

The Role of Audiology: Vestibular Care of Persons with Diabetes (PWD)

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Disclosures

- **Presenter Disclosure:** Financial disclosures: Presenter received an honorarium for presenting this course. Non-financial disclosures: Presenter has no relevant nonfinancial relationships to disclose.
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Learning Outcomes

Be

After this course, participants will be able to:

Assess

Assess vestibular risk factors for people with diabetes (PWD).

Describe

Describe the pathophysiology and epidemiology to better understand the impact this disease has on PWD.

Recommend

Recommend clear counseling for PWD to improve outcomes and to reduce risks for falling.

The Audiology Project (TAP)

- <https://www.theaudiologyproject.com/>
- “Promoting the audiology based medical management of chronic diseases”
 - Newsletter
 - Webinars
 - Educational materials
 - Join at TAP cohort
 - Kathy Dowd, AuD
 - Heads advocacy and collaborates with Audiology organizations to improve patient care
 - Many other AuDs involved! Check out your state leader to collaborate or to start a cohort



Diabetes

- Estimated 30.3 million people in US
- 84.1 million age 18+ have prediabetes

Type 1

- Body does not make insulin
- Immune systems attacks and destroy cells in pancreas
- Can occur at any age
- Insulin is required daily

Type 2

- Body doesn't make insulin well
- Can develop any time, but more common in middle aged and older people.
- Most common type of diabetes
- If history of gestational diabetes, higher risk for developing type 2 later in life
- Higher risk if:
 - >45 yrs.
 - Have a family history of diabetes
 - Are overweight
 - Inactivity, race, and some health issues
- Accelerates the normal rate of aging in multiple body systems
- Overall decline of the sensorimotor and cognitive systems

Diabetes

Healthy Living

Ways To Give

Get Involved

Tools & Support

About Us

Overview

Take Our Risk Test

Understanding A1C

> Type 1

> Type 2

> Gestational Diabetes

Genetics

Newly Diagnosed

Loved Ones & Caregivers

Prediabetes

Cardiovascular Disease

Chronic Kidney Disease

Diabetes & DKA (Ketoacidosis)

Diabetes and Hearing Loss

Diabetes and High Blood Pressure

Diabetes and Skin Complications

> Eye Health



Foot Complications



Neuropathy



Stroke



Balance and Avoiding Falls

- Falls under “Healthy Living and Fitness”

<https://www.mayoclinic.org/diseases-conditions/hypoglycemia/symptoms-causes/syc-20373685>

Hypoglycemia

Glucose is our main energy source

■ *Symptoms:*

- Looking pale
- Shakiness
- Sweating
- Headache
- Hunger or nausea
- Irregular or fast heartbeat
- Fatigue
- Irritability or anxiety
- Difficulty concentrating
- *Dizziness or lightheadedness*
- Tingling or numbness in the lips, tongue or cheek

Severe symptoms:

- Confusion
- *Loss of coordination*
- Slurred speech
- *Blurry vision or tunnel vision*
- Nightmares, if asleep
- Loss of consciousness
- Seizures

Diabetic Microangiopathy

- Microvascular complications are common for PWD
 - Abnormal small vessels –capillaries become “leaky”
 - Results in tissue hypoxia and damage
 - Leading to poor oxygenation and nutrient supply to organs
- Retinopathy
- Nephropathy
- Neuropathy
 - 4 types
- Optimal insulin treatment is needed



