

# What No One Is Saying: The Impact of Diabetes on Hearing and Balance

April 14, 2021

**Centers for Disease Control and Prevention**  
National Center for Chronic Disease Prevention and Health Promotion

Division of Diabetes Translation



# CDC Welcome

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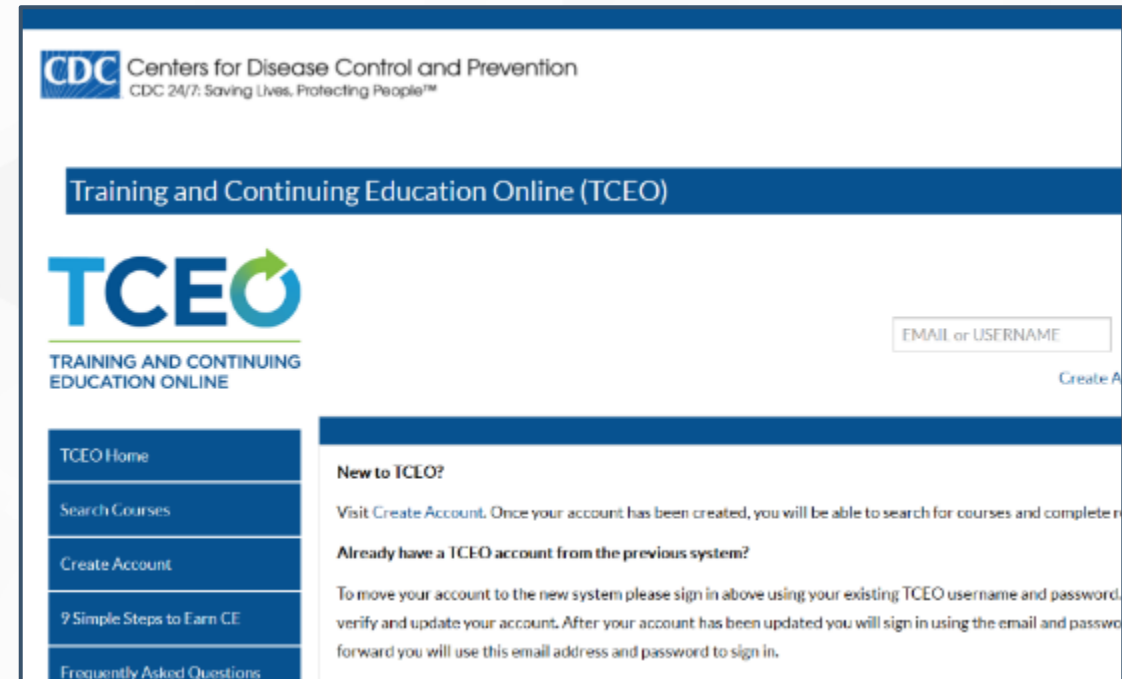
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Today's Moderator

**Kathy Dowd, AuD**

Executive Director

The Audiology Project





# Setting the Stage: Diabetes and Ear Health



## Hearing Loss

- Cochlear microangiopathy
- Neural degeneration



## Balance and Fall Risk

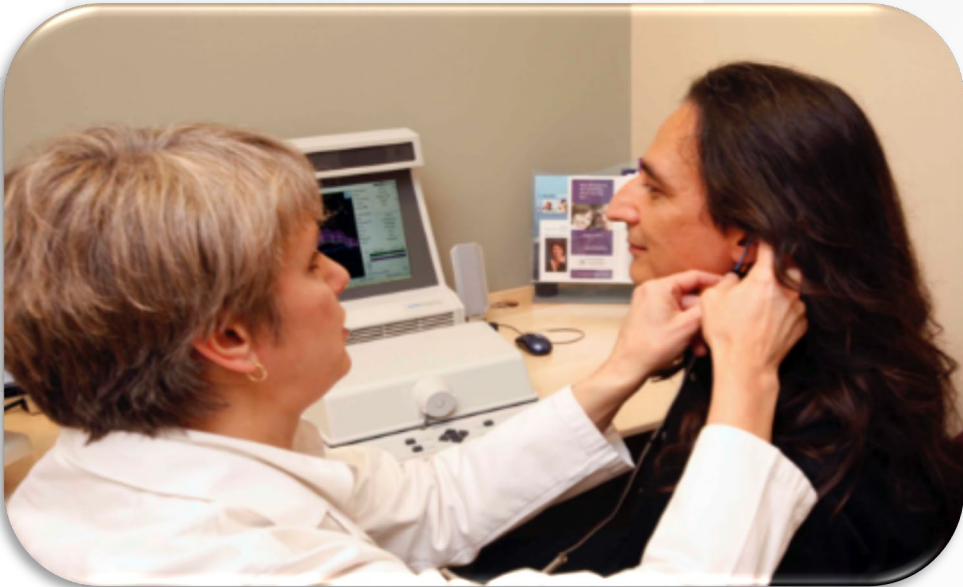
- Foot neuropathy and vision effects
- Vestibular effects of diabetes



## Diabetic Pain and Infection Control

- Ototoxicity
- Vestibulotoxicity

# Audiology Scope of Practice



- Audiology evaluation and management of hearing
- Balance screening and evaluation
- Treatment of hearing loss and balance problems
- Counseling for social, job, personal
- Tinnitus, cochlear implants, pediatric specialties



# Today's Objectives

1. Identify the underlying relationships between blood sugar management, hearing loss, and balance as it relates to both prediabetes and diabetes.
2. Explain the benefits of regular ear health screenings and education for people with diabetes as part of diabetes care and self-management, including through the provision of diabetes self-management education and support (DSMES) services, and in community or team-based clinical settings.
3. Understand how to utilize communication, education, and other strategies and resources for promoting screening for ear health conditions and for supporting people with diabetes, or those who are at risk for type 2 diabetes, who already have hearing loss or difficulties with maintaining balance.

## Have a Question for our Speakers?

Submit your question by clicking the Q&A icon located below. We'll do our best to answer all questions during the Q&A portion at the end of this webinar.



