

Patient Handling & Mobility Solutions



Your trusted partner for patient handling and mobility solutions

With over 40 years' experience as a global leader in the development of innovative mobility and patient handling solutions, Arjo can bring a wealth of experience, and an unrivalled product portfolio, to work with you as a trusted mobility partner to help you drive healthier outcomes for people facing mobility challenges.

With the growing focus on driving patient mobility earlier in the care pathway, it is crucial that caregivers have access to the right evidence, tools and equipment to achieve patient transfer and mobility safely.

This clinical evidence summary provides an overview of patient handling and mobility processes and some of the key studies that have contributed to practice in this area. The summary is intended to provide a clinical evidence base to support key decision making and practice choices in acute and long-term care environments. For the purpose of this document, the person being cared for is termed the 'patient' and the person providing the care (nurse, carer or therapist for example) is termed 'caregiver', whilst respecting the variation in terminology across the different healthcare settings.



The challenges

THE CAREGIVER – RISK OF MUSCULOSKELETAL INJURY

From the busiest hospital to the smallest nursing home, caregivers continue to have one of the highest rates of musculoskeletal disorders (MSDs).

MANUAL PATIENT HANDLING IS HAZARDOUS FOR CAREGIVERS

- Manual handling of patients has been seen to be a key contributor of musculoskeletal injury and pain among nurses and therapists^{1,2}.
- In 2016, nurses in private industry experienced 8,730 days off work due to musculoskeletal disorders, at an incidence rate of 46.0 cases per 10,000 full-time workers, compared to the average of 29.4 cases per 10,000 workers³.
- For employees who provided direct patient care, 59% of the injuries were attributed to patient-handling activities such as repositioning, transferring, preventing a patient fall and assisting a patient during a procedure⁴.

32% of
workplace injuries
and ill health is
as a result of
musculoskeletal
disorders⁵.



Injuries due to transfers and repositioning of patients are often related to the physical nature of the activity and the awkward postures involved. Physical loads are placed on the caregiver's spine in different ways according to the nature of the activity. These loads can be described as **static** and **dynamic** loads. **Psychological** stress may also have an impact on caregiver injury.

Static load

WITHOUT MOVEMENT

Static load can be defined as the result of static working positions. For example, when a caregiver is washing a patient on a bed which is too low, the caregiver's back is in a static, stooped position for up to several minutes⁶.

Static load occurs when a caregiver remains in a fixed position without movement. This load on the spine develops during standing or holding objects or limbs with little movement

such as during the treatment of wounds, hygiene procedures, helping the patient to get dressed etc. If a static posture is held, particularly in a forward leaning (stooped) position, for longer than 1 minute, this is termed Static Overload, when discomfort and potential injury may occur.



It is not advisable to work for longer than 1 minute at more than 30 degrees in a bent forward position^{6,7,8}

Green = Safe Load No intervention needed	Orange = Potential Risk Load Recommended to intervene	Red Risk = High / Immediate Risk Immediate intervention needed
Avoid postures lasting longer than 1 minute with a rotated and / or more than 30° degrees forwards or sideward bent trunk	Postures lasting longer than 1 minute, but less than 4 minutes working with a rotated and / or more than 30° degrees forwards or sideward bent trunk	Postures lasting longer than 4 minutes working with a rotated and / or more than 30° degrees forwards or sideward bent trunk A total length of maximum 4hrs is recommended for activities when static load often occurs (even if the limit of 1 minute isn't exceeded)

ISO/TR 12296:2012 Ergonomics — manual handling of people in the healthcare sector⁸

Dynamic load

WITH MOVEMENT

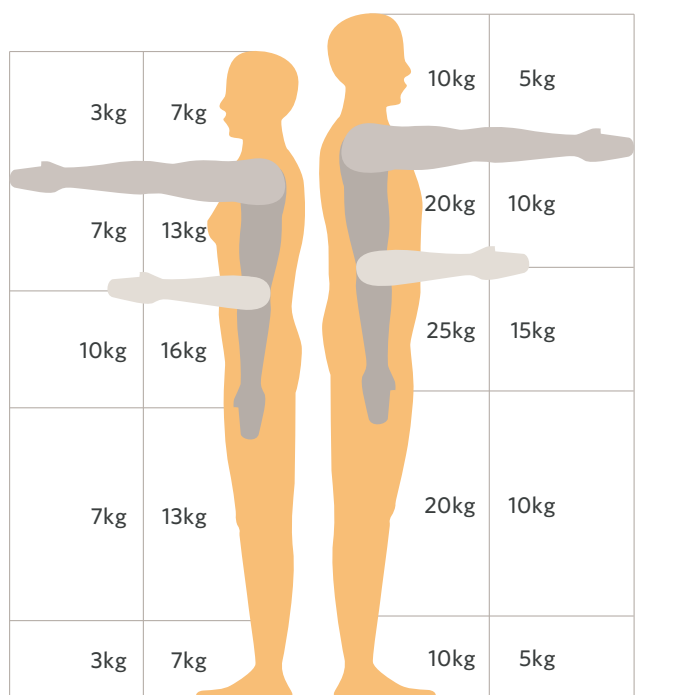
Dynamic load is a moving load or force such as pushing and pulling, occurring for example when caregivers reposition patients in bed or manoeuvre beds when transporting patients. If caregivers exceed their own capabilities and recommended international limits, this is termed Dynamic Overload, when potential injury may occur.

Recognised international standards such as National Institute of Occupational Safety and Health (NIOSH) safe lifting limits⁹, Manual Handling Operations Regulations risk assessment filter¹⁰ and recommended pushing and pulling norms¹¹, provide guidance on safe limits but form only a part of the wider patient handling risk assessment required.



Pulling norms (Mital, 1993)			
Occasional pulling of loads	Men	15kg/1 hand	30kg/2 hands
	Women	10kg/1 hand	20kg/2 hands
Frequent pulling of loads	Men	10kg/1 hand	20kg/2 hands
	Women	7kg/1 hand	14kg/2 hands

Pushing norms (Mital, 1993)			
Occasional pushing	Men	16kg/1 hand	32kg/2 hands
	Women	11kg/1 hand	22kg/2 hands
Frequent pushing	Men	11kg/1 hand	22kg/2 hands
	Women	7.5kg/1 hand	15kg/2 hands



NIOSH recommend a safe lifting limit of 35lbs⁹

Health and Safety Executive (2016) Manual Handling Operations Regulations, 1992 - Guidance on regulations¹⁰

Psychological Load (stress-related factors)

Work-related psychosocial risk factors including emotional demands placed on caregivers, work pace and somatic stress symptoms, appear to also have an important impact on the occurrence of musculoskeletal pain among caregivers⁶⁰.

Extrinsic factors affecting the risk of musculoskeletal injury

THE IMPACT ON THE CAREGIVER

Factors which affect the risks of musculoskeletal disorders⁸

- The number, capacity, experience and qualifications of caregivers
- The number, type and condition of patients to be handled
- Awkward postures and exertion
- The inadequacy (or absence) of suitable equipment
- Restricted spaces for patient handling
- Lack of education and training on specific tasks for caregivers

The impact of these loads placed on the musculoskeletal system can be exacerbated due to the frequency of the tasks carried out, the frequent adoption of poor posture during care procedures and the increasing weight and size of the population.

Injuries sustained can be debilitating and, for some caregivers, career ending. Evidence has demonstrated that education alone is insufficient to protect staff.

