

Guidelines

for the prescription of
a seated wheelchair or
mobility scooter for people
with a traumatic brain injury
or spinal cord injury



Health
Support Services
EnableNSW

Guidelines for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord injury

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A guideline review is scheduled for 2016

It is anticipated that a literature search will be undertaken and the guidelines reviewed and updated where appropriate in 2016.

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Conflict of interest

At the beginning of the guidelines development process the working party members were required to declare any real or perceived conflict of interest. One member declared the potential for a perceived conflict of interest because a family member was employed by a supplier. It was anticipated that only wheelchair features would be discussed, not suppliers or brands. Nevertheless, the working party decided and documented that if those topics arose, the party member with the potential conflict of interest would be excluded from the discussion. However, those subjects were not discussed and no conflict of interest occurred.

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Foreword

by Dr Rhonda Galbally, AO

The United Nations Convention on the Rights of Persons with Disabilities promotes and protects the rights and dignity of persons with disabilities. In 2009, Australia ratified the Convention and so affirmed our agreement and obligation to take measures which meet the rights of persons with disabilities.

Anyone in NSW with a traumatic brain injury or spinal cord injury who needs a wheelchair can have one. Wheelchairs and mobility scooters not only remove physical and environmental barriers, but can assist with the user's activity and participation in many aspects of life. The appropriate wheelchair, for the person and their environments, can enhance not only their quality of life, but also the lives of families, friends and attendant care worker and carers. In contrast, poor prescription of a wheelchair or mobility scooter can mean the person is more dependent, has fewer opportunities and often will be excluded from participation in their community.

The *Guidelines for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord injury* provide a synthesis of the recent research evidence and guidance to help work out which is the most appropriate wheelchair. The guidelines also affirm that the person is, and should be, central to the prescription of their wheelchair, and involved in all stages.

I commend the guidelines to you. They are a very useful tool for all wheelchair and mobility scooter users in lifting the standard of consumer choice, as well as highly valuable for their direct purpose, that of assisting in the prescribing of wheelchairs and scooters.

Dr. Rhonda Galbally, AO

Chair National People with Disability and Carers Council

Foreword

by Dr Adeline Hodgkinson and Dr James Middleton

A wheelchair is a vital item of assistive technology that is prescribed to enhance an individual's function and independence, increase participation in activities and community, and improve health outcomes and overall quality of life.

The need to identify and balance competing priorities contributes to the complexity of wheelchair prescription. Successful wheelchair provision involves collaboration between the wheelchair user, carers, other relevant people, clinicians, suppliers and funding bodies.

It is recognised that incorporating the latest evidence into daily practice is essential. Few evidence-based clinical guidelines exist in the field of brain injury or spinal cord injury.

While the use of evidence-based clinical guidelines does not replace clinical reasoning or the need for clinicians to research the evidence and remain up-to-date, they can provide a basis for further investigation and a structure for more informed practice.

These guidelines have been developed collaboratively with input from experts in the field of wheelchair prescription. The project included a systematic literature review and analysis of all available relevant research in this field.

We would encourage clinicians to use these guidelines as a tool in the wheelchair prescription process for people with acquired brain or spinal cord injury.

We acknowledge the role of EnableNSW and LTCSA in providing funding for these guidelines. We congratulate the working party on the thoroughness with which they developed the guidelines and their comprehensive approach to wheelchair prescription.

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Executive summary

Providing a wheelchair or scooter is a complex therapy intervention which aims to enhance a person's functioning. The *Guidelines for the prescription of a seated wheelchair or mobility scooter* relate to two health conditions—spinal cord injury and traumatic brain injury. The guidelines have been developed using a rigorous methodology of searching for, appraising and grading the research evidence in conjunction with a working party. The topics covered were generated by the concerns and clinical questions raised by the working party. The guidelines are intended to inform and guide the therapist on clinical actions and decisions, but do not replace the need for clinical supervision or clinical judgment.

The guidelines provide recommendations that range from topics on the goals and evaluation, assessment and review, capacity and performance of the client, upper limb capacity and risk of injury, wheelchair features, through to propulsion, training, transport and maintenance. Resources have been developed to support the use of the guidelines and include checklists on key areas such as shoulder injury prevention, long-term needs, training, transport and maintenance.

1 Introduction

Background

EnableNSW (NSW Department of Health) and the NSW Lifetime Care and Support Authority (LTCSA) have funded the development of evidence-based guidelines to help therapists prescribe a seated wheelchair or mobility scooter for a person with traumatic brain injury or spinal cord injury.

The guidelines were developed in consultation with a working party of specialist brain and spinal cord injury therapists, rehabilitation and assistive technology experts, consumer representatives and researchers. The working party also included representatives from NSW Health and the NSW Lifetime Care and Support Authority.

The guidelines use a framework which is informed by a bio-psychosocial model of health, the International Classification of Functioning (ICF)²¹² for health conditions, and the human rights approach articulated in the Convention of the Rights of Persons with Disability (CRPD).¹⁸⁹

Purpose and scope

Our experience has shown that a wheelchair that is poorly matched to individual need adversely affects potential activities and participation, lifestyle goals and health status, as well as adding to costs. Through judicious application of the available research, these guidelines provide best practice recommendations for prescribing the most appropriate wheelchair for an individual.

They include seated wheelchairs and mobility scooters but exclude standing wheelchairs and prone trolleys. Although standing wheelchairs, prone trolleys and other forms of wheeled mobility are not mentioned, this does not mean that they cannot be considered in the prescription process.

The population and applicable health conditions (refer to glossary)

- adults with traumatic brain injury
- adults with spinal cord injury

The definition of adult for these guidelines is 16 years and older.

The guidelines are intended to inform and guide the therapist, but are not rigid regulations. Nor do they replace the need for clinical supervision or clinical judgment. They are not an education tool. These guidelines are different from procedures and process guidelines required by a funding body or those which relate to policy or statutory obligations.

When to consult these guidelines

These guidelines are relevant to therapists treating adults with spinal cord injury, traumatic brain injury or both, whose impairments impact on their function with respect to mobility, activity or participation.

The guidelines do not present new assessment tools, although new checklists have been developed. They also do not recommend particular brands of wheelchairs or scooters. The evidence for some features is included where appropriate and related to clinical questions raised by the working party.

Intended users

The intended users of the guidelines are:

- occupational therapists and physiotherapists who prescribe wheelchairs for people with spinal cord injury or traumatic brain injury
- professionals with specific expertise who are involved in the prescription of a wheelchair, for example, rehabilitation engineers.

Related publications

The publications in this series include:

- Guidelines for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord injury
- Summary of the guidelines for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord injury
- Consumer information brochure for the guidelines for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord injury
- Technical report for the guidelines for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord injury.

In these guidelines the term wheelchair will be used rather than seated wheelchair and scooter will be used rather than mobility scooter. When a guideline or recommendation includes scooters it will be specified. The term attendant care worker (who is paid) will also refer to carer (who is unpaid).

2

Methodology and evidence for recommendations

The body of evidence underlying the recommendations in these guidelines has been graded according to rigorously applied criteria. This section summarises the method used to develop the grading system. A full explanation is provided in the Technical Report (<http://www.lifetimecare.nsw.gov.au/Resources.aspx> or <http://www.enable.health.nsw.gov.au/publications>).

The guidelines have been developed through a systematic appraisal of relevant literature published between 1999 and August 2010. Research identified through the literature search was assessed for relevance and critically appraised by two reviewers.

Research study appraisal was based on the National Health and Medical Research Council (NHMRC) levels for the strength of evidence (levels I–IV) and grading system for guideline recommendations.^{92, 93} ¹⁴³ The literature has included reviews and studies of wheelchair user's experiences and perspectives. Qualitative and single case studies were also considered in order to strengthen the body of evidence. The research evidence was then presented to the working party.

Research articles were appraised according to study design:

- Quantitative studies were assessed using an expanded version of the (NHMRC) appraising the evidence checklist.¹⁴² The partitioned PEDro scale was also utilised for intervention studies.¹⁵⁸
- Qualitative studies were evaluated with the McMaster's University qualitative appraisal checklist Letts et al (2007).¹¹⁵
- Single case studies were reviewed using the Single Case Experimental Design (SCED) scale.¹⁸¹
- Systematic reviews were not appraised.

The strength of the body of evidence for each recommendation was determined using the NHMRC grades for recommendations¹⁴³ with adaptations. The NHMRC grades use a hierarchical model of quantitative research methods. Systematic reviews or meta-analysis of randomised controlled trials are considered to be the most robust evidence.

The NHMRC grading does not incorporate good qualitative research or single case studies, but these methodologies may be relevant to a number of questions raised by therapists for these guidelines. Given the complexity of the intervention, clinical questions and context variables posed by the working party, it was important to include qualitative research in grading recommendations.²⁰³ The qualitative research was appraised and included in the determination of the grade for each recommendation. The way in which qualitative research was incorporated within the NHMRC recommendations is outlined in Table 1. Single case studies were not included in grading the recommendations. The views or interests of EnableNSW and the Lifetime Care and Support Authority have not influenced the final recommendations.

All the research on which these recommendations are based is included in the evidence tables in the Technical Report. The recommendation grades are described in Table 1.

3

Framework and approach

Providing a wheelchair or scooter is a complex therapy intervention which aims to enhance a person's functioning. There is no formula for prescribing a wheelchair or scooter; rather it is an incremental process. When the person and the wheelchair or scooter are well matched the impact of the person's impairment is reduced, enabling them to achieve goals, participate in life roles and improve their health and quality of life. A good match, achieved through the use of the best available evidence, is also more likely to result in the greatest benefit, through the most cost-effective solution to meet the user's need.

The guidelines are informed by:

- *The World Health Organization International Classification of Functioning, Disability and Health (ICF).*²¹² This framework defines a person's functioning based on the bio-psychosocial model of health. The model recognises the complex interaction between a person's *health condition* (disease, disorder and injury) and the contextual factors of the *external environment* (e.g. social attitudes, architectural barriers and terrain, as well as legal and social structures) and *personal factors* (e.g. gender, age, coping style, character, past and current experience). Refer to Appendix 4 for further explanation.
- *The United Nations Convention on the Rights of Persons with Disabilities (CRPD).*¹⁸⁹ This is a human rights instrument which affirms that people with a disability have a right to, and are capable of, making decisions (or being assisted to make decisions) and being active members of society like all citizens. The CRPD reinforces the principle that the user must be actively involved and thereby placed at the centre of the therapy intervention. The CRPD specifically refers to supports and assistive devices related to mobility for living in the community and participation in life (Articles 19, 20 and 26). Refer to Appendix 5 for further explanation.

1. Recommendation

Grade

The therapist should adopt the following fundamental principles:

Principle

- Individually assess the prospective user's functioning and consider their personal variables such as age, goals, personality, co-morbid conditions and environment.
- Involve the user and relevant others such as family in decisions throughout the prescription process.
- Apply clinical reasoning at every stage of the intervention.
- Use research evidence to guide reasoning and decisions.
- Keep appropriate records of the intervention, including goals agreed with the user, joint assessments and outcomes.
- Consult with other specialists where appropriate about specific issues, for example seating specialists or speech pathologists. This could include occupational therapists and physiotherapists consulting each other on different areas of expertise, or consulting medical specialists about future medical conditions or procedures which might affect choice of wheelchair features.
- Ensure that they seek professional supervision commensurate with their skills and experience.
- If seeking funding for the wheelchair or scooter, the therapist must meet the relevant qualifications and experience required by the funding body.

3. Framework and approach

Cultural and language issues

NSW is the most culturally and linguistically diverse of all the Australian states.²⁸ NSW has the highest Indigenous population of all states in Australia (30% of the total Indigenous population of Australia). Seventy per cent of Indigenous people in NSW live in regional or remote areas.¹⁷⁹

The management approach used in prescribing a wheelchair or scooter requires consideration of cultural and language issues that may affect the user and their family's understanding of the intervention and the equipment. This includes Indigenous culture and differences arising from other cultural and linguistic diversity.

Communication is important in the prescription of a wheelchair or scooter. The therapist needs to ensure that information and advice are understood. Poor communication can directly or indirectly impact on the outcome for clients, particularly clients from a non-English speaking background or of Indigenous heritage (including where English is their second language). The therapist should not assume the client shares the same concepts and attitudes related to health, disability, the environment, and the role of the family even if the client seems fluent in conversational English. Education on cross-cultural issues in communication for health professionals, and the use of interpreters, helps minimise the potential for miscommunication.

The resource *Improving Communication in Indigenous Health Care* <http://www.cdu.edu.au/centres/stts/home.html> provides useful guidelines for the clinician. It was the result of a project funded by the Co-operative Research Centre for Tropical and Aboriginal Health and the Australian Council for Safety and Quality in Health Care. Guides have been developed to help people understand Indigenous (Aboriginal or Torres Strait Islander) protocols and to work with Indigenous people in a way that is culturally respectful <http://reconciliation.org.au/nsw/education-kit/protocols/>.

There are also resources and information on cross-cultural issues related to health care for patients from culturally and linguistically diverse backgrounds. A range of support tools—practice guides, handbooks and resources for health professionals—can be downloaded from the Queensland Department of Health at http://www.health.qld.gov.au/multicultural/health_workers/support_tools.asp.

In particular there is a resource with socio-cultural information for health professionals which reinforces the need for the health worker to avoid stereotyping http://www.health.qld.gov.au/multicultural/health_workers/cultdiver_guide.asp.

A guide to practice can be located at http://www.health.qld.gov.au/multicultural/health_workers/guide_pract.asp.

2. Recommendation

Grade

The therapist should consider any additional issues, potential disadvantages or need for additional resources (such as an interpreter) for the client and their family if the client is of Indigenous (Aboriginal or Torres Strait Islander) heritage or from a culturally and linguistically diverse or non-English speaking background.

Principle

4

Ethics

All therapists should be guided by personal and professional ethics in their approach to therapy interventions. Several ethical principles need to be considered in the prescription process. These may apply to areas such as decision making (refer to Section 7.2).^{182,134} The ethical principles are:

- *Respect for the autonomy of others*: This concerns the client's choice, individuality, freedom of will, and confidentiality for the client/their attendant care worker.
- *Benevolence or 'doing good'*: The therapist should perform actions that are done to benefit others and promote the client's wellbeing.
- *Preventing harm*: The therapist must try to prevent harm through due diligence and duty of care.
- *Justice*: The approach adopted should be fair and equitable.

3. Recommendation

Grade

The therapist must ensure that clinical decisions made throughout the prescription process are ethical.

Principle

5

Goals and evaluation

Therapists prescribe assistive devices such as wheelchairs or scooters to enable the user to achieve goals. Establishing a goal, implementing an intervention and measuring the outcome are a cornerstone of evidence-based health care practice.^{50, 93, 173} Establishing goals **with the client** before the intervention ensures better outcomes and thus satisfaction for the user.^{7, 23, 62, 134, 168, 187}

5.1 Goals

The provision of a wheelchair can affect the individual's functioning in any of the ICF domains:²¹² body function and structure, activity, and participation through their interaction with the context (environmental and personal factors). The wheelchair does not only affect mobility or posture. The provision of a scooter does not only affect mobility.

The therapist should consider all areas of functioning in the assessment, prescription and evaluation process so that all client goals are identified and there is minimal impact of one over another. For example, providing a scooter to address the goal of transport to the shops may detract from an individual's goal of regular exercise and maintaining fitness. Goals may be ranked.

The therapist should also recognise that there is potential for change over time in one domain which can influence functioning in another.²³ For example, if a user experiences a change in the tremor of their right arm, the power wheelchair controller will need to be changed or re-programmed.

The therapist also needs to determine whether the client will use the wheelchair or scooter part-time or full-time and for the short or long term.

4. Recommendation

Grade

The prescription of a wheelchair or scooter should include the development of client goals in partnership with the client and relevant others (e.g. family).

Principle

Goals should be SMART so that each goal is:

S – Specific

What does the client want to achieve in the health domain? What exactly will be achieved? What is the target in the specific body function, activity or area of participation? The client's name should be included in the goal statement.

M – Measureable

How is change in functioning towards the goal going to be measured? Will quantitative or qualitative measures be used?

A & R – Achievable and Realistic

Is the goal achievable given the client's current status and the current resources?

T – Time frame specific

How long will it take for the client to achieve the goal?



Goals checklist

This checklist outlines some of the factors for the therapist to consider when establishing goals in partnership with the client (and family).

Factors to consider as well as the client's current functioning

- Diagnosis and progress of recovery
- Prognosis
- Medical history and treatment

Factors to consider within the ICF domains

Body function and structure:

- Variable symptoms and the functions that need to be managed, for example, fatigue, spasm, comfort and early postural control for the longer term effects
- Mobility and transfer limitations
- Risk of secondary complications, for example, injuries subsequent to falls

Activity and participation:

- Types and range of activities and participation before SCI or TBI
- Types and range of activities and participation now
- Types and range of activities projected for the future
- Time efficiencies with activities
- Independence in activities and participation

Environment and personal contextual factors:

- Physical barriers in the client's current home and prospective environments
- Type of transport the client will use (public, private, aeroplanes, boats etc)
- Variations in the different environments that the client will access (e.g. work or study). For example, the client may be independent in mobility at home or at work if they only need to access rooms on the same level in one building involving short, manageable distances. However if work or study requires movement between multiple buildings or floors and across several hundred metres, multiple times per day, there may be a need for a wheelchair.
- Community environment, including the interface between mobility limitations and local terrain—uneven ground, steep hills outside home etc
- Climate
- Personal factors including self-perception, adjustment to disability and the level of independence desired or not desired
- Level of care available
- Satisfaction, client's expectations and motivation
- Feelings of security
- Acceptance of care versus desire for independence
- Expectations of family and work colleagues, friends and social circle

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5. Goals and evaluation

Some examples of goals related to wheelchair prescription are:

- On discharge, Bill will be able to sit in his wheelchair for 4 hours with a reduction in pain by >10%, as measured by scale X.
- In three months, Anthony will be able to maintain sitting balance over different terrains (rough, inclines) and when performing wheelies.
- Lisa will manage transfers to and from her bed to her wheelchair confidently and safely twice per day before she is discharged from the rehabilitation unit.
- Mohammed will operate and manoeuvre his power wheelchair independently around the hospital unit, without hitting objects for three consecutive days.
- In two months, Chris will independently push himself in the wheelchair 80% of the time while he is at the shopping centre.
- Jasmine will resume playing at least one set of tennis each fortnight by December.
- Over the next three months, Xuan will have returned to performing at least two child-related activities as a father within the home, and one parent-related activity outside the home, each week.

5.2 Evaluation and outcome measures

Evaluation of any clinical intervention involves measurement of change. In the case of wheelchair or scooter prescription, the outcome does not arise from provision of the device itself, but rather its impact on the user's functioning.

Before prescribing a wheelchair or scooter, the therapist should establish goals with the client and take baseline measures of functioning, using tools appropriate to the goal. Taking measures on at least two occasions—at a baseline or assessment, and on completion of the prescription—is critical to the evaluation of the wheelchair or scooter prescription.

Measurements can be taken at different stages: during the time goals are being established, prior to provision of the wheelchair or scooter, during trials and set up of the wheelchair or weeks or months later when the user is experienced in their own environments.⁷² A range of outcome measures may be applicable. Typically the same outcome measures are used at baseline and after the intervention.

Selecting Outcome Measures:

When selecting an outcome measure, the therapist needs to consider key criteria for rating it, including psychometric properties.^{101, 134, 101, 172}

The therapist needs to identify whether the tool has been evaluated for:

1. Reliability: Is the test reliable because it can be repeated and the results are consistent?
2. Validity: Does the tool measure what it purports to measure and on a relevant population?
3. Responsiveness: Is the tool sensitive to client changes?
4. Interpretability: Are the scores meaningful?
5. Acceptability: Does the client find the tool a burden?
6. Feasibility and utility: Is the tool cost and time effective and is it useful to the clinician and the client?

