THE CASE FOR WHEELS:
Selecting the Clinically Appropriate Power Wheelchair Base

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Agenda

- Perceptions of Drive Wheel Position
- Advantages/Disadvantages of FWD, MWD and RWD
- Suspension
- Tracking Technology
- Making an Informed, Individual Choice

Learning Objectives

Participants will be able to:

- List two advantages of each of the 3 main power wheelchair configurations available.
- Differentiate the performance of front, mid and rear wheel drive wheel configuration across “outdoor terrain”.
- Relate a minimum of two reasons why suspension would be medically necessary for an individual with a neurological impairment.
- Justify the medical need for tracking technology on a power wheelchair with a specialty control device.

Satisfactory Completion Requirements

- Individual course registration via GoSignMeUp (GSMU) account
- 100% in-class attendance
- Once instructor finalizes attendance, you will receive an email to complete a post-course survey
- Upon completion of survey, your certificate is immediately emailed to you or available in your GSMU account
- No partial credit will be awarded

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Audience Participation

- WiFi –
- Go to www.menti.com
- Once at that website there will be a box to fill in a code to participate
  - The code required is **44 07 79**
  - This will bring you to the questions for today
  - You will be allotted 5 seconds to answer each question by selecting your answer and hitting **SUBMIT**

Question 1

What drive wheel configuration is the best overall for individuals with disabilities?

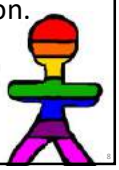
A. Rear wheel drive
B. Mid/center wheel drive
C. Front wheel drive



Is There a Drive Wheel Configuration that is "Best" for an Individual's Life Style?

There is no one mobility base or seating system configuration that is appropriate for an individual with a mobility impairment based on diagnosis, prognosis, deformity, disability or level of function.

It is as unique as the individual!



Life is NOT a Level Tile Floor!

- When, where and how will they will use the power wheelchair?
  - Need to consider **ALL** settings of anticipated use!
- What features are going to be most important?



In the Beginning…

- There was only rear wheel drive…
- Then front wheel drive was introduced
  - Initially it didn't handle as well as RWD in places where active RWD users were use to taking their chairs but…
  - It handled indoor mobility, turning and maneuverability better than RWD = **big swing toward FWD recommendation**
- Mid Wheel drive was introduced last
  - Resolved many issues found by power wheelchair users in a wide array of settings
  - It was stable AND maneuverable = **shift towards MWD recommendation**
- As a result the RWD configuration was almost extinct
- Many FWD prescribers were hesitant to shift to MWD recommendation due to familiarity with FWD configuration

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Today's Power Wheelchairs!

- What are the deciding factors?
- How do we inform and educate our consumers, and **empower** them to make the "correct" or most advantageous choice?
- All they see is a **BLUE** chair!
- Are WE informed, educated and OBSERVANT of their needs and capacities?

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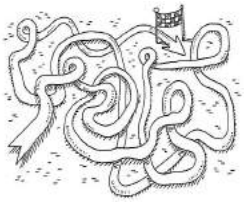
Question 2

What drive wheel configuration is most maneuverable in all environments?

A. Rear wheel drive
B. Mid/center wheel drive
C. Front wheel drive



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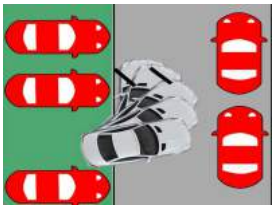
Question 3

What drive wheel configuration is best in tight spaces?

A. Rear wheel drive
B. Mid/center wheel drive
C. Front wheel drive



Question 4

What drive wheel configuration is best out doors?

A. Rear wheel drive
B. Mid/center wheel drive
C. Front wheel drive

Question 5

What drive wheel configuration is best for tracking straight?

A. Rear wheel drive
B. Mid/center wheel drive
C. Front wheel drive

Question 6

What drive wheel configuration is best at high speeds?

A. Rear wheel drive
B. Mid/center wheel drive
C. Front wheel drive

Question 7

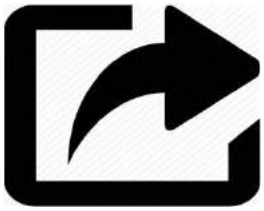
What drive wheel configuration handles rougher terrain best?

