THE VA AUDIOLOGY BALANCE LABORATORY; OPTIMIZING YOUR TOOLS AND RESOURCES

David Domoracki PhD CCC/A
Audiology
Louis Stokes Cleveland VAMC
“When the only tool you have is a hammer, every problem starts to look like a nail”
“Hey doc, I’m having a little problem with gravity”
The VA Balance Lab

Defining Balance

Disorders with the balance systems

The laboratory tools

The flow of activities

The necessary clinic resources

Our unique population; mTBI OEF/OIF with persistent unsteadiness
What is Balance?

- Our orientation to gravity
- Our orientation to a support surface
- Our orientation to our visual environment

Therefore, there is a broad range of disruptive influences that will affect balance, including problems with sensory receptors, sensory integrators, and motor commands.
The Balance Function Clinic

The purpose of balance function studies encompasses three major goals:

1. **Site-of-lesion localization.** This shapes what surgical or medical specialties need to be involved with the further evaluation and management of the veteran.

2. **Assessment of the veteran’s functional ability to use the system inputs in an integrated fashion with the appropriate outputs.** This involves maintenance of stance after postural changes and coordination of head and eye movements during gaze activities.

3. **Determine whether the veteran may be an appropriate candidate for physical therapy rehabilitation.** This involves considerations of the veteran’s lifestyle and the handicap imposed by the disorder.
Impact of Chronic Disorders

69% of medical expenditures
Prevalence increases with population age
Unresolved cases lead to:
  “Doctor shopping”
  Extensive diagnostic testing
  Fear, restriction, & further deterioration
  Increased risk of falls & injuries
Chronic Care: Majority of Health $$

UC San Francisco - Institute for Health & Aging 1995

Total US Direct Medical Expenditures in 1990
$612 Billion

Acute Conditions 31%

Chronic Conditions 69%
Prevalence...

• Approximately $\frac{1}{2}$ of the American population age 65 and over experience falls
  – $\frac{1}{2}$ of the elderly people who fall do so repeatedly

• In 2001, more than 1.6 million seniors were treated in ER departments for fall-related injuries
Gravity exerts a force on each piece of the body that is proportional to the mass of that piece. The body’s CENTER OF GRAVITY (COG) is the point of action of all the total gravitational forces on each piece of the body (NeuroCom International, 2008). Any shift of mass on any side of the COG is counterbalanced elsewhere. In the erect person, the COG is located within the lower abdominal area of the trunk.
People have impaired balance for one or a combination of two reasons;

1. The position of the center of gravity (COG) relative to the base of support is not accurately sensed, and

2. The automatic movements required to bring the COG to a balanced position are not timely or effectively coordinated
What Is Postural Balance?

Ability to Maintain One’s Center of Gravity Over the Base of Support
Concept: Center of Pressure

Pressure is the force exerted by a body in contact with a support surface divided by the area of the contact. When the body is at rest on a support surface, the center of pressure is located vertically below the center of gravity. When the body is moving, the COG may shift independent of the COP.

NeuroCom 2008
Figure F.4  Limits of stability
Components of Balance

- **Sensory**
  - Sense body position relative to the base of support

- **Motor**
  - Execute coordinated body movements

- **Central Adaptation**
  - Use sensory inputs and body movements appropriate to the task conditions
Sensory cues; to be oriented to gravity, visual environment, and support surface, we need the eyes, vestibular system, and somatosensory cues. What are the somatosensory cues for support surface orientation?