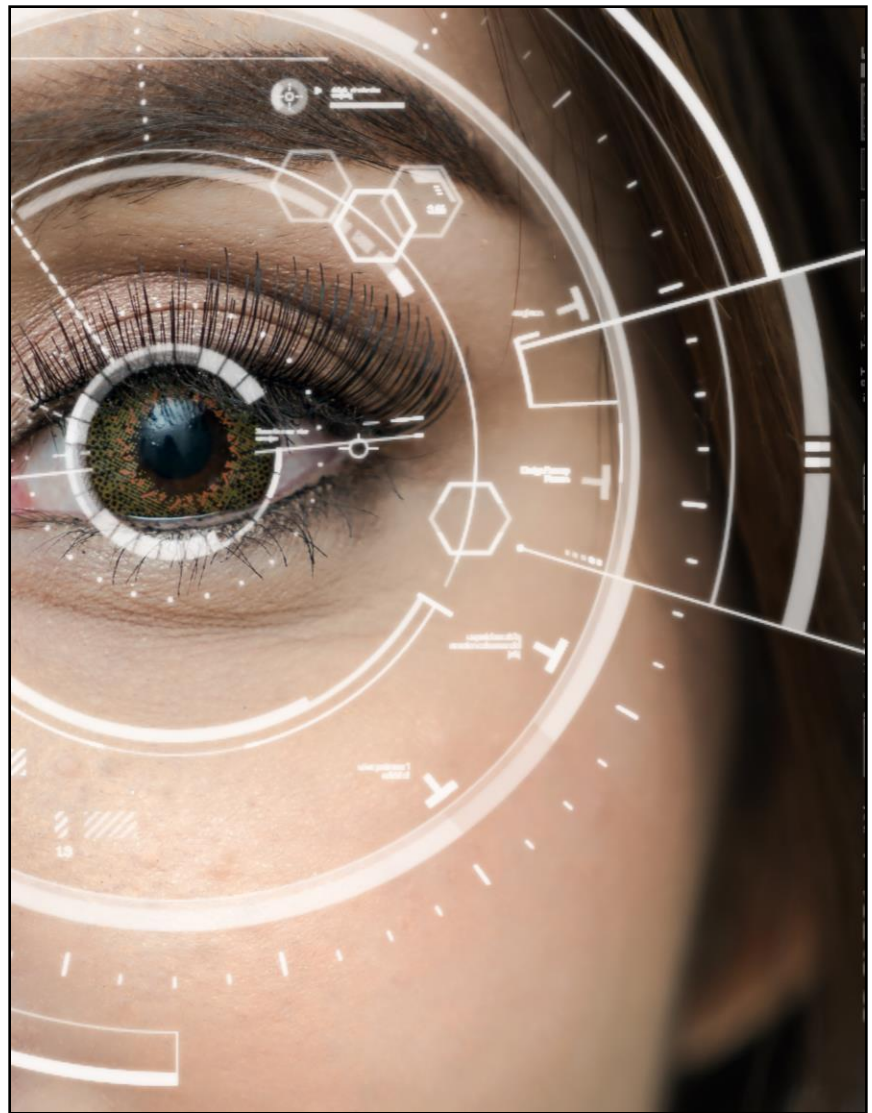
Diabetic retinopathy

- Typically occurs within 5-10 years of diagnosis
- Leading cause of new blindness in individuals 20-64 years of age
- Inequity: People of color are at greater risk of going blind
- Also, at risk for macular edema, glaucoma and cataracts
- In early stages, may not have signs or symptoms



Diabetic retinopathy

- Predicted to increase by nearly 50% by 2030 (over 11 million people)
- Finding early can help protect vision
 - Need to have annual dilated eye exams
- Black Americans are 60% more likely to have diabetes
- Native Americans are more likely to have type 2 than any other US racial group
- Hispanics and Latinos are less likely to have an eye exam, but are high risk



Diabetic nephropathy

- Diabetes is leading cause of kidney disease
- About 1 out of every 3 adults with diabetes has kidney disease
- Kidneys help regulate blood pressure and hormone levels
- Kidneys filter out wastes
- High glucose damages blood vessels in kidneys
- Can result in kidney failure

Diabetic neuropathy-4 types

- *Autonomic neuropathy*
- *Focal Neuropathy*
- *Proximal Neuropathy*
- *Peripheral Neuropathy*



Diabetic neuropathy

- High levels of blood sugar and high levels of fats can cause damage to nerves
- Nerves do not function well when the small blood vessels are damaged
- $\frac{1}{2}$ - $\frac{1}{3}$ of all PWD have peripheral neuropathy
- More than 30% have autonomic neuropathy

Diabetic neuropathy-*Autonomic neuropathy*

Damage to nerves that control internal organs

- Heart rate
- Blood pressure
- Digestion
- Bladder
- Sex organs
- Sweat glands
- Eyes
- Ability to sense hypoglycemia
- *Ears???*

Diabetic neuropathy-*Focal neuropathy*

Damage to single nerves

“Entrapment”—nerve is compressed or trapped in areas where nerves pass through narrow passages

Most commonly in hand, head, torso or legs

- Carpal tunnel syndrome
 - Less than 10% of PWD feel symptoms
 - ~25% of PWD have nerve compression at the wrist
- Peroneal entrapment—pain on outside of lower leg and weakness in big toe
- Ulnar entrapment—pain, numbness, tingling in little and ring fingers



Diabetic neuropathy- *Proximal neuropathy*

- Rare & disabling
- Nerve damage to hip, buttock or thigh
 - Typically affects one side, rarely spreads to other side
 - Causes severe pain and significant weight loss
 - Muscle wasting
 - Loss of reflexes in lower leg
 - Weakness in legs that make it difficult to stand from a sitting position
- More common in men than women
- More common >50 years
- Most have type 2 diabetes

Peripheral Neuropathy

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graph LR; A[Peripheral Neuropathy] --- B[Loss of sensation in feet]; A --- C[Burning or shooting pain in lower legs]; A --- D[Pain can develop over time or occur suddenly]
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Loss of sensation
in feet