# Today's Presenters



Patricia Gaffney, AuD



Christopher Spankovich,  
AuD, PhD, MPH



Erin G. Piker, AuD,  
PhD, CCC-A



Anjulyn M. Ballard, PhD

# OVERVIEW OF AUDITORY AND VESTIBULAR SYSTEMS

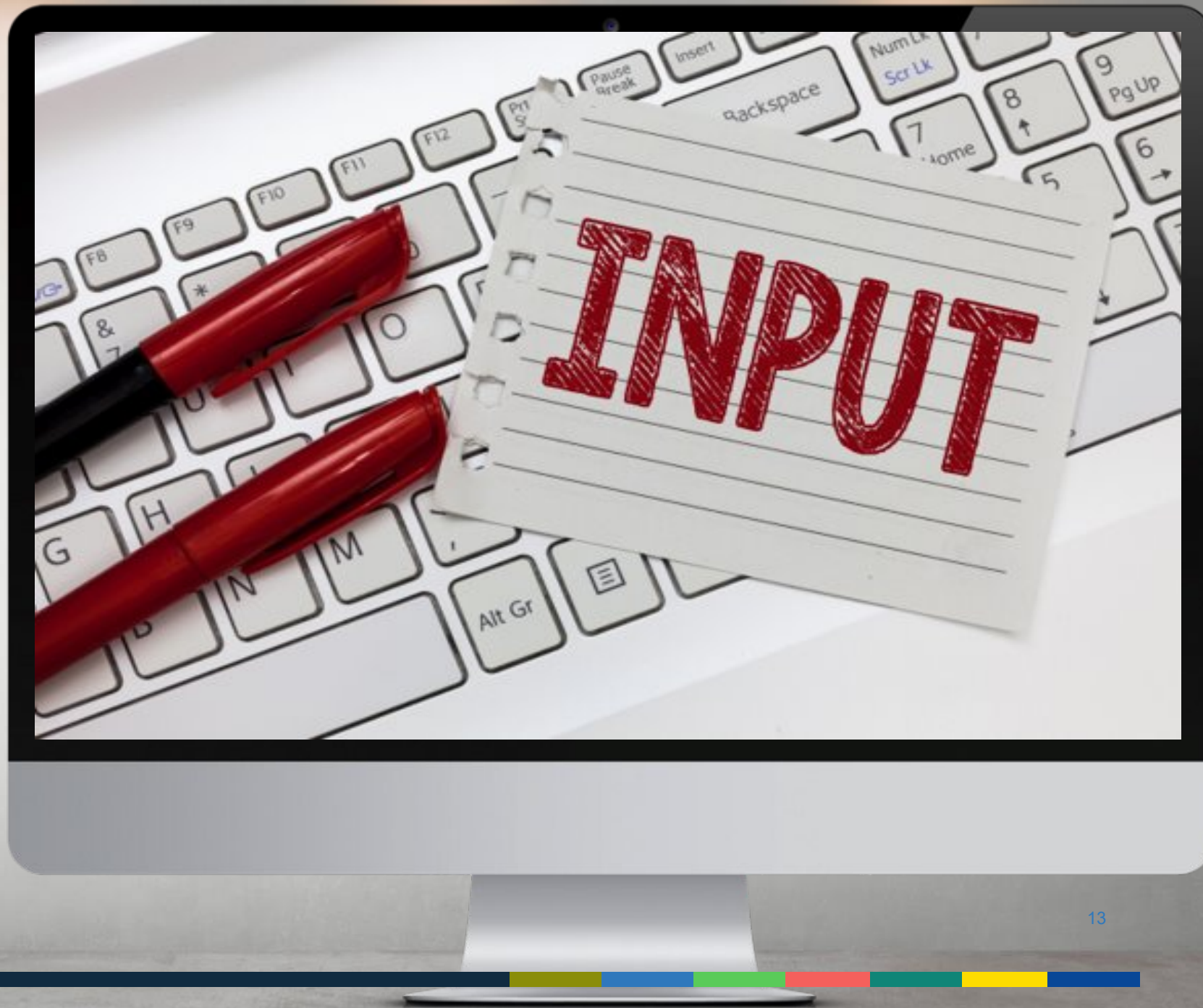
PATRICIA GAFFNEY, AUD

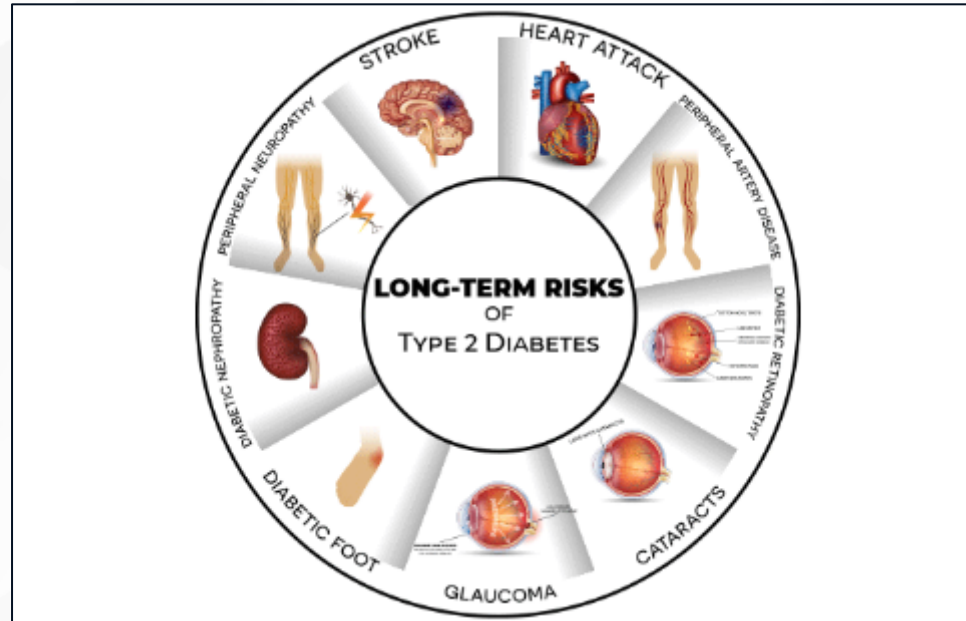
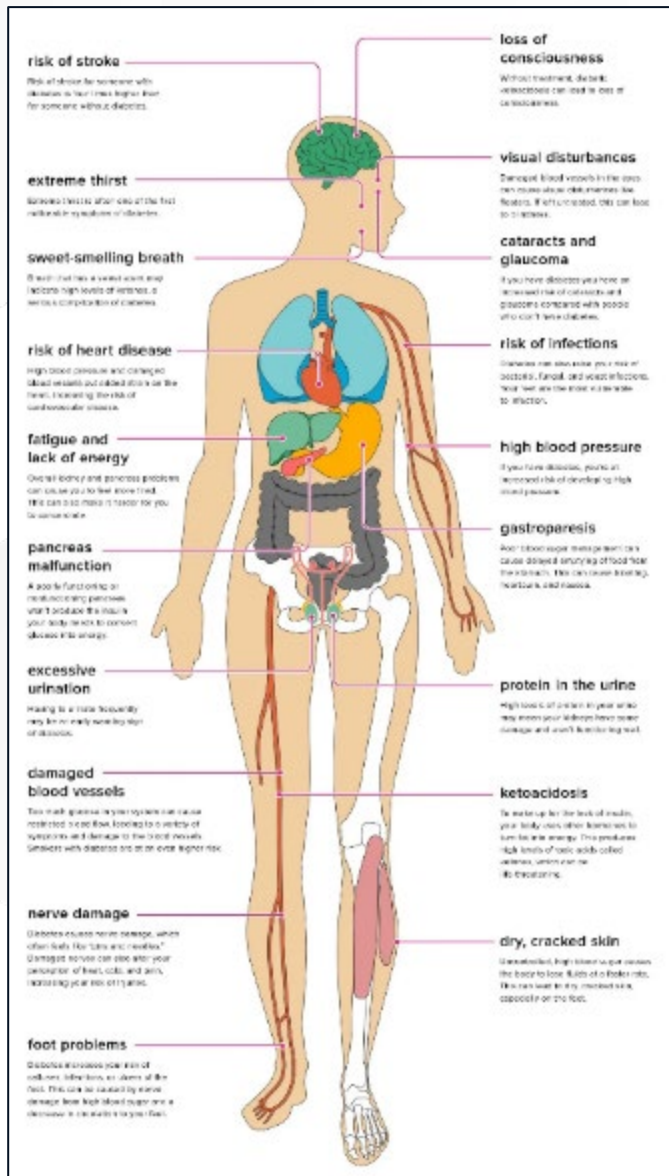
NOVA SOUTHEASTERN UNIVERSITY





## Poll Question #1





# Effects of Diabetes

Monitoring and managing your blood sugar levels is the key to treatment. In fact, the majority of diabetes complications result from elevated blood sugar levels. Below are some serious, negative effects Type 2 Diabetes can have on your body.

- Brain and cerebral circulation: Cerebrovascular disease
- Oral health: Severe periodontal disease
- Pregnancy and birth: Complications, birth defects
- Peripheral nervous system: Neuropathy
- Lower limbs: Loss of sensitivity
- Blood pressure: Hypertension
- Diabetic foot: Ulceration and amputation
- Eyes: Retinopathy and blindness
- Heart and coronary circulation: Heart disease or stroke
- Kidney: Nephropathy

If you have taken Litaler and developed Type 2 Diabetes, you need a lawyer fighting for you. At the Stokin Law Group, we fight for your rights and get you the compensation you deserve. Please don't hesitate to call us at 1-888-913-9815 for more information.

[https://i0.wp.com/images-prod.healthline.com/hlcmsresource/images/topic\\_centers/Diabetes\\_Effects\\_Pinterest\\_crop.jpg?w=1155&h=8061](https://i0.wp.com/images-prod.healthline.com/hlcmsresource/images/topic_centers/Diabetes_Effects_Pinterest_crop.jpg?w=1155&h=8061)

<https://cdn-b.medlife.com/2019/02/risk-type-2-diabetes.png>

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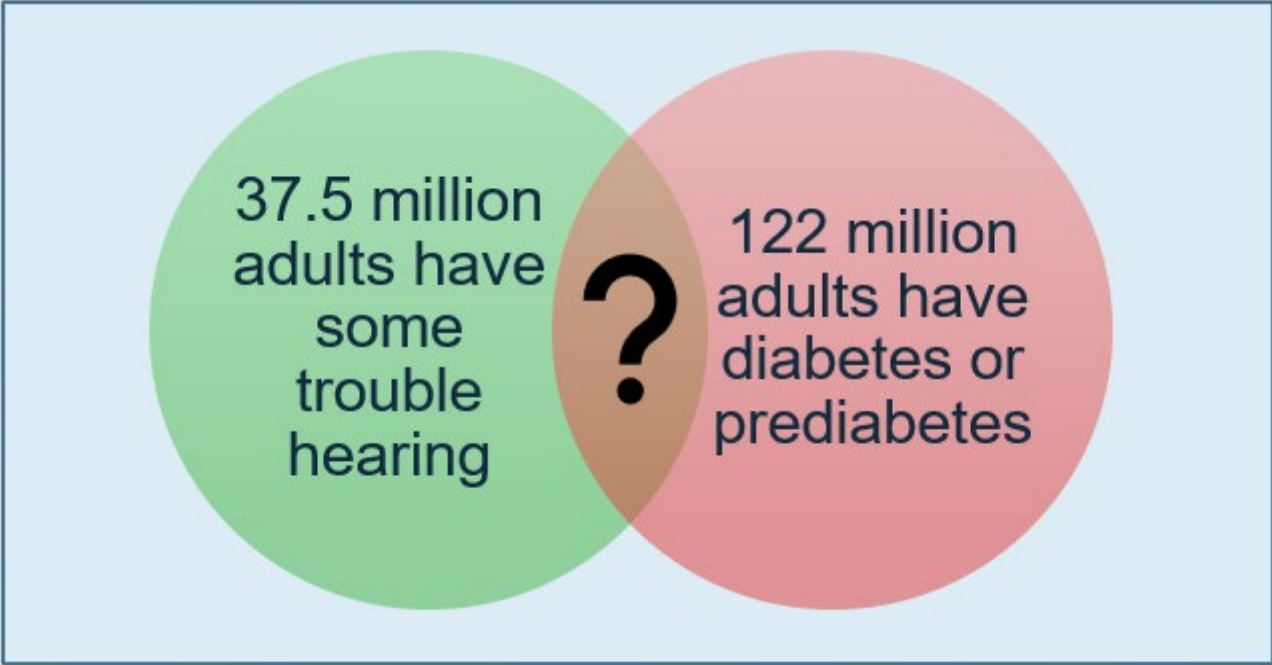
# Ears

- Ears are missing from most consumer awareness information
- Very few resources have the ears listed

Image: <http://digitalprinthouses.com/wp-content/uploads/2017/02/DiabetesandtheBody-e1469861927116.jpg>



# Hearing Loss and Diabetes in the United States

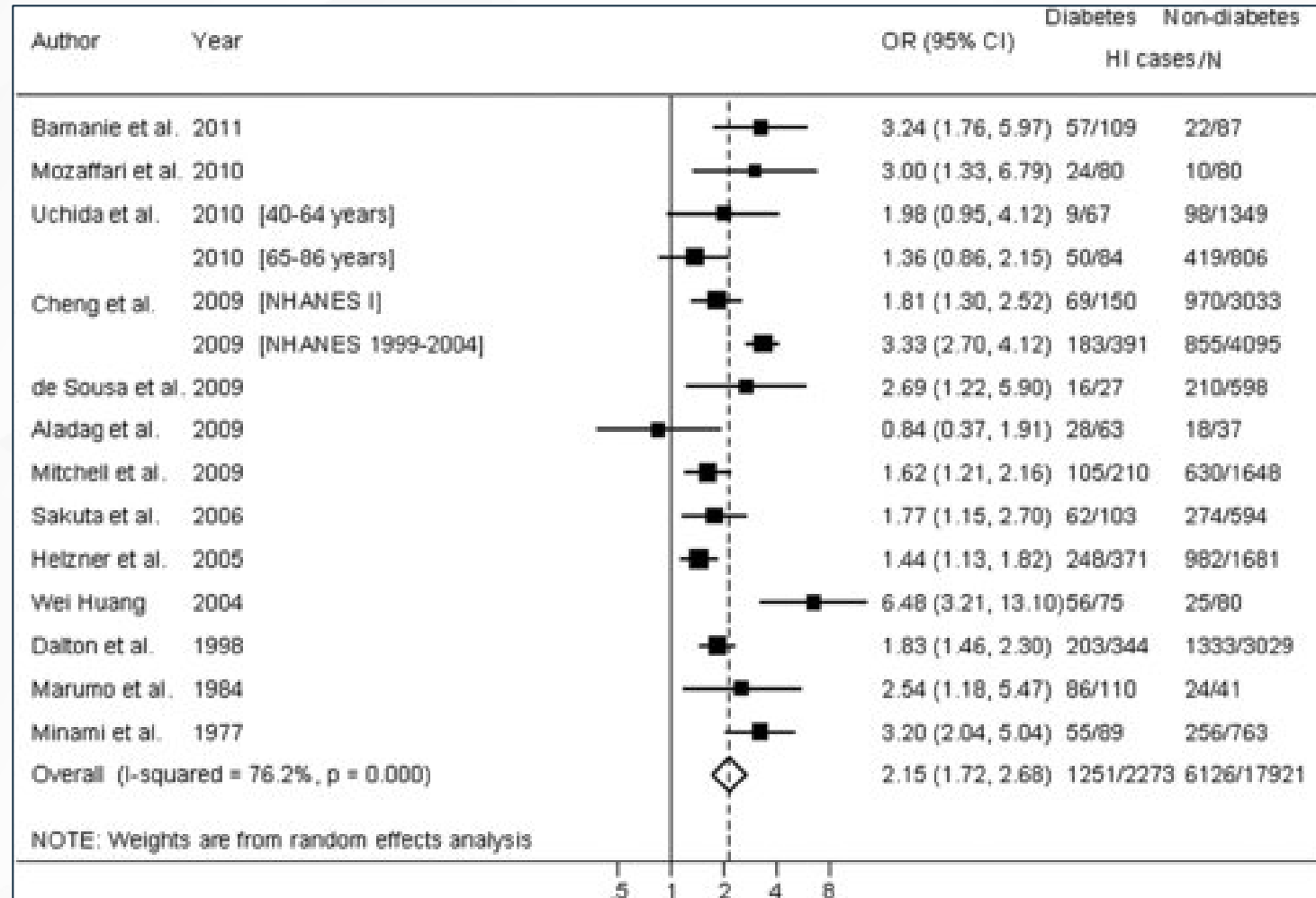


Source: National Diabetes Statistics Report, 2020. Quick statistics about hearing. (2020, October 02).

