Application of the Vestibular EDGE Task Force Recommendations

APTA Combined Sections Meeting
Las Vegas, NV
February 6, 2014
Objectives

• Describe the process used by the Vestibular EDGE Task Force to develop the recommendations
• Identify recommended tests and outcome measures in the ICF domains of body structure/function, activity, and participation
• Utilize the Vestibular EDGE recommendations to select appropriate outcome measures for patient care
• Utilize use of the Vestibular EDGE recommendations to modify entry-level physical therapy curriculum
• Utilize the Vestibular EDGE recommendations for research design
• Identify gaps and future research opportunities in current tests and outcome measures for individuals with vestibular disorders
Vestibular EDGE Task Force Members

- **Matthew R. Scherer, PT, PhD, NCS, Chair**
  - Andrew Radar U.S. Army Health Clinic, Joint Base Fort-Myer Henderson Hall, Physical Therapy, Arlington, VA
- **Linda B. Horn, PT, DScPT, MHS, NCS, Co-Chair**
  - University of Maryland School of Medicine, Physical Therapy and Rehabilitation Science, Baltimore, MD
- **Elizabeth Dannenbaum, MScPT**
  - Jewish Rehabilitation Hospital, Laval, Canada
- **Jennifer L. Fay, PT, DPT, NCS**
  - NYU Langone Medical Center, Rusk Institute for Rehabilitation Medicine, Vestibular Rehabilitation Department, New York, NY
- **Karen H. Lambert, PT, MPT, NCS**
  - Bodies in Balance Physical Therapy, Wilmington, NC
- **Tracy A. Rice, PT, MPH, NCS**
  - West Virginia University, Division of Physical Therapy, Department of Human Performance, Morgantown, WV
- **Jennifer L. Stoskus, PT, MSPT, DPT**
  - Kessler Institute for Rehabilitation, Outpatient Physical Therapy Department, Chester and Saddle Brook, NJ
- **Diane M. Wrisley, PhD, PT, NCS**
  - Wingate University, Department of Physical Therapy, Wingate, NC
Outline

• Introduction
• Application of the recommendations to clinical cases
• Application of the recommendations to entry-level curriculum
• Application of the recommendations to research
• Panel discussion
Introduction

• EDGE = Evaluation Database to Guide Effectiveness
• Formed by the Section on Research in 2006
• Vestibular EDGE differs from other groups
  – Included many different diagnoses

2010 • Stroke
2011 • Multiple Sclerosis
2012 • Spinal Cord Injury
  • Traumatic Brain Injury
2013 • Parkinson’s Disease
  • Vestibular Dysfunction
Process

• Pre-CSM
  – Teleconferences to compile a list of tests and measures

• CSM 2013
  – Finalized list of tests & measures to be reviewed
  – Established primary & secondary reviewer pairs
  – Established rating system
  – Developed Vestibular EDGE (VEDGE) form
  – Discussed collaboration with Rehabilitation Measures Database [RMD] (http://www.rehabmeasures.org/default.aspx)

• Post-CSM
  – Reading, writing, & collaboration
  – Modified Delphi Process
Modified Delphi Process

- Individual reviewer completed review for selected outcome measures (OM)
  - Completed VEDGE and RMD documents

- Partner reviewed measures/documents and pair reached consensus on assigned OM

- Group survey completed

- Discussed measures not achieving 80% agreement
  - 7/8 task force members

- Second group survey completed
ICF Domain

- Body Structure/Function: 39.1%
- Activity: 43.5%
- Participation: 17.4%

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Categories Rated

Acuity
- Acute 0-6 wks
- Chronic > 6 wks

Diagnosis
- Peripheral
- Central
- BPPV
- Other

Entry Level
- Learn OM
- Expose to OM

Research
- Appropriate to use
- More research needed
VEDGE Rating Scale

- **4= Highly Recommended**
  - This outcome measure has excellent psychometric properties and clinical utility,
  - **AND** this measure is free or reasonably accessible to the broad community of providers.

- **3= Recommended**
  - This outcome measure has good psychometric properties and good clinical utility,
  - **OR** this measure has excellent psychometric properties and clinical utility; however, it is not free and may require access to specialized testing equipment that is beyond the means of many clinicians or clinics.

- **2= Reasonable to Recommend at this time**
  - This measure has adequate to good psychometric properties and clinical utility; however, it is not free and may require access to specialized testing equipment that is beyond the means of many clinicians or clinics,
  - **OR** this measure has been validated in other patient populations but not in persons with vestibular deficits
  - **OR** this measure has only adequate clinical utility.

