Navigating Power Assist devices for manual wheelchairs

Young Adults Transition Clinic Wheelchair and Seating Service

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Objectives:

1. Establish 3 user goals in provision of a power assist device

2. Understand the basic product features of 3 different power assist device types

3. Be able to apply a framework to navigate a growing market of power assist devices

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Presentation Plan

Part One: Theory based

- Power Add on types
- Considerations for use
- User experiences
- Assessment through to implementation
- Navigating new markets of power assist devices
- Impact on manual wheelchair components

Part Two: Practical outside the MCG

- 4 groups
- Scenario based
- Analysis provided products
- Aim for each group to navigate power assist devices

Types of Power Assist Devices

Motor position

FRONT

CENTRE

REAR

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Types of Power Assist Devices

Mounting position

- Powered wheel through axle
- Rigid mounted to the frame via axle, leg hanger (rigid MWC) or back canes
- Horizontal adapter bars for folding wheelchairs

Control type

- Joystick (self or attendant)
- Drive assist with speed control
- Push rim activation
- Throttle
- Lever

TYPE: Front

How does this change the manual wheelchair?

- Attached to frame (axle/leg hangers) or adaptor bar
- Lifts front castors of wheelchair
- Typically, highest powered assist type
- Varying levels of power
- Extends footprint
- Varying front wheel size impacting turn circle
- Throttle or lever drive to accelerate
- Mechanical brake leavers , electronic brake systems
- Weight range of 8kg to 17kg

TYPE: Front

Clinical Considerations

- Increases stability (MWC + front power assist)
- Requires upper limb and strength to attach device
- Hand/wrist function for lever or throttle control
- Leg position or skin integrity for mounting position
- Many have max speeds higher than 10km/hr
- High speeds can increase vibrations
- Footprint for indoor environments
- Reach for doors going into rooms
- Limits of use for certain terrains and obstacles
- Increase in rake and impact on reach and pressure injury risk
- Limited portability due to weight and bulk

TYPE: Centre or Push Rim Activated

How does this change the manual wheelchair?

- Motored powered rear wheel replaces the rear wheel of the manual wheelchair
- Attaches to both rigid or folding wheelchairs
- Push rim activated through propulsion assistance and/or cruise mode
- Options for joystick control rather than push rim activated
- Highly compatible with many wheelchair frames
- Programmable for varying push rim forces
- Increases weight approx. 17 kg +
- Active braking systems for declines

Yamaha Navi https://yamahanavi.com/navigo-features.php

TYPE: Centre or Push Rim Activated

Clinical Considerations

- Is the goal to maintain self-propulsion?
- Joystick control powered wheels as alternative to powered wheelchair
- Upper limb movement and strength to brake and for propulsion both in "drive" and manual mode
- Maintains same overall length but may widen overall width
- Review rear wheel position and stability over overall
- This can be challenging going up/down steep hills
- Will the front castors manage different terrains
- Actual portability in vehicles i.e. external support

E-Motion https://www.alber.de/en/products/active-drives/e-motion/

TYPE: Rear

How does this change the manual wheelchair?

- Motor with additional small sized wheel located at rear or under MWC
- Attached on axle for rigid wheelchairs or via an adapter bar for folding wheelchairs
- Motor activated through a separate control attached via frame or wearable, user steers via the push rims
- Highly compatible with many wheelchair frames
- Light weight (approximately 5.8kg-8kgs)
- Highly portable
- Allow the wheelchair to maintain most of its manual functionality

https://www.acekare.com/yomper-power-pack-for-manual-wheelchair/

TYPE: Rear
Clinical Considerations

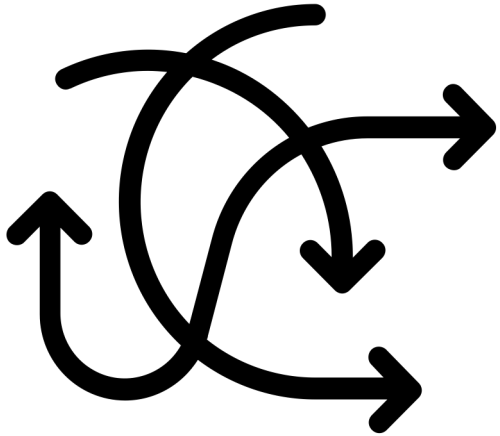
- Need existing outdoor manual wheelchair mobility skills
- Upper limb reach and strength to take on/off
- Upper limb strength to brake
- Consider propulsion both in "drive" and "manual" mode
- Ability to master controls for speed and stopping
- Wheel position can change overall length and stability
- Smaller wheel can limit to terrain type

i.e. loose gravel or debris/twigs can disrupt the drive

https://www.smoovbyalber.com.au/

Where do I start

- Aim for a successful trial by narrowing down the options
- Know what you're trying to achieve
- Do your research beforehand
- Plan your trial