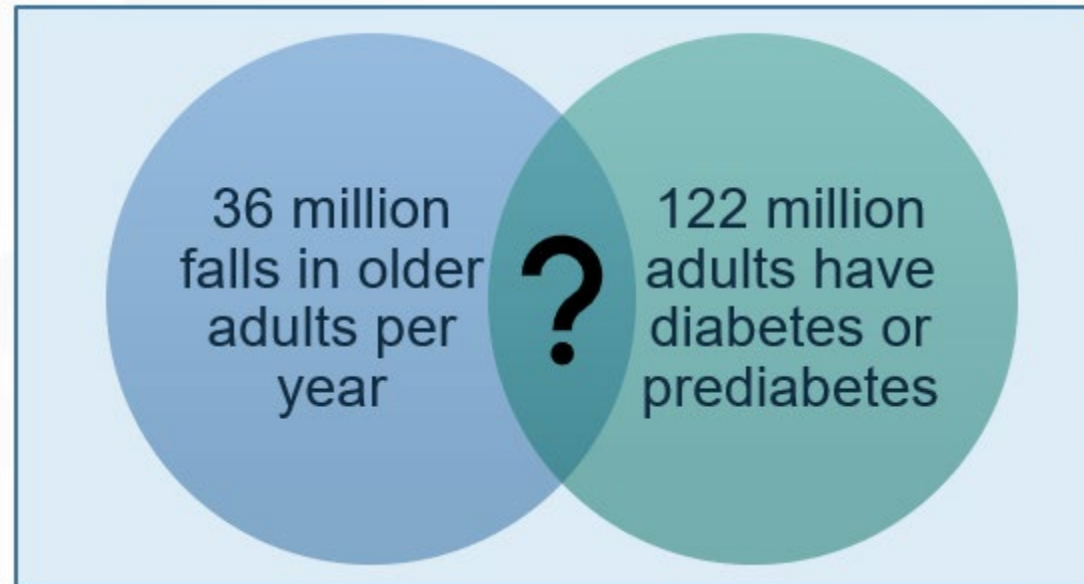
# Link Between Diabetes and Hearing Loss

- *Bainbridge, et al* (2008), using the National Health and Nutrition Examination Survey (NHANES) database, found a prevalence of hearing loss of 28% among those with diabetes.
- Odds ratio of 1.82 of mild or greater hearing loss

# Odds Ratios from Studies for Participants with Hearing Loss and Diabetes



# Falls and Diabetes in the United States

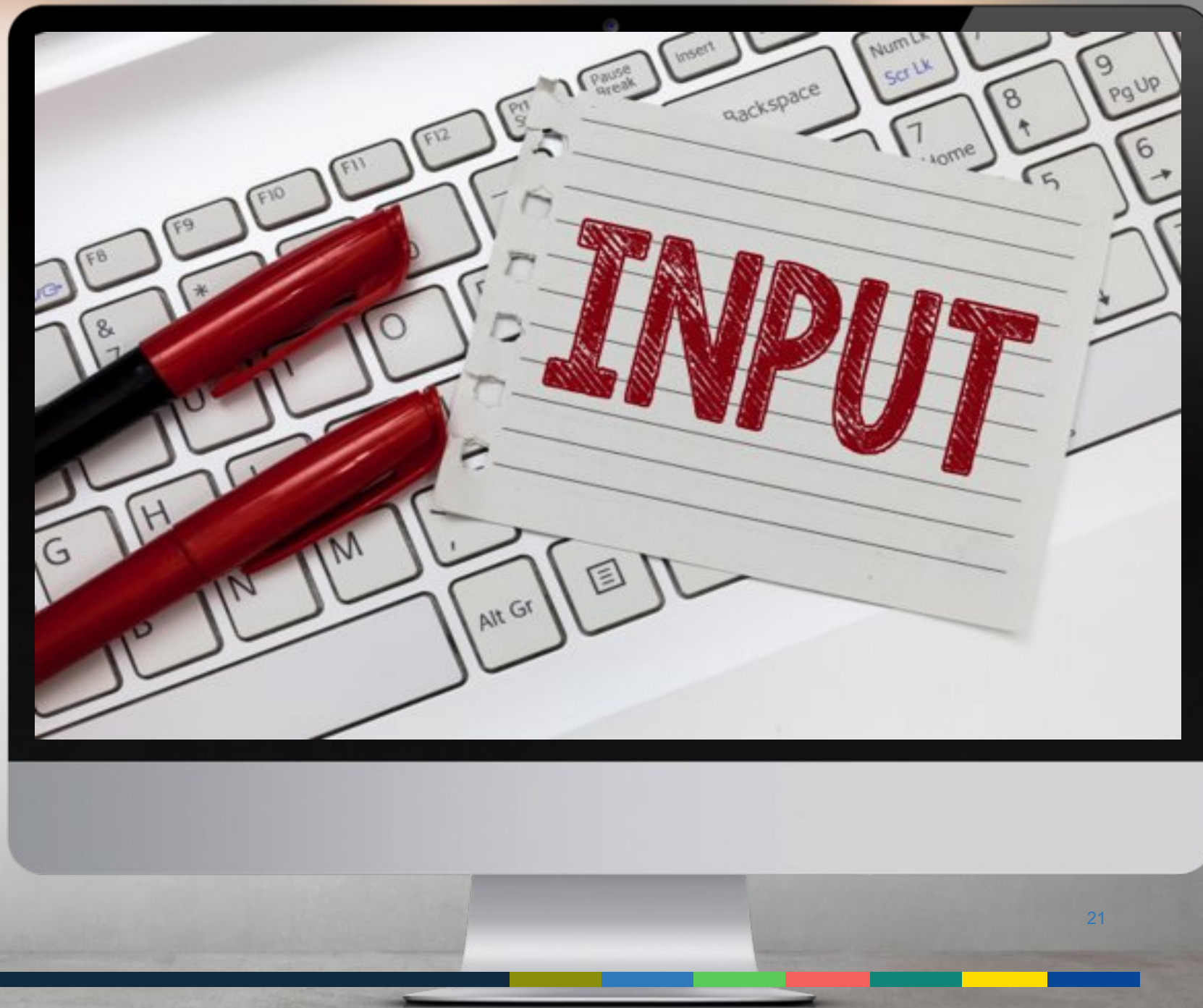


# Vestibular Loss, Falls, and Diabetes

- *Li, et al* (2019) found a higher incidence of vestibular dysfunction in patients with diabetes
- *Chen, et al* (2020) meta-analysis showed diabetes was a risk factor for benign paroxysmal positional vertigo (BPPV)
- *Walley, et al* (2014) showed abnormal performance on postural testing and abnormal vestibular tests with diabetes patients
- *Agrawal, et al* (2010) reported that vestibular dysfunction increased the odds of falling in older adults

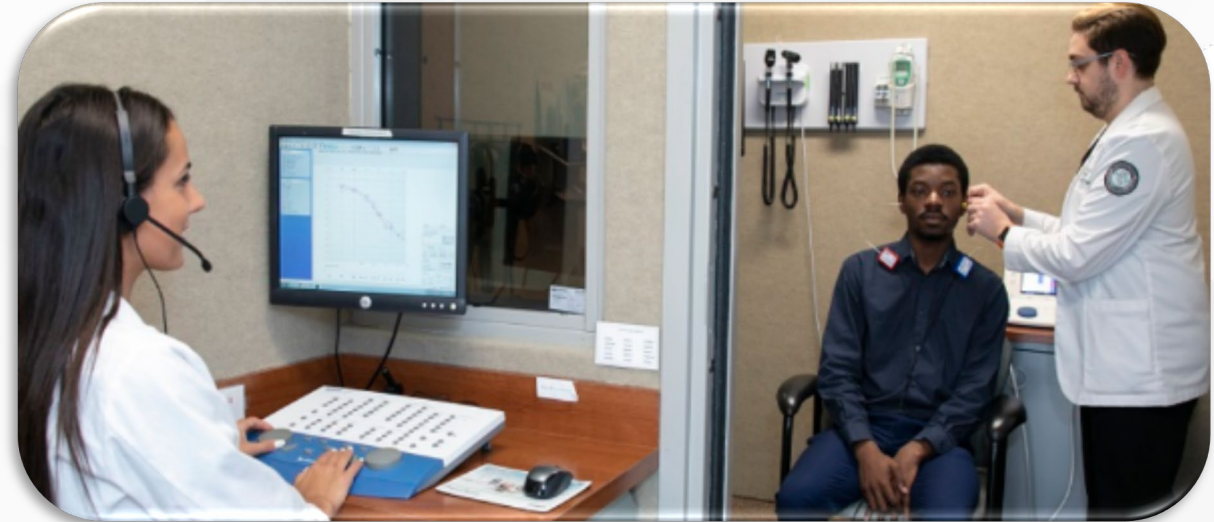


## Poll Question #2



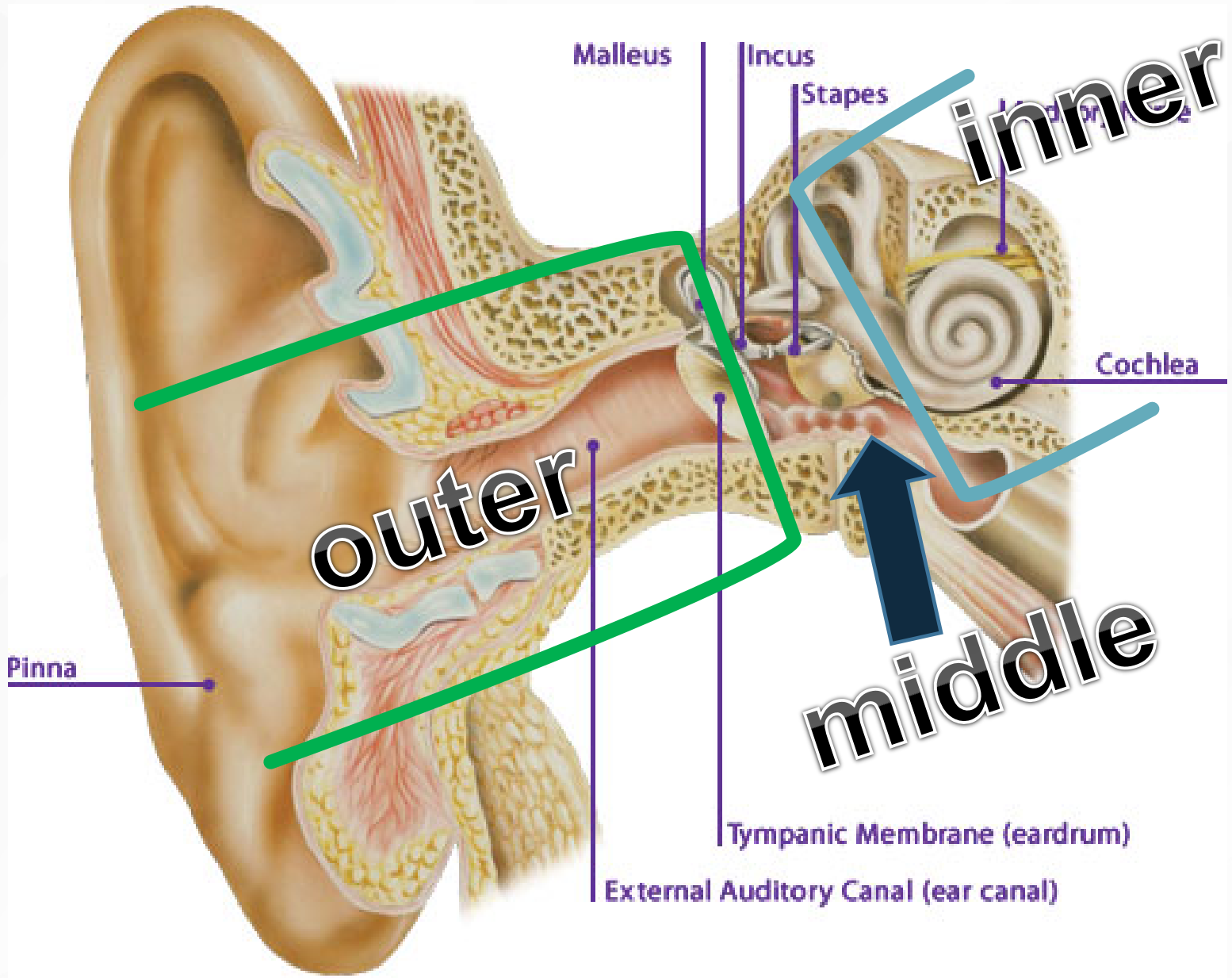
# Audiologists

- Masters or doctoral level non-physician provider
- Counsel patients; evaluate hearing, tinnitus, and vestibular
- Treat and manage with hearing aids, tinnitus maskers, vestibular repositionings/rehabilitation
- Variety of settings: hospitals, ear, nose and throat (ENT) offices, universities, Veterans Affairs (VA) medical centers, and private practices



