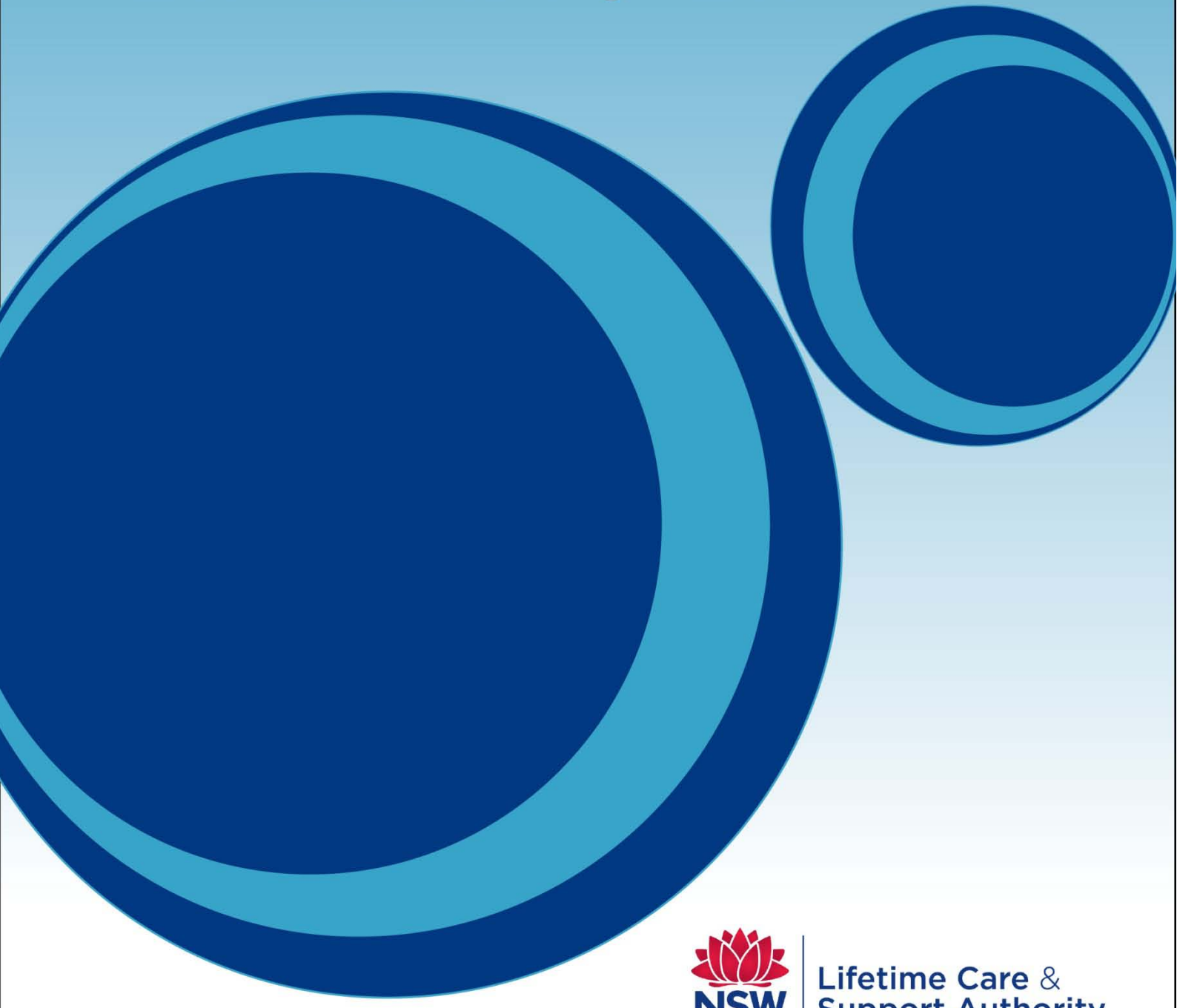
Guidelines

for the prescription of a seated wheelchair

Supplement 1:

Wheelchair features - Standing wheelchair



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Guidelines for the prescription of a seated wheelchair