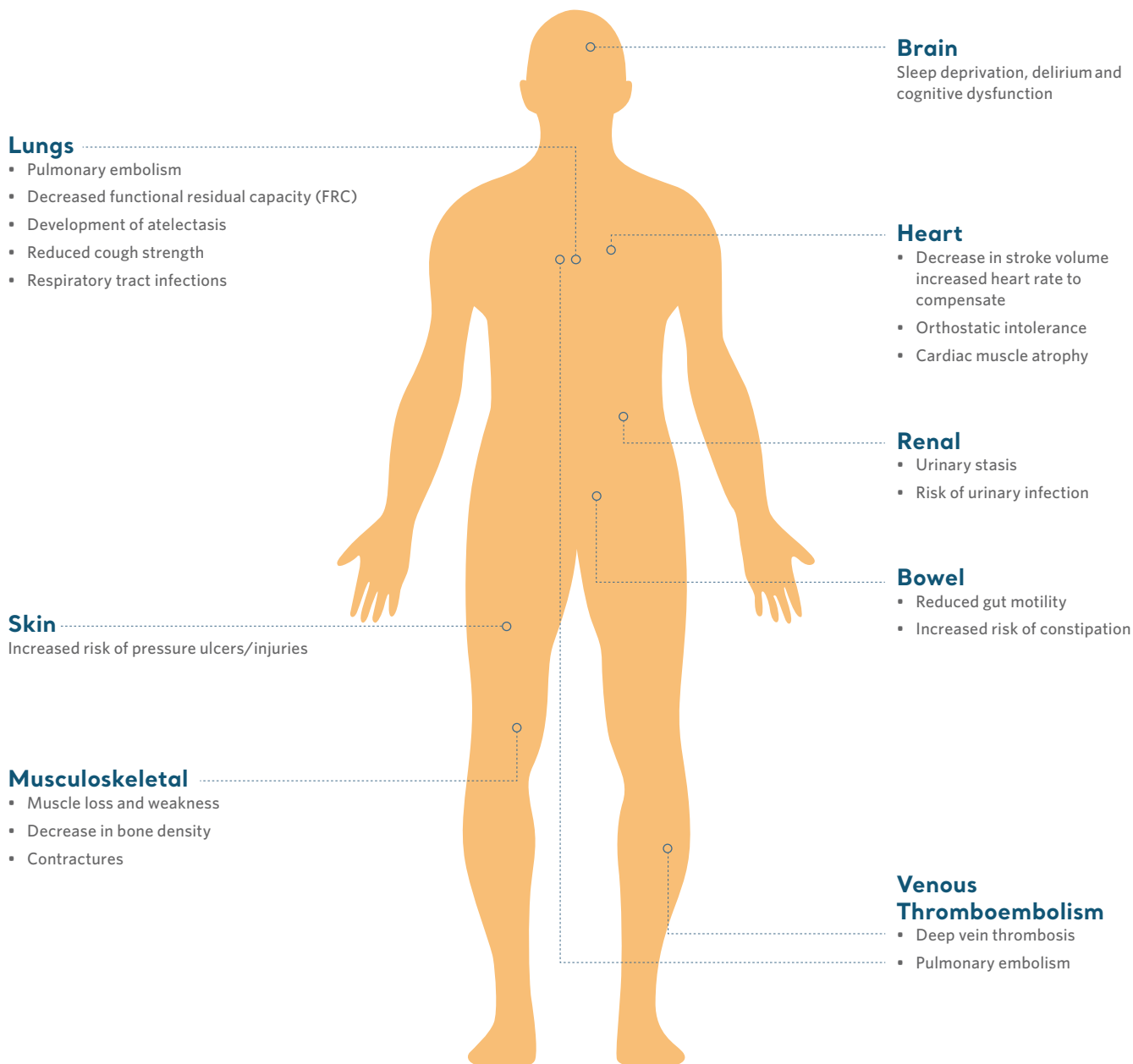
Use of the right mechanical assistive aids improves caregiver safety and reduces injury-related costs for the organisation¹².



Evidence summary

Author	Study	Design	Key findings
Totzkay, D 2018 ⁴	Multifactorial Strategies for Sustaining Safe Patient Handling and Mobility	Evidential review	A combination of factors, such as education, appropriate equipment, and peer coaches can support a culture of safety.
ISO/TR 12296:2012 Ergonomics ⁸	International Standard for manual handling of people in the healthcare sector	Intended for all caregivers and workers involved in patient handling in healthcare	Provides guidance for assessing risks associated with patient handling and for identifying and applying ergonomic strategies and solutions
Humrickhouse and Knibbe (2016) ¹³	The Importance of Safe Patient Handling to Create a Culture of Safety	Evidential review to investigate the effectiveness of SPH programme	While interventions such as appropriate aids, equipment and training have an impact on improving conditions for both healthcare workers and patients, there is value to the implementation of a structured programme
Knibbe JJ, Knibbe NE 2012 ⁶	Static load in the nursing profession	Cross-sectional study identifying the relationship between static load and musculoskeletal injury	There is evidence from this cross-sectional study that static load can be reduced by a combination of introducing the right equipment, creating awareness and education
Waters, 2007 ⁹	When is it Safe To Manually Lift a Patient?	Journal article explaining the NIOSH safe lifting limits	Guidance on use of the NIOSH Lifting Equation
Matz, M 2019 ¹²	Patient Handling and Mobility Assessments. A white Paper. Second Edition	A white paper to facilitate use of Patient Handling and Mobility Assessments in healthcare facilities, with the aim of increasing patient and staff safety and improving the quality of patient care	Improved safety and quality of life for both patients and caregivers, improved patient outcomes from early mobilization and economic benefits from avoiding adverse events related to manual patient handling are commonly recognized benefits of SPHM programs
Da Costa and Vieira 2009 ⁶⁰	Risk Factors for Work-Related Musculoskeletal Disorders	A systematic review of recent longitudinal studies	This review confirms a causal relationship between some commonly reported risk factors (high biomechanical and psychosocial demands, smoking, high body mass index) and work-related musculoskeletal disorders

Immobility associated risks



Patients of all ages are at risk of consequences of immobility such as pressure injury, venous thromboembolism, urinary stasis, and lower respiratory tract infections. Those subjected to prolonged immobility also suffer general deconditioning including muscle loss, weakness and functional decline, effects of which frequently remain following patient discharge resulting in difficulty for patients to achieve pre-hospitalisation levels of mobility.

As the consequences of prolonged immobility are recognised there is an increasing focus on the need to mobilise patients early in their care pathway. This presents an opportunity to mitigate functional decline and help improve patient readiness for discharge from hospital.

It is equally as important to maintain functional mobility for those outside of the hospital setting to prevent deconditioning and the subsequent implications.

The facility – financial implications

Patient handling injuries can be costly not only for the caregiver but also for the organisation. The financial impact is associated with injury investigation and potential claim management, temporarily replacing an injured caregiver and litigation/settlement costs. Caregiver injury can result in fewer staff resources and reduced working efficiencies.

Patient handling claims have the highest average total cost of all workers compensation causes of loss at \$14,100 per claim¹⁴.

Patient immobility can have a financial impact on the organisation. Many patients in hospital will spend the majority of their time in bed, leading to the risk of developing immobility related conditions. This can increase the length of stay and leave patients more physically vulnerable when they are discharged home, often resulting in hospital readmission.

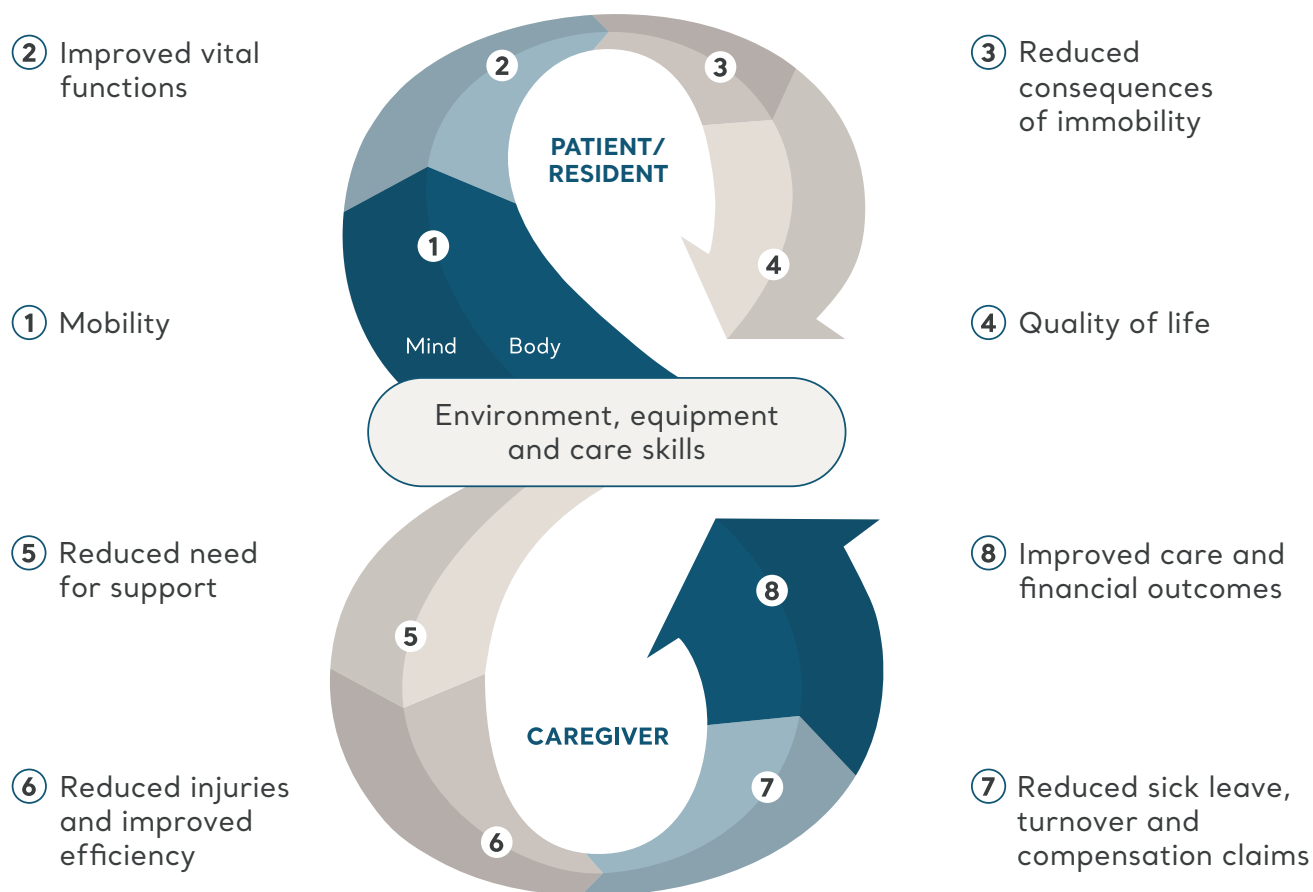
Immobility associated costs may include:

- Falls - serious fall-related injury to inpatients cost \$13,806 per injury¹⁵
- Hospital acquired catheter associated UTIs - \$13,793¹⁶
- Pressure ulcers - can cost the organisation \$14,506 per pressure injury¹⁶
- Venous thromboembolism, each is estimated to cost \$17,367¹⁶

Use of the right mechanical assistive aids improves caregiver safety and reduces injury related costs for the organisation⁴



The Positive Eight™ – mobility is key



The right **environment, equipment and care skills** need to be in place to allow the benefits of the Positive Eight to flow

The Positive Eight

The quality of care received and the quality of work performed by the caregiver are reliant upon having the right environment, using the right equipment and utilising the right care skills. This is represented by the Arjo Positive Eight.