- **1= Not Recommended**
  - This outcome measure has poor psychometric properties,
  - **OR** this measure has poor clinical utility.
Survey Results

![Survey Results Chart]

- **Round 1**
  - < 80%
  - ≥ 80%

- **Round 2**
  - < 80%
  - ≥ 80%

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# Rehab Measures: Dizziness Handicap Inventory

<table>
<thead>
<tr>
<th>Link to instrument</th>
<th>Available on Southampton Hospital's website (other languages available below)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title of Assessment</td>
<td>Dizziness Handicap Inventory</td>
</tr>
<tr>
<td>Acronym</td>
<td>DHI</td>
</tr>
<tr>
<td>Instrument Reviewer(s)</td>
<td>Initially reviewed by Amy M. Yorke, PT, NCS and the MS EDGE task force and Irene Ward, PT, DPT, NCS and the TBI EDGE taskforce of the Neurology Section of the APTA. Updated by Salomi R. Vora in 10/2012.</td>
</tr>
<tr>
<td>Summary Date</td>
<td>2/19/2013</td>
</tr>
<tr>
<td>Purpose</td>
<td>A 25-item self-assessment inventory designed to evaluate the self-perceived handicapping effects imposed by dizziness.</td>
</tr>
</tbody>
</table>
| Description        | - 25 items  
- Maximum score of 100 (28 points for physical, 36 points for emotional and 36 points for functional) to Minimum score of 0. The higher the score, the greater the perceived handicap due to dizziness  
- Item scores are summed  
- Answers are graded 0 (never), 2 (sometimes) and 4 (always)  
| Area of Assessment | Balance; Vestibular; Gait; Quality of Life; Social Relationships; Vestibular |
| Body Part          | Not Applicable |
| ICF Domain         | Body Structure; Body Function; Participation |
| Domain             | |
| Assessment Type    | Patient Reported Outcomes |
| Length of Test     | 06 to 30 Minutes |
| Time to Administer | 10 minutes |
| Number of Items    | 25 items |
| Equipment Required | Score sheet and pen |
| Training Required  | No Training |
Recommendations

• EDGE documents
  – Neurology Section website
  – http://www.neuropt.org/professional-resources/neurology-section-outcome-measures-recommendations

• RMD documents
APPLICATION TO PATIENT CARE

Jennifer L. Stoskus, PT, MSPT, DPT
How can I apply the recommendations?

Vestibular patients may be difficult to diagnose and treat.

Using appropriate outcome measures can help improve the diagnosis, treatment, and the outcome for patients in this population.
Patient Case: Mrs. K

• Mrs. K is a healthy and active 42 yo female reporting severe vertigo and illness/stomach virus beginning 2/12/11.
  – Given a scopolamine patch which relieved her vertigo, but remained with a stomach virus x 6 weeks.
  – Experienced 1 episode of ear pressure/popping and slight vertigo in March 2011
  – Saw internist who referred her to and ENT, who prescribed a nasal spray, reflux medication and meclizine
Mrs. K (cont.)

• Two weeks later:
  – Third episode of dizziness/vertigo that lasted ~ 2 days-
    vertigo was again relieved by scopolamine patch, but did
    not feel better until the next day.
  – Then saw a neurologist who ordered an MRI of carotid
    arteries and brain and MRA which were unremarkable.

• Now presents for OP Vestibular Rehabilitation evaluation:
  – Referring physician: Neurologist
  – IE Date: 5/3/11 (3 month chronicity)
  – Diagnosis on prescription= Vertigo 438.85
Patient Interview

• Chief complaint: positional vertigo/dizziness
  – Patient reports possibly worsened with supine to sit, but unsure; reports feeling “bleh” when moving around
  – Dizziness/vertigo is intermittent and lasts until she takes medication

• Denies:
  – Ringing in ears
  – Loss of hearing
  – Imbalance (only when dizzy)
  – Falls

• (+) for pressure/fullness in L ear
Differential Diagnosis

Chronic and Peripheral Neuritis?

BPPV?
Initial Evaluation

- **Activity and Participation:**
  - **DHI:** total score = 70%

- **Oculomotor exam:**
  - (+) for symptom increase with left eccentric gaze and upward gaze in room light and infrared lenses
  - *Unable to perform HSN or HIT due to hypersensitivity of system (pt refused)*

- **Static and Dynamic Postural Stability:**
  - **FGA:** total score = 25/30
  - **SOT:** total score = 73

- **Positional testing and symptom reporting:**
  - **Dix-Hallpike** negative for nystagmus or dizziness R, slight dizziness reported with Dix-Hallpike L
  - **MSQ:** 37.5%
Treatment planning

Positional Intolerance with Symptom Exacerbation and Perceived Disability

Static and Dynamic Postural Instability

Gaze instability/V OR Dysfunction ?
Treatment plan:

– General conditioning
  • Elliptical, Upright Bicycle, treadmill

– Positional habituation
  • Brandt-Daroff and Log Roll ➔ Crunches/stabilization on tx ball and BOSU

– Static and Dynamic postural stabilization
  • Step-up on BOSU, tandem walking, braid walking
    – Eyes closed, head turns