Burning or
shooting pain in
lower legs

Pain can develop
over time or
occur suddenly

Peripheral neuropathy symptoms

Burning

Tingling

Numb

Painful

Weak

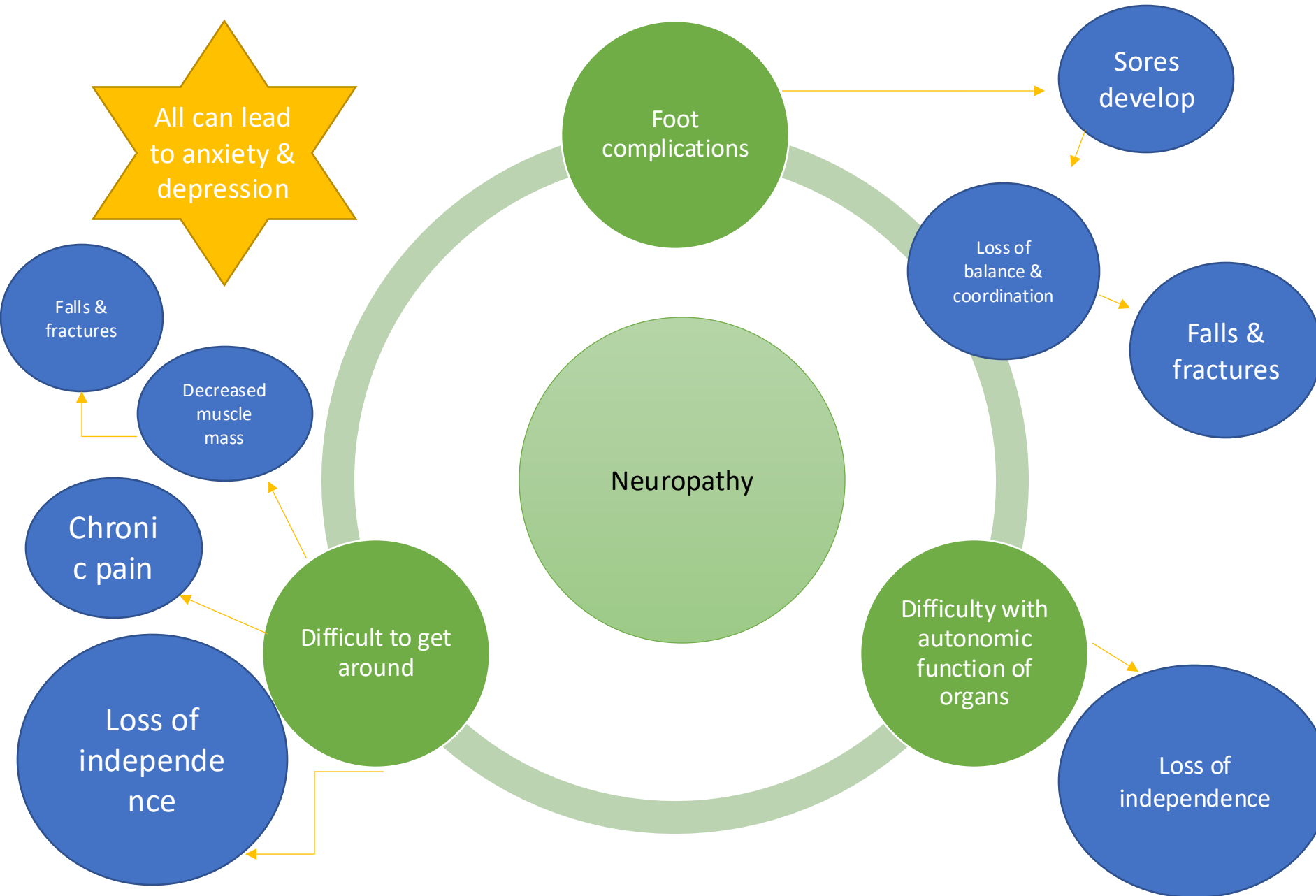
Difficulty sensing
pain or temperature
in feet, legs, hands,
arms

May have extreme
pain even when
touched lightly

Balance issues in peripheral neuropathy

- Changes in walking
- Losing balance, falling more often
- Loss of muscle tone in hands and feet
- Pain walking
- Problems sensing movement or position
- Swollen feet





All can lead to anxiety & depression

Foot complications

Sores develop

Loss of balance & coordination

Falls & fractures

Neuropathy

Falls & fractures

Decreased muscle mass

Chronic pain

Difficult to get around

Loss of independence

Difficulty with autonomic function of organs

Loss of independence

Falls & fractures

Prevention of Neuropathy

- Be physically active
- Follow diabetic meal plan
- Quit smoking
- Limit alcohol
- Diabetes medication
- Manage blood glucose, BP, cholesterol, weight
- Foot care
 - Should have a neurological exam annually
 - Should have a foot exam annually



Treatment for peripheral neuropathy

Medications for nerve pain

- Antidepressants
- Anticonvulsants
- Skin creams, patches, sprays

Physical therapy to improve strength and balance

A “bed cradle”

- Device that keeps sheets and blankets off legs during sleep



Cognitive Impairment in People with Diabetes (PWD)

- Potential complication for both type 1 and type 2 diabetes
- Ranges from mild cognitive impairment to dementia
 - Changes in brain structure (structurally and functionally)
 - Affected by glycemic control
 - The number of severe hypoglycemic events
 - The age of onset and duration of diabetes matters
 - Changes in the posterior fossa will affect posture, balance, and coordination of sensory inputs

Cognitive Impairment in PWD

Poor glycemic control is associated with a 4X increase in mild cognitive impairment in older adults with type 2 diabetes

Cognitive impairment is known to be a risk factor for balance impairments and falls

Older adults with cognitive impairments are 2x more likely to fall vs. cognitively intact individuals.





1/3 of US
population has
prediabetes or
diabetes
=100+ million
people

- Increase in prevalence in diabetes in the US
 - Which may then result in increase in prevalence of cognitive impairments
 - Evidence that there is an association between vestibular dysfunction and cognitive impairment
 - Even with a mild cognitive impairment PWD are at higher risk for falling
 - Can see changes in gait & balance
 - Increased fear of falling
- PWD often don't heal well
- Higher overall risk of falls causing significant injury

Muscular System Changes



- Mechanical and Metabolic muscle function is affected
- Leads to overall decline in muscle strength (in older adults with type 2 diabetes)
- “Progressive frailty” –significant loss of muscle strength and increased risk for falls
- Leg strength and muscle mass is significantly less in older adults with type 2 diabetes
- Risk for difficulties with daily activities

Muscular System Changes



- If balance is disrupted, PWD are less likely to prevent a fall due to poor muscle responses
- Older adults with lower-extremity weakness are 1.76 X more likely to fall
- 3.06 x as likely to fall recurrently
- Sedentary lifestyle further contributes to decline and de-conditioning

Somatosensory System

- Progressive deterioration of sensory nerve fibers leads to the inability to detect changes in balance to avoid a fall.
- Even slight declines can cause imbalance, particularly in PWD