- Pressure receptors to sense interaction with support surface
- Stretch receptors to sense joint alignment and muscle tension
The components of balance are organized and represented in two basic balance control systems;

- **Gaze Control System**
  - Coordinate head and eye movements to maintain stable gaze and visual acuity while actively moving about

- **Posture Control (vestibulo-spinal) System**
  - Maintain postural stability while actively moving about
  - Maintain postural stability after unexpected, forced postural change
Physiological Characteristics

Gaze Control System
- Horizontal semicircular canal & visual inputs
- Cervico-ocular reflex
- Responses dominated by short pathway reflexes
- Simple movement geometry & biomechanics

Posture Control System
- Vertical canal, otolithic, visual & proprioceptive inputs
- Responses mediated by complex central pathways
- Responses influenced by task & environment
- Complex movement geometry & biomechanics
Balance Control

Determination of Body Position

- Compare, Select & Combine Senses
  - Visual System
  - Vestibular System
  - Somato-Sensation

Choice of Body Movement

- Select & Adjust Muscle Contractile Patterns
  - Ankle Muscles
  - Thigh Muscles
  - Trunk Muscles

Generation of Body Movement

Environmental Interaction
Central Sensory Integration

- Create context-dependent hierarchy
- Compare sensory inputs
- Generate appropriate command to motor system for posture control. The central integrator directs the muscle contraction patterns from the pattern of sensory inputs, from the differential WEIGHTINGS of sensory information
Sensory Weighting is Task-Dependent in Normal Individuals

WEIGHTING
Stable Surface
• 70% SOM
• 20% VEST
• 10% VIS

RE-WEIGHTING
Unstable Surface
• 60% VEST
• 30% VIS
• 10% SOM

Inappropriate sensory weighting or a wrong perception of the task or an inappropriately directed motor command to the musculature causes an IMPAIRMENT. Impairment assessments isolates specific causes of functional limitations at the body system level.
What Is An Impairment?

Pathology (site-of-lesion) → Physiological Change → Brain’s Adaptive Response → Impairment → Functional Change → Disability → Environment & Lifestyle Demands
Pathologies do not equal impairments!

Patients with the similar pathologies may present with significant differences in impairments and functional limitations. Because of these differences, patients with similar pathologies may not respond the same to a given treatment.
Additional research has shown that, when treatment is customized to target the individual patient’s pathology and impairments, outcomes are significantly improved over those achieved with generic approaches based upon performance or site-of-lesion (pathology) tests only.
Etiologies of Postural Instability

- Poor sensory input
- Distorted sensory input
- Poor central integration
- Inappropriate motor command
- Abnormal musculoskeletal function
Patients With Postural Balance Problems

- Sensory System Deficits
  - Vestibular, Vision, Proprioception

- Geriatric Fall Risk
  - Chronic Non-Specific
  - Sensory, CNS, Orthopedic Disorders

- Mild Traumatic Brain Injury

- Medical-Legal/Worker Comp

- Parkinson’s Disease/Multiple Sclerosis

- Neuro-Developmental
So What Can We Assess?

For Gaze Stability; ocular-motor function, vestibular semicircular canals, otolith organs, cervical receptors, vestibulo-cerebellar integrity.

For Postural Stability; volitional postural control, motor control for automatic postural corrections and adaptive corrections. Vestibulo-spinal integrity.
Who are the team members in balance assessment and what is their focus?

- The neuro-otologist performs differential diagnostics in the context of a careful case history and clinical examination. The lab exams as site-of-lesion tools are meaningful for clinical correlations only in specific context.

- The physical therapist defines the patient by their impairment and functional deficits. Lab exams are meaningful only as a quantification of control system deficits in order to profile an impairment and predict outcomes.

- The audiologist understands how a quantification of abnormal body function can related to impairments and selects the laboratory tests to meet these needs.
The Clinical examination

- Normal gait
- Tandem walk
- Romberg tests
- Fukuda march test
- Finger past-pointing
- Head Thrust
- Pursuit, gaze, and saccade tests
- Skew eye deviation
- Tragal pressure test
Audiology Assessment Protocols

- Consult triage using chart notes, imaging results, pharmacology review. Consideration to co-morbidities
- Dizziness Handicap Scale
- Dizziness case history
- Clinical examination
Pharmacology profiles for multifactorial cases