Supplement 1: Wheelchair features - Standing wheelchair

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Introduction

Providing a wheelchair is a complex therapy intervention which aims to enhance a person's functioning. This document is a supplement to the "*Guidelines for the prescription of a seated wheelchair or scooter for people with a traumatic brain injury or spinal cord injury"*. Reference should be made to the full guidelines and the resources available on the Lifetime Care and Support Authority (LTCSA) website *(available from http://www.lifetimecare.nsw.gov.au/Brain_Injury.aspx or http://www.lifetimecare.nsw.gov.au/Spinal_Cord_Injury.aspx).* The guidelines are informed by the bi-psychosocial of health and use the framework of the International Classification of Functioning, Disability and Health (ICF)[24]. The guidelines intend to inform and guide therapists who are prescribing a wheelchair for a person with spinal cord injury (SCI) or traumatic brain injury (TBI).

This supplement provides information and the research evidence on the standing wheelchair feature, which may be considered in the prescription of a wheelchair to enhance an individual's functioning, health and well-being. It does not replace the need for clinical supervision or clinical judgment.

There has been limited research conducted on the standing wheelchair feature. Many of the research studies have used lower strength methodologies such as single case studies. The need for a standing wheelchair feature and how it might help the user achieve their goal/s or enhance functioning and participation is often not clear in the literature, although some reasons are made on various sites on the internet, which claim support from the research evidence.

The limited research available that has been used for this supplement relates primarily to people with spinal cord injury. There was no research located which included adults with TBI in the study population. Thus, some of the reasons, concerns and risks relate more to those people with SCI, however others are relevant for people with either spinal cord injury or traumatic brain injury.

Definition

The Rehabilitation Engineering and Assistive Technology Society of North America (RESNA)[1] defines a standing feature for a wheelchair to be:

> A standing feature integrated into a wheelchair base allows the user to obtain a standing position without the need to transfer from the wheelchair. A mechanical or electromechanical system manipulated via levers or the power or manual wheelchair base's controls moves the seat surface from horizontal into a vertical or anteriorly sloping position while maintaining verticality of the leg rests and back rest, thus extending the hip and knee joints.
> *RESNA 2009*[1]

Typically a standing feature in a wheelchair allows the user or occupant to achieve a full vertical standing position, although the feature can be used for different or gradual angle changes appropriate to the individual.

The Therapist's approach

There are many recommendations in the '*Guidelines for the prescription of a seated wheelchair or scooter for people with a traumatic brain injury or spinal cord injury*"[8] which are particularly relevant when considering a standing wheelchair feature. There are implications, benefits and considerations with each wheelchair feature in terms of the person's goals, user activities, the transport interface and the environment where the wheelchair is used. The standing wheelchair feature involves different dimensions, operational demands and training requirements compared to a non-standing wheelchair which need to be considered. For further detail refer to the full "*Guidelines for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord injury" (2011)*[8], and in particular Chapters 5 (goals and evaluation), 6 (assessment and review), 7 (capacity and performance), 11 (training), 12 (Transport) and 13 (Maintenance).

Recommendation	Grade
The therapist should consider all recommendations in the *"Guidelines for the prescription of a seated wheelchair or scooter for people with a traumatic brain injury or spinal cord injury*" when prescribing the wheelchair and when considering the standing wheelchair feature. *Available from http://www.lifetimecare.nsw.gov.au/Brain_Injury.aspx or http://www.lifetimecare.nsw.gov.au/Spinal_Cord_Injury.aspx*	Principle

Key factors to establish for the standing wheelchair feature is why a standing feature is needed and how it might enhance functioning, health, well-being and assist the wheelchair user to achieve their goal/s. The inclusion of any wheelchair feature should be linked to enabling the person's goals within the domains of body function and structure, or activities and participation[8, 24]. A standing wheelchair feature may remove a barrier and assist the person to achieve one goal but in another circumstance may detract or prevent achievement of another goal. For example, the standing feature may allow the person to reach a higher shelf, but limit an activity in their home bathroom because of the wheelchair dimensions. Throughout the assessment, trial and evaluation phases of the prescription the therapist should consider the goal/s and all domains of functioning now and in the future, as well as the potential changes over time and all relevant environments.

