a greater surface area of more tolerant tissue to provide pressure redistribution and reduction of peak pressures.

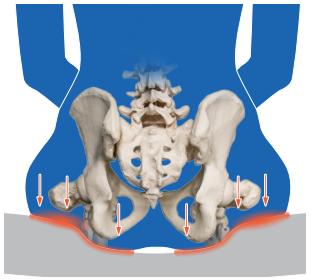




This relocates pressure to more tolerate areas.

With **partial offloading,** instead of completely removing contact from the small, vulnerable area, contact is still partially made between the body and support surface. Peak pressures are greatly reduced by being spread over a greater surface area. Highest pressure is still relocated to more tolerant areas of the body.





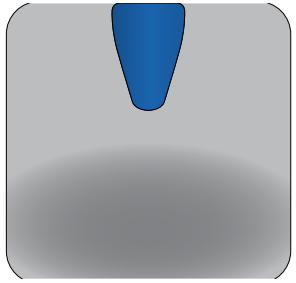
This relocates higher pressure and increases surface area.

How is the pressure loaded onto a greater surface area?

This is achieved through the built-in contours of a cushion that help align and stabilise the spine, pelvis, and LEs to allow the pressure and shear forces to be transferred to a greater surface area.

Contours needed for offloading pressure

Deep posterior pelvic well
When combined with lateral tapered thigh supports, **offloads and suspends the ITs, sacrum, and coccyx and loads the femurs.**

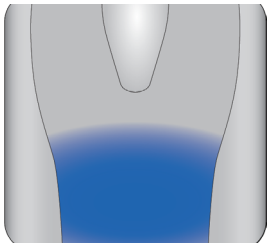


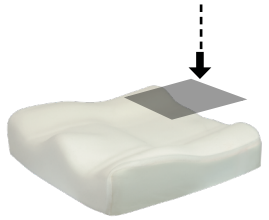
Medial thigh support
Align the LEs and prevent adduction and internal rotation for maximum femoral loading.

Lateral tapered thigh support
Align the LEs and prevent abduction and external rotation for maximum femoral loading.
Assist to load the trochanters.

Posterior pelvic well

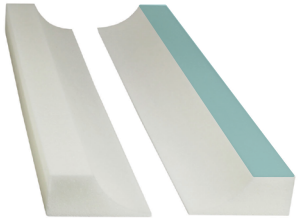
- Delineates where the pelvis is supposed to be on the cushion for stabilisation and pressure redistribution.
- Works in combination with lateral tapered thigh supports.
- Loads the femurs.
- Offloads and suspends the ITs, sacrum, and coccyx.

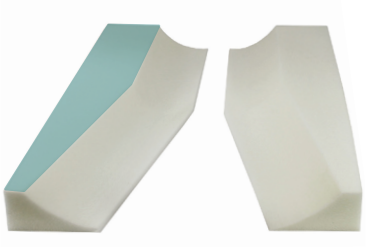




Lateral thigh/hip supporter

There are two styles of lateral thigh/hip supporter, straight and tapered. They both provide LE alignment. Tapered lateral thigh/hip supporter also have an offloading function for the pelvis.

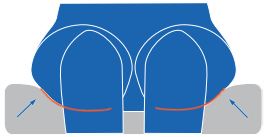




Straight lateral thigh/ hip supports

- Can be rear, front, or entire length of cushion.
- Act as a boundary to assist with LE alignment.
- Prevent abduction of LEs.

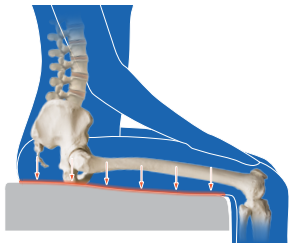
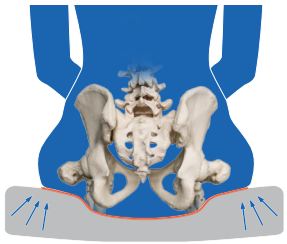




Benefits of using straight lateral thigh/hip supporter
Provides proprioceptive input to the lateral surface of the legs to help with LE alignment.

Tapered lateral thigh/ hip supports

- Wider in the rear to form a shelf where the trochanters sit.
- Allows for loading of trochanters and femurs for pressure redistribution.
- Locks the head of the femur into the acetabulum, stabilising the pelvis.
- Promotes offloading of the ITs, sacrum, and coccyx.

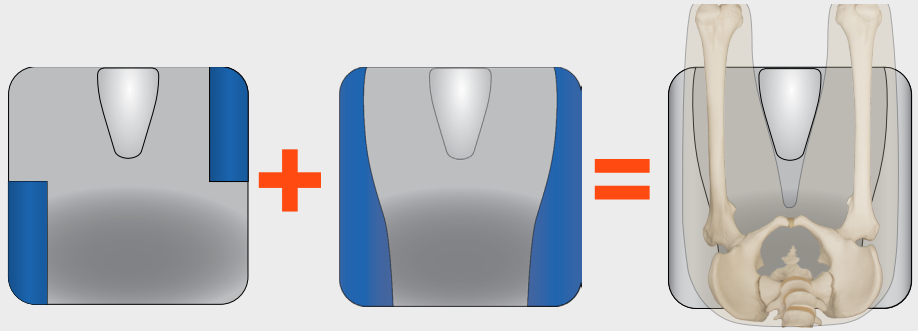




Benefits of using tapered lateral thigh/ hip supports

- Optimal offloading.
- Pelvic stability for patients with trunk and pelvic weakness.
- Minimises unwanted shifting in chair PLUS pressure redistribution.