**UNDER 60 Y.O.**
- PTSD; antianxiety meds, antidepressants
- PAIN; opioid analgesics
- DIZZINESS; meclizine, benzodiazepines
- HEADACHES; tension relievers
- ALCOHOL DEPENDENCE

**OVER 60 Y.O.**
- DEPRESSION AND ANXIETY DISORDERS; antidepressants and antianxiety meds.
- GASTRIC DISORDERS; omeprazole
- DIABETES; complications with peripheral neuropathy
- DIZZINESS: meclizine
- HYPERTENSION; antihypertensives
- PROSTATE DISORDERS; trazadone
- CNS DAMAGE FROM ALCOHOLISM
Audiology Laboratory Assessments

- Audiometrics including fistula tests
- Electronystagmography with canalith repositioning when necessary
- Vestibular Evoked Myogenic Potentials
- Electrocochleography
- Auditory Evoked Potentials
- Motorized Rotary Chair exams
- Computerized Dynamic Posturography
- Dynamic Visual Acuity Testing
Dynamic System with Long Forceplate
Floorplan Diagram
(option 5)

NOTE: The System Hardware setup is going to be directly affected by the dimensions of the room. This configuration requires a minimum 10 ft by 10 ft floor space for the unit only.

Please note that the system's forceplate can be oriented differently to the system monitor depending on what the patient is doing at a given time. The diagram also shows the apron (wooded platform extension) that is used in some applications.

Minimum Recommendations
The ceiling height recommendation is 93.5 inches, and the area should be checked for sprinkler heads and drop light fixtures. If necessary, the system can be "lowered" slightly by adjusting leveling feet. No other special clearances are needed for ventilation, etc.

The recommended floor area for the system is at least six feet square for the dynamic platform alone, and at least eight feet by ten feet for the same system with the long forceplate added. The recommendation is to plan for a 9' x 10' minimum area for system setup, additional space will be required for staff and patients to move comfortably about the room.

Power Source: 120V,
50-60Hz,
10 Amps,
1050W
room height: 8 foot minimum
Total weight: 600 lbs
Electrical Circuit: 120V@20 amps or 220V@10 amps
Lighting: Incandescent on dimmer best
Telephone: next to table

Scale: dimensions in feet

Micromedical Technologies: rotational chair room layout
Cleveland VA Audiology main balance lab

Made with a Trial Copy of SmartDraw

Buy SmartDraw! purchased copies print this document without a watermark.
Visit www.smartdraw.com or call 1-800-276-3729.
Minimum requirements

- If no long forceplate is being used, and an ENT examination chair is being used in lieu of a table, then ENG, VEMP, and ABR can be performed in a large 10’x10’ audiometric test booth.
- DVA can be added to CDP and it will fit in a 6’x6’ space.
- The rotary chair requires the minimum of a 9’ by 12’ room.
- Ceiling height has to be at least 8’ for CDP and rotary chair, but suggest higher due to clearance of fan vents, light fixtures, and sprinkler systems.
Common Balance lab flowchart from PCP referrals

**REFERRAL; Search for clinical correlation**

- Review all comorbidities, medications, physical and cognitive limitations, chart history

  - Audiometrics with fistula testing, DHI, case history, clinical exam, assure pre-test compliance

  - **Posturography**

- **mTBI from blast exposure?**
  - yes
  - Dizziness?
    - yes
    - ENG
    - no
    - ENG show BPPV?
      - yes
      - canalith repositioning and stop
      - no
      - ENG normal or bilateral weakness?
        - yes
        - Does DVA or rotary chair show central or vestibular disorder?
          - yes
          - VEMP then Posturography
          - no
        - no
          - Is there a handicap?
            - yes
            - VEMP then Posturography
            - no

*Made with a Trial Copy of SmartDraw*

*Buy SmartDraw!- purchased copies print this document without a watermark.*
*Visit www.smartdraw.com or call 1-800-768-3729.*
ELECTRONYSTAGMOGRAPHY (ENG) assesses the integrity of the right and the left peripheral vestibular systems individually and the function of the ocular motor system. Eye movement recordings are analyzed. The standard seven subtests include exams of:

• Saccadic eye movements
• Smooth pursuit eye movements
• Optokinetic eye movements
• Gaze center, left, right, up, and down w/ and w/o fixation
• Eye stability during sitting, supine, head turn left, right, and hang positions
• Eye stability during Dix-Hallpike maneuvers
• Nystagmus from bithermal water or air caloric irrigations to each ear
Dix-Hallpike Maneuver
Positional and Positioning Testing

**HALLPINE: Head Right**

**Horizontal Eye Position**

**Vertical L Eye Position**

(Diagram showing eye position measurements)
Vestibular Evoked Myogenic Potentials (VEMP’s)

- Utricle and saccule detect linear acceleration
- Saccule slightly responsive to sound due to its position near the oval window
- VEMP’s stimulate the saccule and record EMG output in the SCM
Vestibular Evoked Myogenic Potentials (VEMP’s)

- Clicks or tones presented to the ear stimulate saccule, inferior vestibular nerve, vestibular nucleus, medial vestibulospinal tract, accessory nucleus, cranial nerve XI
- EMG of SCM records output after click stimulation of ear
- Allows unilateral testing
Vestibular Evoked Myogenic Potentials (VEMP’s)

- VEMP’s may be absent in patients with vestibular neuritis
- Patients with lower threshold VEMP’s and a conductive hearing loss same side may have SCC dehiscence syndrome
- Absent in bilateral vestibular loss in aminoglycoside ototoxicity
- VEMP’s show higher thresholds and are absent in patients with Meniere’s disease
- Absent in acoustic neuromas
- May be used in failed vestibular nerve section
Right side canal dehiscence
What Is Computerized Dynamic Posturography (CDP)?

- A scientific framework for understanding the control of balance & postural stability

- Objective method for quantifying impairments in use of sensory inputs, use of motor patterns, and central adaptation
<table>
<thead>
<tr>
<th>CONDITION</th>
<th>SENSORY SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Normal Vision</td>
<td></td>
</tr>
<tr>
<td>Fixed Support</td>
<td></td>
</tr>
<tr>
<td>2. Absent Vision</td>
<td></td>
</tr>
<tr>
<td>Fixed Support</td>
<td></td>
</tr>
<tr>
<td>3. Sway-Referenced Vision</td>
<td></td>
</tr>
<tr>
<td>Fixed Support</td>
<td></td>
</tr>
<tr>
<td>4. Normal Vision</td>
<td></td>
</tr>
<tr>
<td>Sway-Referenced Support</td>
<td></td>
</tr>
<tr>
<td>5. Absent Vision</td>
<td></td>
</tr>
<tr>
<td>Sway-Referenced Support</td>
<td></td>
</tr>
<tr>
<td>6. Sway-Referenced Vision</td>
<td></td>
</tr>
<tr>
<td>Sway-Referenced Support</td>
<td></td>
</tr>
</tbody>
</table>
Sensory Organization Test
(Sway Referenced Gain: 1.0)

Equilibrium Score

<table>
<thead>
<tr>
<th>FALL</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>2</td>
<td>N</td>
</tr>
<tr>
<td>3</td>
<td>S</td>
</tr>
<tr>
<td>4</td>
<td>S</td>
</tr>
<tr>
<td>5</td>
<td>N</td>
</tr>
<tr>
<td>6</td>
<td>S</td>
</tr>
<tr>
<td>Composite</td>
<td>70</td>
</tr>
</tbody>
</table>

Sensory Analysis

<table>
<thead>
<tr>
<th>SOM</th>
<th>VIS</th>
<th>VEST</th>
<th>PREF</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>75</td>
<td>50</td>
<td>25</td>
</tr>
</tbody>
</table>

Strategy Analysis

<table>
<thead>
<tr>
<th>FALL</th>
<th>Hip</th>
<th>Ankle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>75</td>
</tr>
</tbody>
</table>