Promoting resident/patient mobility is the driving force behind the Positive Eight – our philosophy for generating long-term

benefits for patients, caregivers and care facilities. Investing in the right environment, suitable assistive equipment and adopting the best caregiver practices can provide the optimal conditions to promote and enhance mobility. Promoting mobility can reduce the need for support, reduce caregiver injuries and improve working efficiencies. Ultimately this all leads to improved care and financial outcomes.



Evidence summary - The Importance of Mobility

Author	Study	Design	Key findings
Lahmann et al 2015 ¹⁷	Mobility is the key! Trends and associations of common care problems in German long-term care facilities from 2008 to 2012	A secondary analysis of data from five consecutive annual cross-sectional multicenter studies in German long-term care facilities - to investigate associations between common nursing care problems	A statistically significant association was found to exist between immobility and urinary incontinence, cognitive impairment, falls, malnutrition and pressure injuries
ISO/TR 12296:2012 Ergonomics — manual handling of people in the healthcare sector, 2012 ⁸	International Standard for manual handling of people in the healthcare sector	Intended for all caregivers and workers involved in patient handling in healthcare	Guidance for assessing risks associated with patient handling in the healthcare sector, and for identifying and applying ergonomic strategies and solutions
Rogers, M et al 2008 ¹⁸	Mobility and other predictors of hospitalization for urinary tract infection	A retrospective cohort study identifying a connection between immobility and UTI (Urinary Tract Infection)	An improvement in mobility may be beneficial in preventing hospitalization for UTI
Fritel, X 2013 ¹⁹	Is there a link between impaired mobility and urinary incontinence in elderly, community-dwelling women?	Journal article reports on a cross sectional study from France, discussing the effect immobility has on urinary incontinence	The article concludes a link between immobility and urinary incontinence

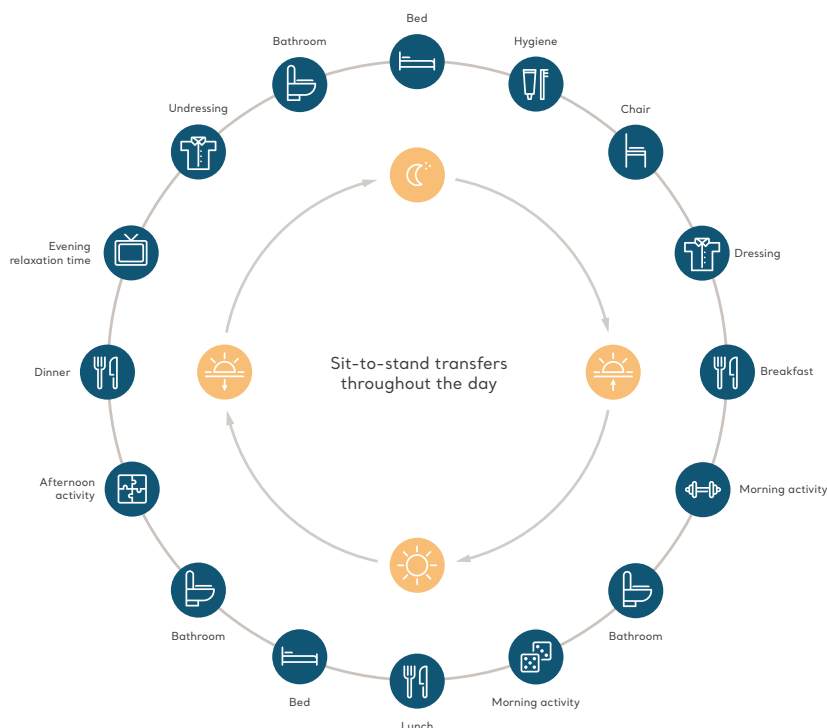
Principles of mobility assessment

The International Standards for manual handling of people in the healthcare sector discuss various methods of assessment⁸.

Some commonly used methods include:

Dortmund approach, Care Thermometer, Bedside Mobility Assessment Tool (BMAT) and Functional Independence Measure (FIM).

The most essential transfers take place multiple times throughout the daily journey. Risk assessment helps to identify the most appropriate transfer and equipment for the situation and activity to be carried out.



As a first step in the assessment process, the key is to understand the person's capabilities and where guidance or assistance is required. Factors to consider are:

- 1. Medical and physical conditions such as** Arthritis, stroke, Parkinson's Disease, diabetes, heart conditions and lung disease can all impact mobility. The caregiver needs to plan and provide care, support and assistance depending on the level of function and potential risks related to balance, stiffness, loss of sensation, pain or anxiety for example.
- 2. Functional mobility can then be established** to identify the most appropriate equipment and transfer solutions to improve or maintain this level of function.
- 3. Preferences and capabilities of the patient/resident should always be taken into account wherever possible.**
- 4. Cognitive ability and emotional state** are important factors to consider as they can impact a person's mobility level. For example, the mobility of a person living with dementia may fluctuate throughout the day, according to their cognitive state. Activities of daily living and the choices caregivers make, may create 'moments of friction' for the person living with dementia.
- 5. The physical environment** such as space, potential slipping or tripping hazards, obstacles, lighting etc should be assessed to maximise patient and caregiver safety.
- 6. Number of caregivers required and if one-to-one care can be provided.** Look at all of the care routines including number of transfers, frequency of hygiene procedures and any differences during the day.
- 7. Caregiver skill-level** - training in safe patient handling and mobility practices is essential and should be kept up to date in line with local policies and international best practice.

Evidence summary

Author	Study	Design	Key findings
Granger, CV, Hamilton, BB, et al 1993 ²⁰	Performance profiles of the Functional Independence Measure (FIM)	Journal article outlining FIM	Explanation of the Functional Independence Measure used to assess a person's functional mobility level
Boynton T et al. 2014 ²¹	Banner Mobility Assessment Tool for Nurses: Instrument Validation	The purpose of this study was to validate a tool created to assess mobility in hospitalized patients	Determining a patient's mobility status as part of a daily nursing assessment, using a validated tool and addressing the need to use safe patient handling equipment can potentially influence risk of falls and decrease the risk of injury to caregivers

Why have a mobility classification tool?

The Arjo Mobility Gallery™

Developed from the internationally validated mobility classification tool (which was originally developed from the Resident Assessment Instrument used in the USA), the Arjo Mobility Gallery is designed as a functional assessment tool to determine:

- The functional mobility level of the patient/resident
- What level of assistance is required
- Level of risk to the caregiver
- How important stimulation of functional mobility is

Knowing who you care for is important to help facilities and caregivers to identify the patient handling & mobility requirements of residents and patients for whom they provide care and support decisions related to repositioning, transferring and mobilising. Referenced in the International Standards for patient handling in the healthcare sector, the tool is designed to support the assessment process for transfer and equipment solutions, but further risk assessment is required in line with local policies to ensure the most appropriate choices are made and safety of caregiver and patient/resident is maintained. Stimulating functional mobility may be less of a priority for completely passive patients/residents (E) depending on the individual's circumstances. Rehabilitation may be the goal, in which case stimulating functional mobility will be crucial as the person's level of mobility improves. Maintaining movement through passive movements is still important.

Normal movement patterns

In all the possible variations in a person's movement certain common principles can be found. There is a base pattern which we utilise to perform common tasks. Principles of 'normal movement' are a foundation on which assisted transfers should be based.

From the Mobility Gallery – Albert to Emma – normal movement patterns can be encouraged through utilising the right equipment and transfers appropriate to their mobility level. Even when repositioning a passive patient/resident in bed, normal movement patterns can be facilitated to make the activity easier for the caregiver and, where appropriate, encourage functional mobility.

Our bodies are designed to move in a natural movement pattern – and we need to enable these patterns to be followed through mobility, transfers and repositioning. Even when a person is passive, (unable to complete these movements by themselves), we need to maintain these movement patterns as far as possible while respecting individual physical conditions and potential limitations.

Stimulating and maintaining the person's mobility is an important objective throughout healthcare. Even so, it is important to keep safety for the caregiver in mind.