Medial thigh supports

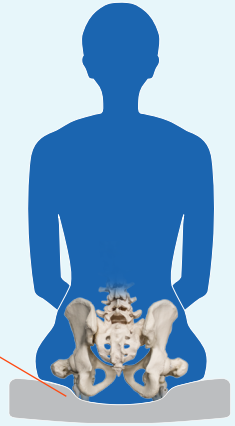
- Minimises adduction of LEs and promotes LE alignment.
- Helps create leg troughs **when combined with LTS.**



Always consider the anatomical shape of your patient and whether they will “fit” in the contours.

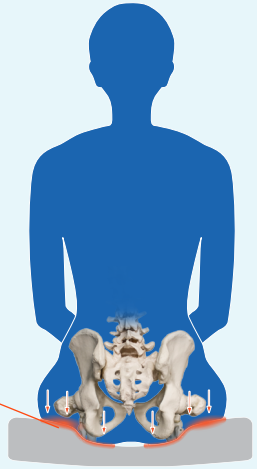
Benefits of using an offloading cushion

- Firmer surface creates a “safer” end feel for patients.
- Provides more stability to someone lacking trunk or pelvic strength in order to prevent unwanted movement.
- Partially or completely suspends the ITs, sacrum, and coccyx.
- Redistributes pressure to areas that can withstand more pressure, i.e. femurs and greater trochanters.



Considerations of using an offloading cushion

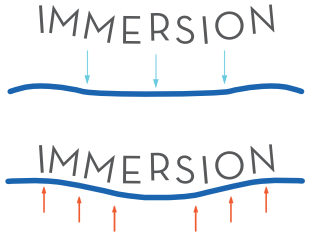
- Not good for patients with trochanter wounds since pressure is redistributed to that area.
- May not be suitable for someone with hypersensitivity due to the firm feel.
- Through the nature of the contours adding more stability and “locking in” the pelvis, it may be more difficult for independent transfers.
- Someone with significant contractures may not “fit” the pre-contoured shape.

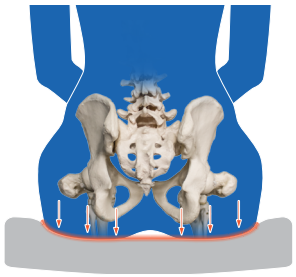


What are immersion and envelopment?

Immersion

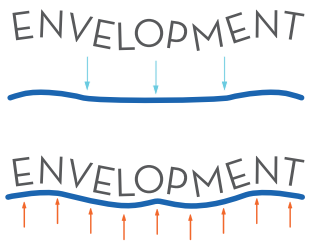
The principle in which a material allows the body to **"sink"** into it and provide some pressure redistribution.

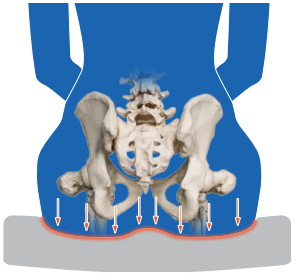




Envelopment

The principle in which a material allows the body to "sink" into it **while the material conforms to the body's shape** to create the greatest surface contact between the body and the support to reduce peak pressures.

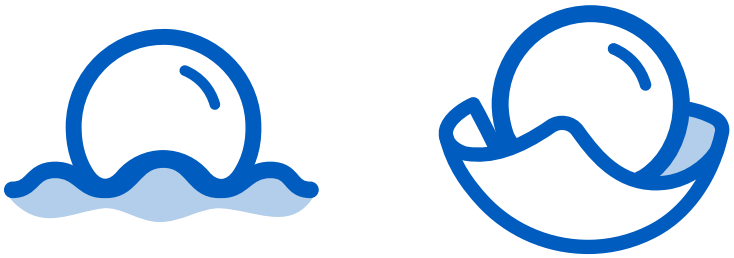




Using immersion and envelopment cushions

Benefits

- Less firm surface, creating a "softer" end feel for the client.
- Envelops or captures the exact curvature of the pelvis to increase pressure. redistribution over the largest area possible.
- Reduces peak pressures at the bony prominences (ITs, sacrum, coccyx).
- May be easier for transfers.



Envelopment

Immersion

Considerations

- Some styles may be less stable and may not be suitable for someone with trunk and pelvic weakness causing fatigue with prolonged, upright posture.
- May not be suitable for someone who desires proprioceptive input from a firmer surface to maintain an upright, midline, posture.
- Some immersion-style cushions require upkeep and could increase peak pressures if not properly maintained.

Are there tests for immersion and envelopment properties of mattresses?

How can I compare support surfaces?