– Gaze stabilization
  • 2 Targets, X1, X2, VOR cancelation, head/body turning to targets

– Total= 12 sessions
Discharge

• **Activity and Participation:**
  – DHI: total score= 70% → 14%

• **Static and Dynamic Postural Stabilization:**
  – FGA total score= 25/30 → 30/30
    • No inc’d symptoms reported
  – SOT: total score= 73 → 76

• **Positional testing and symptom reporting:**
  • Dix-Hallpike negative for nystagmus/dizziness
  • MSQ: 1.56% symptoms only with # 15/16
• Measures by Acuity: Chronic

<table>
<thead>
<tr>
<th>Function/Participation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities Specific Balance Confidence Scale (ABC)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Dizziness Handicap Inventory (DHI)</strong></td>
<td>4</td>
</tr>
<tr>
<td>Vertigo Handicap Questionnaire (VHQ)</td>
<td>2</td>
</tr>
<tr>
<td>Vestibular Disorders Activities of Daily Living Scale (VADL)</td>
<td>2</td>
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<tr>
<td>Vestibular Rehabilitation Benefit Questionnaire (VRBQ)</td>
<td>2</td>
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<tr>
<td>UCLA Dizziness Questionnaire (UCLADQ)</td>
<td>2</td>
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<tr>
<td>Vestibular Activities and Participation (VAP)</td>
<td>2</td>
</tr>
<tr>
<td>Disability Rating Scale (DRS)</td>
<td>2</td>
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</tbody>
</table>

• Measure by Diagnostic Category: Peripheral

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**Chronic**

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<td>Dynamic Gait Index (DGI)</td>
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<tr>
<td><strong>Functional Gait Assessment</strong> (FGA)</td>
<td>4</td>
</tr>
<tr>
<td>Timed Up and Go (TUG)</td>
<td>2</td>
</tr>
<tr>
<td>Modified TUG w/ DTC</td>
<td>2</td>
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<tr>
<td>Gait Velocity (10 m walk test)</td>
<td>2</td>
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<tr>
<td>Five times sit to stand (FTSTS)</td>
<td>2</td>
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<tr>
<td>30-s chair stand test</td>
<td>2</td>
</tr>
<tr>
<td>Fukada Stepping Test</td>
<td>1</td>
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• Measures by Acuity: Chronic

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<th>Static Postural Stability</th>
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<td>Four Square Step Test</td>
<td>3</td>
</tr>
<tr>
<td>Berg Balance</td>
<td>2</td>
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<tr>
<td>Functional Reach Test/Modified</td>
<td>2</td>
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<tr>
<td>CTSIB (c/s instrumentation)</td>
<td>2</td>
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<tr>
<td>MODIFIED CTSIB (No Dome)</td>
<td>2</td>
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<tr>
<td>Balance Error Scoring System</td>
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<tr>
<td>(BESS)</td>
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</tr>
<tr>
<td>BEST Test (in-place, compensatory step)</td>
<td>2</td>
</tr>
<tr>
<td>Mini BEST Test</td>
<td>2</td>
</tr>
<tr>
<td>Romberg</td>
<td>1</td>
</tr>
<tr>
<td>Sharpened Romberg</td>
<td>2</td>
</tr>
</tbody>
</table>

| Sensory Organization Test                 | 2 |
| Head shake SOT (Neurocom) (HSSOT)         |   |
| Unipedal Stance Test (UPST)               | 2 |

| Measure by Diagnostic Category: Peripheral |

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</tr>
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<td>Sidelying Test</td>
<td>2</td>
</tr>
<tr>
<td>Bow and Lean Test</td>
<td>2</td>
</tr>
<tr>
<td>Deep Head Hanging for Anterior Canal</td>
<td>1</td>
</tr>
<tr>
<td><strong>Motion Sensitivity Quotient (MSQ)</strong></td>
<td></td>
</tr>
<tr>
<td>Subjective Visual Vertical (bucket test)</td>
<td>2</td>
</tr>
<tr>
<td>Joint Position Error Test (JPET)</td>
<td>2</td>
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<tr>
<td>Seated Cervical Rotation Test</td>
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<table>
<thead>
<tr>
<th>Symptom Severity</th>
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<tbody>
<tr>
<td>Visual Analog Scale (VAS)</td>
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<tr>
<td><strong>Vertigo Symptoms Scale (VSS)</strong></td>
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<tr>
<td>Visual Vertigo Analogue Scale (VVAS)</td>
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<table>
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<tr>
<th>Gaze Stabilization/VOR/Otologic</th>
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<tbody>
<tr>
<td>Dynamic Visual Acuity (DVA_NI) (using EDTRS chart)</td>
<td>2</td>
</tr>
<tr>
<td>DVA Computerized</td>
<td>3</td>
</tr>
<tr>
<td>Gaze Stabilization Test (Neurocom) (GST)</td>
<td>2</td>
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<tr>
<td>Head Shake/ Head Shaking Nystagmus Test</td>
<td>2</td>
</tr>
<tr>
<td>Head Impulse Test (HIT)/ Head Thrust Test (HTT)</td>
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</table>
Outcome Measures Chosen by ICF Domain