Evidence summary

Author	Study	Design	Key findings
Knibbe, J & Knibbe, N, 2012 ²²	Assessments of patients with a 5-category or a 3-category practical classification system: validity and practicality	This study was carried out over 4 countries to evaluate the functional mobility assessment tools	The study established the benefits a 5-category mobility level system has over a 3-category system
Centers for Medicare & Medicaid Services 2018 ²³	Long-Term Care Facility Resident Assessment Instrument (RAI) User's Manual	Guidance on how to use the Resident Assessment Instrument to ensure quality of care for residents in long term care	The aim of the assessment tool is to ensure quality of care and quality of life, ensuring the mobility of the resident is maximised

The Arjo Mobility Gallery

WHO DO YOU CARE FOR?

	 A	 B	 C	 D	 E
Long term care					
Acute care					
Bariatric					
	Albert	Barbara	Carl	Doris	Emma
	▪ Ambulatory, but may use a walking stick for support ▪ Independent – can clean and dress himself ▪ Usually no risk of dynamic or static overload for the caregiver ▪ Stimulation of functional mobility is very important to maintain independence	▪ Can support herself and may use a walking frame or similar ▪ Dependent on the caregiver in some situations ▪ Usually no risk of dynamic overload for the caregiver ▪ A risk of static overload may occur for example during assistance with daily hygiene activities ▪ Stimulation of functional mobility is very important	▪ Is able to partially weight bear on at least one leg. Often sits in a wheelchair and has some trunk stability ▪ Dependent on caregiver in most situations ▪ A risk of dynamic and static overload to the caregiver when not using proper equipment ▪ Stimulation of functional mobility for Carl is very important	▪ Cannot stand and is not able to weight bear through her feet. Is able to sit if well supported ▪ Dependent on caregiver in most situations ▪ A high risk of dynamic and static overload to the caregiver when not using proper equipment ▪ Stimulation of functional mobility is very important	▪ Might be almost completely bedridden, can sit out only in a special chair ▪ Always dependent on caregiver ▪ A high risk of dynamic and static overload to the caregiver when not using proper equipment ▪ Stimulation of functional mobility is not a primary goal

Pressure injury prevention in patient handling

Reduced mobility is a significant risk factor for pressure injury development and international guidelines emphasise the need for regular turning and repositioning of patients to help prevent tissue damage²⁴.

Common repositioning activities could contribute to pressure injury development due to the increased shear and friction exerted on the skin.

Frequent repositioning in bed can be made easier and safer for both patients and caregivers with the use of appropriate patient handling aids. This may include the use of friction reducing slide sheets and/or patient lifts and slings.

Use moving and handling equipment to reposition the individual. Appropriate equipment assists in lifting the individual and reduces unintended drag²⁴

For chair bound patients, the use of a standing and raising aid such as Sara Plus™ or Sara Steady™ can help facilitate regular standing to allow regular skin inspection and temporarily relieve the sustained high pressures normally encountered during sitting out of bed.



Consider using textiles with low friction coefficients for individuals with or at risk of pressure injuries²⁵

Additional layers between a patient's skin and a support surface has the potential to increase pressure or negatively impact the skin microclimate increasing the risk of pressure injury²⁶. Sling features including material breathability, thickness and location of seams, should be assessed prior to the sling being left under a patient. For each patient caregivers should critically review the impact, both risk and benefit, of leaving a sling beneath a patient.

Do not leave moving and handling equipment under the individual after use, unless the equipment is specifically designed for this purpose²⁴

Evidence summary

Author	Study	Design	Key findings
Edupuganti K and Price C. 2013 ²⁷	Repositioning Slings: The Effects on Skin Pressure, pH, and Temperature.	An experimental study with 4 conditions: supine or head of bed elevated, with or without a sling was used with a convenience sample of 180 healthy adults. Skin temperature, pH, and sacral pressure were measured	There was no statistical significance detected at 20 minutes with or without a repositioning sling with head elevated or in supine position. The study concluded that repositioning slings can be left under patients for safe patient handling without impacting the skin condition
Brienza, D et al. 2015 ²⁸	Do Lift Slings Significantly Change the Efficacy of Therapeutic Support Surfaces? A National Pressure Ulcer Advisory Panel White Paper March	Literature review conducted to explore the impact lift slings have when used in combination with therapeutic support surfaces	The decision regarding placement/removal of SPHM equipment between uses must balance the risk (decreased efficacy of a therapeutic support surface) and potential benefit (easier repositioning increasing frequency and/or efficacy) on pressure ulcer prevention. Without evidence regarding the effect of slings upon support surface performance, the clinical recommendation is based on expert opinion to be found within the Guidelines combined with clinical assessment and an individualized plan of care by the team of health care professionals at the bedside

Single-handed patient care and transfers

The term single-handed care simply refers to a means of safely transferring an individual with the correct equipment and appropriate number of carers.

In some markets, there have long been 'informal working practices' automatically requiring the need for two caregivers when assisting with patient handling activities. However, in recent years there has been a definite shift towards the provision of single-handed care, especially within long-term care settings. This shift is related to working and care efficiencies and towards cost reduction²⁹.

Freeing up carers allows them to meet the needs of more patients and improves patient flow throughout acute hospitals, enabling a timely hospital admission and discharge resulting in

more people to be cared for in their own homes²⁹.

Single-handed care in an acute hospital setting is a relatively new concept. Using the same equipment available in long-term care and within the hospital setting has several benefits. On discharge, the patient is no longer asked to use an unfamiliar piece of equipment. This will reduce anxiety, increase cooperation and has the potential to improve safety and reduce failed discharges²⁹.

With the proper provision of ceiling lifts and other safe patient handling equipment there is a cost reduction associated with having one caregiver to provide the care³⁰. It is a balancing act without placing the patient and the caregiver at increased risk of injury and physical overload. Much of this shift is reliant on investing in the right equipment with the right patient and use of the appropriate care skills to provide dignified one-to-one care.



Sara Plus



**Maxi Move with
Maxi Transfer Sheet**



Sara Steady



Carendo

Evidence summary

Author	Study	Design	Key findings
Harrison, D 2020 ²⁹	Single Handed Care Part one The Winning Formula	Journal article focussed on the benefits of single handed care for patients and caregivers	Positive outcomes for both patient and caregiver are outlined in this article
Smith, H, Orchard, S 2009 ³⁰	The reduction of 'double handling' in the community	Essex County Council established a double handed care project in 2011, aiming to maximise independence of people in the community	The project showed benefits of single handed care for carers and patients, including substantial organisational cost savings

Making appropriate choices according to functional mobility

SELECTING THE APPROPRIATE TRANSFER AND EQUIPMENT SOLUTION

By matching the right transfer solution to the needs of patients, Arjo patient handling equipment can provide a level of support designed to maintain and, where possible, encourage and promote mobility.

Solution overview Equipment selection appropriate to mobility level					
Mobility level	Albert	Barbara	Carl	Doris	Emma
Repositioning in bed		 Sliding sheet	 Sliding sheet  Transfer sheet	 Sliding sheet  Transfer sheet	 Sliding sheet  Transfer sheet
Lateral transfer			 Air-assisted device  Stretcher frame	 Air-assisted device  Stretcher frame	 Air-assisted device  Stretcher frame
General transfer	 Walking stick	 Walking frame  Standing aid	 Active lift	 Passive floor lift  Ceiling lift	 Passive floor lift  Ceiling lift
Showering	 Shower commode chair	 Hi-low shower chair	 Hi-low shower chair  Multi-purpose hygiene chair	 Multi-purpose hygiene chair	 Shower trolley
Toileting		 Shower commode chair	 Shower commode chair  Multi-purpose hygiene chair	 Multi-purpose hygiene chair	

Repositioning a person in bed

Repositioning dependent patients within their bed is the single greatest risk factor for musculoskeletal injuries in health professionals³¹.

60% of risk is related to repositioning in bed including turning, moving up in bed and lateral transfers out of bed³¹

This has long been identified as a high-risk activity undertaken by caregivers. As dependency levels of patients cared for in hospitals and care homes increase, along with the rise in obesity and ageing population, patient handling transfers become more frequent and more physically demanding.

Patients who cannot change position by themselves need to be repositioned to avoid pressure injuries and for other activities of daily living. This requires significant physical effort from caregivers, which sometimes leads to back pain and potential injury. To maintain the motivation of caregivers and protect them from back pain and injuries, the industry has developed equipment for repositioning, lifting and transfer, which ranges in levels of complexity—from simple sheets placed under a patient to manipulate postures, to mechanical lifts³².

In addition to the potential excessive physical overload placed on caregivers performing these activities, there is also a risk of injury to the patient due to shear and friction forces generated between the skin and the surface the patient is on.

The magnitude of pushing/pulling is also dependent upon the weight of the patient and the coefficient of friction between the sliding surfaces³³. A study of musculoskeletal injuries resulting from patient handling tasks identified that 32% of injuries resulted from repositioning/turning or lifting patients in bed³⁴.



Friction reducing devices

Using slide sheet devices for in-bed movements has benefits not only for safety, but also for the patients' comfort, security and dignity³².

Slide sheets can help the more independent patient to move themselves within the bed. They can also be used by caregivers for in-bed repositioning for the more dependent patient.

