


**NIH Toolbox**  
Assessment of Neurological and Behavioral Function

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# Motor

Zev Rymer, MD, PhD  
Rehabilitation Institute of Chicago  
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For more information, please visit [www.nihtoolbox.org](http://www.nihtoolbox.org)  
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## Motor Domain



Phase 1:  
5 Key Domains of Motor Function Were Identified

- Locomotion
- Strength
- Endurance
- Non-Vestibular Balance
- Dexterity

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## Dexterity



**Candidate Measures:**

- Horse Race Between 5 Iterations of Pegboards
  - 9-Hole Pegboard
  - 25-Hole Pegboard (Lafayette)
  - Grooved 25-Hole Pegboard
- Validation Measures
  - Purdue Pegboard (adults)
  - Bruinicks Osteretsky – dexterity scale (pediatrics)


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## Dexterity



### Preliminary Findings

- Pre-tested with convenience sample of adults (n=18)
- Leading Candidate – Grooved 25-hole pegboard
  - Greater task demands for precise peg placement
  - Allows greater discrimination in general population
  - Longer, therefore, more forgiving of participation “errors” – such as dropped pegs
  - Qualitatively – participants report preference for the feel of metal pegs
- Other innovation
  - Video instructions for consistent test administration
  - Computer-based data capture with online timer

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## Strength



### Candidate Measures

- Grip strength dynamometer:  
Jamar PlusDigital
- Electronic Manual Muscle Testing
  - Shoulder Flexion
  - Elbow Extension/Flexion
  - Hip Flexion
  - Knee Extension
- Timed Chair Rise
- Validation Measures
  - Biodex (adults)
  - Bruinicks-Oseretsky Muscle strength scale (pediatrics)



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## Strength



### Preliminary Findings

- Pre-tested for feasibility in adult convenience sample (n=18)
- Leading candidate (Upper Extremity Strength):  
Grip strength dynamometry
  - Easy to administer
  - Reliable and normed for much of the population
- Electronic manual muscle testing
  - Elbow flexion/extension and hip flexion leading candidates
  - Easy of administration
  - Ability of administrators to apply adequate and reliable counter pressure

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## Strength (cont'd)



### Preliminary Findings

- Timed chair rise
  - Shows adequate discrimination
  - Not a pure measure of strength (combines strength, balance and agility without a reliable means of determining the individual contributions of each)

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## Locomotion



### Candidate Measures

- 20 ft walk
- 20 ft walk (out and back)
- 4 m walk
- Metric: Time to walk set distance
- Pace: as quickly as possible
- Pre-testing Plan: Test feasibility with convenience sample (21-65, 75-85) (n=36)
- Status: IRB pending

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## Endurance



### Candidate Measures

- 6 minute walk test (100' course) – criterion standard
- 6 minute walk test (50' course) – distance recorded at 2 minute intervals
- 2 minute walk test (50' course)
- Metric: Distance walk in set amount of time
- Pace: as quickly as possible (rest breaks as needed, timer does not stop)
- Pre-testing Plan: Test feasibility with convenience sample (n=36)
- Status: IRB pending

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## Non-Vestibular Balance



- Vestibular and non-vestibular balance are re-united by a single measure
- Modified Computerized Test of Sensory Integrative Balance under the direction of Dr. Susan Whitney

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## Validation Plan Criteria for Inclusion



- Entire domain validated as a unit at 3 sites (n=450 across the age span)
- Evaluate test-retest and inter-rater reliability ( $\leq .80$ )
- Evaluate ability to discriminate (significant beyond .01 level)
- Evaluate equivalence to criterion standard (correlation .70 or greater)
- Evaluate order & interaction effects across sub-domains
- Evaluate and avoid 'floor' and 'ceiling' effects
- Determine safety and fatigue cut points (for individual measures and domain as a whole)

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## Motor Domain



### Team Members

- W. Zev Rymer, MD, PhD - Rehabilitation Institute of Chicago and Northwestern University (Domain Leader)
- David Reuben, MD - University of California, Los Angeles (Domain Leader)
- Heather McCreath, PhD - University of California, Los Angeles (Development Scientist)
- Inga Wang, PhD - Rehabilitation Institute of Chicago (Development Scientist)
- Susan Magasi, PhD - CORE and Northwestern University (Domain Manager)
- Jin Shei Lai, PhD, OTR/L - CORE and Northwestern University (Domain Manager)
- Dallas Anderson, PhD - National Institute on Aging (NIH representative)
- Richard Bohannon, PhD - University of Connecticut
- Suzann Campbell, PT, PhD - University of Illinois at Chicago (emeritus)
- Christine Chen, PhD, OTR/L - Columbia University
- Diane Darmiano, PhD - Washington University
- William Evans, PhD - University of Arkansas
- Allen Heinemann, PhD - Rehabilitation Institute of Chicago and Northwestern University
- Elizabeth Moberg-Wolff, MD - Children's Hospital of Wisconsin

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