There are standardised tests available from ANSI/RESNA, and additional ISO methods are under development:

RESNA SS-1 Support Surfaces Volume 1: Requirements and Test Methods for Full Body Support Surfaces

- Section 2: Standard protocol for measuring immersion in: full body support surfaces
- Section 6: Envelopment and Immersion – Hemispherical Indenter Test
- Section 7: Envelopment with Dual Semi-spherical Indenter Test

Are there standardised tests for cushions?

There are standardised tests for wheelchair support surfaces, to measure immersion and envelopment, published by both ANSI/RESNA and ISO:

RESNA WC-3 Wheelchairs Volume 3: Wheelchair Seating

- Section 2: Determination of physical and mechanical characteristics of devices intended to manage tissue integrity seat cushions
- Section 12: Envelopment testing of seat cushions with dual semi-spherical indenter

ISO 16840-2 Wheelchair seating Part 2: Determination of physical and mechanical characteristics of devices intended to manage tissue integrity seat cushions

ISO 16840-12 Wheelchair seating Part 12: Apparatus and method for cushion envelopment testing

Depth of immersion allowed by the cushion design can be measured and evaluated. The CPG recommends 1.6-1.7 inches (40-45 mm) of immersion for most individuals into the surface of the cushion to adequately support the pelvis.

The immersion test is based on these dimensions, and has, for example, been adopted in the US as a “pass/fail” measure to evaluate whether a cushion can be classified as “skin protection”.

The method of cushion selection should be based on the individualised needs of the client.

Clinical expertise has shown that prevalence and incidence rates are generally higher in unique populations who are at elevated risk, such as those receiving palliative care, those with spinal cord injuries, neonates and children, and individuals in critical care or palliative care. Although direct comparisons between prevalence studies are confounded by different methodologies and clinical contexts, the evidence indicates that pressure injuries are a commonly occurring health concern globally.

We as doctors, nurses, therapists, end users, and caregivers should be aware of some key clinical practice guidelines discussing principles related directly to seating and wheeled mobility and/or common principles of pressure injury management relating to support surfaces when impaired mobility is the common theme in our world. Without listening to research-based suggestions, we are placing our clients or ourselves at risk for pressure injury development.

Does the wheelchair cushion alone protect against wounds?

It is true that we must utilise appropriate skin protection cushions. However, the wheelchair back support, features, and set-up (or configuration), are just as critical to create even pressure distribution in order to minimise risk of pressure injury or aid in healing. Considerations for every surface in use should also be part of the intervention (toilet, mattress, shower chair, etc).

This makes it **imperative** that we position our clients with the **appropriate seating system** to prevent them from sliding into one of five asymmetrical postures shown below that, when coupled with skin changes and exposure to the extrinsic factors, place them at even greater risk for a pressure injury.

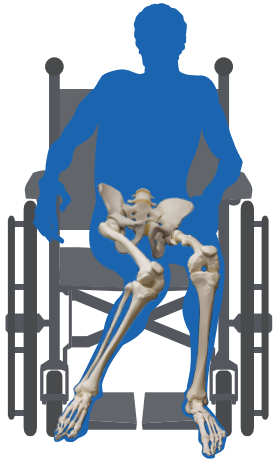
What is the role of the back supports?

There are multiple benefits to using a specialty back support to optimise posture and minimise the risk of a pressure injury, including:

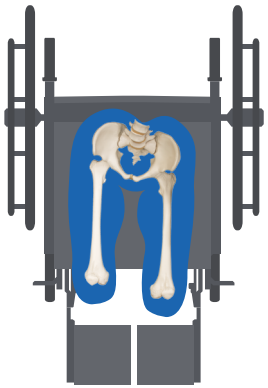
- provides adjustability of seat-to-back angle (STBA) to more accurately match the body angles found in the assessment
- capture the curvature whether normal or abnormal for optimal upright, midline posture
- allow for even pressure redistribution to alleviate peak pressures along the spinous processes

Anterior pelvic tilt/
excessive lordosis

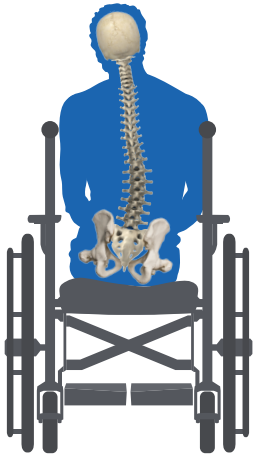
Posterior pelvic tilt/
kyphosis



Windswept
deformity



Pelvic rotation/
spinal rotation



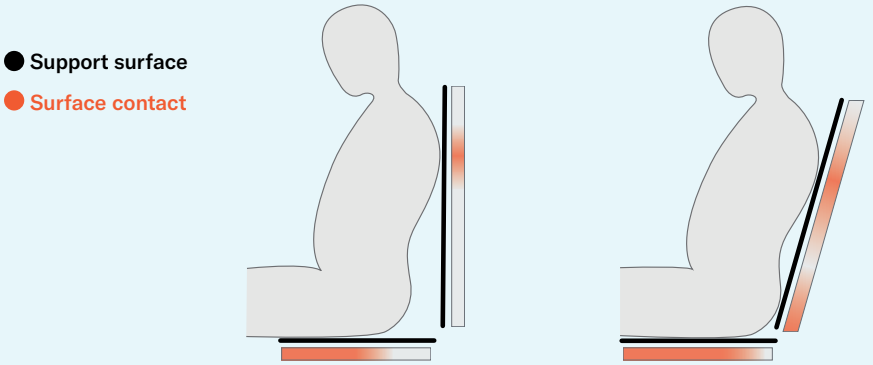
Pelvic obliquity/
scoliosis

The importance of seat-to-back angle (STBA) in pressure redistribution

What is STBA and how does it affect pressure redistribution?