The risks of moving the full body weight of a dependent patient are well recognised. For horizontal transfers and many in-bed movements, the provision of a friction-reducing slide sheet may be a sound solution for reducing physical effort and improving patient comfort^{32,35}.



MaxiSlide sheets



MaxiSlide Tubes

Evidence summary

Author	Study	Design	Key findings
Fray, M, Hignett, S 2015 ³²	A British Journal of Nursing (BJN) supplement article discussing the use of patient handling equipment to manage immobility in and around a bed	This article forms part of the Moving Patients Safely – Essential Care for Pressure Ulcer Prevention supplement. It explores the process to be used when a slide sheet solution would be suitable for a person that spends a significant time in bed and may also require pressure ulcer prevention or treatment	Friction reducing devices can be a sound solution for reducing physical effort and improving patient comfort
Bartnik et al 2013 ³⁵	A study investigating the forces required while moving a patient up in bed	A three-dimensional motion capture study was used to compare the forces between use of friction reducing devices and cotton sheets	The use of friction-reducing slide sheets reduced the potential for musculoskeletal injury among caregivers compared with traditional cotton sheets due to lower spinal compression
Weiner et al 2015 ³⁶	The effects on the caregiver of repositioning patients within the bed	An evidential review of the literature identifying the association between work-related musculoskeletal disorders (WRMSD) and repositioning patients in bed	The review confirmed that chosen technique and assistive devices used by caregivers have a significant influence on low back loading while repositioning patients in bed

Repositioning slings with use of a passive lift

A repositioning sling used in combination with a passive lift can help reduce the impact on caregiver workflow³⁷. These can be used to reposition within the bed and to laterally transfer.



Maxi Transfer Sheet

Maxi Transfer Sheet

- Used together with Maxi Sky 2 or Maxi Move, the dual-purpose Maxi Transfer Sheet is designed to be used as a hospital bed sheet and repositioning/transfer sling.
- Combining the benefits of a transfer sling for lateral transfer and the functionality of bed linen with soft, breathable fabric construction, Maxi Transfer Sheet can remain in place under the patient in between transfers. Testing showed no interference with the pressure redistribution characteristics of the non-powered or low air-loss surface the patient is lying on. A study has also shown that Maxi Transfer Sheet can reduce biomechanical load on the caregiver³⁸.

Another growing trend, due to the frequency of in-bed transfers and lateral transfers undertaken, especially in emergency care and ICU or for dependent patients within end-of-life care, is the requirement to keep a repositioning sling underneath a patient. Substantial testing related to interface pressure and breathability, including microclimate, must be done for devices to enable the clinicians to use devices in such a way and in line with the new international guidelines, which state in the section for repositioning: 'Do not leave moving and handling equipment under the individual after use, unless the equipment is specifically designed for this purpose'³⁹. Maxi Transfer sheet is a suitable option in the Arjo portfolio for the management of patients in such a situation.

Evidence summary

Author	Study	Design	Key findings
Wiggerman et al, 2020 ³⁷	Effect of repositioning aids & patient weight on biomechanical stresses when repositioning patients in bed	A motion capture study to estimate the risk of injury when repositioning patients of different weight with repositioning aids	A repositioning sheet together with an overhead lift can provide the most robust option for repositioning with the least impact to caregiver work flow
Knibbe et al, 2015 ³⁸	Effects on Quality of Care and Work of a Transfer and Repositioning Device for horizontal transfers on an ICU	Prospective, single center case study - comparing the situation pre, and 3 months post the Maxi Transfer Sheet introduction in the clinical setting	Significant reduction in biomechanical load during transfer and repositioning and elimination of certain manual transfer and repositioning activities were seen as a result of using Maxi Transfer Sheet
European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel, Pan Pacific Pressure Injury Alliance, 2019 ³⁹	Prevention and Treatment of Pressure Ulcers/Injuries: The International Guideline 2019	Clinical Guideline on the prevention and treatment of pressure injuries	This third edition of the guideline is the result of an international collaboration of three specialist stakeholder organisations: The European Pressure Ulcer Advisory Panel (EPUAP, Europe) The National Pressure Injury Advisory Panel (NPIAP, USA & Canada, formerly the National Pressure Ulcer Advisory Panel) and the Pan Pacific Pressure Injury Alliance (PPIA, Australia, New Zealand and Asia). The 3rd edition builds on the work of the previous 2 editions of this guideline (1st edition, 2009 & 2nd edition, 2014)

Lateral transfers

Caregivers considered air-assisted devices "best-in-class" for overall comfort, ease of use, effectiveness in reducing injuries, time efficiency, and reducing patient risk⁴⁰

For many years, the use of slide sheets has been commonplace for in-bed repositioning activities performed by nurses and caregivers, however due to the global trend in growing obesity, and the subsequent increase in the average weight of patients, this common and frequently performed activity is becoming more and more physically demanding, as well as being carried out with more dependent patients. For those reasons, there is a growing trend for the use of even more assistive devices over low-friction sliding sheets. Specifically, air filled devices which

reduce the effort of the movement for plus-size patients more than the use of low-friction sliding sheets. For this population, caregivers considered air-assisted devices "best-in-class" for overall comfort, ease of use, effectiveness in reducing injuries, time efficiency, and reducing patient risk⁴⁰.



MaxiSlide flites



Maxi Air



Maxi Transfer sheet with passive ceiling or floor lift



Repositioning sling with passive ceiling or floor lift

Evidence summary

Author	Study	Design	Key findings
Baptiste, A et al. 2006 ⁴⁰	A clinical evaluation of the effectiveness of lateral transfer devices	An experimental design was used for the study, to evaluate eight randomly selected devices	Caregivers considered air-assisted devices "best-in-class" for overall comfort, ease of use, effectiveness in reducing injuries, time efficiency, and reducing patient risk
Hwang, J et al. 2018 ⁴¹	Evaluation of different patient transfer devices in reducing biomechanical exposures among caregivers	A repeated-measures laboratory study was conducted to measure the muscle activity in the upper extremity and low back and hand pull force during standardized lateral patient transfer tasks with four different commercially-available transfer devices	Both objective and subjective measures supported that a slide board and air-assisted device could substantially reduce the effort of caregivers to laterally transfer patients
Meepradit, P et al. 2018 ⁴²	The effectiveness of the lateral patient transfer device to reduce musculoskeletal risk	This study was a quasi-experimental research measuring the effectiveness of a lateral transfer device	The risk to caregivers after using the lateral patient transfer device was lowered - using Rapid Upper Limb Assessment (RULA) as a measure

Passive lift transfers and sling selection

Passive lifts are designed to lift and transfer a person who is non weight bearing (mobility classification level D & E) from one surface to another e.g. bed to chair, chair to wheelchair or from the floor.

Selecting the most appropriate lift and sling is important to ensure these are appropriate for the patient and for the type of transfer being carried out.

There are many different types of patient lifts and slings with different attachment configurations. The main types of passive lift can be divided into two categories – ceiling and floor lifts. Within both categories, there are two types of sling and lift configurations:

Loop arrangement

Loop slings used in combination with a lift which has a hook attachment spreader bar



Clip arrangement

Clip slings used in combination with a lift which has a clip attachment spreader bar



Some lifts have interchangeable spreader bars which allow the lift to be used with a variety of slings, depending on the transfer required.

For example – a stretcher sling may be used with a stretcher frame to allow the patient to be moved in a stable, supine position.



Many variations, styles and sizes of slings are available to meet a variety of specific patient needs.



Standing slings



Seated slings



Ambulation slings



In Bed/ Repositioning slings



Stretcher slings



Clip slings



Loop slings



Bariatric slings



Washable slings



Disposable slings

Patient sling assessments should take into consideration:

- Height, weight and body shape
- Medical condition, continence, muscle tone and muscular control
- Skin condition
- Behaviour and cognition
- Anxiety, pain and sensation

It is of great importance that the manufacturer's instructions for use are followed to ensure the correct combination of both sling and hoist and to ensure they are used correctly.

Duration of the transfer with a hoist should be taken into account and minimised to ensure comfort of the patient and prevent skin damage.

Floor lifts

The use of passive floor lifts can reduce work-related injuries

If the patient is ready for transfer out of bed, this may involve utilising equipment such as a patient lift system initially, until assisted standing transfers to the chair can be achieved. Appropriate transfer equipment and seating is fundamental to meet this aim and ensure patients at varying levels can sit out safely.

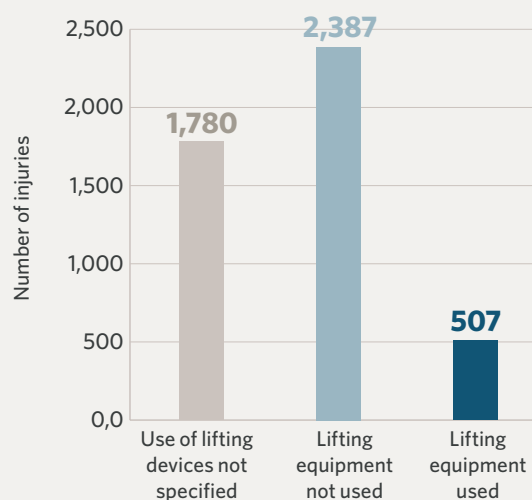
The use of mechanical lifting equipment (in addition to other assistive patient handling devices) is a key component of any safe patient handling or caregiver injury program¹².