- **Body Structure/Function**: DHI, DHI, FGA, SOT, Dix-Hallpike, MSQ, HIT, DVA, VSS
- **Activity**: MSQ, DHI, FGA, SOT, Dix-Hallpike
- **Participation**: MSQ, DHI, FGA, SOT, Dix-Hallpike

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Clinical Application of Recommendations

Dizziness Handicap Inventory
Dynamic Gait Index
Dix-Hallpike
Functional Gait Assessment

Highly Recommended
Recommendations for BPPV

Dix-Hallpike = 4

Roll Test = 2

Sidelying Test = 2

Bow and Lean Test = 2

Deep Head Hanging = 1
<table>
<thead>
<tr>
<th>Clinical diagnostic category:</th>
<th>Recommended measures:</th>
<th>Reasonable to recommend at this time:</th>
<th>Unable to recommend at this time</th>
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</thead>
<tbody>
<tr>
<td>BPPV:</td>
<td>Dix-Hallpike* DHI*</td>
<td>Static Postural Stability:</td>
<td>- HSN</td>
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<td></td>
<td></td>
<td>- BERG</td>
<td>- Deep head hanging</td>
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<td>- Functional</td>
<td>- Fukuda Step Test</td>
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<td>Reach/Modified FRT</td>
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<td>- CTSIB/modified no dome</td>
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<td>- BESS</td>
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<td>- 5TSTS</td>
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<td>- 30-sec chair stand</td>
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<td>Gaze stabilization/VOR and Otolith Function:</td>
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APPLICATION TO ENTRY LEVEL EDUCATION
Entry Level Education Recommendations

• 4 task forces have paved the way prior to VEDGE
  – Stroke
  – MS
  – BI
  – SCI
Entry Level Education Recommendations

• Stroke EDGE
  – Number of measures reviewed= 54
  – Number of measures students to learn= 12
  – Number of measures student exposure= 26
Entry Level Education Recommendations

• Multiple Sclerosis EDGE
  – Number of measures reviewed = 63
  – Number of measures students to learn = 18
  – Number of measures student exposure = 11
Entry Level Education Recommendations

• Brain Injury EDGE
  – Number of measures reviewed = 88
  – Number of measures students to learn = 19
  – Number of measures student exposure = 32
Entry Level Education
Recommendations

• Spinal Cord Injury EDGE
  – Number of measures reviewed= 63
  – Number of measures students to learn= 9
  – Number of measures student exposure= 14
Entry Level Education Recommendations

• Vestibular EDGE
  – Number of measures reviewed = 46
  – Number of measures students to learn = 24
  – Number of measures student exposure = 13
Entry Level Education Recommendations

• 5 EDGE taskforces
  – 314 measures reviewed
  – 82 measures students to learn
  – 96 measures to expose to students
Entry Level Education Recommendations

• Vestibular EDGE
  – Number of measures reviewed= 46
  – Number of measures students to learn=24
  – Number of measures student exposure= 13
Entry Level Education Recommendations

- **4= highly recommended**
  - This outcome measure has excellent psychometric properties and clinical utility;
  - AND this measure is free or reasonably accessible to the broad community of providers

- **3= recommended**
  - This outcome measure has good psychometric properties and good clinical utility;
  - OR this measure has excellent psychometric properties and clinical utility however; it is not free and may require access to specialized testing equipment that is beyond the means of many clinicians or clinics.

- **2= reasonable to recommend at this time.**
  - This measure has adequate- good psychometric properties and clinical utility however; it is not free and may require access to specialized testing equipment that are beyond the means of many clinicians or clinics;
  - OR this measure has been validated in other patient populations but not in persons with vestibular deficits;
  - OR this measure has only adequate clinical utility.

- **1= not recommended**
  - This outcome measure has poor psychometric properties;
  - OR this measure has poor clinical utility
Entry Level Education Recommendations:  
Symptom Severity Measures

Students Learn

– Visual Analog Scale (2)

Students Exposed

• Motion Sensitivity Quotient (2)
• Vertigo Symptom Scale (2)
• Visual Vertigo Analogue Scale (2)
Entry Level Education Recommendations: Gaze Stability

Students Learn

– Dynamic Visual Acuity – using EDTRS chart (2)

Students Exposed

• DVA – instrumented (3)
Entry Level Education Recommendations: Postural Stability

**Students Learn**

- Four Square Step Test (3)
- Berg Balance Test (2)
- Functional Reach (2)
- Modified Functional Reach (2)
- CTSIB (2)
- Modified CTSIB-no dome (2)
- Mini BEST Test (2)
- Romberg (1-2)
- Sharpened Romberg (2)
- Unipedal Stance Test (2)