STBA is too often misunderstood to be tilt. IT IS NOT tilt but rather the relative angle between the seat and the back support that can be opened or closed to accommodate for ROM limitations. This allows for **more surface area contact between the person and the support surfaces (back support and cushion)** for pressure redistribution.

Look at the difference opening the STBA can make in the amount of contact made with the support surfaces for a person with the same ROM limitation.



Fixed 90°
Small surface area, high peak pressures

Open STBA
Greater surface area, lower pressure

Adjusting STBA

- Use a wheelchair model that has built-in STBA adjustability through the back canes **and/or**
- use a specialised back support that can change STBA through the hardware.

What do we gain by adjusting STBA?

Utilising chairs with fixed 90° angles increases the risk of sliding into postural asymmetries if the wheelchair user cannot tolerate sitting upright at 90° at the hips.

Therefore, opening or closing STBA according to the patient's ROM will allow for:

- maximum contact with the back and seat surface
- pressure redistribution off of the bony prominences
- the pelvis to reside in the intended area of the cushion
- stabilisation at the pelvis and spine

Why worry about providing a more supportive, adjustable back support?

individuals at risk for pressure injuries often present with an abnormal curvature of the spine that is now their "normal."

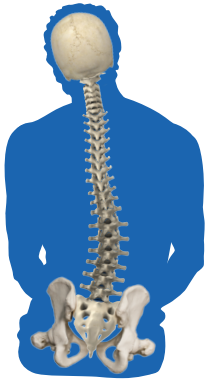
If we allow wheelchair users to sit on sling backs or straight back chairs that cannot mimic their now "normal" shape, pressure will enter only at the apex of the curvature.

Specialised back supports allow for immersion and allow for conformity to abnormal curvatures, which will protect the spine from peak pressures.

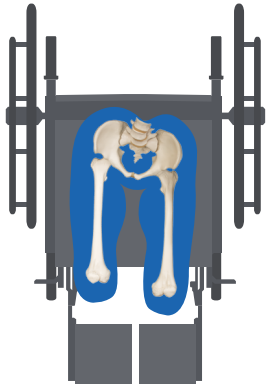
What are the common abnormal spinal postures?

Kyphosis

Lordosis



Scoliosis



Pelvic rotation/spinal rotation

How does a specialty back support help reduce the risk for a pressure injury?

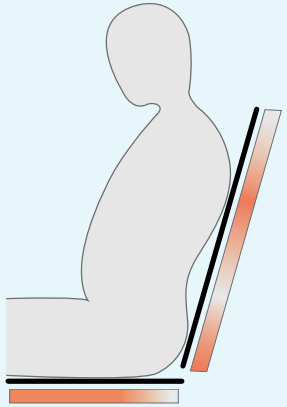
- Allows for optimal contact with seat and back support surface
- Provides even pressure redistribution along the spine
- Reduces shear forces by maximising stability of the spine and, in turn, the pelvis to prevent unwanted movement in the chair

Taking it one step further

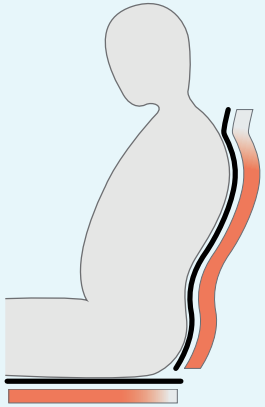
Look at the difference you can achieve in the amount of contact made with the support surfaces, even after opening the STBA, when using a back support that can conform to the spine

● Support surface

● Surface contact



Open STBA
Greater surface area, lower pressure



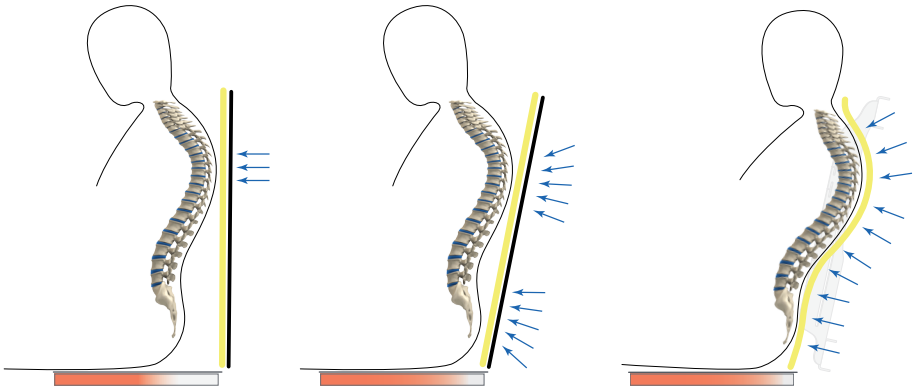
Open STBA + contour
Even pressure along the entire back

Pelvic stability and alignment can be achieved with the assistance of a back support. A common mistake is the thought that a cushion alone corrects the pelvis. The back support plays a critical role in pelvic correction!