As with any wheelchair feature, the therapist needs to apply clinical reasoning throughout the prescription process, and be guided by the research evidence to establish whether the standing feature will assist the user and therefore whether the standing feature is reasonable and necessary. The therapist should use the link to refer to the reasonable and necessary criteria for Lifetime Care and Support Authority - http://www.lifetimecare.nsw.gov.au/Guidelines_and_Policies_for_Professionals.aspx.

The therapist and potential user will need to answer questions concerning the standing wheelchair feature and articulate their reasoning in the equipment application to LTCSA. Some of the questions are:

- What is the participant's goal with which the standing feature will assist?
- How will the standing feature assist goal achievement and does the research support this?
- Who will operate the standing mechanism?
- When will the standing wheelchair feature be used and how frequently will it be used?
- Where will the standing wheelchair feature be used and has the standing position been trialled in the specific environments? (Those situations and environments where it is planned to be used need to be identified and information on trials provided to establish that the goal is achievable and has been achieved).
- Are there goals which may be negatively affected by the use of the standing wheelchair feature and do these outweigh the benefits?

Research evidence

A systematic literature search was conducted using multiple databases to locate the relevant literature and research studies on the standing wheelchair feature published in the period from 2000 - May 2012 (refer to Appendix 1 for the Method). The search results confirm that there has been limited research on the standing wheelchair feature in peer reviewed journals. A number of the studies located, use less rigorous methodology. Few studies explored the benefits and harms around the standing wheelchair feature. As a result no evidence based recommendations could be developed. Further research is needed.

The search results provided below are aligned with the reasons identified in the literature for the use of a standing wheelchair feature. The information is grouped into the ICF domains of functioning and health[24]. A number of the sub-sections of body function and structure relate more specifically to SCI (e.g. bone mass) and therefore is most relevant to people with SCI.

1. Body function and structure

1.1 Improve bone mass or bone health

Osteoporosis is low bone mass (bone mass refers to the amount of bone minerals present or the bone mineral density). It can affect any person with a spinal cord injury below the level of the lesion and in particularly the lower limbs. Preserving bone mass is important to reduce the risks of fractures and particularly low-trauma fractures occurring during transfers or falls [2, 21]. Immediately after the spinal cord injury there is a loss of bone mass with the most significant decline occurring in the lower extremity in the first year after injury. Recent research suggests that loss of bone mass continues to show a steady decline for up to 3 years [2, 21]. The immediate and steady decline in bone mass after spinal cord injury was previously thought to be as a result of mechanical unloading because the person was not standing and weight bearing. However, more recent research suggests that because the onset is so rapid, there may be other "neurogenic" factors and responses to bone cells that account for the loss of bone mass[2]. Other factors might also contribute to loss of bone mass such as inadequate calcium in the person's diet, insufficient vitamin D, ageing and the onset of menopause in women[25]. There needs to be ongoing monitoring of bone mineral density in particular for people with spinal cord injury[21].

There is a lack of evidence regarding passive standing to **prevent** loss of bone mass after a spinal cord injury. The evidence is inconclusive regarding the effectiveness of **treatments** for low bone mass including movement interventions such as Reciprocating Gait Orthoses, self-reported physical activity and passive standing (such as in a wheelchair with a standing feature or the use of a tilt-table or standing frame) to treat low bone density [2, 3, 5, 11, 13, 18, 21].

There has also been a small study (n=7) of participants with SCI to assess the effect of high dose bone compressive loads (150% of body weight) using stimulation of the quadriceps in a supported stance[6]. After 3 years of 5 times per week dose, there was a significant difference in bone mineral density around the site of the stimulation (femur) only, but not at the more distal part of the lower limb (tibia). However, the study results cannot be generalised to a wheelchair with a standing feature as the standing feature will allow up to a maximum of the person's body weight in loading of the bones and not 150% of body weight as was the method in the study.