**Students Exposed**

- Balance Error Scoring System (BESS) (1-2)
- BEST Test (2)
- NeuroCom Sensory Organization Test (2)
Entry Level Education Recommendations:
Activity and Participation

**Students Learn**
- Activities Specific Balance Confidence Scale (ABC) (2-3)
- Dizziness Handicap Inventory (DHI) (4)

**Students Exposed**
- Vertigo Handicap Questionnaire (VHQ) (2)
- Vestibular Disorders Activities of Daily Living Scale (VADL) (2)
- Vestibular Rehabilitation Benefit Questionnaire (VRBQ) (2)
- UCLA Dizziness Questionnaire (UCLADQ) (2)
- Vestibular Activities and Participation Questionnaire (VAP) (2)
- Disability Rating Scale (DRS) (2)
Entry Level Education Recommendations: Dynamic Stability

**Students Learn**
- Dynamic Gait Index (DGI) (2-4)
- Functional Gait Assessment (FGA) (2-4)
- Timed Up and Go (TUG) (2-3)
- TUG with dual task/cognitive (2)
- Gait Velocity (2)
- Five Times Sit to Stand (FTSTS) (2)
- 30s Chair Stand Test (2)

**Students Exposed**
- Fukuda Stepping Test (1)
Entry Level Education Recommendations: Positional Testing

Students Learn
- Dix-Hallpike (2-4)
- Roll Test (1-2)
- Sidelying Test (1-2)

Students Exposed
Entry Level Education Recommendations: Diagnostic

Students Learn

- Head Impulse Test/ Head Thrust Test (2-4)

Students Exposed

- Head Shaking Nystagmus Test (1-2)
Entry Level Education Recommendations

• **Tests Beyond Entry Level:**
  – NeuroCom Head Shake SOT
  – NeuroCom Gaze Stabilization Test
  – Bow and Lean Test
  – Deep Head Hanging Test
  – Subjective Visual Vertical Test/ Bucket Test
  – Joint Position Error Test
  – Seated Cervical Rotation Test
So Many Tests...So Little Time

How can the material be incorporated into the curriculum?
Goal

• To have students prepared to use the most appropriate, reliable and valid measures with patients
Foundations

• Introduction to test psychometrics
  – Evidence-based Practice
  – Research
Organization

• Students instructed in developing a “toolbox”
  – Maintaining electronic copies of tests and measures
  – Awareness of test psychometrics
• EDGE taskforce ratings
• Use of Rehab Measures Website
  http://www.rehabmeasures.org/default.aspx
General Postural and Dynamic Stability Tests

• Introduced in Clinical Practice and Motor Control Courses

• Reinforced in diagnostic specific courses
  – Diagnosis and Management of Neuromuscular Dysfunction I and II
Symptom Severity and Activity and Participation Scales

• Global scales (VAS, ABC) introduced in clinical practice and research series
• Disease-specific in diagnosis and management courses
• How to handle the many activity and participation scales students should be exposed to?
Vestibular Specific Tests and Measures

• Gaze stability, diagnostic and positional testing taught in vestibular unit of diagnosis and management of neuromuscular dysfunction
APPLICATION TO RESEARCH

Matthew R. Scherer, PT, PhD, NCS
Diane M. Wrisley, PhD, PT, NCS
OBJECTIVES

• Utilize the Vestibular EDGE recommendations for research design
• Identify gaps and future research opportunities in current tests and outcome measures for individuals with vestibular disorders
• Illustrate application of VEDGE TF Recommendations informing Clinical Research
VEDGE Research Recommendations:

Introduction

• 46 measures organized by assessment domains relevant to population with vestibular involvement
  – Postural Stability
  – Dynamic Stability/ Gait
  – Positional Vertigo Assessment
  – Gaze Stability/ VOR
  – Cervicogenic Dizziness Assessment
  – Activity and Participation
  – Symptom Severity/ Self Report measures
Research Criteria

• Is this measure appropriate for use in research intervention studies?
  – Yes: 36
  – No: 15

• Criteria for decision making based on established test psychometrics and clinical utility
  – Reliability (Test Re-test, Intra-rater, inter-rater)?
  – Validity (Criterion, construct)?
  – Relevant “strength” of the measure psychometrics relative to other tests and measures assessing a given construct
  – Clinical Utility/ Feasibility (Cost, size, time to administer)
VEDGE Measures *Recommended for Research*

- **Postural/ Dynamic Stability**
  - Four Square Step Test
  - Berg Balance
  - CTSIB/ modified CTSIB
  - BEST/ mini-BEST
  - SOT
  - DGI/ FGA
  - TUG
  - Gait Velocity (10M WT)
  - 30 Second Chair Test

- **VOR/Gaze/Cervicogenic**
  - DVA-Instrumented
  - DVA- Non Instrumented
  - GST
  - HIT
  - JPET