A. Rear wheel drive
B. Mid/center wheel drive
C. Front wheel drive

Question 8

What drive wheel configuration is most responsive when driving forward into a turn?

A. Rear wheel drive
B. Mid/center wheel drive
C. Front wheel drive



Question 9

What drive wheel configuration performs best going uphill?

A. Rear wheel drive
B. Mid/center wheel drive
C. Front wheel drive

Question 10

Which drive wheel configuration climbs obstacles best?

A. Rear wheel drive
B. Mid/center wheel drive
C. Front wheel drive

What do you think are the advantages of front wheel drive?

Advantages of Front Wheel Drive

- Make tight turns around corners
- Climbs obstacles well
- Large front wheels drive over obstacles with less impact on the user
- As long as the front anti-tip wheels are high enough FWD will transition over grade changes easily
- Provides an advantage for individuals with tight hamstrings for lower extremity positioning
- Works well for people who's center of gravity tends to be "forward" in the seating system. (i.e., bariatric population)
- Because FWD pulls it handles softer terrains better (i.e., grass, gravel, etc.)

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What do you think are the disadvantages of front wheel drive?

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Disadvantages of Front Wheel Drive

- May require slower driving speeds to maintain control
- Anti-tip casters can interfere with foot placement for stand pivot transfers
- Turning in tight spaces can be tricky for new users because more chair is behind them
- Turning quickly can cause dizziness because the inner ear is further from the drive axle
- Harder to drive straight at higher speeds
- Has a tendency to veer uphill traversing side slopes
- Less control with non-proportional controls

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What do you think are the advantages of mid wheel drive?

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Advantages of Mid-Wheel Drive

- Tightest turning radius for a 360° turn
- Most intuitive to drive for individuals who have previously been ambulatory
- Offers comparable control to rear wheel drive
- Climbs obstacles fairly well, can be limited by how high caster wheels lift
- Having 6 wheels on the ground provides stability to the base
- As long as the front caster suspension has enough travel the MWD w/c will transition over grade changes easily
- Good traction on most surfaces, inclines and side slopes

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What do you think are the disadvantages of mid wheel drive?

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Disadvantages of Mid-Wheel Drive

- Front caster wheels can interfere with stand pivot transfers
- Front caster wheels can be problematic for individuals with tight hamstrings
- Can high center on very uneven terrains
- Have limitations in the height of obstacle they can climb
- Can give a sense of "pitching forward"
- Jolting forces directly blow the user

What do you think are the advantages of rear wheel drive?

Advantages of Rear Wheel Drive

- Provides very good control at higher speeds
- Handles aggressive terrain very well
- Largest base = Most stable
- Will transition grade changes easily
- Can allow a care provider to assist with climbing a curb or obstacle due to drive wheel location in rear
- Can provide enhanced control with non-proportional inputs
- May be familiar for some users

What do you think are the disadvantages of rear wheel drive?

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Disadvantages of Rear Wheel Drive

- Users typically have greater access issues due to large turning radius
- Front caster wheels can interfere with footplate placement
- May require some speed to get over obstacles that must be climbed
- Must drive straight on, to climb higher obstacles
- Front caster wheels can be problematic for individuals with tight hamstrings
- Least intuitive to drive for new users who were previously ambulatory
- Tend to veer downward traversing a side slope

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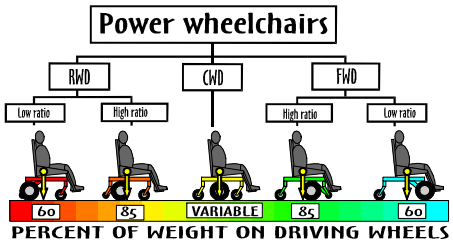
Wheel Location



Dennison, I. (2012). Understanding the Potential of Powered Mobility Devices. *Proceedings of the 2012 International Seating Symposium.*, PPT presentation