What should a clinical team aim for?

When selecting a back support consider the individual's range of motion (ROM), muscle integrity, and joint integrity. Take a measurement of the **tolerable hip ROM that would dictate the STBA** and adjust the chair accordingly.

- Open or close the seat-to-back angle to accommodate for the client's degree of hip ROM and to reduce the likelihood of them sliding into a postural asymmetry.
- Change seat-to-back angle to allow for more contact with the back support and seat surface and reduce peak pressures.
- Use a back support that conforms to the patient's curvature for maximum pressure redistribution along the ENTIRE spine.



Fixed 90°
Peak pressure
at the apex
Not Ideal

Open STBA
More surface contact
matches patient ROM
Better

Open STBA + contour
Optimal pressure
redistribution
Best

Myth busters

Myth #1: A person with a pressure injury should be on bed rest

A wheelchair that has features or seat functions such as tilt, recline, and elevating legrests can promote wound healing, while allowing the person to be out of bed and more active. Additionally, wheelchairs that have standing function allow for offloading of the wound area.

These positions cannot be provided by the bed, and the wheelchair allows for mobility and reduction of secondary complications that result from bed rest:

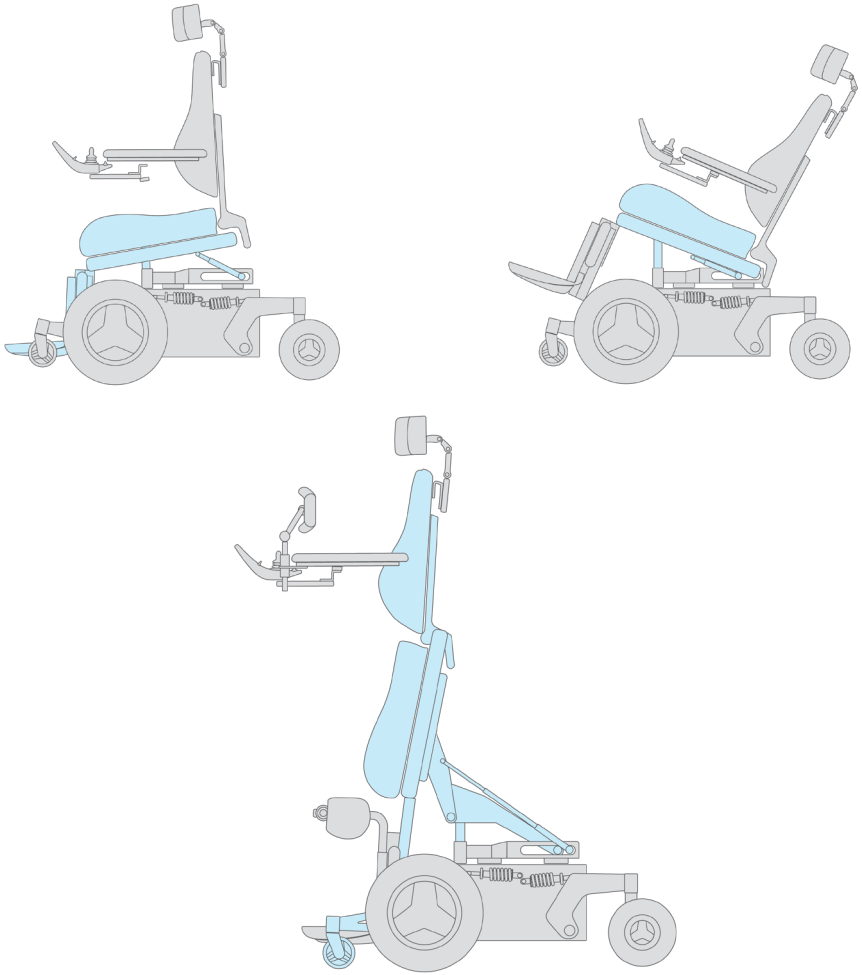
- Pulmonary complications
- Mental health issues
- Digestive issues
- Cardiovascular
- ROM and strength deficits

Wheelchair functions that can be considered to assist even further with pressure redistribution such as:

- Tilt (manual or power wheelchair): the entire body is tilted backwards, reducing pressure from the pelvis and shifting weight along the trunk, creating a greater surface area to reduce peak pressures.
- Recline (manual or power wheelchair): the back support moves from an upright sitting position to a more horizontal position.

Elevating legrests should always be combined with recline to support the legs and place the body in a more horizontal position, redistributing pressure over the back and legs.

- Tilt + Recline + Elevating Legrests: research findings reveal the combination of all three seat functions provides more effective pressure relief than the use of tilt alone.
- Power wheelchair standing: the wheelchair support system moves from a seated position to standing position. Research reveals compared to tilt and recline pressure redistribution, standing was the only configuration that decreased loads off the seat and backrest simultaneously.



The CPG recognise the importance of these pressure redistribution methods and wheelchair functions in the 2019 edition.