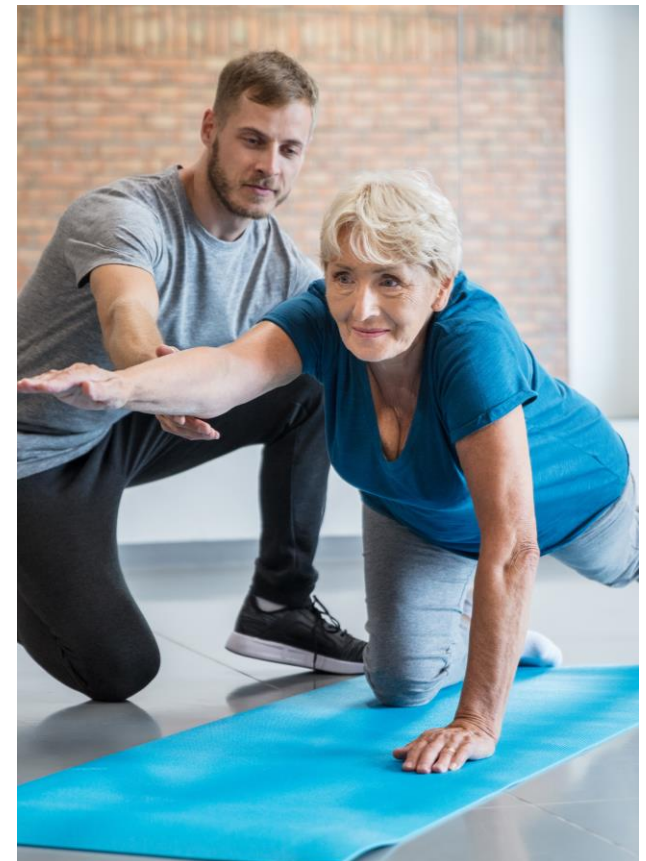
Visual System



- Macular edema distorts:
 - Central vision
 - Ability to see detail, form and colors
- Diabetic retinopathy and scar tissue that accumulates can cause reduced contrast sensitivity
- Cataracts: higher incidence in PWD
 - Reduces contrast sensitivity
- 1.41x more likely to fall if there is reduced contrast sensitivity in PWD
 - Correlates with research that shows that contrast sensitivity is the strongest risk-factors for falls
 - Unable to recognize balance threats and avoid obstacles
 - Low light conditions can be more dangerous
 - Need tripping hazards removed particularly if they have low contrast