One review of wheelchair-specific outcome instruments for activity and participation found that of the eleven tools identified, most focused on mobility.¹³⁴ Further, while reliability information was generally available, information on validity and responsiveness was not. The tools without validity or responsiveness data were (at the time of the review) the *Wheelchair Users Functional Assessment* (WUFA), *Functional Evaluation in a Wheelchair Questionnaire* (FEW-Q), *Four Functional Tasks* (FFT), *Power-mobility Indoor Driving Assessment* (PIDA) and *Power-mobility Community Driving Assessment* (PCDA). Another study reviewed assessment tools for posture and postural stability¹⁶³ and came to similar conclusions—that reliability data were available but validity data was not.^{146, 166, 193}

A systematic review of wheelchair skills tests¹⁰¹ concluded that agreement was needed on which skills should be included in evaluation and measurement of outcomes. Some studies have looked at wheelchair skills and performance assessment tools. Other tools examine specific areas of functioning such as balance in a wheelchair.¹⁵⁷ Adaptation of existing tools such as the FIM has also been explored in order to include more mobility and locomotion items for wheelchair users.¹²⁹

Table 1 Grade of recommendation

Grade of recommendation	Description
A	<p>Body of evidence can be trusted to guide practice.</p> <ul style="list-style-type: none"> • One or more level I or several level II studies with low risk of bias and all studies consistent, or inconsistency can be explained. • The clinical impact is very large. • The population(s) studied in the body of evidence are the same as the target population for the guidelines. • Directly applicable to the Australian healthcare context.
B	<p>Body of evidence can be trusted to guide practice in most situations.</p> <ul style="list-style-type: none"> • One or two level II studies with a low risk of bias or a systematic review/several level III studies with a low risk of bias with most studies consistent or inconsistencies can be explained. • Clinical impact is substantial. • Population studied in the body of evidence is similar to the guideline population. • Applicable to Australian healthcare context with few caveats.
B^a	<p>Body of evidence can be trusted to guide practice.</p> <ul style="list-style-type: none"> • As above for quantitative studies. • Qualitative studies have been included in the body of evidence so there is one or more qualitative studies of high quality and rigour (credibility, transferability, dependability, conformability).
C	<p>Body of evidence provides some support for recommendation(s) but care should be taken in its application to individual clinical and organisational circumstances.</p> <ul style="list-style-type: none"> • One or two level III studies with low risk of bias or level I or II studies with a moderate risk of bias. • Some inconsistency reflecting some uncertainty. • Clinical impact is moderate. • Population studied in the body of evidence differ from the guideline population but it is sensible to apply it to target population. • Applicable to Australian health care context with some caveats.
C^a	<p>Body of evidence provides some support for recommendation(s) but care should be taken in its application to individual clinical and organisational circumstances.</p> <ul style="list-style-type: none"> • As above for quantitative studies. • Qualitative studies have been included in the body of evidence so there is one or more qualitative studies of reasonable rigour (credibility, transferability, dependability, conformability).

2. Methodology and evidence for recommendations

D	<p>Body of evidence is weak and recommendation must be applied with caution.</p> <ul style="list-style-type: none">• Level IV studies or level I to II studies/systematic reviews with a high risk of bias.• Evidence is inconsistent.• The clinical impact is slight.• Population studies in the body of evidence differ to target population and hard to judge whether it is sensible to apply it to the target population.
Consensus	<p>Consensus based recommendation.</p> <p>A systematic review of the evidence was conducted as part of the guideline research strategy. In the absence of high quality evidence, the working party utilised the literature available in combination with the best available clinical expertise and practices to reach a consensus on the recommendation. Consensus recommendations may be context sensitive in some cases.</p>
<p>Some recommendations are not based on evidence or expert opinion. They involve compliance with professional ethics, standards or statutory requirements. These recommendations are referred to as principles (professional best practice) or requirements (regulatory or statutory requirements).</p>	
P (Principle)	<p>A principle provides the standard required for a best practice therapy intervention. The working party reached agreement on the wording of the principle.</p>
R (Requirement)	<p>This recommendation is guided by a legal requirement, regulation or rule established by a statutory authority (e.g. Roads and Traffic Authority).</p>

5. Goals and evaluation

Some tools are being refined and new tools are being developed. However, at the time of writing, there is no single tool which meets all criteria for an outcome measure and is relevant to all possible goals of wheelchair prescription.

Each outcome measure has its own merits in terms of applicability to client goals, usefulness, and availability. The therapist needs to select the most appropriate outcome measure for the client goals. Some measures are simple; others are standardised quantitative tools or self-rating scales that are either freely available on the internet or can be purchased. There are many tools which could potentially be appropriate for wheelchair prescription.

There are a number of internet resources devoted to outcome measures for health conditions generally. Two of these resources identify outcome measures specifically for brain and spinal cord injury and some of the measures identified in them are relevant to the prescription of a wheelchair. Information on the criteria and psychometric properties for rating the outcome measurement tool is available through the weblinks. Both resources classify the outcome measures in terms of the ICF domains. The resources are:

1. Spinal Cord Injury: SCIRE172 <http://www.scireproject.com/rehabilitation-evidence/wheelchairs-and-seating-equipment>. There are a range of outcome measures identified that are relevant for different interventions. However, there is one section on related outcome measures specifically for wheelchair and seating equipment.
2. Traumatic Brain Injury: Tate, Robyn L. (2010) *A compendium of tests, scales and questionnaires: The practitioner's guide to measuring outcomes after acquired brain impairment*. This compendium provides information on an extensive number of measures including some specifically for participation and contextual factors as well as multi-domain measures.

Examples of outcome measures are listed below. Some may be relevant to both SCI and TBI. This is not an exhaustive list.

Simple numeric measures:

- Frequency qualifiers to describe activity and participation domains: frequency (for example occasionally 0–33%, frequently 33–66%, or constantly 66–100%). These can be used to measure intensity and time or to count occurrences or events.
- An ordinal scale similar to the qualifiers used with activity and participation domains in the ICF, which has an order but does not provide the relative difference (e.g. 0 = no difficulty, 1 = mild difficulty, 2 = moderate difficulty, 3 = severe difficulty, 4 = complete difficulty).

Freely available outcome measures that may be helpful include:

- *Goal Attainment Scale* (GAS) available through the original article. Details at <http://www.maa.nsw.gov.au/default.aspx?MenuID=376>
- *Community Integration Measure* (CIM) <http://www.maa.nsw.gov.au/default.aspx?MenuID=376>
- *Impact on Participation and Autonomy* (IPA) <http://www.maa.nsw.gov.au/default.aspx?MenuID=376>
- *WHO Quality of Life – BREF* (WHOQOL-BREF) http://www.who.int/substance_abuse/research_tools/whoqolbref/en/
- *Individually Prioritised Problem Assessment* (IPPA) <http://www.maa.nsw.gov.au/default.aspx?MenuID=376> and http://www.siva.it/ftp/eats_deliverable3.pdf
- *Wheelchair Users Shoulder Pain Index* (WUSPI) available through the article <http://www.scireproject.com/outcome-measures/wheelchair-users-shoulder-pain-index-wuspi>
- *Craig Handicap Assessment and Reporting Technique* (CHART) <http://www.tbims.org/combi/chart/index.html>
- *Impact on Participation and Autonomy* (IPA) Questionnaire <http://www.nivel.nl/pdf/INT-IPA-E.pdf>
- *Wheelchair Outcome Measure* (WhOM) http://www.rehab.ubc.ca/miller/wheelchair_tools.htm
- *Wheelchair Skills Test* (WST) <http://www.wheelchairskillsprogram.ca/eng/manual.htm>

5. Goals and evaluation

Examples of outcome measures that can be purchased include:

- *Canadian Occupational Performance Measure (COPM)*
Available through the Canadian Association of Occupational Therapists at https://www.caot.ca/ebusiness/source/orders/index.cfm?task=0_
- *Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST)*

<http://www.matchingpersonandtechnology.com/index.html>

5. Recommendation

Grade

The therapist should use an appropriate outcome measure at baseline or assessment and at other stages during the prescription of the wheelchair or scooter to measure change and the user's progress towards the goals.

Principle

6

Assessment and review

Review times should be chosen when goals are established. Reviews are recommended at three months and twelve months at a minimum and at any other time when there are significant changes, when a replacement item is required or if there are delays between prescription or funding availability.

Literature was sought on best practice in terms of the assessment and review of the person, wheelchair and environment interface. The parameters considered included the time, place, progress of the health condition, order of assessment (seating system or wheelchair), and the reasons for non-use of prescribed wheelchairs. Limited research literature was found.^{106, 134, 200, 209}

6.1 When and where to assess

6. Recommendation

Grade

Assessment for the prescription of a wheelchair or scooter should occur when the client is medically stable, although the review continues beyond that time.

Consensus

7. Recommendation

Grade

The therapist should obtain information on the home environment and surrounds as a key component of the assessment and prescription of the wheelchair or scooter.

Consensus

8. Recommendation

Grade

The assessment for the prescription and review of the wheelchair or scooter should continue throughout the recovery period, once all the ICF domains have been evaluated and relevant goals established.

Consensus

9. Recommendation

Grade

Assessment for the prescription of a wheelchair or scooter should include trials for an adequate period while performing activities in environments that are usual and relevant to the client and their attendant care worker (including the home environment or similar and surrounds, and anticipated modes of transport).

Consensus

6.2 Order of prescription of the seating system and wheelchair

10. Recommendation

Grade

The seating system needs to be integrated with the wheelchair and should be assessed with consideration of the goals and contextual factors.

Consensus

11. Recommendation

Grade

The therapist should consider referral of a patient with complex postural needs to a specialist (interdisciplinary) seating team who have expertise in specialist seating and work alongside the prescribing therapist. This could be through face-to-face consultation or other media (e.g. teleconference and photographs, video conference).

B^a

12. Recommendation

Grade

For clients with complex impairments of body function and structure, it may be appropriate to identify the seating system prior to the wheelchair.

Consensus

13. Recommendation

Grade

If the wheelchair seating system is identified first, it needs to be further evaluated and trialled in conjunction with the wheelchair.

Consensus

6.3 Review

The research located was limited to two studies.^{58, 169} The working party identified the factors that may be involved. A review of the user and wheelchair interface may involve, but is not limited to:

- review of the intervention goals and outcomes
- ensuring the device is adjusted properly
- making new adjustments if required
- consolidating training
- confirming suitability
- confirming that the user and/or their family understand the maintenance requirements
- checking the wheelchair's operation.

14. Recommendation

Grade

The client's goals should be reviewed at three months and twelve months following supply of the wheelchair or scooter, preferably face-to-face and at a minimum via phone contact.

Consensus

Reviews can occur at other times and can be initiated by the therapist, client or others such as the attendant care worker or wheelchair maintenance service.

6.4 Client changes

Potential user changes are varied. Examples include increase or decrease in body weight, range of motion, posture changes as a result of surgery or therapy, age related changes, additional health concerns and a change in user skills. There is the potential for similar changes in the attendant care worker.

15. Recommendation

Grade

The therapist should consider the need for adjustable features in the wheelchair when there are anticipated or expected user changes. Adjustable features of the wheelchair include seat height, back rest angle and height, width, axle position, adjustable footplates and a range of other set up features.

Consensus

6.5 Reasons for non-use

Research studies have examined the reasons why people provided with assistive technology continue to use it, do not ever use it or stop using it. The assistive technologies included communication devices, aids for self-care and mobility devices (manual and power wheelchairs). Some of the studies specifically targeted wheelchairs.

Factors related to use and non-use of assistive technology are listed here.

*Frequently identified factors are marked with an asterisk.

Assessment and intervention (AT support)

Non-use occurred when there was

- * a lack of follow-up service^{207, 57, 169}
- * poor instruction and training, including wheelchair maintenance knowledge^{65, 207, 57, 209}
- * limited client participation throughout the prescription process and the client's opinion was not proactively taken into account^{106, 134, 209}
- delays in delivery of the definitive (final) equipment or wheelchair^{106, 67, 207}
- delays with required modifications.⁶⁷

Continued use occurred when the provision process was well-managed with correct selection, installation and measurement.^{134, 209}

Personal factors related to the client

Non-use occurred because of:

- * changes that could not be accommodated by the equipment, for example, progression of disability, change in severity of the disability, change in needs or function^{52, 209}
- severe disability with multiple devices used¹⁸⁶
- changes in client demand (e.g. need for outings)⁶⁷
- feelings of user insecurity about wheelchair safety.⁶⁷

Continued use occurred when:

- * the user was comfortable^{99, 106, 168, 169, 206}
- * the user was satisfied and their expectations were met^{78, 169, 206, 207, 209, 57, 152, 153}
- * the user accepted their disability²⁰⁹
- the equipment was consistent with the expectations of their social circle¹⁵³
- the user was emotionally mature and motivated.¹⁸⁶

Device-related

Non-use occurred when:

- * the device was poor quality, leading to failure or a short fatigue life^{57, 69, 207, 209}
- * the person and the equipment were poorly matched, for example, a conflict between form and function or inappropriate features that did not meet functional needs^{134, 209}
- the appearance of the device did not appeal to the user.²⁰⁹

Environmental

- * Non-use occurred when there were physical barriers.^{67, 52, 137}

Continued use occurred when there was attendant care worker and social circle support.¹⁸⁶

16. Recommendation

Grade

The factors identified in research related to non-use of provided assistive technology (as listed) should be considered by the therapist during the wheelchair prescription process, as these may influence the outcomes.

B^a

7

Capacity and performance

Capacity refers to an individual's maximum ability to execute a task or action, whereas performance refers to what an individual does in his or her current environment.²¹² Many wheelchair and scooter prescriptions involve assessment of capacity but do not adequately identify user performance in different environments.

Best practice wheelchair or scooter prescription includes assessing the client's physical, cognitive, perceptual and behavioural capacity in standardised environments such as a hospital corridor or set obstacle course as well as their performance in variable environments such as the home, shopping centre or workplace. Incremental assessment involves repeat testing for accurate comparison and identifying the user's performance in their various environments (refer to recommendations in Section 6).

The therapist should also consider other factors such as:

- the need for additional equipment to be carried on the wheelchair or scooter, such as carry bags, mobile phone, water bottle and large capacity urine bag
- the efficient and safe use of the wheelchair or scooter
- the impact of training and practice
- transport issues
- resources needed to maintain the wheelchair or scooter.

7.1 Physical capacity

Assessing physical capacity includes noting the medical history and physical attributes, and performing a physical ('hands on') assessment. Physical assessment may include:

- diagnosis
- medical history, treatment and complications
- physical attributes (e.g. muscle strength, balance, muscle tone and spasm, range of motion)
- body anthropometrics (e.g. weight, height, limb length, symmetry)
- physical complications that particularly affect function (e.g. fixed deformities, loss of sensation, ossification, hypotension)
- bowel and bladder function
- cardiovascular, respiratory function and swallowing.

There are resources available and information on best practice protocols and tools for physical assessment of people with spinal cord injury. These include:

NSW Health Spinal Seating Professional Development Program http://www.health.nsw.gov.au/gmct/spinal/ssdpdp/module_02_3.asp

Spinal Cord Injury Rehabilitation Evidence (Canada) <http://www.scireproject.com/rehabilitation-evidence>

Queensland Spinal Cord Injuries Service http://www.buildinghealth.qld.gov.au/qscis/info_equipment.asp

Some of the protocols from these websites can be used for people with traumatic brain injury. No online resources were found specifically designed for physical assessment of people with traumatic brain injury for the purpose of wheelchair acquisition. The tools on the aforementioned websites may be appropriate in some instances.

7.2 Decision making capacity

During the prescription process it is important that the therapist respects the client's freedom to make choices and ethically engages them in decision making. However, the client's capacity to make decisions must be considered. In these guidelines, the issues relate to a user's capacity to contribute to decisions and choices related to the wheelchair or scooter.

When a person has the capacity to make a particular decision, they can:

- understand the facts
- understand the main choices
- express themselves
- weigh up the consequences of the choices
- understand how the consequences affect them
- communicate the decision.¹⁰

The therapist must try to help the client make decisions and engage in the wheelchair prescription process. To enhance decision making:

- Discuss and provide well-prepared information to the client and relevant others so that they are as informed as possible.
- Minimise the effect of individual and circumstantial barriers⁸², for example, by using assistive technology devices to overcome communication barriers.

A person's decision making capacity can vary depending on the nature of the decision and the circumstances. In some instances the therapist's ethical constraints must override the client's choice or preferences. Decision making performance (like wheelchair use) is context-dependent and may fluctuate.¹¹³ The client's capacity to contribute and make decisions about the wheelchair or scooter can be influenced by factors such as:

- the type of decision
- the timing (whether the client is fatigued or not their best at a particular time of the day)
- the complexity of the decision
- how much information the client has been given, their understanding of the information and how much is recalled.

Example: A client who has cognitive impairment due to a TBI may have reduced capacity to make decisions about the technical aspects of the wheelchair or scooter, but can make decisions about comfort or colour.

Sometimes when there are differences of opinion between client and therapist—irrespective of whether reduced capacity is an issue—there may be a 'trade-off' between client choice and what is feasible.

Example: The client may not want to have a head rest for the wheelchair. However, the therapist is required to prescribe a head rest for safety of the client and to meet transport regulations. The therapist must choose the ethical principle of prevention of harm and meeting their duty of care to promote the safety of the client over the client's choice not to have a head rest.

The clinical reasoning, issues, concerns and trade-offs, should be discussed with the client and relevant others and documented.

17. Recommendation

Grade

When a client has reduced capacity to be involved in and/or make decisions about the wheelchair or scooter, the therapist should ensure that adequate discussion has occurred with the client's relevant others (e.g. family or guardian with specific functions) prior to the decisions on the device being finalised. In some instances there may be a trade-off between client choice and what is feasible.

Principle

7.3 Psycho-social and behavioural considerations

Research has found that the following psycho-social factors could influence the long-term use of the wheelchair (also refer to personal factors listed in reasons for non-use in Section 6.5):

- client engagement throughout the prescription process
- family and social support
- client expectations of, and satisfaction with the wheelchair or scooter
- the stage of recovery
- adjustment to disability.

There is some literature on the impact of psycho-social factors on the wheelchair user's capacity and performance. Studies have found that using a wheelchair can be empowering because it typically increases activity, participation, independence and freedom and thus can assist psycho-social adjustment.^{152, 153} But other studies note that physical and social barriers can hinder the user's psycho-social adjustment to being a wheelchair user.¹⁵² One study found no significant correlation between personality traits and power wheelchair driving performance.¹²⁰

No research specifying the behavioural requirements for safely operating a manual or powered wheelchair could be found. Two consensus recommendations were developed.

18. Recommendation

Grade

The therapist should consider a person's behaviour, psychological status and risk of causing harm to themselves or others prior to and during the trial of a powered wheelchair or scooter.

Consensus

19. Recommendation

Grade

The therapist should consider consulting with a suitable health professional (e.g. clinical psychologist) to develop a behavioural support plan for users with challenging behaviours impacting on safe use of a powered wheelchair or scooter.

Consensus

7.4 Cognition and perception

The client's cognitive and perceptual capacity affects the seating and wheelchair requirements. When there are concerns about cognitive and perceptual capacity, assessment by, or consultation with, a neuropsychologist needs to be considered.

The user needs to be sufficiently aroused; able to maintain attention; make judgments, including those concerning spatial requirements and predicting environmental changes (e.g. a person walking nearby changing direction); process information; attend to detail; make decisions; plan, problem solve, remember and recall (visual and verbal) and learn from errors.

The level of cognitive and perceptual demands will vary between environments, for example, a familiar home environment compared to a busy shopping centre. Thus for some people with limitations in cognition or perception, variations in performance in different environments could mean that both client-operated and attendant-operated controls should be considered.

No literature was found addressing the specific cognitive skills required for self-propulsion in a manual wheelchair. Some research has identified cognitive requirements for training children in a powered wheelchair and guidelines for intervention with children have been developed.¹⁴⁸ One study explored the cognitive predictors of young children's readiness for powered mobility.¹⁸³ There has also been long-term research on exploring achievements and learning cause-effect relationships made through training people with profound cognitive disabilities in a joystick operated powered wheelchair.¹⁴⁸ However, research exploring the cognitive and perceptual demands for power wheelchair use in adult or aged populations was limited.

7. Capacity and performance

There was literature examining the cognitive parameters necessary for driving a motor vehicle. However, the working party concluded that this research could not be generalised to operating a powered wheelchair. Thus these motor vehicle studies were excluded from the evidence base related to this clinical question.

The literature does emphasise that visual perceptual and cognitive skills are important for operating powered mobility devices (seated).^{22, 45, 120, 126, 135, 183} Yet there is only limited research and inconsistent evidence on the appropriate assessment tools for cognitive and perceptual skills.

- Inconsistent findings were reported on the correlation between scores on the *Motor Free Visual Perceptual Test* and power wheelchair use.^{114, 120}
- One study found figure copying predictive of users' functional performance in power wheelchairs.⁴⁵
- A study of people with tetraplegia concluded that people adapt to altered body dimensions as wheelchair users in the short term. The authors suggested that individuals rely on visual memory rather than somatosensory information to judge and navigate a doorway.⁹¹
- A study examining unilateral neglect showed that individuals make improvements in driving accuracy after only minimal practise.⁴⁷

Most authors recommended observational assessment of performance to determine whether an individual has the capacity to safely use a power wheelchair.

20. Recommendation	Grade
The therapist should consider the client's cognitive and perceptual skills prior to and during the trial of a wheelchair or scooter. For example: judgment, attention, decision making, speed of information processing, planning, problem solving, memory and level of arousal.	Power wheelchairs C ^a Manual wheelchair, one-arm drive or power-assist Consensus

21. Recommendation	Grade
The therapist should design an initial trial of the wheelchair or scooter which accommodates a client's cognitive and perceptual deficits and aims to provide a positive and safe experience for the client.	Powered wheelchair C ^a Manual wheelchair, one-arm drive, power-assist Consensus

22. Recommendation	Grade
If the user displays cognitive and/or perceptual deficits they should participate in graded and repeated trials of a wheelchair or scooter. Trials can be graded in terms of environment, time spent in chair, speed of powered chair and equipment features and configuration.	Powered wheelchair C Manual wheelchair Consensus

23. Recommendation	Grade
The user should demonstrate (observational assessment) safe use of the wheelchair or scooter in their anticipated physical and social environments prior to prescription of the power wheelchair or scooter.	Consensus

24. Recommendation	Grade
Where a user does not have the cognitive or perceptual capacity to independently operate a powered wheelchair over different environments or an extended period of time, controls for the attendant as well as the client should be considered.	Consensus

7.5 Sensory impairments

7.5.1 RTA requirements

NSW has no licensing requirements for powered mobility devices such as powered wheelchairs and scooters. All powered mobility devices should be speed limited to a maximum of ten kilometres per hour so that the person and their device are considered a pedestrian pursuant to the NSW Australian Road Rules. When available, the footpath or nature strip should be used in preference to the road.

