



Learning and Lifelong Mobility Inclusivity for All

Wheelchair Skills Training

The Digital Book
Version 2.0

2024-1-TR01-KA220-HED-000250390

Wheelchair Skills Empowerment through Learning and Lifelong Mobility Inclusivity for All

This educational e-book is intended for educators, students, researchers, and practitioners in the fields of physiotherapy, rehabilitation, adapted physical activity, and inclusive sport, as well as for anyone interested in understanding how adaptive technology can support wheelchair users in everyday life and active participation.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.



Greetings from the WELLDONE Team

We are delighted to present the WELLDONE Wheelchair Skills Training Digital Book, developed through the WELLDONE project: Wheelchair Skills Empowerment through Learning and Lifelong Mobility Inclusivity for All.

This book was created to support wheelchair users, physiotherapists, occupational therapists, wheelchair-service personnel, sport and adapted physical activity professionals, peer trainers, students, educators, caregivers, and other stakeholders who contribute to safe and inclusive wheelchair mobility.

Wheelchair mobility is more than moving from one place to another. It is closely connected to independence, confidence, health, participation, access to education and employment, and engagement in family, community, cultural, and sporting life. For this reason, wheelchair skills training should be individualised, progressive, safe, and meaningful to the person who uses the wheelchair.

The WELLDONE partnership brings together knowledge and experience from Türkiye, Poland, Finland, and Lithuania. The material combines theoretical information, practical teaching principles, structured wheelchair skills, assessment approaches, environmental accessibility, social participation, and emerging rehabilitation technologies.

OUR SHARED PURPOSE To help wheelchair users develop safe, effective and confident mobility while supporting lifelong participation and inclusion.

We hope this book becomes a practical and accessible resource that can be used in rehabilitation, education, community programmes, sport, peer training, and everyday life.

With best wishes,

The WELLDONE Project Team



PROJECT TEAM

TOGETHER FOR INCLUSIVE MOBILITY



Wheelchair Skills Empowerment

through Learning and Lifelong Mobility Inclusivity for All

**COLLABORATION • INCLUSION • EMPOWERMENT**

Building confidence, independence and participation through wheelchair skills.

2024-1-TR01-KA220-HED-000250390

welldone-eu.org

The translations were prepared with the support of AI-based translation tools and subsequently reviewed and revised by the project partners in their respective languages.

Welcome to the WELLDONE Wheelchair Skills Training Book

How to Use This Book?

This book is designed as a flexible learning and practice resource. It does not need to be read from beginning to end, and it should not be used as a rigid, one-size-fits-all training programme. Readers may enter the book at different points according to their role, experience, needs, and goals.

The theoretical chapters explain wheelchair users, wheelchair characteristics, propulsion, accessibility, participation, training, assessment, and technology. The practical chapters translate these principles into structured wheelchair skills with learning objectives, safety considerations, teaching methods, verbal cues, assessment criteria, common problems, and progression strategies.

IMPORTANT The user, wheelchair, task and environment should always be considered together. Training decisions should be based on individual capacity, safety, personal goals and real-life mobility needs.

Choose Your Route Through the Book

FOR USERS	FOR TRAINERS	FOR EDUCATORS
Choose the skills that match your goals and practise progressively.	Use the teaching, safety and assessment guidance to structure training.	Combine the theoretical chapters with practical demonstrations and reflection.

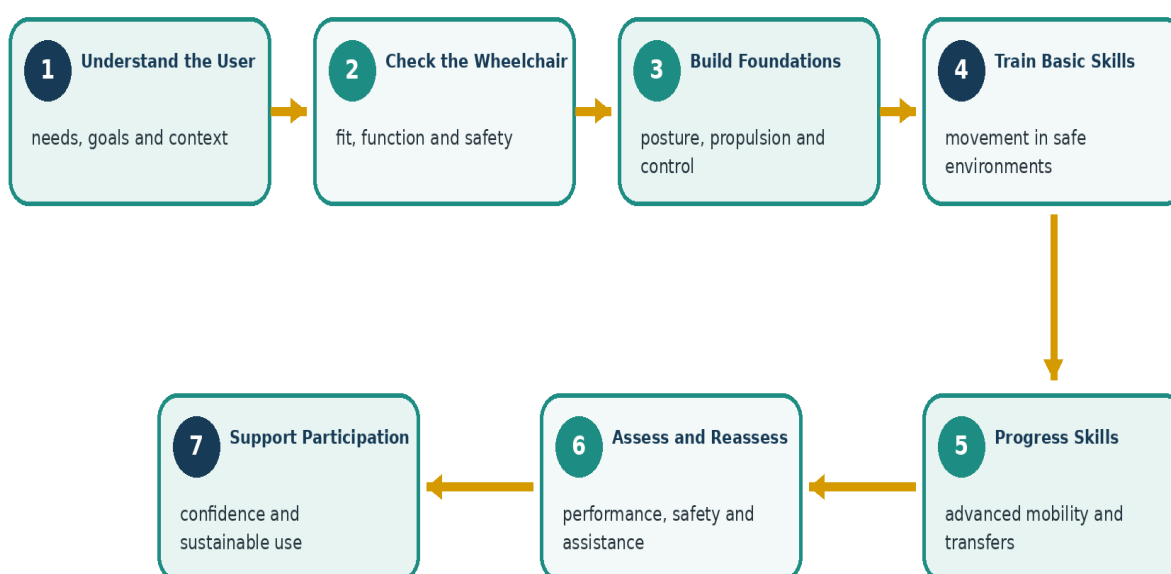
Use the Book Flexibly

- Focus on one theoretical chapter or one practical skill that is relevant now.
- Combine reading with demonstration, supervised practice and reflection.
- Begin with safe and achievable conditions, then increase complexity gradually.
- Use assessment findings to identify priorities and monitor progress.
- Return to earlier skills whenever the wheelchair, environment or user's needs change.

The WELLDONE Learning Roadmap

The roadmap shows how the main elements of WELLDONE connect. Learning can begin at different points, but safe practice usually develops through an ongoing cycle of understanding, preparation, training, assessment, and participation.

THE WELLDONE LEARNING ROADMAP



A CONTINUOUS CYCLE Assessment does not mark the end of training. Results should guide the next training priorities, and skills should be revisited when the user's goals, health, wheelchair or environment changes.

The Roadmap in Practice

Readers can move backwards and forwards within this pathway. A wheelchair user may return to wheelchair adjustment before progressing to advanced skills, while a trainer may reassess basic skills after a change in health, equipment, confidence, or environment.

What WELLDONE Aims to Support?

WELLDONE aims to strengthen the knowledge, skills and conditions that enable safe, confident and sustainable wheelchair mobility. The project supports:

- safe and increasingly independent wheelchair mobility;
- effective propulsion and protection of the upper limbs;
- appropriate wheelchair selection, fit, adjustment and maintenance;
- confidence in daily mobility, transfers and environmental negotiation;
- structured training and meaningful assessment;
- participation in education, employment, community life, culture and sport;
- inclusive environments and greater awareness of accessibility; and
- lifelong learning through practical, digital and technology-supported resources.

How to Get Started?

You do not need to use everything at once. Start with the user's immediate priorities and choose a realistic first step:

- Check the user's health status, goals, experience and confidence.
- Inspect the wheelchair and confirm that it is safe and appropriately adjusted.
- Select one or two relevant skills at an achievable level.
- Practise in a controlled environment with appropriate supervision.
- Record performance, safety and the level of assistance required.
- Reassess progress and transfer the skill gradually to real-life environments.

Explore the WELLDONE Digital Resources

The WELLDONE digital resources complement this book with project information, practical materials, visual guidance and updates. Use them alongside supervised teaching and individual clinical or professional judgement.

CHECK IT OUT HERE

Scan the QR code to access the WELLDONE website and digital project resources.

Use the online materials to support learning, demonstrations, training sessions and dissemination activities.

[Active Wheelchair Skills Instagram Page](#)

WELLDONE DIGITAL RESOURCES

Scan the QR codes to access our online resources.



WELLDONE Web Sites
weldonet.org



WELLDONE Instagram
www.instagram.com/welldone.org

Before You Begin Training

SAFETY REMINDER Wheelchair skills should be practised only when the user, wheelchair, environment and available supervision allow safe participation. Stop or adapt the activity if pain, excessive fatigue, fear, loss of control, equipment problems or unsafe environmental conditions arise.

One Small Step Is Enough to Begin

Choose one relevant section, identify one meaningful mobility goal, and begin with a safe and achievable activity. Progress grows through repeated practice, reflection and adaptation—not through completing every part of the book at once.

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The WELLDONE project information

Erasmus+ Programme

2024-1-TR01-KA220-HED-000250390 (2024-2026)

The project title: Wheelchair Skills Empowerment through Learning and Lifelong Mobility Inclusivity for All

The project acronym: Welldone

The project Leader:

Yalova University, Yalova, Türkiye

The project Partners:

Jozef Pilsudski University of Physical Education in Warsaw, Poland

Satakunta University of Applied Sciences in Pori, Finland

Lithuanian Sports University in Kaunas, Lithuania

Technical University of Gebze, Gebze, Türkiye

Manifesto for the WELLDONE project: Empowering Wheelchair Mobility

We believe...

In the transformative power of knowledge: that sharing information about wheelchair mobility skills can enhance independence, confidence, and quality of life for individuals with disabilities.

In the power of dissemination: that documenting and spreading expertise on wheelchair mobility across the EU and beyond accelerates progress and supports both professionals and individuals alike.

In the importance of accessibility: that clear, digital, and widely available resources empower disabled individuals and specialists working in this area to thrive.

In the value of preservation: preserving local knowledge ensures it remains a resource for future generations at the national, international, and global levels.

In the strength of collaboration: physiotherapists, students, and young experts working together can make a tangible difference in the lives of people who rely on wheelchair mobility.

In the power of interdisciplinary impact: wheelchair mobility skills are not only valuable for users but also serve as a resource for academics, researchers, and students, contributing to advancements in education and research.

Therefore, we commit to...

- Documenting and sharing expertise: through the WheelMob App and a comprehensive digital book, reaching audiences across the EU and worldwide.
- Creating accessible and impactful resources: ensuring information on wheelchair mobility is easy to access, practical to use, and widely disseminated.
- Empowering professionals and individuals: by providing tools and resources that enhance their knowledge, skills, and quality of life.
- Promoting inclusion and collaboration: by fostering networks between physiotherapists, students, and experts, and recognizing their unique contributions.
- Preserving knowledge for future generations: ensuring that local practices and innovations in wheelchair mobility are not lost but become part of a global knowledge base.

-
- Offering opportunities for academic growth: ensuring that university staff and students can benefit from the technology and methods developed, fostering research and innovation in wheelchair mobility.
 - Celebrating progress and achievements: recognizing the value of wheelchair mobility skills and their impact on improving lives.
 - Continuously striving to grow and innovate, remaining committed to feedback, reflection, and improvement in all aspects of our mission.

Glossary

Abbreviation	Definition
FEW	Functioning Everyday with a Wheelchair: a self-report measure of perceived everyday function related to wheelchair or scooter use.
PIDA / PCDA	Power-Mobility Indoor Driving Assessment / Power-Mobility Community Driving Assessment: performance-based assessments of powered mobility indoors and in the community.
SCI	Spinal cord injury: damage to the spinal cord that may affect motor, sensory, and autonomic function.
TOWM	Test of Wheeled Mobility: a performance-based assessment of ability, movement quality, completion time, and anxiety during wheeled mobility tasks.
VFM	Valutazione Funzionale Mielolesi: a functional assessment scale developed for individuals with spinal cord injury.
VR / AR	Virtual reality / augmented reality: simulation technologies used to support safe, interactive wheelchair-skills training.
WC	Wheelchair: a wheeled mobility device that supports movement and seated mobility.
WhOM	Wheelchair Outcome Measure: a client-centred measure of participation goals, their importance, and satisfaction with performance.
WST	Wheelchair Skills Test: an objective test of wheelchair skill capacity and safety.
WST-Q	Wheelchair Skills Test Questionnaire: a self-report version assessing perceived capacity and performance.

Abstracts

English abstract

The aim of the Erasmus+ project (2024-1-TR01-KA220-HED-000250390) was to prepare an e-book for teachers and students who wish to work with persons with disabilities, including wheelchair users. The project is titled *Wheelchair Skills Empowerment through Learning and Lifelong Mobility Inclusivity for All*, and its acronym is WELLDONE. The project is coordinated by Yalova University, Türkiye.

This book has been prepared for wheelchair users, physiotherapists, rehabilitation nurses and physicians, occupational therapists, sports instructors and coaches, clinical movement specialists, kinesiologists, assistive technology specialists, university educators, and students. It provides up-to-date information on wheelchair users, wheelchair types, and wheelchair configuration. It also presents wheelchair skills assessment methods described in the literature and supports the development of individualized training programs for wheelchair users. This book can serve as a foundation for developing educational programs that prepare physiotherapy and occupational therapy students to work with wheelchair users, assess and adapt wheelchair configurations, teach wheelchair skills, and evaluate skill performance.

We believe that the international collaboration among project partners from Türkiye, Poland, Finland, and Lithuania, together with the expertise gathered from these countries and evidence obtained from the literature review, has resulted in a comprehensive and valuable resource for developing wheelchair-related education in European universities.

Turkish abstract

Erasmus+ programı kapsamındaki 2024-1-TR01-KA220-HED-000250390 numaralı projenin amaçlarından biri, engelli bireyler ve tekerlekli sandalye kullanıcılarıyla çalışmak isteyen öğretim elemanları ve öğrenciler için yararlı bir e-kitap hazırlamaktır. Projenin adı "Öğrenme ve Yaşam Boyu Hareketlilik Kapsayıcılığı ile Tekerlekli Sandalye Becerilerinin Güçlendirilmesi" ve projenin kısaltması "Welldone"dur. Projenin lideri Yalova Üniversitesi'dir (TUR).

Tekerlekli Sandalye Becerileri Eğitimi başlıklı bu kitap, tekerlekli sandalye kullanıcıları ve fizyoterapistler, ergoterapistler, spor eğitmenleri ve koçları, klinik hareket uzmanları, kinezyologlar, adaptif teknoloji uzmanları vb. gibi diğer paydaşların yanı sıra üniversitelerdeki öğretim elemanları ve öğrenciler için hazırlanmıştır. Tekerlekli sandalye kullanıcıları, tekerlekli sandalye türleri ve tekerlekli sandalye kullanıcıları için ortamlar hakkında en yeni bilgileri içermektedir. Ayrıca, okuyucu, tekerlekli sandalye becerilerini test etme yöntemleri için literatürdeki birçok öneriyi öğrenebilir ve hastalar için kendi tekerlekli sandalye becerileri programlarını oluşturabilir. Bu kitap, fizyoterapi ve ergoterapi öğrencileri için tekerlekli sandalye kullanıcılarıyla çalışmaya, tekerlekli sandalye ayarlarının değerlendirilmesine ve uyarlanmasına, tekerlekli sandalye becerileri öğretimine ve tekerlekli sandalye becerileri değerlendirmesine hazırlık niteliğinde bir öğrenme programı oluşturmak için bir temel oluşturabilir.

Türkiye, Polonya, Finlandiya ve Litvanya'daki proje ortaklarımız arasındaki uluslararası iş birliğimizin, bu dört ülkeden seçilen bilgilerin ve bu e-kitabı oluşturmak için hazırlanan literatür taramasından elde edilen verilerin, Avrupa'daki üniversitelerde fizyoterapi ve ergoterapi bölümü öğrencileri için programlar oluşturmak ve geliştirmek için kapsamlı ve değerli bir belge olacağına inanıyoruz.

Polish abstract

Jednym z celów projektu w ramach programu Erasmus+: 2024-1-TR01-KA220-HED-000250390 było przygotowanie e-booka, który będzie przydatny dla nauczycieli i studentów, którzy chcieliby pracować z osobami z niepełnosprawnościami i poruszającymi się na wózkach inwalidzkich. Tytuł projektu to: „Wzmocnienie umiejętności poruszania się na wózkach inwalidzkich poprzez uczenie się i integrację mobilności przez całe życie dla wszystkich”, a jego akronim to: „WELLDONE”. Liderem projektu jest Uniwersytet Yalova (TUR).

Książka zatytułowana została przygotowana dla użytkowników wózków inwalidzkich i innych interesariuszy, takich jak fizjoterapeuci, pielęgniarki i lekarze rehabilitanci, terapeuci zajęciowi, instruktorzy i trenerzy sportowi, specjaliści ruchu klinicznego, kinezyolodzy, eksperci technologii adaptacyjnych itp., a także dla nauczycieli akademickich i studentów. Zawiera najnowsze informacje na temat użytkowników wózków inwalidzkich, ich rodzajów i warunków korzystania z nich. Ponadto, Czytelnik może zapoznać się z wieloma sugestiami zawartymi w literaturze naukowej dotyczącymi metod testowania umiejętności poruszania się na wózkach inwalidzkich i tworzyć własne programy rozwoju umiejętności poruszania się na wózkach inwalidzkich dla pacjentów. Niniejsza książka może stanowić podstawę do stworzenia programu nauczania dla studentów fizjoterapii lub terapii zajęciowej, który będzie przygotowywał studentów do pracy z osobami poruszającymi się na wózkach inwalidzkich, oceny i adaptacji ustawień wózków inwalidzkich, nauczania umiejętności poruszania się na wózkach inwalidzkich oraz oceny tych umiejętności.

Jesteśmy przekonani, że nasza międzynarodowa współpraca z partnerami projektów z Turcji, Polski, Finlandii i Litwy, wybrana wiedza z tych czterech krajów oraz dane z przeglądu literatury, który został przygotowany w celu stworzenia niniejszego e-booka, będą kompleksowym i cennym dokumentem, który pomoże w uruchomieniu i rozwoju programów studiów fizjoterapii na uniwersytetach europejskich.

Finnish abstract

Erasmus+ -ohjelman hankkeen 2024-1-TR01-KA220-HED-000250390 yhtenä tavoitteena oli laatia e-kirja pyörätuolin käsittelytaitojen ohjaamisen ja oppimisen tueksi. Hankkeen virallinen nimi oli *Wheelchair Skills Empowerment through Learning and Lifelong Mobility Inclusivity for All* (WELLDONE), ja sen koordinaattorina toimi Yalovan yliopisto (Turkki).

Tämä e-kirja on suunnattu pyörätuolia käyttäville henkilöille sekä heidän kanssaan työskenteleville, alaa opettaville ja opiskeleville ammattilaisille. Kirja sisältää ajantasaista tietoa pyörätuoleista, pyörätuolin käyttäjistä ja keskeisimmistä pyörätuolin käsittelytaidoista. Lisäksi siinä esitellään kirjallisuudessa suositeltuja pyörätuolin käsittelytaitojen arviointimenetelmiä, joita voidaan hyödyntää pyörätuolin käsittelytaitojen harjoitusohjelmien suunnittelussa. Kirja voi toimia perustana hyvinvointi- ja terveysalan opiskelijoille suunnattujen opintokokonaisuuksien kehittämisessä. Tavoitteena on valmentaa opiskelijoita työskentelemään pyörätuolin käyttäjien kanssa, arvioimaan ja mukauttamaan pyörätuolien säätöjä sekä ohjaamaan pyörätuolin käsittelytaitojen harjoittelua.

Uskomme, että hankekumppaneiden välinen kansainvälinen yhteistyö Turkin, Puolan, Suomen ja Liettuan välillä, näistä maista koottu asiantuntemus sekä e-kirjan laatimista varten tehty kirjallisuuskatsaus muodostavat kattavan ja arvokkaan kokonaisuuden. Se tarjoaa vahvan perustan fysioterapian opiskelijoiden koulutusohjelmien kehittämiseksi eurooppalaisissa yliopistoissa.

Lithuanian abstract

Vienas iš „Erasmus+“ programos projekto Nr. 2024-1-TR01-KA220-HED-000250390 tikslų buvo parengti el. knygą, kuri bus naudinga mokytojams ir mokiniams, norintiems dirbti su neįgaliaisiais ir neįgaliųjų vežimėlių naudotojais. Projekto pavadinimas yra „Neįgaliųjų vežimėlių įgūdžių įgalinimas per mokymąsi ir visą gyvenimą trunkantį mobilumą visiems“, projekto santrumpa – „WELLDONE“. Projekto vadovas yra Jalovos universitetas (TUR).

Ši knyga, pavadinta skirta neįgaliųjų vežimėlių naudotojams ir kitoms suinteresuotosioms šalims, tokioms kaip kineziterapeutai, reabilitacijos slaugytojai ir gydytojai, ergoterapeutai, sporto instruktoriai ir treneriai, klinikinių judesių specialistai, kineziologai, adaptyviųjų technologijų ekspertai ir kt., taip pat universitetų dėstytojams ir studentams. Joje pateikiama naujausia informacija apie neįgaliųjų vežimėlių naudotojus, jų tipus ir jiems pritaikytas sąlygas. Be to, skaitytojas gali susipažinti su daugybe literatūroje pateiktų pasiūlymų, kaip testuoti neįgaliųjų vežimėlių įgūdžius, ir sukurti savo neįgaliųjų vežimėlių įgūdžių programas pacientams. Ši knyga gali būti pagrindas kuriant kineziterapijos ar ergoterapijos studentų mokymosi programą, kuri parengtų studentus darbui su neįgaliųjų vežimėlių naudotojais, neįgaliųjų vežimėlių aplinkos vertinimui ir pritaikymui, neįgaliųjų vežimėlių naudojimo įgūdžių mokymui ir vertinimui.

Tikime, kad mūsų tarptautinis bendradarbiavimas tarp projektų partnerių iš Turkijos, Lenkijos, Suomijos ir Lietuvos, atrinktos žinios iš šių keturių šalių ir duomenys iš literatūros apžvalgos, kuri buvo parengta kuriant šią el. knygą, bus išsamus ir vertingas dokumentas, padėsiantis pradėti ir plėtoti kineziterapijos studentų programas Europos universitetuose.

1. INTRODUCTION

The physical, social, and environmental challenges faced by wheelchair users in daily life are among the main issues that directly affect an individual's quality of life. For these individuals to lead an independent life, it is not only a matter of physical accessibility, but also the establishment of a psychologically and socially empowering structure (1, 2).

Rehabilitation is a systematic and multidimensional intervention process aimed at enabling individuals with disabilities to achieve maximum functional independence. However, rehabilitation centers in Türkiye have been reported to allocate limited time to training in wheelchair use, assistive devices, and orthotic equipment (3, 4). This situation makes it more difficult for individuals to become active and productive members of society in their daily lives (3, 4).

Independent and sustainable wheelchair mobility depends not only on the mechanical functionality of the wheelchair but also on the individual's ability to use it correctly, effectively, and safely. Therefore, standardized wheelchair skills training is essential. Through systematic skills training, individuals can overcome barriers encountered in daily life, make independent decisions, and interact more effectively with their environment (2–4).

Sport, especially disciplines such as wheelchair basketball, enhances physical capacity while also improving self-confidence and supporting social integration. Research has shown that participation in wheelchair sports can improve wheelchair mobility skills. Therefore, this book has been prepared as a practical and evidence-based resource for individuals seeking independent mobility in daily life and for professionals involved in wheelchair skills training (5–7).

In Poland, wheelchair assessment and configuration are important components of the rehabilitation process for individuals who are unable to walk independently. Physiotherapists work both with individuals who have congenital physical impairments and may require wheelchairs from early childhood and with individuals who acquire mobility impairments later in life. Physiotherapists are often among the first healthcare professionals to introduce a wheelchair as an assistive device. Nonetheless, physiotherapists are these medical staff who first introduce wheelchairs as an adaptive device to their patients, clients, etc. Therefore, physiotherapy curricula should include theoretical and practical education on wheelchair assessment, configuration, and use. In Poland, physiotherapy education is based on national standards that apply to all institutions offering physiotherapy programs. Universities and other higher education institutions are required to ensure that at least 80% of their physiotherapy curricula comply with these national standards. The remaining part of the curriculum may be adapted according to the institution's profile. For example, medical universities may offer

different courses from universities of physical education. Physiotherapy programs in Poland are periodically evaluated by an authorized commission to determine whether they meet the required educational standards.

As noted above, physiotherapy curricula may vary among institutions within the limits of national educational standards. At the Józef Piłsudski University of Physical Education in Warsaw, academic staff continually update the physiotherapy curriculum to address current professional needs. Several courses provide theoretical and practical education on the needs of individuals with visual, intellectual, hearing, and physical impairments. Courses such as “Adapted Physical Activity” and “Team Games for People with Disabilities” introduce wheelchair use and disability sport as components of lifelong rehabilitation. These courses provide basic theoretical information on wheelchair configuration and practical exercises involving wheelchair propulsion and assistance techniques. Although this content is valuable, wheelchair-related education within the curriculum could be expanded.

The development of the Active Rehabilitation Foundation in Poland provides an important example of how identified needs can lead to organized support for wheelchair users and promote independent living. During the 1980s, representatives of Fundacja Aktywnej Rehabilitacji (FAR; Active Rehabilitation Foundation) received training in Sweden from Rekryteringsgruppen för Aktiv Rehabilitering (<https://far.org.pl/o-fundacji/nasza-historia/>) about wheelchair active pushing, wheelchair settings, etc (6). Since 1988, FAR has organized courses and rehabilitation camps for different groups of wheelchair users, including children, adults, women, men, and athletes. The foundation collaborates with physiotherapists, occupational therapists, physicians, and other professionals to promote independence and active participation in personal and working life.

Another example from Poland is GTM Mobil, a company established to produce more affordable active wheelchairs. The first GTM wheelchair was developed in 2004 (<https://www.gtmobil.com.pl/o-firmie/>). The architects of this success were designer and aviation enthusiast Tomasz Walisiewicz (a multiple medalist at the Paralympic Games, World Championships, and European Championships, and a two-time World Cup winner in wheelchair fencing), and Marek Fudalewski (a constructor). Tomasz's life motto is "a man does not live for himself alone," so his dream was to create an active wheelchair affordable for Poland (5,6). Tomasz's experience and Marek's design expertise resulted in the creation of a completely new wheelchair, which became an alternative to expensive imported equipment. Just one year after the first unit was produced, the GTM HAMMER wheelchair won the REHABILITACJA 2005 award at the Łódź Fair (4,5,6).

This e-book brings together practical knowledge that has often been transferred through training but has not previously been compiled in a single resource. Although Professor Tasiemski has published important Polish-language works in this field, an updated and internationally accessible resource is needed for students and other stakeholders.

2. Who is a WHEELCHAIR USER in the 21st century?

A wheelchair user is an individual who uses a wheelchair to support mobility because of a temporary or permanent limitation in walking. Wheelchairs may be used by individuals with congenital or acquired impairments and can serve as essential assistive products for maintaining mobility, independence, and participation in daily life. The mobility provided by the wheelchair enhances an individual's participation in social life and contributes to improving psychological well-being by boosting self-confidence (7).

Individuals may require a wheelchair because of medical conditions or circumstances including:

- spinal cord injury, which may result in paraplegia or tetraplegia and varying degrees of motor, sensory, and trunk impairment;
- poliomyelitis and post-polio syndrome, which may cause muscle weakness, paralysis, fatigue, and reduced mobility;
- cerebral palsy, which may involve spasticity, dyskinesia, ataxia, impaired balance, and limitations in walking;
- multiple sclerosis, which may cause muscle weakness, sensory disturbances, fatigue, impaired balance, and visual symptoms;
- spina bifida, which may involve lower-limb weakness or paralysis, sensory impairment, musculoskeletal deformities, and limitations in walking;
- upper- or lower-limb amputation or congenital limb difference;
- traumatic brain injury, which may cause motor, balance, coordination, cognitive, and mobility impairments;
- stroke, which may result in muscle weakness, spasticity, impaired balance, reduced coordination, and limitations in walking;
- neuromuscular diseases, such as muscular dystrophy, which may cause progressive muscle weakness, fatigue, and reduced mobility;
- other temporary or permanent conditions that substantially limit functional mobility.