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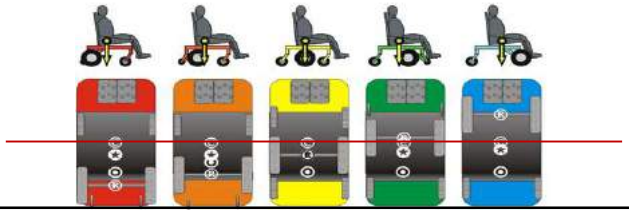
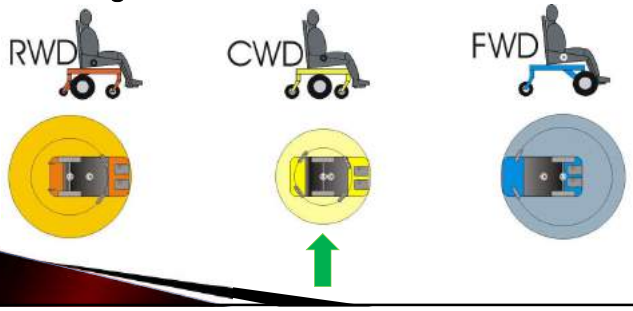
- Geometric Centre
- Centre of Gravity
- Centre of Head
- Centre of Rotation

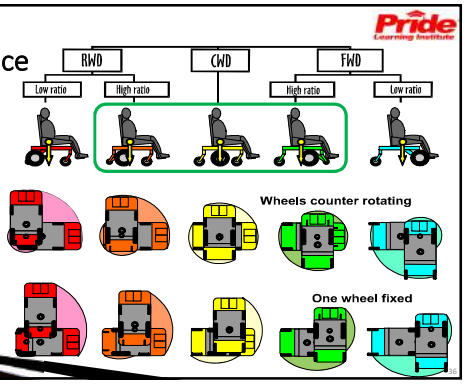


Turning Circles

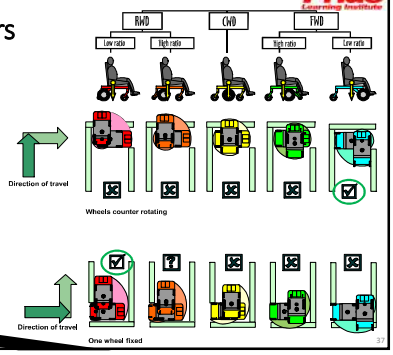


Shape of Space

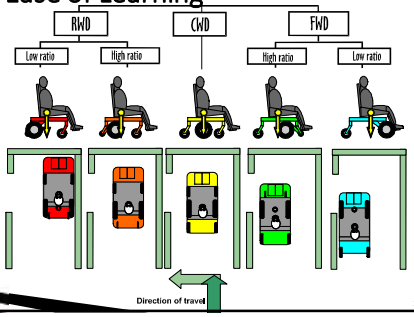
- Generally a CWD or HR chair provides a reasonable compromise with tight space requirements for effective maneuverability



Corridors and Doors



Visual Cues and Ease of Learning



Which is Best Suited for Indoors vs. Outdoors?

	Indoor	Indoor	Outdoor	Outdoor
	AB	ID	AB	ID
LR RWD				
HR RWD				
CWD/MWD				
HR FWD				
LR FWD				

Least advantageous Acceptable performance Best performance

AB = Allan Boyd, (2011) Rehab Magazine Comparing PWC Platforms
ID = Ian Dennison, (2012) Understanding the Potential of Powered Mobility Devices. *Proceedings of the 2012 International Seating Symposium*, PPT presentation

Performance Analysis – Indoor

- Speed
- Handling
- Size
- Maneuverability
  - Rate of turn
  - Turning radius
  - 3 point turn
  - Shape of space
  - Corridors and doors
  - Visual cues and ease of learning

	Indoor	
	AB	ID
LR RWD		
HR RWD		
CWD/MWD		
HR FWD		
LRFWD		

Least advantageous Acceptable performance Best performance

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Performance Analysis - Outdoor

- Speed
- Handling
- Curbs / Curb cuts
- Acceleration / Braking
- Tracking
- Changing Direction
- Range
- Soft Terrain
- Comfort

	Outdoor	
	AB	ID
LR RWD		
HR RWD		
CWD/MWD		
HR FWD		
LRFWD		

Least advantageous Acceptable performance Best performance

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Question 11

Does suspension make a difference when considering drive wheel configuration?

A. Yes
B. No

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What does Suspension Provide?