Key features and questions of power assist devices

- **Mounting style:** How does it attach and detach it from the wheelchair?
- **Acceleration:** How do you accelerate or activate the motor
- **Powered control system:** How do you control the speed?
- **Brake:** How do you stop the motor?
- **Reverse mode:** How can you go backwards?
- **Manual mode:** How do you control the wheelchair without the motor on?
- **Battery life:** Will this device be able to manage the type of terrain and distances needed?
- **Type of battery (lithium):** Can this device travel on a plane?
- **Weight and portability of the device:** How easy is this to put into a car?
- **Wheelchair compatibility:** Will this device be suitable for X chair to use?
- **Battery charge point:** How often does this need to charge this and how?

User reviews and feedback

THIS IS WHY HE WORRIES ABOUT ME....😱

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Irma is superblij met de Alber e-fix

Invacare Nederland
557 subscribers
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Chris and his smart drive

Navigating the market
Curtis

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Navigating the market
USER FEEDBACK

Table 3. Perceptions about *user–device interactions*.

	Benefits	Challenges
Front-mounted attachments	Easy to turn on/off Easy to adjust the speed Easy to brake and stop Easy and intuitive to learn Able to install and detach while seated in MWC Reduces strain on upper extremities	Must keep at least one hand on the handlebar Requires adequate upper body and hand function to install and detach Difficult to lift, carry and transport (e.g., into a car) Blocks user's lap (e.g., user is unable to place items on lap)
Rear-mounted attachments	Able to operate hands-off Able to install and detach while seated in MWC Reduces strain on upper extremities Easy to lift and carry with one hand	Difficult to turn on/off Difficult to brake and stop Difficult to learn Requires great hand dexterity to operate the device Requires adequate upper body & hand function to install and detach
Powered wheels	Easy to turn on/off Easy to brake and stop Easy to adjust sensitivity and responsiveness Somewhat easy to learn Reduces strain on upper extremities Most similar to propelling an ordinary MWC	Unable to install and detach while seated in MWC Takes time to become accustomed to wheels' sensitivity (i.e., difficulty keeping straight and smooth wheeling) Somewhat difficult to independently lift, carry and transport

(M Khalili et al 2023)

Navigating the market
Chris

Key Assessment Areas and Goal Setting

Function	Terrain	Distance	Circulation	Portability
Manual Wheelchair type	Wheelchair skills	Learning skills	Function in arms and hands	Need for Support to use
		Preference for style or look		

From assessment onwards

Power assist devices = Powered Mobility

PROCESS

- Referral
- Assessment
- Trials
- Device recommendations
- Education and training
- Communication
- Monitoring and review

(K Townsend 2020)

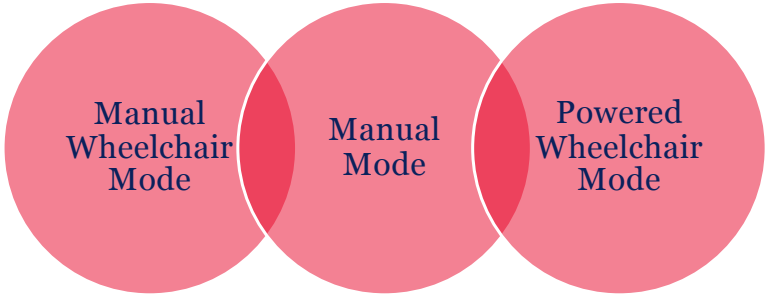
ACTIONS

- Subjective/user interview
- Observation of current wheelchair skills
- Assessment of environments
- **ESTABLISH YOUR GOALS**
- Discussion of options for trial
- Discussion with supplier for suitability
- Complete trial – is this an assessment of powered mobility?
- Education and training sessions
- Establish your review period