- **BPPV**
  - Dix-Hallpike
  - Roll Test
  - Bow and Lean
  - Sidelying Test
VEDGE Measures *Recommended* for Research

**Activity/ Participation**
- Activities Specific Balance Confidence Scale (ABC)
- Dizziness Handicap Inventory (DHI)
- Vertigo Handicap Questionnaire (VHQ)
- Vestibular Disorders Activities of Daily Living Scale (VADL)
- Vestibular Rehabilitation Benefit Questionnaire (VRBQ)
- UCLA Dizziness Questionnaire
- Vestibular Activities and Participation (VAP)

**Symptom Severity Scales**
- Visual Analog Scale (VAS)
- Motion Sensitivity Quotient (MSQ)
- Vertigo Symptoms Scale (VSS)
- Visual Vertigo Analogue Scale (VVAS)
Summary of Results for Research
Recommendations:
Need for additional research

- Is there a need for additional research on this measure?
  - Binomial Response (yes/ no)
- 45/46 measures would benefit from additional research
- Qualitative Feedback from VEDGE team members included (explaining justification for additional research)
  - Reliability
  - Validation required in population with vestibular involvement.
  - Convergent validity between instruments assessing related constructs (e.g. gaze stability and aVOR gain)
Where should research go from here?

• Postural Stability
  – mCTSIB
    • Test-retest reliability in people with vestibular dysfunction (MDC)
    • Normative data/ cut-off scores
    • MCID
  – mini-BESTest
    • Reliability in people with vestibular dysfunction (MDC)
    • Normative data/ Cut-off scores
    • MCID
Where should research go from here?

• VOR/Gaze/Cervicogenic
  – GST
    • Reliability, MDC
    • Content validity
    • MCID, functional correlates
  – Non-instrumented DVA
    • Validity studies comparing to instrumented versions
    • Reliability in adults
Where should research go from here?

• **BPPV**
  - Roll Test
    • Reliability
    • Validity
  - Deep Head Hanging for Anterior Canal
    • Reliability
    • Validity
Where should research go from here?

• Activity and Participation Measures
  – Vestibular ADL Scale
    • Reliability, MDC
    • Normative scores
    • MCID
  – Vestibular Activities and Participation Measures
    • Reliability
    • Normative scores
    • MCID
Interventional Research Case Report

**PP:** 64 y.o. retired military officer, lobbyist, semi-retired Judge

**CC:** 10 year hx of vestibular like symptoms increasing in severity in recent months. Impairments and restrictions include:

- **Nausea** and *motion intolerance* during boating, riding as a passenger in a car (2 month duration of sx)
- Sensation of *disequilibrium* (“feel like my head is in a fish bowl”)
- *Diminished postural stability* and *dynamic instability* particularly with rapid right head turns resulting in 1-2 falls/week
- **Gaze instability** with rapid head movements
- **Visual deficits** “vertical diplopia” and diminished responsiveness to oncoming stimuli
- **Activity and Participation restrictions:** Symptoms dramatically impacting ability to pursue recreational activities (biking, sailing, cross country skiing) and confidence, symptom tolerance, and self percept of capability in the work place (i.e. courtroom)
Interventional Research Case Report

**PMH:** Significant for:

- Blast exposure with (+) LOC (1972)
- MVA with 72 hour LOC (August 1966)
- Sports concussions (x 20-30 over 40 year time frame)
- Viral infection, pericarditis and pneumonia (2002) of unknown etiology corresponds with first onset of significant gaze, postural, and gait instability

**Chart Review:** Caloric Asymmetry: 42% R sided weakness (2002)
Case Report: Chart Review and Findings on Clinical Examination

• **Gait assessment**: (+) R lateropulsion on level surfaces.

• **Gaze Testing** (Micromedical Oculomotor assessment suite (IR Goggle Recordings performed 27 February 2013))
  – Spontaneous (fixation removed): WNL,
  – Gaze Holding L, R, U, D – (fixation removed): WNL,
  – Gaze holding/ position dependent nystagmus (up, down, left, right- fixation removed): WNL

• **Head Shake Nystagmus** (fixation removed) : (-)
  – Positional Testing (fixation removed):
    (-) Dix-Hallpike Left ; (-) Dix-Hallpike Right
VEDGE Outcome Measure Selection

Problem List
• Motion Intolerance, c/o unsteadiness: VAS
• Postural Instability: SOT
• Gaze Instability: DVAT Instrumented
• Unsteadiness of Gait: FGA
• Participation Level Measures: ABC, DHI

Constructs to be assessed:
• Symptom severity
• Postural stability
• Dynamic stability/ Gait
• Gaze Stability/ VOR function
• Activity/ Participation
V EDGE Evaluation Criteria

– **4= highly recommended**
  • This outcome measure has excellent psychometric properties and clinical utility;
  • AND this measure is free or reasonably accessible to the broad community of providers