# Professionals Who See Those with “Ear” Complaints

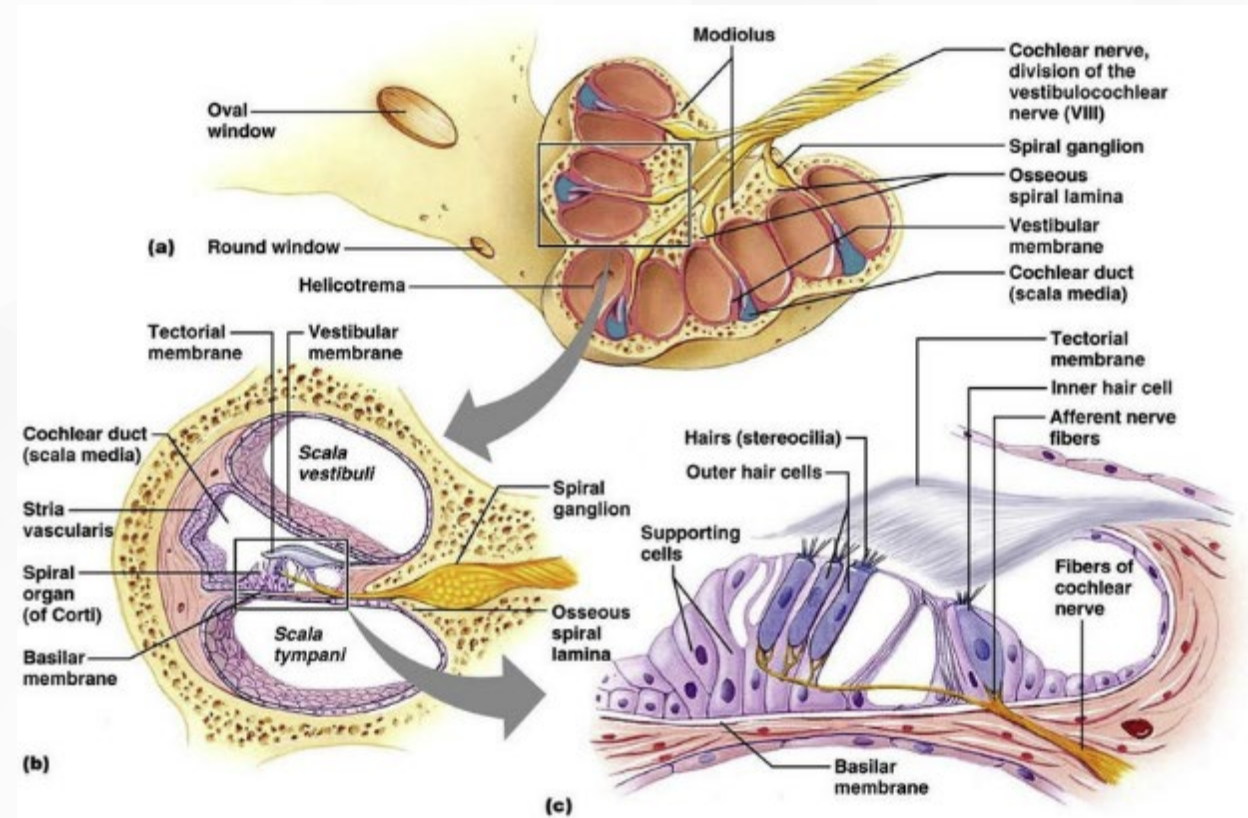
Otolaryngology	Audiology	Hearing aid dispenser
<ul style="list-style-type: none"><li>• Physicians that treat medical and surgical issues of the ear</li><li>• Prescribe medication</li><li>• Education: DO, MD</li></ul>	<ul style="list-style-type: none"><li>• Assess hearing, tinnitus, vestibular of all ages</li><li>• Treat and manage disorders of hearing and vestibular (ex. hearing aids, repositionings)</li><li>• Education: Masters, AuD, PhD</li></ul>	<ul style="list-style-type: none"><li>• Assess hearing</li><li>• Fit with hearing aids</li><li>• Education: minimum of HS diploma</li></ul>

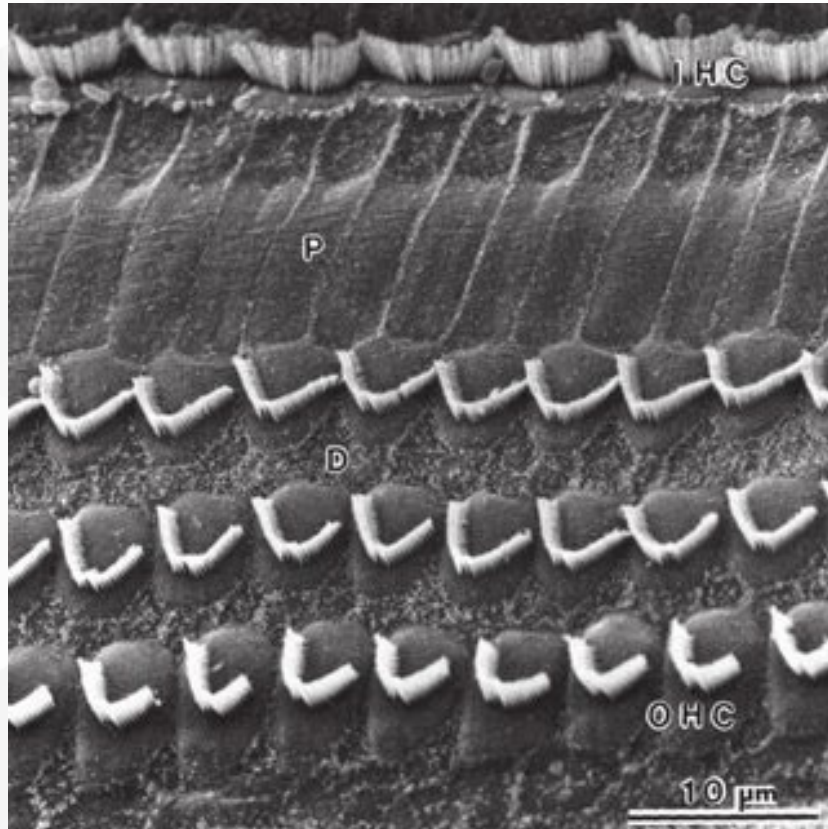




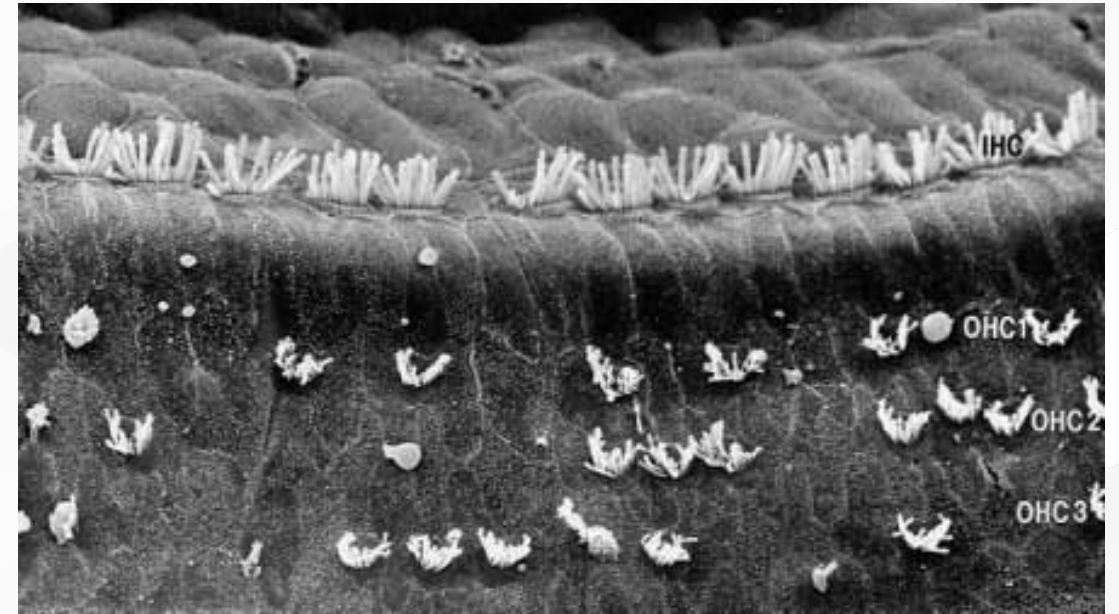
# Inner Ear - Cochlea

- Hair Cells
  - These small hair cells are the sensors for hearing
- Stria Vascularis
  - Blood supply to the cochlea





[https://www.researchgate.net/profile/Aage-Moller/publication/226274949/figure/fig2/AS:557423018639361@1509911412722/Scanning-electron-micrographs-of-inner-hair-cells-IHC-and-outer-hair-cells-OHC-in-a\\_Q320.jpg](https://www.researchgate.net/profile/Aage-Moller/publication/226274949/figure/fig2/AS:557423018639361@1509911412722/Scanning-electron-micrographs-of-inner-hair-cells-IHC-and-outer-hair-cells-OHC-in-a_Q320.jpg)



<https://acoustixhearing.co.nz/media/24822/acoustix-hearing-damaged-ear-hair-cells-widex-aps-4.jpg>



# Hearing Loss

## Conductive

- Hearing loss caused by an abnormality of the outer/middle ear
- Can often be treated through medication/surgery