From assessment onwards

Manual or Powered

- For many, power assist devices are new to them
- Consider the types of wheelchair-based skills required
- How many modes of drive does this device require
- What existing manual wheelchair skills does the user have for outdoor mobility
- What skills does the power assist device required?
- Establish if training support is needed for implementation



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Challenges establishing wheelchair skills

Curtis

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Establishing Wheelchair skills
User confidence

Wheelchair Use Confidence Scale

WheelCon

19)	can move your wheelchair down a dry steep slope (> 5° incline) and stopping as soon as you are off the slope?	
20)	can move your wheelchair up a curb cut?	
21)	can move your wheelchair down a curb cut?	
22)	can move your wheelchair over a drainage grate and then up a curb cut?	
23)	can move your wheelchair down a curb cut then over a drainage grate?	
24)	can move your wheelchair through a puddle then up a curb cut?	
25)	can move your wheelchair down a curb cut then through a puddle?	
26)	can move your wheelchair through slush then up a curb cut?	
27)	can move your wheelchair down a curb cut then through slush?	
28)	can move your wheelchair down a curb cut then though 5cm (2") snow?	

Establishing wheelchair skills
Assessment and Training

Powered Mobility Device Use Skills & Behaviours

	Performance Score (1) Centre environment Date: ___/___/___	Performance Score (2) Home environment Date: ___/___/___	Performance Score (3) Optional Date: ___/___/___
1. Mount device			
Drive:			
2. In a straight line			
3. In a figure of 8			
4. In reverse			
5. Negotiate rough ground			
Speed control:			
6. Indoor, quiet Environment			

Performance Scores Rating Scale

4 Independent & Competent
3 Developing Competence
a. Hesitancy or overconfidence
b. Knocks wall or other objects lightly
2 Verbal Prompting

https://pomodatt.files.wordpress.com/2016/11/pomodatt-forms.pdf

Wheelchair Skills Test (WST) Version 5.4 Form
Powered Wheelchairs
Name of wheelchair user: _____
Caregiver assisting (if any): _____
Tester: _____ Date: _____

#	Individual Skill	Capacity (0-3)*	Comments
1	Positions controller		
2	Turns power on and off		
3	Operates battery charger		
4	Disengages and engages motors		
5	Changes program modes		
6	Changes speed setting		
7	Operates body positioning options		
8	Rolls forward		
9	Rolls backward		
10	Turns in place		
11	Turns while moving forward		
12	Turns while moving backward		

https://wheelchairskillsprogram.ca/en/skills-manual-forms/

Powered mobility on roads
Speed limits in Victoria, Australia

- Powered mobility considered as a medical device has a max speed limit of 10km/hr
- These can be used on pedestrian foot paths
- Many power assist devices have higher speed ranges

- Electronic recreational devices such as e-bikes and e-scooters have a max speed limit of 20km/hr
- These recreational devices are not permitted on pedestrian foot paths
- They are permitted on shared public paths or on roads up to 60km/hr
- Users are required to use a helmet when using these types of devices

https://www.vicroads.vic.gov.au/safety-and-road-rules/pedestrian-safety/motorised-mobility-devices
https://www.vicroads.vic.gov.au/safety-and-road-rules/e-scooters-in-victoria

Case example: Kim

- 23-year-old, just finished TAFE course in administration
- Uses a Rigid wheelchair
- Self-propelling for all functional mobility
- Looking for employment in an office-based environment
- Recently moved in with friends, no day to day supports.
- Parents still helping with complex new tasks like managing finances
- Would like to learn to drive with modified car
- Has a mate that has this fancy motor on their wheelchair and would like to see if this would work for her

Case example: Kim

Assessment finding	Goal	Product Attributes	Trial Plan
Function: Would like to travel to work via public transport instead of drive	To be able to use from my house, local area, on/off trains and at my workplace	Be able to manage up to 10km in current environments	Trial in home and local area Ask supplier Review user experiences online or peers
Terrain: Lives in mainly urban environment, one major hill to train station.	To be able to manage concrete pathways, curbed ramps, steep inclines	Have adequate motor power to manage steep inclines	Trial outdoors and on steep inclines
Distances: Train station 1km away from home, do distances up to 10km per day	To be able to manage 10-15 km on one charge	Have adequate battery power to manage distances	Discuss with supplier battery life and strategies Review user experiences online or peers
Portability: Would like option to take in/out of car on her own, considering use for holidays interstate, maybe take off at work	To be able to use for car and air transportation	Light to be able to manage with one hand/arm Battery compatible with air travel	Trial device in/out of car Discuss battery for air travel
Circulation: Indoors in an apartment, restaurants/shops to wide open outdoors.	To maintain a similar footprint of current wheelchair	To not increase footprint of wheelchair or minimally	Trial indoors in narrowest areas i.e. in the lift to car