- Absorption of jolting /vibratory forces on wheelchair and wheelchair user
  - Influences an individual's posture and balance in the (stability of positioning)
  - Reduces or mitigates spasticity and/or reflex activity
  - Supports pain management
  - Increases sitting tolerance
  - Improves durability of the power base
- Ability to maneuver over a variety of terrains, optimizing environmental transitions
- Stability of the power base

Question 12

What industry did Quantum consult with to help design the suspension system in the 4FRONT and Edge 3?

A. Mountain bike
B. Motocross
C. Construction vehicle
D. Monster truck

Impact of Suspension on the Individual

- "Vibration, shock (single event and repeated), and motion have a significant effect on the health and quality of life for individuals who utilize a wheelchair for mobility.
- Vibration and shock can cause back pain and injury, which has been well documented in the literature."

(Griffin, 1975, 1990; Kitazaki & Griffin, 1998; Paschold & Mayton, 2011; Wilder, Magnusson, Fenwick, & Pope, 1994)

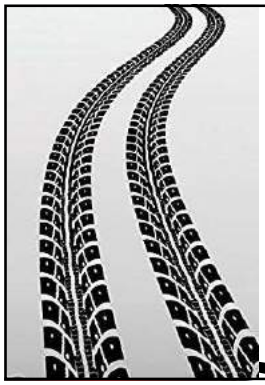
Impact of Suspension on the Individual

TRUE shock absorption limits the jolting/vibratory forces, which decreases the terrains effect on the individual:

- Support postural control, maintain positioning in the chair and contact with support components
- Preserve access to the drive control device, especially a specialty control
- Manage spasticity
- Minimize pain
- Decrease fatigue and increase sitting tolerance
- Reduce fear of driving across rough terrain and increase access to **all** environments of use

Position of the Person in the Wheelchair – Center of Gravity

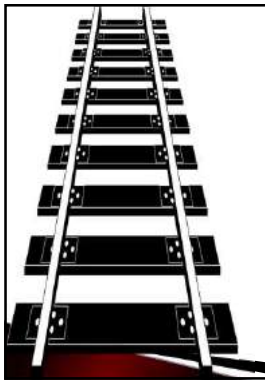
- Center of gravity of the individual in the seating system impacts the performance of the chair
- The center of gravity will significantly alter the performance of the suspension of the wheelchair
- If casters in the front or rear of a wheelchair are overloaded it affects wheelchair performance and drivability
- Front or rear loading of the caster wheels will affect the durability of the tires/wheels themselves.
- Note: People who carry a great deal of weight forward may get the best performance out of a front wheel drive



Tracking Technology – What is it?

A **feature** on the motors that interface with the control module so that the speed of the drive wheels can change in relation to one another to:

- Maintain a straight course of operation
- Compensate for discrepancies in terrain, transitions and thresholds
- Track independently over surfaces the consumer encounters in their home and community



Tracking Technology – What does it do?

- Allows an individual to control their w/c without having to make continual adjustments due to unequal drive wheel revolutions
- Minimized the need for excessive movements of the (hand, head, neck, chin, foot or other body part) to stay on track
- Compensates for veering when using non-proportional (switch) type controls
- Promotes safe, accurate operation of the w/c

Tracking Technology – Why is it Medically Necessary?

- Allows individuals with limited motor control, muscular fatigue, physiological fatigue, balance challenges and/or spasticity to compensate for their loss of function
- Increases length of time individuals can drive
- Minimizes the risk for accidents or an adverse occurrence

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After EDUCATION and TRIAL your Client Needs to Decide which is BEST for THEM!

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ASK Questions, TEST Drive Chairs, Know WHAT you are recommending and WHY!

The Case for Wheels Questions

1. What drive wheel configurations does each manufacturer offer? (circle all that apply)

AVID	Invacare	Permobil	Quantum	Rovi	Sunrise
FWD /MWD /RWD	FWD /MWD /RWD	FWD /MWD /RWD	FWD /MWD /RWD	FWD /MWD /RWD	FWD /MWD /RWD

Notes

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Thinking Out Loud

- What are two things you learned and how can you relate it to your practice?
- How does this course relate to your practice setting?
- How will this course change your behavior in the future?

Thank You for Your Time – Any Questions?

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