The RTA requires that people using a powered mobility device need to be able to spot obstacles and avoid collisions, judge speed and distance, and react quickly.^{37, 162}

25. Recommendation

Grade

The therapist should assess that a person using a powered wheelchair in the community is able to identify obstacles and avoid collisions, judge speed, distance and react quickly.

Requirement

7.5.2 Vision

The two most important aspects of vision for using a wheelchair or scooter on a road are visual acuity and field of vision.

Visual acuity

Visual acuity refers to clarity, or the ability to distinguish details, with or without glasses or contact lenses. Visual acuity should be assessed by an optometrist. Each eye should be measured without corrective lenses, and then retested with corrective lenses if required. The visual acuity should be better than 6/12 on the Snellen chart (or equivalent).¹⁶²

Visual field

Visual field refers to the area that can be seen when the eye is directed forward, including the area outside the centre of gaze (peripheral vision). Visual field is initially screened by confrontation.

Any person who has or is suspected of having a visual acuity or field impairment should be referred for assessment by an optometrist or ophthalmologist. Vision should be reviewed every ten years if under 55 years of age and every five years if over 55 years of age, or if there are any new eye conditions.¹⁶²

26. Recommendation

Grade

A client who will be using the wheelchair or scooter **on a road** without supervision and who has or is suspected of having visual field and/or visual acuity impairments, should be referred for assessment by an appropriate professional, according to the Roads and Traffic Authority (RTA) Guidelines for private vehicles. This applies to manual or powered wheelchairs and scooters.

Consensus

27. Recommendation

Grade

The client should be trained to use compensatory techniques, where the client has an identified visual field or acuity deficit below that specified by the RTA. After training on compensatory techniques, their safety to use the device on the road should be reviewed in the environment the device will be used.

Consensus

Compensatory techniques

Using hearing to compensate for visual impairment

If vision is impaired, the client may use their hearing to detect oncoming traffic at crossings. Environmental features such as bends and hills significantly affect the client's ability to hear vehicles well enough to make a judgment about when it is safe to cross. Wheelchair or scooter users who use hearing to compensate for visual impairment need to check their ability to hear vehicles and remain at the curb at each road crossing, to determine whether they can hear vehicles well enough. Once this is determined with passing traffic, the decision can be made as to whether it is safe to cross.⁶⁶

Unilateral neglect

Visual imagery is not the only compensatory technique for unilateral neglect. However, some research suggests that for unilateral neglect after stroke or brain injury, using a visual image analogy to teach scanning techniques does help to improve ambulation, route finding and problem solving.¹⁴⁷

Results from another research study suggest that patients with left-sided neglect (after a right hemisphere stroke) will deviate to the left side when using a power wheelchair. The researchers concluded that the reason the person deviates to the left is that the direction is task dependent. If a person with left-sided neglect were walking, the deviation would be to the right.¹⁸⁸ This needs to be considered by therapists when assessing the client's performance.

Use of visuo-spatial prism adaptation with visual field defects

Limited published research has explored the use of wedge prisms to successfully shift the visual field in unilateral neglect, resulting in successful wheelchair navigation.⁹⁶ However, clinical experience suggests that the effects are only short-term.

7.5.3 Hearing

There is no standard or requirement for hearing when using a manual wheelchair, power wheelchair or scooter on the road.

Points that the therapist should consider include:

1. Research indicates that hearing matters more as cognition declines, whereas cognition matters more as hearing declines.¹² The therapist needs to be aware of this interaction for wheelchair or scooter users.
2. If there is recent hearing loss, the client needs to be trained to adopt compensatory techniques such as regular visual scanning (including when crossing the road).
3. If there is a pre-existing impairment and recent hearing loss, the client needs to adopt compensatory techniques and then their capacity to use the device should be reviewed.

28. Recommendation

Grade

The therapist should consider referral to other specialist services (e.g. optometrist, ophthalmologist, audiologist, mobility trainers) where a vision or hearing impairment is identified.

Consensus

29. Recommendation

Grade

When a client experiences a change in their vision or hearing and adopts compensatory techniques, their capacity to use the wheelchair or scooter should be reviewed in the environment where the device will be used.

Consensus

7.6 Upper limb capacity and risk of injury

The upper limb includes the shoulder, elbow, wrist and hand. Additional demands are made of the wheelchair user's arms because they are used for:

- the majority of movements for most activities of daily living
- weight bearing, for example, postural adjustments, transfers, weight-relief lifts
- controlling the device (e.g. hand controls instead of foot controls).

In the case of manual wheelchair users, the upper limbs are used for wheelchair propulsion (requiring push forces) and to negotiate terrain (requiring adequate range of movement and forces). Terrain can include uneven, rough, loose or resistant surfaces as well as ramps, curbs and steps.

Because of these increased demands, wheelchair users, particularly manual wheelchair users, are at greater risk of upper limb injury.

In the **manual** wheelchair user population, studies have identified a higher incidence of:

- premature degenerative shoulder changes^{4, 21, 112}
- shoulder injury such as impingement, encapsulitis, dislocation, rotator cuff tear, tendinitis and pain²⁹
- median nerve injury (carpal tunnel syndrome) and ulnar nerve injury^{81, 95, 29}
- pain in the shoulder, hand and wrist, wrist tendinitis and wrist arthritis, elbow pain and injury.^{6, 29, 64, 123, 165}

7.6.1 Upper limb capacity

This section discusses some of the key research on the upper limb strength required to operate a **manual** wheelchair. Strength is closely linked to loading of the shoulder and propulsion technique.

Strength

Greater propulsion velocity (speed) or more demanding terrain (for example slopes, ramps, carpets or curbs) significantly increases shoulder joint loading.^{167, 24, 40, 159, 196} Whilst there are differences between individuals in terms of stroke and peak

kinetics, wheelchair differences, the forces and moments (the torque exerted, the tendency of a force to cause rotation) at the shoulder joint were 1.2 to 2 times greater at moderate speed versus slow speed.¹⁰⁷ At maximal acceleration, the power going through the joint increases the load at the shoulder and decreases in the elbow and wrist. The shoulder carries the greatest load with increased propulsion velocity.¹⁵⁹

The research also indicates that peak shoulder joint loading occurs when the shoulder is extended and internally rotated.²⁴ One study suggested that peak posterior forces occurred near the end of the propulsion phase and at the same time the shoulder was maximally flexed and minimally abducted.¹⁰⁷

There has been research into the differences between wheelchair users with paraplegia and tetraplegia. The level of spinal cord injury affects muscle recruitment during wheelchair propulsion.^{46, 138, 145} As a result, individuals with paraplegia demonstrate more effective force application on the hand rim in wheelchair propulsion than people with tetraplegia. Users with tetraplegia show significantly lower effective force application in the frontal plane and apply greater wrist extension but less forearm pronation.⁴⁶

In terms of gender, one study suggested that women were weaker than men in wheelchair propulsion.⁹⁰ While the speed of wheelchair propulsion in the community was the same for men and women, women exerted more effort and were more susceptible to fatigue.⁹⁰ Another study found that women propelled with significantly higher radial force (force directed toward the axle) than men. In this study, a significant relationship (although the effect size was not clear) was found between radial force and increased risk of changes on an MRI after a two year period, suggesting a greater risk of injury.¹⁸

There is no single assessment that therapists can use to identify upper limb strength and capacity to use a manual wheelchair. Multiple factors influence upper limb strength demands, including the impairment, personal factors such as gender, body weight and stroke technique, and environmental factors.

7. Capacity and performance

30. Recommendation

Grade

The therapist should take into account the user's upper limb strength and the factors that influence strength demands to propel a manual wheelchair. The user needs to have the ability to put force through shoulder flexion with elbow extension over different terrains for prolonged periods, without significant fatigue.

B

Range of Motion

Studies confirm that range of motion demands during wheelchair propulsion are greatest at the shoulder joint, compared to the elbow and wrist.¹⁶⁷ Typically, the wrist and elbow joints stabilise the propulsion configuration. The tendency is for these joints to be in extension and ulnar deviation with adduction movements. During propulsion, the shoulder is in a combination of flexion and internal rotation.⁵⁴ However, many factors can influence range of motion demands on joints in the upper limb. A wider wheelchair means greater shoulder abduction demands. Depending on the user's body dimensions (body length, arm length, body weight and upper limb circumference) the wheelchair height can influence the demands on both the shoulder and wrist.^{109, 193, 205} Posterior positioning of the axle adversely affects propulsion biomechanics³⁸, as does wheelchair weight.^{40, 193}

Muscle fatigue is another factor which can lead to harmful changes in the pattern of movement at the shoulder and wrists and hinder performance.¹⁷⁵ There is a tendency for other muscles to compensate if, for example, the shoulder is fatigued. This has implications if the wheelchair user lacks the capacity to redistribute demands to other muscles (e.g. a user with tetraplegia or spasticity in particular muscles).⁸³ Heavier wheelchairs require greater force to propel and will lead to fatigue.^{13, 29, 40} Difficult terrain—inclined, rough or resistant—also causes fatigue.⁴⁰

31. Recommendation

Grade

Therapists should take into account the user's upper limb range of motion, and the factors that influence the range of motion demands for manual wheelchair propulsion. Factors that may influence the user's range of motion demands include wheelchair width and weight, wheelchair seat height, axle position and fatigue.

B

Scooters and upper limb capacity

There is limited research on the upper limb capacity required for scooter use. Scooter operation requires adequate upper limb functioning but there are no specific measurement tools available to assess its functioning for this purpose. The therapist should be aware that scooters have a wide variety of hand controls and tiller position which place demands on the hand and arm, together with seat height and configuration which impact on upper limb function.

32. Recommendation**Grade**

Potential scooter users are to refer to the *Motorised Wheelchair Safety Handbook* (RTA).

Requirement

The handbook recommends that scooter users require the following:

- the ability to manipulate controls, e.g. turn a key, adjust dials, use the accelerator
- the ability to steer and turn, even in tight corners
- the ability to turn the head to look to the side or behind if reversing
- the ability to maintain balance when travelling across uneven or rough terrain
- the ability to adjust body position when travelling up or down inclines
- the ability to handle different weather conditions and long distances
- the ability to be seated for extended periods
- the ability to stand and walk short distances if required to leave the scooter.

7.6.2 Upper limb injury

Using a manual wheelchair requires repetitive use of the upper limb. There is a body of evidence which links repetitive tasks and repetitive force with upper limb injury.^{11, 144, 199,131,192} The shoulder is at particular risk as it is a complex joint with a high level of flexibility for movement, yet a low level of intrinsic stability.⁸³ A number of studies of manual wheelchair users indicate that prolonged and frequent manual wheelchair propulsion, transfers and weight-relieving lifts can cause upper limb pain and injury. There is also evidence that personal and environmental factors can contribute to increased risk of upper limb injury. However, as Table 2 shows, the quality and consistency of the research is limited.

The research studies cited in Table 2 focus on the incidence of pathology, pain and injury associated with the wheelchair use. Some ergonomic studies are also included. Many of the subjects were people with paraplegia or tetraplegia subsequent to spinal cord injury. Other studies used able-bodied subjects for the study sample or the control group. Some studies included people with a range of impairments. No studies were found that used a sample of people with traumatic brain injury.

After considering the evidence and noting that the demands of wheelchair use on the upper limbs are similar irrespective of diagnosis, the working party concluded that the risks to the upper limb identified in the literature could be generalised to both spinal cord injury and traumatic brain injury.

While it was not possible to grade the body of evidence to develop clear and concise recommendations, the risks associated with injury could be highlighted. Table 2 describes some of the risks identified in the literature, cites the studies and states the level of evidence. It is not an exhaustive list.

7. Capacity and performance

Table 2 Upper limb risk factors for manual wheelchairs

Risk factors for UL injury for manual wheelchairs	Details	Study and level of evidence
Age	Older wheelchair users are at greater risk than younger wheelchair users.	Lal 1998 (level II) ¹¹²
	Shoulder pain is greater in adults who began using their wheelchairs as adults, compared to those who began using their wheelchairs as a child.	Sawatzky 2005 (level IV) ¹⁷¹
Body weight	Heavier body weight is associated with increased shoulder loading and thus forces required during wheelchair propulsion.	Collinger 2008 (level IV) ²⁴ Mercer 2006 (level IV) ¹²⁷
	The user's weight is related to the push rim forces applied and to median nerve function—thus weight loss to change push rim biomechanics may prevent median nerve injury (carpal tunnel injury) in manual wheelchair users.	Boninger 1999 (level IV) ¹⁷
Fatigue	Shoulder muscle fatigue is associated with negative changes in tissue loading, movements and the development of chronic pain.	Grieve 2008 (literature review) ⁸³ Sood 2007 (level IV) ¹⁷⁵
	Wheelchair users' shoulder muscles adapt to long-term demands but there may be a change in the strength ratio between muscles, which can create an imbalance.	Veeger 2002 (level IV) ¹⁹⁹
Gender	Women are at greater risk of upper limb injury from wheelchair propulsion than men.	Boninger et al 2003 (level IV) ¹⁸ Lal 1998 (level II) ¹¹² Hatchett 2009 (level III–3) ⁹⁰
Propulsion technique	The shoulder joint undergoes the greatest range of motion and the greatest load during manual wheelchair propulsion.	Sabick 2004 (level IV) ¹⁶⁷ Price 2007 (level IV) ¹⁵⁹
	Peak shoulder joint loading occurs when the arm is extended and internally rotated.	Collinger 2008 (level IV) ²⁴ Koontz 2002 (level IV) ¹⁰⁷
	The range of motion required at the wrist during wheelchair propulsion (deviation, extension and flexion and a combination of all three planes) is linked to carpal tunnel syndrome.	Veeger 1998 (level IV) ¹⁹⁸
	The level of SCI affects muscle recruitment and effective force application on the hand rim. Hence people with tetraplegia demonstrate less effective wheelchair propulsion.	Mulroy 2004 (level IV) ¹³⁸ Dallmeijer 1998 (level IV) ⁴⁶ Newsam 1999 (level IV) ¹⁴⁵
	The level of impairment can affect wheelchair propulsion technique. There is a higher relative demand (higher upward/directional force) for wheelchair users with tetraplegia. Users who experience higher directional force are more likely to have upper limb pathology.	Mercer 2006 (level IV) ¹²⁷ Kulig 2001 (level IV) ¹¹⁰

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Prolonged or repetitive overhead activities or reaching (e.g. lifting wheelchair into vehicle)	There are strong relationships between shoulder musculoskeletal disorders and prolonged and repetitive overhead upper limb activity (hand above the head)	Sood 2007 (level IV) ¹⁷⁵ Consortium for Spinal Cord Medicine 2005 (AGREE) ²⁹
Transfers	Upper limb strength demands during sitting pivot transfers are particularly high at the shoulder. The demand on muscles is similar whether using preferred or non-preferred transfer direction (left or right hand leading). However, a combination of the range of movement and pushing forces, plus the coordination effort required of the trailing upper limb may be linked to the development of upper limb injury. Higher demands are made on the trailing arm when transferring to a high target seat compared to a level one.	Gagnon 2008 (level IV) ⁷⁶ Gagnon 2009a (level IV) ⁷⁵ Gagnon 2008 (level IV) ⁷⁴ Forslund 2007 (level IV) ⁷⁰ Gagnon 2009b (level IV) ⁷⁷
Weight-relieving lifts	Weight-relieving lifts place higher forces on the shoulder than level propulsion. While weight-relieving lifts are lower frequency compared to propulsion, the potential strain is higher. The studies noted a potential difference in technique between people with different levels of impairment.	Morrow 2010 (level IV) ¹³³ Van Drongelen 2005 (level III–2) ¹⁹⁶
Inclines, ramps, hills and curbs	Weight-relieving lifts place the most demands on the shoulder (forces). Ramps are the next most demanding (force direction) compared to level propulsion or level start/stop. All inclines place significant demands on the shoulder, with steeper ramp grades requiring more shoulder flexion under load. For example, small inclines (e.g. 1:20 rise ramp) require >30% (moment) capacity of the shoulder (Sabick 2004).	Van Drongelen 2005 (level III–2) ¹⁹⁶ Morrow 2010 (level IV) ¹³³ Sabick 2004 (level IV) ¹⁶⁷
Speed	Faster propulsion places more demands on the upper limbs.	Mercer 2006 (level IV) ¹²⁷ Collinger 2008 (level IV) ²⁴ Price 2007 (level IV) ¹⁵⁹ Veeger 2002 (level IV) ¹⁹⁹
Terrain	Uneven, loose or resistive surfaces, such as carpet, place more demands on the upper limb.	Sabick 2004 (level IV) ¹⁶⁷ Collinger 2008 (level IV) ²⁴ Cowan 2009 (level II) ⁴⁰ Vandrongelen et al 2005 (level III–2) ¹⁹⁶
Wheelchair height	Lower but optimal seat height (rather than high seat height) may reduce strain on the upper limb and improve efficiency (e.g. improve push time) as well as reducing range of motion demands at the wrist.	Kotajarvi 2004 (level II) ¹⁰⁹ Van der Woude 2009 (level II) ¹⁹³ Wei 2003 (level IV) ²⁰⁵

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Wheelchair weight (includes weight of additional features)	Lighter wheelchairs improve efficiency of propulsion for all users (speed and distance travelled) and may particularly assist people with tetraplegia.	Beekman 1999 (level II) ¹³
	Lighter wheelchairs require less force to propel. It is important to reduce the force required of the upper limb.	Cowan 2009 (level II) ⁴⁰ Consortium for Spinal Cord Medicine (2005) (AGREE) ²⁹
Wheelchair width	Within the range of possible widths between push rims, a narrower width is preferred to reduce extremes of shoulder joint range of motion and to help preserve upper limb joints.	Expert opinion
Wheelchair set-up	Shoulder joint moment is not affected by changes to seat tilt angle or seat to back rest angle while the wheel-axle position is constant. A posterior seat position reduces the superior component of the shoulder joint force and potentially diminishes the risk of impingement (subacromial structures).	Desroches 2006 (level IV) ⁵³ Mulroy 2005 (level IV) ¹³⁹ Gutierrez 2005 (level IV) ⁸⁴
	An 8 cm displacement of axle position adversely affects biomechanics in an older cohort.	Cowan 2009 (level II) ⁴⁰

33. Recommendation

Grade

When prescribing a self-propelled wheelchair the therapist should aim to minimise the risk of upper limb injury by taking into account the risk factors (as listed in Table 2) and risk management strategies (refer to *shoulder injury risk management strategy checklist*).

Consensus



Shoulder injury risk management strategy checklist

Ensure the best match between the person, equipment and environment.

- Maintain wheelchair user fitness and strength through appropriate and balanced exercise programs.
- Train the user in optimum wheelchair propulsion (refer to Section 11 on training).
- Use ergonomic risk management strategies such as:
 - » Eliminate or avoid demands for extreme joint positions of the shoulder, elbow and wrist.
 - » Pace activities, allowing sufficient recovery time for the shoulder. For example, take a short break if pushing up an incline, between weight-relieving lifts and during activities of daily living that have high upper limb demands.
 - » Reduce the intensity and frequency of activities that are identified as shoulder injury risks. Examples include alternative pressure-relieving strategies to reduce the frequency of weight-relieving lifts, environmental modifications to reduce the ramp gradient, changing terrain (replacing uneven or resistant surfaces with smoother surfaces, removing carpet etc) or changing the order or method of tasks to avoid the need for specific activities such as pushing up a ramp or curb or pushing at greater speed.
 - » Reduce the performance demands and forces required for activities. This may include maintaining an ideal body weight, using optimum propulsion techniques, adjusting transfer technique, varying transfer technique to avoid over-use (e.g. alternating the arm that leads when possible), using transfer assistive equipment, reducing the distance or changing the configuration of equipment during transfers, performing level transfers where possible.
 - » Adjust the wheelchair set up; for example, place the rear axle as far forward as possible without affecting stability.

Not an exhaustive list

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

34. Recommendation

Grade

The therapist should educate the wheelchair user and their attendant care worker about the risks of upper limb pain and injury, means of prevention and risk minimisation (refer to *shoulder injury risk management strategy checklist*), treatment and the need to maintain fitness.