⚠ Some individuals may be unable to stand or walk, whereas others may be able to walk only short distances or under specific conditions. A wheelchair can support safe and efficient mobility, independence, and participation according to the individual's needs and goals (7, 9).

⚠ Wheelchair users have diverse personal, functional, and environmental characteristics, including:

- age and gender;
- medical condition, functional abilities and limitations, muscle strength, balance, sensation, and cognitive status;
- social environment and support system, personal goals and desired levels of participation in daily, social, occupational, recreational, and sporting activities.

Therefore, wheelchair selection, configuration, and skills-training requirements vary among individuals. A comprehensive assessment of the user's abilities, needs, environment, and goals is essential for selecting an appropriate wheelchair and planning an individualized training program.

◇ 2.1. Active And Inactive Wheelchair Users

Wheelchair users may have different levels of physical activity. Some participate regularly in recreational activities or sports such as wheelchair basketball, whereas others may have low activity levels and spend extended periods engaging in sedentary behaviour.

- Physically active wheelchair users may develop greater physical capacity, wheelchair skills, self-confidence, and social participation. Studies have reported higher wheelchair skill and physical performance levels among physically active users and athletes.
- Inactive wheelchair users may have fewer opportunities to practise wheelchair skills and may experience greater restrictions associated with environmental barriers, limited training, or insufficient support. Physical activity level should therefore be considered when planning individualized wheelchair skills training programs (6-9).

Learning fields of this section

- To distinguish between physically active and inactive wheelchair users. To recognize medical conditions and functional limitations that may lead to wheelchair use.
- To understand how physical activity and sports participation may contribute to the development of wheelchair skills.

-
- To recognize the importance of appropriate wheelchair configuration and individualized skills training based on each user's needs.

3. WHEELCHAIR CHARACTERISTICS

A wheelchair is not merely a means of transportation; it is an essential assistive product that supports mobility, independence, and participation. Selecting and configuring an appropriate wheelchair can improve functional performance and help reduce the risk of musculoskeletal, cardiopulmonary, and pressure-related complications associated with prolonged sitting (10, 11).

◇ 3.1. Types of wheelchairs

There are two main groups of wheelchairs (13):

1. Manual Wheelchairs:

- propelled by the user using their upper limbs on hand rims or levers (figure 1),
- lightweight, practical, and easy to transport,
- ideal for active individuals and independent users.

2. Powered (Electric) Wheelchairs:

- operated by an electric motor, controlled via a joystick or pilot with the lowest level of physical movement needed from a user,
- suitable for long distances or individuals with severely impaired muscle power of the whole body.

In addition to manual wheelchairs, there are special-purpose wheelchairs designed for specific users' needs, e.g.:

- **sport wheelchairs** to play team games as wheelchair basketball, or to do other sports like tennis, marathons, cross-country skiing, alpine skiing, etc.,
- **active wheelchairs** to be mobile in everyday life, to keep high maneuverability level in a home field, a work field as well as being able to transport from and to the chosen places,
- **Rehabilitation wheelchairs** are models with positioning support, used to transport people with special needs, mostly available in the hospitals or other medical care places to transport people who need medical care.

The sport wheelchair and the active wheelchair are built and developed for a selected person according to their needs, functional abilities, limitations as well as their interests and settings requirements, i.e.: to practice a special sport, in special surroundings like wheelchair runners.



Figure 1. Manual Wheelchairs

◆ 3.2. Specificity in wheelchair adaptation for users needs

Each wheelchair for a permanent wheelchair user must be properly set to the individual's anthropometric parameters and adapted to functional abilities, physical limitations as well as their needs and requirements in everyday life and free time. Otherwise, the following issues may arise: pressure sores, body pain, structural and permanent changes in the musculoskeletal system and decreased wheelchair user mobility (13-16).

The wheelchair construction elements are presented in figure 2 and their role is explained in table 1.

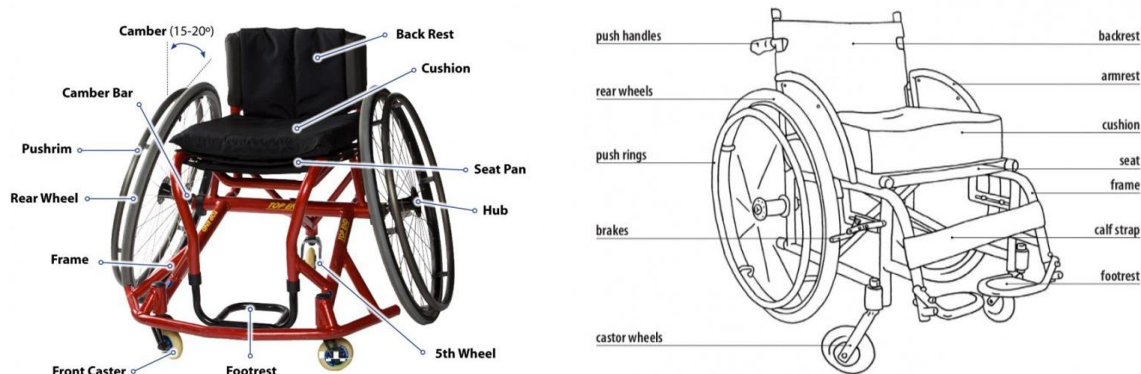


Figure 2. The wheelchair construction elements (AI-assisted illustration).

Table 1. Main wheelchair components and their functions.

No.	Wheelchair Component	Function
1	Armrests	Support the upper limbs and may assist with positioning and transfers.
2	Wheel locks	Stabilize the wheelchair during transfers and other stationary activities.
3	Rear wheels and pushrims	Enable mobility; pushrims allow the user to propel and control a manual wheelchair.
4	Front casters	Support manoeuvrability and directional changes.
5	Seat and backrest	Support the body and contribute to postural alignment and stability.
6	Footrests	Support the feet and lower limbs and contribute to appropriate sitting posture.

● To select and configure a wheelchair appropriately, the following key measurements should be obtained accurately:

- **Seat width:** determined according to the user's hip width, with sufficient clearance for comfort, clothing, and safe positioning;
- **Seat depth:** selected to support the thighs while maintaining adequate clearance behind the knees;
- **Backrest height:** determined according to the level of trunk support, postural stability, upper-limb function, and activity needs;
- **Footrest height:** adjusted according to lower-leg length while ensuring appropriate thigh support and foot positioning;
- **Armrest height:** adjusted with the shoulders relaxed and the elbows flexed to approximately 90°.

Wheelchair dimensions and technical specifications vary according to the wheelchair type, intended use, and individual user requirements. Seat dimensions, wheel and caster sizes, frame configuration, and total weight should therefore be selected according to an individualized assessment rather than a single standard specification.

○ Example technical specifications of a standard adult manual wheelchair

As an example, the Ottobock Start M2 manual wheelchair, designed for daily use and rehabilitation, has the following adjustable dimensions:

- seat width: 380–530 mm (38–53 cm),
- seat depth: 430 or 480 mm (43 or 48 cm),
- overall width: 565–690 mm (56.5–69 cm),
- overall length: 970–1045 mm (97–104.5 cm),
- overall height: approximately 940 mm (94 cm),
- backrest height: 400–475 mm (40–47.5 cm),

- lower-leg length: 390–490 mm (39–49 cm),
- total weight: approximately 14.7 kg,
- maximum user weight: 130 kg.

These specifications represent one commercially available standard adult manual wheelchair and should not be interpreted as universal dimensions. Wheelchair dimensions must be selected according to the user's anthropometric measurements, functional abilities, postural needs, environment, and intended activities.

Wheelchairs are available in different designs and specifications and should be configured according to the user's anthropometric measurements, functional abilities, and intended activities. As an initial clinical reference, when the user sits upright with the arms relaxed beside the body, the rear-wheel axle may be positioned near the level of the middle fingertip. However, final axle positioning should also consider stability, propulsion efficiency, shoulder load, and the user's skill level (Figure 3). Wheelchair requirements may also differ according to whether the wheelchair is used indoors, outdoors, at work, during transportation, or in sport. Understanding wheelchair components and their configuration is therefore essential for supporting safe and independent mobility.

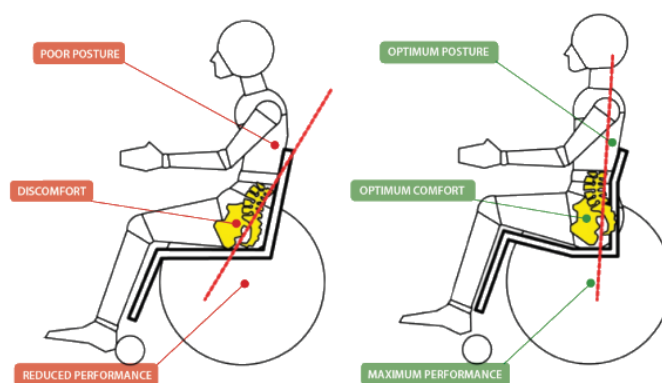


Figure 3. Comparison of suboptimal and optimal sitting posture in a wheelchair. AI-assisted illustration.

◇ 3.3. Wheelchair Selection

Wheelchair selection should be based on a comprehensive assessment rather than solely on the individual's diagnosis or impairment. Functional abilities, postural and physiological needs, environment, lifestyle, personal goals, transportation requirements, and desired level of participation should also be considered. Examples of factors influencing wheelchair selection are presented in Table 2 (14–16).

Table 2. Factors influencing wheelchair selection.

No.	Factors	Description
1	Intended use	Daily living, education, employment, recreation, sport, or rehabilitation
2	Environmental conditions	Indoor and outdoor surfaces, architectural barriers, climate, and available space
3	Transfer requirements	Transfer method, frequency, and need for assistance
4	Functional abilities	Upper-limb and trunk function, balance, coordination, endurance, and ability to propel or control the wheelchair
5	Transportability	Frame type, foldability, weight, and compatibility with available transportation
6	Funding and service access	Personal budget, insurance or public funding, availability of assessment, maintenance, and repair services

An appropriately selected and configured wheelchair can enhance independent mobility and reduce the need for assistance. Developing wheelchair skills is important for mobility in daily life, education, employment, recreation, and sport. Propulsion on smooth surfaces and in accessible spaces is generally less demanding than mobility on uneven or soft surfaces and within confined spaces. Independent community mobility may require the user to negotiate gravel, uneven or soft surfaces, gaps, potholes, slopes, ramps, and other environmental barriers. Wheelchair skills training can therefore contribute to greater independence and participation in everyday life.

Wheelchair skills can be developed through task-specific practice in real or simulated environments and through participation in appropriate recreational and sporting activities. Wheelchair sports may improve coordination, propulsion capacity,

cardiovascular endurance, and manoeuvrability. Athletes may also develop advanced control through repeated practice of rapid acceleration, stopping, turning, and movement in crowded or changing environments (13–16). When selected according to the individual's interests, abilities, and health status, sport can complement rehabilitation and support long-term physical activity and participation.

Learning fields of this section

- To distinguish among different types of wheelchairs and their intended uses.
- To understand the measurements and configuration factors involved in individualized wheelchair selection.
- To recognize how appropriate wheelchair selection and configuration can influence mobility, independence, participation, and quality of life.

4. WHEELCHAIR SKILLS

Manual wheelchair use involves learned motor skills based on biomechanical principles and the coordinated activity of the upper limbs and trunk. Safe and efficient wheelchair use extends beyond basic propulsion and is important for reducing energy expenditure, protecting musculoskeletal health, and maintaining long-term mobility and independence (5–7, 14–17).

♦ 4.1. Wheelchair skills

Wheelchair users may need to learn a range of skills to achieve safe and independent mobility, including:

- starting and accelerating;
- stopping in a controlled manner;
- responding to and recovering from a backward fall (Figure 4);
- maintaining rear-wheel balance (wheelie balance) (Figure 5);
- propelling forward and backward;
- turning and manoeuvring;
- negotiating environmental barriers such as curbs, ramps, and stairs (Figures 6–10);
- transferring into and out of the wheelchair (Figure 11).



Figure 4. Practising a controlled backward fall onto a mat while maintaining contact with the pushrims (5).

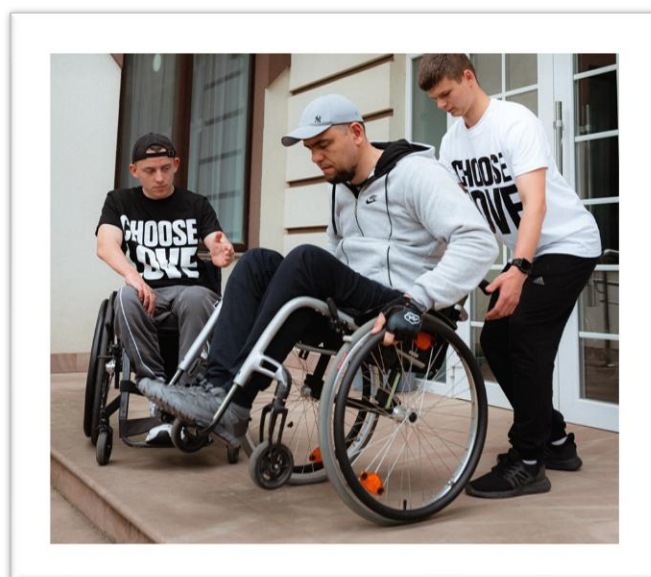


Figure 5. Practising rear-wheel balance with rear spotter support and verbal guidance (5).



Figure 6. Practising obstacle ascent with rear spotter support and verbal guidance (5).



Figure 7. Practising a controlled descent from a raised surface with front and rear spotter support (5).



Figure 8. Practising ramp ascent with rear spotter support and verbal guidance (5).



Figure 9. Practising controlled ramp descent with front and rear spotter support and verbal guidance (5).

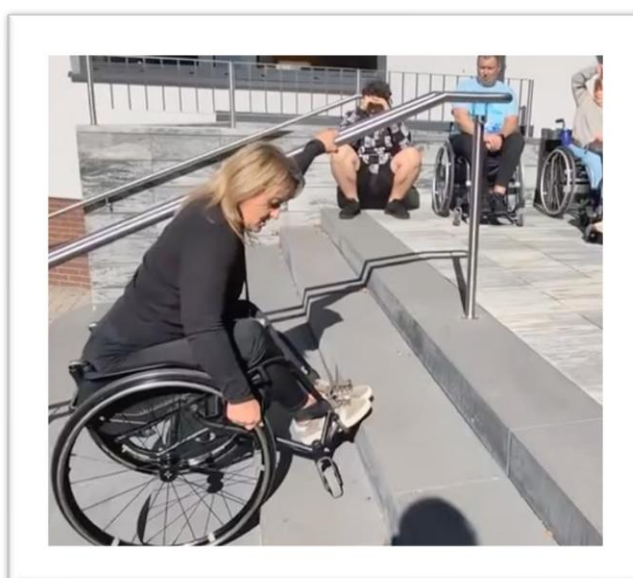


Figure 10. Descending stairs while using the handrail with the upper limb closest to the rail (5).

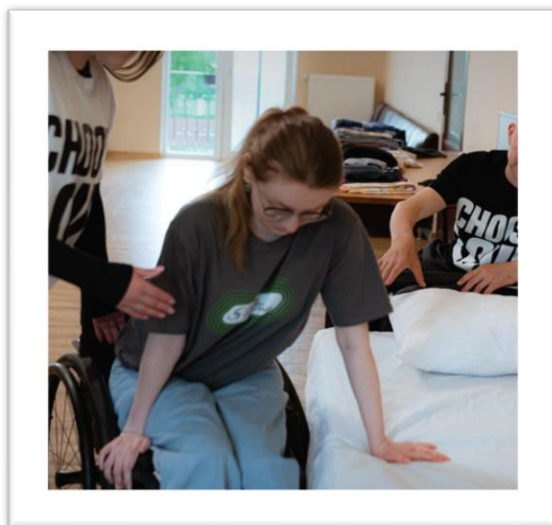


Figure 11. Practising a transfer from the wheelchair to a bed with supervision and verbal guidance (7).

◇ 4.2. Basic principles of wheelchair propulsion

Manual wheelchair propulsion is based on biomechanical principles and requires coordinated activity of the upper limbs and trunk. An efficient propulsion technique can reduce energy expenditure and repetitive mechanical loading on the upper limbs, thereby supporting mobility and musculoskeletal health (14–17). The propulsion cycle consists of two main phases:

- the push phase; and
- the recovery phase.

The upper limbs and trunk contribute to both phases, although force is applied to the pushrim primarily during the push phase. Appropriate propulsion technique and load distribution may improve mechanical efficiency and reduce the risk of upper-limb overuse (18, 19). Four commonly described hand patterns during wheelchair propulsion are presented in Figure 12.

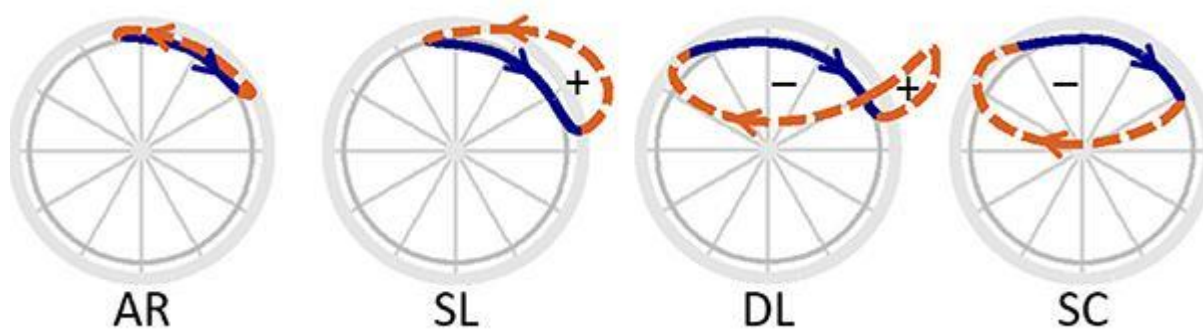


Figure 12. The four common hand patterns used during wheelchair propulsion: arcing (ARC), single-loop (SL), double-loop (DL), and semicircular (SC). Positive and negative signs indicate the signed areas used to calculate net radial thickness (NRT) for each pattern(30,33).

◇ 4.3. Wheelchair Push Phase

The push phase begins when the hands contact the pushrims and ends when they are released. During this phase, the user applies force to the pushrims to accelerate or maintain the movement of the wheelchair (31–34).

At initial hand contact, the shoulders are generally positioned in extension, the elbows are flexed, and the wrists are maintained in a functional position. As the hands move forward along the pushrims, the shoulders move toward flexion, the elbows extend, and the wrists help stabilize the hand–pushrim interface.

The anterior deltoid, pectoralis major, and triceps brachii are among the primary muscles contributing to propulsion. The biceps brachii, wrist flexors and extensors, scapular stabilizers, and trunk muscles may also contribute depending on propulsion speed, resistance, slope, and the user's technique.

◇ 4.4. Wheelchair recovery phase

The recovery phase begins when the hands leave the pushrims and ends at the next hand contact. Its primary purpose is to reposition the upper limbs in preparation for the subsequent push. Although no propulsive force is applied to the pushrims during this phase, coordinated muscle activity is required to decelerate, reverse, and reposition the upper limbs (14–29).

● 1. Hand Release and Transition Phase

The hands leave the pushrims at the end of the push phase. During this transition, the upper limbs are decelerated and begin to move towards the next contact position. The middle and posterior deltoid, middle trapezius, subscapularis, and supraspinatus contribute to shoulder control and glenohumeral stability. Muscle co-contraction may increase during the transition between the push and recovery phases.

● 2. Return Motion Phase

The hands travel backwards towards the starting position for the next push. This movement generally involves shoulder extension and/or abduction, elbow flexion, scapular retraction, and repositioning of the wrists and hands. The posterior deltoid and other shoulder extensors contribute to moving the upper limbs backwards, while the middle trapezius and rhomboid muscles support scapular control. The biceps brachii

contributes to elbow flexion, and the rotator-cuff muscles stabilize the glenohumeral joint throughout the movement.

Muscle activation and joint movement during recovery may vary according to the propulsion pattern, speed, resistance, wheelchair configuration, and the user's functional characteristics. A smooth and controlled recovery path may reduce unnecessary upper-limb movement and prepare the user for efficient hand contact during the next propulsion cycle.

◇ 4.5. Kinematic parameters in wheelchair propulsion

Kinematic and temporal parameters provide objective information about manual wheelchair propulsion technique. Important variables include hand-contact and hand-release positions, push angle, push time, recovery time, cycle time, and push frequency. In general, a longer and smoother push applied over a larger push angle may reduce push frequency and repetitive upper-limb loading. However, these parameters are also influenced by propulsion speed, resistance, slope, wheelchair configuration, and the user's functional characteristics (16, 17, 30–33, 35). Rear-wheel axle position also influences wheelchair stability and propulsion efficiency. Moving the axle forwards generally improves access to the puchrims and may increase propulsion efficiency, but it reduces rearward stability. Moving the axle rearwards increases stability but may increase propulsion effort and upper limb loading. Axle position should therefore be individualized according to the user's balance, propulsion ability, and wheelchair skills (15, 35).

Table 3. Common angular and temporal parameters of manual wheelchair propulsion (16, 30–33, 35).

No.	Parameters	Definition	Effect
1	Push angle (PA) (angular parameter)	Angular displacement of the hand on the pushrim between hand contact and hand release	A larger push angle may permit a longer application of force and reduce push frequency.
2	Push time (temporal parameter)	Time between hand contact and hand release	Indicates the duration for which propulsive force can be applied to the
3	Recovery time	Time between hand release and the next hand contact	Represents the time available to reposition the upper limbs for the next push.

Table 3 (Continue). Common angular and temporal parameters of manual wheelchair propulsion (16, 30–33, 35).

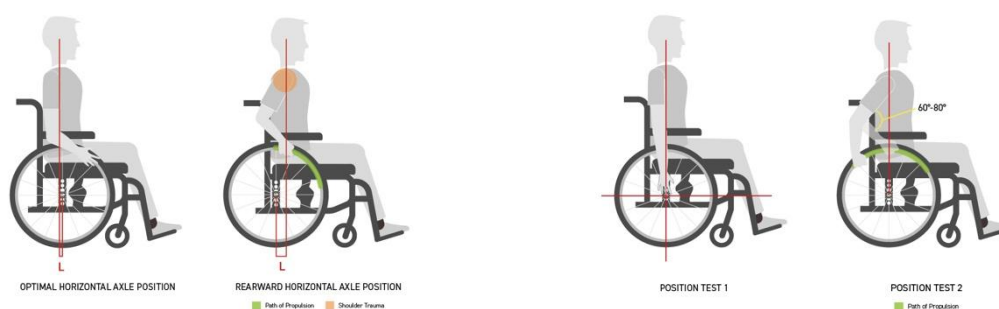
4	Cycle time	Total duration of one push phase and one recovery phase	Shorter cycle times are generally associated with a higher propulsion cadence.
5	Push frequency (temporal parameter)	Number of propulsion cycles completed per minute	Excessively high frequency may increase repetitive upper-limb loading and energy expenditure.

The angular parameters used to describe the hand–pushrim interaction during the wheelchair propulsion cycle are illustrated in Figure 13.

- **HC (Hand Contact)** represents the point at which the user’s hand first contacts the handrim, marking the beginning of the push phase.
- **HR (Hand Release)** represents the point at which the user’s hand leaves the handrim, marking the end of the push phase.
- **TP (Top Point)** is the uppermost point of the wheel and serves as the reference point for angular measurements.
- **SA (Start Angle)** is the angle between TP and HC, measured at the centre of the wheel. It indicates where handrim contact begins relative to the top of the wheel.
- **EA (End Angle)** is the angle between TP and HR, measured at the centre of the wheel. It indicates where handrim contact ends relative to the top of the wheel.
- **PA (Push Angle)** represents the total angular displacement between HC and HR during the push phase.

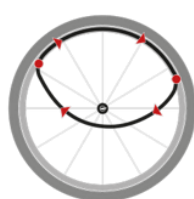
The arrow indicating the direction of propulsion represents the forward movement of the wheelchair generated during the push phase.

These angular parameters are commonly used to analyse propulsion technique, mechanical efficiency, and upper-limb loading (30–33, 35). Figure 14 illustrates hand contact and push angle during active propulsion, while Figure 15 presents rear-wheel axle



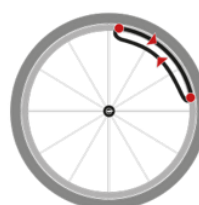
1. The axle should be at or just in front of the shoulder joint

2. The vertical axle position is crucial for stability of the client, protection of shoulder health, and efficiency of propulsion stroke



SEMICIRCULAR

3. Most efficient propulsion technique for level ground



ARC

4. Most efficient propulsion stroke for traveling uphill

Figure 15. Rear-wheel axle positioning and propulsion patterns in a manual wheelchair. With the user sitting in a natural posture and the hand placed on the pushrim, an elbow angle of approximately 60°–80° may be used as a clinical reference for assessing vertical axle position. The semicircular pattern provides a longer and smoother recovery path and is generally recommended for level-ground propulsion, whereas a shorter arc pattern may be used when greater push frequency is required, such as during uphill propulsion.

Kinematic analysis of manual wheelchair propulsion can be performed using high-speed video, motion-capture systems, instrumented pushrims, or wearable sensors. These methods can be used to examine angular, spatial, temporal, and kinetic parameters. Wheelchair speed is influenced by the magnitude and direction of the applied force, push frequency, push angle, rolling resistance, slope, and wheelchair configuration (16, 17, 30–33, 35).

Angular and temporal parameters influence propulsion performance and upper-limb loading. At a given speed, using longer pushes over a larger push angle may reduce push frequency and the number of repetitive loading cycles. However, the most efficient technique varies according to the user, wheelchair configuration, speed, slope, and external resistance. Kinematic variables such as wrist and elbow velocity may also be examined in relation to physiological demands, including oxygen consumption (30–33, 35).

Four recovery patterns are commonly described in manual wheelchair propulsion: arc, single-loop-over, double-loop-over, and semicircular. These patterns differ primarily in the path followed by the hand after pushrim release and before the next hand contact. The selected pattern affects upper-limb kinematics, smoothness of movement, and preparation for the subsequent push (16, 17, 33, 35).

Trunk movement may contribute to propulsion by assisting force generation, maintaining balance, and repositioning the upper body. The extent of trunk involvement varies according to propulsion speed, slope, resistance, trunk control, and the user's functional characteristics. Excessive trunk movement may also indicate insufficient upper-limb force, inappropriate wheelchair configuration, or a compensatory propulsion strategy (14, 16, 17, 37).

Appropriate seating and wheelchair configuration should provide pelvic and trunk stability while allowing effective access to the pushrims and sufficient freedom of upper-limb movement. Seat angle, seat height, rear-wheel axle position, and backrest configuration should be individualized rather than determined by a universal knee-to-hip position (15–17, 35). Alterations in upper-limb kinematics may indicate the need to review propulsion technique, seating position, or wheelchair configuration. Because users differ in anthropometry, functional ability, environment, and mobility goals, wheelchair–user interaction should be assessed individually (15–17, 30–33, 35).

◆ 4.6. Practical training implications

Efficient propulsion technique is important for wheelchair mobility during daily living, recreational activities, and sport. Training programs should combine task-specific propulsion practice with exercises that address the physical requirements of wheelchair use. Training may include:

- activation and coordination of the upper-limb, scapular, and trunk muscles;
- propulsion technique and movement quality;
- upper-limb and trunk strength and muscular endurance;
- shoulder flexibility and joint mobility;
- cardiovascular endurance;
- push angle, push frequency, and recovery pattern;
- controlled force application to the pushrims;
- postural control and dynamic sitting balance;
- propulsion on different surfaces, slopes, and environmental conditions.