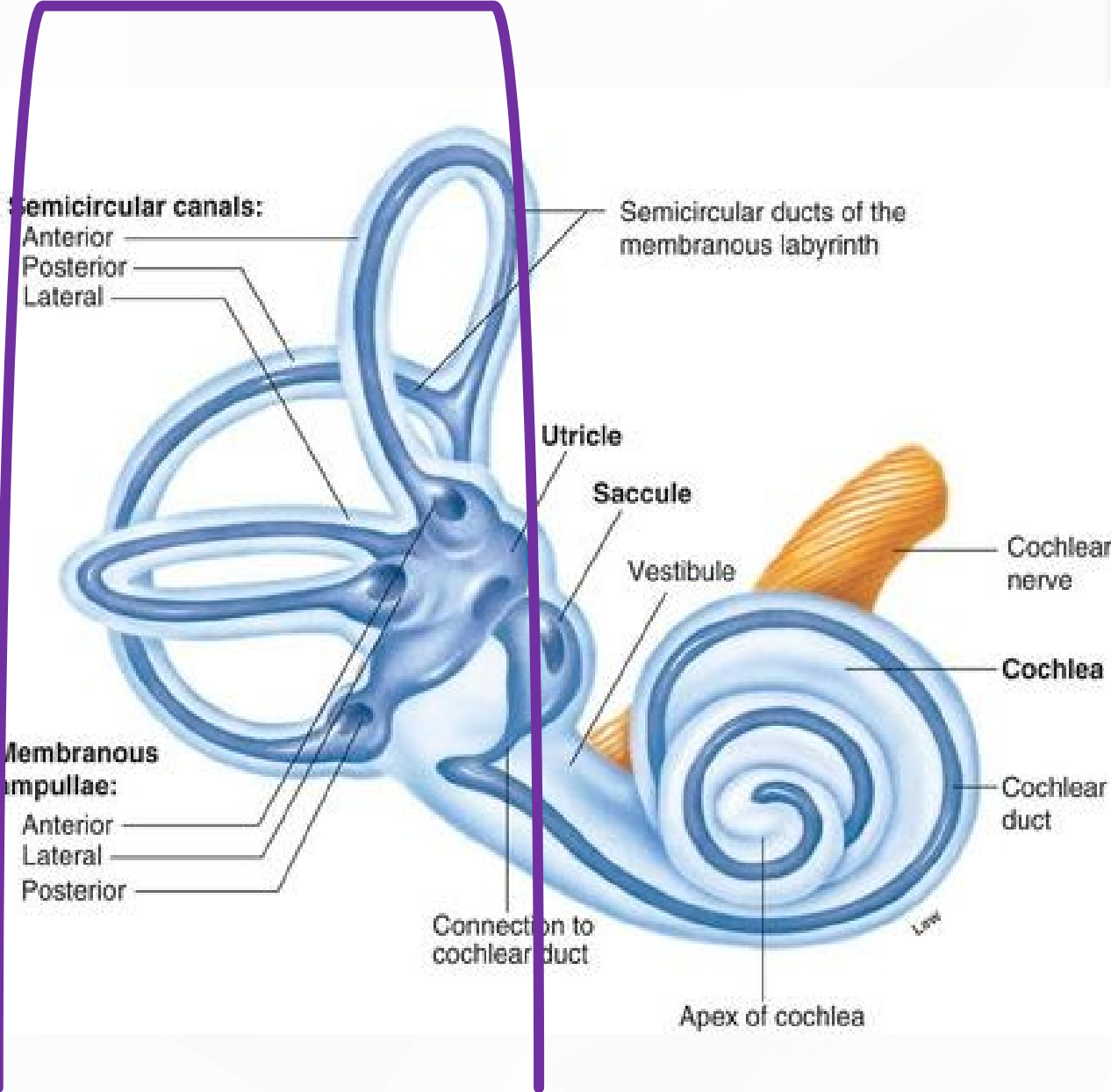
## Sensorineural

- Hearing loss caused by damage to the cochlea or auditory nerve
- Permanent hearing loss\*
- Typically treated with a hearing aid or cochlear implant

## Mixed

- Hearing loss that has a conductive component and a sensorineural component
- The conductive component could be treated

# Vestibular



[https://greymattersjournal.org/content/images/2020/06/The\\_Vestibular\\_System\\_and\\_the\\_Spins--\\_A\\_Proposal.jpg](https://greymattersjournal.org/content/images/2020/06/The_Vestibular_System_and_the_Spins--_A_Proposal.jpg)

# Inner Ear - Vestibular

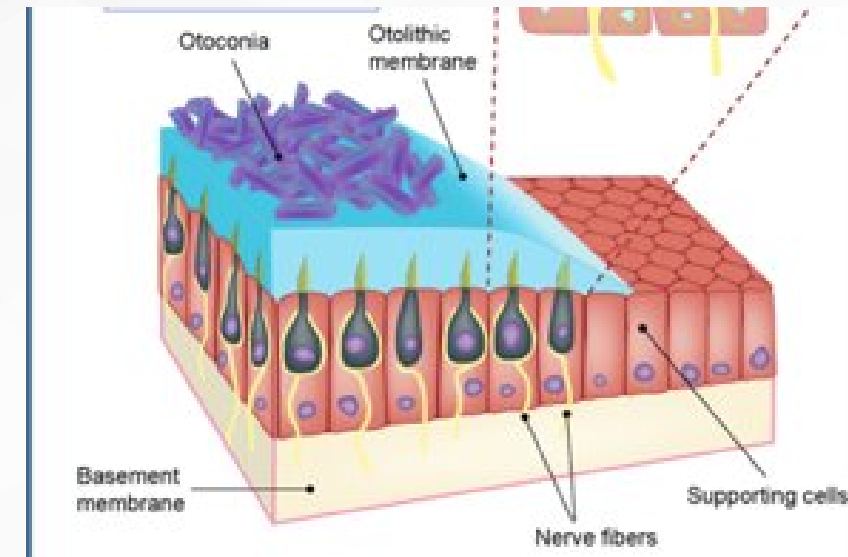
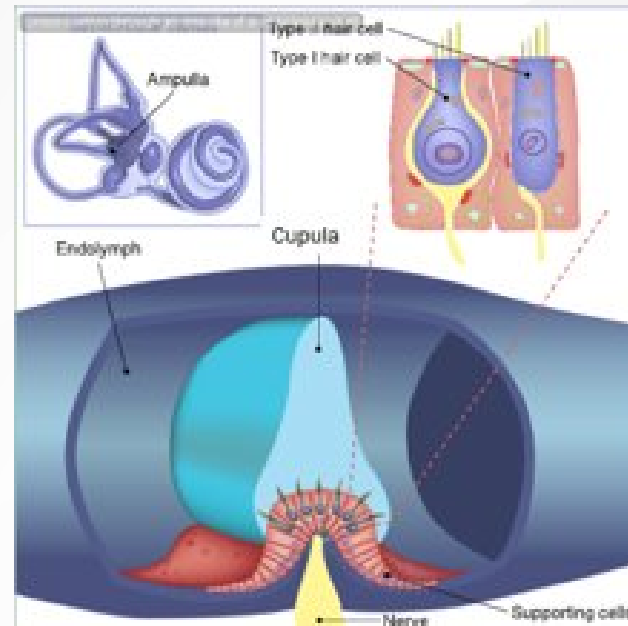
## Semicircular Canals

Detect rotation

Angular movement

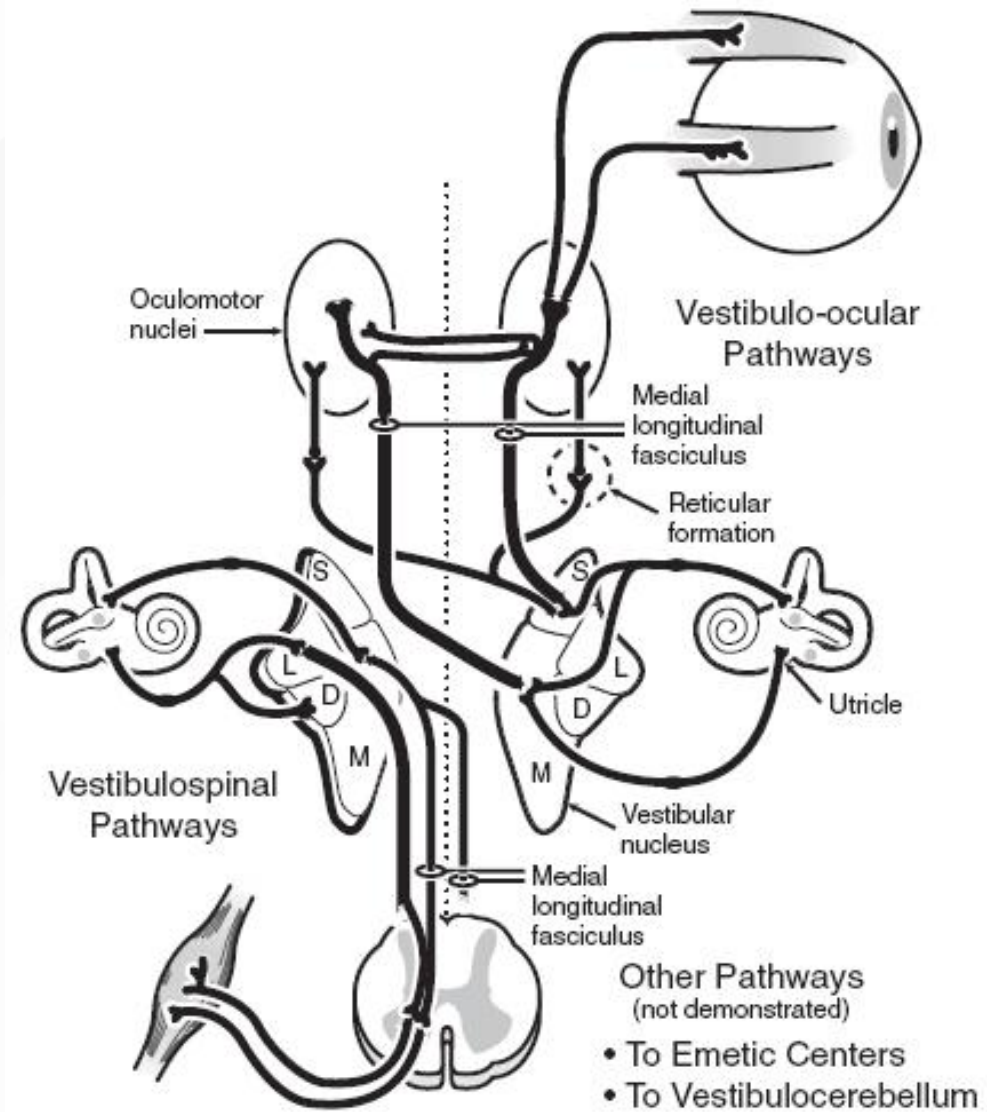
## Otoliths

Detect gravity,  
linear acceleration,  
tilt, centrifugation



[http://www.anatomy.tv/head\\_ent/release/default.aspx?app=head\\_ent\\_flash](http://www.anatomy.tv/head_ent/release/default.aspx?app=head_ent_flash)