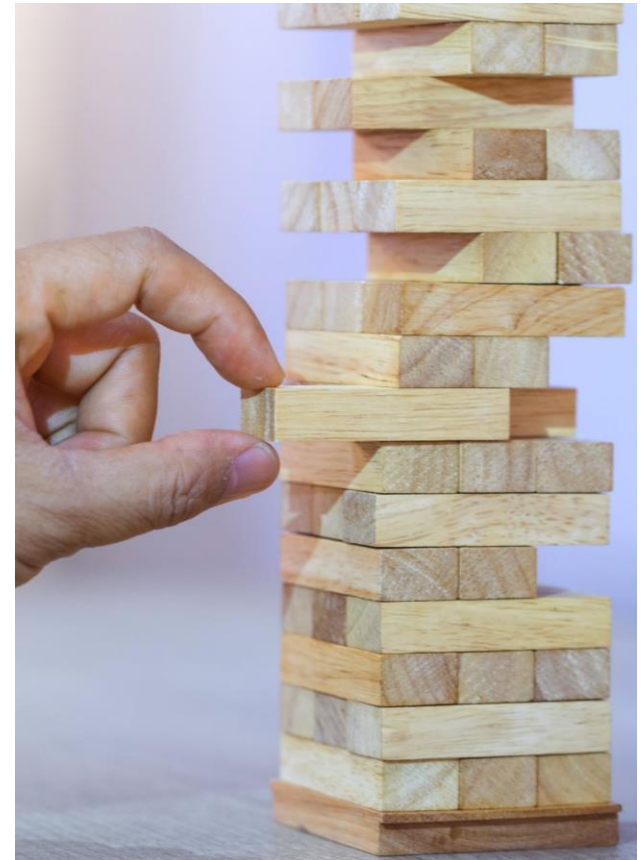
Vestibular System

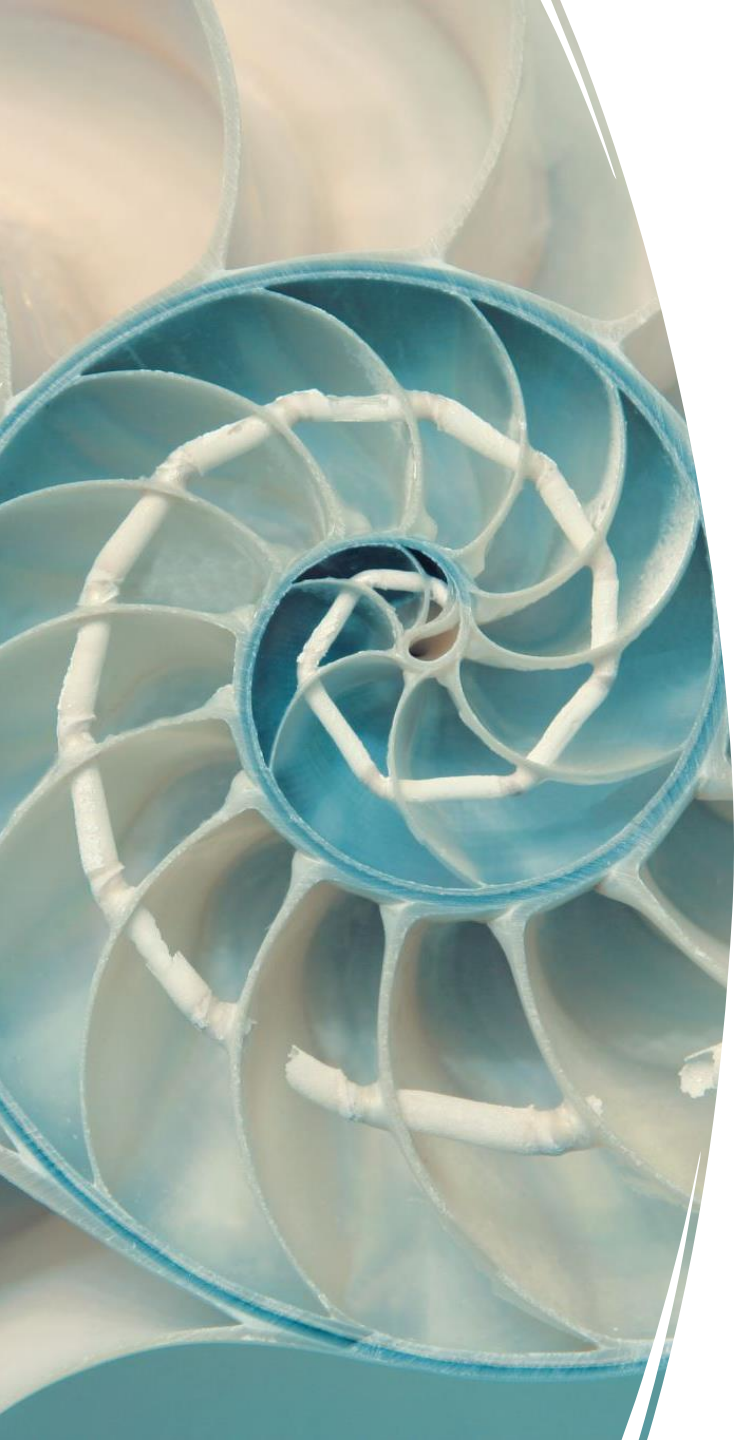
- Inflammation and reduced sensitivity in the ear
- Otolith organs damaged
 - Sense linear acceleration with the utricle and saccule
- Prolonged phase lag of the VOR
 - Results in gaze-holding deficits in the dark
- Reduces quality and quantity of vestibular information related to the vestibulospinal tract
 - Results in poorer posture and head stabilization
- PWD have an increased risk for BPPV



Vestibular System

- Vestibular dysfunction is 2.3x more likely in PWD
- Widespread effects on nerves
- People with vestibular dysfunction are more likely to fall
- Possible weaker bilateral VOR
- Possible that metabolic function of the labyrinth is affected, affecting balance





