ASSISTIVE TECHNOLOGY AT UOFL PHYSICIANS: Tools for Functional Independence

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Presentation Objectives

1. Philosophy: Assistive technology and overview of interventions for functional impairment
2. Create synergy between “recovery” and “adaptation/compensation” approaches
3. Primary issues being addressed at ULP’s Neuro and PM&R clinic
4. Reimbursement issues and justification support
The International Classification of Functioning, Disability & Health (ICF)

- An organizing concept for measuring health and disability within a context
- A standard that supports communication and measurement among researchers and health care professionals
- In general, we consider ourselves “healthy” when can return to valued Activities & Participation
How does Assistive Technology fit?

• The ICF is a useful road map or conceptual framework
• Physicians/researchers commonly work at the *Body structure* and *Body function* level
• AT intervenes at the level of *Activities & Participation* and at the *Environmental Factors*
  • Activities & Participation is the level at which we self identify: life roles, human occupations… what we *do* that expresses who we are!
The International Classification of Functioning, Disability & Health (ICF)

Part 1: Body Functions and Structures

a: Impairments of Body *Functions*

- Mental, sensory, speech, *circulation*, breathing, digestion, *metabolism*, endocrinology, genitourinary, reproductive & *neuromusculoskeletal*

b: Impairment of Body *Structures*

- The *structures* that allow the function of each of the above body function systems, e.g., healthy lungs or arteries.
The International Classification of Functioning, Disability & Health (ICF)

Part 2: Activity Limitations & Participation Restrictions

a: Activity = the execution of a task

b: Participation = involvement in a life situation

- Learning & applying knowledge (watching, listening, reading, writing, calculating, solving problems),
- General tasks, communication (giving & receiving spoken & non-verbal information)
- Mobility (lifting, carrying, hand use, walking, driving a car, using transportation),
- Self-care, domestic life (acquiring goods & services, meal prep, assisting others, caring for the house)
- Interpersonal interactions & relationships, community social & civic life.
Part 3: Environmental Factors

- **Products and Technology** (for consumption, personal use, transportation, communication, the design of buildings for personal & public use)
- **Environmental Changes** (ramps, lights, climate, assistive listening systems)
- **Support & Relationships** (family, friends, neighbors, personal care providers, health professionals)
- **Attitudes** (expressed within these relationships)
- **Services, Systems and Policies** (accessible housing transportation and communication; laws and agencies for social support, health, employment, etc.)
Dramatic Changes in Outlook for Neurological Impairment

• We work in exciting times
• The impact of translational research, drug therapies, treatment interventions are being felt
  • Translational research based on understanding of neural plasticity
  • Intervention break-thoughts promote a recovery approach to many neuro diagnoses
  • UofL’s potential to develop a Neuroscience Institute
  • Long held concept: In development motor follows sensory
A Model for Effectively Implementing AT

- The HAAT Model: Human, Activities, & AT within a Context
- Focus: “Activities & Participation” level of the ICF
  - Individualized to the patient’s factors
  - Functions like any system
Improving Quality of Life Now

• Assistive Technology
  • Should be considered when neurological impairment affects activities and participation
  • Goal: use or augment existing “performance skills” with “technical adaptations” to enable return to valued life roles
  • With new emphasis on a recovery approach…
    • Need a fluid intervention approach for times when recovery is possible
    • Intent to complete activities promotes new use patterns and the active motivation of participation
  • Then, reduce compensation as recovery occurs
Activity & Participation require motor & sensory skills

- **Activities**
  - Holding & Carrying
  - Manipulating
  - Lifting & Reaching
  - Sitting
  - Standing
  - Walking
- **Participation**
  - Work or School
  - Home management
  - Play

- With variations created by:
  - **Physical environment**:
    - light, temperature, moisture, ramps & curb cuts, elevators
  - **Social setting**:
    - home, work, school, leisure
  - **Culture**:
    - attitudes about self-reliance versus care or protection of family members
    - Stigma versus acceptance of difference
Attitudes toward AT?

- Personal factors
  - Age cohort
  - Personality
  - Self image
  - Attitude toward barriers

- Social attitudes
  - Prejudice, pity
  - Environmental limits
  - Public Policy & Insurance

Tom Morris: IU Fitness Coach [Video](http://www.youtube.com/watch?v=MaiNjuEJzZA)
Motor and Sensory Performance Skills

A prime concept in Occupational Therapy

- All activities have motor, sensory, cognitive and psychosocial components
- The skills needed for activities change based on materials, socio-cultural dimension, and human context, e.g., eating, working, childrearing vary greatly
- The therapist assesses and develops a treatment plan to remediate, strengthen, substitute, or compensate for these skills
- The goal? Return to Human Occupations: the activities engaged in by humans throughout the day and across the lifespan
Motor and Sensory Performance Skills

When these skills are lost…Use assistive technology to compensate

• Back to the human dimension
  • Some work extremely hard to recover
  • Others are overwhelmed and lost without hope
  • Some cannot accept anything but recovery
  • Some see the value in adaptation and feel the pull of meaningful occupation