(adapted from Consortium for Spinal Cord Medicine 2005)²⁹

Consensus

Resources include:

- propulsion training guidance outlined in these guidelines (refer to Section 11.3)
- the Consortium for Spinal Cord Medicine (2005) *Preservation of upper limb function following spinal cord injury: A clinical practice guideline for health-care professionals*²⁹ (<http://www.pva.org/site/apps/ka/ec/catalog.asp?c=ajlRK9NJLcJ2E&b=6423003&en=7eKIIMOnHfKFKJOMG9LEKIMqGfKRKXMTf9LFJROuEkLVL7J&CategoryID=322146>) and the pending update of this document for guidance and recommendations on:
 - » exercise
 - » treatment of chronic musculoskeletal pain to maintain function
 - » management of acute and sub-acute upper limb injuries and pain.

7. Capacity and performance

7.7 Cardiovascular fitness

The literature was searched for research on cardiovascular fitness and wheelchair users, and the role of manual wheelchair propulsion in maintaining cardiovascular fitness. Research into cardiovascular risk has been undertaken for people with spinal cord injury but not for people with traumatic brain injury. Therefore, care needs to be taken about generalising the information to people with traumatic brain injury.

Lack of physical activity is a risk factor for cardiovascular disease.¹⁷² Consistent evidence indicates that the risk of cardiovascular disease is higher in people with spinal cord injury compared to ambulant people.^{172, 202, 97, 39, 140} Haisma et al (2006)⁸⁵ conducted a critical review of the literature from 1980 to approximately 2006, with quality appraisal and some meta-analysis of results for different aspects of physical capacity in people with spinal cord injury. The study suggests that physical capacity is reduced in persons with a spinal cord injury. Another study (Widman 2007)²⁰⁸, which included people with spinal cord injury and people with spina bifida, confirmed that aerobic capacity was lower and associated with being overweight.

The studies did not investigate how using a manual wheelchair could help fitness, but did identify that wheelchair users (primarily spinal cord injury) were less fit and had higher cardiovascular risks than an able-bodied population. One of the reasons suggested is that wheelchair propulsion is mechanically less efficient than arm-cranking or hand cycling (Haisma et al 2006).⁸⁵ Despite performing upper limb activity while using a wheelchair, fitness is not maintained in wheelchair users. Day-to-day pushing of a manual wheelchair does not constitute aerobic exercise. However, research does confirm that regular aerobic exercise for wheelchair users (such as hand cycling, hand cranking or ball exercise) can improve fitness and reduce the risks of cardiovascular disease.^{1, 39, 55, 73, 97, 99, 100, 136, 185, 191, 172}

Therapists should encourage wheelchair users to maintain fitness through regular moderate aerobic (endurance) exercise (e.g. daily or at least three times per week). Aerobic exercise can involve a range of activities such as hand cycling, hand cranking, or ball game wheelchair sports. More information on the frequency of training for a person with spinal cord injury is on the Spinal Cord Injury Rehabilitation Evidence (SCIRE)¹⁷² website. SCIRE has developed

key points on exercise and spinal cord injury
http://www.scireproject.com/sites/default/files/cardiovascular_health.pdf.

35. Recommendation

Grade

The therapist should encourage wheelchair users to maintain fitness through regular daily or weekly moderate aerobic (endurance) exercise.

B

7.8 Co-morbid conditions

The literature search did not find any reference to specific co-morbid conditions that would preclude the use of a manual or power wheelchair (e.g. temporary loss of consciousness or control). This **does not mean** that there are no pre-morbid conditions that preclude the use of a wheelchair or could place a wheelchair user at risk. The therapist must consider any known pre-morbid conditions, including obesity, and decide whether these preclude the use of a wheelchair or could pose a risk to the user.

The Roads and Traffic Authority (RTA) does specify some limitations for motor vehicle drivers who have conditions such as epilepsy, sleep disorders, syncope, blackouts or vestibular disorders. Temporary abstinence from driving is also recommended after anaesthesia. However, the literature does not identify these as relevant to wheelchair or scooter users.

Power wheelchairs and scooters have controls that are designed to be fail safe, so a loss of consciousness or seizure would not place the user or others at risk. Any mechanical or electronic fault will shut the wheelchair or scooter down. Pressure is required to activate the control of both wheelchairs and scooters, so whenever pressure is released the mobility device will come to an immediate halt (within its own length). Furthermore, power wheelchairs and scooters are designed to travel slowly (compared to a motor vehicle) and primarily on footpaths or for short distances on roads. It is possible that pressure could be maintained accidentally if the controller jammed because it became caught on something or the user experienced a spasm.

7. Capacity and performance

7.9 Alcohol, prescribed medications and illicit drug use

Alcohol, prescription medications and illicit drugs can affect the user's capacity to operate a wheelchair or scooter. Used in combination they have an even greater effect on driving performance, risking the safety of the user and others.

36. Recommendation	Grade
The user and attendant care worker should be informed that alcohol, prescribed medications (where relevant) and illicit drugs may impact on their capacity to operate a wheelchair or scooter.	Consensus

Alcohol

Any alcohol can impair a wheelchair or scooter user's driving performance. Its impact is affected by a range of factors including the health and fitness of the person, the amount of food ingested, the duration of the drinking and the presence of other drugs or substances.

37. Recommendation	Grade
A user of a motorised wheelchair or scooter must be aware that it is an offence to use the device on a road or related areas if their blood alcohol level is 0.05 or more.	Requirement

www.rta.nsw.gov.au/roadsafety/pedestrians/motorisedwheelchairs.html

Prescribed medications

38. Recommendation	Grade
The user and attendant care worker should seek medical advice on how medication or a change in medication impacts on their capacity to operate a wheelchair or scooter.	Consensus

Illicit Drugs

Illicit drugs will impair driving performance. A power wheelchair or scooter should not be driven on the road if the operator is under the influence of illicit drugs.

7.10 Long-term need

Establishing whether the wheelchair will be needed in the long term is a judgment made through clinical reasoning, considering all the parameters that may influence the need. These relate to all domains of the health condition of the user. A checklist has been developed to assist and guide the therapist during this process.

39. Recommendation	Grade
The therapist should consider the range of factors listed in both the <i>Long-term need checklist</i> and <i>Goals checklist</i> to assist in the determination of the need for a wheelchair or scooter in the long term.	Consensus



Long-term need checklist

This checklist outlines some of the factors to consider when deciding if there is a long-term need for the wheelchair or scooter. It is not an exhaustive list.

Diagnosis, prognosis and medical history

- Client goals
- Variables within the ICF domains

Body function and structure factors

- Variable symptoms or conditions that need to be managed, for example, fatigue or spasm
- Anticipated change in functioning
- Risk of secondary complications, for example, injuries subsequent to falls

Activity and participation factors

- Types and range of activities now and projected for the future
- Time efficiencies
- Limited performance or capacity for mobility
- Type of transport the client will use (public, private, aeroplanes, boats etc)

Environment and contextual factors

- Level of care available and projected level of care
- The level of control over environment in which client will operate (e.g. work or study). Less control of the environmental conditions necessary for independent mobility, or safety concerns, may mean greater need for a wheelchair.
- Physical barriers in the community environment (including local terrain—uneven ground, steep hills outside the home etc). Climate may also be a consideration.
- Interface with other devices, for example, transport options
- Personal factors such as attitude, motivation and acceptance of care versus desire for independence
- Perception and acceptance of disability (self, attendant care worker and relevant others)

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7.11 Health and safety concerns

The therapist should take into account the range of activities in all current and potential environments and consider the safety of both the wheelchair user and the attendant care worker.

Therapists have a professional and legal obligation in relation to the health and safety of the clients for whom they prescribe a wheelchair or scooter and to their attendant care workers.^{119, 121} The responsibilities of public service agencies and providers are outlined in the *Carer Recognition Act 2010*.²⁵ Occupational health and safety (OHS) refers

to the legislation, policies, procedures and activities that aim to protect the health, safety and welfare of all people at a workplace (WorkCover NSW <http://www.workcover.nsw.gov.au/healthsafety/Pages/default.aspx>).

For wheelchair and scooter users and their attendant care workers, this means the home and all other potential environments.

Using a wheelchair involves manual tasks. On occasion, there could also be some risk to the attendant care worker because of the wheelchair user's poor compliance or challenging or unpredictable behaviours (e.g. during transfers).

7. Capacity and performance

The relevant state and national legislation, the NSW *Occupational Health and Safety Act 2000*¹⁵⁰ and the *National Standard for Manual Tasks 2007*²⁷, describes the duties of the therapist, client, attendant care worker and carer. There is a duty to adopt procedures and activities that protect the health and safety of the occupant and the attendant care worker during the use and operation of the wheelchair.

The *National Standard for Manual Tasks (2007)*²⁷ and the *National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work (2007)*²⁶ provide a standard and a code of practice to prevent injuries. While a manual task can be any physical activity requiring a person to use part of their body to perform their work, the standard and code of practice identify hazardous manual tasks which have greater likelihood of causing an injury. For information on the risk of upper limb injury in manual wheelchair users refer to Section 7.6.2.

The situation will be different for each wheelchair occupant and attendant care worker. Consequently, the potential hazards and risks will be different. However, there are basic principles that should be followed to manage the risks of injury:

- a. identify *hazardous* manual tasks
- b. assess the *risks*
- c. *eliminate* or *control* the risks to minimise the potential for injury.

A *hazard* is any thing or situation with the potential to cause or contribute to an injury or disorder. Hazardous manual tasks have any of the following characteristics²⁶

Points marked with an asterisk * are most relevant to wheelchair users or attendant care workers:

- * repetitive or sustained awkward posture
- * sustained movement or application of force
- * working with people or animals
- * handling unstable or unbalanced loads
- * handling loads which are difficult to grasp or hold
- the application of high force (such as hitting something with a hammer)
- exposure to sustained vibration (such as using a drill for an extended period).

Risk refers to the likelihood of a task causing harm, an injury or a disorder.²⁶ To prevent injury, risks must be eliminated or controlled.

Client attitudes, cognition or behaviour can also present a risk, either to themselves or to their attendant care worker. This possibility needs to be considered for each client and potential difficulties identified.

A hierarchy of risk controls should be adopted. The risk controls, in order of effectiveness are:^{151, 180}

1. eliminate or substitute the task
2. (re) design the task or use engineering/equipment controls
3. use administrative controls (training and procedures)
4. use personal protective equipment.

An example is the weight of a wheelchair user who is dependent with transfers. The weight is a hazard. The risk of harm is reduced if a hoist with adequate space for manoeuvring is used by the attendant care worker during transfers (design/engineering control).

40. Recommendation

Grade

There should be a risk assessment conducted on the tasks performed by the user/occupant and their attendant care worker with respect to all aspects of the use of the wheelchair.

Requirement

41. Recommendation

Grade

Risks should be eliminated or appropriate controls should be implemented where risks are identified.

Requirement

7. Capacity and performance

There is more information on manual handling, challenging behaviour and risk management, risk assessment tools and risk controls in the documents on the URL links listed below, available through national and government department websites.

General

Disability Safe, NSW Department of Human Services
<http://www.disabilitysafe.org.au/hazards-risks>

Department of Families, Housing, Community Services and Indigenous Affairs
http://www.fahcsia.gov.au/sa/disability/pubs/employers/Documents/quality_strategy_toolkit/section5/5_1.htm

Manual Handling

National Standard for Manual Tasks 2007
http://www.safeworkaustralia.gov.au/AboutSafeWorkAustralia/WhatWeDo/Publications/Documents/273/NationalStandardForManualTasks_2007_PDF.pdf

Manual Tasks Involving the Handling of People Code of Practice 2001
<http://www.deir.qld.gov.au/workplace/law/codes/handlingpeople/index.htm>

Queensland Government, manual tasks and people handling advice
<http://www.deir.qld.gov.au/workplace/subjects/manualhandling/people/index.htm>

WorkCover NSW, *Manual Handling Guide for Nurses: Guide*
http://www.workcover.nsw.gov.au/formspublications/publications/Pages/WC04799_ManualHandlingforNursesGuide.aspx

WorkCover NSW, manual handling
<http://www.workcover.nsw.gov.au/formspublications/publications/pages/manualhandlingsaferworkplacesmartmove.aspx>

Behaviour and management of risks

Challenging behaviours, guidelines on the principles, assessment and management and other topics
http://www.adhc.nsw.gov.au/individuals/caring_for_someone/challenging_behaviour

National Disability Services behaviour support training resources
<http://www.nds.org.au/projects/article/49>

Assessment tools and risk controls

Risk assessment tool within the *Manual Handling Code of Practice 2010* (Chapter 8 for risk assessment and Chapters 9 and 10 for risk control and options)
http://www.deir.qld.gov.au/workplace/resources/pdfs/manualtasks_code2010.pdf

National Code Manual tasks risk assessment form (long and short version)
<http://www.safeworkaustralia.gov.au/AboutSafeWorkAustralia/WhatWeDo/Publications>

WorkCover NSW Manual Risk Assessment worksheet http://www.workcover.nsw.gov.au/formspublications/publications/pages/WC04928_ManualHandlingRiskAssessmentReferenceShe_.aspx

Sample OHS assessments in the home
NSW <http://www.disabilitysafe.org.au/hazards-risks/working-external-locations>
Victoria <http://www.nds.org.au/projects/article/69>

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Table 3 Examples of risks and risk control options

Risk	Characteristic that makes the task a hazard	Risk Control E – eliminate D – (re) design A – administrative control
Attendant-controlled manual wheelchair with a low handle height (tilt angle may contribute to this).	Sustained and awkward posture (handle height too low requiring the attendant care worker to bend forward, to change their centre of gravity)	E: Prescribe wheelchair with height-adjustable push handles. D: Provide stroller handles on wheelchair. A: Change tilt position to upright or less tilt when wheelchair is pushed by the attendant care worker, but particularly when travelling longer distances.
Re-positioning client in the seat of the wheelchair so that their back is supported and the pelvis correctly aligned.	Sustained awkward posture. Sustained application of force. Working with people (need for cooperation etc). Handling loads that are difficult to grasp or hold.	E: Use the tilt in space feature if available on the wheelchair. D: If a hoist is used, give preference to hoist with pivot bar and spreader. A: Engage the client to assist where possible. Use small movements rather than one large movement. A: Use two people to adjust from in front: face the client, attendant care worker's feet placed appropriately, one knee against the client knee, attendant care worker bending at the knees and hips with back straight. A: One person adjust from the side, one side at a time, moving one buttock back at a time, attendant care worker's knees and hips bent, back straight.
Pushing a heavy or tall person in a manual wheelchair.	Sustained awkward posture. Application of force.	E: Use power wheelchair or power drive mechanism to push wheelchair. A: Attendant care worker to use push forces, not pull forces, whenever possible. Avoid going quickly as it is harder to stop. Keep the wheelchair and client closer to your body except when on an incline. Use your own body weight to assist with pushing at appropriate times.
Accommodating differences in surface heights during transfers.	Handling unstable or unbalanced loads. Handling loads which are difficult to grasp or hold. Working with people.	E: Lower one surface height to be level with the other. D: Use a slide board or height adjustable equipment. A: Transfer from higher to lower where possible and avoid transferring from lower to higher unless client can assist.
Securing the tie-down of the wheelchair in a vehicle.	Awkward posture.	E: Install automatic lock downs. A: Kneel on the floor of the vehicle at the front/rear or bend one knee if from the side and outside the vehicle, face the lock down rather than twist at an angle.

42. Recommendation

Grade

The manual handling demands and potential risks should be considered during the prescription process with respect to the features of the wheelchair, the client, attendant care workers, other equipment and the interface with the wheelchair (e.g. hoist, bed), together with the user's anticipated activities in the possible environments.

Principle

7.12 Two wheelchairs

Access to two wheelchairs may be a consideration for many long-term wheelchair users (this does not refer to replacement wheelchairs or changing wheelchairs). There was no literature located that focused on this aspect of wheelchair prescription. Reasons for a second wheelchair, identified by the working party include:

- Emergency or safety issues, for example, having a backup wheelchair when the primary wheelchair is being repaired.
- Activity and participation reasons, when a second wheelchair with different features is required for particular activities. For example, a wheelchair for sport, or a power wheelchair for long distance travel.

Many long-term wheelchair users keep their older wheelchair for emergency backup when their primary wheelchair is being repaired or serviced. It is worth considering provision of a replacement wheelchair before the need becomes urgent and the first wheelchair becomes irreparable.

The second wheelchair does not always have to be purchased. It could be a backup wheelchair required periodically (brief periods every few months), or for a longer time but only occasionally (e.g. holidays once per year). In these circumstances loan or hire of the second wheelchair may be an option.

The following points may be relevant:

- It would be unusual to need a second wheelchair which is exactly the same as the primary wheelchair. Different activities require different wheelchair features, e.g. sports, outdoor or all-terrain wheelchairs.
- Consider whether the seating components are transferrable to the second wheelchair e.g. the pressure cushion.
- Consider the need for regular maintenance and service on the second or backup wheelchair.
- Some environments might require a different wheelchair to achieve participation, for example, accessing different buildings in the community, visiting relatives or friends, using different modes of transport or needing an inside and an outside wheelchair because of interior space limitations.
- Prescribing a second wheelchair should include determining the projected use. For example a user with low level tetraplegia may use both a manual wheelchair (for indoor, short distances) and a power wheelchair (for longer distances and outdoors or in the community).⁵⁷ The frequency or duration of use of the second wheelchair should be considered.
- Assessing the need for a second wheelchair or backup wheelchair often cannot be done until the user has returned home and performance, function and patterns of activity have been established.

8

Wheelchair features

There are many wheelchair features that could have been considered in this section. However, some features change too often due to advances in design and technology and others were considered outside the scope of the guidelines. The features discussed here are the ones of key concern to therapists.

Features of wheelchairs or seating which have not been included are:

General

- pressure cushions
- customised seating
- axle position
- tyres
- materials used e.g. frame or seat.

Manual wheelchairs

- anti-tip devices
- push rims
- type and material of frame
- wheel camber
- wheel type and size, castors
- footplates and hangers.

Power wheelchairs

- head rest
- controller options
- armrests
- footplates and hangers
- ventilator attachments.

8.1 Pressure management

For many people with traumatic brain injury and spinal cord injury, posture and pressure management is critical for the prevention of secondary conditions. The wheelchair and associated aids such as pressure cushions or customised seating can assist with pressure care management. Recommendations and guidance on pressure management are included in the guidelines and resource documents listed below.

43. Recommendation

Grade

Therapists should refer to existing guidelines on pressure management and ulcer prevention for people with spinal cord injury. The seating systems should be prescribed on the basis of individual considerations and assessment. The existing guidelines on pressure management are considered relevant to people with traumatic brain injury.

Consensus

Resources

Department of Health NSW, Agency for Clinical Innovation (ACI) Spinal Cord Injury: Spinal Seating Professional Development Program (2008)
http://www.health.nsw.gov.au/gmct/spinal/ssdpdp/module_08_6.asp

Spinal Cord Injury Rehabilitation Evidence (SCIRE) (2010) <http://www.scireproject.com/rehabilitation-evidence/pressure-ulcers>

Paralyzed Veterans of America (2000) *Pressure ulcer prevention and treatment following spinal cord injury* available at http://www.pva.org/site/c.ajlRK9NJLcJ2E/b.6305401/k.BCBB/Home.htm#page_17

8.2 Ride and comfort

User discomfort in the wheelchair can lead to dissatisfaction, decreased quality of life, difficulty using the wheelchair and poor postures, as well as having a negative impact on functioning (activities and participation).^{43,44} However, this aspect of wheelchair use is complex because sitting comfort and ride are influenced by personal factors and subjective constructs. Comfort is a difficult concept to define.¹⁵⁴ Comfort can be a physical sensation, a psychological state or both. It is not considered to be the same as the absence of pain.¹⁵⁴ Yet, the features that provide sitting comfort for one person may not be comfortable for another.

As with comfort, ride (or better ride) is a concept influenced by personal factors (such as weight, size, co-morbidities). It is affected by environmental factors such as heat. Ride is also affected by the vibration experienced by the user, which is influenced by the wheelchair wheels, suspension, seat and how well the wheelchair has been maintained. The materials and features of the wheelchair are only one component of the judgment of a 'better ride'.

There have been a number of studies on wheelchair vibration and comfort. These suggest indicators but do not draw conclusions sufficiently to develop recommendations. Sickel (2001)¹⁹⁷ analysed vibrations during wheelchair propulsion and concluded that vibrations may contribute to muscle fatigue in manual wheelchair users. A longitudinal study of vibrations in manual and power wheelchairs²¹⁰ using unimpaired subjects suggested that whole body vibrations while travelling over certain surfaces may increase the risk of injury.

Other studies have explored different wheelchair features and vibration. Hughes et al (2005)⁹⁴ suggested that people with spinal cord injury preferred Spinergy over conventional spoke wheels in terms of comfort and ride, although further research is required as there was no difference in terms of energy efficiency. Another study²⁰¹ of people with spinal cord injury suggested that compared with standard steel spoked wheels, Spinergy did not reduce vibration or perceived spasticity and did not improve comfort.

Sawatzky (2004)¹⁷⁰ identified that a reduction in tyre inflation by 50% in manual wheelchairs resulted in significantly more energy expenditure but was still better than solid tyres.