The most effective treatment that has been identified in the research at this time for bone mass is drug interventions and supplements[2, 19, 21]. In spinal cord injury these need to commence early after injury.

***Conclusion**: The research evidence suggests that the use of a standing wheelchair feature will not prevent nor improve (treat) bone mass density decline in the short nor medium term. On the basis of the currently available research evidence, it is not reasonable to prescribe a standing wheelchair for the purposes of preventing or improving bone mass loss. The most effective treatment is drug interventions and supplements.*

1.2 Enhance bowel function or decrease the incidence of urinary tract infections

A SCI will generally result in a loss of nervous system control. As a consequence, there are frequently problems with bowel and bladder management or colonic dysfunction. Bowel and bladder management are a high priority for a person with a SCI and result in major disruptions to lifestyle, activities and participation in major life roles[20]. There have been case reports of some people with a SCI where a perceived improvement in bowel function (motility) is reported with the use of a standing wheelchair feature. One study described short periods using the standing wheelchair feature (approximately 12 minutes three times per week to an average angle of 61º) [22] and another measured improvement of bowel motion frequency and reduced bowel care time through the use of a standing frame for 1 hour per day for 5 days per week (angle of tilt not reported)[14]. A self-reported survey conducted in the United States in 1998 of people with SCI who used standing devices concluded that some individuals perceived a decrease in urinary tract infections, improved bladder and bowel emptying[7]. However, there was no significant correlation between the standing frequency and reduction of urinary tract infections and the majority of people did not find, know nor report a change in bladder or kidney function following the use of a standing frame.

While decreased mobility and reduced sensation may contribute to the bowel and bladder management problems, it is considered by a number of research studies to be predominantly as a result of disrupted autonomic control of the gastro-intestinal tract[20]. The lack of autonomic control results in delayed gastric emptying, poor colonic motility which

leads to prolonged bowel transit time, constipation, abdominal distension after eating. Recent research has also shown an association with bowel dysfunctions and autonomic dysreflexia [20].

***Conclusion**: There is limited evidence and largely self report studies which support the use of a standing table or standing wheelchair feature to improve bowel function or reduce constipation for a person with SCI. If a standing feature was to be prescribed to improve bowel function, the benefits should be substantiated through measurement of functioning before and during a trial of a standing wheelchair feature.*

1.3 Enhance joint range of motion and muscle tone

There have been suggestions that standing will increase lower limb joint range of motion, reduce spasticity and thereby enhance ankle mobility and/or stretch the hip flexors. This is based on the assertion that regular stretch with weight loading reduces muscle tone[1, 12, 22]. A more recent quality study with SCI participants (assessor blinded randomised controlled trial) investigated ankle mobility and regular standing[18]. The researchers found that regular passive standing of 30 minutes three times each week for 12 weeks had a small effect (4 degrees improved range of motion) on ankle mobility but this may not be clinically worthwhile. The authors concluded that therapists should not expect improvements in ankle mobility from 3 months of regular standing.

In contrast, the development of spasticity has been associated as one of the adverse complications arising from orthostatic hypertension[4]. In some individuals who experience orthostatic hypertension in standing, there may also be an increase in muscle tone and spasticity.

***Conclusion:** There is no evidence to suggest that standing will functionally enhance ankle or hip joint range of motion nor reduce spasticity.*

1.4 Enhance breathing or respiratory functioning

Respiratory functioning in terms of lung capacity and expiration is considered to be enhanced by an upright posture. A study of able bodied participants confirms that a slumped seated posture significantly decreases lung capacity and expiratory flow[17].

However, the only research identified which refers to breathing and standing is the study Eng, 2001[9]. The study was a survey of 126 people with SCI of which 30% (38) engaged in prolonged standing as a method to improve or maintain their health. Approximately 10% of the survey respondents perceived an improvement in breathing after prolonged standing, although 5 % reported breathing difficulties as a negative effect of prolonged standing.

No evidence was located which involved the standing wheelchair features to improve respiratory management for individuals with tetraplegia[20].