# Vestibular Pathway



# Key Takeaways

Impacts of diabetes on the ear are often not addressed

- Need to ask the questions and make the referrals

Audiologists are the professionals who test hearing and vestibular

- Knowing where to refer

Hearing loss and vestibular loss is permanent

- Prevention is key

# References

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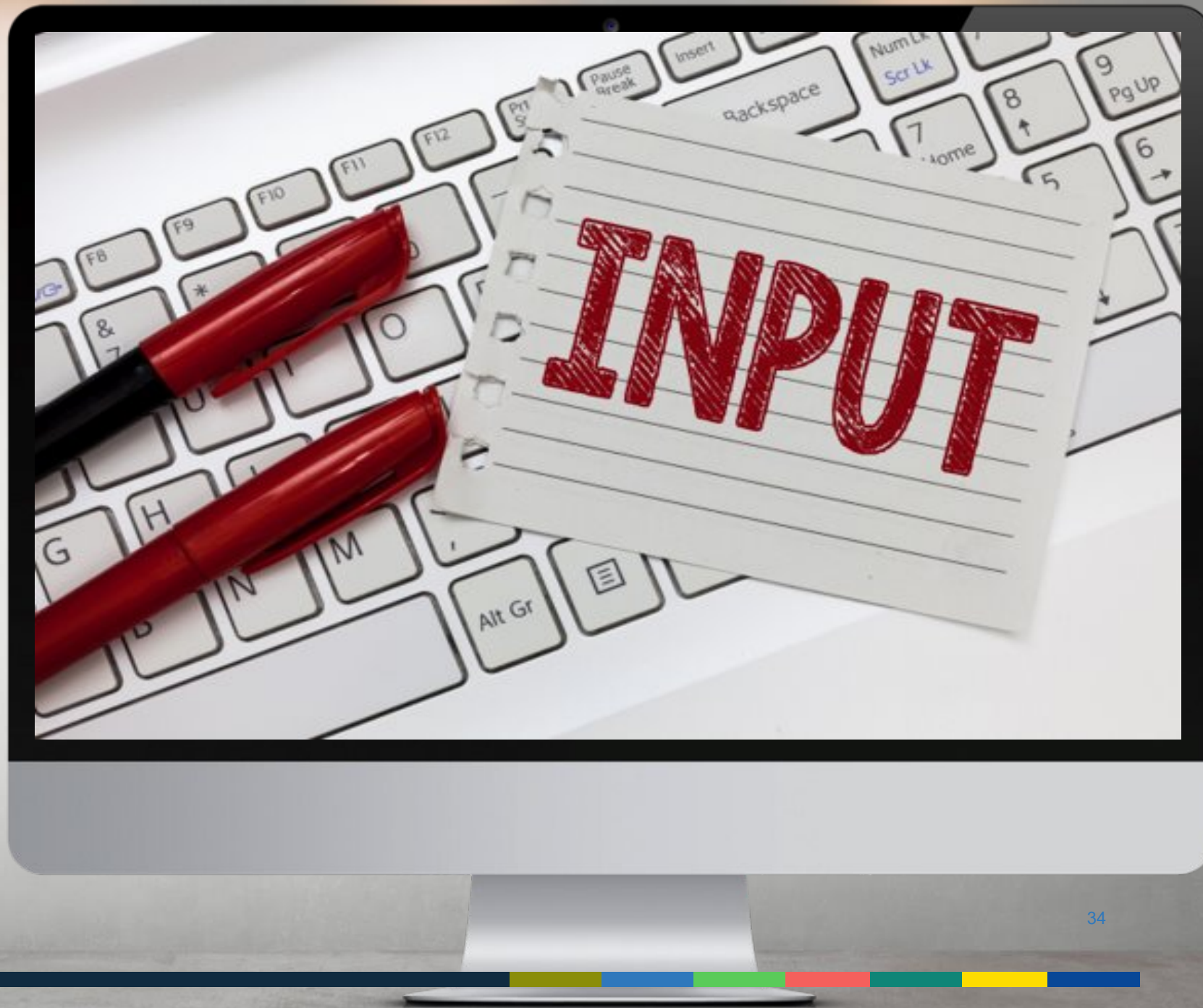


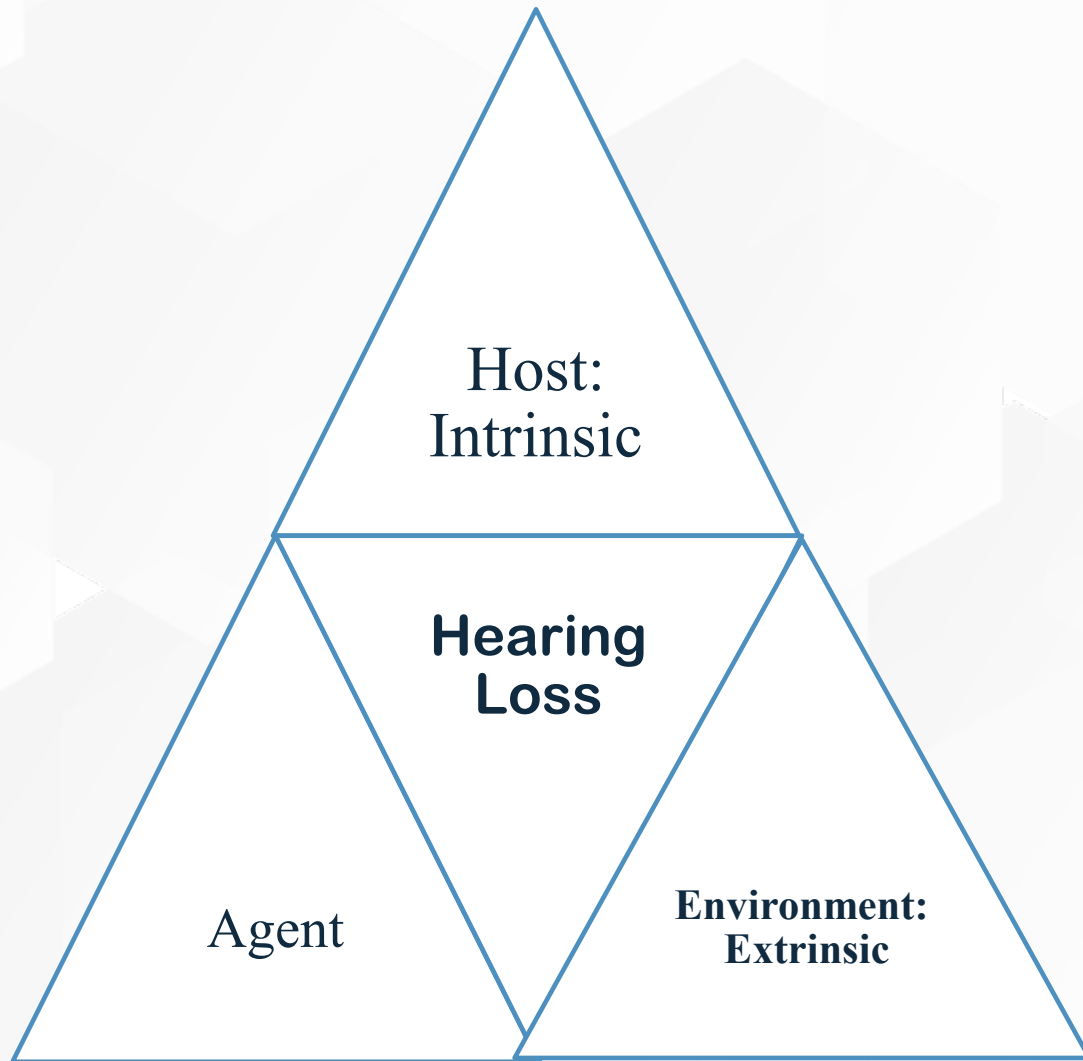
# DIABETES AND HEARING

CHRISTOPHER SPANKOVICH, AUD, PHD, MPH  
ASSOCIATE PROFESSOR, VICE CHAIR OF RESEARCH



## Poll Question #3

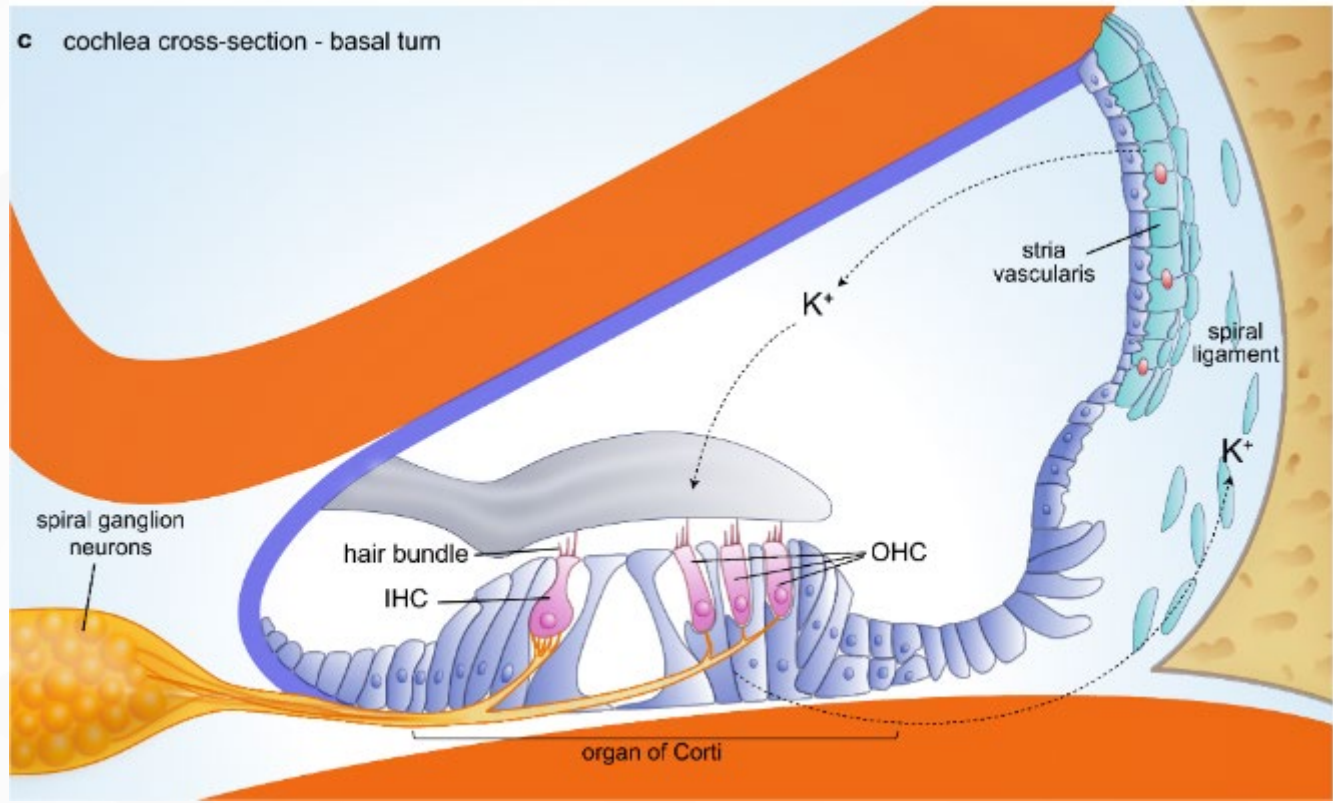
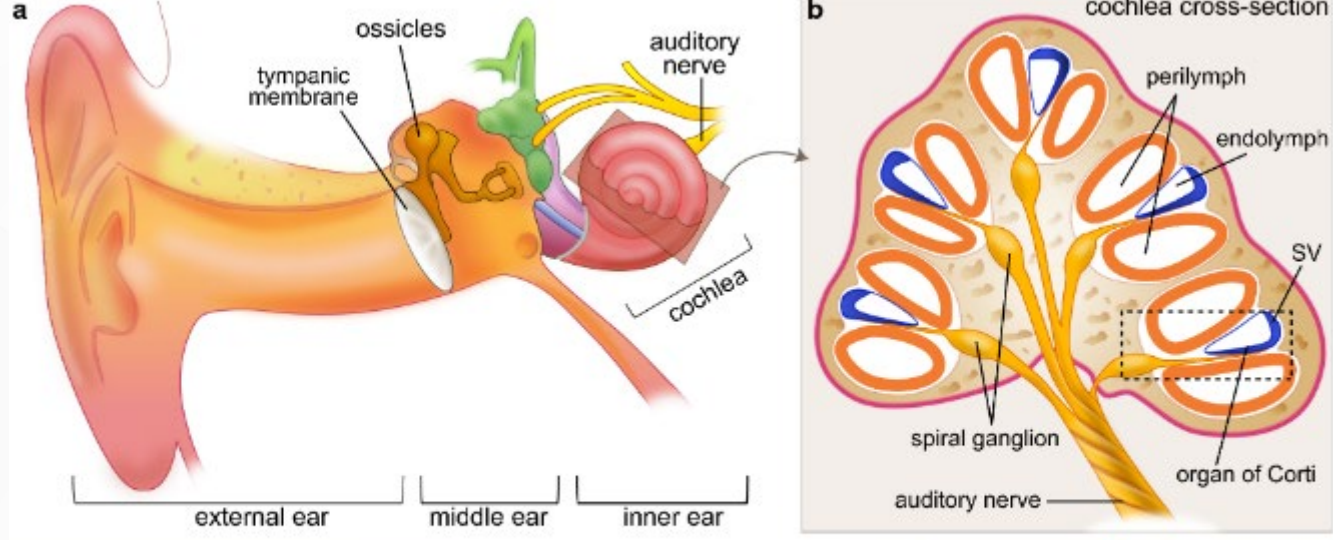