Therapists should be aware of the following factors that influence sitting comfort and ride:

- Vibration can affect ride and comfort.^{34, 197}
- Some evidence suggests that wheelchair users exposed to greater vibration may be at risk for injuries and muscle fatigue due to whole body vibrations.^{197, 210}
- Vibration can contribute to fatigue in manual wheelchair users.¹⁹⁷
- Pneumatic tyres reduce vibration but the tyres for manual wheelchair users need to be adequately inflated. Tyres that are not adequately inflated (< 50%) require higher energy expenditure.¹⁷⁰ The study recommends that tyres are checked at least once a month and pumped up to maintain adequate pressure.

44. Recommendation

Grade

The therapist should consider any or all of the following features when considering and evaluating the wheelchair for sitting and ride comfort:

B

- personal factors (e.g. adjustment to disability, perception of comfort, body shape, co-morbidities or secondary conditions)
- time spent in the wheelchair and the ability to make postural changes
- the user's activities
- vibration (*better ride with less vibration*)
- wheelchair set up and features such as:
 - » pneumatic tyre inflation is maintained >50%
 - » pneumatic rather than solid tyre
 - » type of cushion and upholstery
 - » angle of tilt
 - » back rest
 - » frame design e.g. boxed/solid/folding
 - » suspension elements of the wheel
 - » front castors.

45. Recommendation**Grade**

The therapist needs to be aware of the potential difference between the trial equipment and newly supplied equipment which may affect sitting, ride and comfort, such as the age of the trial equipment, differences in model and/or set up.

Consensus

Sitting comfort and ride are extremely complex to measure objectively because of all the variables involved. However, they can be subjectively measured and the user's perception of ride and comfort is of prime importance.

The *Tool for Assessing Wheelchair Discomfort*, TAWC (formerly called WcS-DAT) is one measurement tool that has been studied for reliability, internal consistency, concurrent validity and responsiveness to change.^{41, 42, 44} It has not been validated for spinal cord injury or traumatic brain injury. It is used for persons with *intact* sensation. However, it is considered a useful tool for therapists. A copy is provided in the resources.

Therapists can develop their own tool for assessing comfort, taking into account the principles suggested by Pearson (2009)¹⁵⁴ or using some of the questions in the TAWC supplemented with other questions relevant to the individual. The principles are:

- Wording of questions:
 - » Separate general body questions from specific feature questions, e.g. cushions.
 - » Asking about comfort may focus on areas that were previously not considered uncomfortable.
- Scale type and end points:
 - » Scales could have comfort at one end and pain at the other or rate comfort on a continuum with a positive scale.
 - » Numeric/Likert scales and/or using descriptors each have benefits and potential for different interpretations.
- Eliciting additional information:
 - » Use a body diagram.
 - » Use open ended questions (qualitative information).

- Consider:
 - » Sensory loss
 - » Cognition
 - » Language and comprehension
 - » Behaviour
 - » Body temperature and perspiration.
- Consider using objective measurements, e.g. pressure mapping.
- Consider using more than one measure.

8.3 Tilt in space

Evidence suggests that tilt in space is effective for pelvic pressure management for people with neurological impairment.^{30, 128, 156, 172} The tolerance for pressure at the tissue level and therefore the risk of pressure ulcers, depends on a range of factors including the person's impairment, age, nutrition, temperature, anatomical location of pressure, moisture, incontinence, tissue metabolism, duration of the pressure⁵⁹ and the effectiveness of the pressure-relieving cushion.

The angle of tilt in space required to effect pressure relief varies between individuals. Pressure management is influenced by a range of factors (equipment and individual parameters). 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.^{59, 60, 128, 156, 172, 174, 177}

Tilt in space is a wheelchair feature to consider with respect to other goals, not just pressure relief. Studies show that tilt in space is frequently used for comfort, stable postures and function.^{56, 60, 111, 174}

The research studies identified some of the physiological and functional reasons why a person may benefit from tilt in space and recline. However, there was no definitive conclusion in the body of evidence, and the user's contextual factors were variable and complex. Thus it was not possible to develop a clear and concise recommendation. Table 4 lists some factors to be considered, the studies on which these are based and the level of evidence.

8. Wheelchair features

46. Recommendation

Grade

When considering the inclusion of dynamic tilt in space and recline, the therapist should consider physiological and functional factors (as listed), together with the user's ability to manage the tilt in space control system.

Consensus

Table 4 Factors to consider with tilt in space

Factor	Details	Study and level of Evidence
Pressure management	Tilt in space may provide the opportunity for independent weight shifts for pressure relief, prevention of pressure areas and management of pressure ulcers. Tilt in space and recline enable regular position changes (this is in combination with support surfaces, cushion pressure-relieving features and other postural changes such as forward and side leaning).	Consortium 2000 (AGREE) ³⁰ Desroches 2006 (level IV) ⁵³ Ding 2008 (level IV) ⁶⁰ Dreier 2010 (Addendum RESNA) ⁶³ Michael 2007 (level I) ¹²⁸ Sprigle 2010 (level III–2) ¹⁷⁷
Comfort, pain rest and fatigue	Tilt in space and recline provide opportunities to change posture and a means of assisting with dynamic movement which may increase comfort and reduce pain and fatigue.	Desroches 2006 (level IV) ⁵³ Dewey 2004 (Qual. rigour 4/4) ⁵⁶ Ding 2008 (level IV) ⁶⁰ Lacoste 2003 (level IV) ¹¹¹ Sonnenblum 2009 (level IV) ¹⁷⁴
Posture	Tilt in space and recline alter the centre of gravity and therefore may impact on trunk or head control.	Ding 2008 (level IV) ⁶⁰ Dreier 2010 (Addendum RESNA) ⁶³ Sonnenblum 2009 (level IV) ¹⁷⁴
Contractures or orthopaedic disorders	Tilt in space and recline in conjunction with detailed assessment and monitoring may improve postural alignment (e.g. progressive or static scoliosis, limitations in hip range of motion).	Expert opinion
Extensor tone and/or management of spasticity	Tilt in space can assist to reduce the occupant's tendency to slide forward on the seat or out of the wheelchair. It allows changes in position but maintains static joint angles and thus muscle length.	Dewey 2004 (Qual. rigour 4/4) ⁵⁶
Management of acute symptoms of orthostatic hypotension	Tilt in space and recline may assist to manage acute symptoms of orthostatic hypotension. More research is needed to clarify whether it assists with long-term management.	Dewey 2004 (Qual. rigour 4/4) ⁵⁶
Reach range	Tilting anteriorly or forward tilt may functional reach range and enhance independence.	Ding 2008 (level IV) ⁶⁰ RESNA 2009 Position paper ⁵⁹ Dreier 2010 (Addendum RESNA) ⁶³ Sonnenblum 2009 (level IV) ¹⁷⁴

8. Wheelchair features

Dynamic balance and stability	Tilt can promote stability particularly when driving downhill, over uneven terrains, when carrying objects on the lap or when stationary on a slope.	RESNA 2009 Position paper ⁵⁹ Sonnenblum 2009 (level IV) ¹⁷⁴
Sitting and activity tolerance	Tilt may increase the user's capacity to maintain a seated posture for longer periods and engage in an activity.	Ding 2008 (level IV) ⁶⁰
Orientation and communication	For impaired visual orientation, speech, alertness and arousal, tilt in space may assist to better orient the trunk and head position, stimulate the vestibular system, improve the occupant's line of sight and allow for better communication by maximising breathing and speaking ability (through maintaining organ capacity).	Expert opinion
Bowel and bladder management	Tilt in space and recline can assist some users who have reduced bowel and bladder function, and in some circumstances enhance their independence.	Dewey 2004 (Qual. rigour 4/4) ⁵⁶
Transfers	Tilt in space may improve or make transfers safer and potentially reduce the number of transfers. Tilt in space and recline can result in adjustment to the centre of gravity, enhance sliding transfers and adjustment of the height of the load.	RESNA 2009 Position paper ⁵⁹ Dreier 2010 (Addendum RESNA) ⁶³
Access	Tilt in space may enable access to otherwise inaccessible equipment, e.g. tilt forward for under-table knee access.	RESNA 2009 Position paper ⁵⁹

Dynamic recline without posterior (rearward) tilt in space

There is little evidence available on wheelchair recline without posterior tilt in space. Using dynamic recline without posterior tilt can adversely change posture and may result in the need for assistance to restore it. There are also concerns that recline position without tilt may result in changes to:

- pressure distribution
- comfort
- functional ability.

47. Recommendation

Grade

The therapist should educate the user about the concerns associated with the use of recline without posterior tilt in space.

Consensus

8. Wheelchair features

8.4 Elevating leg rest

Research on elevating leg rests is limited. One study indicated that there is a change in posture with leg rests that have a fixed axis of rotation.³ An increase in pressure at the ischial tuberosities was noted in the study's normal subjects.

Elevating leg rests are not frequently prescribed. (Elevating leg rests may be articulating or fixed). Some conditions may be managed by tilt in space and/or recline in preference to elevating leg rests.⁵⁹ However, therapists should consider the factors which have been identified through the limited literature available, together with clinical experience. The factors are listed below.

Elevating leg rests may assist with:

- ground clearance for those with low seat heights
- positioning as a treatment of dizziness when used in conjunction with tilt/recline
- sliding transfers of a person in the supine position when used in conjunction with recline
- supporting knee extension contractures.

Other factors to take into account include:

- To avoid obstacles, elevating leg rests need to be easily adjustable, either manually by the user or with a power control.
- Elevating leg rests increase the wheelchair's 'footprint', making it more difficult to manoeuvre, e.g. around corners.
- Elevating foot rests change the dimensions of the wheelchair so access may be restricted for activities that require sitting at a desk or table.
- When in use, elevating leg rests alter the centre of gravity which can affect balance and the stability of the wheelchair.
- They can get in the way during sitting transfers.

48. Recommendation

Grade

Elevating leg rests may be considered where there is a medical condition, co-morbid condition or functional requirement which needs management by sustained leg elevation.

D

49. Recommendation

Grade

The therapist should consider the functional implications of elevating leg rests including:

- size, circulation space required and the impact on activity and participation
- the user's ability to operate the leg elevation mechanism independently
- the user's driving and spatial skills to manoeuvre and negotiate the wheelchair and leg rests around obstacles, corners and corridors.

Consensus

50. Recommendation

Grade

Where elevating leg rests are prescribed to manage oedema in the leg, a tilt in space feature should also be included to allow for the leg to be raised to a level above the heart.

Consensus

51. Recommendation

Grade

If a therapist prescribes an elevating leg rest to accommodate knee extension then the effect on pressure and hip position must be considered.³

D

8.5 Elevating seat

The RESNA position paper (2005)^{8, 160} and best practice guideline supplement¹³² provide a position statement on an elevating seat, based on clinical experiences. One study located found that seat elevation was primarily used for activities of daily living (reach), psycho-social benefits (seat height for communication) and transfers. However only 55% of those equipped with seat elevation used the feature (Ding 2008).⁶⁰

One study has suggested that the majority of users who have the seat elevating feature on their wheelchair do not use it (Ding 2008).⁶⁰ The therapist should also consider other seat elevation issues such as the potential frequency of use, and if the seat remains elevated in transit, the wheelchair stability over variable terrains.¹³²

The following factors were compiled on the basis of the limited literature and clinical experience. Therapists should consider these in their prescription.

Seat elevation may:

- facilitate a transfer between different surface heights or positions, e.g. lower to ground, sit to stand
- help preserve the upper limbs as long as possible if the health condition is progressive¹³²
- enable greater reach range e.g. access supermarket or library shelves, high counters in customer service offices, reach down to dishwasher
- facilitate communication (eye to eye contact) and improve visual access
- enhance access of the environment, e.g. lower to get under table, lower to coffee table height
- improve psycho-social functioning, e.g. being served from a counter.

When considering seat elevation note that:

- Some behavioural issues could raise safety or social concerns.
- The user requires adequate cognitive capacity, including spatial awareness and judgment.
- The user needs adequate physical capacity to operate the mechanism independently and safely.

- The elevating mechanism may raise the overall seat height of the wheelchair (when not in use) which affects other wheelchair features such as foot rests.
- There will be an impact on stability and balance while reaching or driving on variable terrains.
- It is important to estimate how often seat elevation will be needed.

52. Recommendation

Grade

The therapist should consider the functional benefits and concerns of an elevating seat including:

Consensus

- the enhancement of functioning with reach, transfers, upper limb
- the impact on communication and psycho-social functioning
- the impact of environmental (physical) factors (as a facilitator and barrier)
- behavioural, cognitive and capacity considerations
- the impact on performance (stability, balance)
- frequency of use.

8.6 Back rest

The back rest plays an important role in providing support, comfort and rest for the wheelchair user. Whether the back rest is a rigid support or soft upholstery, its height, width, lateral support and contours should optimise the user's comfort, postural alignment, sitting balance, upper limb reach and ability to perform activities.

The working party sought to clarify whether a rigid back rest or firm postural support on a manual wheelchair influenced pushing efficiency. There was some research on wheelchair back supports which compared the benefits and functional gains for different types^{117, 122, 178} but no research suggested that the presence of a rigid back rest makes pushing a manual wheelchair more efficient.

9

Propulsion

9.1 Power or manual

The therapists raised the issue of whether a power wheelchair or a manual wheelchair is recommended for specific levels of function or mobility. No research was located. This reinforces that there is no 'formula' to wheelchair prescription. The suitability of a power or manual wheelchair can only be established through clinical reasoning and thorough individual assessment. Many significant variables affect the match between the potential user, the wheelchair and the wheelchair features. These include the goals (activity and participation), the user's and the attendant care worker's capacity and performance, and the context (environment and individual factors).

9.2 Foot propulsion

There was no research located on foot propulsion as a method of propelling or controlling the wheelchair. Foot propulsion is usually not relevant for people with spinal cord injury, but it could be considered for conditions such as central cord syndrome (bilateral foot propulsion) or hemiplegia (unilateral foot or hand-foot propulsion).

53. Recommendation

Grade

For effective and safe foot propulsion, the therapist should consider:

Consensus

- the user's lower leg length and cushion profile when determining seat to floor height of the wheelchair
- pelvic stability
- the ability to independently move forward to propel with the foot and move back to re-position
- clearance behind calf muscles, and foot during foot propulsion
- wheelchair set up such as:
 - » castor size and spin
 - » seat length
 - » position of axle.

For unilateral and/or part-time foot propeller, foot support should be included in the prescription.

54. Recommendation**Grade**

The factors that should be considered with respect to foot propulsion include pelvic stability and posture, and the ability to recover a better posture. In order to achieve foot propulsion, symmetry of posture may be compromised which has potential long term musculoskeletal implications.

Consensus

9.3 Power assisted

Compared to manual wheelchairs, a push rim activated power-assisted wheelchair (power-assisted or PAPAW) reduces energy and muscle demands during propulsion.^{5, 33, 116, 141} Furthermore, power-assist may help to preserve shoulder joint function for people with tetraplegia or shoulder pain.¹¹⁶ Refer to Section 7.6 on the upper limb.

Studies have shown that power-assisted wheelchairs make it easier to travel long distances, traverse thick carpet, inclines and uneven or difficult terrain, especially in outdoor activities.^{5, 61, 79, 141} One study found that power-assisted wheelchairs led to increased participation in new or social events⁷⁹, but in another study there was no significant difference in community participation between manual and power-assisted wheelchairs⁶¹ or between power and power-assisted wheelchairs.⁶⁰ Giesbracht (2009)⁶⁰ compared power and power-assisted wheelchairs and concluded that the power-assisted wheelchair could be an alternative option for maintaining community activities.

55. Recommendation**Grade**

Power-assist wheels could be considered as they may improve functional mobility and performance for wheelchair users with reduced upper limb function.

B

56. Recommendation**Grade**

Power-assist wheels may need to be considered for a wheelchair user who is at high risk of upper limb injury or is experiencing significant shoulder pain and/or reduced cardiovascular function. The therapist needs to consider the transport interface, wheelchair portability, wheelchair configuration (such as rear wheel axle position, floor-to-seat height) and the environments in which the wheelchair will be used (e.g. going up/down a gutter).

B

57. Recommendation**Grade**

The therapist should trial power-assist wheels, prior to prescription, as there may be significant functional implications arising from their difference to a manual wheelchair. These implications include: transport use, wheelchair portability, wheelchair configuration, the environments in which the wheelchair can be used and limitations in distances that can be travelled.

Consensus

9.4 Drive wheel position

The drive wheel transmits the wheel power and guides the wheelchair but does not steer.¹⁶¹ In power wheelchairs, the drive wheel position (front, mid/centre or rear) interacts with other factors such as overall wheelchair size, control device and programming, and influences user demands and performance. Different user priorities will also influence choice of drive wheel position.

There are differences in the performance, ride quality, manoeuvrability, size, reach in confined spaces and turning circle between wheelchairs across the three drive wheel positions. There are also variations between wheelchair brands, so the characteristics of the same drive wheel position can differ from one manufacturer to another. The complex interaction between the variables makes it difficult to isolate the influence of one factor over another.

Key points include:

- The main factors to consider are the user's needs in their current or potential environment and their ability to control the power wheelchair.
- The turning circle is different for each drive wheel position. Intuition, judgment and planning are required.
- Some users have a strong preference for a particular drive wheel position which is not necessarily related to environment or activities and participation. The preference may be based on prior experience or difficulty handling the characteristics of a particular drive wheel position.
- When the drive wheels are positioned in an approximate line under the user's head or centre of gravity ('mid wheel drive' or 'centre wheel drive'), manoeuvring the wheelchair is often more intuitive, and less anticipation is needed to manoeuvre in tight spaces. The further the drive wheels are in front of or behind the position of the user's head, the more cognitive processing and skill are needed. This is important when considering the user's environment and their innate ability to adapt to the control of a power wheelchair.
- It is necessary to trial the client in a range of wheelchairs before finalising a prescription for a new user, or changing drive wheel positions for an experienced user.

- If an experienced user is familiar with a particular drive wheel position, it can be difficult for them to make the cognitive adjustments necessary to switch to a different drive position (e.g. rear wheel drive and change to mid wheel drive).
- Overall wheelchair dimensions and turning circle will be critical for some users. For others, specific combinations of wheelchair manoeuvring and reaching, typically in the home, will be important. The performance of a particular wheelchair can only be determined by trial or reference to the overall dimensions and drive wheel location of a previously successful wheelchair.
- Some drive positions are problematic for attendant-controlled wheelchairs. The mid wheel drive is more difficult for the attendant than rear wheel, unless the attendant walks alongside or is only a part-time driver. Attendant control may not be practical for front wheel drive.
- The turning radius can be estimated by measuring the distance between the middle of the drive wheels and the furthest point of the wheelchair (e.g. front castors, footplates, rear castors, battery box). The closer the drive wheel is to the middle of the wheelchair, the smaller the turning radius will be.
- When travelling down a corridor and turning into a doorway, different drive positions will require varying distances from the wall before beginning to turn. This is due to their different shape or the space required for their turning radius. For example, rear wheel drive wheelchairs need to be further away from the wall leading to the doorway before turning.

Table 5 lists advantages and disadvantages of each drive wheel position. It has been adapted from Minkel (2005)¹³⁰ with further information included from Denison and Gayton 2002⁵¹, Pellegrini (2010)¹⁵⁵ and Koontz (2010)¹⁰⁸.

Table 5 Advantages and disadvantages of different drive wheel positions

Improvements in technology and changes in wheelchair design mean that for some models, not all advantages and disadvantages will necessarily occur as described.

Drive wheel position	Advantages	Disadvantages
Rear wheel drive	<p>Manages higher speeds for outdoor driving.</p> <p>Can provide a good balance between indoor manoeuvrability and outdoor or uneven ground ride quality.</p> <p>Ease of use of controls</p> <p>Ease of use for attendants.</p>	<p>Not as good for manoeuvring in tight indoor spaces.</p>
Mid/centre wheel drive	<p>Good for turning in tight indoor spaces.</p> <p>People with cognitive and/or perceptual impairment may find the wheelchair easier to learn how to drive and use, because manoeuvring is more intuitive when drive wheel position is in line with head and centre of gravity.</p>	<p>Some fluttering of caster wheels at high speed.</p> <p>Some users may find the ride quality unsatisfactory on uneven ground although it can also be influenced by softness of all wheels and quality of suspension.</p> <p>Potential for traction or control problems over different inclines. The wheelchair has been known to become stuck halfway across ramps, gutters, spoon drains and during vehicle entry or exit.</p> <p>If an attendant is operating the power wheelchair, control of mid-wheel drive might be difficult.</p>
Front wheel drive	<p>Better obstacle climbing ability over small steps or gutters and outdoors on rough ground.</p>	<p>Some users may be challenged by the different handling characteristics.</p> <p>Tendency for the rear of the wheelchair to 'fishtail' with speed.</p> <p>'Swings' at high speeds.</p> <p>It is difficult for an attendant to operate the controls of a front-wheel drive wheelchair.</p>

9. Propulsion

58. Recommendation

Grade

The therapist should conduct a thorough trial of the user's capacity to operate the specific wheel drive and wheelchair.

Consensus

59. Recommendation

Grade

The therapist should conduct a thorough trial if the experienced user is changing from one drive wheel position to another.