Training intensity, duration, progression, and exercise selection should be individualized according to the user's diagnosis, functional abilities, upper-limb capacity, trunk control, cardiovascular fitness, wheelchair configuration, activity goals, and environmental requirements (12, 14–17, 30–33, 35, 37).

Training should begin in a safe and controlled environment and progress gradually from low-resistance, level-ground propulsion to more demanding tasks. Progression may include increasing distance or duration, changing propulsion speed, negotiating slopes and uneven surfaces, practising rapid starts and controlled stops, and integrating turning or obstacle-negotiation tasks. Shoulder pain, excessive fatigue, loss of technique, and compensatory trunk movements should be monitored throughout training.

Examples of resistance-band strengthening and upper-limb flexibility exercises that may support wheelchair propulsion are presented in Figures 16 and 17.

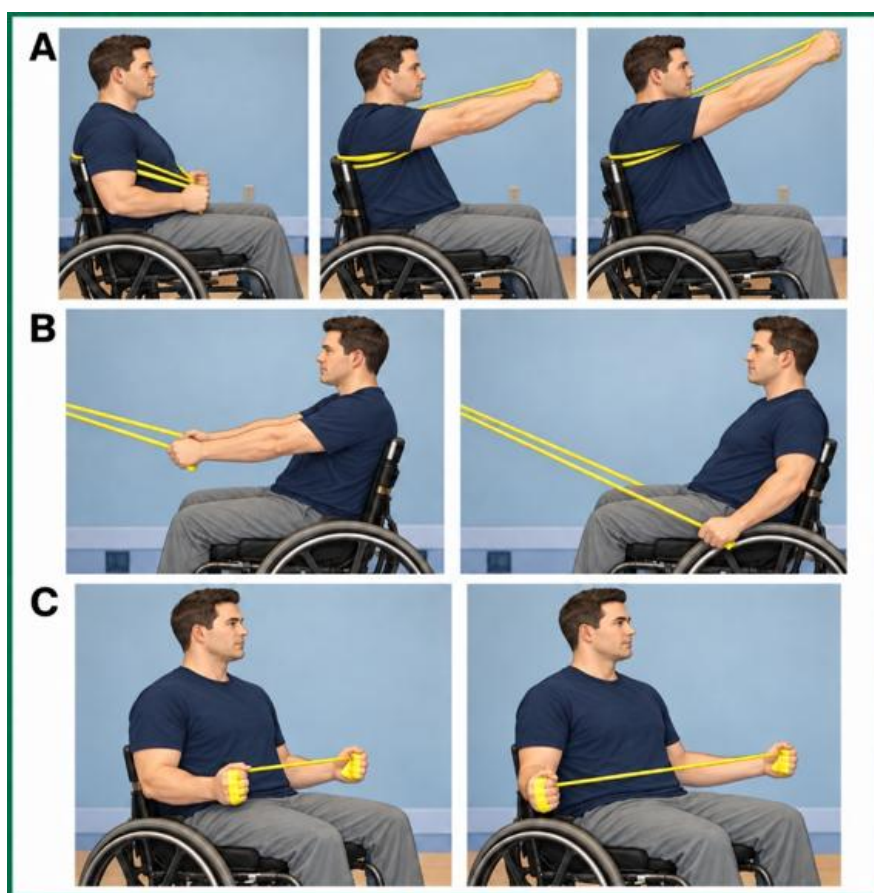


Figure 16. Examples of resistance-band exercises for wheelchair users: (A) shoulder flexion, (B) shoulder extension, and (C) shoulder external rotation.



Figure 17. Examples of assisted and self-administered stretching exercises for maintaining upper-limb and shoulder flexibility in wheelchair users.

Strengthening and flexibility exercises should be performed with appropriate posture and controlled movement. Resistance and range of motion should be adjusted according to the user's muscle strength, joint mobility, pain, fatigue, and clinical condition. Exercises that provoke or increase shoulder pain should be modified or discontinued and reviewed by a qualified rehabilitation professional.

Learning fields of this section

- To identify fundamental wheelchair skills required for safe and independent mobility.
- To distinguish between the push and recovery phases of manual wheelchair propulsion.
- To recognize the principal upper-limb, scapular, and trunk muscles involved in propulsion.
- To understand angular, temporal, and kinematic parameters related to propulsion technique.
- To explain how rear-wheel axle position and wheelchair configuration influence stability and propulsion efficiency.
- To apply basic principles of individualized propulsion, strength, flexibility, and endurance training.

5. SOCIAL PARTICIPATION AND ENVIRONMENTAL ACCESSIBILITY

A good everyday life is shaped not only by an individual's physical, psychological, and social well-being, but also by the environments in which they live, move, and participate in community life. For wheelchair users, independent mobility and meaningful participation are shaped by the interaction between individual factors—such as body functions and structures and wheelchair skills—the wheelchair, and the surrounding physical and social environment. These interconnected factors influence an individual's opportunities to move, participate, and engage in everyday and community life. (1, 36, 38–40).

Wheelchair users may encounter barriers in their daily lives that restrict mobility, activities, participation, and life space. These barriers, together with individual factors, influence where mobility is possible and how independently and safely it can be carried out. The socioecological framework provides a useful perspective for understanding these interactions (Figure 18). The framework considers five interconnected levels: individual, interpersonal, organisational, community, and policy. From this perspective, wheelchair mobility and participation are influenced not only by individual capabilities and wheelchair skills, but also by social relationships, physical and social environments, and broader societal structures and policies. When the wheelchair is appropriately fitted to the user's needs, wheelchair skills meet the demands of everyday environments, and the environment supports accessible mobility, wheelchair use can be safer, smoother, and more independent. This can broaden the user's life space and increase opportunities for participation in everyday and community life.



Figure 18. Wheelchair mobility and participation are influenced not only by individual capabilities and wheelchair skills, but also by social relationships, physical and social environments, and broader societal structures and policies. (Karinharju & Kuusiluoma, 2026, AI-assisted illustration).

◆ 5.1. Accessibility and Social Participation

Accessibility refers to the extent to which physical environments, transportation systems, services, information, communication, and social opportunities can be reached and used safely, independently, and equitably by people with different abilities. For wheelchair users, accessibility is a fundamental requirement for independent living, education, employment, healthcare, recreation, sport, and participation in community life (1, 36, 38–40).

Barriers may be physical, environmental, informational, social, institutional, or attitudinal. Examples include stairs, narrow doorways, uneven surfaces, inaccessible transportation, inadequate information, negative attitudes, limited support, and exclusionary practices. These barriers may restrict participation, reduce independence, increase reliance on assistance, and contribute to social isolation.

Accessibility should be incorporated from the beginning of the planning and design process rather than addressed only through later modifications. Environments designed according to accessibility and universal-design principles benefit wheelchair users as well as older adults, individuals with temporary mobility limitations, families with young children, and the wider community.

Promoting accessibility also requires a person-centred approach that considers the individual's functional abilities, wheelchair dimensions and characteristics, daily activities, environment, and social roles. Physical accessibility and social inclusion are closely connected: when people can move safely, access services, and participate in meaningful activities, their independence, quality of life, and sense of belonging may be strengthened (1, 36, 38–42).

◇ 5.2. Architectural Accessibility and Environmental Adaptations

The built environment can either support or restrict the independence and participation of wheelchair users. Public buildings, outdoor areas, transportation connections, and commonly used services should comply with applicable accessibility standards and should be planned according to universal-design principles.

An accessible barrier-free network should provide continuous and safe movement from parking areas and public transportation points to building entrances and throughout the interior environment. Doorways, corridors, ramps, elevators, sanitary facilities, work surfaces, controls, and manoeuvring areas should be designed so that wheelchair users can approach, reach, enter, turn, and use them safely and independently. A continuous barrier-free network benefits not only wheelchair users but the wider community (36, 38–42).

In private homes and individualized rehabilitation settings, environmental adaptations should also consider the user's anthropometric measurements, functional abilities, wheelchair characteristics, transfer method, daily activities, and personal priorities. Standard accessibility requirements provide an essential minimum framework, while individualized assessment helps determine whether additional adaptations are needed. It should be noted that accessibility criteria and requirements may vary between

countries. In this section, Finnish accessibility legislation, regulations, and criteria are used as a reference (41, 42, 73).

Key architectural and environmental accessibility considerations are summarized below:

Accessible Routes and Ramps

An accessible indoor route should be continuous, stable, firm, slip-resistant, and free from avoidable obstacles. The minimum clear width should generally be 1500 mm. Where changes in level cannot be avoided, an appropriately designed ramp or lift should be provided. Under the Finnish accessibility regulation, the maximum running slope of a ramp is generally 5 %. However, if the difference in height is 1000 millimetres or less, the gradient of the ramp may not exceed 8 %. Ramp design should also consider rise, landing dimensions, edge protection, handrails, drainage, and the user's functional abilities (41, 42, 72).

Lifts and Elevators

Where a ramp is not feasible because of limited space or a substantial vertical change, an accessible lift or elevator should be provided. Escalators do not constitute an accessible alternative for wheelchair users.

Doorways

Doorways should provide sufficient clear width for wheelchair passage. The clear opening is measured between the face of the open door and the opposite door stop, rather than by the nominal width of the door leaf. Under the Finnish accessibility regulation, the minimum clear opening is generally 850 mm. (41, 42, 72).

Thresholds

There must be no level difference or threshold at the door, unless this is necessary for reasons of noise, damp or other similar conditions. In such cases, the threshold or level difference must not exceed 20 mm in height, and the threshold must be designed so that it can be easily crossed by a wheelchair or a walking frame fitted with wheels. (72).

Door Hardware and Operation

Door handles, locks, latches, and other operable parts should be usable with one hand and should not require tight grasping, pinching, or twisting of the wrist. The force required to open and close the door should be minimized. Lever handles, automatic

doors, or power-assisted opening systems may improve accessibility for users with limited hand or upper-limb function (41, 42).

Corridors and Circulation Routes

Accessible circulation routes should generally provide a minimum clear width of 1500 mm. Wider spaces or passing areas may be required where two-way traffic is expected. Additional manoeuvring space should be provided at doors, corners, changes in direction, and confined areas (41, 42, 72).

Manoeuvring and Turning Space

The space required for manoeuvring the wheelchair is approximately 150 mm on either side. A circle with a diameter of 1500 mm is used as a guideline for calculating the space required when turning (Figure 19). (74)

Knee Clearance

Where a forward approach to a table, counter, sink, or work surface is required, adequate knee and toe clearance should be provided. The clear space should be at least 800 mm wide and 670 mm high with 600 mm in depth (Figure 19). (72).

Reach Range

The sitting position limits the reach of a wheelchair user. The wheels and footrest of the wheelchair restrict access to the corners of a room and to work surfaces with, for example, cupboards or drawers underneath. Examples of the reach distance is shown in Figure 20 (74).

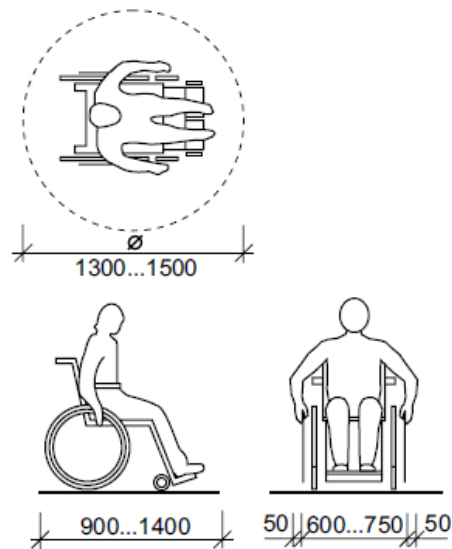


Figure 19. Turning circle and minimum space required when stationary (74). All dimensions are in millimetres.

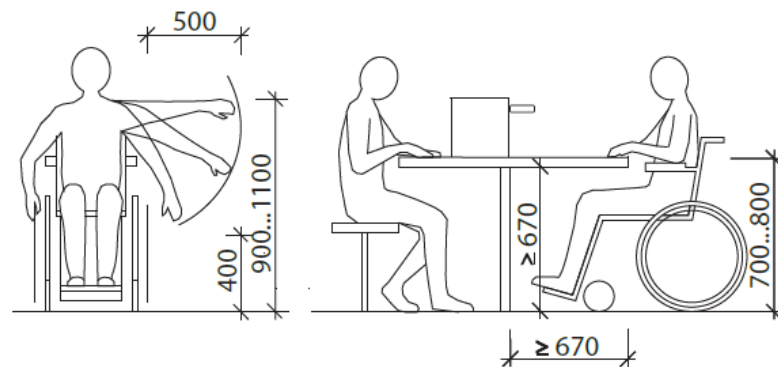


Figure 20. Reach distances and knee clearance for wheelchair users (74). All dimensions are in millimetres.

Flooring and Ground Surfaces

- Accessible floor and ground surfaces should be stable, firm, and slip-resistant.
- Abrupt level changes, loose materials, deep joints, and uneven surfaces should be avoided.
- Carpet or carpet tile should be securely attached and should have a firm texture.
- Transitions between different flooring materials should be smooth and should not create a barrier to wheelchair movement (72-74).

Common Physical Access Barriers

- steps or stairs without an accessible alternative;
- steep, narrow, or discontinuous ramps;
- narrow doorways and corridors;
- heavy doors or inaccessible door hardware;
- high or abrupt thresholds;
- uneven, loose, or slippery surfaces;
- insufficient turning and manoeuvring space;
- inaccessible toilets, sinks, counters, and service areas;
- elevators that are unavailable, too small, or difficult to operate;
- inaccessible parking, pedestrian routes, and public transportation (36,38-42,72-74).

Examples of Environmental Accessibility Measures

- continuous accessible routes and appropriately designed ramps;
- automatic or power-assisted doors and accessible door hardware;
- accessible toilets, sinks, counters, and work surfaces;
- adequate clear floor, turning, knee, and toe space;
- wheelchair-accessible sidewalks, pedestrian crossings, and public transportation;
- accessible elevators with sufficient internal space and reachable controls;
- appropriately positioned handrails and grab bars;
- accessible parking spaces connected to an accessible route;
- clear signage and accessible information (36, 38-42, 72-74).

◇ 5.3. Enhancing Social Inclusion

Physical accessibility alone does not ensure full participation. Social attitudes, institutional policies, communication practices, available support, and equal opportunities also influence inclusion. Wheelchair users should have equitable opportunities to participate in education, employment, healthcare, cultural activities, recreation, sport, and community decision-making.

Social inclusion should be promoted across the following areas:

- education and lifelong learning;
- employment and vocational development;
- healthcare and rehabilitation services;
- cultural and community activities;
- recreation, physical activity, and sport;
- accessible transportation and digital services;
- public consultation and decision-making processes.

Participation in recreational and competitive sport can support physical fitness, self-confidence, social interaction, identity, and community participation. Paralympic and other adapted sports may also challenge negative stereotypes and increase the visibility of athletes with disabilities. However, sport should be presented as one possible form of participation rather than an expectation for every wheelchair user (2, 4, 8).

Creating an inclusive society therefore requires both the removal of physical barriers and the prevention of prejudice, discrimination, and exclusion (36,38-40).

Learning fields of this section

- To recognize physical, social, institutional, and attitudinal barriers affecting wheelchair users.
- To understand fundamental accessibility requirements for routes, ramps, doors, corridors, turning spaces, reach ranges, and work surfaces.
- To explain the relationship between environmental accessibility, independence, and social participation.

-
- To recognize the importance of universal design and individualized environmental adaptations.
 - To understand how education, employment, recreation, and sport can contribute to social inclusion.

6. WHEELCHAIR SKILLS TRAINING

Wheelchair skills training is a structured, task-specific process designed to improve a user's capacity to operate a wheelchair safely, effectively, and independently in daily life. In addition to technical skill acquisition, training may improve confidence, self-efficacy, problem-solving, and participation in community activities (43, 44, 49, 58). This section is intended for wheelchair users, physiotherapists, occupational therapists, other rehabilitation professionals, personal assistants, caregivers, sports trainers, and relevant stakeholders. It provides a shared framework for learning, teaching, supporting, and assessing wheelchair skills safely and effectively.

♦ 6.1. Why Is Training Necessary?

Wheelchair users may receive insufficient structured training before beginning independent wheelchair use. Inappropriate propulsion technique, unsafe transfers, inadequate obstacle-negotiation strategies, or improper wheelchair configuration may increase the risk of falls, collisions, fatigue, pain, and upper-limb overuse.

Structured training helps users develop safer and more efficient strategies for propulsion, turning, stopping, transfers, ramps, curbs, uneven surfaces, and other activities relevant to daily mobility. Training may improve wheelchair skills capacity, confidence, independence, and participation while reducing the need for assistance (35, 43, 44, 48, 49, 58).

◇ 6.2. Training Phases and Descriptions

A structured wheelchair skills training process and examples of progressively challenging tasks are presented in Tables 4 and 5 (43, 44, 48, 49, 58).

Table 4. Suggested stages of a wheelchair skills training process.

No.	The phase	The description
1	Assessment and goal setting	The user's wheelchair, functional abilities, previous experience, environment, safety risks, and personal mobility goals are assessed.
2	Basic skill acquisition	Fundamental skills such as starting, stopping, forward and backward propulsion, turning, and basic doorway navigation are taught.
3	Intermediate skill development	Skills involving confined spaces, transfers, slopes, uneven surfaces, and small obstacles are introduced.
4	Advanced skill development	More demanding skills such as wheelie balance, curb negotiation, steeper slopes, and complex community mobility are practised when appropriate.
5	Safety and problem-solving training	Fall prevention, spotting, risk recognition, safe alternatives, and strategies for unexpected environmental barriers are taught.
6	Outcome assessment and follow-up	Skill performance, safety, confidence, and progress towards individual goals are reassessed, and further training needs are identified.

Table 5. Examples of wheelchair skills included in a progressive training program (43, 44, 48, 49).

Wheelchair skill	Primary training focus
Forward and backward propulsion	Directional control, coordination, and propulsion efficiency
Starting and stopping	Controlled acceleration and deceleration
Turning in both directions	Directional control and manoeuvrability
Passing through doorways	Spatial awareness, hand protection, and door management
Propulsion on slopes	Force application, trunk control, braking, and speed regulation
Negotiating uneven surfaces	Maintaining momentum, direction, balance, and safety
Negotiating small obstacles or curbs	Caster management, timing, balance, and controlled landing
Wheelie balance	Rear-wheel balance and preparation for advanced obstacle negotiation
Transfers into and out of the wheelchair	Positioning, stability, upper-limb use, and safety

◇ 6.3. Who Delivers Wheelchair Skills Training?

Wheelchair skills training may be delivered by trained rehabilitation professionals, wheelchair-service personnel, sports professionals, peer trainers, or other appropriately qualified individuals. Effective training requires assessment of the user's functional abilities, wheelchair configuration, environment, safety needs, experience, and personal goals. The wheelchair user should be an active member of the goal-setting and training process (43, 44, 47–49).

○ The training team may include:

- wheelchair users and trained peer mentors;
- physiotherapists;
- occupational therapists;
- wheelchair-service and assistive-technology professionals;
- prosthetists and orthotists with wheelchair-service training;
- sports instructors and coaches;

-
- kinesiologists or clinical exercise specialists;
 - caregivers and personal assistants who have received appropriate training.

Learning fields of this section

- To explain the purpose and potential benefits of wheelchair skills training.
- To describe the assessment, goal-setting, skill-acquisition, progression, and follow-up stages of training.
- To distinguish between basic, intermediate, and advanced wheelchair skills.
- To identify professionals, peer trainers, caregivers, and stakeholders who may contribute to training.
- To recognize the importance of individualized, task-specific, and safety-focused training.

7. ASSESSMENT OF WHEELCHAIR SKILLS

Standardized performance-based tests and self- or proxy-reported questionnaires can be used to monitor wheelchair skills, identify training needs, evaluate change over time, and examine the effectiveness of training programs. Performance-based tests provide direct observation of skill execution, whereas questionnaires provide information about perceived capacity, confidence, and performance in daily life. These complementary approaches can support individualized training and rehabilitation planning (19–22, 43, 46).

7.1. Core Wheelchair Skills Assessment Tools

● Wheelchair Skills Test (WST)

- The WST is a standardized, performance-based assessment in which wheelchair skills are directly observed by a trained tester.
- Separate forms are available for manual and powered wheelchairs.
- Skills progress from basic wheelchair operation to more complex community-mobility tasks.
- Examples include propulsion, turning, manoeuvring, transfers, slopes, uneven surfaces, obstacles, and wheelie-related skills where appropriate.
- Skill execution is evaluated using standardized criteria, including successful completion and safety considerations.
- The results can be used to identify training priorities and monitor change over time (43).

● Wheelchair Skills Test Questionnaire (WST-Q)

- The WST-Q is the questionnaire version of the WST and does not require direct performance of the skills.
- Depending on the version and purpose of administration, it can assess perceived capacity, confidence, and performance.
- It may be completed by the wheelchair user or administered with the assistance of an interviewer; relevant caregiver versions are also available.
- It is useful when direct testing is impractical and for examining wheelchair use in everyday situations.
- Because it is based on self- or proxy-report, responses may be influenced by perception, recall, confidence, and interpretation of the questions.

-
- It may be used alongside the WST to compare observed capacity with perceived or reported wheelchair performance (21, 43, 46).

Examples of performance-based tests, questionnaires, and wheelchair-related outcome measures identified in the literature are presented in Tables 6 and 7 (19, 21–24, 43, 44, 46).

Table 6. Examples of other wheelchair skills assessment tools.

No.	The tool	The scope	Notes
1	Wheelchair Skills Test (WST)	Observed wheelchair skills capacity and safety	Performance-based assessment available for manual and powered wheelchairs
2	Wheelchair Skills Test Questionnaire (WST-Q)	Perceived capacity, confidence, and performance	Self- or proxy-reported questionnaire corresponding to WST skills
3	Valutazione Funzionale Mielolesi (VFM)	Functional manual wheelchair mobility	Functional manual wheelchair mobility
4	Functioning Everyday with a Wheelchair (FEW)	Perceived wheelchair function in daily life	Self-reported measure examining how effectively the wheelchair supports everyday activities
5	Wheelchair Outcome Measure (WhOM)	Individual mobility goals and satisfaction	Client-centred interview measure based on personally identified participation goals
6	Power-Mobility Indoor Driving Assessment (PIDA)	Indoor powered-mobility performance	Performance-based assessment of powered-wheelchair use in indoor and institutional environments
7	Power-Mobility Community Driving Assessment (PCDA)	Community powered-mobility performance	Performance-based assessment of powered-wheelchair use in community environments

Table 7. Potential relevance of wheelchair-related assessment tools to sport and advanced mobility.

No.	The tool	Suitability for Sports	The description
1	Test of Wheeled Mobility (TOWM)	☑ High	Includes 30 functional wheeled-mobility tasks and evaluates ability, movement quality, performance time, and anxiety. Its scores have demonstrated relationships with sport participation, making it relevant to advanced manual wheelchair mobility, although it is not a sport-performance test (52, 56).
2	Short Wheelie Test	☑ High	Includes eight challenging wheelie tasks and evaluates ability, movement quality, performance time, and anxiety. It is particularly relevant to advanced balance and wheelchair-control skills that may be useful in sport and community mobility (52, 56).
3	Wheelchair Skills Test (WST)	⚠ Moderate	Provides a standardized assessment of functional wheelchair skills ranging from basic to advanced mobility. It may be useful for identifying an athlete's general wheelchair skill capacity, but it does not directly assess sport-specific performance (19, 22, 43, 44).
4	Valutazione Funzionale Mielolesi (VFM)	⊖ Low	Assesses functional status and manual wheelchair mobility in individuals with spinal cord injury. It may provide useful rehabilitation information but has limited coverage of sport-specific speed, agility, or technical performance (19, 22).
5	FEW and WhOM	⊖ Low	Focus on perceived wheelchair function, individualized participation goals, and satisfaction rather than directly observed speed, agility, or wheelchair skill execution (23, 24).
6	PIDA and PCDA	⚠ Context-specific	Assess powered-wheelchair driving in indoor and community settings. They may be relevant to power-mobility participation but are not suitable for evaluating manual wheelchair sport performance (23, 24).

The relevance ratings in this table represent an educational interpretation based on the constructs and tasks assessed by each tool. They should not be interpreted as evidence that the instruments were developed or validated specifically as sport-performance tests.

How Can the Short Wheelie Test Provide Information Relevant to Agility?

1. Task Structure and Agility Relevance

The Short Wheelie Test comprises eight tasks involving increasingly challenging forms of rear-wheel balance and wheelchair control. Several of these tasks require dynamic balance, directional control, acceleration, deceleration, and adaptation to changing surfaces, which are also relevant to wheelchair agility and manoeuvrability (Table 8) (51, 55).

Table 8. Short Wheelie Test tasks and their potential relevance to dynamic wheelchair control.

No.	The task	The wheelchair agility and manoeuvrability
1	Stationary wheelie	Maintenance of the balance point and controlled postural adjustments
2	One-handed wheelie	Unilateral control, trunk stability, and maintenance of balance with reduced hand support
3	Wheelie forward for 10 m	Dynamic balance, propulsion control, directional maintenance, and speed regulation
4	Wheelie backward for 10 m	Reverse control, spatial awareness, and balance during backward movement
5	Circular movement in a wheelie	Directional control, turning accuracy, and differential pushrim use
6	Wheelie on an uneven surface	Adaptation to surface changes and reactive balance control
7	Acceleration and stopping in a wheelie	Controlled acceleration, deceleration, force modulation, and maintenance of balance
8	Moving backward over a curb in a wheelie	Coordination of backward propulsion, balance, timing, and obstacle negotiation

Adapted from the Short Wheelie Test described by Fliess-Douer et al. (52, 56).

2. Qualitative Scoring (Quality Score)

Each Short Wheelie Test task includes task-specific quality criteria. Depending on the task, the quality score may reflect:

- maintenance of wheelie balance;
- smoothness and continuity of movement;
- directional control;
- coordinated trunk and upper-limb movement;
- appropriate timing and force application;
- controlled use of the pushrim; and
- safe and technically effective task completion.

The quality score therefore provides information about how the task is performed, rather than recording only whether it is completed successfully (51, 55).

3. Time Scores and Dynamic Output

Selected Short Wheelie Test tasks include performance-time measures, such as forward and backward movement and acceleration–stopping tasks. Time scores provide information about how quickly a task is completed, but they should be interpreted together with ability and quality scores. A shorter completion time does not necessarily represent better control if it is achieved through unsafe technique, loss of balance, or excessive risk-taking (51, 55).

→ However, as the authors note, time alone may not be fully reliable, as it may also reflect risk-taking behavior rather than controlled skill.

4. Academic Evidence Supporting Agility Measurement

The Short Wheelie Test demonstrated strong positive correlations with the TOWM for total ability scores ($r = 0.84$; $p < 0.001$), quality scores ($r = 0.88$), and anxiety scores ($r = 0.66$). The correlation between the total time scores of the two tests was moderate ($r = 0.47$), supporting their related but complementary assessment of manual wheelchair mobility (51). Participants who were active in sport demonstrated significantly higher Short Wheelie Test ability and quality scores than participants who were not active in

sport. However, this association does not establish that the test is a sport-specific agility measure or that sport participation alone caused higher scores (51).

Conclusion

The Short Wheelie Test provides a multidimensional assessment of advanced wheelie performance through:

- ability scores indicating whether tasks can be completed;
- quality scores describing technical execution and movement control;
- time scores reflecting the speed of selected tasks; and
- anxiety scores reflecting the user's perceived anxiety during task performance.