– **3= recommended**
  • This outcome measure has good psychometric properties and good clinical utility;
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# Symptom Severity

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<tr>
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<th>Acuity Rating: Acute</th>
<th>Acuity Rating: Chronic</th>
<th>Diagnostic Category: Peripheral</th>
<th>Diagnostic Category: Central</th>
<th>Diagnostic Category: BPPV</th>
<th>Diagnostic Category: Other</th>
<th>Students should learn to administer</th>
<th>Students should be exposed</th>
<th>Tool appropriate for use in intervention research studies?</th>
<th>Need for additional research on this measure?</th>
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## Gaze Stability

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<th>Diagnostic Category: BPPV</th>
<th>Diagnostic Category: Other</th>
<th>Students should learn to administer</th>
<th>Students should be exposed</th>
<th>Appropriate for use in intervention studies?</th>
<th>Is there a need for additional research on this measure?</th>
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<td>Dynamic Visual Acuity (DVA_NI) (using EDTRS chart)</td>
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## Activity and Participation

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<th>Academic: Students should learn to administer</th>
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<th>Research: Is this tool appropriate for use in intervention research studies?</th>
<th>Research: Is there a need for additional research on this measure?</th>
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<td>Disability Rating Scale (DRS)</td>
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</table>
Clinical Outcome Selection and Research Recommendation Application

- **VAS** – (Dizziness, vertigo, oscillopsia, motion intolerance): Excellent clinical utility, adequate Test-ReTest Reliability, Not yet validated
- **DVAT** – (Gaze Instability): Reasonable clinical utility; Excellent Reliability, Validated with SSC
- **FGA** (Dynamic Instability, Unsteadiness with Gait): Excellent clinical utility; Excellent reliability in VH; Well validated in VH (concurrent validity)
- **SOT** (Postural Instability): Moderate utility (cost/ time); Good reliability and established validity (MDC > 8 points)
- **CTSIB-I** (Postural Instability): Moderate clinical utility (instrumented); Reliability established in healthy controls and persons with CVA, validity well established
- **ABC** - Balance Confidence affecting activities and participation; Excellent clinical utility (self report), Reliability not established in VH, TBI; validated in TBI and VH populations.
- **DHI** - Self perception of handicap in VH; Excellent Test-Retest reliability; Validation in VH, Excellent correlation with ABC and SF-36, SOT and HS-SOT
Intervention: Methods and Results

• Plan of Care:
  – Postural stability training in busy visual environments and full visual field stimulation to promote habituation
  – Gaze stability training in dynamic conditions
  – Dynamic stability training with desensitization to visual cues
  – Patient education to encourage progressive reintegration of vocational and avocational activities
CAREN

• **Computer Assisted Rehabilitation Environment Immersive virtual reality experience**

• Realistic and carefully controlled visual, somatosensory and auditory stimuli tailored to patient impairments.

• Emerging evidence for management of dynamic instability *(Robago et al 2011)* and motion intolerance *(Gottshall 2013)* in Service Members with vestibulopathy and post traumatic dizziness
Computer Assisted Rehabilitation Environment (CAREN)  
(Motec Medical Inc, Netherlands)

1) VICON system with 12 cameras
2) 180 degrees of visual field projection providing an immersive virtual environment
3) 2 x 2 meter split belt treadmill with imbedded force plate mounted on a moveable platform with 6 degrees of freedom
4) Participant wore a safety harness suspended from an overhead frame that did not restrict freedom of movement
5) Visual and audio stimuli are linked specifically to treadmill speed and platform orientation
Intervention

- CAREN: 1-2 interventions/week x 7 weeks
- VICON markers integrate patient movements with synchronized visual and movement stimuli
- Postural Stability: Progressive weight shifting linked to visual challenges, variable bases of support, decreasing surface stability, increasing complexity of visual perturbations
- Gaze Stability: Head movements cued with metronome at 1 and 2 hz during locomotion on split belt treadmill.
- Habituation: Full visual field stimulation with progressive increases in stimulation and interactive demands.
- Dynamic Stability: Split belt locomotion, pitch and roll platform perturbations synched with visual stimuli, variable speeds,
Postural Stability

Assessment

• Baseline Composite SOT: 46%
• Baseline Instrumented CTSIB (Firm and compliant, EO, EC, VC)

Intervention

• Limits of Stability
• Slalom skiing
• Shark Attack
Gaze Stability/ Dynamic Conditions

Assessment
• Baseline DVAT (L Yaw): 0.3
• Baseline DVAT (R Yaw): 0.3
• FGA: 18

Intervention
• Gaze Stabilization during locomotion
  – 1 hz, 2 hz of head movement
  – Yaw and Pitch
  – Shifting platform
  – Busy Surround
Dynamic Stability/ Habituation