Consensus

9.5 Control device

The control device is the means by which the occupant directs an electrically powered wheelchair to move at the desired speed and in the desired direction of travel¹⁶¹. Examples include the joystick, 'sip and puff' devices, head arrays and proximity switches. The control device can be adapted to perform additional wheelchair functions or to operate external devices (e.g. control of the environment).

60. Recommendation

Grade

The therapist should consider referral of a client with complex or different needs for an alternative to the standard joystick controls (including attendant control joystick) to a specialist (interdisciplinary) seating/technology team who have expertise in specialist seating. This could be through face-to-face consultation or other media (e.g. teleconference, photographs or video conference).

Consensus

10 Scooters

A scooter might be prescribed when mobility assistance is needed for specific activities. The therapist should consider the user's short- and long-term capacity as well as longer term power mobility needs and access in potential environments. The weight capacity of the scooter also needs to be assessed.

Although there is no formal testing for scooter users, some funding agencies have specific assessment requirements before supply of a scooter (e.g. the Department of Veteran Affairs). As with wheelchairs, scooter users should undergo training (refer to Section 11).

Using a scooter for mobility has advantages and disadvantages which must be considered when deciding between a scooter and a power wheelchair. Advantages include the fact that they can be less stigmatising and cheaper than power wheelchairs.² Disadvantages include the following:¹⁹

- limited weight capacity
- difficulties with transportation (for example using taxis or public transport)
- quality and design problems
- injuries related to scooter use and the risk of a fatal accident (average of six deaths per year in Australia¹⁹).

A scooter may be prescribed for a person with traumatic brain injury who needs mobility assistance for specific activities such as access to the shopping centre.

Scooters are not usually prescribed for people with SCI. The reasons relate to the high postural and pressure care needs of a person with spinal cord injury which cannot be met by the seating system of a scooter. However, in some circumstances, following a trial, a scooter may be appropriate.

61. Recommendation

Grade

The therapist should trial a scooter, prior to prescription, as there may be concerns arising from their difference to a powered or manual wheelchair. The concerns include: transport use, seating system, scooter portability, lack of adjustability, the environments in which the scooter can be used, weight and limitations in distances that can be travelled.

Consensus

Posture and pressure

Scooters are not intended to have modified seating and they do not have lumbar support. They are designed for local transport, not prolonged sitting, so the therapist should ensure that the user is not at risk of developing secondary conditions.

Resources on scooters

1. Guidance on the use of scooters on public and private transport is provided in Section 12.
2. A variety of consumer information booklets are available:
 - » *Buyers Guide—Scooters* (Independent Living Centre ILC, NSW)
 - » <http://www.ilcnsw.asn.au/items/4542>
 - » *Stay Safe!* (Victorian Department of Human Services, Rural Access, Loddon Shire Council, City of Greater Bendigo)
 - » <http://www.bendigo.vic.gov.au/files/1ad0eb24-6b67-48e5-94bb-9ee800fe8eab/STAYS SAFE.pdf>
 - » Emergency wheelchair & scooter assist (Royal Automobile Club of Victoria, RACV)
 - » <http://www.racv.com.au/wps/wcm/connect/internet/primary/roadside+assistance/wheelchair+assistance>
 - » *Guide for choosing and using motorised mobility devices: mobility scooters and electric wheelchairs* (VicRoads)
 - » <http://www.vicroads.vic.gov.au/Home/Moreinfoandservices/Pedestrians/MotorisedMobilityDevices.htm>
 - » *Keeping You SAFE in the Rider's Seat* (Department of Veteran Affairs)
 - » <http://www.dva.gov.au/aboutDVA/publications/health/Pages/scooter.aspx>
 - » *Scooters: safe use within the community* (Government of South Australia, Department for Families and Communities)
 - » http://www.sa.gov.au/upload/franchise/Community%20Support/Disability/Information%20sheets%20-%20Disability%20SA/Scooters_safe%20use%20in%20the%20community.pdf
 - » *Wheelchairs or scooters: selecting a scooter* (Government of South Australia, Department for Families and Communities)
 - » <http://www.sa.gov.au/upload/franchise/Community%20Support/Disability/Information%20sheets%20-%20Disability%20SA/Wheelchairs%20or%20Scooters-Selecting%20a%20Scooter.pdf>
 - » Motorised Mobility Devices Scooters and Powered Wheelchairs Independent Living Centre (ILC) Tasmania
 - » *Scooter accommodation handbook* (Scooters Australia)
 - » <http://www.scootersaus.com.au/index.html>
 - » *Help cut mobility scooter accidents* (Australian Competition & Consumer Commission) Federal Government
 - » <http://www.accc.gov.au/content/index.phtml/itemId/945577>

11 Training

Research evidence consistently emphasises that wheelchair training has a positive effect on the client's capacity to use the device (including skill, performance and power output).^{15, 47, 49, 118, 149, 164, 195, 209} Training on the use of mobility scooters is also recommended.^{37, 65, 125, 149} Effective training programs include instruction, practice and experience in the community and potential environments.^{15, 31, 35, 36, 86, 89, 104, 114, 118, 209}

62. Recommendation

Grade

The therapist should undertake training on the use of a wheelchair device to improve their own knowledge and understanding of wheelchair user skill, wheelchair user capacity and performance requirements.

B

63. Recommendation

Grade

The therapist should facilitate the provision of client/attendant care worker training on the wheelchair to improve skill and performance.

A

64. Recommendation

Grade

Training for the user should include the elements of instruction, practice sessions and experience in the community/ potential environments.

A

65. Recommendation

Grade

The content and intensity of training with the client/attendant care worker on the wheelchair should be the same for part-time and full-time users.

Consensus

66. Recommendation

Grade

The content and intensity of training may differ if the client is an experienced wheelchair user.

Consensus

11.1 Training duration

The duration of training depends on a number of factors including:

- the individual user
- contextual factors such as motivation, adjustment to disability, and support
- whether the user has previous wheelchair experience
- opportunities for practice
- the environments in which the user can practice.

The most effective and reliable training programs described in the literature were face-to-face with the individual rather than group-based. Most of the programs provided wheelchair skills training for two to five hours plus practice time.^{15, 31, 104, 105, 118} Typically face-to-face training involved individual sessions of 30 minutes.

67. Recommendation

Grade

At a minimum, the novice wheelchair user should receive training on the use of the wheelchair for an average of three to four hours over a number of weeks in sessions of approximately 30 minutes. The practice sessions are in addition to this individual training time.

A

Key points arising from the research are described here as considerations rather than recommendations.

Considerations for training duration:

Manual wheelchairs

- Highly structured programs which include video and trainer demonstration, mirror feedback and verbal feedback take less time and have similar success to programs which involve instruction and practice only.¹⁰⁴
- Women may take longer to learn the wheelie skill (take-off, balance and landing) than men.¹⁰⁵
- It is not clear whether older people need more training time as the evidence is inconclusive.^{16, 105}

11.2 Training content

There are resources available which provide guidance on training content. The details on where to obtain these resources are listed at the end of the section.

The following checklist outlines the topics which should be included in wheelchair training at a **minimum**. It is based on the topics covered in a variety of training resources and guides (Paralyzed Veterans America (PVA) wheelchair guides, NRMA scooter safe, PIDA, PCDA, Wheelchair skills program, Nitz 2008).

68. Recommendation

Grade

The client should be provided with training in the listed topics as appropriate (refer to *Training topics checklist*).

Consensus

69. Recommendation

Grade

The attendant care worker should be provided with training in the listed topics (as with a wheelchair user) as relevant and particularly if the attendant care worker operates the manual or powered wheelchair.

Consensus

The research provided limited information on the content to be covered in training topics, duration of training, appropriate training schedules, mode of training or who should conduct the training. However, key points arising from the research have been listed here as considerations for training rather than recommendations.



Training topics checklist

Manual wheelchair

The wheelchair and user interface

- set up, components and adjustments
- user limits, protecting yourself and assistance
- propulsion techniques
- relieving pressure
- reaching, bending and lifting
- transfers
- upper limb capacity

Safe practices

- planning, preparation and precautions
- emergency skills (falling, evacuation)
- wheelchair maintenance
- inclement weather and night time safety
- transport

Navigation skills

- thresholds, obstacles, ramps and slopes, cross slopes
- manoeuvres: turning, doorways, tight environments and congested areas
- crossing streets, intersections, curb cuts and curbs,
- smooth and rough terrain, tracks and grates
- stairs, elevators and platform lifts, escalators

Power wheelchair or scooter

The wheelchair and user interface

- set up, components and adjustments, including joystick

- use of the controller/drive modes and speeds, tilt and recline function, battery and charging
- user limits, protecting yourself and assistance
- relieving pressure
- reaching, bending and lifting
- transfers

Safe practices

- planning, preparation and precautions
- emergency skills (falling and recovery to seated position, evacuation, stairs, power breakdown)
- wheelchair or scooter maintenance
- inclement weather and night time safety
- transport
- road safety principles and rules
- speed testing
- night driving

Navigation skills

- thresholds, obstacles, ramps and slopes, cross slopes
- manoeuvres: turning, doorways, tight environments and congested areas
- crossing streets/intersections, curb cuts and curbs
- smooth and rough terrain, tracks and grates
- stairs, elevators and platform lifts, escalators
- reversing

Rights and responsibilities of wheelchair and scooter users Insurance

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

Considerations for training content

Any research specific to a particular condition appears like this.

Manual wheelchairs

- A program that involves low intensity strengthening and aerobic training^{49, 164} (one study involved seven weeks, three times per week for 70 minutes) can improve the mechanical efficiency of a manual wheelchair user (improvement in propulsion technique and physiological adaptations such as improved heart rate⁴⁹).

SCI: The training program did not increase shoulder and elbow joint stressors^{49, 164}. In this population the largest improvement in skill occurred in the first three months after training.

- Low intensity programs over a number of weeks on hand rim wheelchair training can improve aerobic and sprint power output.⁴⁹
- The goal of training should not necessarily be to obtain a higher push force as it increases the risk of upper limb injury.⁴⁹
- Users should be educated to use long, smooth strokes that limit high impacts on the push rim (level B recommendation Consortium Guidelines), and to allow the hand to drift down naturally, keeping it below the push rim when not in actual contact with that part of the wheelchair (a level C recommendation in the Consortium Guidelines for the preservation of upper limb function following SCI).²⁹
- High rolling resistance training did not improve success rate or reduce training time for learning the wheelie skill.¹⁰⁵

SCI: The most important factor in performing a wheelie take-off is learning to coordinate the movements rather than needing to produce a large force.¹⁶

SCI: Wheelchair training in the context of work enhances the potential to return to work and the level of participation.^{102, 195}

TBI: For people with brain injury or hemiplegia, the difficulties experienced in performing wheelchair skills (in particular the high rolling resistance or a wheelie balance) are due to inherent difficulties with the tasks, rather than due to the neurological impairments.¹⁰³

Power wheelchairs

- In the absence of prior experience, virtual reality/simulated training can help to prepare for actual powered wheelchair use and to develop cognitive skills such as route finding. Training with a simulator program using a joystick and personal computer/virtual reality tool provides an opportunity for early skill development, although it does not replace actual wheelchair driving experience.^{88, 89}
- Training in the use of the powered wheelchair at dusk and in the evening is appropriate. One study identified that users of powered wheelchairs are most active during the afternoon and evening hours.³²

SCI: Wheelchair training in the context of work enhances the potential to return to work.¹⁹⁵

TBI: Practice using an obstacle course improved driving accuracy in people with unilateral neglect.⁴⁷

TBI: Computer assisted training (virtual reality driving environment) has the potential to train people for scanning left and right, learning the use of the controller and direction tasks for powered wheelchairs.^{176, 204}

Scooters

TBI: Simulator training/virtual reality has the potential to improve driving skills but complements real life training.⁹⁸

11.3 Training in propulsion techniques

Research confirms that training exercises which target propulsion technique increase biomechanical efficiency and reduce metabolic cost to the user. Studies suggest that training effects include increased strength and force, decreased stroke frequency, increased push time and endurance, without significantly increasing the stressors on the upper limb joints, even during fatigue.^{48, 49, 164} Verbal instruction has helped to change propulsion biomechanics and technique, although longer training is likely to be needed to consolidate propulsion technique changes.⁴⁸ In terms of stroke technique, more research is needed but the Consortium for Spinal Cord Medicine (2005)²⁹ recommend (www.pva.org):

- using long smooth strokes that limit high impacts on the push rim
- allowing the hand to drift down naturally, keeping it below the push rim when not in actual contact with that part of the wheelchair.

11.4 Mode of training

The literature suggests that large group training for wheelchair skills is not appropriate. Individual face-to-face training is more effective and results in longer term retention of skills.^{15, 104, 118} There is a role for group or peer discussions and teaching where experiences can be shared between users.

Some studies have utilised a buddy or paired system of training³¹, although this was with subjects who were able-bodied. The World Health Organization recommends peer training for 'less resourced settings' and to develop capacity of organisations.²¹¹ There is a potential role for training by a peer wheelchair user in some circumstances. The peer trainer should undergo selection and be given training in teaching wheelchair skills.

70. Recommendation

Grade

The face-to-face training should primarily be conducted on an individual basis although practice sessions can involve buddy/paired or peer methods.

B

71. Recommendation

Grade

The client/attendant care worker needs to be supervised during training of wheelie skills on a manual wheelchair, until the client/attendant care worker is competent.

Consensus

The literature has explored the role of virtual reality in wheelchair training, both manual and powered, but in most cases this option is neither available nor cost effective and rehabilitation services lack the resources. In some circumstances it might be feasible to use a computer and joystick to teach early operating skills such as route finding and scanning left and right (refer to the considerations above).

Considerations for mode of training

Manual wheelchairs

Virtual reality provides a risk-free environment without physical constraints, but it does not replace learning to navigate in the real world.^{35, 88}

Resources and training guides

The Powered Wheelchair Training Guide

<http://www.pva.org/site/c.ajlRK9NJLcJ2E/b.6357755/apps/s/content.asp?ct=8825425>

The guide costs \$20 USD plus postage and handling.

The Manual Wheelchair Training Guide

<http://www.pva.org/site/c.ajlRK9NJLcJ2E/b.6357755/apps/s/content.asp?ct=8825367>

The Guide costs \$20 USD plus postage and handling.

NRMA, *Scooter Safe*

http://www.mynrma.com.au/cps/rde/xchg/mynrma/hs.xsl/older_drivers_driving_alternatives.htm

Wheelchair Skills Program

<http://www.wheelchairskillsprogram.ca/>

Roads and Traffic Authority motorised wheelchairs information

<http://www.rta.nsw.gov.au/roadsafety/pedestrians/motorisedwheelchairs.html>

12 Transport

Access to the wider community for a wheelchair user is essential to activity and participation in life. Possible modes of transport include buses, trains, light rail, ferries, taxis, community transport buses, aeroplanes and private vehicles.

There are risks, and therefore the potential for adverse events, associated with the use of a wheelchair in both public and private vehicles. There is no incidence data on wheelchair occupant injuries sustained during transport because many of the injuries would not be reported (particularly non-crash injuries).^{14, 68} However, there is a known risk of injury to wheelchair occupants in a vehicle which crashes or moves violently due to sudden braking, acceleration, sharp turning or excessive speed over a speed hump, especially if restraints are inadequate.^{14, 68, 194} Furthermore, one study found that prescribing therapists, attendant care providers and wheelchair users had poor knowledge about wheelchair transport safety.²⁰

When travelling in motor vehicles, it is safest for wheelchair users to transfer into a car seat. The vehicle should be fitted with seatbelts, and comply with legislative safety requirements. The wheelchair should be secured as luggage.^{68, 184, 186} However, in many instances this is neither possible nor practical. If the wheelchair is to be used as a seat in transport, ways of reducing the risks should be factored into the assessment and wheelchair prescription process. The exception is for low speed urban public transport, where the likelihood of a severe crash is lower.¹⁸⁴

72. Recommendation

Grade

The therapist should consider factors to reduce the risk of injury for wheelchair users in vehicles including those listed in the *Injury prevention during transportation checklist (for wheelchair users in vehicles)*.

Consensus



Injury prevention during transportation checklist

A range of strategies can help reduce the risks (to an acceptable level) of injury to the wheelchair user. This is not an exhaustive list:

- Reduce the risk of equipment failure:
 - » Prescribe only proven, crashworthy wheelchairs (refer to manufacturer's information).
 - » Use only proven wheelchair tie-down (anchor) restraints and occupant restraint systems (seatbelts), that comply with Australian standards (AS/NZS 10542: 2009) and that are maintained in working order.
- If relevant, provide a means of attachment of the seating system to the wheelchair, which is also suitable for transport.
- Wheelchair components to be considered:
 - » Provide a head rest, which must be no lower than the most prominent point on the back of the head and above the person's ears, close to the back of the head and well padded. The brackets at the of the head rest must not pose a risk to other passengers.¹⁸⁴
 - » Provide a back support^{184, 186} and a head rest.
 - » Wheelchair brakes must be in good working order and able to be locked in transit.
 - » Dimensions of the wheelchair must be accommodated in the proposed modes of transport.
 - » Wheelchair and user height must be compatible with internal height and door height of the proposed vehicle.
 - » The wheel drive position (rear, mid or front wheel drive) can have an impact on safe vehicle entry and egress.
- Use a properly fitted occupant restraint system that is anchored to the vehicle (lap sash seatbelt or lap belt NOT pelvic belt attached to the wheelchair). The sash portion should be across the chest and mid shoulder and the lap portion should be over the pelvis not the abdomen.^{184, 186}
- Position the wheelchair in the vehicle so that the wheelchair and occupant face the front of the vehicle when in motion.
- Consider the local environment and available modes of transport the client will potentially access (public or private), and any alternatives.
- Consider the interface between the wheelchair and the vehicle. This includes:
 - » Wheelchair dimensions
 - » How to enter and exit the vehicle safely (e.g. ramps—rear or side entry, manual or motorised hoist, entry door size).
 - » If transferring to a seat, safe stowage of the wheelchair and battery (for powered wheelchairs) in all forms of anticipated public and private transport options, including aeroplanes.
 - » The wheelchair user should sit as upright as possible, within 30 degrees of the vertical. Tilt in space should not be used in the vehicle while in transit.^{184, 186}
 - » Decide how to manage additional equipment such as trays and augmentative communication devices. Hard trays, communication devices and mounting should be removed for transport and stored securely to avoid the risk of obstruction or a missile in the vehicle.
 - » Chin controls can be an obstruction and should be swung away if possible.
 - » Powered wheelchair controls should be switched off during travel.
- Take into account individual factors such as:
 - » Medical concerns, for example, the need for medical devices such as ventilators to remain in situ and secured during travel, or access to assistance if the wheelchair user has a condition which requires immediate responses (epilepsy or airway difficulties).
 - » Behavioural issues such as the user habitually releasing the seatbelt and safety restraints at an inappropriate time. The preferred option is a behavioural intervention program developed by a psychologist. If further intervention is required, other options include an escort or a seatbelt cover. (http://www.ilcnsn.asn.au/search?search_phrase=seat+belt+buckle+cover)

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

12.1 Public transport

Access standards

The draft Australian standards for accessible public transport were formulated under the *Disability Discrimination Act 2002*. The standards set minimum requirements to be met by providers and operators of public transport, related infrastructure and premises. A full copy of the disability standards can be obtained from <http://www.comlaw.gov.au/Details/F2005B01059>

In NSW, information on accessible transport can be viewed through various links on the NSW Transport website:

<http://www.transport.nsw.gov.au/abouttrans/access-trans.html>.

Included are access guides, disability standards and the state action plan as well as information on trains, buses and taxis, including complaint mechanisms.

Buses

Wheelchair users (who do not transfer to a bus seat) can use low floor buses with designated accessible spaces. The restraint device or strap provided in the bus must be used. Not all buses are wheelchair accessible and provide wheelchair restraints. The wheelchair must meet the following specifications:

- Overall width less than 800 mm, and less than 750mm up to 300mm above the ground for use on front door entry buses
- Able to negotiate a door height of 1400mm
- Fits in an allocated space of 800 mm wide by 1300 mm long
- Able to turn 180 degrees within a specified area and meet other stability and manoeuvrability specifications.

Mobility scooters and similar mobility devices are considered to be small vehicles and are often used as an alternative to public transport. They are not considered to be essential mobility aids, and are usually too heavy and unstable to be carried with safety. Public buses will only carry scooters with a laden weight of less than 300 kg which can be driven onto the bus and manoeuvred to fit wholly within the allocated wheelchair space (refer to specifications above).

Any mobility aid not complying with the specifications for mobility aids listed above is not permitted on a bus. This includes large ride-on scooters and all three-wheeled ride-on scooters.

Information from Sydney buses about scooters can be downloaded from

<http://www.sydneybuses.info/getting-around/bus-accessibility/wheelchairs-mobility-aids.htm>.

Taxis

There are modified wheelchair-accessible taxis designed to transport passengers who travel seated in their wheelchair. Some taxis accommodate one wheelchair user and others up to three. A taxi transport subsidy scheme provides half fare travel for eligible passengers, up to \$30.

