<u>Putting It All Together: Translating Evaluation Findings to Configure the Ultralightweight Manual Wheelchair</u>
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This Presentation is Part of a Series. We are tackling this subject matter to breakdown the complex task of prescription into manageable pieces that can stand alone, but also build upon each other to provide a solid foundation for making prescriptive recommendations based on basic science and research evidence.

<u>Objectives</u>

1. Following the presentation, attendees with be able to explain the value of adjustability in a K0005 manual wheelchair configuration.
2. Following the presentation, attendees with be able to list three examples of adjustability to consider incorporating into the prescriptive configuration of a K0005 manual wheelchair.
3. Following the workshop, participants will be able to list three potential changes in user need during the life of the wheelchair and how they might change the optimal wheelchair set up.

1) **Wheelchair machine**-each wheelchair has an inherent mechanical efficiency

A) There is nothing that the user, ***in the act of propelling it***, can do to improve it

B) What can be done to affect the inherent efficiency of this machine?

i) Wheelbase adjustment

ii) Wheel and tire selection

iii) Configuration

iv) Prescriptive Planning

2) **Evidence-Based Practice**- philosophy of providing health care guided by the integration of client factors and values, clinical expertise, and best available research evidence

A) Client Factors and Perspectives-based on values, priorities, and expectations of client

B) Clinical Expertise-accumulation of information that is available to draw on when we make clinical decisions

C) Best Research Evidence-should be current, stand up to critical appraisal, answer clinical question

3) **The Hallmarks of a K0005 wheelchair**

A) Custom configuration

B) Adjustability

4) **Wheelchair adjustments do not happen in isolation**

A) The entry point for adjustments does not matter, it still requires us to assess other aspects of the chair that may require subsequent adjustment

B) Consideration for this process needs to happen at the time of prescription-to provide best options for adjustments in the field

5) **Axle Position in Horizontal Plane**

A) Influences two important aspects of wheelchair mobility

i) Stability

ii) Propulsion efficiency

B) Center of Gravity (CG) Location vs. Mass Distribution

i) CG and Mass distribution are inversely proportional

ii) Weight of the user dominates system in most circumstances

C) More rearward drive wheel position
   i) Decreases system mass over drive wheels
   ii) Improves rearward chair stability
   iii) Increases rolling resistance
   iv) Decreases user access to drive wheel

D) More forward drive wheel position
   i) Increases system mass over the drive wheels
   ii) Decreases rearward chair stability
   iii) Decreases rolling resistance
   iv) Increases user access to drive wheel

E) Considerations
   i) Stability vs agility for user
   ii) CG can be impacted by changes in posture resulting from changes to the chair
   iii) CG can be impacted by frame length

6) **Axle Position in Vertical Plane**-Rear seat height relative to the drive wheel, determines available wheel arc for propulsion

A) Stability

B) Propulsion efficiency

C) Higher seat heights for a given wheel diameter
   i) Reduces available wheel arc
   ii) Shown to increase push frequency-Increased potential for muscular fatigue

D) 100-120 degrees of elbow angle when hand is at top of handrim (12 o'clock)
   i) Maximizes user access to handrim throughout push stroke
   ii) Places shoulder and elbow in most mechanically advantageous positions
   iii) Protects the upper extremity by eliminating harmful ranges for shoulder and elbow
   iv) Associated with improved propulsion efficiency
   v) Associated with decreased energy expenditure

E) Lower seat heights for a given drive wheel diameter
   i) Less efficient handrim forces
   ii) Less efficient cardiorespiratory parameters

F) Considerations
   i) Can be impacted by seat cushion height
   ii) Can be impacted by seat slope
   iii Can be impacted by wheel diameter

7) **Seat Angle**-Seat Inclination relative to the horizontal plane

A) "Dump" is the difference in inches between Front Seat Height (FSH) and Rear Seat Height (RSH)

B) Seat angle is formed by seat inclination relative to the horizontal plane, and is dependent on seat depth

i) The shorter the seat depth (run) for a given “dump” (rise), the steeper the angle

C) Considerations

i) Can be important to functional stability

a) Can improve pelvic stability to help prevent sliding

b) Can reduce forward trunk instability

ii) Can impact weight distribution over rear wheels

8) **Back Angle**-Measurement of back cane angle in relation to seat rail, and becomes relative angle of two support surfaces formed by back and seat cushion when chair has seating

A) Back Upholstery

i) Wear can result in changes in back angle, seat depth, positioning, orientation to drive wheels, CG location and mass distribution

B) Solid Backrest

i) Mounting and adjustment hardware can reduce available seat depth and impact drive wheel access, CG location, and mass distribution

ii) The use of back cane adjustment can sometimes accommodate for limitations in backrest hardware

C) Considerations

i) Can facilitate improved seated stability

ii) Can facilitate functional use of upper extremities

iii) Can impact access to rear wheels for propulsion

iv) Can impact weight distribution over rear wheels

9) **Back Height**

A) Higher Support

i) Provides increased posterior trunk support

ii) May decrease shoulder extension range of motion

B) Lower Support

i) Provided less posterior trunk support

ii) May increase shoulder extension range of motion

C) Considerations

i) Can impact postural stability

ii) Can impact upper extremity range of motion for function

10) **Front Frame**

A) **Length**

i) Increasing the distance to the casters through front frame length with the same axle position, results in a greater percentage of mass over the drive wheels

a) Provides another way to balance stability and mobility for a client

b) Can impact access/maneuverability

c) Can impact lower extremity/foot support and must be considered in conjunction with front frame angle and style of foot support

B) **Angle**-Measurement of lower leg support angle

i) Chair with removable footrest-angle is measured in relation to seat rail assuming a level seat (horizontal with the ground)

ii) Rigid front frame-Most manufacturers relate angle of the frame to the ground

a) Some manufacturers provide angle in relation to a level seat regardless of seat inclination at time of order

b) Some manufacturers provide angle in relation to seat "dump" at time of order

c) Changing seat "dump" in the field will change angle in relation to the ground

iii) Considerations

a) Hamstring length and range of motion (hip/knee/ankle)

b) Spasticity/Tone

c) Seated stability

d) Maneuverability

11) **Prescriptive Planning**

A) Role of the Wheelchair for the User

i) Individuals who use wheelchairs do much more than propel from wheelchair

ii) Consider activities a user must do/wants to do from the chair

iii) Consider context in which they perform those activities

B) Critical Questions for prescriptive planning

i) What is likely to change for this user during the life of this wheelchair?

ii) How will the change(s) impact the setup of the chair?

iii) What can we do to help plan for the change(s)?

12) **Prescriptive Planning: Clinical Application**

A) Clinical Example 1-New T10 SCI planning for skill acquisition and decrease in postural support needs

B) Clinical Example 2-New onset multisystem atrophy planning for decrease in function and increase in postural support needs

C) Clinical Example 3-Teenager with cerebral palsy/spastic diplegia planning for skill acquisition and growth