***Conclusion**: At this time, there is no research evidence to support the use of a standing frame or standing wheelchair feature to enhance breathing. There is the research evidence which suggests there is a benefit to maintaining an appropriate upright **seated** posture to promote lung capacity and expiratory flow.*

1.5 Assist with pressure management

Pressure management and wound prevention is influenced by a range of factors (equipment and individual parameters). There is partial distribution of pressure when using tilt or recline wheelchair features. Research indicates that pressure starts to reduce at 20 degrees of tilt in space but effective pressure relieving posture does not occur until the tilt in space angle is approximately 45 degrees, with increasing effectiveness in pressure relief up to 65 degrees[8]. A standing posture relieves pressure on the ischial tuberosities. However, a research study which compared the loading on the seat and back during phases of tilt, recline and standing concluded that standing (to 75 degrees) and recline (to 90 degrees) provided similar seat load reductions[23].

One potential harm is that there may be some sacral shearing occurring when moving from a seated to standing position (or stand to sit). These shearing forces have the potential to negatively affect skin integrity in the sacral region[1, 12].

The standing wheelchair feature may not be compatible with a highly contoured or custom or adaptive one-piece seating system. As a result the benefits of standing have to be balanced with the need for pressure care in the seated posture, particularly as a standing posture would not be maintained for prolonged periods. In any event, if there are pressure management concerns, it is important that interface pressure measurements are conducted for all positions between the seated and standing configurations of the wheelchair.

***Conclusion:** The need for pressure care in seating may preclude the use of a standing wheelchair feature for reasons of incompatible pressure care or seating systems. Further, if there is a high risk of skin breakdown, the potential harm from shearing forces need to be considered.*

1.6 Aid digestion and promote general health

There have been suggestions that the use of a standing wheelchair feature or standing frame improves circulation, digestion, and general well-being[9, 16].

Conclusion: *There have been self-reported perceptions of the standing wheelchair feature aiding digestion and promoting general health and well-being through survey. However, no quantitative research could be identified to support this claim.*

2. Activities and participation

2.1 Enhance performance and participation with activities

There have been suggestions, personal narratives[10, 15], various manufacturers' and individual's websites which describe how a standing wheelchair feature enhances performance with some work, education, community and recreational activities. However, there was no research located which referred to the standing wheelchair feature and enhanced participation and performance with activities. Despite the lack of evidence, it is recognised that there are particular activities which require standing or reaching to complete (e.g. reaching for items on a high shelf) or the activity is enhanced when performed from a standing posture.

A standing wheelchair feature will not entirely replicate able body movement for activities which, for example, require dynamic and complex postural changes in standing/walking or bending, lumbar flexion, turning to face a different direction or end of range reaching. A standing wheelchair feature does enable an upright position, although not necessarily in full standing (e.g. 90 degrees). The standing feature also does not allow for lumbar flexion beyond the midline. Consequently the standing wheelchair feature will be appropriate for some standing activities but not others, depending on the task demands. Examples of activities which might be enhanced, if performed in stationary (predominantly) standing position are: painting at an artist's easel, attending a rock concert or presenting to group or class. An example of a dynamic activity with complex postural demands that can be performed in standing (although can also be performed in sitting) is cooking at a stove top. The ergonomic factors that need to be assessed and measured in the example of standing to cook on the stove top are described below:

- User's anthropometry (e.g. reach distance, height of wheelchair plus individual, upper body strength)
- Environmental dimensions (e.g. height of stove top, floor surface, distance to sink and its dimensions, distance to bench top, hip distance from stove top, position and access of utensil drawer, kick board height)
- Wheelchair equipment dimensions (position of chest support, angle of upright, position of controller, front castor position and size)

The standing wheelchair feature can enhance the reach range of the user from a standing position[1, 16]. However the increase in reach range is largely a vertical advantage, whereas forward reach might be limited due to concerns about the wheelchair's stability (when in the standing position), physical limitations of the user and restrictions in forward flexion of the trunk. For a person with cervical tetraplegia, independent reach range against gravity may not be enhanced with the use of a standing wheelchair feature.