Data Range Note: NeuroCom Data Range: 20–59
Sensory Organization Test Raw Data

Trial 1 | Trial 2 | Trial 3
---|---|---
1 | NO DATA | NO DATA
2 | NO DATA | NO DATA
3 | NO DATA | NO DATA
4 | NO DATA | NO DATA
5 | NO DATA | NO DATA
6 | NO DATA | NO DATA

= 5 degrees; 35 lb force
20 seconds
Motor Control Test

- Rapid, involuntary reactions to support surface translations are triggered primarily by proprioceptive stimuli.
- Visual and vestibular inputs modulate but are not likely in isolation to initiate these responses.
- Patients with profound bilateral vestibular weakness can give normal latencies for the automatic responses.
MCT analysis

- Abnormal latency
  - Consistent latency prolongation
  - Variable effects on SOT scores
  - Seen with peripheral neuropathy and demyelization
Cleveland VA (Brecksville division) Physical Therapy
Balance Team outcome data

- The interest and specialized training in balance rehabilitation makes the physical therapist integral to the management of fall risk, head trauma, vestibular disorder, and sensory-motor integration defect patients.

- Megan Salvatore DPT, Adam Wendt PT, and Joe Bonscar PT form the Cleveland team responsible for the following outcomes.

- By focusing on balance IMPAIRMENTS, a variety of multifactorial cases improve in functional abilities.
VARIETY OF DISORDERS AND THE TREATMENT OF IMPAIRMENT

During the past 12 months we have tested over 100 veterans on the Smart Equitest Balance System. We have been able to compile completed data on 41 of those veterans. The data collected showed several positive findings including: decreasing the average number of falls from 4.4 down to 2 after treatment and the average composite score of each veteran improved by 14.8% going from 48.1% to 62.9.

Below is a list of veteran diagnoses that we have treated on the Smart Equitest Balance System.

- CVA
- Vertigo
- Amputee
- BPPV
- Hip Fracture
- Total Hip Replacement
- Rhabdomyolysis
- Anoxic Brain Injury
- Cervical Myelopathy
- Alcoholism
- Parkinson’s disease
- Ankle Fracture
- PVD
- Tibial Plateau Fracture
- Seizure Disorder
- Diabetic Neuropathy
- Sick Sinus Syndrome
- CABG
- Normal Pressure Hydrocephalus
A COMPARISON OF THE NUMBER OF falls DURING PRE- AND POST- TREATMENT ASSESSMENTS  N=41

Number of falls
(Averages: Initial = 4.4, Final = 2.0)
CDP PRE-TREATMENT AND POST-TREATMENT COMPOSITE SCORES  N=41. VARIETY OF DISORDERS.
Computerized Rotary Chair

A means to assess the integrity of the peripheral vestibular system at rapid head speeds and quantify the gain (amplitude) of the vestibulo-ocular reflex (VOR), and its duration
Purpose of Rotational Testing

Further investigation of suspected peripheral vestibular involvement when caloric responses are normal during electronystagmography

(Gates, 2003; Shepard, 2002)
Purpose of Rotational Testing

- Monitor compensation and partial recovery

- Determine/verify bilateral weakness
  - “Gold Standard” for diagnosis of bilateral vestibular loss (bilateral vestibulopathy)

(Gates, 2003; Shepard, 2002)
System Software

- Pursuit Tracking
- Saccade
- OPK
- Gaze
- Sinusoidal VOR
- Step velocity test (impulse testing)
- Visually enhanced VOR (VVOR)
- Visual fixation suppression of VOR (VFX)

(“Guymark Systems;” “Guymark Specifications;” Shepard, 2002; Vestibular, 2005)
Sinusoidal Rotation

- Sinusoidal rotation (velocity)
  - Peak Velocity = 50-60 deg/sec
- Many Frequencies
  - 0.01, 0.02, 0.04, 0.08, 0.16, 0.32, 0.64, 1.28Hz
- Lower Frequencies
  - Weakest VOR
  - Nausea & vomiting

(Amin, 2005; Hain, 2004; Shepard, 2002; Stockwell & Bojrab, 2002)
Normal Results

FIG 10-6.
Phase, gain, and asymmetry values in relation to oscillation frequency for a normal individual. Note that, for convenience, the eye velocity signal is inverted during the analysis, so that a phase angle of 180° is expressed as a phase angle of 0°.