A mobility scooter is not considered to be a wheelchair. A scooter might be taken by some taxis but the passenger **must** occupy a seat in the vehicle and use a seatbelt. The scooter will be treated as luggage. The driver may secure the scooter in the best possible way so that it does not move in transit.

A three-wheeled scooter cannot be locked down on four points so the user must move out of the scooter and use the taxi seat. If the user remains on the mobility scooter and is subsequently injured in an accident, liability is a significant issue. The driver of the vehicle can refuse the hiring if he or she feels it is unsafe.

Refer to NSW wheelchair accessible taxis <http://www.transport.nsw.gov.au/taxi/wheelchair.html>.

Trains

Trains

Excerpt from City Rail transport guidance

http://www.cityrail.info/travelling_with/accessible_services/wheelchairs

Wheelchair accessible stations have a step-free path to all platforms and essential station facilities. Assisted access stations may be accessible to people using motorised wheelchairs and scooters, or for a person using a manual wheelchair, with the help of a friend or attendant care worker. Remember to check that the station facilities on your journey meet your access needs before setting out.

Size and manoeuvrability

Our accessible trains and stations are designed for mobility aids up to 80cm wide and 130cm long. Your wheelchair or scooter should be able to turn 180 degrees in a space no more than 154cm wide by 207cm long to ensure safe access to stations, lifts, level crossings and trains.

Boarding ramps

Portable platform to train boarding ramps are the only safe way to board a train using a wheelchair or scooter. Boarding ramps are 80cm wide with a maximum load tolerance of 300kg. This includes the weight of yourself, your aid and anyone helping you on the ramp. All of our trains are accessible using a platform to train boarding ramp.

On trains

Space for wheelchairs is available at the end of carriages—look for the wheelchair symbol beside the train door of wheelchair accessible cars. While on the train, position your wheelchair or scooter in the space designated for wheelchairs, where marked, at the end of the carriage.

Safety

- On the station platform, park your mobility aid sideways rather than facing the track.
- Apply the brakes when waiting on the platform or travelling on the train.
- Please remember to give way to pedestrians and travel at no faster than walking pace on stations and trains.
- Petrol-fuelled devices are not allowed on stations or trains.
- Storage facilities for mobility aids are not available at stations.
- Staff cannot operate mobility aids, lift or carry customers or mobility aids.
- Staff cannot attend to a customer's personal care on trains or stations. If you need this help to use our services, you will need to travel with a friend or attendant care worker.

Aeroplanes

The wheelchair user's requirements and need for assistance should be discussed with the airline when the flight is booked. Each airline and aeroplane (e.g. regional or international) has different procedures for boarding, disembarking and in-flight assistance.

Resources

Transport Safety Guidelines for People with a Disability (2010) 2nd ed. SPOTonDD

Order through http://www.spotondd.org.au/affiliated_groups.htm (cost AUD \$30) or email: spotonddsec@aussiesp.net.au

Draft best practice guidelines – 'Vehicular transportation for users occupying their wheelchairs' (2010) *International Interdisciplinary Conference on Posture and Wheeled Mobility*, Glasgow, June 7–9: pp 205–223

Information on vehicle transfer aids
http://www.ilcnsw.asn.au/system/at_a_glance_documents/9/original/61_Vehicle_Transfer_Aids.pdf?1285306849

Wheels within Wheels 2011 available from Road Safety Trust (ACT). <http://www.roadsafetytrust.org.au/c/rtt>

ANS/RESNA WC10: Wheelchairs used as seats in motor vehicles
http://www.ercwts.org/RERC_WTS2_KT/RERC_WTS2_KT_Stand/Standards.html

12.2 Standards

Australian standards

AS/NZS 3696.19: 2009 Wheelchairs – Wheeled mobility devices for use as seats in motor vehicles

AS/NZS 10542.1 and 10542.2: 2009 Technical systems and aids for disabled or handicapped persons – Wheelchair tiedown and occupant-restraint systems

AS/NZ 3856.1 and 3856.2: 1998 Hoists and ramps for people with disabilities – Vehicle mounted

Australian design rules for road vehicles: ADR 22/00 Head Restraints and ADR 3/03 Seats and Seat Anchorages

International standards

ISO 7176–19: 2008 Wheelchairs – Part 19: Wheeled mobility devices for use as seats in motor vehicles

ISO 16840–1: 2006 Wheelchair seating – Part 1: Vocabulary, reference axis convention and measures for body segments, posture and postural support surfaces

ISO 16840–3: 2006 Wheelchair seating – Part 3: Determination of static, impact and repetitive load strengths for postural support devices

ISO 16840–4: 2009: Wheelchair seating – Part 4: Seating systems for use in motor vehicles

ISO 10542 – Parts 1–5: Technical systems and aids for disabled or handicapped persons – Wheelchair tiedowns and occupant-restraint systems

13 Maintenance

Maintenance and repair is critical to the efficient and safe use of wheelchairs and scooters. Several studies have reported accidents attributable to mechanical or electrical failures, particularly in power wheelchairs.⁷¹ ¹²⁴ One study found that a more active maintenance program of manual wheelchairs reduced accidents.⁸⁷

There are three levels of wheelchair maintenance:

- *Routine maintenance:* contributes to the prevention of breakdown and helps the life span of parts. It involves tasks such as removing lint from axles and castors, checking tyre pressure, checking castors, cleaning upholstery, arm rests and headrests to prevent vinyl corroding. For power wheelchairs it includes topping up fluid levels for acid cell batteries, checking for battery leaks, applying protective lubricants to frame metals and zinc treated bolts and inspecting the keypad and joystick for damage.
- *Service:* includes lubricating folding mechanisms, pivot points, ball bearings (manual wheelchairs); inspecting motors, gear box, control box and batteries; cleaning and degreasing where necessary (power wheelchairs).
- *Repair:* involves a range of tasks in response to breakdown or breakage of parts.

Resources

The manufacturer or supplier should be able to provide details on their local providers for wheelchair service. The Independent Living Centre (NSW) also has a list of repair, service companies http://www.ilcnsw.asn.au/minor_groups/652/list/1. At the time of writing, the NRMA Road Service provided a free emergency service for flat tyres on manual or power wheelchairs and mobility scooters.

Maintenance guides are available from

- the manufacturer
- <http://www.health.qld.gov.au/mass/docs/resources/equipment/youyourpwc0310.pdf> for power wheelchairs
- http://www.health.qld.gov.au/qscis/PDF/Equipment/Manual_Wheelchairs_maintenance.pdf for manual wheelchairs
- Independent Living Centre
- Paraquad NSW

73. Recommendation

Grade

The therapist will consider each point in the *Maintenance checklist* prior to finalisation of the prescription.

Consensus

The therapist should provide advice and ensure the manufacturer's information is provided to the user.



Maintenance checklist:

Planning and information

- i. Obtain information about the:
 - Possibility of a service agreement with the supplier
 - Cost of repairs, routine maintenance and service and who will pay for this
 - Whole of life costs of the wheelchair and associated equipment
 - Known or perceived breakdown rates (gained through team or individual client experience)
 - Impact of the environment on the need for routine maintenance and service requirements e.g. salt air, dusty environment, group home.
- ii. Formulate a care plan which establishes:
 - Recommended periods, frequency and routine for service, routine maintenance and repairs needed (power versus manual)
 - Who will be responsible for arranging and performing the maintenance
 - Time frames for access to repairs (e.g. emergency and regular service turnaround times)
 - Availability of local repairer for service and repairs such as a local bicycle repairer, automotive electricians (for power wheelchairs), NRMA road service for service and repairs
 - Contingency plans for adverse events such as power failure, breakdown in the street.

Practical tasks

Ensure that tools are available and that the client or attendant care worker knows how to use them. Ensure that daily, weekly or fortnightly routine maintenance tasks are completed.

Plan for provision of:

- A backup wheelchair when primary wheelchair is being repaired or serviced
- Written guides (therapist's or manufacturer's) or weblinks on recommended maintenance tasks and frequency
- Annual training for attendant care workers on wheelchair routine maintenance (to accommodate turnover in staff)
- Spare parts (what and how many) to be kept or carried by client e.g. spare tyres (may be one or more sets)
- An emergency repair kit for flat tyres (temporary).

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

13. Maintenance

74. Recommendation

Grade

The therapist should inform the user/attendant care worker that there needs to be regular maintenance checks. Service of the wheelchair should occur every twelve months and/or at a frequency recommended by the supplier.

C

75. Recommendation

Grade

The therapist should ensure that the user is provided with information regarding the options for and availability of maintenance and repair service, plus who to contact.

Consensus

76. Recommendation

Grade

The therapist should inform the user/attendant care worker that the wheelchair or scooter should undergo at least one maintenance service prior to the expiry of the manufacturer's warranty period.

Consensus

14 Resources

The checklists developed for the guidelines are provided in each relevant section but also grouped together below.

14.1 Goals checklist



Goals checklist

This checklist outlines some of the factors for the therapist to consider when establishing goals in partnership with the client (and family).

Factors to consider as well as the client's current functioning

- Diagnosis and progress of recovery
- Prognosis
- Medical history and treatment

Factors to consider within the ICF domains

Body function and structure:

- Variable symptoms and the functions that need to be managed, for example, fatigue, spasm, comfort and early postural control for the longer term effects
- Mobility and transfer limitations
- Risk of secondary complications, for example, injuries subsequent to falls

Activity and participation:

- Types and range of activities and participation before SCI or TBI
- Types and range of activities and participation now
- Types and range of activities projected for the future
- Time efficiencies with activities
- Independence in activities and participation

Environment and personal contextual factors:

- Physical barriers in the client's current, home and prospective environments
- Type of transport the client will use (public, private, aeroplanes, boats etc)
- Variations in the different environments that the client will access (e.g. work or study). For example, the client may be independent in mobility at home or at work if they only need to access rooms on the same level in one building involving short, manageable distances. However if work or study requires movement between multiple buildings or floors and across several hundred metres, multiple times per day, there may be a need for a wheelchair.
- Community environment, including the interface between mobility limitations and local terrain—uneven ground, steep hills outside home etc
- Climate
- Personal factors including self-perception, adjustment to disability and the level of independence desired or not desired
- Level of care available
- Satisfaction, client's expectations and motivation
- Feelings of security
- Acceptance of care versus desire for independence
- Expectations of family and work colleagues, friends and social circle

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

14.2 Shoulder injury prevention checklist



Shoulder injury risk management strategy checklist

- Ensure the best match between the person, equipment and environment.
- Maintain wheelchair user fitness and strength through appropriate and balanced exercise programs.
- Train the user in optimum wheelchair propulsion (refer to Section 11 on training).
- Use ergonomic risk management strategies such as:
 - » Eliminate or avoid demands for extreme joint positions of the shoulder, elbow and wrist.
 - » Pace activities, allowing sufficient recovery time for the shoulder. For example, take a short break if pushing up an incline, between weight-relieving lifts and during activities of daily living that have high upper limb demands.
 - » Reduce the intensity and frequency of activities that are identified as shoulder injury risks. Examples include alternative pressure-relieving strategies to reduce the frequency of weight-relieving lifts, environmental modifications to reduce the ramp gradient, changing terrain (replacing uneven or resistant surfaces with smoother surfaces, removing carpet etc) or changing the order or method of tasks to avoid the need for specific activities such as pushing up a ramp or curb or pushing at greater speed.
 - » Reduce the performance demands and forces required for activities. This may include maintaining an ideal body weight, using optimum propulsion techniques, adjusting transfer technique, varying transfer technique to avoid over-use (e.g. alternating the arm that leads when possible), using transfer assistive equipment, reducing the distance or changing the configuration of equipment during transfers, performing level transfers where possible.
 - » Adjust the wheelchair set up; for example, place the rear axle as far forward as possible without affecting stability.

Not an exhaustive list

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

14.3 Long-term need checklist



Long-term need checklist

This checklist outlines some of the factors to consider when deciding if there is a long-term need for the wheelchair or scooter. It is not an exhaustive list.

Diagnosis, prognosis and medical history

- Client goals
- Variables within the ICF domains

Body function and structure factors

- Variable symptoms or conditions that need to be managed, for example, fatigue or spasm
- Anticipated change in functioning
- Risk of secondary complications, for example, injuries subsequent to falls

Activity and participation factors

- Types and range of activities now and projected for the future
- Time efficiencies
- Limited performance or capacity for mobility
- Type of transport the client will use (public, private, aeroplanes, boats etc)

Environment and contextual factors

- Level of care available and projected level of care
- The level of control over environment in which client will operate (e.g. work or study). Less control of the environmental conditions necessary for independent mobility, or safety concerns, may mean greater need for a wheelchair.
- Physical barriers in the community environment (including local terrain—uneven ground, steep hills outside the home etc). Climate may also be a consideration.
- Interface with other devices, for example, transport options
- Personal factors such as attitude, motivation and acceptance of care versus desire for independence
- Perception and acceptance of disability (self, attendant care worker and relevant others)

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

14.4 Training topics checklist



Training topics checklist

Manual wheelchair

The wheelchair and user interface

- set up, components and adjustments
- user limits, protecting yourself and assistance
- propulsion techniques
- relieving pressure
- reaching, bending and lifting
- transfers
- upper limb capacity

Safe practices

- planning, preparation and precautions
- emergency skills (falling, evacuation)
- wheelchair maintenance
- inclement weather and night time safety
- transport

Navigation skills

- thresholds, obstacles, ramps and slopes, cross slopes
- manoeuvres: turning, doorways, tight environments and congested areas
- crossing streets, intersections, curb cuts and curbs,
- smooth and rough terrain, tracks and grates
- stairs, elevators and platform lifts, escalators

Power wheelchair or scooter

The wheelchair and user interface

- set up, components and adjustments, including joystick

- use of the controller/drive modes and speeds, tilt and recline function, battery and charging
- user limits, protecting yourself and assistance
- relieving pressure
- reaching, bending and lifting
- transfers

Safe practices

- planning, preparation and precautions
- emergency skills (falling and recovery to seated position, evacuation, stairs, power breakdown)
- wheelchair or scooter maintenance
- inclement weather and night time safety
- transport
- road safety principles and rules
- speed testing
- night driving

Navigation skills

- thresholds, obstacles, ramps and slopes, cross slopes
- manoeuvres: turning, doorways, tight environments and congested areas
- crossing streets/intersections, curb cuts and curbs
- smooth and rough terrain, tracks and grates
- stairs, elevators and platform lifts, escalators
- reversing

Rights and responsibilities of wheelchair and scooter users Insurance

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

14.5 Injury prevention during transportation checklist (for wheelchair users in vehicles)



Injury prevention during transportation checklist

A range of strategies can help reduce the risks (to an acceptable level) of injury to the wheelchair user. This is not an exhaustive list:

- Reduce the risk of equipment failure:
 - » Prescribe only proven, crashworthy wheelchairs (refer to manufacturer's information).
 - » Use only proven wheelchair tie-down (anchor) restraints and occupant restraint systems (seatbelts), that comply with Australian standards (AS/NZS 10542: 2009) and that are maintained in working order.
- If relevant, provide a means of attachment of the seating system to the wheelchair, which is also suitable for transport.
- Wheelchair components to be considered:
 - » Provide a head rest, which must be no lower than the most prominent point on the back of the head and above the person's ears, close to the back of the head and well padded. The brackets at the of the head rest must not pose a risk to other passengers.¹⁸⁴
 - » Provide a back support^{184, 186} and a head rest.
 - » Wheelchair brakes must be in good working order and able to be locked in transit.
 - » Dimensions of the wheelchair must be accommodated in the proposed modes of transport.
 - » Wheelchair and user height must be compatible with internal height and door height of the proposed vehicle.
 - » The wheel drive position (rear, mid or front wheel drive) can have an impact on safe vehicle entry and egress.
- Use a properly fitted occupant restraint system that is anchored to the vehicle (lap sash seatbelt or lap belt NOT pelvic belt attached to the wheelchair). The sash portion should be across the chest and mid shoulder and the lap portion should be over the pelvis not the abdomen.^{184, 186}
- Position the wheelchair in the vehicle so that the wheelchair and occupant face the front of the vehicle when in motion.
- Consider the local environment and available modes of transport the client will potentially access (public or private), and any alternatives.
- Consider the interface between the wheelchair and the vehicle. This includes:
 - » Wheelchair dimensions
 - » How to enter and exit the vehicle safely (e.g. ramps—rear or side entry, manual or motorised hoist, entry door size).
 - » If transferring to a seat, safe stowage of the wheelchair and battery (for powered wheelchairs) in all forms of anticipated public and private transport options, including aeroplanes.
 - » The wheelchair user should sit as upright as possible, within 30 degrees of the vertical. Tilt in space should not be used in the vehicle while in transit.^{184, 186}
 - » Decide how to manage additional equipment such as trays and augmentative communication devices. Hard trays, communication devices and mounting should be removed for transport and stored securely to avoid the risk of obstruction or a missile in the vehicle.
 - » Chin controls can be an obstruction and should be swung away if possible.
 - » Powered wheelchair controls should be switched off during travel.
- Take into account individual factors such as:
 - » Medical concerns, for example, the need for medical devices such as ventilators to remain in situ and secured during travel, or access to assistance if the wheelchair user has a condition which requires immediate responses (epilepsy or airway difficulties).
 - » Behavioural issues such as the user habitually releasing the seatbelt and safety restraints at an inappropriate time. The preferred option is a behavioural intervention program developed by a psychologist. If further intervention is required, other options include an escort or a seatbelt cover. (http://www.ilcnsn.asn.au/search?search_phrase=seat+belt+buckle+cover)

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

14.6 Maintenance checklist



Maintenance checklist

Planning and information

- i. Obtain information about the:
 - Possibility of a service agreement with the supplier
 - Cost of repairs, routine maintenance and service and who will pay for this
 - Whole of life costs of the wheelchair and associated equipment
 - Known or perceived breakdown rates (gained through team or individual client experience)
 - Impact of the environment on the need for routine maintenance and service requirements e.g. salt air, dusty environment, group home.
- ii. Formulate a care plan which establishes:
 - Recommended periods, frequency and routine for service, routine maintenance and repairs needed (power versus manual)
 - Who will be responsible for arranging and performing the maintenance
 - Time frames for access to repairs (e.g. emergency and regular service turnaround times)
 - Availability of local repairer for service and repairs such as a local bicycle repairer, automotive electricians (for power wheelchairs), NRMA road service for service and repairs
 - Contingency plans for adverse events such as power failure, breakdown in the street.

Practical tasks

Ensure that tools are available and that the client or attendant care worker knows how to use them. Ensure that daily, weekly or fortnightly routine maintenance tasks are completed.

Plan for provision of:

- A backup wheelchair when primary wheelchair is being repaired or serviced
- Written guides (therapist's or manufacturer's) or weblinks on recommended maintenance tasks and frequency
- Annual training for attendant care workers on wheelchair routine maintenance (to accommodate turnover in staff)
- Spare parts (what and how many) to be kept or carried by client e.g. spare tyres (may be one or more sets)
- An emergency repair kit for flat tyres (temporary).

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

14.7 Wheelchair comfort tool

General Information about the Tool for Assessing Wheelchair disComfort (TAWC)

Thank you for your interest in using the Tool for Assessing Wheelchair disComfort (TAWC). Here is a copy of the assessment tool as developed and validated at the University of Pittsburgh to assess wheelchair seating discomfort. Here is some general information about use of this tool and scoring methods. The final two pages indicate the scoring methodology used in my study.

When used in my dissertation research, I generated two discomfort scores – the General Discomfort Assessment (Part II) and the Discomfort Intensity Score (Part III). I asked individuals in my study to rate their levels of discomfort and to answer all questions in the tool based on the previous 4-hour period. I had them complete an assessment every 4 hours throughout the day. In a clinical setting, it might be more useful to have the person answer the questions based on an average day, or based on the previous day, etc. Just be sure the requested time period is short enough so that the person's memory will be valid. I found that discomfort develops particularly after 4 – 6 hours of sitting, so an assessment within the first 4 hours probably will not be a true assessment of long-term seating discomfort.

The GDA score is derived by scoring the boxes with 1 – 7 scores, as indicated in the scoring key at the end of this document, then totaling all scores for the items.

The DIS score is derived by adding "1" to each of the scores in part III, with the exception of the final score if it is left blank, then totaling these scores.

I hope to have several publications out for this tool in the near future, the first of which is in Press in the International Journal of Rehabilitation Research. If you are using this for research purposes and would like to have the references, email me and I will send along whatever I have.

Feel free to email me if you have any other questions or concerns.

Barbara Crane
Barb.crane@cox.net

Download from <http://www.enable.health.nsw.gov.au/publications> or <http://www.lifetimecare.nsw.gov.au/Resources.aspx>

Introduction and directions:

This questionnaire has been developed as a way of determining the level of discomfort you experience while you are sitting in your wheelchair.

There are three parts to this questionnaire:

- Part I asks you to provide general information that is important in evaluating seat discomfort.
- Part II asks you to rate your level of agreement with several statements about comfort and discomfort.
- Part III asks you to assign a number on a scale from 0 to 10 to describe a discomfort level for each region of your body.