A BIOMECHANICAL LABORATORY STUDY AND PSYCHOPHYSICAL EVALUATION SHOWED THAT MECHANICAL LIFTS⁴³:

- Reduce the back-compressive forces on nursing personnel by an estimated 60%
- Remove two-thirds of the lifting activities per transfer
- Increase the residents' perceptions of comfort and security, as compared with being manually lifted

An Occupational Health Safety Network study found that, of the 62% of injuries that included data on lifting equipment, almost 83% of the injuries occurred when lifting equipment was not used, while only 18% of the injuries occurred when equipment was used⁴⁴.

PATIENT HANDLING INJURIES AMONG ALL HEALTHCARE PERSONNEL AT 112 US HEALTHCARE FACILITIES PARTICIPATING IN OHSN, 2012-2014



Adapted from Gomaa AE et al, 2015



Ceiling lifts

Biomechanical loading results of a study identified that ceiling lifts require lower forces to operate than floor lifts, and that caregivers in a home environment should be provided with a ceiling lift to reduce the risk of injury⁴⁵. Addressing the need for ceiling lifts early within the facility planning is crucial to accommodate installation requirements of such equipment. Space aspects related to provision of safe patient handling equipment can also be addressed with the provision of ceiling lifts, with ceiling lifts requiring less space compared with using passive floor lifts.

There is a move in many markets towards the installation of ceiling lifts to manage a growing dependent patient population and address working safety and efficiencies of caregivers when delivering the care process.

Working efficiencies with the reduced availability of care workers are high on the agenda in many European markets such as Germany, UK and Netherlands. Working efficiencies are possible with the use of ceiling track lift and stretcher slings and the number of nurses required is significantly reduced. There is also an increase of 54.1% of transfers performed within safe limits, when compared to not using a stretcher sling and ceiling lift⁴⁶.



MaxiSky 2 IC (Infection Control) with standard loop sling



MaxiSky 2 PDPS (Powered Dynamic Positioning System) with standard clip sling

Evidence summary

Author	Study	Design	Key findings
Health and Safety Executive, 2012 ⁴⁷	Getting to Grips with Hoisting, HS1S3	A practical guide to ensuring safe use of patient hoists and slings	Standards for use of patient hoists including safety checks, assessment and hoist/sling selection
Gomaa et al. 2015 ⁴⁴	A study to review if mechanical assistive technology can decrease the risks of manual patient handling and mobility for both patients and caregivers	Data gathered on 5,140 patient handling and movement injuries between 2012 and 2014, through the NIOSH Occupational Health Safety Network (OHSN)	The study found that, of the 62% of injuries that included data on lifting equipment, almost 83% of injuries occurred when lifting equipment was not used, compared to 18% when equipment was used
Wolf et al 2004 ⁴⁸	Use of mechanical patient lifts decreased Musculoskeletal symptoms and injuries among health care workers	Pre/post intervention study to evaluate the effectiveness of mechanical patient lifts in reducing musculoskeletal symptoms, injuries and workers' compensation costs at a community hospital	Reductions were observed in injury rates, lost workday injury rates, workers' compensation costs and musculoskeletal symptoms after deployment of mechanical patient lifts

Passive sitting and standing

Where edge of bed sitting is likely to be difficult to achieve, but early weight bearing and upright positioning are desirable, the Sara Combilizer multiposition aid can be utilised to help achieve out of bed rehabilitation goals early in the care pathway.

The patient can be easily repositioned into a supine, standing, or seated position, as the functions of a tilt table, stretcher and tilt in space chair are combined.

The Sara Combilizer allowed mobilisation of patients at a more acute phase of their illness⁴⁹

The introduction of the Sara Combilizer was associated with a significant reduction in time to first mobilise⁴⁹

The sitting position has a number of benefits both physically and psychologically. Upright posture challenges the patients sitting balance and trunk control and can be adjusted according to their current ability. A more upright posture will also support functional tasks such as eating and drinking, brushing teeth or communicating with family. There are benefits psychologically for the patient and their relatives and caregivers as mobility progresses out of bed.

Due to the more gradual change to a standing position, the Sara Combilizer can provide a method to continue early mobilisation with more challenging patients.

As the Sara Combilizer is mobile it enables the patient to be wheeled short distances often to the window to give the patient a new perspective and get in touch with the outside world again.



Evidence summary

Author	Study	Design	Key findings
McWilliams et al, 2017 ⁴⁹	Prospective before and after study Multi specialty ICU	80 patients mechanically ventilated for ≥5 days. Sara Combilizer introduced coupled with training for staff and protocol for use	Reduced time to first mobilise by 3 days. Patients were mobilised at a more acute phase of illness with no adverse events

Sitting on the edge of the bed

The process of sitting a patient on the edge of the bed forms an important part of the early patient assessment and subsequent provision of a structured rehabilitation programme and seating plan. This process provides vital information with regard to patients' sitting balance and readiness for sitting out of bed and their physiological stability in response to activity and positional change, as well as many other specific physical and psychological benefits.

BENEFITS OF SITTING ON EDGE OF BED

- Increased functional residual capacity⁵⁰
- Challenges the trunk and allows assessment of static and dynamic sitting balance⁵¹
- Less supportive / more physically demanding position promotes a cardiorespiratory response⁵²
- Provides neurological stimulus to aid waking and reorientation⁵³
- Positive psychological benefits of commencing rehabilitation for patient and family



Evidence summary

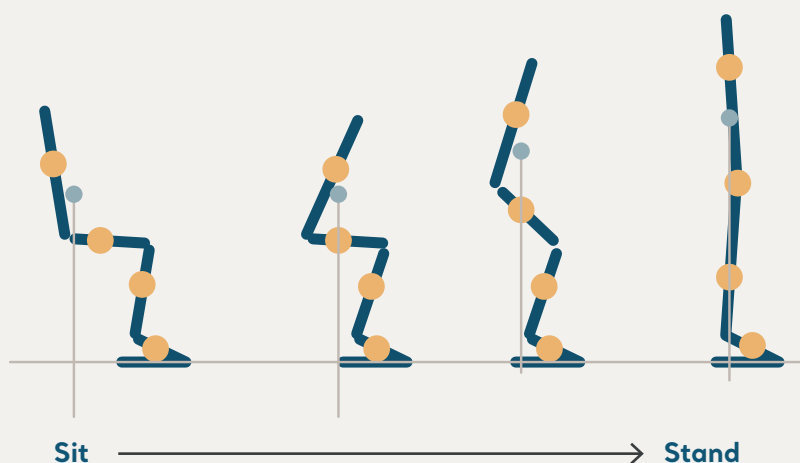
Author	Study	Design	Key findings
Collings N et al. 2015 ⁵²	This study aimed to compare the acute exercise response between passive and active sitting in critically ill patients	A repeated measures, randomized cross-over trial	The study concluded that sitting on the edge of the bed is a more metabolically demanding activity than a passive chair transfer in stable, mechanically ventilated, critically ill patients
McWilliams, D.J. et al. 2011 ⁵¹	Weakness on the Intensive Care Unit - Current Therapies	Journal article discussing early mobilisation and how this has been demonstrated to decrease ICU length of stay and shorter stays in hospital	Sitting on the edge of the bed challenges the trunk and allows assessment of static and dynamic sitting balance

Active standing and raising

Helping patients relearn to transfer is a central goal addressed by many therapists during physical rehabilitation. The elevated risk of back injury in therapists performing more than 6 to 10 assisted

transfers per day highlights the need to explore alternative strategies including the use of equipment to help patients relearn to stand and transfer⁵⁴.

Normal movement patterns in sit-to-stand



Main phases of the sit-to-stand:

1. Begin to stand up by moving the upper body forward, which moves body mass toward the feet – in preparation for balance when standing
2. The knees move forward
3. Prior to leaving the chair, hip and knee extensor muscles are activated to provide antigravity support for these joints. This action is commonly referred to as “weight shift”
4. Achieve upright stance

STANDING AND ACTIVE LIFTS

A study published in 2016 strongly advised that safe patient handling and mobility technology should be used to promote patient mobilisation with the goal of rehabilitation and restoring independence. Quality of care should be increased, while decreasing the injury risk to both healthcare recipient and worker. Indeed, the availability of sit-stand lifts (active lifts) is associated with quality indicators of mobility. Their use within a safe patient handling programme is one strategy to prevent immobility, which has been shown to be linked to many negative outcomes including pressure ulcers⁵⁵.



Sara Plus



Much criticism of active sit-to-stand lifts has been related to normal movement patterns and the difficulties associated with achieving this natural pattern with the use of an active device.