Because several tasks require dynamic balance, rapid adjustments, turning, acceleration, stopping, and obstacle negotiation, the test provides information relevant to wheelchair agility and manoeuvrability. Nevertheless, it should be described primarily as a test of advanced manual wheelchair mobility and wheelie performance, rather than as a validated sport-specific agility test (51, 55).

Learning fields of this section

To distinguish between performance-based wheelchair skills tests and self- or proxy-reported questionnaires.

- To explain the purpose and basic structure of the WST and WST-Q.
- To identify assessment tools suitable for manual and powered-wheelchair users.
- To compare measures of observed skill capacity, perceived capacity, confidence, performance, participation goals, and satisfaction.
- To recognize the TOWM and Short Wheelie Test as measures of advanced manual wheelchair mobility.
- To understand the potential relevance and limitations of wheelchair mobility tests in sporting contexts.
- To select assessment tools according to the wheelchair type, user characteristics, assessment purpose, and intended outcome.

8. COMPLEX REHABILITATION TECHNOLOGY: PAST, PRESENT, AND FUTURE PERSPECTIVES

Wheelchair mobility technologies have evolved from conventional handrim-propelled manual wheelchairs to include crank-, lever-, and geared-propulsion systems, power-assist devices, and fully powered wheelchairs. Conventional manual wheelchairs may offer low weight, manoeuvrability, ease of transportation, and opportunities for physical activity. However, repetitive upper-limb propulsion - particularly over long distances, slopes, uneven surfaces, or high-resistance environments - may contribute to fatigue and upper-limb overuse.

Powered mobility can reduce the physical demands of propulsion and provide independent mobility for individuals who cannot use a manual wheelchair safely or efficiently. Alternative manual propulsion systems and power-assist devices aim to improve mechanical efficiency and reduce upper-limb demand. Nevertheless, some systems may involve trade-offs related to weight, size, transportability, cost, maintenance, availability, and user preference (59, 60).

Complex Rehabilitation Technology (CRT) has advanced substantially over recent decades and includes individually configured technologies supporting communication, mobility, positioning, environmental access, and object manipulation. When appropriately assessed, prescribed, and supported, CRT can enhance independence, participation, safety, and quality of life (61). However, barriers persist in CRT service delivery, including administrative requirements, limited funding or insurance coverage, shortages of qualified providers, delays in assessment and equipment delivery, and prolonged repair times (63). A scoping review identified substantial variation in assistive-technology funding and service-delivery systems across 21 countries, highlighting the need for policies that respond more effectively to user needs and support timely access, maintenance, and repair (64). Potential improvements in CRT services include telehealth-supported assessment and follow-up, funding for preventive maintenance, improved repair coordination, online repair tracking, and stronger communication among users, clinicians, suppliers, and funding organizations (62). Emerging areas include pervasive and context-aware assistive technologies, cognitive assistive systems, robotics, sensor-based monitoring, artificial intelligence, and technology-assisted rehabilitation. These developments may expand opportunities for personalized support, training, mobility, and participation (65). Despite technological advances, substantial inequalities remain in access to assistive technology, particularly between high-resource and low-resource settings. Cost, infrastructure, workforce capacity, supply chains, policy, maintenance, and repair services all influence whether technologies are available and sustainable in practice (61, 63).

Rehabilitation and assistive technologies for wheelchair users include tools designed to support mobility, positioning, safety, skills training, environmental interaction, monitoring, and remote rehabilitation. The following subsections summarize major technology categories and selected examples.

◇ 8.1. Training and Skill Acquisition Technologies

a) Virtual Reality (VR) Systems: Immersive or screen-based virtual environments can simulate wheelchair propulsion or driving, turning, stopping, navigation, and obstacle-avoidance tasks. They provide a safe, controlled, and repeatable setting in which task difficulty and feedback can be adjusted according to the user's performance (66–69).

b) Augmented Reality (AR): AR systems superimpose digital instructions, directional cues, or performance feedback onto the user's view of the real environment. Although AR may support wheelchair navigation and skill acquisition, its clinical application remains less established than that of VR.

c) Wheelchair Simulators: Wheelchair simulators reproduce selected characteristics of manual or powered wheelchair mobility using computer displays, head-mounted displays, motion sensors, rollers, joysticks, or mechanical platforms. They can support training and assessment while reducing the risks associated with practising unfamiliar tasks in real environments (66,68).

Virtual reality-based wheelchair training uses interactive computer-generated environments to simulate wheelchair mobility tasks. Depending on the system, training may involve manual wheelchair propulsion or powered-wheelchair driving, including starting, stopping, turning, navigating confined spaces, and avoiding obstacles. Its principal advantages are safe and repeatable practice, adjustable task difficulty, immediate performance feedback, and the possibility of practising situations that may initially be difficult or unsafe in real environments (65–68).

The use of VR in wheelchair training is consistent with motor-learning principles such as task-specific repetition, graded progression, feedback, active problem-solving, and practice within varied environmental contexts. However, performance achieved in a virtual environment should not automatically be interpreted as equivalent to real-world wheelchair performance. Transfer should be evaluated through subsequent practice and assessment using the individual's wheelchair in real-world environments (66–68).

Studies of wheelchair simulators have reported that virtual environments can support the practice or assessment of wheelchair manoeuvring tasks. However, the available findings vary according to wheelchair type, simulator design, display method, participant group, and outcome measure. Therefore, current evidence should be interpreted as promising but not conclusive (65,67,69).

VR-based activities may also increase enjoyment and engagement in some rehabilitation populations. Nevertheless, enjoyment or perceived motivation should be distinguished from demonstrated improvement in wheelchair mobility skills (68).

Head-mounted displays, motion sensors, physical wheelchair interfaces, and haptic or kinaesthetic feedback may increase the realism of wheelchair simulators. However, increased immersion may also cause cybersickness or discomfort in some users; therefore, simulator tolerance and safety should be monitored individually (65).

Simulation-based wheelchair training is an emerging rehabilitation approach that may support safe, repeatable, and individualised practice. It may be particularly useful during initial training, assessment, or preparation for potentially hazardous mobility tasks. Nevertheless, simulator-based practice should complement rather than replace supervised training and assessment using the individual's wheelchair in real-world environments (65-69).

◇ 8.2. Simulation-Based Wheelchair Use Training

Simulator-based wheelchair training should complement, rather than replace, supervised practice and assessment using the individual's actual wheelchair in real environments. Evidence concerning real-world skill transfer remains limited and varies according to the simulator, wheelchair type, participant characteristics, and training protocol (65–68,70).

Table 9. Overview of stimulation-based wheelchair training.

No.	Aspect	Description
1	Definition	A training or assessment approach that uses virtual, screen-based, or mechanical simulation to practise selected manual or powered wheelchair mobility skills within a controlled environment (65,67,70).
2	Target Users	New or experienced manual or powered wheelchair users, including individuals with spinal cord injury, stroke, cerebral palsy, multiple sclerosis, amputation, brain injury, or other conditions affecting mobility. The appropriate simulator and control interface should be selected according to the user's cognitive, sensory, and motor abilities.
3	Types of Simulation	• Immersive VR systems using head-mounted displays • Screen-based virtual environments • Manual wheelchair simulators using rollers or instrumented wheels • Powered-wheelchair simulators using joysticks or alternative control interfaces • Mechanical platforms providing resistance, motion, or haptic feedback • AR-assisted training systems
4	Training Goals	• Starting, stopping, and speed control • Straight-line propulsion or driving • Turning and manoeuvring in confined spaces • Obstacle detection and avoidance • Indoor and outdoor navigation • Powered-wheelchair control-interface practice • Propulsion-technique training and performance feedback • Cognitive, visual, or dual-task mobility practice

Table 9 (continued). Overview of simulation-based wheelchair training.

5	Key Benefits	• Safe and repeatable practice • Adjustable task difficulty • Immediate visual, auditory, or haptic feedback • Objective performance recording • Practice of potentially hazardous situations without direct environmental risk • Potential improvements in engagement and confidence • Opportunities for clinician observation and assessment (65–68,70).
6	Limitations	• Virtual performance may not fully transfer to real-world wheelchair mobility • Some systems provide limited physical or environmental feedback • Head-mounted displays may cause cybersickness, visual discomfort, or disorientation • Equipment, software, and maintenance costs may be high • Systems may require trained personnel and individual calibration • Simulator accessibility may be limited for users with sensory, cognitive, or severe motor impairments (65–67).
7	Evidence from Literature	• Alapakkam Govindarajan et al. (2022): A manual wheelchair simulator was considered potentially useful for wheelchair-skills training; head-mounted display use increased the sense of presence but also increased cybersickness symptoms (65). • Levac et al. (2015): VR-based motor learning may benefit from task-specific practice, repetition, feedback, and carefully planned transfer to real environments (66). • Alshaer et al. (2020): A VR powered-wheelchair simulator enabled clinicians to observe and assess driving tasks in a controlled virtual environment (68). • Kwon et al. (2023): A VR power-mobility simulator provided a safe and objective method for assessing driving capacity in people with brain diseases (69).

Table 9 (continued). Overview of simulation-based wheelchair training.

8	Common Settings	• Inpatient and outpatient rehabilitation • Wheelchair service and assessment centres • Paediatric and adult rehabilitation • University and research laboratories • Clinical education and professional training • Home-based or remotely supervised rehabilitation where technically appropriate
9	Example Tools	• Manual wheelchair roller simulators • Instrumented wheels and pushrim sensors • VR headsets or computer-screen displays • Joystick-controlled powered-wheelchair simulators • Motion-tracking and pressure-sensing systems • Custom wheelchair-training software
Abbreviations: AR, augmented reality; VR, virtual reality.		

◇ 8.3. Adaptive and Assistive Mobility Technologies

- a) **Power-Assist Devices:** Power-assist systems add motorised assistance to a manual wheelchair while allowing the user to retain manual control. They may reduce the physical effort required for propulsion, particularly during ramp ascent, long-distance mobility, or movement over high-resistance surfaces. Device selection should consider the user's functional capacity, wheelchair compatibility, environmental requirements, and ability to operate the system safely (59,60)
- b) **Smart Wheelchairs:** Smart wheelchairs integrate sensors, computer-based control, and assistive functions to support mobility. Depending on the system, these functions may include obstacle detection, collision avoidance, route planning, environmental monitoring, semi-autonomous navigation, or autonomous navigation. Such systems may be particularly valuable for users whose motor, sensory, or cognitive impairments make conventional wheelchair control difficult (64,71).
- c) **Alternative Control Interfaces:** Users who cannot operate a conventional joystick or manually propel a wheelchair may use alternative interfaces such as sip-and-puff systems, head arrays, chin controls, switches, eye-gaze systems,

electromyographic controls, or brain–computer interfaces. The selected interface should match the user’s reliable voluntary movements, cognitive and sensory abilities, postural control, fatigue level, and intended environment of use (71).

Adaptive mobility technologies should be selected through an individualised assessment and configured by appropriately trained professionals. Training should include starting and stopping, speed control, emergency procedures, obstacle negotiation, battery management where applicable, and recognition of situations in which the device should not be used. Technological assistance should enhance rather than unnecessarily restricting the user’s independent control.

◇ 8.4. Monitoring and Feedback Systems

- a) **Smart Cushions and Pressure Monitoring:** Pressure-sensing cushions or mats measure the distribution and duration of pressure at the wheelchair–user interface. Some systems provide alerts when sustained or asymmetrical pressure is detected and may support pressure-relief education, seating assessment, and monitoring. However, these systems do not replace regular skin inspection, appropriate cushion prescription, postural assessment, or individualised pressure-management strategies.
- b) **Biofeedback Tools:** Biofeedback systems provide real-time visual, auditory, or haptic information about variables such as posture, pressure distribution, propulsion force, push frequency, contact angle, trunk movement, or wheelchair speed. This feedback may help users modify propulsion techniques, improve postural control, and recognise potentially inefficient or harmful movement patterns.
- c) **Wheelchair Activity-Monitoring Systems:** Wheel-mounted sensors, accelerometers, inertial measurement units, and wearable devices can record distance travel, speed, propulsion bouts, movement duration, and daily activity patterns. These data may support clinical follow-up, training evaluation, research, and the development of individualised mobility goals.

◇ 8.5. Telerehabilitation Technologies

Telerehabilitation technologies enable wheelchair education, consultation, training, and selected forms of assessment to be delivered remotely. Synchronous methods may involve videoconferencing and real-time feedback from a rehabilitation professional or trained peer, whereas asynchronous methods may include recorded demonstrations, digital educational materials, exercise programmes, and uploaded performance videos. A community-based eHealth programme combining virtual peer-training sessions with a tablet-based home-training application has demonstrated improvements in community participation and manual wheelchair-skills capacity (70).

Telerehabilitation may improve access for users who experience geographical, transportation, or service-related barriers. However, remote delivery may be inappropriate for wheelchair skills involving a substantial risk of falling or injury unless a trained spotter, appropriate equipment, and a safe practice environment are available. Internet access, digital literacy, privacy, data security, and emergency procedures should also be considered (42,70).

◇ 8.6. Mobile Applications and Smart Tools

Mobile applications and connected digital tools may support wheelchair users by recording mobility and physical-activity data, providing wheelchair-maintenance or battery reminders, prompting pressure-relief activities, supporting accessible route planning, and enabling interaction with smart-home systems. Some applications may also provide educational materials, wheelchair-skills checklists, or communication with rehabilitation professionals (61,64,70). Their accessibility, data accuracy, usability, compatibility, privacy protections, and data-security characteristics should be evaluated before clinical recommendation.

◇ 8.7. Emerging Technologies

Emerging wheelchair-related technologies include wheelchair-exoskeleton hybrid systems, shared-control and autonomous navigation, computer-vision-based obstacle detection, robotic mobility assistance, advanced alternative control interfaces, and haptic systems that communicate environmental information. These technologies may expand mobility options for users with complex motor or sensory impairments. However, many remain at the prototype or early clinical-evaluation stage, and further evidence is required concerning their safety, effectiveness, usability, affordability, maintenance requirements, and long-term use (61,64,71).

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Appendix 1: COMMON PRINCIPLES FOR THE TRAINING AND ASSESSMENT OF WHEELCHAIR SKILLS

1. Purpose and Scope

This section explains the common principles to be applied in the training and assessment of all wheelchair skills included in this book. Skill-specific techniques, teaching methods, and assessment criteria are presented in the relevant skill sections.

Assessment and training are complementary processes. The initial assessment identifies the user's current skill level, safety requirements, and training priorities. Reassessment under the same conditions after training enables changes in performance, safety, and self-confidence to be monitored.

The aim is not for every user to apply the same technique, but to develop a method that is safe, functional, efficient, and suited to the individual needs of each user.

1.2. Preparation Before Training and Assessment

Before each session, the user, wheelchair, and environment should be checked.

Assessment of the User

The following characteristics should be considered:

- sitting balance and trunk control;
- upper-extremity strength and joint range of motion;
- hand function and grip;
- sensation, coordination, and motor control;
- vision, hearing, and cognitive functions;
- pain, fatigue, fear, or anxiety;
- previous falls and injuries;
- shoulder, elbow, and wrist problems; and
- the user's health status and mobility goals.

If the user's health status is not suitable for safe practice, the skill should be postponed or adapted, or an appropriate health assessment should be obtained.

Wheelchair Inspection

The following components should be checked:

- the wheelchair's general condition and stability;
- tyres, rear wheels, and casters;
- brakes;
- footrests and armrests;
- cushion and seating system;
- removable components;
- anti-tip devices; and
- postural supports in use.

If a problem affecting safety is identified, the necessary adjustment should be made before practice begins.

Environmental Inspection

The practice area should provide sufficient space, be well lit, have surface characteristics appropriate to the skill, and be free from unnecessary obstacles. Initial training should take place in a quiet and controlled environment. Practice may progress to real-life conditions as the user's skills develop.

1.3. Assessment Method

The initial assessment should be conducted before training is provided. The assessor should explain the task clearly but should not teach the technique or provide guiding cues during performance.

For each task, the following information specified in the relevant section should be used:

- practice environment;
- starting conditions;
- task description;
- successful performance criteria; and
- safety characteristics.

If the user misunderstands the instruction, the task may be explained once more. The reason for the additional attempt should be recorded.

Self-Perceived Capacity and Confidence

Before performing the skill, the user may be asked:

“Do you think you can perform this skill safely?”

The response may be recorded as “Yes,” “No,” or “Not sure.” When necessary, confidence may be rated from 0 to 10, where 0 means “not confident at all” and 10 means “completely confident.”

The user’s self-assessment should be recorded separately from the observed performance.

1.4. Recording the Results

Performance Outcome

- **Successful:** The user completes the task while meeting the skill-specific criteria.
- **Unsuccessful:** The user cannot complete the task or requires physical assistance to do so.
- **Not attempted:** The task is not performed because of health status, pain, fear, fatigue, environmental conditions, or equipment problems.
- **Not applicable:** The task is unsuitable because of the user’s wheelchair type, physical characteristics, or living conditions.

Safety Outcome

- **Safe:** The user maintains postural and wheelchair control throughout the movement without creating a significant hazard.
- **Unsafe:** A risk of falling, tipping, collision, loss of control, or injury occurs.

If the assessor must intervene physically to prevent a fall or injury, the performance should be recorded as “unsafe.”

Level of Assistance

- **Independent:** No verbal or physical assistance is required.
- **With verbal guidance:** A brief reminder or cue is required.
- **Under supervision:** Close safety supervision is required without physical contact.
- **With partial physical assistance:** Physical assistance is required during part of the task.

- **With full physical assistance:** Substantial physical assistance is required throughout the task.
- **Terminated by safety intervention:** The assessor intervenes to prevent a fall, tipping, or injury.

All verbal and physical assistance provided should be recorded.

1.5. Training Approach

Training should be user-centred and progressive:

1. Explain the purpose of the skill in daily life.
2. Demonstrate the technique from an appropriate angle.
3. Divide the task into smaller components when necessary.
4. Allow the user to practise under safe conditions.
5. Provide brief and clear verbal cues.
6. Give feedback on one or two priority problems during each attempt.
7. Gradually reduce assistance as the user's performance improves.
8. Progress the skill from a controlled environment to real-life conditions.
9. Reassess the skill after training using the same criteria.

Too many instructions should not be given at the same time. Demonstration, verbal explanation, and physical guidance should be selected according to the user's learning needs.

Position of the Instructor

The instructor should remain in a position that permits intervention when necessary without obstructing the user's movement. The appropriate position should be determined according to the difficulty of the skill, the user's trunk control, wheelchair characteristics, and tipping risk.

The instructor should not routinely push or pull the wheelchair. Physical intervention should be used only when it is part of planned teaching or is necessary to maintain safety.

Individualisation

Training may be adapted by:

- reducing the distance, duration, or obstacle height;

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- dividing the task into smaller stages;
 - providing additional rest;
 - using visual markings or verbal cues;
 - simplifying the environment;
 - using appropriate assistive equipment; and
 - modifying the level of assistance.

Adaptation should not eliminate the purpose of the skill or its fundamental safety criteria.

1.6. Attempt and Stopping Criteria

Under normal assessment conditions, a maximum of two attempts may be allowed. A second attempt may be used when the instruction was misunderstood, a temporary environmental problem occurred, a minor equipment problem was present, or performance requires confirmation. The reason should be recorded.

Practice should be stopped in the following situations:

- risk of falling or tipping;
- marked loss of control;
- chest pain or severe shortness of breath;
- dizziness, nausea, or altered consciousness;
- new or increasing severe pain;
- unusual weakness;
- equipment failure;
- deterioration of environmental safety; or
- the user asks to stop.

Safety takes priority over completing the task or using the permitted number of attempts.

1.7. Reassessment

After training has been completed, the skills should be reassessed under conditions similar to the initial assessment. The following changes should be compared:

- performance outcome;

-
- safety;
 - level of assistance;
 - technique and movement control;
 - completion time;
 - pain and fatigue;
 - self-confidence; and
 - transfer of the skill to daily life.

Progress should be evaluated not only according to whether the task is completed, but also according to whether it is performed more safely, with greater control and efficiency, and with less assistance.

2. TRAINING AND ASSESSMENT OF WHEELCHAIR SKILLS ACCORDING TO LEVEL

2.1. Basic-Level Skills

Basic-level skills include the initial skills required for a wheelchair user to move safely, with control, and as independently as possible in level and obstacle-free environments. These skills provide the foundation for learning more complex activities, including changing direction, passing through doors, travelling over different surfaces, using ramps, and negotiating environmental obstacles.

2.1.1. Moving Forwards and Backwards on Level Ground

Moving forwards and backwards on level ground is fundamental to manual wheelchair use. This skill includes moving the wheelchair in a straight line, maintaining direction and speed, monitoring the environment, and stopping safely at a designated point. An effective propulsion technique facilitates movement while also helping to reduce the load placed on the upper extremities.

Learning Objectives

After completing the training, the user is expected to be able to:

- move the wheelchair forwards and backwards;
- maintain a straight line of travel;

- adjust speed according to environmental conditions;
- use an effective propulsion technique while moving forwards;
- monitor the environment before and during backward movement; and
- stop with control at a designated point.

Environment and Equipment

Practice should take place on a level, firm, dry, and obstacle-free surface. A course approximately 1.2 m wide may be used, with a distance of 10 m for forward movement and 5 m for backward movement. The start and finish lines should be clearly marked on the ground. Initial practice should take place in a quiet and spacious environment, progressing to real-life conditions as the skill develops.

Technique and Teaching

Before moving forwards, the user should assume a balanced and upright sitting position and check that the feet are supported and the route is clear. The hands are placed at a comfortable starting point on the rear-wheel pushrims. Similar force should be applied through both arms to move the wheelchair in a straight line.

Long and fluid pushes suited to the user's capacity should be preferred to short and frequent pushes. After each push, the hands should relax and return to the starting position for the next push. If the wheelchair moves towards one side, the force applied by each arm, hand placement, and wheelchair configuration should be checked. The user should not lose directional control when increasing speed. To stop, progressively increasing and balanced friction should be applied to both pushrims simultaneously.

Before moving backwards, the user should look over the shoulder and check the area behind the wheelchair. Both pushrims should be pulled backwards simultaneously and with control. During movement, the user should repeatedly check the area behind and make small hand movements to correct direction. Backward movement should be performed at a low speed, avoiding sudden and forceful pulls.

Forward and backward movement should initially be practised over short distances. The distance may be increased as the user becomes able to maintain direction and speed. Practice should be stopped and the technique reassessed if pain, excessive fatigue, or loss of control develops.

► **Moving Forward – 10 m**

 **Watch the video demonstration**

► **Moving Backward – 5 m**

 **Watch the video demonstration**

Suggested Verbal Cues

- “Check your route.”
- “Apply equal force with both hands.”
- “Use long and controlled pushes.”
- “Look ahead and maintain your direction.”
- “Check behind you before moving backwards.”
- “Correct your direction using small movements.”
- “Stop with control using both hands.”

Assessment

Assessed task	Procedure	Successful performance
Moving forwards	The user moves forwards for 10 m from the starting line and stops after crossing the finish line.	The user remains within the course boundaries, controls direction and speed, and stops safely at the finish.
Moving backwards	The user checks the area behind, moves backwards for 5 m, and stops at the designated point.	The user continues to monitor the environment, remains within the course boundaries, and completes the task without losing control.

During assessment, the user’s sitting position, hand placement, bilateral coordination of the pushes, directional control, environmental monitoring during backward movement, and stopping technique should be observed. The need for physical assistance and the safety outcome should also be recorded according to the common assessment principles.

If forward propulsion time is assessed, timing should begin when the wheelchair starts moving from the starting line and stop when the casters cross the finish line. Time should be recorded separately from the performance outcome; safety and movement control should not be compromised for speed.

► **Timed 10 m Forward Propulsion**

 **Watch the video demonstration**

Common Problems and Training Strategies

Observed problem	Possible cause	Recommended training strategy
The wheelchair moves towards one side	Difference in force or movement between the arms, or inappropriate wheelchair configuration	Check hand placement and the force applied through both arms; assess the wheelchair configuration when necessary
The user performs short and frequent pushes	Releasing the pushrim too early or hesitancy during movement	Practise longer and smoother pushes at a low speed
Trunk control decreases during propulsion	Excessive forward reaching or an inappropriate sitting position	Correct the sitting position and reduce the propulsion arc
The user does not check behind before moving backwards	Inadequate environmental awareness	Teach the “look-move-look again” sequence
The wheelchair changes direction while moving backwards	Lack of synchronisation between the hands	Practise small, simultaneous hand movements at a low speed
The user stops suddenly	Uneven or excessive force on the pushrims	Practise applying progressively increasing force to both pushrims simultaneously

Skill Progression

The skill may be progressed by:

- increasing the distance;
- reducing visual markings;
- using different firm surfaces;
- adding turns and planned stopping points;
- moving through narrower areas; and
- practising in real-life environments.

Distance and speed should be increased only when the user can maintain directional control, monitor the environment, and stop safely.

► Forward Propulsion Over 100

m

 **Watch the video demonstration**

Skill-Specific Recording

The following should be recorded:

- completion of the 10 m forward movement;
- completion time, when measured;
- completion of the 5 m backward movement;
- directional and speed control;
- environmental monitoring during backward movement;
- stopping control;
- pain or fatigue; and
- level of assistance required.

2.1.2. Changing Direction and Manoeuvring on Level Ground

This skill group covers turning right and left on level ground, changing direction within a confined area, and positioning the wheelchair laterally by combining small forward and backward movements. Changing direction and maneuvering are fundamental to daily activities such as passing through doors, approaching a table or bed, preparing for a transfer, and moving within confined spaces.

Learning Objectives

After completing the training, the wheelchair user is expected to be able to:

- turn 90° to the right and left while moving forwards and backwards;
- turn 180° to the right and left within a confined area;
- position the wheelchair laterally by combining small forward and backward movements;
- control direction, speed, and posture while turning; and
- complete the manoeuvre without colliding with surrounding objects.

Environment and Equipment

Practice should take place on a level, firm, and obstacle-free surface. Turning directions and movement boundaries may be marked using clearly visible lines on the ground. An area approximately 120 cm wide should be prepared for 90° turns, while an area approximately 1.5 × 1.5 m should be used for 180° turns.

For lateral manoeuvring, a starting line should be marked parallel to the target surface, and the permitted forward and backward movement area should be defined. Ground markings used during initial practice may be reduced as the user develops better directional and distance control.

Technique and Teaching

Before turning, the user should look in the intended direction of travel, assess the available space, and approach the turning area at a controlled speed. Turning is achieved by applying different amounts or directions of force to the right and left wheels.

To turn right, greater forward force is applied to the left pushrim than to the right. The opposite is used for a left turn. For a wide turn, the inside wheel moves more slowly while the outside wheel is pushed forwards. When a tighter turn is required, the inside wheel may be stopped or moved backwards.

When turning during backward movement, the user should check the area behind before and throughout the manoeuvre. Backward turns should be performed at a low speed using small hand movements. The user should consider not only wheel movement but also the space occupied by the footrests, rear wheels, and other wheelchair components.

During a 180° turn in a confined area, the outside wheel is moved forwards while the inside wheel moves more slowly or, when necessary, backwards. The turn may be completed using small, consecutive movements rather than one large, uncontrolled movement. Turning to the right and left should be practised separately.

Because a wheelchair cannot move directly sideways, lateral manoeuvring is performed by combining small forward and backward turns. The user first moves the front of the wheelchair towards the target surface and then uses a small backward movement in the opposite direction to bring the rear of the wheelchair closer. These movements are repeated until the wheelchair is at an appropriate distance from and approximately parallel to the target surface.

Initial practice should take place within a spacious area and at a low speed. As control develops, the turning area may be reduced, visual markings may be removed, and manoeuvres may be practised in real-life environments.