Part I: General Information:

1. What time did you first transfer into your wheelchair today? _____ am/pm
2. How much assistance do you need to transfer?
 - _____ I transfer completely by myself
 - _____ I require assistance from another person to help me transfer
 - _____ Another person transfers me, I am unable to help
 - _____ Another person uses a mechanical lifting device to transfer me
3. If someone assisted you in transferring, were you positioned properly in your chair after being transferred?
 - _____ yes _____ no
 - Describe problems if any occurred (anything out of the ordinary): _____
4. What time is it now? _____ am/pm
5. In the last 4 hours, have you asked anyone to help you change your position in your wheelchair?
 - _____ yes _____ no
 - 5a. If yes, how many times have you asked someone to reposition you? _____
6. In the last 4 hours, have you changed your own position?
 - _____ yes _____ no
 - 6a. If yes, how many times have you changed your own position? _____
7. What types of activities have you done in your wheelchair in the last 4 hours?
 - (check all that apply)
 - _____ moved around in the house
 - _____ went outside of the house
 - _____ into the yard (grassy or rough surface)
 - _____ onto a deck or paved driveway
 - _____ traveled on a sidewalk surface
 - _____ traveled somewhere in a van or car
 - _____ went to work in my wheelchair
 - _____ went to school setting in my wheelchair
8. How many car lengths would you say you drove your wheelchair in the last 4 hours? _____
 - (a typical car is 12 feet long)

Tool for Assessing Wheelchair disComfort (TAWC)

Think about how you have felt while seated in your wheelchair:

Part II: General Discomfort Assessment

Please rate your answer on the following scale: (place a mark in the appropriate box)	Strongly disagree	Disagree	Partly disagree	Neither agree nor disagree	Partly agree	Agree	Strongly agree
<i>While seated in my wheelchair...</i>							
...I feel poorly positioned							
...I feel like I have been in one position for too long							
...I feel like I need to move or shift my position							
...I feel aches, stiffness, or soreness							
...I feel pressure in some part or parts of my body							
...I feel too hot or cold or damp							
...I seek distraction to relieve discomfort							
...I feel uncomfortable							
...I feel no pain							
...I feel stable (not slicing or falling)							
...I feel comfortable							
...I feel good							
...I feel able to concentrate on my work or activities							

Part III: Discomfort Intensity Rating

On a scale of 0 to 10, **0 being no discomfort** and **10 being severe discomfort**, please **RATE and DESCRIBE** the amount of discomfort you feel for each body area listed below.

This rating should reflect the intensity of your discomfort for the time you were in your wheelchair:

Body Areas	Rating:	Please describe the discomfort (for example: aching, burning, pressure, instability, or others)
Back		
Neck		
Buttocks		
Legs		
Arms		
Feet		
Hands		
Overall Discomfort Level (General discomfort level)		
Other areas? Please list:		

**Tool for Assessing Wheelchair discomfort
(TAWC) – Scoring Key for GDA Score (total all item scores)**

Part II: General Discomfort Assessment

Please rate your answer on the following scale: (place a mark in the appropriate box)	Strongly disagree	Disagree	Partly disagree	Neither agree nor disagree	Partly agree	Agree	Strongly agree
<i>While seated in my wheelchair...</i>							
...I feel poorly positioned	1	2	3	4	5	6	7
...I feel like I have been in one position for too long	1	2	3	4	5	6	7
...I feel like I need to move or shift my position	1	2	3	4	5	6	7
...I feel aches, stiffness, or soreness	1	2	3	4	5	6	7
...I feel pressure in some part or parts of my body	1	2	3	4	5	6	7
...I feel too hot or cold or damp	1	2	3	4	5	6	7
...I seek distraction to relieve discomfort	1	2	3	4	5	6	7
...I feel uncomfortable	1	2	3	4	5	6	7
...I feel no pain	7	6	5	4	3	2	1
...I feel stable (not sliding or falling)	7	6	5	4	3	2	1
...I feel comfortable	7	6	5	4	3	2	1
...I feel good	7	6	5	4	3	2	1
...I feel able to concentrate on my work or activities	7	6	5	4	3	2	1

Part III: Discomfort Intensity Rating – Scoring Key for DIS score – add indicated figures to each item and then total the items.

Body Areas	Rating:	Please describe the discomfort (for example: aching, burning, pressure, instability, or others)
Back	Add "1" to score indicated	
Neck	Add "1" to score indicated	
Buttocks	Add "1" to score indicated	
Legs	Add "1" to score indicated	
Arms	Add "1" to score indicated	
Feet	Add "1" to score indicated	
Hands	Add "1" to score indicated	
Overall Discomfort Level (General discomfort level)	Add "1" to score indicated	
Other areas? Please list:	Add "1" to score indicated; unless blank, then count "0" for this score	

14.8 Internet-based education and information

Spinal Seating Professional Development Program
<http://www.health.nsw.gov.au/gmct/spinal/education.asp>

Queensland Health Spinal Cord Injuries Service
equipment
http://www.buildinghealth.qld.gov.au/qscis/info_equipment.asp

Spinal Cord Injury Rehabilitation Evidence (SCIRE)
<http://www.scireproject.com/>

15 Appendices

Appendix 1 External reviewers

APA	Australian Physiotherapy Association, NSW Branch	Sydney, NSW
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15. Appendices

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TASC	Technology solutions for computer Access, Seating and Communication Consultative Services Cerebral Palsy Alliance, Sydney, NSW	Sydney, NSW
Transpot	Louise Mather-Mullard Transport Seating Group Family & Community Services Ageing, Disability and Home Care Children, Family and Therapy Community Access	Sydney, NSW
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Appendix 2 Definitions and terms

i. Conditions

Spinal cord injury (SCI)

Spinal cord injury is defined as damage to the neural tissues as a result of trauma or a non-progressive disease process, resulting in temporary or permanent sensory deficit, motor deficit, or bladder/bowel dysfunction. Non-progressive diseases include: transverse myelitis, compression by infective process, canal stenosis, haemorrhage or vascular occlusion. Spinal cord injury does not include progressive conditions such as demyelination, genetic disorders, degenerative conditions of the spinal cord and compression by metastatic lesions.

Traumatic brain injury (TBI)

Traumatic brain injury is an insult to the brain following birth, caused by an external force that produces diminished or altered states of consciousness, which can result in a complex range of temporary or permanent neurological impairments in the cognitive, physical, behavioural and emotional domains.

ii. Client

A client is any person who receives services for the prescription of a seated wheelchair or scooter. For the purposes of the guidelines, the term *client* has been used, although other terms such as *patient*, *user*, *consumer* or *participant* are often used as synonyms.

- A patient or consumer is a person who receives health care services.
- A participant refers to an injured person who is an interim or lifetime participant in the Lifetime Care and Support Scheme.

The use of the term *client* in these guidelines may also refer to an attendant care worker in some contexts.

iii. Care

Attendant care worker

An attendant care worker is a paid attendant who assists people with disabilities (and their family/carer), the frail aged, and those recovering from acute health issues, to perform tasks of daily living and to participate in social, family and other activities in the

person's home or community. Other terms include: paid carer, personal care attendant or assistant (PCA), or support worker.⁹

Carer

A carer is a family member or friend who provides varying levels of unpaid support or care to a frail older person or someone with a disability or chronic condition and who lives in a home/community.⁹

iv. Wheelchair operators

Assistant

The assistant (attendant care worker or carer) is a person other than the occupant who operates the wheelchair.

User or Occupant

The user or occupant is the person supported by the wheelchair seating system.

Part-time user: the wheelchair or scooter is used for a proportion of the time or proportion of mobility needs.

Full-time user: the wheelchair or scooter is used for most or all mobility needs or for a large proportion of the time.^w

Short-term user: the wheelchair or scooter will only be required for an immediate and finite period.

Long-term user: the wheelchair or scooter will be used by the client now and in the future.

The term *user* may have additional time qualifiers: occasional, infrequent, frequent or constant. The term *user* in these guidelines may also refer to a carer or attendant care worker in some contexts.

v. Descriptions of functioning

Ability

Ability is a basic trait; what a person brings to their performance of a new task.²¹²

Activity

Activity is the execution of a task or action by an individual.²¹²

Capacity

Capacity describes an individual's ability to execute a task or an action the highest probable level of functioning that a person may reach in a given

domain at a given moment. To assess the full ability of the individual one needs a 'standardised' environment to neutralise the varying impact of different environments on the ability of the individual. This standardised environment may be (a) an actual environment commonly used for capacity assessment in tests settings or (b) in cases where this is not possible an assumed environment which can be thought to have a uniform impact.²¹³

Participation

Involvement of an individual in a life situation.²¹²

Performance

Performance describes what an individual does in his or her current environment.

The gap between capacity and performance reflects the difference between the impacts of current and uniform environments, and thus provides a useful guide as to what can be done to the environment of the individual to improve performance.²¹³

Skill

Skill is the level of proficiency with which someone performs a task.

vi. Periods of progress in health

Clients may move between periods as they improve or deteriorate. Clients may also be in or across several periods at any one point in time.

Medically stable period

Being medically stable means reaching a point in medical treatment where life-threatening injuries and disease have been brought under control for a sustained period.

Recovery period

The recovery period is the phase of health care intervention where there is a comprehensive program with combined and coordinated use of medical, social, educational and vocational measures to overcome or attempt to overcome deficits following injury or illness. The program aims to help the individual to attain their optimal level of physical, cognitive, psychological and social functioning. Intervention in this period may be intensive or aimed at consolidating function.

vii. Activities, participation and contextual factors

Activities of Daily Living

Activities of daily living are routine tasks essential for living that people perform every day. The core areas of activity include eating, grooming, sleeping, bathing, dressing, toileting, continence, managing medication and transfers.

Instrumental Activities of Daily Living

Instrumental activities of daily living are tasks that are not necessary for basic day-to-day functioning, but enable the person to live independently within a community. The core areas of activity include using the telephone, shopping, food preparation, housekeeping (light and heavy), laundry, transportation, money management, using computers and information technology.

Context

Context refers to the client's overall surroundings, circumstances, environment, background and settings, which can all influence function.²¹²

Environmental factors²¹²

Environment makes up the physical, social and attitudinal environment in which people live and conduct their lives. Environmental factors include:²¹²

- setting (individual home, group home, employment, school, community)
- social attitudes
- architectural characteristics
- legal and social structures
- climate
- terrain.

Personal factors

Personal factors include:

- gender and age
- coping style
- social background and cultural context (which can influence use of time, sense of personal space, values, roles and social support)
- education and profession,
- past and current experience
- overall behaviour pattern
- character
- other factors that influence how disability is experienced by the individual.

Assistive technology (AT) or assistive device

Assistive technology is any item, piece of equipment, or product system—whether acquired commercially off-the-shelf, modified, customised, or custom made—that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities.¹⁹⁰

Assistive technology (AT) support

AT support includes needs assessment, set-up, trial, training and follow-up for optimal outcomes. It refers to the human areas of decision making, strategy, training and concept formation.

Occupational Health (and Safety)

Occupational health and safety refers to promoting and maintaining protection of the safety, health and welfare of people engaged in work or employment.

viii. Seated wheelchair

A seated wheelchair is a wheeled system or piece of equipment which seats a client with impaired mobility. The system can be manual, powered or a combination of both.

Wheelchair

A wheelchair is a device to provide wheeled mobility with a seating support system for a person with difficulty walking.²¹¹

Manual wheelchair

A manual wheelchair is a wheelchair which is propelled by the user or pushed by another person.²¹¹

Powered wheelchair

A powered wheelchair is a wheelchair in which the motor power is derived from an integral source of electric power. This includes front wheel drive, mid and rear wheel drive.¹⁶¹

Scooter

A scooter is an electrically powered wheelchair with a manual tiller to control the steering.

Attendant propelled/controlled wheelchair

An attendant propelled or controlled wheelchair is a wheelchair which is operated by someone other than the occupant.

Power-assisted wheelchair

A power-assisted wheelchair is a manual wheelchair with a motorised boost.

ix. Wheelchair features**Set up**

Set up is the configuration and adjustment of the wheelchair to best suit the needs of the user and their interaction with their environment. Examples include seating angles, seat height, wheel position, the control settings on a power wheelchair, tilt angle and ease of brake use.

Tilt systems (tilt in space)

Tilt systems change seat angle orientation in relation to the ground while maintaining the seat to back and seat to leg rest angles. Tilt operates in the sagittal plane.^{59, 161}

Recline systems

Recline systems provide a change in seat to back angle orientation while maintaining a constant seat angle with respect to the ground.^{59, 161}

Elevating leg rests

Elevating leg rests allow individuals to change the angle of orientation of the legs and/or footrests relative to the seat, extending the knee. Some leg rests are articulating, which means they lengthen while also extending the knee.⁵⁹

Seat elevation

A seat elevator will raise and lower the user in their seated position through the use of a powered system, without changing the seated angles or the seat's angle relative to the ground in order to provide varying amounts of added vertical access. A seat elevator may elevate from a standard seat height, or may lower the user closer to the floor.⁸

Drive systems

Control device: the means by which the occupant directs an electrically powered wheelchair to move at the desired speed and in the desired direction. The control device can be adapted to perform additional functions related to the wheelchair or external devices (e.g. control of environment).

Controller: the device which converts input signals from the occupant into output signals which activate powered components of the wheelchair.

Postural supports

Seating systems: the seat and back support surfaces and their associated hardware, plus those accessories deemed necessary.

Other wheelchair features¹⁶¹

Push handle (push cane): a component designed to be grasped by the hand of an assistant to propel or tip the wheelchair (the user may also use the push handle).

Hand rim (push rim): the outer, circular component of the manoeuvring wheel intended for propelling a manual wheelchair with an upper limb.

Anti-tip device (anti-tipper, anti- tipping lever): a device which limits the extent of tipping of a wheelchair and may operate in the forward, rearward or lateral directions of instability.

Swing-away: intended to be moved into and out of position without the use of tools while remaining attached to the wheelchair.

Removable (detachable): capable of being detached without the use of tools.

Appendix 3 Abbreviations

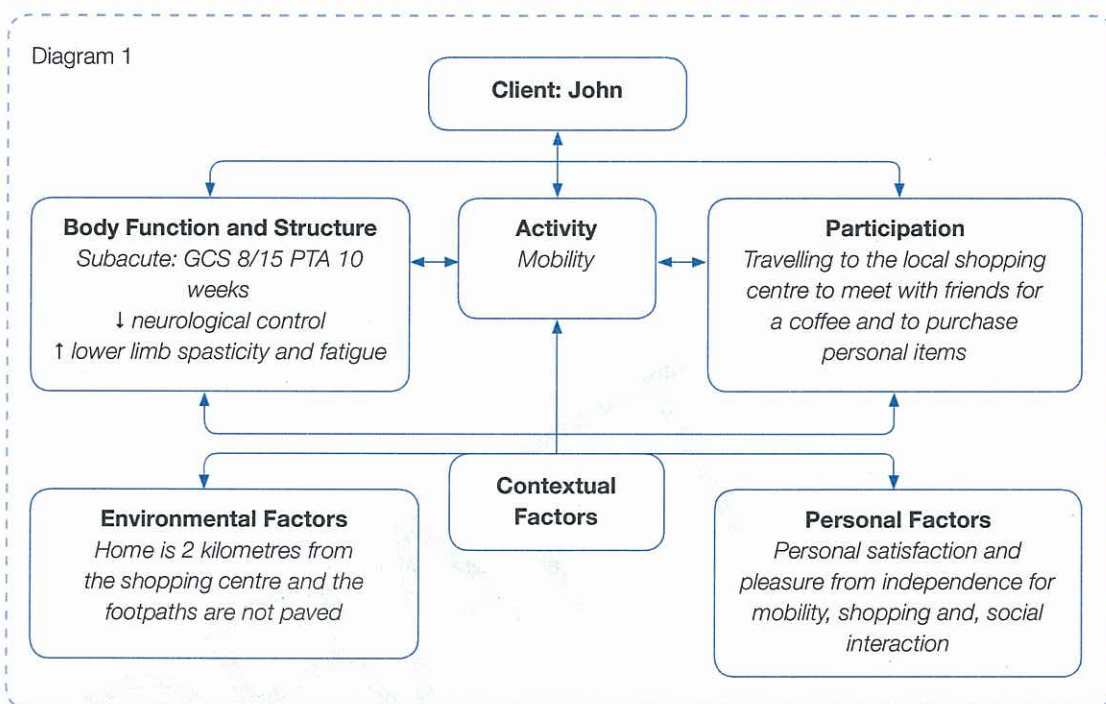
ACI	Agency for Clinical Innovation
CHART	Craig Handicap Assessment and Reporting Technique
CIM	Community Integration Measure
COPM	Canadian Occupational Performance Measure
CRPD	Convention on the Rights of Persons with Disabilities
FEW-Q	Functional Evaluation in a Wheelchair Questionnaire
FFT	Four Functional Tasks
FIM	Functional Independence Measure
GAS	Goal Attainment Scale
ICF	International Classification of Functioning
ILC	Independent Living Centre
IPA	Impact on Participation and Autonomy
IPPA	Individually Prioritised Problem Assessment
LTCSA	Lifetime Care and Support Authority
MRI	Magnetic resonance imaging
MSD	Musculoskeletal Disorder
NHMRC	National Health and Medical Research Council
NRMA	National Roads and Motorists' Association
PAPAW	Pushrim Activated Power Assist Wheelchair
PCDA	Power-mobility Community Driving Assessment
PEDro	Physiotherapy Evidence Database
PIDA	Power-mobility Indoor Driving Assessment
PVA	Paralyzed Veterans of America
QUEST	Quebec User Evaluation of Satisfaction with Assistive Technology
RESNA	Rehabilitation Engineering and Assistive Technology Society of North America
RTA	Roads and Traffic Authority
SCED	Single Case Experimental Design
SCI	Spinal cord injury
SCIRE	Spinal Cord Injury Rehabilitation Evidence
TAWC	Tool for Assessing Wheelchair Discomfort
TBI	Traumatic brain injury
WHO	World Health Organization
WhOM	Wheelchair Outcome Measure
WHOQOL	WHO Quality of Life
WST	Wheelchair Skills Test
WUFA	Wheelchair Users Functional Assessment
WUSPI	Wheelchair Users Shoulder Pain Index

Appendix 4 ICF framework

The ICF provides an international standard language and framework to describe health conditions and health related domains. These domains comprise body function and structure, activity and participation and take into account the contextual factors of the environment and the person. The ICF provides a broad scope for communicating information about spinal cord injury or traumatic brain injury because it is inclusive of an individual's activities, participation and environment after injury.

Diagram 1 illustrates the ICF framework, showing the three levels of human functioning: functioning at the level of body or body part, the whole person (activity) and the whole person in a social context (participation).²¹³

The diagram uses the example of a client (*John*) and his activity limitations and participation restrictions. John lives in a regional town where he went to school and worked prior to his traumatic brain injury. His brain injury has affected his mobility.



Explanation of Terminology

Body functions are physiological functions of body systems (including psychological functions).

Body structures are anatomical parts of the body, such as organs, limbs and their components.

Impairments are problems in body function or structure, significant deviation from or loss of normal capacity.

Activity is the execution of a task or action by an individual.

Participation is involvement in a life situation.

Activity limitations are difficulties an individual may have in executing activities.

Participation restrictions are problems an individual may experience during involvement in life situations.

Environmental factors make up the physical, social and attitudinal environment in which people live and conduct their lives.

Appendix 5 Convention on the rights of people with disabilities (CRPD)

These guidelines are informed by the United Nations Convention on the Rights of Persons with Disabilities.¹⁸⁹ Of particular relevance is the Convention's recognition that:

- Disability results from the interaction between persons with impairments, and contextual factors, including attitudinal and environmental barriers.
- These factors can hinder the person's full and effective participation, enjoyment in and contribution to society on an equal basis with others.

The articles of the Convention that are specifically relevant to these guidelines are (*excerpts only*):

Article 3 General principles

- respect for inherent dignity and individual autonomy, including the freedom to make one's own choices and independence of persons
- non-discrimination
- full and effective participation and inclusion in society
- respect for difference and acceptance of persons with disabilities as part of human diversity and humanity
- equality of opportunity
- accessibility.

Article 9 Accessibility

To enable persons with disabilities to live independently and participate fully in all aspects of life, and take appropriate measures to access to the physical environment, transportation, information and communications.

Article 19 Living independently and being included in the community

Facilitate full enjoyment by persons with disabilities and their full inclusion and participation in the community.

Article 20 Personal mobility

Facilitating the personal mobility and access by persons with disabilities to quality mobility aids, devices, assistive technologies and forms of live assistance and intermediaries, including by making them available at affordable cost. Also included is the provision of training in mobility skills

Article 26 Habilitation and rehabilitation

Strengthen and extend rehabilitation services and programmes, continuing training for professionals and staff working in rehabilitation services, and promote the availability of knowledge and use of assistive devices and technologies designed for persons with disabilities as they relate to rehabilitation.

References

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Guidelines

for the prescription of a seated wheelchair or mobility scooter for people with a traumatic brain injury or spinal cord injury

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