Assessment
• Baseline VAS 4.9 (mean)
VASo, VASv, VASd, VASm

Intervention
• Dynamic Stability
  – Yaw head movement stimulation
  – Shifting platform
  – Busy Surround
VAS Motion Intolerance

VAS M Pre vs. Post

<table>
<thead>
<tr>
<th>Treatment Session</th>
<th>VAS M Pre</th>
<th>VAS M Post</th>
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<tr>
<td>1</td>
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<tr>
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<td>2.5</td>
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<td>5</td>
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<tr>
<td>7</td>
<td>2.3</td>
<td>3</td>
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</tbody>
</table>

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Postural Stability Assessment

CTSIB:
- 165 (Pre: Treatment 2)
  165 (Post: Treatment 7)
- MDC: Not established
- Excellent Test-Retest Reliability in HC (r= 0.99) (Cohen et al 1993)

SOT:
- 46 (Pre)
  71 (6 weeks Post)
  25 point net improvement
- MCD= 8 points per Wrisley et al 2007
- Adequate reliability for composite score in healthy controls
  ICC= 0.67 (Wrisley et al 2007)
Medio-Lateral Motion of the Center of Mass

- EO
- EO_foam
- EC
- EC_foam
- OpFlow
- OpFlow_Foam

Medio-Lateral RMS (m)

- Session 2
- Session 6

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Dynamic Stability

**FGA (PRE): 18**
- Gait Level Surfaces: 1 (7.75 secs)
- Change Gait Speed: 3
- Gait with Horz Head Turns: 1
- Gait with Vertical Head Turns: 2
- Gait with pivot Turn: 2
- Step over obstacle: 3
- Gait with Narrow BOS: 0 (2 steps and LOB)
- Gait with Eyes Closed: 1
- Ambulating Backwards: 3
- Steps: 2

**psychometrics**
- MCID: 8 points (Marchette and Lin, 2010)
- Excellent interrater reliability (ICC = 0.86)
- Excellent intrarater reliability (ICC = 0.74) (Wrisley et al 2004)

**FGA (POST): 27**
- Gait Level Surfaces: 3 (+2)
- Change Gait Speed: 3
- Gait with Horz Head Turns: 2 (+1)
- Gait with Vertical Head Turns: 3 (+2)
- Gait with pivot Turn: 3 (+1)
- Step over obstacle: 3
- Gait with Narrow BOS: 3 (+3)
- Gait with Eyes Closed: 2 (+1)
- Ambulating Backwards: 3
- Steps: 2

**9 Point Change**
Lateral Foot Placement Variation

- Session 2 - Left
- Session 5 - Left
- Session 2 - Right
- Session 5 - Right

Foot Position (m)

- Walk
- OpFlow
- LR_1hz
- LR_2hz

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Gaze Stability

• Active DVAT (PRE)
  – Left Yaw: 0.3 LogMAR (20/40 equivalent)
  – Right Yaw: 0.3 LogMAR (20/40 equivalent)
  – Normative 60-69 y.o. is 0.08 LogMAR (< 20/26)

• Excellent test-retest reliability for *active yaw* impulses in VH, ICC: r = 0.83 (Herdman et al 1998)

• MCID/ MDC not established

• Active DVAT (6 weeks POST)
  – Left Yaw: 0.2 LogMAR (20/32 equivalent)
  – Right Yaw: 0.2 LogMAR (20/32 equivalent)

• Age matched DVA

• Patient reported significantly increased tolerance for gaze and postural stability with Rightward head movements.

96
Activity and Participation

- **ABC: 71 (PRE)**
  - Self-report measure of balance confidence
  - *Excellent* Test-Retest Reliability (r=0.92) (elderly adults)
  - Scores < 67% indicates risk for falling (elderly adults)
  - *Excellent negative correlation between the DGI and the ABC* Scale in patients with mild or moderate caloric weakness (r=0.65) Legters 2005

- **DHI: 64 (PRE)**
  - Self report measure of dizziness handicap
  - *Excellent* Test-Retest reliability (r=0.97, Jacobsen and Newman 1990)
  - *Moderate* (Jacobsen 1991) to *Excellent* (Lim 2012) negative correlation with SOT composite score

- **ABC: 57.5 (10 weeks POST)**
  - Decrement in balance confidence reported
  - Increased insight/ reflection into deficits?
  - Anecdotal reports of increased willingness to ski, bike, and sail.
  - ABC and DHI were well correlated

- **DHI: 60 (10 weeks POST)**
  - Despite strong concurrent validity with SOT, post test demonstrated no clinically significant improvement in self-perceived DH
  - Did *not* meet MCID threshold of 18 Points (Jacobsen and Newman 1990)
  - BH sequeallae?
VEDGE Concluding Remarks

- Targeted End User = ?
- “Considerations” Section
- VEDGE scope- Tests and Technologies
- Clinical Management meets research agenda
THANK YOU!

![Group Photo](image-url)