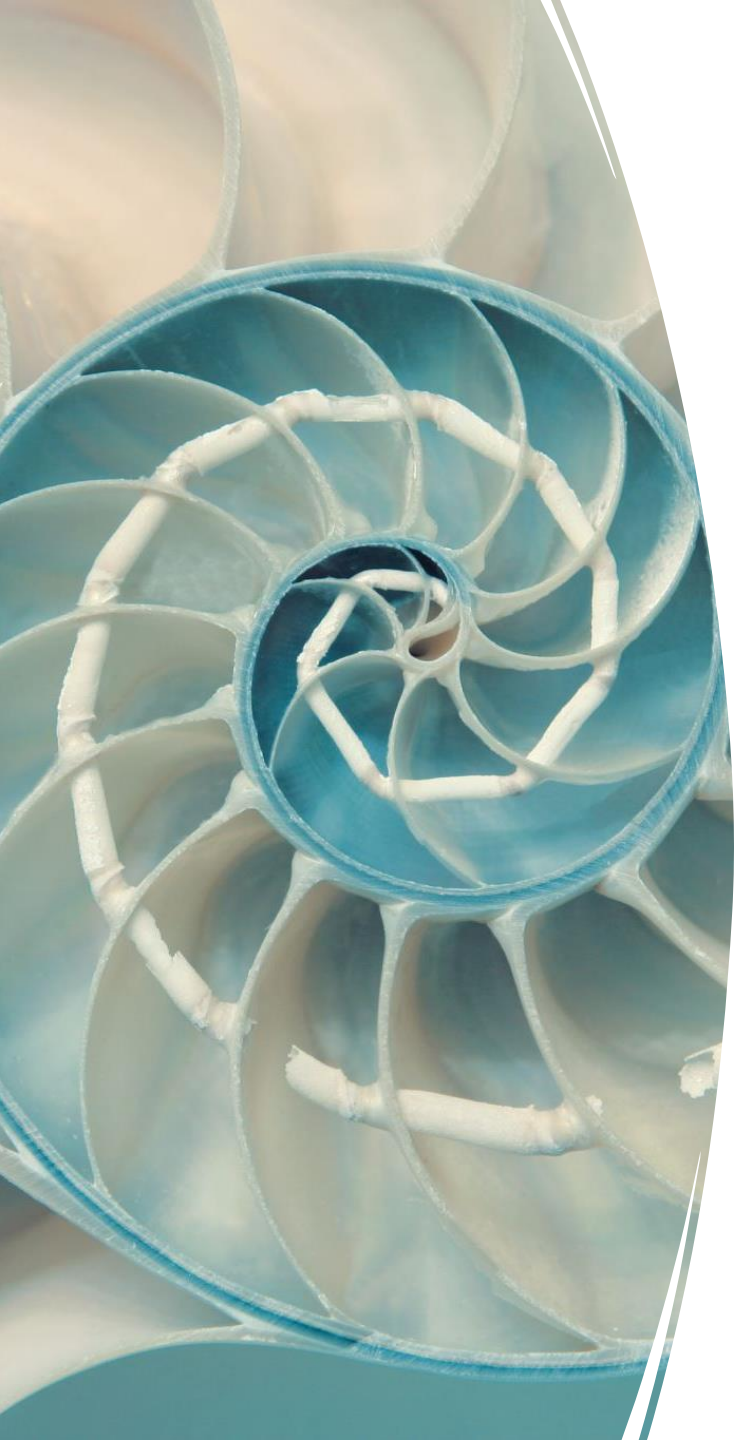
Hearing loss

- Microangiopathy in the cochlea
- Neural degeneration
- The primary energy source in the cochlea is glucose
- We use glutamate in the synapses
- Antioxidants (glutathione) in the ear to help protect against noise exposure. Diabetes can cause a dysregulation of glutathione, allowing free radicals to cause cell death after noise exposure

Hearing loss

- Diabetes causes damage in the stria vascularis in the apical end
 - Causes low frequency sensorineural hearing loss
- High frequency hearing loss is more likely due to free radicals and glutathione dysregulation
 - Outer hair cells are damaged in the basal end of the cochlea, resulting in HF SNHL



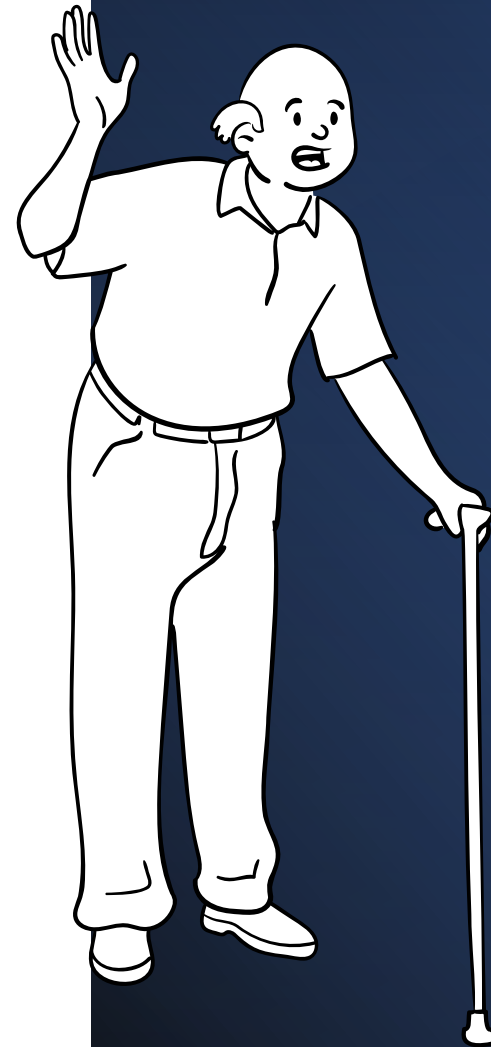


Hearing loss

- Earlier onset of hearing loss in 20-30s in PWD
- Increased risk for tinnitus
- This population should be screened early and often
- If ototoxic medication is being used (for example diuretics), hearing should be monitored more frequently
- At increased risk for sudden hearing loss

Hearing aids and balance

- Some indication that people with hearing loss are inherently more likely to fall and that hearing aids may help—more research needed
- Most research has looked at static balance and single sources
- May help with cognitive load?





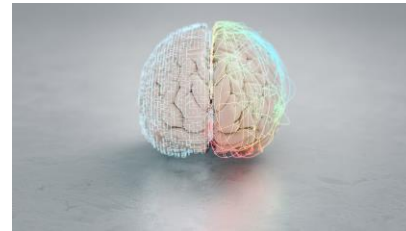
Medications

- Over 1000 drugs list vertigo as a side effect
- 2000+ with “dizziness” as an effect
- Difficult to know how medications interact
- Polypharmacy can be a problem
- Patients on more than 4 medications have a higher incidence of falls.
- Oto or vestibulo-toxic drugs?

Diabetes—multiple risk factors for falling



Central Nervous System must regular visual, proprioceptive and vestibular information to maintain balance



Not all PWD
need a full
vestibular
evaluation

Hearing screenings are easier for the patient, less expensive, and less stressful

Using the DSP along with functional balance screenings should help determine who to refer a full evaluation

PWD may be dizzy due to vestibular dysfunction, BPPV, dehydration, medicine, medicine interactions, cognitive changes.



Romberg on Foam

- The Romberg is a test of static balance, but easy to perform
- Have patient stand with eyes open, arms crossed in front
- If patient can maintain balance, perform with eyes closed
- If patient is unable to stand with eyes open, try performing on solid surface
- In each condition, can the patient maintain balance for 20-30 seconds without significant sway, fall, or changing foot position
- Always remember safety and be near the patient (but don't touch them during the screening)

ASSESSMENT

Timed Up & Go (TUG)

Purpose: To assess mobility

Equipment: A stopwatch

Directions: Patients wear their regular footwear and can use a walking aid, if needed. Begin by having the patient sit back in a standard arm chair and identify a line 3 meters, or 10 feet away, on the floor.