► **Making a 90° Turn While Moving Forward**

 **Watch the video demonstration**

► **Turning While Moving Backward**

 **Watch the video demonstration**

► Lateral Manoeuvring

 **Watch the video demonstration**

► Making a 180° Turn to the Right and Left

 **Watch the video demonstration**

Suggested Verbal Cues

- “Look in the direction you are turning.”
- “Slow down as you approach the turn.”
- “Move the inside and outside wheels at different speeds.”
- “Check behind you while moving backwards.”
- “Use small and controlled movements.”
- “Check the distance and angle of the wheelchair.”
- “Position the wheelchair parallel to the target.”

Assessment

The following tasks should be assessed separately for right and left directions: During assessment, the user should also be observed for environmental checking before the turn, adjustment of speed to the available space, awareness of the space occupied by the footrests and rear of the wheelchair, and completion of the manoeuvre without collision or loss of control. Differences between right- and left-sided performance should be recorded separately.

Assessed task	Procedure	Successful performance
90° turn while moving forwards	While moving forwards, the user turns right or left within the marked area and continues in the new direction.	The turn is completed at a controlled speed, the wheelchair remains within the boundaries, and the new direction of travel is maintained.
90° turn while moving backwards	The user checks the area behind, moves backwards, and turns in the specified direction.	Environmental monitoring is maintained, the turn is completed within the boundaries, and the user stops with control.
180° turn within a confined area	The user turns to face the opposite direction within an area measuring approximately 1.5 × 1.5 m.	The wheelchair remains within the area, does not contact the surrounding boundaries, and completes an approximately 180° turn.
Lateral manoeuvre	Using small forward and backward movements, the user positions the wheelchair towards the right or left.	The forward and backward boundaries are not exceeded, the wheelchair does not contact the target surface, and it finishes at an appropriate distance from and approximately parallel to the target.

Common Problems and Training Strategies

Observed problem	Possible cause	Recommended training strategy
The user enters the turning area too quickly	Speed is reduced too late or the turn is planned too late	Use a clearly marked slowing point before the turn
The turn is too wide	The inside wheel is not slowed sufficiently	Practise the roles of the inside and outside hands separately
The wheelchair moves beyond the turning boundaries	Inappropriate starting position or delayed initiation of the turn	Correct the starting position and begin the turn earlier
The user turns comfortably in only one direction	Differences in strength, coordination, habit, or fear	Assess both directions separately and provide additional practice in the more difficult direction
The user does not check behind during a backward turn	Inadequate environmental awareness	Teach the “look-move-look again” sequence
Too many corrections are made during a 180° turn	Inadequate hand coordination or turn planning	Practise in a larger area first and reduce the area as control develops
The wheelchair collides with the target during lateral manoeuvring	Incorrect distance judgement or excessively large movements	Use visual distance markers and reduce the size of the movements
The wheelchair is not parallel to the target after lateral manoeuvring	The front and rear of the wheelchair have not been moved equally towards the target	Have the user check the distance and wheelchair angle after each movement

Skill Progression

The skill may be progressed by gradually reducing the turning area, removing ground markings, combining consecutive forward and backward movements, and approaching real-life targets such as tables, beds, and doors. Practice may then include consecutive turns in different directions, stopping at a designated point after manoeuvring, and performing the skill in environments with safe distractions.

Before the level of difficulty is increased, the user should demonstrate adequate speed, directional, and postural control in both directions.

2.1.3. Reaching, Retrieving Objects, and Weight Shifting in a Seated Position

This skill group covers reaching objects at different heights while maintaining a seated position, retrieving an object from the floor, and shifting body weight in a controlled manner to reduce pressure over the pelvic region. These skills are important for participation in daily activities, independent access to objects, maintenance of postural control, and reduction of pressure-related risks associated with prolonged sitting.

Learning Objectives

After completing the training, the user is expected to be able to:

- position the wheelchair appropriately in relation to the target before reaching;
- use the brakes when necessary;
- check the stability of the support surface and assess environmental risks;
- maintain sitting balance while reaching in different directions;
- grasp an object safely;
- return to an upright sitting position with control;
- shift body weight to reduce pressure over the pelvic region; and
- recognise the limits of their physical capacity.

Environment and Equipment

Practice should take place on a level, firm, and obstacle-free surface. The wheelchair brakes should be functional, and the stability of any support surfaces should be checked.

For reaching a high object, a lightweight and easily grasped object may be placed at a height of approximately 1.5 m. For retrieving an object from the floor, an object measuring approximately 5 × 10 × 10 cm, weighing approximately 0.2 kg, and having no sharp edges may be used. The height and distance of the objects should be adapted according to the user's height, arm length, joint range of motion, and trunk control.

Technique and Teaching

Before reaching, the user should assess the target's location and distance and identify any surrounding hazards. To avoid excessive reaching, the wheelchair should be moved as close as possible to the target and positioned at an appropriate angle. Depending on the selected technique, the brakes should be locked, the feet supported, and the stability of the intended support point checked.

When reaching for an object at height, the user may use one hand for support on an armrest, the seat, or another stable support point while reaching towards the object with the other hand. The pelvis should maintain safe contact with the seat, and the trunk should not move forwards or sideways without control. After grasping the object, the user should return to an upright sitting position without making a sudden movement.

When retrieving an object from the floor, the wheelchair should be moved as close as possible to the object. Approaching the object slightly from the side may be safer than leaning excessively forwards. The user may support themselves with one hand on a stable part of the wheelchair while reaching for the object with the other. The head and trunk are lowered with control, the object is grasped, and the user slowly returns to an upright sitting position.

During initial practice, objects should be positioned close to the user and on a raised surface. As control develops, the distance may be increased and the height gradually reduced. If the object cannot be reached safely, an appropriate reaching aid should be used or assistance requested.

To reduce pressure, the user may shift body weight forwards, to the right, or to the left. If upper-extremity strength and shoulder health permit, the pelvis may be partially lifted using the armrests or stable support surfaces. However, a full pelvic lift is neither

necessary nor appropriate for every user. Tilt or repositioning mechanisms may also be used when available on the wheelchair.

Before weight shifting, the brakes should be locked and the feet supported. The user should slowly shift weight in the intended direction, maintain the position for as long as it remains safe and tolerable, and return to the midline with control. The user should not hold their breath. Practice should be stopped if pain, dizziness, skin friction, or excessive fatigue occurs.

Pressure-relief techniques alone do not prevent pressure injuries. They should be used together with an appropriate seating system and cushion, regular skin inspection, and an individualised pressure-management plan.

► Reaching for an Object at a Height of Approximately 1.5 m

 Watch the video demonstration

► Retrieving an Object from the Floor

 Watch the video demonstration

► Weight Shifting and Pressure Relief While Sitting

 Watch the video demonstration

Suggested Verbal Cues

- “Move your wheelchair closer to the target first.”
- “Lock the brakes.”
- “Use a stable support point.”
- “Reach with control.”
- “Grasp the object safely.”
- “Return slowly to an upright position.”
- “Shift your weight with control.”
- “Do not hold your breath.”
- “Return slowly to the midline.”

Assessment

Assessed task	Procedure	Successful performance
Reaching an object at height	The user positions the wheelchair appropriately in relation to a target at a height of approximately 1.5 m and touches or retrieves the object.	The wheelchair is controlled, the target is reached without excessive extension, and the user returns to a balanced sitting position.
Retrieving an object from the floor	The user moves the wheelchair closer to the object, retrieves it from the floor, and returns to an upright sitting position.	The object is grasped safely and not dropped, and the task is completed without loss of movement control.
Weight shifting	The user shifts body weight forwards or sideways, maintains the position for as long as tolerated, and returns to the midline.	The load over the targeted pelvic region is reduced, wheelchair and postural control are maintained, and the user returns safely to the starting position.

During assessment, wheelchair positioning, brake use, the selected support point, postural control, grasping and releasing the object, return to a safe sitting position, and any symptoms arising during the task should be observed. The weight-shifting method, direction, and duration for which it can be maintained should also be recorded.

Common Problems and Training Strategies

Observed problem	Possible cause	Recommended training strategy
The user reaches excessively towards the target	The wheelchair is too far from the target	Move the wheelchair closer before reaching
The wheelchair moves during reaching	The brakes are not used or are inadequate	Check brake function and teach appropriate use
The user loses balance	The target is too far away, trunk control is inadequate, or no support is used	Move the target closer, reduce the movement range, and use stable support
The user cannot grasp the object	Limited hand function or an unsuitable object shape	Use a larger, more easily grasped object or an appropriate gripping aid
The user leans excessively forwards to retrieve an object from the floor	The wheelchair is not positioned appropriately	Teach a side approach or the use of a reaching aid
The user cannot return to an upright position	Inadequate trunk or upper-extremity strength	Reduce the reaching distance and use a more appropriate support point
Weight shifting is insufficient	Limited strength or range of motion	Select an alternative method, such as forward or lateral leaning, and assess the seating system
Excessive load is placed on the shoulders	A full pelvic lift is inappropriate for the user	Use forward or lateral weight shifting instead of a full lift
The user slides while shifting weight	Uncontrolled movement or an unsuitable sitting surface	Slow the movement and review the cushion and seating system

Skill Progression

The skill may be progressed by changing the direction and height of the target, using lightweight objects of different sizes and shapes, moving an object from one surface to another, and practising in real-life environments. Weight-shifting methods should be incorporated into the user's daily routine, and the user should be taught to request assistance when an object cannot be reached safely.

When increasing the level of difficulty, the user's postural control, grasping ability, shoulder health, and fall risk should be considered.

2.1.4. Approaching, Opening, and Passing Through a Door

Passing through a door includes assessing the direction in which the door opens and the surrounding space, positioning the wheelchair appropriately, operating the door

handle, and moving through the opening without colliding with the door panel. The technique is affected by whether the door must be pushed or pulled, the width of the opening, the presence of a threshold, and whether the door closes automatically.

Learning Objectives

After completing the training, the user is expected to be able to:

- assess the direction in which the door opens and the available passage space;
- position the wheelchair at an appropriate angle and distance from the door;
- reach the door handle safely;
- control both push and pull doors;
- pass through a narrow doorway without collision;
- close the door with control; and
- request assistance when a safe passage is not possible.

Environment and Equipment

Initial practice should use a lightweight, easily operated door that closes slowly. Sufficient space should be available on both sides of the door for positioning and manoeuvring the wheelchair. The door handle should be accessible, and the floor should be free from slippery areas, high thresholds, or objects obstructing the passage.

Push and pull doors should be practised separately. As the user's control develops, narrower openings, different door handles, self-closing doors, and low thresholds may be introduced.

Technique and Teaching

Before approaching the door, the user should assess the direction in which it opens, the position of the handle, the width of the opening, the presence of a threshold, and the available space on the other side. The wheelchair should be positioned so that the user can reach the handle without excessive extension and remains outside the path of the moving door panel.

Forward-Opening Push Door

The user approaches the push door at a controlled speed and positions the wheelchair within reach of the handle. After operating the handle, the user pushes the

door with the hand, forearm, or a safe part of the wheelchair. Once the opening is sufficiently wide, the wheelchair is moved through without contacting the door panel or frame. If the door tends to close, the user should continue controlling it throughout the passage.

Pull Door Opening Towards the User

For a pull door, sufficient space should be left for the door panel to open. The user grasps the handle and pulls the door while moving the wheelchair backwards in small increments to clear the path of the door panel. Once the opening is sufficiently wide, the wheelchair is redirected and moved through. The wheelchair should not move backwards without control, and the user's hand should not become trapped between the door and frame.

Passing Through a Narrow Doorway

The user should approach a narrow doorway as straight as possible. The widest components of the wheelchair—including the rear wheels, pushrims, armrests, and footrests—should be considered. If necessary, the wheelchair should be realigned using small forward and backward movements before entering the opening. The hands should not extend beyond the pushrims, and the fingers should be kept clear of the door frame to prevent injury.

Assessed task	Procedure	Successful performance
Opening and passing through a push door	The user approaches a door that opens forwards, pushes it open, and moves through the doorway.	The door is opened with control, the wheelchair is positioned appropriately, and the user passes through without striking the door panel or frame.
Opening and passing through a pull door	The user pulls the door towards themselves, moves the wheelchair out of the path of the door panel, and passes through.	The door and wheelchair are controlled together, and the user completes the passage without trapping the hand, foot, or wheelchair components.
Passing through a narrow doorway	The user aligns the wheelchair with the opening and moves through with control.	The wheelchair, hands, elbows, and footrests pass through without striking the frame.
Closing the door	After passing through, the user assumes an appropriate position and closes the door.	The door is closed without uncontrolled movement or risk of entrapment.

During assessment, the assessor should observe whether the user identifies the door's opening direction, positions the wheelchair appropriately, reaches the handle

safely, controls the door panel, avoids contact during passage, and uses an appropriate closing technique. Push and pull doors should be assessed separately.

Common Problems and Training Strategies

Observed problem	Possible cause	Recommended training strategy
The user reaches excessively towards the door handle	The wheelchair is too far from the handle	Position the wheelchair closer to the handle and at an appropriate angle
The door closes onto the wheelchair	The door is not opened sufficiently or its closing speed cannot be controlled	Begin with a lightweight, slow-closing door and increase the duration for which the user controls it
The wheelchair becomes trapped while a pull door is opened	The wheelchair remains within the path of the door panel	Teach the user to create space for the door panel using small backward movements
The user's hand is at risk of entrapment	The hand is placed too close to the door edge or frame	Demonstrate safe grasping points and keep the fingers away from the door edge
The footrests strike the door or frame	The wheelchair is not aligned appropriately with the opening	Align the wheelchair straight before entering the doorway
A rear wheel or pushrim rubs against the frame	The wheelchair's width or rear section is not considered sufficiently	Teach the user to identify the wheelchair's widest point and understand the path followed by the rear wheels
The user cannot reach the handle after passing through	The final position was not planned in advance	Identify the final position required to close the door before beginning the passage
The door is too heavy for the user	Door weight or resistance from the closing mechanism	Use an alternative entrance, modify the environment, or request assistance

Skill Progression

The skill may be progressed by using doors that open in different directions, different types of handles, narrower openings, low thresholds, and controlled closing mechanisms. Opening the door, passing through, and closing it may subsequently be practised as one continuous task.

When increasing the level of difficulty, the door's weight, closing speed, available passage space, threshold height, and the user's reaching and manoeuvring capacity should be considered.

2.1.5. Travelling Over Different Surfaces and Negotiating Small Obstacles

Travelling over different surfaces includes maintaining wheelchair control on uneven firm surfaces, soft surfaces such as grass or carpeting, and when crossing small thresholds or surface gaps. As surface resistance and irregularity increase, greater force may be required for propulsion, and there may be an increased risk of the casters becoming trapped, the wheelchair changing direction, or the user losing balance.

Learning Objectives

After completing the training, the user is expected to be able to:

- assess the firmness, evenness, and suitability of a surface;
- adjust propulsion force and speed according to the surface;
- maintain direction on uneven and soft surfaces;
- approach a low threshold at an appropriate angle and speed;
- cross a small surface gap safely; and
- select an alternative route or request assistance when a surface is unsafe.

Environment and Equipment

Initial practice should take place in a controlled and obstacle-free environment. A short section of paving, gravel, or uneven ground may be used as a firm but irregular surface. Firm grass, thick carpeting, or a similarly resistant area may be used as a soft surface. For small-obstacle practice, a stable threshold approximately 1–2 cm high and without sharp edges should be used initially.

Surface-gap practice should begin with a narrow gap that will not trap the casters and that the rear wheels can cross safely. Obstacles should be secured, and the practice area should be free from objects that could cause injury in the event of a fall or tipping.

Technique and Teaching

Before entering a new surface, the user should assess its firmness, gradient, moisture, irregularities, and visible obstacles. Whenever possible, the shortest, smoothest, and safest line of travel should be selected.

A low and controlled speed should be used on firm but uneven surfaces. The user should look ahead, plan the path of the wheels, and avoid sudden directional changes.

Trunk balance should be maintained during minor jolts, and the pushrims should not be released completely.

► **Travelling Over an Uneven Surface**

 **Watch the video demonstration**

► **Crossing a 2 cm Threshold**

 **Watch the video demonstration**

► **Ascending and Descending a 2 cm Level Change — Additional Demonstration**

 **Watch the video demonstration**

► **Ascending and Descending a 2 cm Level Change — Alternative Demonstration**

 **Watch the video demonstration**

Because rolling resistance increases on soft surfaces, longer and more forceful pushes may be required. The user should maintain continuous movement whenever possible to prevent an unnecessary loss of speed and should avoid frequent, small directional corrections. If the wheelchair deviates towards one side, the force balance should be corrected using small movements. The user should rest or return to a more suitable route before becoming excessively fatigued.

A low threshold should be approached as close to perpendicular as possible. Very low thresholds may be crossed with controlled forward propulsion. If there is a risk of the casters becoming trapped, briefly shifting weight backwards may reduce the load on them. After the casters have crossed the obstacle, controlled and simultaneous force should be applied to both pushrims to move the rear wheels over it. The wheelchair should not approach the threshold at an oblique angle, as one caster may become trapped and cause the wheelchair to change direction.

When approaching a narrow surface gap, the width and direction of the gap should be assessed. To prevent the casters from entering the gap, the user should approach it perpendicularly while maintaining sufficient but controlled momentum. The load over the casters may be reduced briefly when necessary. Gaps whose width or depth cannot be assessed safely should not be crossed; an alternative route should be used.

► **Travelling Over Different Surfaces and Negotiating Small Obstacles**

 **Watch the video demonstration**

Suggested Verbal Cues

- “Assess the surface first.”
- “Select the smoothest line of travel.”
- “Adjust your speed to the surface.”
- “Use long and controlled pushes.”
- “Approach the obstacle perpendicularly.”
- “Check the path of the casters.”
- “Stop and select another route if it is unsafe.”

Assessment

Assessed task	Procedure	Successful performance
Travelling over a firm, uneven surface	The user travels across the designated surface and stops at the finishing point.	Directional and speed control are maintained without collision, entrapment, or marked loss of balance.
Travelling over a soft surface	The user completes the designated distance over grass, carpeting, or a similarly resistant surface.	Propulsion force is adapted to the surface, movement is maintained, and the wheelchair remains controlled.
Negotiating a low threshold	The user approaches the small threshold appropriately and crosses it.	The threshold is approached approximately perpendicularly, and the casters and rear wheels cross without loss of control.
Crossing a narrow surface gap	The user assesses the gap and moves the wheelchair across it.	The casters do not become trapped, direction is maintained, and the crossing is completed safely.

During assessment, the assessor should observe whether the user inspects the surface in advance, selects an appropriate route, chooses a suitable approach direction, adjusts propulsion force, controls the casters, and decides not to proceed when the crossing is unsafe.

Common Problems and Training Strategies

Observed problem	Possible cause	Recommended training strategy
The wheelchair repeatedly changes direction on an uneven surface	The line of travel was not planned or there is a difference in force between the arms	Select a smoother line and practise small directional corrections
The user cannot travel over a soft surface	The pushes are too short or all momentum is lost	Teach longer and more forceful pushes and use a shorter surface initially
The user becomes fatigued quickly	High surface resistance or inefficient propulsion technique	Reduce the distance, provide rest periods, and consider an alternative route
The casters become trapped at the threshold	The threshold is approached too slowly or at an oblique angle	Approach the threshold perpendicularly and briefly reduce the load over the casters
The rear wheels cannot cross the threshold	Insufficient or asynchronous propulsion	Practise applying controlled force to both pushrims simultaneously
A caster enters the surface gap	Oblique approach or inappropriate speed	Align the wheelchair perpendicular to the gap and maintain controlled momentum
The user continues over an unsafe surface	Inadequate risk assessment	Practise decisions to stop, turn back, and select an alternative route

Skill Progression

The skill may be progressed by increasing the length and irregularity of the surface, using surfaces of different firmness consecutively, and practising small thresholds in real-life environments. Firm ground, carpeting, grass, and small thresholds may be combined within the same course.

When increasing the level of difficulty, surface slipperiness, obstacle stability, caster size, wheelchair characteristics, the user's trunk control, and upper-extremity endurance should be considered.

2.1.6. Travelling on Slopes and Ramps

Ramp skills include ascending and descending different gradients, maintaining direction and speed, stopping with control on a slope, and restarting safely. As the gradient increases, greater force is required to propel the wheelchair upwards, and the risk of backward tipping increases. During descent, the wheelchair may accelerate, creating a risk of the user falling forwards.

Learning Objectives

After completing the training, the user is expected to be able to:

- assess the gradient, length, width, and surface of a ramp;
- adapt ascent and descent techniques according to the gradient;
- maintain direction and speed throughout the ramp;
- stop with control on a slope;
- restart safely after stopping;
- recognise the need for rest or assistance; and
- select an alternative route when a ramp is unsafe.

Environment and Equipment

Initial practice should take place on a dry, non-slip ramp of sufficient width, with clearly defined edges and level surfaces. A short ramp with a gentle gradient should be used initially. The gradient and distance may be increased as the user's control develops.

Safe stopping areas should be available at the beginning and end of the ramp. The side edges, handrails, and potential fall areas should be checked, and the movement of other people within the practice area should be restricted. On steeper ramps, a spotter should remain in a position that allows intervention when necessary without obstructing the user's movement.

Technique and Teaching

Before using a ramp, the user should assess its gradient, surface slipperiness, length, edge protection, and the available space on the upper landing. Practice should not be undertaken on wet, icy, or damaged ramps or on ramps that exceed the user's capacity.

► Travelling Across a Side Slope

 [Watch the video demonstration](#)

Ascending a Ramp

The user should approach the ramp as straight as possible. The trunk is moved slightly forwards, within the user's ability to maintain control, to shift the centre of mass forwards. The pushrims are grasped towards the rear, and balanced force is applied on both sides. Pushes should be regular and sufficiently forceful to prevent the wheelchair from rolling backwards.

Long and fluid pushes may be used on gentle gradients. As the gradient increases, shorter, more frequent, and more forceful pushes may be required. The wheelchair should not roll backwards without control while the hands are repositioned for the next push. The user should consider resting or requesting assistance before becoming excessively fatigued midway up the ramp.

On wide ramps where a straight approach is not possible, travelling diagonally may be considered to reduce the effective gradient. However, this method requires more space and increases the risk of the wheelchair moving sideways. Speed should be reduced at turning points, and the wheelchair should not approach the edges of the ramp.

► **Ascending a Ramp**

 **Watch the video demonstration**

► **Ascending a Steeper Ramp**

 **Watch the video demonstration**

Descending a Ramp

Before beginning the descent, the user should check that the area at the bottom of the ramp is clear. The trunk should remain balanced and may be moved slightly backwards with control when necessary. Both hands should be maintained in similar positions on the pushrims, and speed should be regulated through friction.

The pushrims should not be released completely or gripped suddenly. Applying greater braking force on one side may cause the wheelchair to change direction. If speed increases, the user should regain control before continuing the descent.

Descending backwards may be an alternative for some users on steep ramps. However, this technique should only be taught when the user has appropriate trunk

control and adequate visibility and when trained supervision is available. It should not be used if the user cannot assess the area behind safely.

► Controlled Descent on a Gentle Ramp

 **Watch the video demonstration**

► Descending a Steeper Ramp

 **Watch the video demonstration**

Stopping and Restarting on a Slope

To stop while ascending, the user should grasp both pushrims simultaneously and with control. The hands may be repositioned after the wheelchair has been brought fully under control. If the brakes can be reached safely, they may be used during prolonged stationary periods. However, parking brakes should not be used to stop a moving wheelchair.

To restart, the user moves the trunk forwards appropriately, positions the hands for effective propulsion, and applies force to both sides simultaneously. The first push should be sufficiently firm to prevent the wheelchair from rolling backwards.

To stop during descent, simultaneous and progressively increasing friction should be applied to both pushrims. Sudden stopping should be avoided. If control is lost, the user should attempt to keep the wheelchair travelling straight rather than steering towards the edge of the ramp and should request assistance from the spotter.

Suggested Verbal Cues

- “Check the ramp and the area at the bottom.”
- “Approach the ramp in a straight line.”
- “Move your trunk forwards with control while ascending.”
- “Apply balanced force with both hands.”
- “Do not allow the wheelchair to roll backwards.”
- “Do not release the pushrims while descending.”
- “Control your speed equally with both hands.”

- “Stop or ask for assistance before becoming fatigued.”

Assessment

	Procedure	Successful performance
Ascending a gentle ramp	The user approaches the ramp, travels upwards, and stops on the upper landing.	An appropriate trunk position and propulsion technique are used, direction is maintained, and uncontrolled backward rolling does not occur.
Descending a gentle ramp	The user descends the ramp forwards and stops on the lower landing.	The pushrims are used with control, speed and direction are maintained, and the descent is completed safely.
Ascending a steeper ramp	The user ascends the ramp using the technique taught to them.	The gradient is assessed, an appropriate push frequency is used, and no backward tipping or loss of control occurs.
Descending a steeper ramp	The user applies an appropriate forward or backward descent technique.	Wheelchair direction and speed are maintained, and the user reaches the safe area at the bottom of the ramp.
Stopping and restarting on a slope	The user stops with control on the ramp and then resumes movement.	The wheelchair stops without rolling backwards or accelerating, and movement is restarted with control.

During assessment, the assessor should observe whether the user inspects the ramp in advance, selects an appropriate approach direction, adopts a suitable trunk position, uses an effective propulsion or braking technique, prevents backward rolling, maintains directional control, stops safely on the upper and lower landings, and requests assistance when necessary.

Gentle and steep gradients should be assessed separately. The ramp gradient, length, surface condition, and technique used should be recorded.

Common Problems and Training Strategies

Observed problem	Possible cause	Recommended training strategy
The wheelchair rolls backwards during ascent	Excessive delay between pushes or inappropriate hand placement	Reduce the interval between pushes and position the hands at a more effective starting point
The casters rise from the ramp	The trunk remains too far back or excessive propulsion force is applied	Move the trunk forwards with control and regulate propulsion force
The user becomes fatigued midway up the ramp	The ramp is too long or steep, or the propulsion technique is inefficient	Practise on a shorter ramp, plan rest periods, and consider assistance

Observed problem	Possible cause	Recommended training strategy
The wheelchair moves towards one side	Difference in force between the arms or a cross-slope	Make small directional corrections and balance the force applied through both hands
Speed increases during descent	The pushrims are released or insufficient friction is applied	Practise continuous and balanced speed control on both pushrims
The wheelchair stops suddenly during descent	The pushrims are gripped abruptly	Teach the user to increase braking force progressively
The user cannot restart on the slope	The initial push is insufficient or the hands are positioned ineffectively	Correct the starting hand position and increase the first push with control
The user attempts a ramp that exceeds their capacity	Incorrect assessment of the gradient or distance	Teach pre-ramp risk assessment, selection of an alternative route, and requesting assistance

Skill Progression

The skill may be progressed by gradually increasing ramp length and gradient, practising stopping and restarting on the slope, performing ascent and descent consecutively, and practising on different safe surfaces. Real-life tasks involving a door, turn, or landing may subsequently be combined with ramp use.

Before the level of difficulty is increased, the user should be able to maintain direction and speed, stop with control, and restart safely on a gentle gradient.

► Ascending and Descending a Steeper Ramp — Advanced Demonstration

 [Watch the video demonstration](#)

2.1.7. Controlled Caster Lift and Negotiating Low Level Changes

Briefly lifting the casters is a basic skill used to negotiate thresholds, surface gaps, and level changes approximately 5 cm high. The aim is not to maintain prolonged balance on the rear wheels, but to lift the casters only as much as necessary and lower them with control at the intended point.

Applying excessive force may cause the wheelchair to tip backwards, while an insufficient lift may cause the casters to become trapped against the obstacle. The movement should therefore first be taught on level ground under the supervision of a spotter.

Learning Objectives

After completing the training, the user is expected to be able to:

- lift the casters briefly and with control;
- adjust the lifting height according to the obstacle;
- lower the casters at a designated point;
- cross a small surface gap by lifting the casters;
- ascend and descend a level change approximately 5 cm high; and
- stop and select an alternative method when an obstacle is unsafe.