• Individuals offered a means to adapt and compensate often move forward with very meaningful lives
Assistive Technology: Technical Adaptations to Support or Substitute for Performance Skills

- Specialized Seating
- Wheeled Mobility
- Specialty Controls
- Adaptive Computer Access
- Electronic Aids to Daily Living
- Augmentative Communication Devices
Specialized Seating

- Often an essential aspect of managing neurological impairment
- **Postural support:** impaired muscle control leads to postural collapse: posterior pelvic tilt, pelvic obliquity, and scoliosis and a cascade of associated issues
- **Skin protection** from pressure ulcer and shear
  - More than 50% of individuals with SCI will experience pressure ulcer (PU) during their lives
  - Treatment costs = $15K to $90K per PU
  - Significant social/psychological costs, too
- **Comfort** as a result of shape and material properties
- **Secondary disabilities** can be prevented
Pressure Ulcer Causes

• Occur in muscle soft tissue adjacent to bony prominences when gravitational pressure is greater than capillary blood pressure
• Associated with...
  • Pressure over time
  • Shear: poor transfers, inadequate management
  • Poor nutrition
  • Heat and moisture
  • Incontinence
  • Reduced connective tissue elasticity secondary to normal aging
Pressure Mapping
Pressure Ulcer Prevention

Two approaches to pressure management:

1. Load averaging: use envelopment to maximize surface area for pressure distribution, consider material properties of the cushion

2. Load management: Off-load the sacrum, coccyx & ischial tuberosities: transfer load to pressure tolerant areas: posterior ilium of pelvis, greater trochanter & posterior femur
Load Averaging: Maximize the Surface Area

- Select cushions based on materials properties
  - Foam
  - Air flotation
  - Viscous fluid
  - Combinations
- Maintain proper inflation to allow immersion
- Challenge: Balance immersion with stability
Load Management: Off-load High Risk Areas

- High risk areas:
  - Ischial Tuberosities
  - Coccyx
  - Sacral Spine
- Transfer loads to:
  - Posterior ilium of pelvis
  - Posterior femurs
  - Greater trochanter
  - Float the Ischial
Load Management: *Off-load* High Risk Areas

- RideDesigns Custom Contour
- An Orthotic approach
  - Assess, mold, correct, fabricate, & fit
- Supports weak musculature, optimize posture
- Restores a stable base
- Breathable material
Case: C5-6 SCI, 40 years post

Unable to sit without assist, severe right pelvic obliquity & PU

Able to sit hands-free, with pelvic obliquity accommodated
Pressure Mapping: A teaching Tool

- Train for pressure relief: 1 minute every 30
  - Wheelchair push ups
  - Also…

Elbow on thighs

Side leaning
Assistive Technology: Technical Adaptations to Support Performance Skills

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Gold Standard: Ultralight Manual Wheelchairs

- Most inpatients are discharged in a standard wheelchair, i.e., no adjustability
- Expectation for limited need?
- Ultralight features:
  - Lightweight
  - Adjustable axle position
  - Highly maneuverable
  - Custom body dimensions
  - Needed features to support function
- Critical for anyone who uses a wheelchair full time
Evidence Based Practice on Manual Wheelchairs

• The PVA Guide: Preservation of the Upper Limb
  • 16 peer reviewed studies with >2000 subjects used X-rays, exams, electro diagnostistics, MRI, history, surveys to report:
  • Wrist pain, elbow pain, shoulder pain, carpal tunnel, rotator cuff tears, shoulder degeneration, neuropathy, etc.
  • Repetitive strain injury prevalence ranged from 30% to 70% of subjects
  • Some showed > prevalence with > duration
• The outlook is NOT good for standard manual wheelchair propulsion when these guidelines are ignored
Recommendations from the PVA Guide

- Minimize the forces from frequent, repetitive UE tasks
- Minimize extreme joint positions:
  - Wrist,
  - Resistive activities with hands above head,
  - External/internal rotation and abduction of shoulder
- Educate about the merits of power mobility for high risk patients, e.g., those with higher than C-6 level injury
Recommendations from the PVA Guide

• Use rigid, light, strong custom wheelchairs
• Forward placement of rear axle under center
• Wheel height so that with hand @ top of pushrim: elbow is at 100° to 120° flexion
• Use long, smooth, low impact push strokes
• Optimal stroke shape: hand drops below rim
• Optimize seated posture
• Learn appropriate transfer skills
  • Seat elevation: has great preventative & functional value; but considered a “luxury”
Recommendation from PVA Guide

• Home modifications: more than a convenience; helps with prevention of secondary disability
• Exercise and maintain ROM for shoulder strength and flexibility
• Interrupt and treat acute pain as quickly as possible
  • Rest for manual wheelchair users is really difficult
  • Teach alternate techniques
  • Gradually return to normal activities
  • Use interdisciplinary approaches to treat chronic pain
• May inevitably need change to powered mobility with their greater demand for an accessible environments
Axle Position

- Changes the relationship of upper extremity to push rims
  - Fixed axles: reduce the effectiveness of a push stroke and requires shoulder internal rotation
  - Ultralight with adjustable axle: Increases access to pushrim, body mass over wheels, fewer push strokes with reduced force
Wheel Camber