(Stockwell & Bojrab, 2002)
Classic Patterns

- Acute Unilateral Peripheral Lesion
  - Abnormal low frequency phase leads
  - High frequency asymmetry
- Compensated Unilateral Peripheral Lesion (Acoustic Neuroma)
  - Abnormal low frequency phase lead
- Bilateral Peripheral Lesion
  - Extremely low overall gain
  - Overall symmetry

(Stockwell & Bojrab, 2002)
Acute Unilateral Peripheral Lesion

Phase, gain, and asymmetry values in relation to oscillation frequency in a patient with an acute right peripheral vestibular lesion.

(Stockwell & Bojrab, 2002)
Bilateral Peripheral Lesion

![Graph showing gain and asymmetry values in relation to oscillation frequency in a patient with bilateral absence of caloric response, showing absent responses at all oscillation frequencies. Phase values are not plotted due to low response gains.](Stockwell & Bojrab, 2002)
Bilateral vestibular weakness
Bilateral vestibular weakness
Bilateral vestibular weakness
Step Velocity Test

- Sudden changes in chair velocity.
- Peak velocity = 100 deg/sec
- Sustained for 45-60 seconds
- Second impulse presented = 0 deg/sec
- 14-20 seconds

(Shepard, 2002; Stockwell & Bojrab, 2002)
Parameters Analyzed

- **Gain** (same as previous test)
- **Time Constant**
  - Time, in seconds, it takes for the nystagmus to decline to 37% if its maximum value.
  - 14-20 seconds
  - Short Time Constant = Peripheral lesion
  - Long Time Constant = Central lesion

(Shepard, 2002; Stockwell & Bojrab, 2002; Eggers & Zee, 2003)
Expected Outcomes

CAN:
- Bilateral vs. Unilateral
- Acute vs. Compensated
- Peripheral vs. Central

CANNOT:
- Determine pathological causes
- Isolate one ear

(Stockwell & Bojrab, 2002)
DSVV Protocol

- Room is darkened and the patient sets the lightbar to vertical
- Alignment of light bar is viewed by the clinician via infra red camera and is recorded in degrees
- Patient sets light bar off center and closes their eyes
- Chair is accelerated at 10 deg/sec² up to 300 deg/s and remains at that velocity for 60 seconds.
Patient Setup
DSVV Protocol

- Patient opens eyes and re-aligns light bar to vertical from both the right and the left directions
- Alignment of the light bar (in deg.) is again recorded by the clinician
- Chair is decelerated at 5 deg/sec²
  - This procedure is repeated after the chair is translated 4 cm lateral in the coronal plane to eccentric position to the right and to the left
Normal

a  static
b  on center
c  off center

← centrifugal force
• estimated position of utricle
○ center of head
↻ direction of rotation
 |_| light bar tilt
Are there the resources?

Staffing: a balance evaluation takes between one to four hours.

Equipment: balance lab tools cost between $10,000 and $100,000. Examination tables and/or motorized exam chairs.

Support personnel and team members: Pharmacist on call. Neurotologist (ENT and/or neurology). Physical therapist with training in balance rehabilitation. IRM template assistant. Polytrauma team?

Space requirements: CDP and Rotary Chair exams impose constraints.
Rationale for CDP

A comprehensive balance assessment and treatment clinic includes computerized dynamic posturography (CDP) as a means to differentiate underlying sensory and motor impairments for the patient with balance disorders. Somatosensory, vestibular, and visual sensory information is systematically manipulated with this tool. It is viewed as primarily an impairment assessment tool but has value in training balance, providing immediate feedback to the patient, and generalizing to the outside world.

