Technology for Mobility and Balance in Neurologic Populations

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Download the CoreX equine app on your iPhone
• If you are able and willing please download the iPhone app for CoreX equine, it is free.
• We are using equine because it is free and it is the same as the old Level Belt app.
• If you have the Level Belt app and it is still working you can use that.
• We will be “playing” with this app during class.

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Disclosures
• Dr. Kegelmeyer is a board member and has ownership in Neuvanta LLC.
• Dr. Kegelmeyer has received funding from Honda R&D for work on the Stride Management Assist device.
• Dr. Kegelmeyer is an associate and collaborator of the creators of CoreX and Rekovo.
Objectives:

- Examine benefits and limitations of technology as a means to assess and treat mobility and balance in neurologic populations.
- Understand the potential uses of iPhone apps, gaming consoles and robotics in neurologic rehabilitation.
- Gain exposure to the use of selected technologies.

Technology for Mobility and Balance

Pros:

- Technology can do things that therapists cannot do:
  - Hold a person upright during gait without fatigue or injury.
  - Provide meaningful, appropriate and ongoing feedback.
  - Manage multiple joints at one time.
  - Measure output such as weight distribution that we cannot assess.
- The ability to be fun and engaging is an important variable in physical therapy interventions because it stimulates reward-related dopaminergic systems in the brain that are known to facilitate learning through long-term potentiation of neural connections (Janssen, 2017).

Cons:

- Technology cannot provide the “human touch.”

Telerehabilitation

- Delivery of rehabilitation services via information and communication technologies.
- A bit of a misnomer as we now use tools like Adobe Connect and web conferencing applications to connect with patients.
  - Provides a means to work with the client in their home.
  - Especially beneficial for clients living in remote areas.
  - Beneficial for clients who may not be able or willing to leave their home due to cognitive or psychological issues.
Research consumer apps/devices in assessment

- Caution in using consumer versions.
- The Wii balance board is not accurate but can be used to compare performance across two individuals or two time points. Does not give absolute measurement. (Severini, 2017)
- iPhone accelerometer has been shown to be valid (accurate) and reliable so can be used to measure things like:
  - Trunk sway (Kegelmeyer, 2017)
  - Gait speed
- GAITRITE/Prokinetics/Gwalk all have multiple studies demonstrating their validity and reliability

Trunk Control in Huntington’s Disease

- Study showed it to be effective way to examine trunk sway in clients with Huntington’s disease. (Kegelmeyer, 2017)
- Trunk stability is more impaired in static postural tasks than in dynamic locomotor tasks.
- In contrast to the slow, smooth sinusoidal trunk movements of controls, individuals with HD demonstrated rapid movements with varying amplitudes that continuously increased without stabilizing.
- Students were able to use it to measure sway in elderly clients in the emergency department. (Slattery, 2017; Kegelmeyer pub pending)

Gait assessment

- GAITRITE and Prokinetics are both carpets with sensors that connect to a computer.
- The client walks across the carpet and it produces a report describing the spatiotemporal characteristics of gait such as gait speed, time in stance and swing, variability and width of base of support.
- G Walk is a more affordable accelerometer based device you put on a belt at level of L1. Uses the same measures.
- Why use in clinic? Can provide more detailed descriptors of gait to better allow clinicians to address specific gait issues.
- To collect data for long-term, real life studies of clinical practice to better change the reimbursement atmosphere.
Research Evidence: Gaming

- In most cases, Video game training offered similar results as conventional therapy. (Bonnechère, 2016)
- Therefore, Video games could be added as an adjunct treatment to stimulate patient motivation or at home to maintain rehabilitation benefits.
- More evidence that games improve impairments and activity, more studies needed to look at participation and plasticity. (Deutsch, 2017)

Therapists can learn from gaming

- Make therapy a game to improve engagement. (Janssen, 2017)

Gaming: Consumer Consoles

- Has been used in multiple populations: Spinal cord injury, stroke, multiple sclerosis, Parkinson disease, and Huntington's disease.
- In our study in both Huntington disease and Multiple sclerosis use of Dance Dance Revolution improved aspects of balance (double support time) (Kloos, 2013)
- Clients in our study reported they enjoyed the game, they stayed on task for 45 minutes and requested to play the game at home.
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Rehabilitation specific Gaming

- Recovery Rapids used for constraint induced UE rehab but also can be used to improve balance in sitting and standing. Available for clinics to purchase.
- For Rekovo/Agility Arts: Patients in in-patient rehabilitation report that:
  - It helps them stick with rehabilitation endeavors for long durations
  - It helps them "get in the zone"
  - Provides an artifact of their work, motivates them and they share with their family. (Worthen-Chaudhari, 2013)
- To use Rekovo you strap the sensor to the limb and the person stands in front of a monitor and moves the limb to create a painting. Can change settings to encourage smaller or bigger movements and can change colors to improve motivation.

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Research in robotics

- There are many types from brain controlled to computer programmed, from full body support to only assisting at the hip for swinging.
- Has primarily been used in stroke and spinal cord injury but also in other populations like multiple sclerosis. Generally well accepted by patients from young to elderly and both males and females. (Fundaro, 2018; Swinnen, 2018)
- More severely disabled patients may obtain greater benefit from robotic training but, need residual trunk control as this was identified as a good prognostic factor for robotic walking training. (Morone, 2018)
- Spinal Cord Injury: Does not out-perform conventional therapy and should be incorporated into a multi-modality rehabilitation approach. (Hayes SC, 2018)
- CVA: For lower limb patients with severe impairment, robotic training produces better outcomes than conventional training. (Lo K, 2017)

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Robotics: SMA

- The stride management assist (SMA) device is intended to assist with gait in individuals who are independent ambulators and can maintain upright stance without assistance.
- SMA and functional task specific gait training interventions provided similar, significant improvements in spatiotemporal gait parameters; however, the SMA group showed additional improvements across more parameters at various time points. (Buesing, 2015)
Robotics: SMA

• The SMA is placed around the pelvis with straps around the distal thigh. An iPad device is used to individualize the settings.
• It can assist or resist swing initiation and can assist or resist terminal swing.
• Level of assistance and resistance can be adjusted.

Technology for Mobility and Balance Demonstrations

• CoreX (Level Belt)
• GAITRite/Gwalk
• Rekovo/Ability Arts
• Robotics: Stride Management Assist (SMA) Honda R&D
• Virtual Reality
• Telerehabilitation......
Demonstrations

• We will form 3 groups and will rotate through each of the following demonstrations:
  • Gait Assessment
  • Gaming for Rehabilitation
  • Robotics