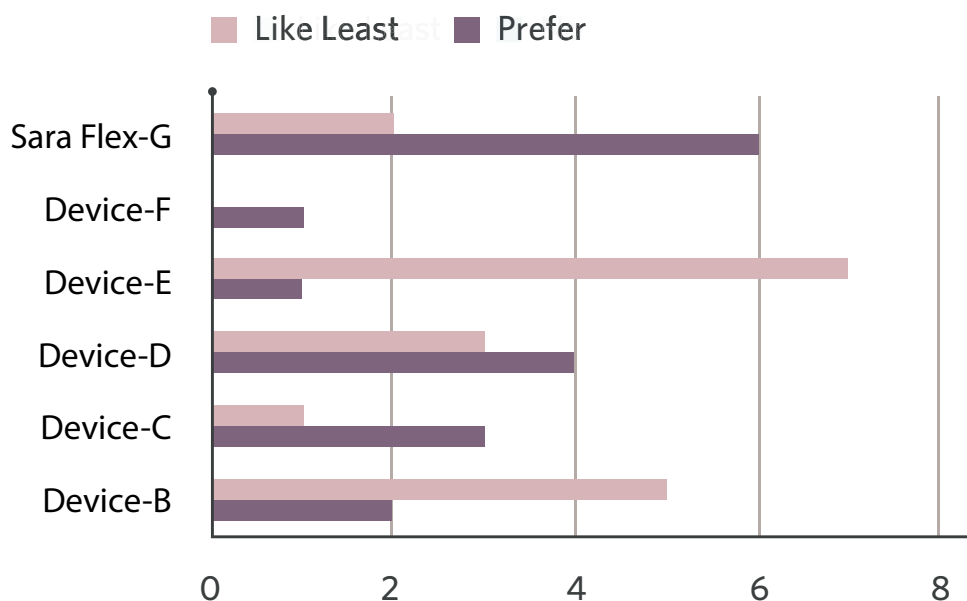
In an evaluation of sit-to-stand devices, Sara® Flex was shown to⁵⁶:

- Allow more forward knee movement during raising and lowering
- Allow more bodyweight through the feet during raising
- Give one of the closest centre of pressure movement patterns to the natural active movement and allow the patient to be more active through sitting and standing assisted transfers

Preference and dislike ratings for slings

Graph 1 shows the ratings for the sling preference. Devices B and E recorded more negative views than positive. Specifically E had a slow and very vertical lift pattern which increased the slippage of the sling against the participant. The devices D, C and G had more positive than negative ratings. The Sara® Flex device showed the most positive response. Interestingly F and G had identical slings but the combination with the silicone knee support affected the ratings.

GRAPH 1⁵⁶





Sara Stedy

Whilst the real-time cost savings are easily measurable, the unseen cost of care is also important. An independent equipment review study reported that Sara Stedy can greatly facilitate carers in their role, reducing the amount of hands-on support required, reducing the potential of caregiver strain and enabling greater levels of independence for the patient/resident⁵⁸.

Evidence summary

Author	Study	Design	Key findings
Gucer et al 2013 ⁵⁵	To determine associations between long-term care powered mechanical lift (PML) availability and mobility-related resident outcomes	Questionnaires to quality directors of 217 USA LTC facilities	Increasing numbers of sit-stand lifts used per 100 residents resulted in them remaining in bed for less time and incidence of pressure ulcers declined. In facilities with 3 or more sit-stand lifts (active lifts) per 100 residents only 9.5% of the residents experienced pressure ulcers
Slaughter, SE et al. 2015 ⁵⁷	Mobility of vulnerable elders study: effect of the sit to stand activity on mobility, function and quality of life	Longitudinal quasi-experimental intervention study	Compared with residents receiving usual care, those who completed the sit-to-stand activity over 6 months demonstrated fewer declines in mobility and functional outcomes
Fray, M et al 2018 ⁵⁶	An evaluation of sit to stand devices for use in rehabilitation	Trial followed by repeated measures to explore relationships between the movement patterns in an unassisted active sit to stand, and active stand to sit	Sara Flex allowed more forward knee movement, more bodyweight distributed through the feet and gave one of the closest normal performance of movement patterns

Walking

Gradually increasing muscle strength and stamina will lead to increasing levels of functional independence and have beneficial effects on a patient's psychological status as they become more independent and the improvements become more tangible. To support mobilisation in the early stages, ceiling lifts or walking harnesses can be used to support the patient and protect them from falls during stepping or walking practice.

People with impaired mobility are at a risk of falls. Impairments of balance, special awareness, loss of sensory skills can all exacerbate the occurrence of falling and hence the secondary injuries caused by such falls. A high occurrence of falls occur during sit-to-stand transfers among older adults⁵⁹.

The need for an assistive walking or standing device means that the individual has some problem with strength, gait, balance, or cognitive status; hence, attempting to rise and walk introduces the risk of falling. Ironically, the fall-prevention remedy for the partially mobile patient/resident is similar to the risk. Exercise reduces the occurrence of falls, and although sit-to-stand activities and walking increase strength, it may also improve balance and gait.



Sara Plus



Ceiling lift with walking harness

Patient Handling and Mobility Programs

Facilities that implement a safe patient handling programme can significantly reduce their costs associated with patient handling injuries^{12,13}.



Key elements to successfully sustain a safe patient handling and mobility (SPHM) programme include the following¹³:

- Creating a culture of safety
- Ensuring appropriate and available equipment
- Having unit-based peer coaches to address and remedy issues as they occur

Studies detailed in the recently published USA white paper have shown that capital investments in patient handling programs can be recovered in less than five years, and one health care provider that initially invested \$2 million in an SPHM program saw their return on investment in just three years. Crucially the introduction of a structured safe patient handling programme that pairs training with ergonomic intervention and mechanical aid use is now believed to be the most effective workplace intervention to prevent injuries relating to manual patient handling.

Patient handling education

The many benefits of safe patient handling and mobility (SPHM) programmes and technology can only be seen when adequate and appropriate SPHM education and training are provided. Such education and training promote behavioural changes that reduce risk of injury from patient handling by decreasing physical exertion when handling patients, ultimately achieving safer working practices and environments of care for both staff and patients.

Although accepted for many years, research has shown that training in body mechanics and proper lifting techniques alone are not adequate to reduce physical exertions during patient lifting and handling. A systematic review of patient handling literature found that interventions based solely on training in techniques had little effect on the working practices of staff and on injury rates.

Arjo Clinical Consultancy Programme

This clinical consulting programme combined with education is designed to work in partnership with an organisation to embed cultural change in patient handling. 'Insight' assessments identify mobility levels of patients/residents, current equipment availability (and condition) and transfer choices made by carers, enabling recommendations for best practice.

Education equips identified carers with skills that will enable them to become coaches and ambassadors in safe patient handling and mobility within their own facility.

The programme is based on the fundamental principle of a person-centred approach – optimising mobility of the people we provide care for whilst reducing risk to the carer, both of which can be achieved by ensuring appropriate environment, equipment and care skills are in place. This is the Arjo philosophy of the Positive Eight™.

The Positive Eight and Mobility Gallery are key cornerstones of the programme. Care skills training is supported by the evidence-based Handbook of Transfers.

Summary

Workplace injuries amongst caregivers as a result of patient handling are common. Patient handling transfers using a multifaceted approach including use of appropriate devices such as ceiling lifts, passive and active floor lifts and repositioning/transfer devices can help to reduce injury amongst caregivers and promote healthier outcomes for those affected by mobility challenges. The associated cost benefits to the organisation are recognised, but to be successful there is overwhelming evidence that implementation of any device(s) has to be accompanied by the right type of equipment in sufficient numbers and in appropriate locations alongside a programme of education, support and funding throughout the organisation.

Reference list

1. Richardson et al. Perspectives on preventing musculoskeletal injuries in nurses: A qualitative study. *Nursing Open*. 2019. 6;915-929
2. Daragh A, et al. Safe Patient Handling Equipment in Therapy Practice: Implications for Rehabilitation. *The American Journal of Occupational Therapy*. 2013
3. US Bureau of Labor Statistics. https://www.bls.gov/opub/mlr/2018/article/occupational_injuries_and_illnesses_among_registered_nurses.htm. 2018; Accessed 10th March 2020
4. Totzkay, DL. Multifactorial Strategies for Sustaining Safe Patient Handling and Mobility. *Crit Care Nurs Q*, 2018. 41(3): p. 340-344
5. Health and Safety Executive. Human Health and Social Work Activities Statistics in Great Britain 2019. <https://www.hse.gov.uk/statistics/industry/health.pdf>. Accessed 10th March 2020
6. Knibbe JJ, Knibbe NE. Static load in the nursing profession; the silent killer?. *Work*. 2012; 41 Suppl 1:5637-5638
7. Knibbe JJ, Knibbe NE, Geuze I. Work package Better, Sector funds Care and Welfare, Sector Hospitals, Utrecht, 2003 (Dutch guidelines prevention of physical overload for General Hospitals)
8. ISO/TR 12296:2012 Ergonomics — Manual Handling of People in the Healthcare Sector, 2012
9. Waters TR. When is it Safe To Manually Lift a Patient? *AJN* August 2007 t Vol. 107, No. 8
10. Health and Safety Executive (2016) Manual Handling Operations Regulations, 1992 - Guidance on regulations
11. Mital A, Nicholson AS, Ayoub MM 1997, A guide to manual materials handling – as cited in ISO/TR 12296:2012 Ergonomics — manual handling of people in the healthcare sector
12. Matz M, 2019. Patient Handling and Mobility Assessments: A White Paper Second Edition
13. Humrickhouse R, Knibbe JJ. The Importance of Safe Patient Handling to Create a Culture of Safety: An Evidential Review. *The Ergonomics Open Journal*, 2016, 9, 1-16
14. AON Risk Solutions (2016). Healthcare Workers Compensation Barometer. <https://www.aon.com/attachments/risk-services/Health-Care-WC-Barometer-2016-web.pdf>. Accessed March 10th 2020
15. Wong, C. A., Recktenwald, A. J., Jones, M. L., Waterman, B. M., Bollini, M. L., & Dunagan, W. C. (2011). The cost of serious fall-related injuries at three midwestern hospitals. *Joint Commission Journal on Quality and Patient Safety*, 37(2), 81-87
16. Agency for Research Healthcare and Quality 2015. Estimating the Additional Hospital Inpatient Cost and Mortality Associated With Selected Hospital-Acquired Conditions
17. Lahmann et al 2015. Mobility is the key! Trends and associations of common care problems in German long-term care facilities from 2008 to 2012
18. Rogers, M et al. Mobility and other predictors of hospitalization for urinary tract infection. *BMC Geriatrics* 2008, 8:31