Hand functioning is a major factor when considering a standing wheelchair feature to enhance participation in activities. The potential user should have sufficient hand function (with/without aids) to be able to manipulate, operate, hold or use equipment related to the proposed activity in the seated position before consideration of the activity in standing.

Conclusion: *At this stage, on the basis of the designs currently available, a standing wheelchair feature is likely to be more functional for enhancing stationary standing activities rather than dynamic standing activities with complex and multiple postural demands. Repeated trials of the standing wheelchair feature by the potential user, in the environment in which it will be used, are essential before a definitive wheelchair prescription is made.*

2.2 Enhance communication and psycho-social well-being

A standing wheelchair feature will enable the user to be at eye level when talking with people. This might be particularly relevant for social, work or education settings. Some examples are:

- Speaking or presenting to a group (e.g. teaching a class, presenting to colleagues, or hosting meetings)
- Work roles and situations such as reception, serving customers and where a regular change from a sit to stand posture is not required
- A limited number of machine operation duties although there needs to be consideration of safety issues and risks to the wheelchair user and others
- Social situations where people are standing such as pubs, work or school functions.

However, for adults in many social situations and workplaces, communication which continues for more than a few minutes between individuals or small groups frequently occurs in a seated position. This includes at bars, clubs, restaurants, home environment and workplaces. Younger children infrequently communicate in stationary standing for prolonged periods such as in a school playground as the activity is likely to be less static. Adolescents might often been seen standing and talking together. However, in an education setting or with group activities, and particularly with children and adolescents, the safety issues for the user of a standing wheelchair feature and others around them, should be considered. Further, where the individual using the standing wheelchair feature is dependent on assistance to change from a sitting to standing posture, the practicalities, and

implications for group disruption and time constraints should be clarified. The individual circumstances need to be considered to establish whether a standing wheelchair feature is reasonable and necessary, and will be used to enhance communication or psycho-social well-being.

When a standing wheelchair feature is being considered - for reasons of the user's communication and psycho-social well-being, the following should be documented regarding anticipated use:

- The potential user's goal to which the standing wheelchair feature relates
- The specific situations where the standing feature will be used
- Current and anticipated frequency and time that the person will be exposed to the situations
- The people with whom the user will be communicating
- How long it is anticipated the user will remain in standing per occasion of operation (compared to being in the sitting position)
- The user's capacity and performance in the actual situation to operate the standing feature independently

Conclusion: *A standing wheelchair feature is a consideration to enhance communication and psycho-social well-being. However, the parameters of where, with whom, how and when needs to be established. The user needs to have goals to which the standing feature relates, assessment, trial and review of the use of the standing wheelchair feature in the social environments where it is anticipated the standing feature will be used, and articulation of the anticipated pattern of use.*

Considerations, potential harms and risks

There are a range of factors that are described in the research regarding the potential problems and risks associated with the standing wheelchair feature. These have been listed below into factors which relate to the person or the environment (which includes the wheelchair).

Individual factors

- The presence of contractures in the lower extremities or skeletal deformities or heterotopic ossification in relevant areas may prevent optimal standing[1, 12, 16].

- The presence of orthostatic hypotension or postural hypertension is a potential problem for people with SCI and may preclude the use of a standing wheelchair feature[1, 4, 20].

  Orthostatic hypotension refers to at least a 20mmHg decrease in systolic blood pressure or a 10 mmHg in diastolic blood pressure upon the change in body position from a supine position to an upright posture regardless of the presence of symptoms[20]. Orthostatic hypotension can occur in sitting and standing postures. It occurs during the acute period, but there are a significant number of people with SCI where it does not resolve for many years[20]. A self reported survey was conducted in the United Kingdom in 2009[4] which sought to establish the proportion of people with SCI who were restricted from using a standing device because of inducing symptomatic orthostatic hypotension or fear of same. Of the 293 SCI participants 38% experience orthostatic hypotension and most of these were T5 paraplegia or above. Of those that were using a standing device such as a standing wheelchair feature, 20% were limited because of orthostatic hypotension. Approximately 6 % did not use a standing device due to concerns about their orthostatic hypotension.

- If a person is at risk of, or experiences seizures, it needs to be clarified if standing might trigger seizures[12].