- Reposition all individuals with, or at risk of, PI on an individualised schedule, unless contraindicated. 5.1
- Implement repositioning reminder strategies to promote adherence to repositioning regimens. 5.4
- Reposition the individual in such as a way that optimal offloading of all bony prominences and maximum pressure redistribution is achieved. *GPS - 5.5*
- Reposition the individual to relieve or distribute pressure using equipment that reduces friction and shear. 5.6
- Promote seating out of bed in an appropriate chair or wheelchair 5.11
- Ensure the individual's feet are well supported on the floor or footrests when sitting upright in a chair or wheelchair 5.12
- Tilt the seat to prevent the individual sliding forward in the chair or wheelchair 5.13
- Teach and encourage individuals who spend prolonged durations in a seated position to perform pressure-relieving techniques 5.14
- Position the individual to reduce the risk of PI development by distributing pressure over a larger body surface area and offloading bony prominences. *GPS - 5.19*
- Individuals with pelvic pressure injuries should limit the time spent in seated position (three times a day for one hour or less).

Myth #2: A scar from a previous pressure injury reduces the risk for another PI

It is sometimes assumed that pressure injuries heal completely and the skin and tissues return to normal. In actuality, the tissue is never the same. While this scar tissue is “tougher”, it actually makes the area more prone to future pressure injuries, since the tough scar tissue is surrounded by softer tissues.

The CPG states: “Consider individuals with a history of pressure injuries to be at risk for breakdown of scar tissue (pressure injury recurrence) in anatomical locations with evidence of a healed category/stage III or IV pressure injury”, and “Consider the potential impact of a previous pressure injury on additional pressure injury development”.

Myth #3 Bariatric individuals have lower risk for pressure injury

It is sometimes assumed that larger people have more “cushion” and should be better protected from PIs. As a person gains weight, their skeletal system does not grow, and the pelvis must support the added weight over the same small area (bony prominences). While the force increases, the bony area does not, and therefore the pressure at the bony prominences becomes higher.

The CPG states that: “There is indirect evidence to suggest that individuals with obesity experience stresses and forces that increase tissue loading, particularly on a harder seating surface”.

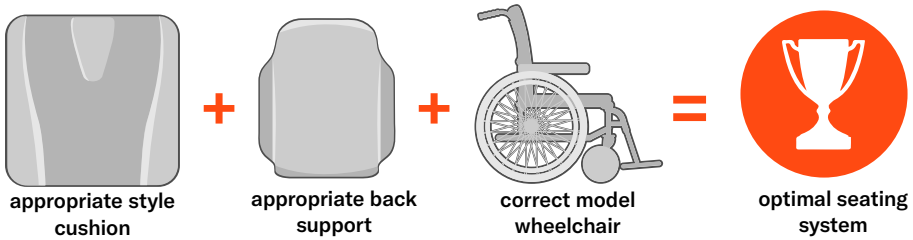
Myth #4: Daily cushion checks are not required for some cushions

This is indeed false. Despite manufacturer claims, the CPG recommends a daily cushion check regardless of manufacturer or type of support surface and material. Examples of what the check includes:

- correct orientation of cushion AND cover
- cleanliness of cover
- no bottoming out
- correct position on wheelchair

What is the simple equation?

Now it is clear that it is the interaction between the appropriately configured **wheelchair frame, back support and cushion** that creates the optimal seating system to reduce the risk for developing a pressure injury!



Together, they allow for **maximum contact** with the seat and back surface to:

- optimally stabilise the trunk and pelvis to prevent unwanted movement
- allow for even pressure redistribution off of the bony prominences which are at greater risk for a pressure injury
- attain and maintain optimal postural alignment for hours in the seating system to prevent sliding into an abnormal posture that can increase the risk for a pressure injury

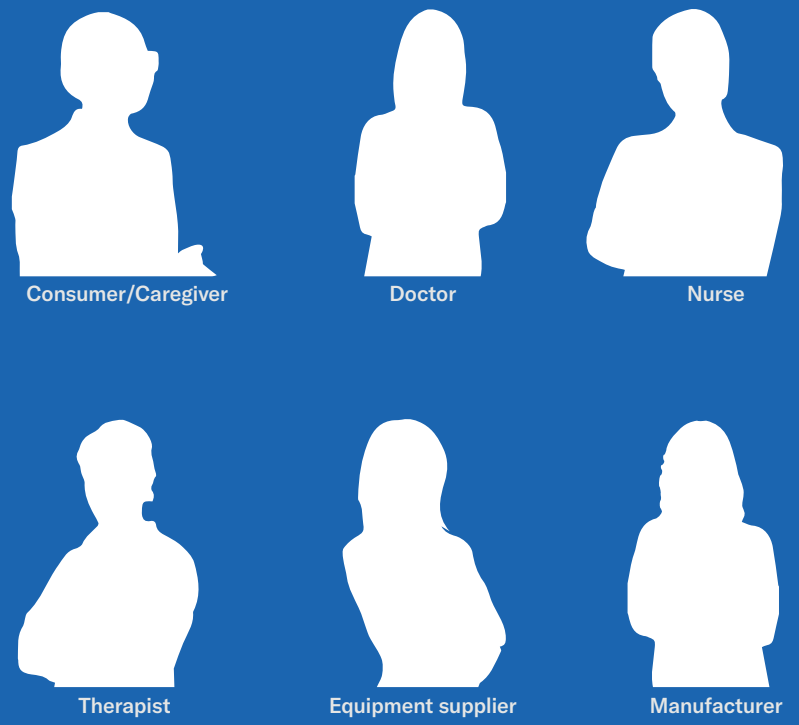
It is essential to get the right fit and quality of all three (wheelchair, cushion, and back support) to create an optimal seating SYSTEM for prevention and treatment of pressure injuries. And remember... all equipment is NOT created equal!