19. Fritel, X. Is there a link between impaired mobility and urinary incontinence in elderly, community-dwelling women? *OBG Management*, August 2013, Vol. 25 No. 8
20. Granger, CV, Hamilton, BB, et al. Performance profiles of the Functional Independence Measure. *American Journal of Physical Medicine and Rehabilitation*, 72(2):84-89, April 1993
21. Boynton T et al. Banner Mobility Assessment Tool for Nurses: Instrument Validation. 2014. *Am J SPHM* • Volume 4, Number 3, 86-92
22. Knibbe JJ, Knibbe NE, Waaijer EM. Assessments of patients with a 5-category or a 3-category practical classification system: validity and practicality, 2012. *Work* 655-5656
23. Centers for Medicare & Medicaid Services 2018. Long-Term Care Facility Resident Assessment Instrument 3.0 User's Manual Version 1.16
24. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline. The International Guideline, Emily Haesler (Ed.). EPUAP/NPIAP/PPIA:2019. Section 8: Repositioning and Early Mobilisation. Recommendation 5.6 Repositioning Techniques. Page 121
25. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline. The International Guideline, Emily Haesler (Ed.)EPUAP/NPIAP/PPIA:2019. Section 6: Preventive Skin Care. Recommendation 3.4 Bed Linen. Page 88
26. Williamson R, Lachenbruch C, Van Gilder C. A Laboratory Study Examining the Impact of Linen Use on Low-Air-Loss Support Surface Heat and Water Vapor Transmission Rates. *OWM* 2013; 59(8):32-41
27. Edupuganti K, Price C. Repositioning Slings: The Effects on Skin Pressure, pH, and Temperature. *Am J SPHM*. 2013; 3(2): 48-54
28. Brienza, D et al. Do Lift Slings Significantly Change the Efficacy of Therapeutic Support Surfaces? A National Pressure Ulcer Advisory Panel White Paper March 2015
29. Harrison, D. Single Handed Care Part One The Winning Formula. ATToday, UK. Available from <http://attoday.co.uk/single-handed-care-part-one-the-winning-formula/> Accessed on 27.04.2020
30. Smith H, Orchard S. The reduction of double handling in the community. *The Column*, 2009. 23(3)
31. McCoskey KL. Ergonomics and Patient Handling. *AAOHN Journal*, 2007, 55(11): 454-62
32. Fray M, Hignett S. Using patient handling equipment to manage immobility in and around a bed. *British Journal of Nursing*, 2015; Vol 24 Issue 6
33. Waters et al. Patient handling tasks with high risk for musculoskeletal disorders in critical care. *Crit Care Nurs Clin North Am*, 2007. 19(2): p. 131-43
34. Pompeii LA et al. Musculoskeletal injuries resulting from patient handling tasks among hospital workers. *Am J Ind Med*, 2009. 52(7): p. 571-8

35. Bartnik LM, Rice MS. Comparison of caregiver forces required for sliding a patient up in bed using an array of slide sheets. *Workplace Health & Safety*, 2013. 61, 393-400
36. Weiner et al. Repositioning Patients in Bed Comprehensive Narrative Review. *Workplace Health & Safety*, May 2015
37. Wiggerman et al. Effect of repositioning aids & patient weight on biomechanical stresses when repositioning patients in bed, 2020. <https://doi.org/10.1177/0018720819895850>. Accessed 24.04.20
38. Knibbe et al. Effects on Quality of Care and Work of a Transfer and Repositioning Device for horizontal transfers on an ICU, 2015
39. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel, Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: The International Guideline 2019. Emily Haesler (Ed.). EPUAP/NPIAP/PPIA:2019
40. Baptiste A, et al. Friction-Reducing Devices for Lateral Patient Transfers. A Clinical Evaluation. *AAOHN Journal*. APRIL 2006. VOL. 54, NO. 4
41. Hwang J. Evaluation of Different Patient Transfer Devices in Reducing Biomechanical Exposures Among Professional Caregivers 2018. Proceedings of the Human Factors and Ergonomics Society 2018 Annual Meeting
42. Meepradit P et al. The Effectiveness of the Lateral Patient Transfer Device to Reduce Musculoskeletal Risk among Practical Nurses in a Hospital, Thailand. *Journal of Biosciences and Medicines*, 2018, 6, 45-51
43. Collins JW, et al. *Inj Prev* 2004; 10(4):201-211
44. Gomaa et al. Occupational Traumatic Injuries Among Workers in Health Care Facilities - United States, 2012-2014. *Morbidity and Mortality Weekly Report Weekly* 2015. Vol. 64. No. 15
45. Alamgir H, Yu S, Fast C et al (2008). Efficiency of overhead ceiling lifts in reducing musculoskeletal injury among carers working in long-term care institutions. *Injury*, 39:570-577
46. Knibbe JJ et al. Flying through the hospital: efficiency and safety of an ergonomic solution. *Work* 41 (2012) 5642-5643
47. Health and Safety Executive, Getting to Grips with Hoisting, HS1S3. 2012
48. Wolf L et al. Use of mechanical patient lifts decreased musculoskeletal symptoms and injuries among health care workers. *Injury Prevention* 2004;10:212-216
49. McWilliams D et al. The Sara Combilizer as an early mobilisation aid for critically ill patients: A prospective before and after study. *Australian Critical Care*. 2017; 30(4): 189-195
50. Chang AT, Boots RJ, Brown MG, et al. Ventilatory changes following head-up tilt and standing in healthy subjects. *Eur J Appl Physiol*. 2005;95(5-6):409-17
51. McWilliams, D.J., Westlake, E.V., Griffiths, R.D. Weakness on the Intensive Care Unit – Current Therapies. *British Journal of Intensive care*. 2011 Summer edition. pp. 23-27

52. Collings N, Cusack R. A repeated measures, randomized cross-over trial, comparing the acute exercise response between passive and active sitting in critically ill patients. *BMC Anesthesiol* 2015;15:1
53. Gillick BT, Marshall WJ, Rheault W, Stoecker J. Mobility criteria for upright sitting with patients in the neuro/trauma intensive care unit: an analysis of length of stay and functional outcomes. *Neurohospitalist* 2011; 1: 172-177
54. Burnfield J, McCrory B, Shu Y et al (2013). Comparative kinematic and electromyographic assessment of clinician and device assisted sit-to-stand transfers in patients with stroke. *Physical Therapy*, 93(10): 1331-1341
55. Gucer et al. Sit Stand Powered Lifts in Long term care and resident quality indicators. *American College of Occupational and Environmental Medicine*. Volume 55, Number 1, January 2013
56. Fray M et al. An evaluation of sit to stand devices for use in rehabilitation, 2018
57. Slaughter SE. et al. Mobility of Vulnerable Elders Study: Effect of the Sit-to-Stand Activity on Mobility, Function, and Quality of Life. *JAMDA, Journal of Post Acute and Long Term Care Medicine*. 2015. 16 138e143
58. Rice S, 2016. Sara Stedy Equipment Review, March – August 2016
59. Tinetti M E et al. Risk Factors for Falls Among Elderly Persons Living in the Community. *N Engl J Med* 1988 Dec 29;319(26):1701-7
60. Da Costa B, Vieira ER. Risk Factors for Work-Related Musculoskeletal Disorders: A systematic review of recent longitudinal studies. *American Journal of Industrial Medicine*. 2009. 53:285-323

At Arjo, we are committed to improving the everyday lives of people affected by reduced mobility and age-related health challenges. With products and solutions that ensure ergonomic patient handling, personal hygiene, disinfection, diagnostics, and the effective prevention of pressure injuries and venous thromboembolism, we help professionals across care environments to continually raise the standard of safe and dignified care. Everything we do, we do with people in mind. www.arjo.com

Arjo International HQ · Hans Michelsengatan 10 · 211 20 Malmö · Sweden · +46 10 335 4500

www.arjo.com