To properly utilize this, professionals trained in balance retraining are essential. We envision CDP as utilized by both physical therapists in a rehabilitation setting and by clinical audiologists. The device, if procured, should be located in a physical therapy treatment setting. Our audiologists can differentially diagnose balance disorders, separating vestibular, somatosensory, visual, and central components with the assistance of physical therapists. Once site-of-lesion information can be obtained from electronystagmography, rotary vestibular tests, and CDP, a treatment program can be devised.
RATIONAL FOR ROTARY CHAIR

The rotary chair system expands the clinician’s ability to differentiate lesions in the peripheral vestibular system function by using a natural stimuli; head angular acceleration. The patient with complaints of dizziness sits in a dark booth and the motorized chair swings in a sinusoidal pattern from a standstill to a fixed velocity. Head mounted cameras measures eye movements and allows the device to gauge the patient’s vestibular-ocular reflex behavior. The eyes respond to stimulation from the peripheral vestibular system. The device allows audiologists to examine peripheral as well as central vestibular function when the patient moves at normal body speeds. The contributions of the brainstem and cerebellum can be assessed so disease processes can be carefully monitored. Currently, audiology utilizes only electronystagmography (ENG) to assess a limited vestibular function. ENG is performed only when the patient is still. Physicians and other professional staff of VA daily see patients complaining of balance disorders, so site-of-lesion lab exams during patient movement is important. Any treatment protocols depend on accurate differentiation between vestibular, CNS, somatosensory, and visual disorders. The rotary chair device along with electronystagmography accurately assesses the complex involvement of vestibular function in daily balance.
Inpatient Pharmacy Consult from Audiology Balance Clinic:

Z2 CAVALIER, CLEVELAND E, has been referred to the Audiology Balance Clinic with complaints of dizziness. The clinic assesses the integration of somatosensory, visual, and vestibular input elements, as well as motor output elements which produce musculoskeletal postural realignments. This consult has been placed to Pharmacy service to conduct a chart review for this patient prior to the scheduled clinic appointment on [...].

Please focus on identifying medications in this patient's profile that produce the following adverse drug reactions (ADR's):

- Vestibulotoxicity (NOT Ototoxicity)
- Dysmetria
- Nystagmus/compromised Vestibular-Ocular reflex
- Oculomotor Effects
- Sedation
- Orthostasis

Please also identify medications that indicate that patient may have peripheral neuropathy.

Once the chart review is complete, a note will be entered in CPRS with the requested information.

Other Inpatient Pharmacy Consult:
What is the purpose for this audiology referral?

- Obtaining a hearing aid due to hearing loss
- Hearing loss due to medical condition (i.e., ear infection, past ear surgeries)
- Sudden onset hearing loss
- Tinnitus
- **Dizziness**

* Normal age-related balance changes should be excluded. Also, *
* please rule out orthostatic Hypotension and medicine interactions *
* as cause of the dizziness. If you wish to continue, you will *
* have the choice of submitting the consult to either Audiology or *
* Physical Therapy.

****OPTION 1 - AUDIOLOGY CONSULT****
IF clinical correlations for differential diagnosis are needed,
CONTINUE SENDING THE CONSULT TO AUDIOLOGY. This veteran should
be experiencing either dizziness, vertigo, unsteadiness,
pre-syncopeal episodes, or light-headedness of unknown
etiology and possible progressive or fluctuating hearing loss
is evident.

****OPTION 2 - PHYSICAL THERAPY CONSULT****
IF the veteran has unsteadiness or dizziness (NOT true vertigo)
from a pre-existing diagnosed condition which you are
managing, and the disorder is limiting the veteran's
daily activities, the CONSULT SHOULD BE SENT TO
EITHER BRECKSVILLE OR WADE PARK PHYSICAL THERAPY.

- Ear pain/fullness
- Hearing aid problem