- Some people have reported an increase in pain and fatigue with prolonged standing[9].

- The person (SCI or TBI) with ankle or joint instability may be at risk of further injury if positioned in a wheelchair with a standing feature.

- The risk of low trauma fractures after SCI is well established. In persons with existing osteoporosis in the lower limbs, there is the potential and risk of fracture if positioned in a standing posture[1, 16].

- The frequency of use is a major factor to consider in the prescription of the standing wheelchair feature. The frequent use of the standing feature to complete activities or for participation in key life roles might outweigh other disadvantages such as the greater weight of the wheelchair (compared to a manual wheelchair without the standing feature), the size of the wheelchair or fear of orthostatic hypotension. This would depend entirely on the circumstances of the person and whether these barriers to use could be overcome. There was no research located which established the frequency of use versus non-use of the standing feature[a].

- The capacity of the person to operate the standing wheelchair mechanism will influence the frequency of use. Where the person is dependent on another for assistance to operate the standing feature, and change from sitting to standing posture - the feature will be used less. The capacity of the user to re-position appropriately and adjust clothing in seating after standing will also influence the frequency of use. The implications need careful consideration.

Environment

- A standing wheelchair feature has a larger "footprint" when in the standing position compared to a wheelchair in the seated position.
- In one case study the user stated that going up curbs with the standing wheelchair was problematic and the wheels did not adjust according to the surface camber[22].
- The turning circle and manoeuvrability of the wheelchair with a standing feature needs to be considered in the context of the person.
- The parameters of the wheelchair with a standing feature and the interface with a vehicle or public transport need to be assessed in terms of access, time and whether assistance is required (and available).
- The inclusion of the standing wheelchair feature to a manual wheelchair also results in a heavier wheelchair. There are reports in the literature regarding problems arising from the greater weight of a manual wheelchair with a standing feature. The weight can reduce its usefulness in everyday activities. It is also problematic when transporting the wheelchair[16, 22]. These issues may also arise with some powered wheelchairs with standing features depending on the environment and activities.

  Manufacturer's specifications were located from their website and from the specifications provided to the Independent Living Centre (ILC) (http://www.ilcnsw.asn.au/) for a range of wheelchairs with the standing feature. The weight of a power wheelchair (including batteries) **without** a standing

[a] There is only one study available on the use of standing devices which involved surveying people who had purchased the standing device from one of two companies (Dunn 1998). There are limitations to this study.

mechanism ranges from approximately 82-115 kg depending on the make, brand and other features for the models available in Australia. The weight of a power wheelchair **with** standing mechanism is between 125 kg and up to 163 kg. A self propelled manual wheelchair with standing feature weighs around 25 kg.

- The need for adaptive or custom seating may preclude the use of a standing wheelchair feature. If the wheelchair user requires a one piece adaptive seating or custom seating, or highly contoured seating systems, it may not be compatible with the use of a standing feature[1]. The potential for greater shear forces should also be considered.

- The angle may not be fully upright when the standing feature is used. Many models of wheelchairs with standing features enable the user to assume an upright standing position to a maximum of 90º and so are not fully upright because of instability factors[16]. Some users have reported this to be problematic with some activities. It has implications for prolonged neck flexion if the user needs to visualise activities from a more upright angle.

Appendix 1

Method

A systematic search for relevant published literature was conducted in April 2012 using key search terms and a number of databases. It was anticipated that there would be a paucity of high quality research evidence related to the standing wheelchair feature. As the technology for standing wheelchair feature is relatively new, the search was limited to literature and reports published in the past 12 years. The following databases were searched:

- Medline
- Cinahl
- AMED
- PsychINFO
- OTseeker
- PEDro

In addition relevant information was also sourced from:

- SCIRE (2010)
- Paralysed veterans of America (PVA)

Search terms used;

wheelchair$, Standing or stand$, wheelchair$ and Standing or stand$, standing wheelchair$, stand$ wheelchair$

Inclusion criteria:

- Studies in English
- Adults
- Humans
- Papers published between 2000-2012 (current - May)

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