- Place pushrims close to body
- Re-aligns push force
- Increases stability
- Increases chair width but caution for accessibility
Ultralight Wheelchair Skills

- Teach the “Wheelie”
  - Find center of mass and balance there!
- A survival skill for:
  - Gravel
  - Curbs with NO cut
  - Down a steep ramp
  - Dancing!
- Excellent training at:
  www.wheelchairskillsprogram.ca
Pushrim Activated Power Assist Wheels

- Well-designed
- NiCad battery & motor wrap around the axle
- Add to a ultralight manual wheelchair
- Forward movement on the pushrims activate the motors
- Options for % of power assist
- Cost is high: ~$6K
Power Add-on: Smart Drive

- Clips onto the rear axle
- Add it to an ultralight manual wheelchair
- Push typical wheelchair pushrims which triggers the drive motor.
- Maintains user’s speed until SD senses braking
- Adjusts to maintain contact with surface
- Great for borderline upper extremity
Powered Mobility Devices

- Allow independent mobility and access to the environment
- Medicare only pays for mobility “inside the home”
- Medicare has been ripped off by fraud and abuse
- Now, extensive procedures and justification for wheelchairs & their features

Standard or Group 2 Power chair
Powered Mobility Devices

- Physicians must address these issues in a “Face-to-face” visit
  - Address the “Algorithm”
  - Document in chart notes
  - Sign off on a detailed product description
- Each feature of a custom wheelchair must be justified
- Our service: detailed eval by a RESNA-certified seating and mobility therapist… not just a salesperson

Standard or Group 2 Power chair

Frazier Rehab Institute
KentuckyOne Health™
Powered Mobility Devices

• Customized
• Allows focus on activities & roles instead of effort of “getting there”
• Definitely require accessible home and transportation
• Enable improved pressure management/postural support/positional change for comfort
• Alternate controls for driving and managing position

Group 3 Power or Custom/Complex Power
Quickie QM-7
Specialty Controls

• Use existing abilities
  • Sip ‘n Puff
  • Head array
  • Micro joystick
  • Tongue touch keypad

• Use a single control technology to operate multiple devices
  • Wheelchair + computer + electronic devices (EADLs)
  • Now equipped with infrared (IR) and Bluetooth

Sip and Puff controller can control WC + seating + TV/DVD/music/computer
Wheelchair Transportation Safety
Wheelchair Transportation Safety

- Transportation is a daily activity/context
- Use equipment that complies with voluntary industry standards
- Secure wheelchair with 4 tiedowns or dock
- Secure the passenger with 3-point occupant restraint
Wheelchair Transportation Safety
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Frazier Rehab Institute
KentuckyOne Health™

Physicians Neurosurgery
Adaptive Computer Access

• Alternate mice & keyboards
• Text enlargement
• Accessibility options or universal access: built into both Macs & Windows
• Dragon Speech Recognition: Text generation and OS control
• Text-to-speech (speaks the text on the screen)
• Optical Character Recognition (OCR): converts print to digital text
Adaptive Computer Access

- Enables computing for:
  - Shopping & Banking
  - Finding community resources
  - Communicating & sharing ideas
  - Learning & education
  - Employment
  - Dating
  - Surfing, games, blogging, social networking, etc.
Adaptive Computer Access

• Computing is pervasive
• It part of how we live life today!
• Costs are dramatically lower
• Usability is better than ever
• Mainstream products & operating systems supports reduce complexity
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Electronic Aids to Daily Living

• Alternate controls for the environment through various transmission technologies:
  • Infrared (IR) controlled devices
    • TV, DVD, CD, IR interface for X-10
  • Radio frequency (RF) controlled devices
    • Door openers, intercoms,
  • X-10 (house wiring) controlled devices
    • Thermostats, blinds, lights, fans
  • Wi-Fi for remote control via the Internet
Electronic Aids to Daily Living

- Alternative control of appliances:
  - Telephone
  - Opening and closing doors
  - Home entertainment
  - Lights, fans, HVAC
- Can be simple or complex
- Computer-based or stand-alone

Hand held + Unity Remote™ by Gear4 via Bluetooth
Electronic Aids to Daily Living

• An application of home automation technology for individuals with functional limitations
  • Independence: pursue interests & entertainment
  • Safety: telephone use, door openers for egress,
  • Creates a more accessible supportive environment at home or work

Via house wiring with Insteon or X-10
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Vanguard
Prenke-Romich

MyTobii
EyeGaze
Augmentative Communication Devices

• Enable communicating ideas, choices, needs
  • Especially with non-familiar communication partners for participation in work or education or caregiving

• Plan an access method that will continue to adapt with a progressive diagnosis

• A Speech-Language specialization
In closing… is it Recovery vs. Compensation?

• The AT goal: Function for living now without constraining recovery… regain an identity!
• AT does NOT prevent recovery:
  • Recovery is a process
  • Walking will always be chosen over wheelchair use
  • Keyboard over pointing with a head mouse
  • Speaking over AAC device use
• Support patient choice of method based on the demand of the environment or the task
• Select AT devices with continuum of skill recovery in mind