The CPG makes these recommendations about support surfaces for an at-risk client:

Select a support surface that meets the individual's need for pressure redistribution based on the following factors: *GPS - 7.1*	• Level of immobility and inactivity • Need to influence microclimate and shear reduction • Size and weight of the individual • Number, severity, and location of existing PIs • Risk for developing new PIs
For individuals with a PI, consider changing to a specialty support surface when the individual: *GPS - 7.9*	• Cannot be positioned off the existing PI • Has PIs on two or more turning surfaces that limit repositioning options • Has a PI that fails to heal or the PI deteriorates despite appropriate comprehensive care • Is at high risk for additional PI • Has undergone flap or graft surgery • Is uncomfortable • "Bottoms out" on current support surface
Select a seat and seating system support surface that meets the individual's need for pressure redistribution with consideration to: *GPS - 7.11*	• Effects of posture and deformity on pressure distribution • Body size and configuration • Mobility and lifestyle needs
For individuals with obesity, select a support surface with enhanced pressure redistribution, shear reduction and microclimate features. *GPS - 7.3*	
Use a pressure redistribution cushion for preventing pressure injuries in people at high risk who are seated in a chair/wheelchair for prolonged periods, particularly if the individual is unable to perform pressure-relieving maneuvers. *GPS - 7.12*	
Use a bariatric pressure redistribution cushion designed for individuals with obesity on seated surfaces. *GPS - 7.14*	
For individuals with or at risk for a pressure injury, consider using a pressure redistributing support surface during transit. *GPS - 7.15*	

Implementation

The most important part of being successful in providing equipment: understand the team!



Develop a good relationship with an equipment supplier to collaborate and find the most suitable wheelchair equipment to meet your consumers' needs.

How does the team identify at-risk clients who need specialty equipment?

In the CPG, there are Good Practice Statements (GPS) regarding the screening process to quickly identify clients at risk in your setting.

- Conduct a PI risk screening as soon as possible after admission to the care service and periodically thereafter (perform quarterly and annual screens or upon medical status change) *GPS 1.21*
- Conduct a comprehensive skin and tissue assessment for all individuals at risk of PI:
  - As soon as possible after admission/transfer to the healthcare service
  - As part of every risk assessment
  - Periodically as indicated by individual's degree of PI
  - Prior to discharge from care service *GPS 2.1*
- Develop and implement a risk-based prevention plan for individuals identified as being at risk (see above risk factors) *GPS 1.23*

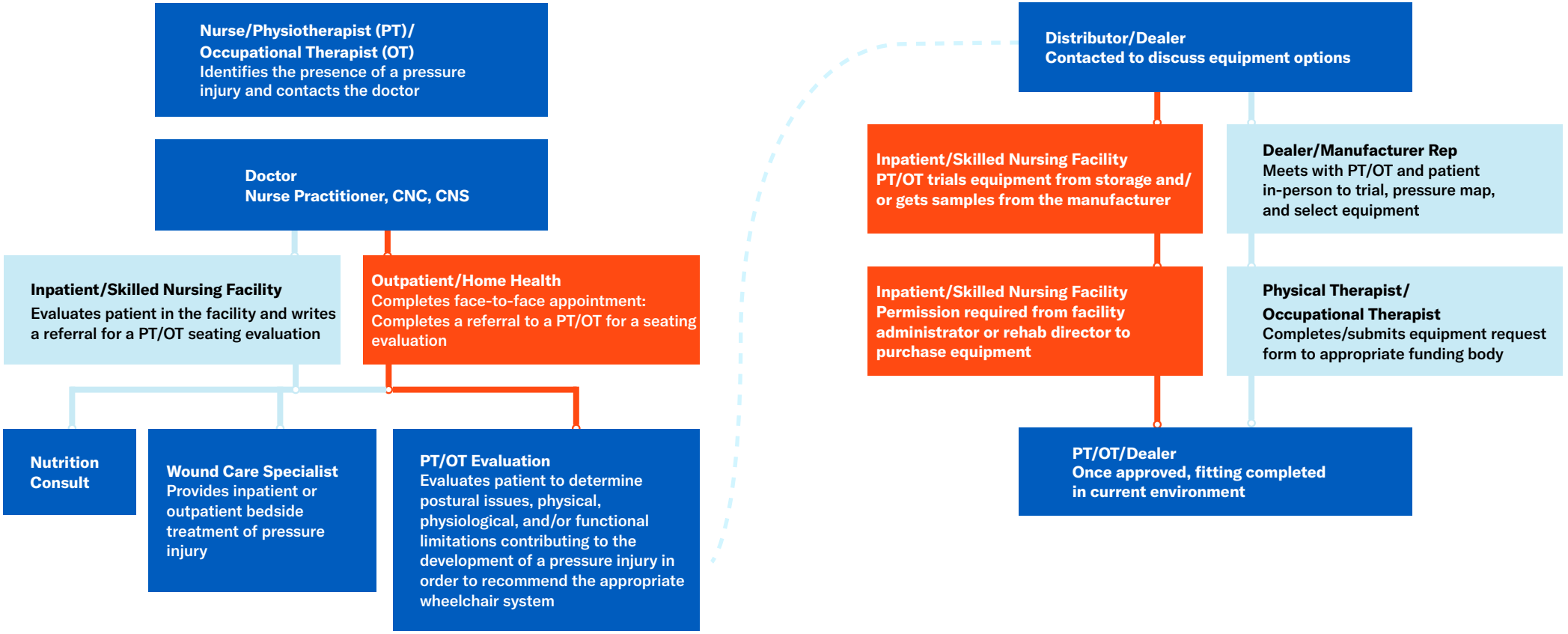
Support surfaces developed with skin protection properties should be used with clients with certain risk factors. According to the CPG, consider the following risk factors for risk of pressure injury (PI).