Environment and Equipment

Initial practice should take place on a level, firm, dry, and obstacle-free surface. Objects that could cause injury in the event of a fall or tipping should be removed. A spotter should stand behind the wheelchair in a position from which the user's trunk or a strong section of the wheelchair can be controlled when necessary.

A target line may initially be marked on the ground. Practice may then progress to a securely fixed narrow surface gap and a stable step approximately 5 cm high with no sharp edges. Anti-tip devices may be used appropriately until the user develops sufficient control; however, it should first be determined whether they restrict the caster-lifting movement.

Technique and Teaching

Brief Caster Lift

The user should sit in a balanced position, support the feet, and check the route. The hands are placed at an appropriate starting point towards the rear of the pushrims. While the wheelchair moves forwards slowly, a brief and firm forward push is applied to both pushrims. When necessary, the trunk may be moved backwards with control to reduce the load over the casters.

The casters should be lifted only high enough to clear the obstacle. The user should maintain control of the pushrims after the movement and lower the casters gently to the ground. The hands should not release the pushrims completely, and the trunk should not be thrown backwards suddenly.

During initial practice, it is sufficient for the casters to lift only slightly from the ground. As movement control develops, lifting height and duration may be increased gradually in small increments.

Lowering the Casters at a Target Point

After lifting the casters, the user reduces the force applied to the pushrims and allows the wheels to descend with control. The casters are lowered onto or immediately beyond the target line. Forceful contact with the ground or landing before the target indicates inadequate control.

Crossing a Small Surface Gap

The wheelchair is positioned approximately perpendicular to the surface gap. The user assesses the width of the gap and the intended crossing line. The casters are lifted immediately before reaching the gap and lowered onto the firm surface on the opposite side. The rear wheels are then moved across the gap using controlled forward propulsion.

If the casters are lowered too early, they may enter the gap. If they are lowered too late, wheelchair control may decrease. The timing of the lift and the crossing speed should therefore be practised together.

Ascending a Level Change of Approximately 5 cm

The user approaches the step approximately perpendicularly. The casters are lifted immediately before reaching the edge and placed on the upper surface. The user moves the trunk forwards with control and applies a strong, simultaneous push to both pushrims to move the rear wheels onto the step.

It is not sufficient for the casters simply to strike the step; they must be positioned securely on the upper surface. Movement should not stop completely when the rear wheels contact the step, but uncontrolled speed should also be avoided.

Descending a Level Change of Approximately 5 cm

The user approaches the edge slowly and approximately perpendicularly. The casters are moved beyond the edge with control and lowered gently onto the lower surface. The user maintains trunk control while moving the rear wheels towards the edge. Without releasing the pushrims, the descent of the rear wheels is controlled.

If one rear wheel drops over the edge before the other, the wheelchair may turn sideways. The step should therefore be approached perpendicularly, and both rear wheels should advance together.

► **Descending a Level Change of Approximately 5 cm**

 [Watch the video demonstration](#)

► **Ascending and Descending a 5 cm Level Change – Additional Demonstration**

 [Watch the video demonstration](#)

Suggested Verbal Cues

- “Approach the obstacle perpendicularly.”
- “Move your hands to an appropriate starting position.”
- “Use a brief and firm push.”
- “Lift the casters only as much as necessary.”
- “Lower them gently at the target point.”
- “Move your trunk forwards with control.”
- “Move both rear wheels together.”
- “Do not release the pushrims.”

Assessment

Assessed task	Procedure	Successful performance
Brief caster lift	The user lifts and lowers the casters on level ground.	Both casters lift from the ground with control, without excessive backward tipping or loss of control.
Lowering the casters at a target	The user lowers the raised casters onto a designated line.	The casters land close to the target without striking the ground forcefully.
Crossing a small surface gap	The user lifts the casters and crosses a narrow gap.	The casters reach the firm surface without entering the gap, and the rear wheels cross with control.
Ascending a level change of approximately 5 cm	The user positions the casters on the upper surface and moves the rear wheels onto the step.	The step is approached perpendicularly, and the casters and rear wheels reach the upper level without becoming trapped or causing backward tipping.
Descending a level change of approximately 5 cm	The user lowers the casters and rear wheels sequentially onto the lower surface.	Wheelchair direction is maintained, and the wheels descend without forceful impact or uncontrolled dropping.

During assessment, the assessor should observe the approach angle and speed, timing and height of the caster lift, caster landing point, trunk control, rear-wheel movement, and the user's control of the pushrims.

Common Problems and Training Strategies

Observed problem	Possible cause	Recommended training strategy
The casters do not lift from the ground	Insufficient propulsion or inappropriate starting position	Position the hands farther back and practise a brief, firm push
The wheelchair rises excessively backwards	Excessive force or sudden backward trunk movement	Reduce the force and repeat the movement under close spotting
The casters strike the ground forcefully	Pushrim control is released too early	Maintain pushrim control until the casters reach the ground
A caster enters the surface gap	The casters are lowered too early	Practise lift timing and looking towards the intended landing point
The casters do not reach the upper surface of the step	The lift begins too far from the step or is insufficiently high	Adjust the approach distance and initiate the lift closer to the edge
The rear wheels do not ascend the step	Insufficient propulsion or the trunk remains too far back	Move the trunk forwards with control and apply simultaneous propulsion
The wheelchair turns sideways during descent	The step is approached obliquely or the rear wheels descend at different times	Approach the step perpendicularly and monitor both rear wheels together
The user cannot determine whether the obstacle is safe	Incorrect estimation of height or gap depth	Develop the habit of stopping, inspecting the obstacle, and abandoning the attempt when necessary

Skill Progression

The skill may be progressed by changing the target line, using safe surface gaps of different widths, and performing ascent and descent of an approximately 5 cm level change consecutively. It may subsequently be practised on different but safe surfaces and in daily-life environments.

Before increasing the obstacle height, the user should be able to lift the casters consistently, lower them at the target point, and negotiate an approximately 5 cm level change safely in both directions.

► Ascending a 15 cm Level Change

 [Watch the video demonstration](#)

2.2. Advanced Wheelchair Skills

Advanced skills involve the balance, timing, strength, and environmental decision-making required to negotiate higher obstacles, kerbs, wide gaps, potholes, and stairs.

These skills should be taught only to users who can demonstrate safe and consistent basic wheelchair control. Advanced training should not begin until the user can move forwards and backwards, change direction, stop with control, lift the casters, and negotiate low level changes adequately.

Because advanced skills involve an increased risk of falling or wheelchair tipping, initial practice should use an appropriate training area, an experienced instructor, close spotting, and a safety strap when necessary.

2.2.1. Wheelie Balance and Control in the Wheelie Position

Wheelie balance involves lifting the casters from the ground and controlling the wheelchair on its rear wheels. This skill provides the foundation for negotiating wide gaps, potholes, high thresholds, and kerbs. It also enables the user to maintain balance during sudden stopping and, when necessary, to rest briefly by leaning against a stable wall in a controlled manner.

Because this skill involves a risk of backward tipping, it should be taught progressively in a controlled environment under the supervision of a spotter.

Learning Objectives

After completing the training, the user is expected to be able to:

- find the balance point over the rear wheels;
- maintain wheelie balance with control;
- make small forward and backward movements and turns in this position;

- maintain control without falling forwards or backwards during sudden stopping;
- lean against a stable wall with control;
- apply safe recovery strategies when balance is lost; and
- recognise situations in which the skill should not be used.

Environment and Equipment

Practice should take place on a level, firm, dry, and obstacle-free surface. Sufficient space should be available behind the wheelchair, and the surrounding area should be free from objects that could cause injury.

The spotter should stand behind the wheelchair and be able to control a strong section of the frame or an appropriate safety strap when necessary. The safety strap should be attached to a strong section of the wheelchair frame rather than to the user's trunk. If anti-tip devices prevent the skill from being learned, they should be adjusted only during controlled training and with appropriate safety precautions.

For practising support against a wall, the wall should be level, stable, non-slip, and free from projections.

Technique and Teaching

Finding the Balance Point

The user should sit in a balanced position, support the feet, and place the hands towards the rear of the pushrims. While moving the wheelchair forwards slowly, the user applies a brief and firm push to both sides. The trunk may be moved slightly backwards when necessary to lift the casters.

After the casters rise, the user should not release the pushrims. If the wheelchair moves too far backwards, a backward corrective force should be applied to the pushrims to lower the casters. If the casters descend too quickly, a small forward push may be used to re-establish balance.

Balance should be maintained through small forward and backward corrections on the pushrims rather than large trunk movements.

► **Maintaining Static Wheelie Balance for 30 Seconds**

 **Watch the video demonstration**

► **Maintaining Wheelie Balance — Additional Demonstration**

 **Watch the video demonstration**

► Training the Wheelie-Balance Skill

 **Watch the video demonstration**

Moving Forwards, Backwards, and Turning in Wheelie Balance

After establishing balance, the user may move forwards and backwards over short distances using small, simultaneous hand movements. The caster height should remain as constant as possible during movement.

To turn, one pushrim is moved forwards while the other is slowed or moved backwards with control. Small-angle turns should be used initially, and the turning angle may be increased as control develops. Right and left turns should be practised separately.

Sudden and Controlled Stopping

While travelling slowly in wheelie balance, the user responds to a stopping command by controlling both pushrims simultaneously. The trunk should not be thrown suddenly forwards or backwards during stopping. After the wheelchair stops, balance should be re-established or the casters lowered to the ground with control.

Sudden stopping should first be practised at a very low speed. Speed should not be increased until adequate movement control has been established.

Resting Against a Wall

The user approaches the wall with their back towards it and with control. After establishing wheelie balance, the wheelchair is moved slowly backwards until the push handles or a strong part of the backrest makes contact with the wall. The wheelchair should not strike the wall forcefully.

After contact is established, the user maintains a balanced position while keeping the hands on the pushrims. To move away from the wall, the trunk is moved slightly forwards, controlled forward force is applied to the pushrims, and the wheelchair separates from the wall. The user then maintains wheelie balance or lowers the casters to the ground.

The stability and non-slip surface of the wall should be checked beforehand. Glass, movable partitions, and surfaces of uncertain stability should not be used.

Recovering From Loss of Balance

If balance is lost forwards, a brief forward push may reduce the force with which the casters contact the ground. The casters should then be lowered with control.

If balance is lost backwards, the user should pull the pushrims backwards to lower the front of the wheelchair. If the movement cannot be corrected, the spotter should prevent the wheelchair from tipping completely. The user should not reach backwards with the hands in an attempt to stop the fall, as this may cause wrist and upper-extremity injury.

► **Turning While Maintaining Wheelie Balance**

 **Watch the video demonstration**

Suggested Verbal Cues

- “Keep your hands on the pushrims.”
- “Use a brief and firm push.”
- “Find the balance point using small hand movements.”
- “Maintain the caster height.”
- “Look in the direction you are turning.”
- “Stop with control using both hands.”
- “Approach the wall slowly.”
- “Do not reach backwards if you lose your balance.”

Assessment

Assessed task	Successful performance
Finding and maintaining the balance point	The casters are lifted with control, and balance is maintained for the designated period.
Moving forwards and backwards in wheelie balance	The user travels a short distance with control while maintaining the caster height.
Changing direction in wheelie balance	Right and left turns are completed without the casters touching the ground or loss of control.
Sudden and controlled stopping	The wheelchair stops without tipping forwards or backwards, and balance is re-established.
Leaning against and moving away from a wall	The wheelchair contacts the wall slowly, the position is maintained, and the user moves away with control.

During assessment, the assessor should observe the magnitude of the lifting movement, duration of maintained balance, control of corrective movements, right and left turns, stopping technique, approach to the wall, and recovery from loss of balance.

Common Problems and Training Strategies

Observed problem	Recommended training strategy
The casters do not rise sufficiently	Correct the starting hand position and practise a brief, firm push
The wheelchair tips backwards rapidly	Reduce the applied force and practise smaller lifts with spotting
The casters repeatedly contact the ground	Practise small forward corrections at the balance point
The user makes large trunk movements	Teach the user to maintain a more stable trunk and control balance through the pushrims
Balance is lost during turning	Use smaller turning angles and slower hand movements
The user falls forwards during sudden stopping	Begin at a lower speed and control both pushrims simultaneously
The wheelchair strikes the wall forcefully	Reduce the approach speed and identify the contact point in advance
The user reaches backwards while falling	Practise appropriate pushrim control and protective positioning under close spotting

Skill Progression

The skill may be progressed by increasing the duration of balance, adding short forward and backward movements, increasing right and left turning angles, and practising sudden stopping at a low speed. Practice involving gaps, potholes, or kerbs should not begin until the user can maintain basic wheelie balance safely.

► Travelling Over a Soft Surface in Wheelie Balance

 **Watch the video demonstration**

2.2.2. Negotiating Wide Gaps and Potholes Using Wheelie Balance

This skill covers negotiating wide surface gaps and potholes in which the casters could become trapped by using wheelie balance. The user should assess the obstacle's width and depth, the stability of its edges, and the area beyond it.

The user should not attempt to negotiate an obstacle whose width or depth cannot be assessed safely, whose surface cannot support the rear wheels, or whose edges are unstable. In such situations, an alternative route should be selected or assistance requested.

Learning Objectives

After completing the training, the user is expected to be able to:

- assess a gap or pothole before attempting to cross it;
- align the wheelchair appropriately with the obstacle;
- establish wheelie balance before reaching the obstacle;
- move the casters onto the safe surface;
- move the rear wheels across the obstacle with control;
- recognise when one wheel is approaching a hazardous surface and correct the direction; and
- abandon an unsafe crossing.

Environment and Equipment

Initial practice should take place in a level, firm, and obstacle-free area. The gap or pothole should be created under controlled conditions using stable and secure materials. Practice should begin with a narrow, shallow obstacle. Its width should be increased only after the user demonstrates adequate balance and directional control.

A stable surface capable of supporting the rear wheels should be available on both sides of the obstacle. Sharp edges, loose components, and projections that could cause injury should not be used. The spotter should remain in a position from which backward tipping or falling into the obstacle can be prevented when necessary.

Technique and Teaching

Assessing and Preparing for the Crossing

Before approaching, the user examines the width, depth, and direction of the gap and the surface on the opposite side. The crossing line should be selected so that the rear wheels remain on stable surfaces. The wheelchair should be positioned as close to perpendicular to the obstacle as possible.

If the obstacle does not appear safe, the user should stop the approach, select a different crossing point, or retreat.

Crossing a Gap Using Wheelie Balance

The user approaches the obstacle at a controlled speed and establishes wheelie balance before the casters reach the edge. While the casters are kept above the gap, the wheelchair is moved forwards on the rear wheels.

When the casters reach the firm surface on the opposite side, they are lowered with control. The rear wheels are then moved across the gap using a simultaneous and firm push. The pushrims should not be released until the crossing has been completed.

Travelling Over a Pothole

If the pothole is sufficiently wide, wheelie balance is maintained without lowering the casters into it. Using small and controlled pushes, the user moves the rear wheels along the stable crossing lines on either side of the pothole. The casters are lowered only after the pothole has been cleared completely.

This method should not be used when there is insufficient stable surface to support the rear wheels throughout the crossing.

► **Negotiating a 15 cm Gap or Pothole Using Wheelie Balance**

 **Watch the video demonstration**

► **Verbal Instruction for Negotiating a Pothole — Additional Demonstration**

 **Watch the video demonstration**

Correcting When One Wheel Approaches a Hazardous Surface

If one rear wheel approaches the edge of the gap or pothole, the user should not make a sudden or large turn. Movement should be slowed, balance maintained, and the wheel redirected towards the safe line using small corrections. If the safe line cannot be re-established, the user should retreat with control.

Retreating From an Unsafe Obstacle

The user should abandon the attempt before lowering the casters or allowing the rear wheels to move too close to the edge. The pushrims are moved backwards with control to move the wheelchair away from the obstacle. After reaching a sufficient safe distance, the casters are lowered to the ground and a new route is selected.

Suggested Verbal Cues

- “Check the width and depth of the gap first.”
- “Identify the crossing line.”
- “Approach the obstacle perpendicularly.”
- “Lift the casters before the edge.”
- “Maintain your balance using small movements.”

- “Keep the rear wheels on a stable surface.”
- “Do not continue if it is unsafe.”
- “Retreat with control.”

Assessment

Assessed task	Successful performance
Preparing for the crossing	The obstacle and opposite surface are assessed, a safe line is selected, and the wheelchair is aligned appropriately.
Crossing a wide gap	Balance is established before the obstacle, the casters reach the opposite surface without entering the gap, and the rear wheels cross with control.
Travelling over a pothole	Balance is maintained without lowering the casters into the pothole, and the rear wheels remain on the stable crossing line.
Correcting away from a hazardous edge	The user recognises that a wheel is approaching the edge and re-establishes the safe line using small movements.
Retreating from an unsafe crossing	The user stops advancing, moves away from the obstacle with control, and returns to a safe position.

During assessment, the assessor should observe whether the user inspects the obstacle, selects an appropriate crossing line and approach angle, establishes the balance point at the correct time, controls the paths of the casters and rear wheels, and abandons an unsafe crossing when necessary.

Common Problems and Training Strategies

Observed problem	Recommended training strategy
The casters enter the gap	Practise establishing balance earlier and keeping the casters elevated until they reach the opposite surface
The user approaches the obstacle obliquely	Use an approach line marked on the ground to align the wheelchair perpendicularly
Balance is lost over the gap	Practise with a narrower gap using small and controlled pushes
A rear wheel approaches the edge of the gap	Slow the movement and make small directional corrections
The casters land forcefully on the opposite surface	Maintain pushrim control and lower the casters gently
The user incorrectly assesses the obstacle's width	Develop the habit of stopping before the crossing and examining the path of both the casters and rear wheels
The user continues an unsafe crossing	Practise retreating and selecting an alternative route as separate skills

Skill Progression

Practice should begin with a narrow and shallow obstacle. Its width may be increased gradually as the user's wheelie balance, directional control, and ability to retreat

improve. Gaps in different directions and safe obstacles in real-life environments may subsequently be introduced.

Before the obstacle is widened, the user should be able to maintain wheelie balance continuously, keep the rear wheels on the safe crossing line, and abandon the crossing with control when necessary.

2.3. Transfer Skills

A transfer is the movement of a user between the wheelchair and another support surface, such as a bed, chair, toilet, shower seat, vehicle seat, or the floor.

A safe transfer involves more than reaching the target surface. It also requires assessing the environment, positioning the wheelchair appropriately, using the brakes, adjusting the footrests and armrests, protecting the skin, and assuming a balanced position after the transfer.

No single transfer technique is appropriate for every user. The technique should be selected according to the user's upper- and lower-extremity strength, trunk control, joint range of motion, balance, body weight, pain, skin condition, cognitive capacity, wheelchair, and the characteristics of the target surface.

Because transfers involve risks such as falling, shoulder injury, skin friction, finger entrapment, and uncontrolled wheelchair movement, initial practice should be supervised by an experienced healthcare professional.

2.3.1. Transfer Between a Wheelchair and a Surface of Similar Height

A transfer involves moving safely between a wheelchair and another surface, such as a bed, examination table, chair, toilet, or shower seat. Successful performance depends not only on moving between the two surfaces, but also on positioning the wheelchair correctly, applying the brakes, moving the footrests and armrests out of the transfer path, and establishing a balanced sitting position afterwards.

The transfer method should be selected according to the user's upper- and lower-extremity function, trunk control, joint range of motion, skin condition, and environmental circumstances. Every user should not be expected to apply the same transfer technique.

Learning Objectives

After completing the training, the user is expected to be able to:

- assess the transfer surface and surrounding risks;

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- position the wheelchair at an appropriate angle and distance;
 - manage the brakes and removable components in the correct sequence;
 - select an appropriate transfer method;
 - use stable support points;
 - position a transfer board safely when required;
 - shift body weight using the head–hips relationship; and
 - assume a safe sitting position after the transfer.

Environment and Equipment

Initial practice should take place in a level, dry, non-slip, and obstacle-free environment. The transfer surface should be stable and approximately level with the wheelchair seat. When a bed or examination table is used, its movable components should be locked.

The user's usual wheelchair and cushion should be used. When necessary, a transfer board of an appropriate length and weight capacity may be used. The board should have no cracks, sharp edges, or surfaces that could damage the skin.

Technique and Teaching

Pre-Transfer Preparation

The user assesses the height, stability, and slipping risk of the target surface. The wheelchair is generally positioned at an angle of approximately 20–45° to the surface, with the gap between them kept as small as possible. A more parallel position may be selected if it is appropriate for the user's transfer method and the available space.

The brakes are locked. The footrest and, when necessary, the armrest on the transfer side are moved out of the way. The user's feet are placed on the floor or another safe support surface according to the selected technique. The stability of the intended hand support points is checked. A movable armrest, footrest, or brake lever should not be used for support.

Head–Hips Relationship

During a lateral seated transfer, the user may reduce the load over the pelvis by moving the head and trunk in the direction opposite to pelvic movement. For example, when moving the pelvis to the right, the head and trunk are moved forwards and towards the left with control. This counter-movement facilitates movement of the pelvis onto the transfer surface.

The movement should be adapted to the user's trunk control. The head and trunk should not be lowered excessively.

Direct Lateral Transfer

The user moves the pelvis towards the transfer side of the seat. The feet and hands are positioned appropriately, the trunk is moved forwards with control, and the pelvis is transferred onto the target surface using support from the hands. The transfer may be completed in one movement or through several small and controlled lifts.

After reaching the target surface, the user moves the pelvis into a safe position and re-establishes balanced sitting.

Transfer Using a Transfer Board

A transfer board may be used when the gap between the surfaces makes a direct transfer difficult. One end of the board is positioned beneath the user's pelvis on the transfer side, while the other end is placed on the target surface with sufficient contact.

Rather than dragging across the board, the user should support body weight through the hands and advance the pelvis using small and controlled movements. The fingers should not be left between the board and the sitting surfaces. The board should be removed only after the transfer has been completed and balance established.

A transfer board does not eliminate a large height difference or an unsafe gap between the surfaces. The transfer should not be performed unless both ends of the board are supported adequately.

Returning to the Wheelchair

Before returning from the target surface, the wheelchair should be fully opened, the cushion positioned correctly, and the brakes locked. The footrests and armrest are moved out of the transfer path. The user applies the same basic movements in the opposite direction to transfer the pelvis onto the cushion.

After the transfer, the pelvis is moved backwards and centred on the cushion. The armrest and footrests are replaced, the feet are supported, and the brakes are not released until the user confirms sitting balance.

Transfer to a Toilet or Shower Seat

Before transferring to a toilet or shower seat, the dryness of the floor, the stability of the support surfaces, and the security of the seat should be checked. Clothing

management should be planned separately from the transfer and performed without disrupting the user's balance. Because a wet floor increases the risk of slipping, suitable grab rails and slip-resistant surfaces should be used.

► Transfer Between a Wheelchair and Another Surface

 **Watch the video demonstration**

Suggested Verbal Cues

"Check the surface and surrounding area."

"Move the wheelchair closer and position it at an appropriate angle."

"Lock the brakes."

"Clear the transfer path."

"Position your feet safely."

"Use stable support points."

"Move your head in the direction opposite to your pelvis."

"Move your pelvis using small and controlled movements."

"After the transfer, move backwards and towards the centre."

Assessment

Assessed task	Successful performance
Preparing the wheelchair for transfer	The surface is assessed, the wheelchair is positioned appropriately, the brakes are locked, and the transfer path is cleared.
Transfer from the wheelchair to a stable surface	The hands and feet are positioned safely, the pelvis is moved onto the target surface without loss of control, and sitting balance is established.
Transfer from a stable surface to the wheelchair	The wheelchair setup is checked, the pelvis is transferred onto the cushion, and the user assumes a safe sitting position.
Horizontal transfer using a transfer board	The board is supported adequately on both surfaces, the pelvis is moved with control, and the board is removed safely.
Transfer to a toilet or shower seat	The floor and support surfaces are checked, the transfer is completed using an appropriate method, and no slipping or fall risk occurs.

During assessment, the assessor should observe wheelchair positioning, brake use, removed components, hand and foot placement, use of the head–hips relationship, transfer-board position, skin friction, and sitting position after the transfer.

The method used and level of assistance should also be recorded. Every user should not be expected to demonstrate both direct transfer and transfer-board techniques.

Common Problems and Training Strategies

Observed problem	Recommended training strategy
The wheelchair moves during the transfer	Check the brakes and tyre contact, and standardise brake use before the transfer
An excessive gap remains between the surfaces	Reposition the wheelchair and adjust the approach angle
The user cannot lift the pelvis sufficiently	Practise the head–hips relationship, divide the movement into smaller stages, or use a transfer board
The feet slip during the transfer	Correct foot placement and contact with the floor, and remove slippery surfaces
The user relies on movable wheelchair components	Clearly demonstrate stable frame sections and support points
The transfer board slips	Increase contact between the board and both surfaces and reduce the distance between them
The user drags across the transfer board	Teach small pelvic lifts using support through the hands
The user cannot position themselves correctly on the wheelchair cushion	Practise moving the pelvis backwards and towards the midline after the transfer
Shoulder or wrist pain develops	Reduce the number of transfers and loading demands, and reassess the technique and surface height

Skill Progression

Training should begin with a wide and stable surface. It may then progress to transfers in different directions and to real-life surfaces such as beds, chairs, toilets, and shower seats. If the user can perform a safe and effective direct transfer, the amount of assistance and number of movements required may gradually be reduced.

Before increasing the level of difficulty, the user should be able to position the wheelchair correctly, manage the brakes and components, and assume a balanced sitting position after the transfer.

2.3.2. Transfer Between Surfaces of Different Heights

Transferring between surfaces of different heights requires greater strength, balance, and movement planning than transferring between surfaces of similar heights. A transfer to a higher surface requires movement against gravity, while a transfer to a lower surface requires control of movement speed and descent.

If the height difference exceeds the user's safe movement capacity, the surface height should be adjusted, a transfer board used, or assistance requested.

Learning Objectives

After completing the training, the user is expected to be able to:

- assess the height difference between the surfaces;
- plan the direction and method of transfer;
- position the wheelchair at an appropriate angle and distance;
- transfer to higher and lower surfaces with control;
- use a transfer board safely for inclined transfers;
- use an adjustable bed height effectively; and
- request assistance when the height difference is unsafe.

Environment and Equipment

Practice should take place in a level, dry, non-slip, and obstacle-free environment. The transfer surface should be stable, and its movable components should be locked. A small height difference should be used initially and increased gradually as the user develops control.

When necessary, a transfer board of appropriate length and weight capacity may be used. The board should have adequate contact with both surfaces and should not create an excessively steep angle. If an adjustable bed is used, its height should be set before the transfer and the bed secured.

Technique and Teaching

Planning the Transfer

Before the transfer, the user assesses the height difference and gap between the two surfaces, the stability of the surfaces, and the direction of transfer. Whenever possible, the transfer may be planned from the higher surface towards the lower surface. However, the user's ability to return to the wheelchair should also be considered.

The wheelchair is positioned close to the transfer surface and at an appropriate angle. The brakes are locked, and the footrests and armrest on the transfer side are moved out of the way. The stability of the intended hand support points is checked.

Transfer to a Higher Surface

The user moves the pelvis towards the transfer side of the wheelchair and positions the feet safely. The head and trunk are moved forwards and in the direction opposite to pelvic movement to reduce the load over the pelvis. Using support through the hands, the user moves the pelvis upwards and sideways.

If the transfer cannot be completed in one movement, several small and controlled lifts may be used. The user should reach a safe position sufficiently far from the edge of the target surface. A direct transfer should not be attempted if the height difference is excessive or places too much load on the shoulders.