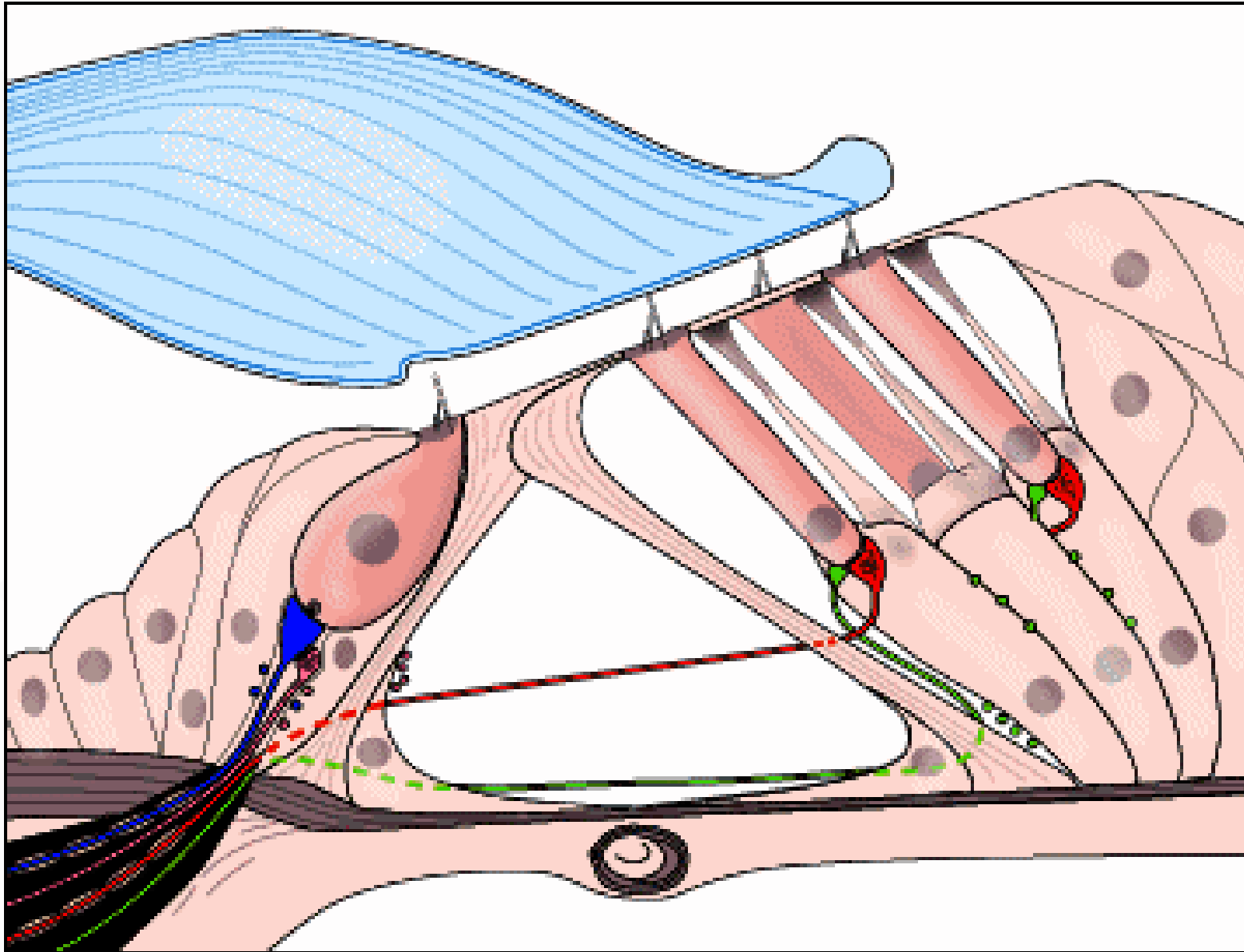


$$\int_{\text{Sat}}^{\text{NM}} R_x \frac{dt}{t} dR_x + \int_{90}^{\text{HO}} \text{Megaphone} dB$$

$$+ \int_A^{\Omega} \text{Hourglass} dt = \text{PTS} \text{ Ear} -dB$$

Hawkins, 1973 © Karger



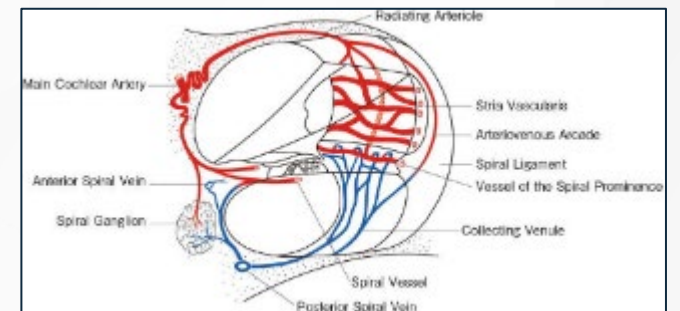
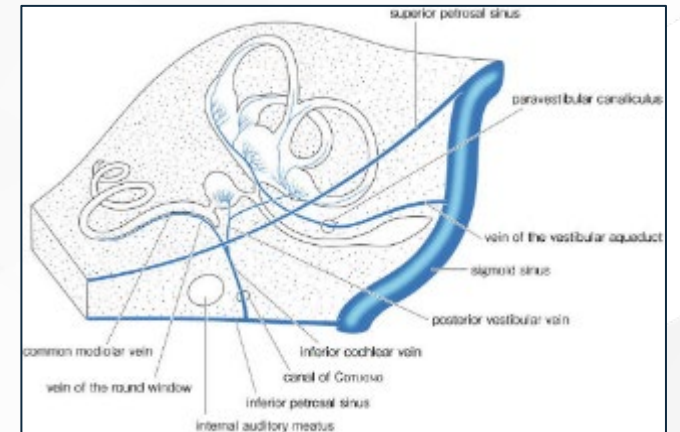
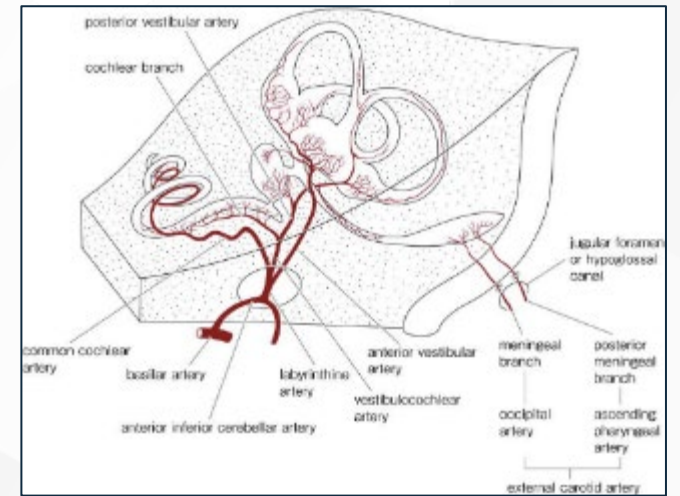