① Instruct the patient:

When I say “Go,” I want you to:

1. Stand up from the chair.
2. Walk to the line on the floor at your normal pace.
3. Turn.
4. Walk back to the chair at your normal pace.
5. Sit down again.

NOTE:
Always stay by the patient for safety.

② On the word “Go,” begin timing.

③ Stop timing after patient sits back down.

④ Record time.

Time in Seconds: _____

An older adult who takes ≥ 12 seconds to complete the TUG is at risk for falling.

CDC's STEADI tools and resources can help you screen, assess, and intervene to reduce your patient's fall risk. For more information, visit www.cdc.gov/steadi

Patient _____

Date _____

Time _____ AM PM

OBSERVATIONS

Observe the patient's postural stability, gait, stride length, and sway.

Check all that apply:

- Slow tentative pace
- Loss of balance
- Short strides
- Little or no arm swing
- Steadying self on walls
- Shuffling
- En bloc turning
- Not using assistive device properly

These changes may signify neurological problems that require further evaluation.

- https://www.cdc.gov/steady/pdf/TUG_Test-print.pdf
- Free on CDC website
- Timing the patient walking
- Area to mark “observations”



Centers for Disease
Control and Prevention
National Center for Injury
Prevention and Control

2017

STEADI Stopping Elderly Accidents,
Deaths & Injuries

Dizziness Symptom Profile (DSP)

- <https://vestibular.org/dizziness-symptom-profile-dsp/>
- Developed at Vanderbilt -Gary Jacobson, Ph.D.
- “Smart” case history form that puts patients' symptoms into categories
- Categories dizziness into the 7 most common types of dizziness:
 - Unsteadiness
 - Chronic Subjective Dizziness (CSD or 3PD)
 - BPPV
 - Vestibular Neuritis/Labyrinthitis
 - Superior Canal Dehiscence
 - Meniere's Disease
 - Vestibular Migraine

Take Charge of Your Diabetes—Healthy Ears

- <https://www.cdc.gov/diabetes/library/factsheets/healthy-ears.html>
- Free infographic
- Link to American Academy of Audiology
- Includes information about balance

TAKE CHARGE OF YOUR DIABETES



Healthy Ears

Did you know that diabetes can harm your hearing and your balance? The good news is you can take steps to hear well and reduce your risk of falls. You've already taken an important step by finding this guide!

Tips to Keep Your Ears Healthy

- **Make an appointment with a health care provider called an audiologist (aw-dee-OL-uh-jist) to check your hearing and balance as soon as you are diagnosed with diabetes.**
 - Bring a list of your medicines and any illnesses and hospitalizations.
 - Your audiologist will look at your history and test results to help you prevent or deal with ear problems.
 - Your audiologist can tell you ways to protect your hearing and balance. For example, you can:
 - Wear ear protection around loud noises like lawn mowers, leaf blowers, and chain saws.
 - Not clean your ears with objects like cotton swabs, pencils, or paper clips.
 - Eat a healthy diet. You can work with a dietitian or diabetes educator to create a healthy eating plan.
 - Ask your doctor or pharmacist if any of your medicines could harm your hearing. Share this information with your audiologist.



■ Visit your audiologist right away if you:

- Hear ringing or other noise in your ears or head.
- Have problems hearing or maintaining your balance.
- Become dizzy, fall, or feel worried you could fall.
- Have a sudden change in how clearly you can understand what people are saying.
- Have trouble understanding what people are saying because of background noise.
- Feel like people are mumbling when they talk to you.

Patient education for diabetes

- Manage your ABCs
 - A1C measured
 - Blood pressure under control
 - Cholesterol—LDL and HDL
 - Smoking—get help to quit



Patient Education

- Good infographics for diabetes, but hearing and vestibular care are often not included.
 - Infographics are helpful ways of teaching patients through print and visuals.
 - TAP working to add hearing and balance to these common documents
- Self-report—ask patients! Have you fallen? Are you afraid of falling?



Patient education

- Take care of your eyes!
- Highly recommend eye exams
- Recommend Diabetes.org to find a 60 second type 2 Diabetes Risk Test
- Use free RetinaRisk calculator on diabetes.org
 - <https://www.diabetes.org/diabetes/eye-health/retinopathy-risk>



Patient education

- Take care of your feet!
 - Wash feet daily
 - Dry thoroughly and between toes
 - Moisturize feet, but avoid between toes
 - Keep toenails trim, but use an emery board to file down sharp edges
 - Wear socks with moisture wicking
 - Check for small objects before putting on shoes/socks
 - Wear comfortable shoes that don't rub
 - Don't walk barefoot
 - Don't soak feet
 - Don't smoke
- PWD are more likely to have neuropathy, skin changes, calluses, poor circulation, foot ulcers, and to need amputation

Patient education

- **Take care of your ears!**
 - PWD are more likely to have NIHL due to loss of natural antioxidant protection in ears.
 - Wearing hearing protection devices is important!
 - Preventing hearing loss is key
 - Patients need to know they are at increased risk for dizziness, falling and hearing loss
 - Need careful monitoring if ototoxic medication is used



Patient education

- **Take care of your ears!**
 - Ears control balance!
 - Use the Dizziness Symptom Profile (or similar) as part of case history for hearing patients
 - Educate appropriate medical practitioners
 - Should have audiological evaluation every 2 years, sooner if problems arise.