Here is a sample screening tool from the CPG:

Physical impairments that could increase risk of PI per CPG:	**Present: Y/N: If answer yes to any of the following, please refer them for a seating referral and prescribe a skin protection product**	**Action Taken: Referral to therapy for seating evaluation**	**Action Taken: Prescribe a skin protection support surface**
Limited mobility and limited activity *GPS 1.1*	Y / N	Y / N	Y / N
Previous PI on additional PI development *GPS 1.4*	Y / N	Y / N	Y / N
Alterations to skin status over pressure points *GPS 1.5*	Y / N	Y / N	Y / N
Pain at pressure points *GPS 1.6*	Y / N	Y / N	Y / N
Diabetes mellitus *GPS 1.7*	Y / N	Y / N	Y / N
Perfusion and circulation deficits *GPS 1.8*	Y / N	Y / N	Y / N
Oxygenation deficits *GPS 1.9*	Y / N	Y / N	Y / N
Impaired nutrition *GPS 1.10*	Y / N	Y / N	Y / N
Moist skin *GPS 1.11*	Y / N	Y / N	Y / N
Increased body temperature *GPS 1.12*	Y / N	Y / N	Y / N
Older age 13.3 / bariatric 7.14	Y / N	Y / N	Y / N
Impaired sensory perception 1.14	Y / N	Y / N	Y / N

What is my role in the equipment ordering process?

No matter if you are the doctor, nurse, therapist, or equipment supplier, you play a critical role in the recognition, treatment, and prevention of a pressure injury. Take a look at the following flow chart to understand your role and how it fits in the big picture of providing every patient with the appropriate equipment.



What if my team is not up to date with the clinical practice guidelines?

What if they don't understand the importance of proper seating equipment to prevent or treat a pressure injury?

It is important to implement education and training for proper PI prevention and treatment strategies to help protect patients. The CPG has very clear recommendations, and Permobil has comprehensive education programs to bring your facility up to speed!

2019 CPG recommendations: AT THE ORGANISATIONAL LEVEL

Assess and maximise workforce characteristics as part of a quality improvement plan to reduce the incidence of PIs. *GPS 20.1*
Assess the knowledge health professionals have about PIs to facilitate implementation of education and quality improvement programs. *GPS 20.2*
Assess and maximise the availability and quality of equipment and standards for use as part of a quality plan to reduce incidence of PIs. *GPS 20.4*
Provide clinical decision support tools as part of quality improvement plan to reduce incidence of PIs. *GPS 20.8*
Develop and implement a multi-faceted education program for PI prevention and treatment. *GPS 21.2*

2019 CPG recommendations: AT THE PROFESSIONAL LEVEL

Provide education in PI prevention and treatment as part of a quality improvement plan to reduce the incidence of PIs. *GPS 20.10*

How do I find a team to assist with this process?

A therapist who specialises in wheelchair seating interventions is an important partner in the process of getting the right solutions.

Summary

When we as healthcare providers understand these key principles and address pressure injuries from all support surfaces, then do we have a chance to win the battle against pressure injuries!

- Appreciate the role of tissue deformation in the formation of pressure injuries.
- Embrace and incorporate the guidance of global experts and authorities on pressure injuries by consulting the Clinical Practice Guideline.
- Understand the intrinsic and extrinsic factors of a pressure injury in relation to the seated posture.
- Educate yourself in the skin changes that make a wheelchair user more susceptible to a pressure injury.
- Understand the critical role addressing the seated posture and all support surfaces play in the holistic approach to the prevention and treatment of a pressure injury.
- Learn the methods of pressure redistribution, the benefits and considerations of each method, and the importance they play in the construction of a cushion and back support to prevent and treat a pressure injury.
- Acknowledge all the components in the simple equation that will result in an optimal seating system.
- Recognise your role, no matter what discipline, in obtaining the appropriate skin protection equipment for the wheelchair system.

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