Transfer to a Lower Surface

Because gravity may accelerate downward movement, the user should control pelvic descent through the hands. The trunk is moved forwards, and the pelvis is transferred onto the target surface using small movements. The user should not fall onto the surface without control or remain at its edge after the transfer.

If the surface is very low, the user's ability to return to the wheelchair should also be assessed.

Upward or Downward Transfer Using a Transfer Board

One end of the transfer board is positioned beneath the pelvis on the transfer side, while the other end is placed on the target surface with sufficient contact. The board should be positioned at the lowest practicable angle.

During an upward transfer, the user supports body weight through the hands and elevates the pelvis using small movements. During a downward transfer, the hands are used to control the speed of sliding. In both directions, the user should avoid dragging across the board, and the fingers should not be left between the board and the surfaces.

The board should not be used if it is excessively inclined, too short, slippery, or inadequately supported on either surface.

Using Adjustable Bed Height

Whenever possible, the height of an adjustable bed may be set to facilitate the direction of transfer. For a transfer from the wheelchair to the bed, the bed may be positioned close to or slightly below the wheelchair seat height. For the return transfer from the bed to the wheelchair, the bed may be positioned close to or slightly above the wheelchair cushion height.

After adjustment, the bed should be checked for stability. Its height should not be changed during the transfer.

Suggested Verbal Cues

- “Assess the height difference and plan the return transfer.”
- “Move the wheelchair closer to the surface.”
- “Lock the brakes and clear the transfer path.”
- “Move your head in the direction opposite to your pelvis.”
- “Move your pelvis using small and controlled movements.”
- “Use your hands to slow your movement during descent.”
- “Check that the transfer board contacts both surfaces.”
- “Ask for assistance if the height difference is too great.”

Assessment

Assessed task	Successful performance
Assessing the height difference and planning the transfer	The surface heights, gap, transfer direction, and possibility of returning are assessed, and an appropriate method is selected.
Transfer to a higher surface	The pelvis is moved upwards and sideways with control, and the user assumes a safe sitting position on the target surface.
Transfer to a lower surface	The speed of descent is controlled, and the user reaches the target surface without falling or remaining at its edge.
Upward transfer using a transfer board	The board is positioned safely, and the user moves upwards using small lifting movements.
Downward transfer using a transfer board	The board is positioned safely, and the speed of downward movement is controlled.

Assessed task	Successful performance
Using an adjustable bed height	The bed is adjusted to an appropriate height, secured, and used to complete the transfer safely.

During assessment, the assessor should observe whether the user assesses surface height correctly, positions the wheelchair appropriately, manages the brakes and removable components, places the hands and feet safely, applies the head-hips relationship, controls the transfer-board angle, and assumes an appropriate final position on the target surface.

The heights of the surfaces, the difference between them, transfer direction, method used, and level of assistance should be recorded.

Common Problems and Training Strategies

Observed problem	Recommended training strategy
The user assesses the height difference incorrectly	Teach the user to compare the two surface heights and plan the return transfer beforehand
The user cannot reach the higher surface	Reduce the height difference, divide the movement into smaller stages, or use a transfer board
The user falls onto the surface during a downward transfer	Practise controlling body weight through the hands and moving in small increments
The user remains at the edge of the target surface	Identify the intended final sitting position before the transfer
The transfer board is positioned at an excessively steep angle	Adjust the surface height or select a safer transfer method
The transfer board slips	Increase the board's contact with both surfaces and reduce the gap between the wheelchair and target surface
Excessive load is placed on the shoulders	Reduce the height difference, adjust the surface height, or use assistance
The user cannot return to the wheelchair from a low surface	Plan the return transfer before moving down and select a different surface when necessary

Skill Progression

Training should begin with small height differences, which may be increased gradually as the user develops a safe technique. Practice may subsequently progress to real-life situations involving beds, examination tables, chairs, and other sitting surfaces.

Before the height difference is increased, the user should be able to plan the transfer, control movement speed, and assume a safe sitting position on the target surface.

2.3.3. Transfer from the Wheelchair to the Floor and from the Floor to the Wheelchair

A floor transfer involves lowering oneself from the wheelchair to the floor in a controlled manner, returning from the floor to the wheelchair, and assessing the situation after a fall to make an appropriate decision. This skill may require a high level of upper-limb strength, trunk control, joint range of motion, and movement planning.

Not every user should be expected to transfer directly from the floor to the wheelchair. Using a stable intermediate surface or requesting assistance are safe and valid alternatives.

► Controlled Transfer from the Wheelchair to the Floor

 [Watch the video demonstration](#)

► Returning from the Floor to the Wheelchair

 [Watch the video demonstration](#)

Learning Objectives

After completing the training, the user should be able to:

- determine whether a floor transfer is appropriate for them;
- prepare the wheelchair and surrounding area for the transfer;
- lower themselves from the wheelchair to the floor in a controlled manner;
- return to the wheelchair using a stable intermediate surface;
- transfer directly from the floor to the wheelchair when appropriate;
- assess for signs of injury following a fall; and
- request assistance without moving when necessary.

Environment and Equipment

Initial practice should take place on a spacious, level, clean, dry, and non-slip surface. An exercise mat may be placed on the floor. The mat must not slide during the transfer or interfere with the movement of the wheelchair.

For transfers using an intermediate surface, a low platform or step that is stable, non-slip, and resistant to tipping may be used. The wheelchair brakes must be functional, and removable components must be managed safely.

Pre-transfer Assessment

Before attempting a floor transfer, the following should be assessed:

- condition of the shoulders, elbows, and wrists;
- upper-limb strength;
- trunk control and sitting balance;
- hip and knee range of motion;
- pain, dizziness, and fatigue;
- skin integrity;
- bone fragility or a history of recent injury; and
- access to assistance from the floor.

A transfer that exceeds the user's capabilities should not be attempted independently.

Technique and Teaching

Controlled Transfer from the Wheelchair to the Floor

Position the wheelchair on level ground and lock the brakes. Move the footrests and any other components obstructing the transfer out of the way. The user moves their hips towards the front of the seat and places their feet securely on the floor.

The hands are placed on stable parts of the wheelchair frame or suitable support surfaces. The user leans their trunk forwards and moves their hips forwards and downwards in a controlled manner. If necessary, the user may kneel or turn to the side while lowering themselves.

The hips must not be allowed to drop uncontrollably onto the floor, and the head and shoulders must not strike any part of the wheelchair.

Returning to the Wheelchair Using an Intermediate Surface

When transferring directly from the floor to the wheelchair is difficult, one or more stable intermediate surfaces may be used. Position the wheelchair on the user's stronger or preferred side and lock the brakes.

The user first transfers from the floor onto a low platform and then onto a higher surface. During the final stage, the hips are transferred onto the wheelchair cushion. Before each movement, check that the intermediate surface is stable and non-slip.

Once the user reaches the wheelchair, reposition the hips backwards and towards the centre of the cushion. Reattach the footrests and armrests.

Direct Transfer from the Floor to the Wheelchair

The user positions themselves with their back or side towards the wheelchair. The hands are placed on stable parts of the wheelchair frame. As the trunk moves forwards, the user pushes downwards and backwards through the arms, lifts the hips from the floor, and transfers them onto the cushion.

This technique requires considerable strength and joint range of motion. It should be discontinued if the user experiences shoulder pain, cannot lift sufficiently, or loses control.

► Direct Transfer from the Floor to the Wheelchair

 **Watch the video demonstration**

Requesting Assistance

If the user cannot rise safely from the floor, they should not make repeated or forceful attempts. Assistance should be requested using a telephone, call system, or nearby person.

Until help arrives, the user should adopt a safe and comfortable position. If there is traffic or another hazard in the area where the fall occurred, this must be clearly communicated.

Assessment Following a Fall

The user should not immediately attempt to return to the wheelchair following a fall. They should first remain calm and check for:

- head, neck, or back pain;
- new and severe pain;
- deformity or suspected fracture;
- bleeding;

- dizziness or altered consciousness;
- difficulty breathing;
- new numbness or loss of strength; and
- significant pain that increases with movement.

If any of these signs are present, the user should not move and must request emergency assistance. If there are no clear signs of injury, the environment, wheelchair, and user's physical capacity should be assessed before selecting the safest method of returning to the wheelchair.

Suggested Verbal Cues

- "First assess your surroundings and your condition."
- "Lock the brakes and clear the transfer path."
- "Use stable parts of the frame for support."
- "Lower your hips in a controlled manner."
- "Check that the intermediate surfaces are stable."
- "Break the movement into small stages."
- "Stop if you experience pain or lose control."
- "Ask for assistance if you cannot get up safely."

Assessment

Task assessed	Successful performance
Pre-transfer preparation and method selection	The user assesses their capabilities, the environment, and the wheelchair position and selects an appropriate method.
Transfer from the wheelchair to the floor	The wheelchair is prepared, and the user lowers their hips to the floor without an uncontrolled drop.
Returning to the wheelchair using an intermediate surface	Stable intermediate surfaces are used in the appropriate sequence, and the user reaches the wheelchair cushion safely.
Returning directly to the wheelchair	The user applies a technique appropriate to their abilities, transfers their hips onto the cushion, and assumes a balanced sitting position.
Decision-making following a fall	The user checks for signs of injury and decides whether to return to the wheelchair, remain in place, or request assistance.

Not every user should be expected to perform a direct floor transfer. Correctly assessing their capabilities and choosing an intermediate surface or assistance should be regarded as successful performance.

The assessment should consider:

- wheelchair position;
- management of the brakes and removable components;
- support points used;
- signs of injury checked;
- transfer method selected;
- sitting position after the transfer; and
- level of assistance required.

Common Problems and Training Strategies

Observed problem	Recommended training strategy
The user drops uncontrollably onto the floor.	Begin with a higher intermediate surface and divide the lowering movement into smaller stages.
The wheelchair moves during the transfer.	Check the brakes and tyre contact with the floor, and reposition the wheelchair.
The user takes support from movable components.	Demonstrate safe handholds on stable parts of the frame.
The user cannot lift sufficiently from the floor.	Use an intermediate surface or request assistance.
The intermediate surface slides or tips.	Select a wider, more stable, and non-slip surface.
The user makes repeated unsuccessful attempts.	Limit the number of attempts and teach the user when to rest and request assistance.
The user slides on the cushion after reaching the wheelchair.	Practise repositioning the hips backwards and towards the centre of the cushion as a separate skill.
The user tries to get up immediately after a fall.	Teach a systematic assessment for signs of injury before attempting to move.

Skill Progression

Training should begin with a high, stable intermediate surface. As the user gains control, the height of the surface may gradually be reduced. A direct floor transfer should be taught only to users with the necessary physical capacity.

The skill may be practised on different safe surfaces and reinforced through assistance-request scenarios. When increasing the level of difficulty, shoulder health, trunk control, skin integrity, and fall risk must be considered.

2.3.4. Transferring to a Car, Loading the Wheelchair into the Car, and Unloading It

The car should be parked on a level, firm, and safe surface. The engine should be switched off, the parking brake applied, and the driver's door opened fully. Because the door opening generally prevents the wheelchair from being positioned completely parallel to the car, the wheelchair should be positioned at an angle of approximately 30–45°, according to the user's characteristics and transfer method. It should not obstruct the movement of the door and should minimise the distance to the driver's seat. Where sufficient space is available, an angle of approximately 45° may facilitate both transfer-board placement and lateral transfer using push-up movements.

The wheelchair brakes should be locked, the footrests and armrest on the transfer side moved out of the way, and the car seat adjusted to facilitate the transfer. Depending on their physical capacity, the user may transfer to the driver's seat using a transfer board positioned securely between the wheelchair and car seat or by performing push-up movements, briefly lifting the hips while taking support through the hands from stable surfaces.

When a transfer board is used, one end should be positioned beneath the user's hip on the transfer side and the other end placed securely on the car seat with sufficient surface contact. Rather than dragging across the board, the user should take support through the hands and move the hips using small, controlled lifts. When the push-up method is used, the hands should be placed on stable support points, and the hips should be moved onto the car seat through several small lateral transfers instead of one large, uncontrolled movement.

With either method, care must be taken to prevent the fingers from becoming trapped between the transfer board and seating surfaces, the head from striking the upper door frame, and excessive loading of the shoulders. Once the user has transferred completely onto the driver's seat, the transfer board should be removed and the legs brought into the car one at a time.

Because the wheelchair frame must be passed in front of the user and close to the steering wheel during loading, users with limited trunk balance should fasten the seat belt at this stage. Once the seat belt has been fastened to support the trunk, the driver's seat should be moved as far back as reasonably possible to increase the distance between the user and the steering wheel and create sufficient space for the wheelchair frame to pass without becoming trapped against the steering wheel.

However, the seat should not be moved backwards too early or so far that the user can no longer reach the wheelchair components outside the car. Its position should be

adjusted according to the user's trunk balance, arm length, and the interior dimensions of the car.

When loading the wheelchair into the car, the cushion, side guards, and any other easily removable small components should first be removed and placed in a designated safe area inside the car. The rear wheels should then be removed one at a time. Beginning with the wheel furthest from the user may make it easier to remove while the other wheel continues to support the wheelchair frame. However, the removal sequence should be adapted to the user's reach, wheelchair model, and preferred technique.

The wheel should be controlled with one hand while the quick-release button is pressed with the other. Once the wheel has been completely disengaged from the axle, it should be brought directly into the car and must not be left outside where it could roll away. The same procedure should be repeated for the other wheel.

After both wheels have been removed, the backrest should be folded if it is designed to fold, and the wheelchair frame should be reduced to the smallest safe configuration for loading. The user should grasp a stable, weight-bearing section of the frame rather than a removable armrest, footrest, or other movable component.

The wheelchair frame should be lifted in a controlled manner. While passing it in front of the user, care should be taken to prevent it from catching on the steering wheel, gear lever, handbrake, or other vehicle components. The frame may be rotated as required while passing around the steering wheel. However, the user should not twist suddenly at the waist while holding the heavy frame or reach so far forwards or sideways that sitting balance is lost.

The wheelchair frame should be turned upside down and positioned securely on the front passenger seat so that it remains balanced and does not slide. A protective cover may be used to prevent hard or projecting parts of the wheelchair from damaging the seat upholstery. It should be confirmed that the frame does not obstruct door closure, extend into the driving area, or move towards the driver during the journey.

The removed rear wheels should be placed in the front passenger footwell. They should be positioned side by side with the pushrims facing each other. This arrangement reduces the space required, protects the vehicle's interior surfaces from the pushrims, and prevents the wheel axles from catching on surrounding components.

Care must be taken to ensure that the quick-release axles do not contact the user's legs, the vehicle upholstery, or electrical connections. The wheels must be positioned so that they cannot slide towards the pedals, driver's footwell, or driving controls. The cushion, transfer board, and other removable components should also be arranged so that they cannot move during the journey or obstruct the driver's view or access to the vehicle controls.

After the wheelchair frame and all components have been loaded, the door should be closed safely. If the seat belt has not already been fastened, it should now be secured. The driver's seat should then be moved to its final driving position, allowing safe access to the steering wheel, pedals, and other controls. Before moving the car, a final check should confirm that the wheelchair frame, rear wheels, cushion, and transfer board cannot shift during the journey.

When exiting the car, the procedures should generally be performed in reverse order. The car should be brought to a complete stop on a level and safe surface, the parking brake applied, and the engine switched off. The driver's seat should be adjusted to allow the user to reach the wheelchair components and door more easily, and the door should be opened fully.

Users with limited trunk balance should keep the seat belt fastened until the wheelchair has been removed and fully prepared for use. First, the rear wheels should be taken from the front passenger footwell, moved out of the car in a controlled manner, and held or positioned safely so that they cannot roll away.

The upside-down wheelchair frame should then be grasped by a stable section of the frame, lifted in a controlled manner, and passed in front of the user and out of the car without becoming trapped against the steering wheel. The wheelchair frame should be placed on level ground. The backrest and other folding components should be opened completely, and their locking mechanisms checked.

The rear wheels should be fully inserted onto their axles while the quick-release buttons are pressed. After releasing the buttons, each wheel should be pulled gently outwards to confirm that the locks have engaged. The cushion should be placed in the correct orientation and position.

The wheelchair should be positioned as close as possible to the driver's seat at an angle of approximately 30–45°, according to the transfer method. The brakes should be locked, and the armrest and footrests on the transfer side moved out of the transfer path.

The user must not transfer out of the car until confirming that:

- the wheelchair is fully opened;
- the rear wheels are securely locked;
- the cushion is positioned correctly; and
- the brakes are functioning properly.

Once the wheelchair is fully prepared for use, the seat belt may be removed. The legs should be moved out of the car one at a time, and the user should transfer into the wheelchair using either a transfer board or push-up movements, according to their physical capacity.

Following the transfer, the user should assume a safe and balanced sitting position on the cushion, remove the transfer board, replace the armrest and footrests, and position the feet securely. The brakes should only be released and movement initiated after all final checks have been completed.

► **Transferring into a Car**

 **Watch the video demonstration**

► **Transferring out of a Car**

 **Watch the video demonstration**

2.4. Special-Situation Skills and Wheelchair Management

This section covers carrying a manual wheelchair up and down stairs when no accessible route is available, as well as folding and unfolding the wheelchair and managing its removable components.

The stair technique should only be performed with three trained assistants. If a safer ramp, lift, or platform system is available, it should always be used in preference to carrying the wheelchair on stairs.

2.4.1. Ascending and Descending Stairs with Three Trained Assistants

Ascending and descending stairs in a wheelchair is a high-risk procedure requiring considerable physical strength, coordination, and communication. It should only be used when no ramp, lift, platform lift, or other accessible route is available and the passage is essential.

The method described in this section involves carrying a manual wheelchair with three trained assistants. Heavy powered wheelchairs, motorised wheelchairs, and mobility scooters must not be carried on stairs using this method.

Learning Objectives

After completing the training, the team should be able to:

- assess the stairs and wheelchair before beginning;
- assign roles clearly;
- hold the wheelchair only by stable sections of its frame;
- move simultaneously in response to the lead assistant's commands;
- maintain the wheelchair at a controlled angle;

- communicate continuously with the user; and
- stop the procedure if a risk arises.

Environment and Preparation

The following characteristics should be assessed:

- width of the staircase;
- height and depth of the steps;
- size of the landings;
- position of the handrails;
- slipperiness of the surface; and
- obstacles along the route.

The procedure should not be attempted on stairs that are narrow, damaged, slippery, or have insufficient space for turning.

The general condition of the wheelchair, rear-wheel attachments, backrest, and frame should be checked. The cushion and the user's position should be adjusted, and the feet secured on the footrests. A postural support belt may be used when required, but it must not be regarded as a vehicle seat belt.

Bags, trays, and accessories that could fall should be removed. Armrests, footrests, removable parts of the push handles, and side guards must not be used as lifting points.

Positions of the Assistants

First assistant—the leader: Stands behind the wheelchair. This assistant grasps the push handles or stable parts of the frame, controls the wheelchair's angle, and gives all movement commands.

Second assistant: Stands at the front-right side of the wheelchair and grasps a stable point on the lower-front section of the frame.

Third assistant: Stands at the front-left side of the wheelchair and grasps the equivalent stable point on the opposite side.

The two assistants at the front should remain at the same height and move in coordination with each other. Commands should only be given by the lead assistant.

Technique and Teaching

Ascending Stairs

Position the wheelchair at the bottom of the stairs with its back towards the staircase and approximately perpendicular to the steps. The lead assistant stands behind the wheelchair, while the other two assistants stand at its front-right and front-left sides.

On the leader's command, tilt the wheelchair onto its rear wheels in a controlled manner. Check the user's trunk and head position. The front assistants lift the front of the wheelchair while the lead assistant pulls the rear wheels towards the first step. All three assistants should move simultaneously and generate force through their legs.

At each step, confirm that the rear wheels are securely positioned. Re-establish balance before moving the wheelchair to the next step. The wheelchair must not tilt to either side while being lifted.

After reaching the upper landing, move the rear wheels onto the secure surface. Once sufficient space is available, slowly bring the wheelchair forwards and lower it onto all four wheels.

Descending Stairs

Approach the top of the stairs with the wheelchair facing the staircase. The lead assistant stands behind the wheelchair, while the other two assistants stand at its front-right and front-left sides.

Tilt the wheelchair onto its rear wheels in a controlled manner. On the leader's command, move the rear wheels towards the edge of the step. The front assistants support the front of the wheelchair while the lead assistant lowers the rear wheels carefully onto the next step.

At each step, check the position of the wheels and the wheelchair's angle. The assistants must not skip steps, move quickly, or proceed to the next step before receiving the leader's command.

After reaching the lower floor, create sufficient space and slowly lower the wheelchair onto all four wheels. Recheck the user's position and all wheelchair components.

Suggested Commands

- "Let me know when you are ready"
- "Is everyone ready?"

- “Is the user ready?”
- “Check your handholds.”
- “We are tilting the wheelchair.”
- “Lift together.”
- “Place it on the step.”
- “Stop and check the balance.”
- “Move to the next step.”
- “We are lowering the wheelchair onto all four wheels.”

Successful Performance and Safety Criteria

- The stairs and alternative routes are assessed beforehand.
- The roles of all three assistants are assigned before movement begins.
- The wheelchair is held only by stable points on the frame.
- All movements are performed simultaneously on the leader’s command.
- The wheelchair is carried at an appropriate angle while maintaining side-to-side balance.
- Wheel placement is checked at every step.
- The user’s head, trunk, arms, and feet are protected.
- The assistants avoid sudden twisting and uncontrolled lifting.
- The procedure is stopped if the user reports pain, fear, or feeling unsafe.
- The wheelchair is lowered onto all four wheels in a controlled manner on the upper or lower landing.

Common Problems and Training Strategies

Observed problem	Recommended training strategy
The assistants move at different times.	Use one designated leader and brief, predetermined commands.
The wheelchair tilts to one side.	Equalise the front assistants’ handhold heights and distribution of the load.
The wheelchair cannot be maintained at an appropriate angle.	Stop the procedure and adjust the starting position and placement of the assistants.
An assistant holds a removable component.	Identify and demonstrate safe handholds on the frame before beginning.
A rear wheel is not positioned fully on the step.	Check wheel contact before proceeding to the next movement.
The user’s feet change position.	Check the position of the feet and footrests at every stage.
An assistant reports fatigue or pain.	Stop on a safe landing. Do not continue until the team or method has been reassessed.
The landing does not provide sufficient turning space.	Do not use the stair technique; select an alternative route.

Skill Progression

Training should not begin on a full staircase. Initially, practise role allocation, safe handholds, commands, and controlled wheelchair tilting on level ground. Progress to a single step, then several wide steps, and finally a complete staircase only when the team demonstrates adequate control.

Before increasing the height or length of the staircase, confirm that all three assistants can move simultaneously, stop to check balance at every step, and maintain continuous communication with the user.

2.4.2. Folding and Unfolding a Manual Wheelchair and Managing Its Removable Components

Before folding the wheelchair, remove the cushion, bags, transfer board, and loose accessories. Check that straps attached to the wheelchair, clothing, or bags are not caught in the folding mechanism or between the wheels.

Depending on the model, the footrests may swing outwards, fold upwards, or be removed completely. To remove a footrest, release its locking mechanism, swing it to the side, and then lift it upwards out of its mounting socket. Do not force the component or pull it by the footplate.

Removable armrests and side guards should be detached using their locking mechanisms. Pulling forcefully on the armrest padding may damage the component or its mounting socket.

If the backrest has a tension bar, head support, or another rigid attachment, it should be removed or released according to the manufacturer's instructions before folding. Any components that could obstruct folding should be identified in advance.

► Folding and Unfolding a Manual Wheelchair

 **Watch the video demonstration**

Successful Performance Criteria

- The user recognises the wheelchair type and folding mechanism.
- The cushion and loose accessories are removed.

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- Straps and clothing are checked to ensure they are clear of the mechanisms.
 - The footrests are swung away or removed correctly.
 - The armrests and side guards are released using their locks.
 - Removed components are placed in a safe location.
 - The wheelchair is prepared for folding without using excessive force.

Skill-Specific Safety Criteria

- The wheelchair is not folded while the user is seated in it.
- Components are not forced or bent during removal.
- Removable components are not used as carrying handles.
- The user does not step on the footrests, armrests, or side guards.
- Loose components are not left in the route of travel.
- The user does not lean so far forwards that balance is lost.

Suggested Verbal Cues

- "Remove the cushion and bags first."
- "Check that the straps are not caught in the mechanism."
- "Release the footrest lock."
- "Do not force the component."
- "Place the removed components in a safe location."

Folding a Wheelchair with a Folding Frame

In folding manual wheelchairs, the two side frames are connected by a cross-brace mechanism beneath the seat. As the wheelchair is folded, the side frames move towards each other, reducing its overall width.

Before folding, raise the footplates or remove the footrests. Remove the cushion and ensure that no objects remain on the seat upholstery. If a tension bar or accessory on the backrest obstructs folding, remove it.

The user should assume a balanced position beside or in front of the wheelchair. Grasp the middle of the front and rear edges of the seat upholstery and pull upwards. On some models, a lifting strap in the middle of the seat may be used. As the seat upholstery rises, the cross-brace mechanism closes and the side frames move towards each other.

Do not place the hands between the cross-brace mechanism, seat rails, or side frames. Do not attempt to fold the wheelchair by pushing the armrests towards each other. Once folding is complete, confirm that the frame will not reopen unintentionally and engage the transport lock, if fitted.

Successful Performance Criteria

- All components obstructing folding are managed appropriately.
- The footplates are raised.
- The user uses safe handholds.
- The middle of the seat upholstery is pulled upwards.
- The side frames move towards each other in a controlled manner.
- The fingers are kept away from the folding mechanism.
- The wheelchair folds completely without being forced.
- The transport lock is engaged, if fitted.

Skill-Specific Safety Criteria

- The hands are not placed beneath the seat rails.
- The fingers are kept away from the junctions of the cross-braces.
- The wheelchair is not folded by pressing on the armrests.
- Force is not applied if the mechanism resists movement.
- The folded wheelchair is not lifted in a way that could allow it to open unexpectedly.
- The load is kept close to the body while lifting the wheelchair.

Suggested Verbal Cues

- "Raise the footplates."
- "Grasp the middle of the seat upholstery."
- "Pull the upholstery upwards."
- "Keep your fingers away from the cross-brace mechanism."
- "Check the folding lock."

Unfolding a Wheelchair with a Folding Frame

Place the folded wheelchair on level ground and confirm that the rear wheels are attached correctly. Ensure that no objects behind or in front of the wheelchair could become trapped.

Standing in front of or beside the wheelchair, separate the two side frames in a controlled manner. The hands should then be positioned with open palms or closed fists so that the fingers cannot become trapped, rather than being placed directly over or beneath the seat rails.

Apply controlled downward pressure to one seat rail while stabilising the opposite side frame if necessary. Then apply pressure to the other seat rail until the cross-brace mechanism opens fully.

Do not curl the fingers beneath the seat rails while unfolding the wheelchair. Confirm visually and manually that both seat rails are fully seated in their frame supports. Do not transfer into a partially unfolded wheelchair.

Successful Performance Criteria

- The wheelchair is placed on level ground.
- The folding or transport lock is released.
- The side frames are separated in a controlled manner.
- The hands are positioned in safe areas.
- Controlled downward pressure is applied to the seat rails.
- The cross-brace mechanism opens completely.
- Both seat rails are fully seated in their supports.
- The wheelchair is stable before the transfer.

Skill-Specific Safety Criteria

- The fingers are not placed beneath the seat rails.
- The wheelchair is not pushed suddenly towards the floor.
- The frame is not forced or allowed to open unevenly.
- The wheelchair is not used until both seat rails are fully seated.
- The upholstery is not left folded or trapped in the mechanism.