Patient education

Patients should be educated about their fall risks

- Increased risk for activity avoidance death, decline in mobility, with longer and more frequent hospitalizations

Prevent falls:

- Stay active
- Have eyes and hearing tested
- Check side effects on medications
- Get enough sleep
- Limit alcohol
- Stand up slowly
- Use assistive devices

Fall prevention

Manipulate any extrinsic factors (add handrails, improve lighting, remove tripping hazards, make sure assistive devices are being used properly)

Some intrinsic factors cannot change, such as advanced age, a history of previous falls, other chronic conditions (Stroke, diabetes, arthritis, dementia)

Improve muscle strength and treat vision problems, if possible.

Fall prevention

Reducing or preventing falls is essential for this population

Not all PWD have the same issues, so may be necessary to have a variety of assessments to determine each person's diagnosis

Should work with our physical therapy and occupational therapy colleagues to improve safety for our patients.



Helpful hints for exercise

- Pool aerobics
 - Particularly for patients with joint pain or neuropathy
- Yoga
 - Help with balance and core strengthening
- Physical therapy
 - Help with balance, strength, injuries, vestibular loss
- Cardiac rehab
 - Heart disease is common in PWD

Education for Healthcare providers



Work with nutritionists, diabetes educators, nurse practitioners, and physicians to increase the understanding of how hearing and balance can be affected by diabetes.



PWD should have audiological evaluation every 2 years.



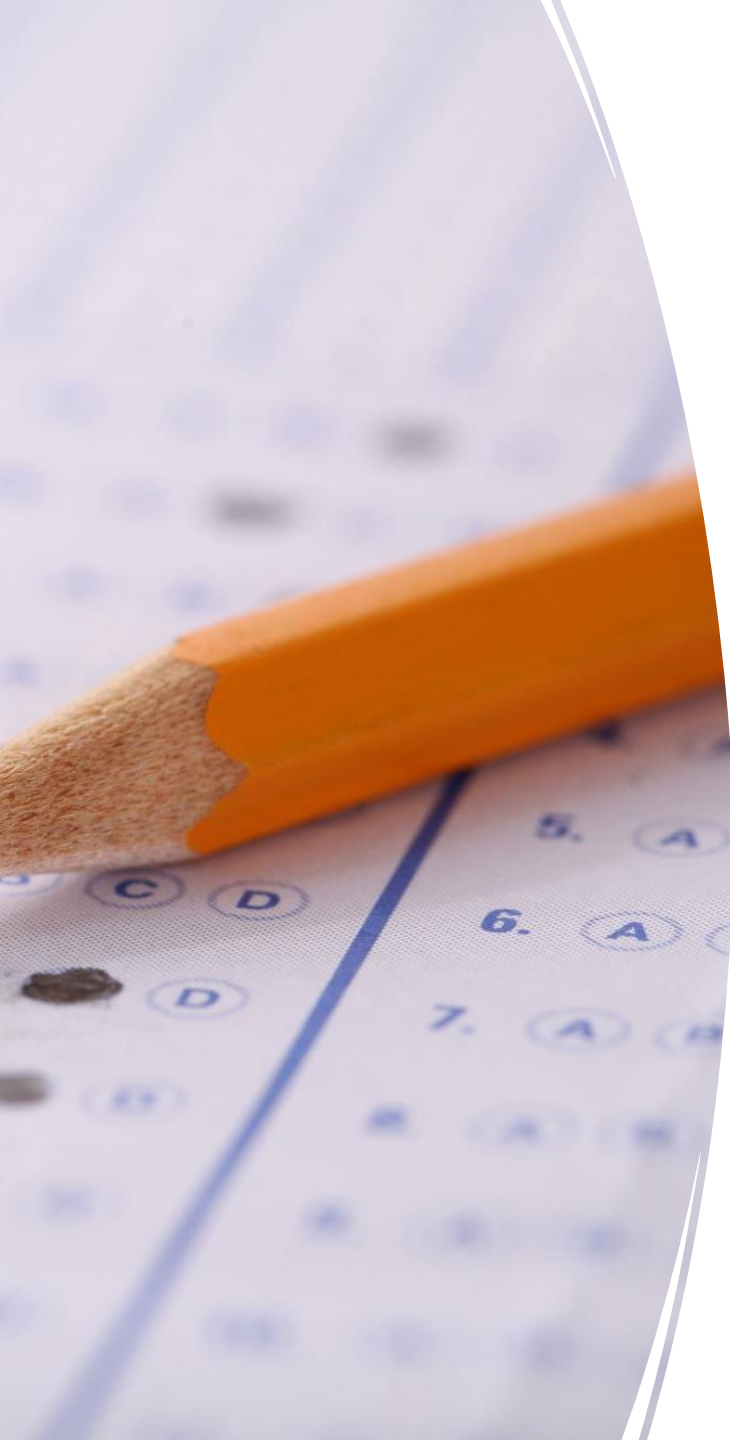
Hearing screening information should be added to the case history



We need to prevent, provide early identification for, and manage hearing loss in this group



Add "Audiologist" to Diabetes Care Team



Education for Healthcare providers

- **Encourage use of an audiologic screener (paper/pencil test):**
 - Do you or your family perceive any change in your hearing?
 - Do you have hearing difficulty in quiet or noise?
 - Have you had your hearing tested in the past 2 years
 - Do you know how diabetes can affect your hearing?
 - Do you know what to do if you perceive a change in hearing?
 - Do you know how to reduce your risk for hearing loss?

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- <https://vestibular.org/dizziness-symptom-profile-dsp/>