Case example: Kim

Assessment finding	Goal	Product Attributes	Trial plan
Wheelchair Skills: New to power assist, has proficient wheelchair skills, able to navigate home and urban environment on their own.	To be able to learn how to use easily and maintain current wheelchair skills like wheelies up curbs	To allow functionality of manual wheelchair whilst attached	Assess uptake of skills (Outcome measure) If okay, trial going up down curbs
Upper limb function: Full upper limb and wrist strength, limited finger grip and strength. Can self-propel but unable to manage fine motor activities with ease	To be able to attach and detach from my wheelchair with ease	Lightweight and easy to attach	Trial attaching on/off
Level of independence: Lives with friends, no supports day to day. Can independently navigate known areas but has not used public transport on their own.	To be able to use in areas that I am not familiar with	Easy to use in crowded places and unexpected scenarios i.e. easy to control or stop	Assess uptake of skills (Outcome measure) If okay, trial in a busier area

Case example: Kim

Questions for the Supplier

- How long has it been on the market? What are other users feeding back?
- Are there wheelchair changes I need to consider if I am using it for longer distances?
- Is this okay for air travel?
- Will this battery last the distances and length of time I need? How can I make the battery last longer?
- Is this easy to learn how to use?
- How does someone manage in crowded areas?
- What is this device not great for? I.e. level of incline, terrains that it does not work well on

Current market

- Varying lengths of time on markets, many in their first generations
- New technologies – wearables & blue tooth connections requiring software updates
- Each device has specific required skills sets and this may include newer generations of exisiting power assist devices.
- Price is still $$$
- Reporting pathways back to manufacturers is unclear

Further clinical considerations for power assist devices

What is the fail safe for each component?

- Braking system if controller stops functioning
- Accelerating system

- **Battery life**
- No standard way measuring battery life in application
- User feedback is all we have
- Dependent other component such as motor, control, gearing

Impact on manual wheelchair and implications for maintenance

Changes to the frame/wheelchair

- Impact on frame – do I need a reinforced frame?
- Impact on rear wheel tyres – do I need different type of tyres? Off road, Solid tyres
- Impact on castors (centre or rear types) - do I need larger castors? Bearings?

Maintenance

- Increase in maintenance frequency to ensure use is not affecting the frame structure
- Increase replacement times for rear tyres and castors
- Consistent review time frames based on amount of use of the power assist device

Influencing the future design of Power Assist Devices

- Products are often in their first generations of production
- Keep an open dialogue with users to suppliers and manufacturers
- Share experiences
- Report incidences to TGA can be an option if the supplier/manufacturer isn't responsive

TGA: Consumers and health professionals are encouraged to report problems with medical devices. Your report will contribute to our monitoring of these products. For more information see the TGA Incident Reporting and Investigation Scheme (IRIS).

(https://www.tga.gov.au/resources/resource/guidance/medical-device-incident-reporting-investigation-scheme-iris)

PRACTICAL

Each group will receive a scenario

Please follow your group facilitator

Exit the room to lifts to outside of gate 3

Please bring your belongings with you

We will not return to the room

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PRACTICAL

Demo of products

Thank you to:

Bryce Alman from Melrose Wheelchairs
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Lauren Hunter from Linds Rehab
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Simon Sheargold from muve tech/Alber
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Bianca Brady from Astris PME/Apex Mobility
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Additional Resources

A guide for choosing and using mobility scooters and powered wheelchairs – VIC roads, November 2020
https://www.vicroads.vic.gov.au/-/media/files/documents/safety-and-road-rules/motorised-mobility-devices/a-guide-to-choosing-and-using-mobility-scooters-and-powered-wheelchairs.ashx

Wheelchair Use Confidence Scare (WheelCon)
The University of British Columbia
https://millerresearch.osot.ubc.ca/tools/mobility-outcome-tools-2/wheelchair-use-confidence-scale-wheelcon/

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Thank you

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