Suggested Verbal Cues

- "Place the wheelchair on level ground."
- "Release the transport lock."
- "Separate the side frames."
- "Do not leave your fingers beneath the rails."
- "Seat both rails completely."
- "Check the wheelchair before transferring."

2.4.3. Removing Rear Wheels with Quick-Release Mechanisms

Removing the rear wheels reduces the transport size and weight of the wheelchair, particularly in rigid-frame models. In a quick-release mechanism, pressing the button at the centre of the wheel hub retracts the locking balls at the end of the axle, allowing the wheel to be removed from its receiver.

The wheelchair should be unoccupied and positioned on level ground. Before removing a rear wheel, assess whether the wheelchair frame could tip or move uncontrollably on the remaining wheel. The frame may be supported securely with one hand.

While controlling the wheel close to the hub or by the pushrim, press the quick-release button fully with the thumb. Keep the button depressed and pull the wheel directly outwards in a straight line. Once the wheel has been removed, prevent the axle from striking the floor, wall, or another hard surface.

Position the removed wheel with the quick-release axle facing upwards or in another protected direction. Do not stand the wheel vertically on its axle or apply a load that could bend the pushrim.

Successful Performance Criteria

- The wheelchair is unoccupied and on a safe surface.
- The user controls the wheelchair frame.
- The quick-release button is pressed without releasing control of the wheel.
- The button is held fully depressed.
- The wheel is pulled directly outwards.
- The axle and receiver are not damaged.
- The wheel is placed in a safe position.
- The second wheel is removed using the same controlled method.

Skill-Specific Safety Criteria

- Rear wheels are not removed while the user is seated in the wheelchair.
- The wheel is not pulled forcefully without pressing the release button.
- The wheelchair frame is not allowed to tip uncontrollably.
- The axle is not allowed to contact the floor.
- The wheel is not placed under a heavy load resting on its pushrim.
- The wheels are not left where they could roll on a sloping surface.

Suggested Verbal Cues

- "Control the wheelchair frame."
- "Do not release the wheel."
- "Press the button fully."
- "Pull the wheel straight out."
- "Do not allow the axle to touch the floor."

Reattaching the Rear Wheels and Checking Their Locks

Before fitting a rear wheel, check that the quick-release axle is clean, straight, and undamaged. Do not use the wheel if the axle is bent, heavily contaminated, or if the locking balls are faulty.

Hold the wheelchair frame in a stable position. Align the wheel axle with the receiver on the frame. Press the quick-release button fully and push the axle into the receiver. Continue until the wheel hub is positioned fully against the receiver, then release the button.

After releasing the button, grasp the wheel with both hands or hold it by the hub and pull it firmly but carefully outwards. If the wheel does not come out of the receiver, the locking mechanism has engaged. Do not rely solely on the button appearing to have returned to its original position; always perform a pull test.

Rotate the wheel to assess whether it moves freely and check for noticeable looseness or side-to-side movement. After attaching both wheels, confirm that the brakes make appropriate contact with the tyres.

Successful Performance Criteria

- The quick-release axle and receiver are inspected.
- The axle is aligned with the receiver.
- The release button is pressed fully.
- The axle is pushed completely into the receiver.
- The button is released.
- A pull test is performed to confirm that the wheel is locked.
- Free rotation and lateral play are assessed.
- The second wheel is attached using the same method.
- Brake function is checked.

Skill-Specific Safety Criteria

- The axle is not inserted into the receiver at an angle.
- The wheel is not forced into position.
- The user does not transfer into the wheelchair before completing the pull test.
- The wheelchair is not used if the release button remains depressed.
- Professional assessment is requested if the wheel has noticeable lateral movement.
- If the right and left wheels have different features, each is fitted to the correct side.

Suggested Verbal Cues

- "Align the axle with the receiver."
- "Press the button fully."
- "Push the wheel all the way in."
- "Release the button."
- "Pull the wheel outwards to check the lock."

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- “Test the brakes.”

2.4.4. Repositioning the Folding Backrest, Armrests, and Footrests

The folding backrest should be opened after the wheelchair frame and rear wheels have been secured. Raise the backrest tubes into their operating position and confirm that the locking mechanisms have engaged on both sides. Do not use the wheelchair if the backrest is locked on only one side.

Align removable armrests with their mounting sockets and insert them correctly. Pull each armrest gently upwards to confirm that its lock has engaged. If the user will place weight through the armrest during a transfer, also confirm that its attachment is designed to support this load.

Insert the footrests into their mounting sockets from above and swing them inwards until they lock in their operating position. Do not confuse the right and left footrests. After opening the footplates, check that they are at the same height and do not obstruct caster movement.

Position the calf strap, heel loops, and leg supports correctly. Use the necessary supports if the user’s feet are at risk of sliding from the footrests.

Successful Performance Criteria

- The backrest is opened fully and locked on both sides.
- The armrests are placed in the correct sockets.
- The armrest locks are checked.
- The right and left footrests are fitted correctly.
- The footrests are locked in their operating position.
- The footplates are open.
- The calf and heel supports are adjusted.
- The components do not interfere with caster movement.

Skill-Specific Safety Criteria

- The user is not seated in the wheelchair until the backrest is locked.
- Weight is not placed on an armrest until it is fully secured.
- Footrests are not inserted into their receivers at an angle.
- The user does not step on the footplates during a transfer.
- Footrest height is not changed arbitrarily by the user.
- Leg supports are not tightened in a way that impairs circulation.

2.4.5. Positioning the Cushion and Completing the Final Safety Check

The cushion should be positioned after all other wheelchair components have been assembled. Identify its front, back, upper, and lower surfaces. On contoured cushions, the leg channels should face forwards and the pelvic well should be positioned towards the back. The cushion cover must not be inside out, and zips or rigid attachments must not contact the skin.

Centre the cushion on the wheelchair seat, position its rear edge appropriately against the back support, and secure any fastening straps. Confirm that the cushion does not extend beyond the seating surface, fold, or slide during a transfer.

Before the user transfers into the wheelchair, complete the following final checks:

- Is the frame fully opened and stable?
- Are the seat rails fully seated in their supports?
- Are the backrest locks engaged?
- Are the rear wheels attached completely?
- Have the quick-release axles passed the pull test?
- Do the brakes hold both rear wheels adequately?
- Do the casters rotate freely?
- Are the armrests and side guards secure?
- Are the footrests positioned correctly?
- Is the cushion correctly orientated and secured?
- Are the anti-tip devices in their operating position?
- Are any loose straps or components contacting the wheels?

After completing these checks, lock the brakes, clear the transfer path, and allow the user to transfer into the wheelchair. Following the transfer, confirm that the hips are positioned backwards and centrally on the cushion, the feet are supported, and the sitting posture is safe.

Successful Performance Criteria

- The cushion is positioned in the correct orientation.
- The cushion is centred and secured on the seat.
- All wheelchair locking mechanisms are checked.
- The rear-wheel pull test is completed.
- The brake function is confirmed.
- The footrests and armrests are assessed.
- The anti-tip devices are returned to their operating position.
- No transfer occurs until the wheelchair is ready for use.
- The user assumes a safe sitting position after the transfer.

Skill-Specific Safety Criteria

- The wheelchair is not used without the cushion unless the seating system has been specifically configured for cushion-free use.
- The user does not sit on a cushion that is reversed, folded, or displaced.
- The wheelchair is not used if either rear wheel is not completely locked.
- The user does not transfer onto a partially opened frame.
- No transfer is performed if the brakes are not functioning.
- Loose straps are moved away from the wheels.

Common Problems and Training Strategies

Observed problem	Possible cause	Recommended training strategy
The wheelchair does not fold.	The cushion, tension bar, or another component is obstructing the mechanism.	Systematically check for obstructing components before folding.
The fingers approach the folding mechanism.	Safe handholds are not known.	Mark the safe handhold areas and practise slowly with an unoccupied wheelchair.
The wheelchair does not open completely.	The seat upholstery is trapped or one seat rail is not fully seated.	Straighten the upholstery and check both seat rails separately.
The quick-release button cannot be pressed.	Contamination, corrosion, or a mechanical fault.	Do not apply force; arrange cleaning and technical maintenance.
The wheelchair tips while a wheel is being removed.	The frame is not supported.	Stabilise the wheelchair frame or request assistance from another person.
A wheel comes out after being fitted.	The axle was not inserted completely or the locking balls did not engage.	Press the button fully, insert the axle completely, and perform the pull test.
The wheel has lateral play.	An adjustment problem with the axle or receiver.	Do not use the wheelchair; request technical assessment.
The brake does not hold the wheel.	Incorrect wheel attachment, low tyre pressure, or incorrect brake adjustment.	Check the wheel lock and tyre pressure and arrange brake assessment.
The footrest does not fit into place.	The right and left components have been confused or the footrest is incorrectly aligned.	Identify the orientation of each component and align the attachment correctly.
The backrest locks on only one side.	One locking mechanism has not engaged completely.	Check both locks separately by sight and touch.
The cushion is positioned backwards.	Its front and back cannot be distinguished.	Mark the front and back of the cushion clearly.
The user struggles to lift the components.	The components are heavy or the user has limited grip.	Carry the components separately and obtain assistance when required.

Observed problem	Possible cause	Recommended training strategy
The user leans excessively forwards.	The components are out of reach.	Reorganise the working area and place the components closer to the user.

Skill Progression

The skill may be progressed by:

- initially managing only the cushion and footrests;
- practising folding and unfolding an unoccupied wheelchair;
- removing and refitting one rear wheel;
- managing both rear wheels in the correct sequence;
- preparing a rigid-frame wheelchair for transport;
- removing and refitting all components in a predetermined sequence;
- gradually reducing visual markings;
- combining the skill with loading the wheelchair into a car;
- becoming familiar with different wheelchairs that use similar mechanisms; and
- completing the final safety check in the correct sequence without a checklist.

Speed should only be developed after the procedure can be completed safely and correctly. The skill should never be performed against time if doing so creates a risk of trapping the fingers or omitting a locking check.

Skill-Specific Documentation

In addition to the common assessment form, record:

- whether the wheelchair has a folding or rigid frame;
- the folding mechanism used;
- the user's position while performing the task;
- ability to remove the cushion and accessories;
- ability to manage the footrests;
- ability to manage the armrests and side guards;
- folding and unfolding of the backrest;
- complete folding of the wheelchair;
- complete unfolding of the wheelchair;
- safe positioning of the fingers;
- removal of the rear wheels;
- reattachment of the rear wheels;
- pull testing of the quick-release axles;

- checking brake function;
- positioning the cushion in the correct orientation;
- reactivating the anti-tip devices;
- completion of the final safety check;
- time required to complete the procedure;
- pain or fatigue experienced by the user;
- verbal, visual, or physical assistance required; and
- any mechanical problems identified.

3. Safe and Sustainable Wheelchair Use

3.1. Inspecting the Wheelchair Before Use and Identifying Basic Problems

Mechanical wheelchair problems may initially present with minor warning signs. Reduced tyre pressure, ineffective brakes, an incompletely locked rear wheel, hair or thread accumulated around the casters, loose connections, torn upholstery, or an incorrectly positioned cushion may cause difficulty with mobility, reduced directional control, wheelchair movement during transfers, and falls.

The user should not be expected to perform detailed maintenance or mechanical repairs. The aim is to identify basic problems at an early stage, determine whether the wheelchair can be used safely, and request technical assistance when necessary.

Learning Objectives

After completing the training, the user should be able to:

- inspect the wheelchair systematically;
- identify problems involving the tyres, brakes, wheels, cushion, and other basic components;
- confirm that the quick-release mechanisms are locked;
- distinguish simple and safe adjustments that they can perform;
- recognise situations in which the wheelchair should not be used; and
- request technical assistance when necessary.

Pre-use Inspection

General Appearance

Conduct a brief visual inspection around the wheelchair. Check for:

- bending or cracks in the frame;
- torn upholstery;
- loose screws or connections;
- hanging cables; and
- missing components.

The wheelchair should remain stable on level ground and should not lean noticeably to one side.

Cushion and Seating System

The cushion should be correctly orientated and positioned. It should not be folded, reversed, or displaced beyond the seating surface. Check for noticeable compression, hardening, tears, or moisture.

The back upholstery and postural supports should not be displaced or loose.

Rear Wheels

Pull each rear wheel gently outwards to confirm that its quick-release axle is locked. The wheels should not have excessive lateral movement, looseness, broken spokes, or deformity. They should rotate freely without rubbing against the frame.

Tyres

Check pneumatic tyre pressure manually and, where possible, with an appropriate pressure gauge. Both tyres should have a similar level of firmness. Check for:

- noticeable pressure loss;
- cracks or cuts;
- excessive wear; and
- embedded foreign objects.

Air pressure does not need to be checked in solid tyres; however, they should still be inspected for cracks, separation, and wear.

Brakes

When locked, the brakes should hold the rear wheels securely. When the wheelchair is pushed gently forwards and backwards, the rear wheels should not rotate. The brake levers should not be excessively loose or too stiff to operate.

Wheelchair brakes are intended to secure a stationary wheelchair rather than stop it while it is moving.

Casters and Forks

The casters should rotate and swivel freely. Hair, thread, fabric, or other material should not be accumulated around the wheels or axles. The forks should not be loose, bent, or moving abnormally.

Footrests, Armrests, and Backrest

The footrests and armrests should be positioned correctly and attached securely. The footplates should not drag on the ground and must support the feet safely.

A folding backrest should be opened fully and locked. If anti-tip devices are used, they should be in the correct operating position.

Simple and Safe Interventions

According to their physical capacity and the manufacturer's instructions, the user may:

- reposition the cushion correctly;
- secure loose bags or accessories;
- remove easily accessible hair or thread from around the casters;
- refit removable components whose correct use they understand; and
- inflate the tyres to the recommended pressure.

Adjustments requiring specialist tools, brake adjustment, spoke replacement, frame repairs, and component replacement should be performed by authorised or appropriately qualified technical personnel.

When the Wheelchair Should Not Be Used

If any of the following conditions are present, the wheelchair should not be used until the problem has been resolved. Safe support should be provided for transfers and mobility when required:

- either rear wheel does not lock completely;

-
- the brakes do not hold the wheelchair stationary;
 - a tyre is completely flat or seriously damaged;
 - the frame is cracked, broken, or noticeably bent;
 - a caster or fork is jammed or at risk of detaching;
 - the seat upholstery is torn or has collapsed;
 - the backrest or another essential support component does not lock; or
 - components are loose in a way that compromises propulsion, transfers, or seating safety.

Daily and Periodic Inspection

Before Every Use

Check:

- the cushion and seating position;
- rear-wheel locking;
- general tyre condition;
- brake function;
- footrest and armrest positions; and
- any visibly loose or damaged components.

At Regular Intervals

The following should undergo technical assessment:

- frame and connections;
- wheel axles and bearings;
- casters and forks;
- spokes and pushrims;
- upholstery and cushion condition;
- brake adjustment; and
- other maintenance points recommended by the manufacturer.

Inspection frequency may vary according to the user's body weight, frequency and intensity of use, surface conditions, and wheelchair model.

Assessment

Ask the user to inspect the wheelchair before daily use and explain what they would do about any problems identified.

For successful performance, the user:

- completes the inspection in a systematic sequence;
- identifies significant safety problems;
- confirms the function of the quick-release axles and brakes;
- checks the position of the cushion and other components;
- distinguishes safe user interventions from unsafe repairs; and
- decides not to use the wheelchair and to request technical assistance when necessary.

Common Problems and Training Strategies

Observed problem	Recommended training strategy
The user conducts only a visual inspection.	Teach the user also to check the wheel locks, brakes, and stability of components manually.
The quick-release axles are not checked.	Add an outward pull test of each rear wheel to the daily inspection sequence.
A brake problem is not identified.	Teach the user to lock the brakes and test them by attempting to move the wheelchair gently.
The user cannot recognise a difference in tyre pressure.	Demonstrate how to compare the two tyres.
Accumulated material around the casters is disregarded.	Demonstrate how this accumulation affects wheel rotation and directional control.
The user attempts to repair a technical fault independently.	Distinguish simple user checks from procedures requiring technical intervention.
The user continues to use the wheelchair despite a serious problem.	Teach the conditions in which the wheelchair should not be used through a short checklist.

3.2. Efficient Long-Distance Propulsion, Fatigue Management, and Upper-Limb Protection

Long-distance wheelchair use requires an effective propulsion technique, appropriate speed selection, route planning, fatigue monitoring, and scheduled rest periods. Inefficient propulsion, unsuitable wheelchair configuration, and prolonged movement without rest may cause pain or overuse problems in the shoulders, elbows, wrists, and hands.

The aim is not to achieve the highest possible speed but to enable the user to move safely and sustainably in daily life.

Learning Objectives

After completing the training, the user should be able to:

- use long and smooth pushes;
- adjust speed according to the surface, slope, and distance;
- select an appropriate route;
- monitor energy expenditure and fatigue;
- plan rest periods;
- recognise warning signs in the shoulders and upper limbs; and
- modify the distance, technique, or route when necessary.

Effective Propulsion Technique

During forward propulsion, the user should maintain a balanced sitting position and place the hands at a comfortable starting point on the pushrims. Pushes should be as long and smooth as possible, with similar force applied on both sides.

After completing each push, the hands should relax and return to the starting position in a controlled manner. The hands should not strike the pushrims forcefully, and unnecessary force should not be applied during each push.

Very short and frequent pushes may increase the number of repetitive upper-limb movements. However, shorter and more frequent pushes may be necessary on ramps,

soft surfaces, or in confined spaces. The technique should therefore be adapted to the environmental conditions.

Effect of Wheelchair Configuration

The position of the rear wheels, seat height, cushion, backrest angle, and footrest adjustment may affect propulsion technique. The user should be able to reach the pushrims comfortably without constantly elevating the shoulders or leaning the trunk excessively forwards to propel the wheelchair.

Wheelchair configuration should be assessed if the following are observed:

- unnecessary shoulder elevation during propulsion;
- excessive extension of the elbows;
- difficulty reaching the pushrims; or
- persistent veering to one side.

The user should not be expected to make technical adjustments independently. Required modifications should be completed by an appropriately qualified professional.

Speed and Energy Management

For long distances, the user should select a sustainable speed rather than beginning too quickly and becoming fatigued within a short period. The user should be able to propel the wheelchair without holding their breath or experiencing excessive difficulty speaking.

Before entering a ramp or high-resistance surface, the user should assess their speed and need for rest. Short and powerful pushes may be used on slopes; however, on long ramps the user should consider resting or requesting assistance before becoming excessively fatigued.

As fatigue increases, shorter pushes, reduced directional control, elevated shoulders, and excessive trunk movement may indicate deterioration of technique.

Route and Surface Selection

Whenever possible, routes that are smooth, firm, dry, and have a low gradient should be selected. A slightly longer but safer and lower-resistance route may require less energy than a short, steep, or uneven route.

Before beginning the journey, assess:

- distance and estimated duration;
- ramps and surface characteristics;

-
- available rest points;
 - accessible entrances;
 - weather conditions; and
 - locations where assistance could be requested.

Carrying Loads

Bags and other loads may affect wheelchair balance and the force required for propulsion. Heavy items should be positioned as close as possible to the centre of the wheelchair and secured to prevent movement.

Hanging heavy bags from the backrest may increase the risk of rearward tipping. Loads must not interfere with the brakes, wheels, pushrims, or foot movement. Heavy objects that obstruct vision or compromise balance should not be carried on the user's lap.

Rest and Effort Monitoring

Rest should be planned throughout long-distance travel rather than taken only after severe fatigue has developed. The user should stop on a safe, level surface, lock the brakes, and relax the shoulders.

The user may rate their level of effort on a scale such as 0–10. If effort increases more quickly than expected, recovery takes longer, or propulsion technique deteriorates, the distance and speed should be reduced.

Protecting the Upper Limbs

To protect the upper limbs:

- avoid unnecessarily short and frequent pushes;
- do not keep the shoulders continuously elevated;
- avoid gripping the pushrims too tightly;
- minimise sudden and forceful stopping;
- avoid carrying heavy loads;
- do not attempt to complete long distances without resting; and
- do not continue moving despite pain.

Performing several high-force tasks in succession, such as transfers, ramps, and kerb negotiation, may increase upper-limb loading. Daily mobility should be planned accordingly.

Warning Signs

The activity should be stopped and the method reassessed if any of the following occur:

- new or progressively increasing pain in the shoulder, elbow, or wrist;
- numbness, tingling, or reduced grip strength;
- significant shortness of breath;
- dizziness or nausea;
- chest pain;
- unusual muscle weakness;
- a noticeable reduction in directional or wheelchair control; or
- excessive fatigue that does not resolve shortly after resting.

Appropriate medical assessment should be requested for severe, sudden, or persistent symptoms.

Suggested Verbal Cues

- "Use long and smooth pushes."
- "Choose a speed that you can maintain."
- "Keep your shoulders relaxed."
- "Select the smoothest route with the lowest gradient."
- "Rest before you become fatigued."
- "Position loads securely and close to the centre."
- "Do not continue despite the pain."
- "Reduce your speed and distance if your technique deteriorates."

Assessment

Ask the user to complete a predetermined distance on a suitable route while managing their speed and need for rest.

For successful performance, the user:

- applies an effective and controlled propulsion technique;
- selects a sustainable speed;
- maintains directional control;

- adapts the technique to the surface and slope;
- recognises signs of fatigue;
- rests at an appropriate time;
- stops if pain or a safety risk develops; and
- completes the task without unnecessary upper-limb loading.

Record:

- distance;
- duration;
- surface type;
- gradient;
- number of rest periods;
- perceived exertion;
- pain; and
- level of assistance required.

Common Problems and Training Strategies

Observed problem	Recommended training strategy
The user performs very short and frequent pushes.	Practise longer and smoother pushes on level ground.
The user begins at an excessively high speed.	Establish a sustainable starting speed appropriate for the distance.
The shoulders rise during every push.	Assess the seating and rear-wheel configuration and teach the user to relax the shoulders during propulsion.
The user continually veers to one side.	Check arm strength, hand contact, tyre pressure, and wheelchair configuration.
The user continues without resting.	Establish predetermined rest points along the route.
The user selects the shortest but most difficult route.	Teach the user to consider gradient and surface resistance as well as distance.
Loads compromise wheelchair balance.	Reduce the load and position its weight closer to the centre of the wheelchair.
The user continues despite pain.	Teach the user to regard pain as a signal to stop and reassess the activity.

Skill Progression

Training should begin on a short, level route. Distance should only be increased when the user can maintain an effective propulsion technique and directional control. Safe ramps, different surfaces, planned rest points, and light loads may then be introduced gradually.

Progress should not be assessed solely according to the distance completed. The primary criteria are the user's ability to move without pain, manage effort, and maintain a safe technique.

4. Appendix 2: COMMON WHEELCHAIR SKILLS ASSESSMENT FORM

User Information

- Name and surname:
- Assessment date:
- Assessor:
- Wheelchair type:
- Duration of wheelchair use:
- Cushion and seating system used:
- Primary health condition or diagnosis:
- Pain, fatigue, or joint problem that may affect the assessment:
- Assistive equipment used:
- Assessment environment:

Outcome Codes

Performance

- **S:** Successful
- **NS:** Not successful
- **NT:** Not attempted
- **NA:** Not applicable

Safety

- **Safe:** Safe performance
- **Unsafe:** Unsafe performance

Assistance Level

- **0:** Independent
- **1:** Verbal guidance
- **2:** Supervision
- **3:** Partial physical assistance
- **4:** Full physical assistance
- **5:** Terminated through safety intervention

Assessment Table

No.	Skill/task	Self-confidence 0-10	Performance	Safety	Assistance level	Comments
1	Propelling forwards for 10 m					
2	Propelling backwards for 5 m					
3	Turning 90° to the right while moving forwards					
4	Turning 90° to the left while moving forwards					
5	Turning 90° to the right while moving backwards					
6	Turning 90° to the left while moving backwards					
7	Turning 180° to the right within a confined area					
8	Turning 180° to the left within a confined area					
9	Manoeuvring sideways to the right					
10	Manoeuvring sideways to the left					
11	Reaching for an elevated object					
12	Retrieving an object from the floor					
13	Shifting weight forwards					
14	Shifting weight to the right					

No.	Skill/task	Self-confidence 0-10	Performance	Safety	Assistance level	Comments
15	Shifting weight to the left					
16	Opening and passing through a push door					
17	Opening and passing through a pull door					
18	Passing through a narrow doorway					
19	Closing a door in a controlled manner					
20	Travelling over a firm, uneven surface					
21	Travelling over a soft surface					
22	Negotiating a low threshold					
23	Negotiating a narrow surface gap					
24	Ascending a gently sloping ramp					
25	Descending a gently sloping ramp					
26	Ascending a steeper ramp					
27	Descending a steeper ramp					
28	Stopping and restarting on a slope					
29	Briefly lifting the casters					
30	Lowering the casters onto a target point					
31	Negotiating a small surface gap					

No.	Skill/task	Self-confidence 0–10	Performance	Safety	Assistance level	Comments
	by lifting the casters					
32	Ascending a level change of approximately 5 cm					
33	Descending a level change of approximately 5 cm					
34	Finding the wheelie balance point					
35	Maintaining wheelie balance					
36	Moving forwards and backwards in the wheelie position					
37	Turning right and left in the wheelie position					
38	Stopping suddenly and safely in the wheelie position					
39	Leaning against a wall in the wheelie position					
40	Ascending a kerb approximately 10–15 cm high					
41	Descending a kerb forwards in the wheelie position					
42	Descending a kerb backwards					
43	Stopping and repositioning at the edge of a kerb					
44	Approaching a wide gap and					

No.	Skill/task	Self-confidence 0-10	Performance	Safety	Assistance level	Comments
	planning the crossing					
45	Negotiating a wide gap using wheelie balance					
46	Travelling over a pothole using wheelie balance					
47	Correcting direction near a hazardous surface edge					
48	Withdrawing from an unsafe obstacle					
49	Preparing the wheelchair for a transfer					
50	Transferring to a surface of similar height					
51	Transferring from a surface of similar height to the wheelchair					
52	Performing a level transfer using a transfer board					
53	Transferring to a toilet or shower seat					
54	Transferring to a higher surface					
55	Transferring to a lower surface					
56	Transferring upwards using a transfer board					
57	Transferring downwards using a transfer board					
58	Using adjustable bed height during a transfer					

No.	Skill/task	Self-confidence 0-10	Performance	Safety	Assistance level	Comments
59	Performing a controlled transfer from the wheelchair to the floor					
60	Returning from the floor to the wheelchair using an intermediate surface					
61	Transferring directly from the floor to the wheelchair					
62	Assessing the situation and requesting assistance after a fall					
63	Transferring into a car					
64	Loading a manual wheelchair into a car					
65	Unloading and reassembling the wheelchair					
66	Transferring from the car to the wheelchair					
67	Ascending stairs with three trained assistants					
68	Descending stairs with three trained assistants					
69	Preparing the wheelchair for folding					
70	Folding a folding-frame wheelchair					
71	Unfolding a folding-frame wheelchair					

No.	Skill/task	Self-confidence 0–10	Performance	Safety	Assistance level	Comments
72	Removing rear wheels with quick-release mechanisms					
73	Reattaching the rear wheels and checking their locks					
74	Managing the backrest, armrests, and footrests					
75	Positioning the cushion and completing the final safety check					
76	Inspecting the wheelchair before use					
77	Efficient and sustainable long-distance propulsion					

General Observations

- Skills in which the user demonstrates particular strength:
- Priority skills requiring training:
- Safety issues requiring particular attention:
- Adaptations or assistive equipment used:
- Skills during which pain or fatigue was reported:
- Issues requiring technical wheelchair assessment:
- Recommended training plan:
- Reassessment date:

Comparison of Results

Assessment period	Number of successful tasks	Number of safe tasks	Number of independently completed tasks	Mean self-confidence	Comments
Before training					
After training					
Follow-up					



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WELLDONE Website



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