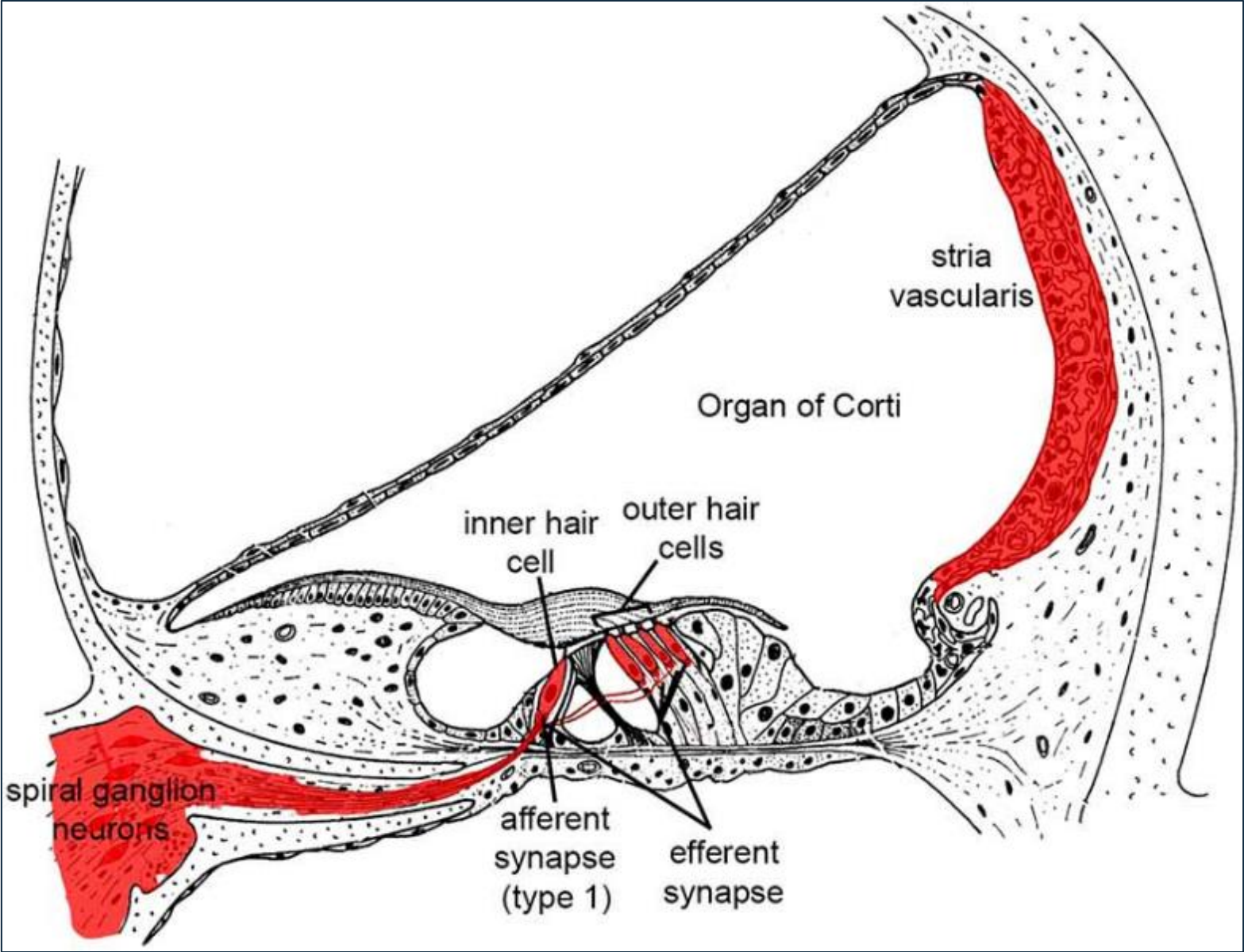
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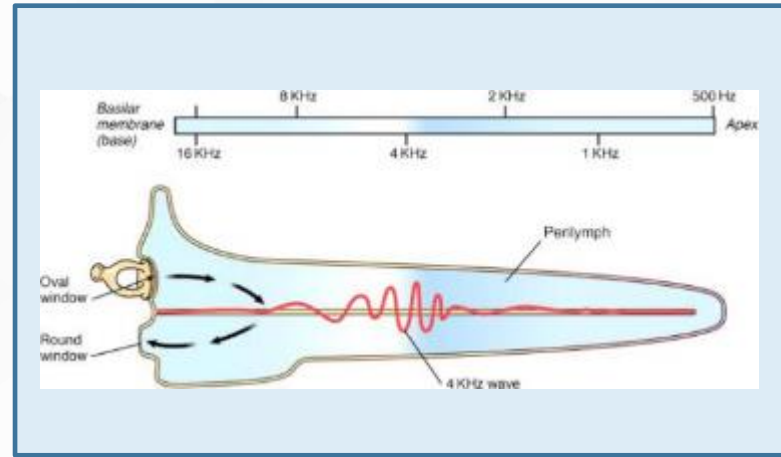
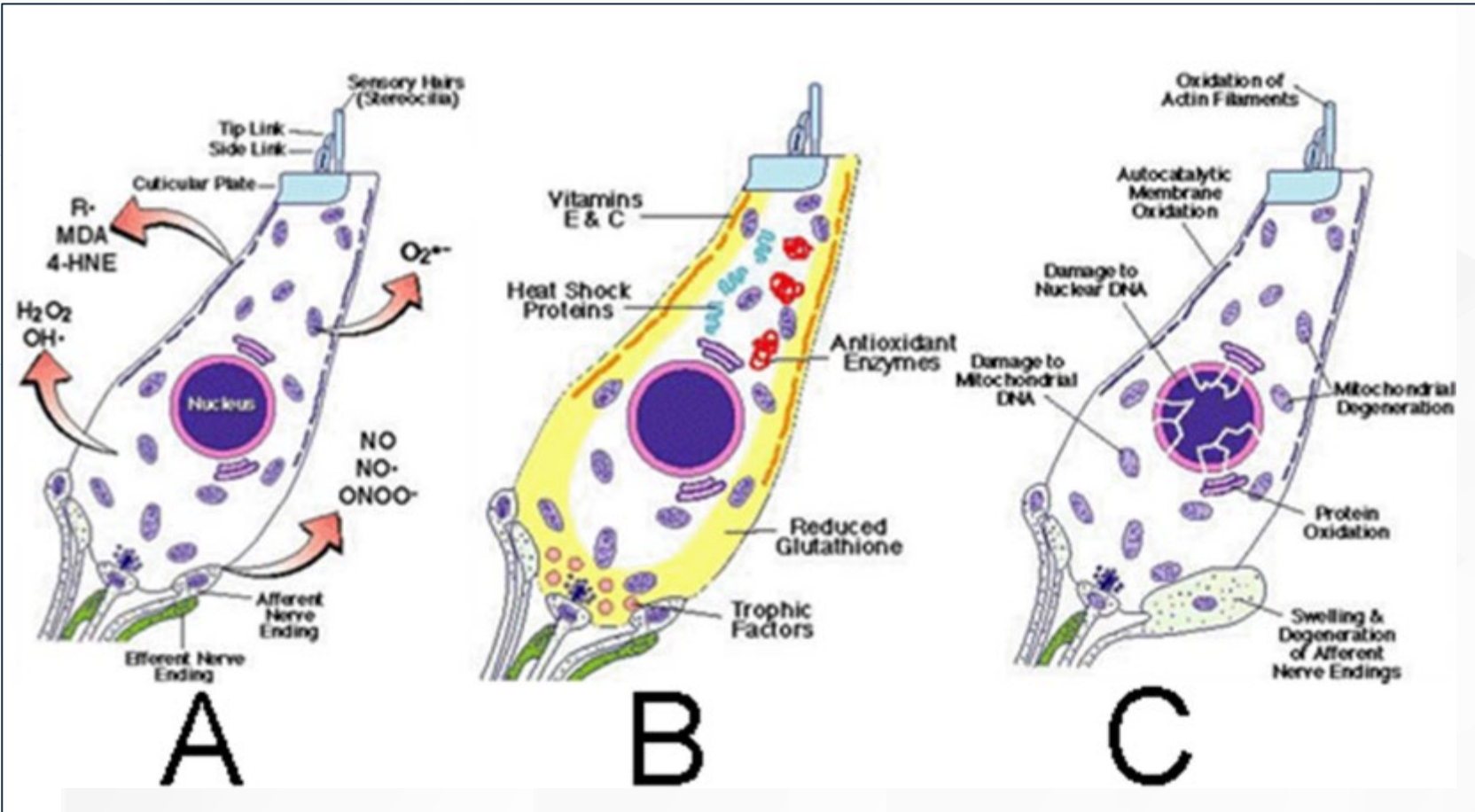


# How Does Diabetes Cause Damage?

- **Microangiopathy**
- Mitochondrial dysfunction
- Advanced glycation end products
- Inflammation
- Glutathione dysregulation
- Protein synthesis dysfunction
- **Glutamate excitotoxicity**

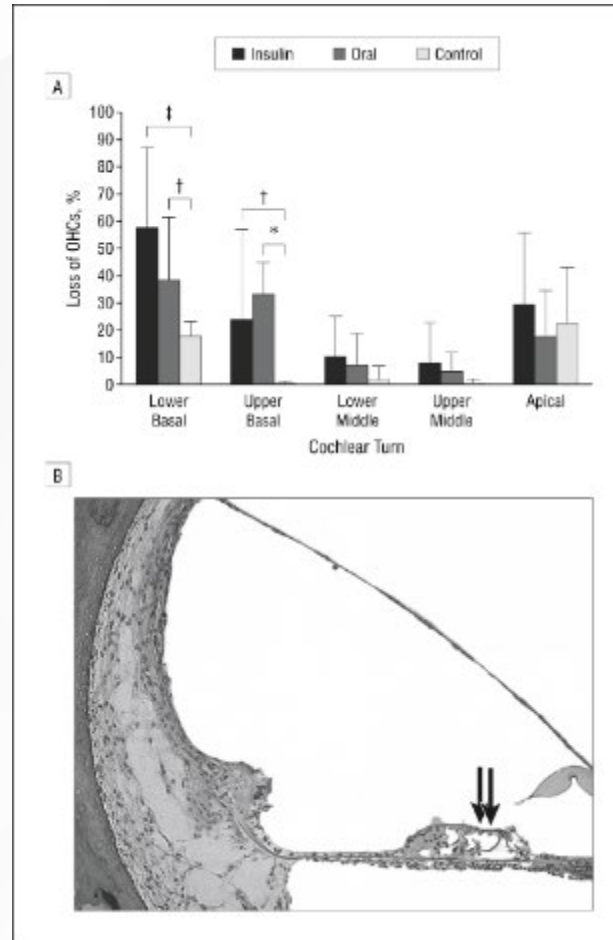
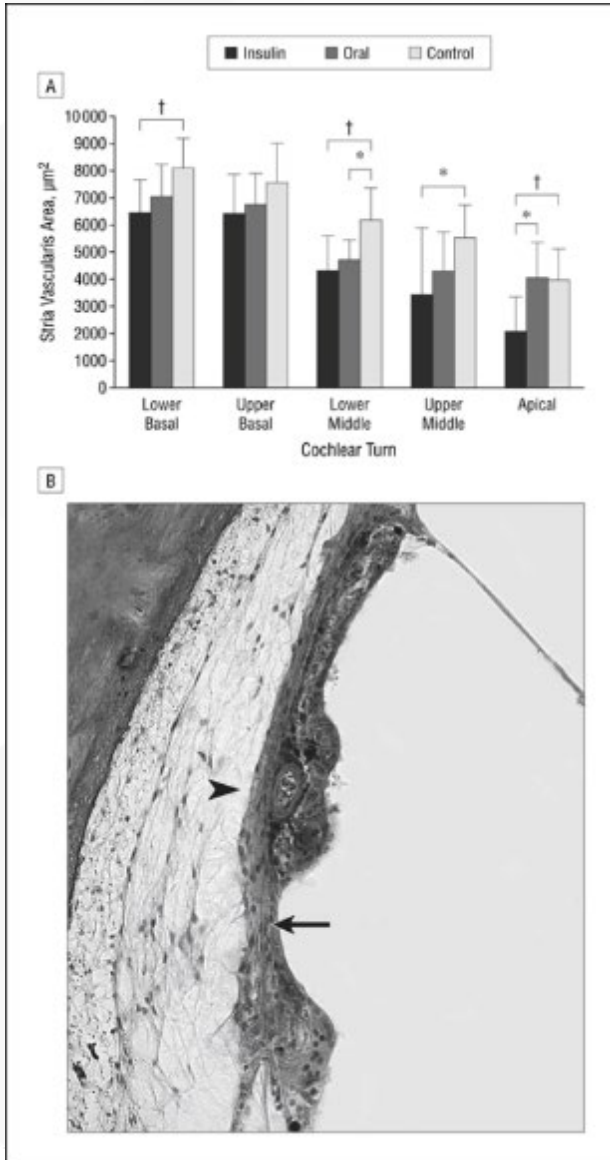




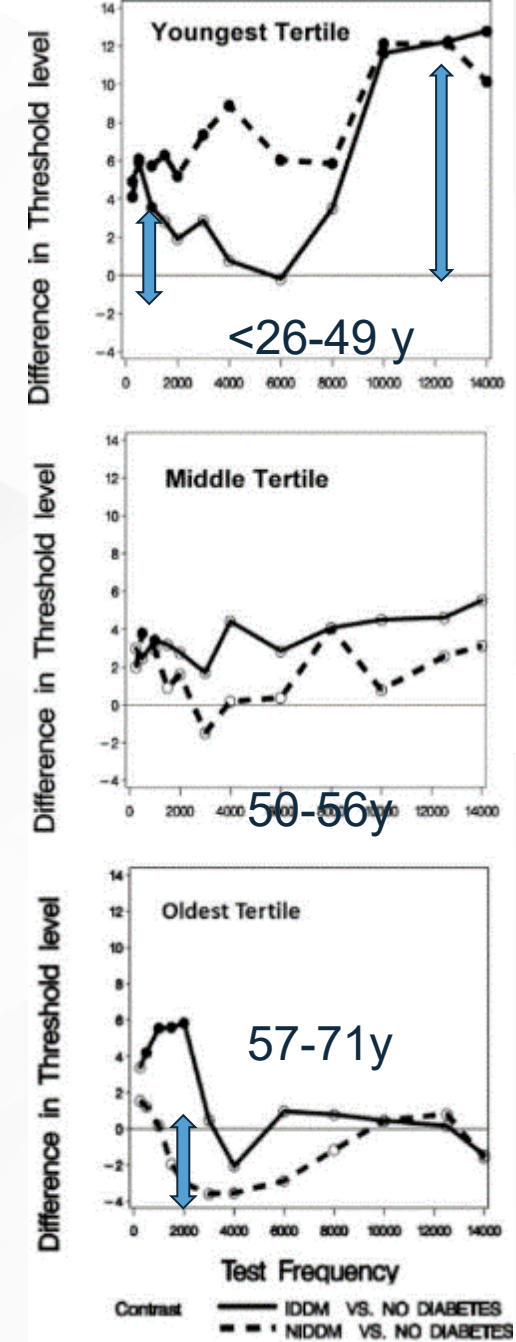




Fukushima et al. (2006)



Austin et al. (2009)



# Recap: Summary of Literature

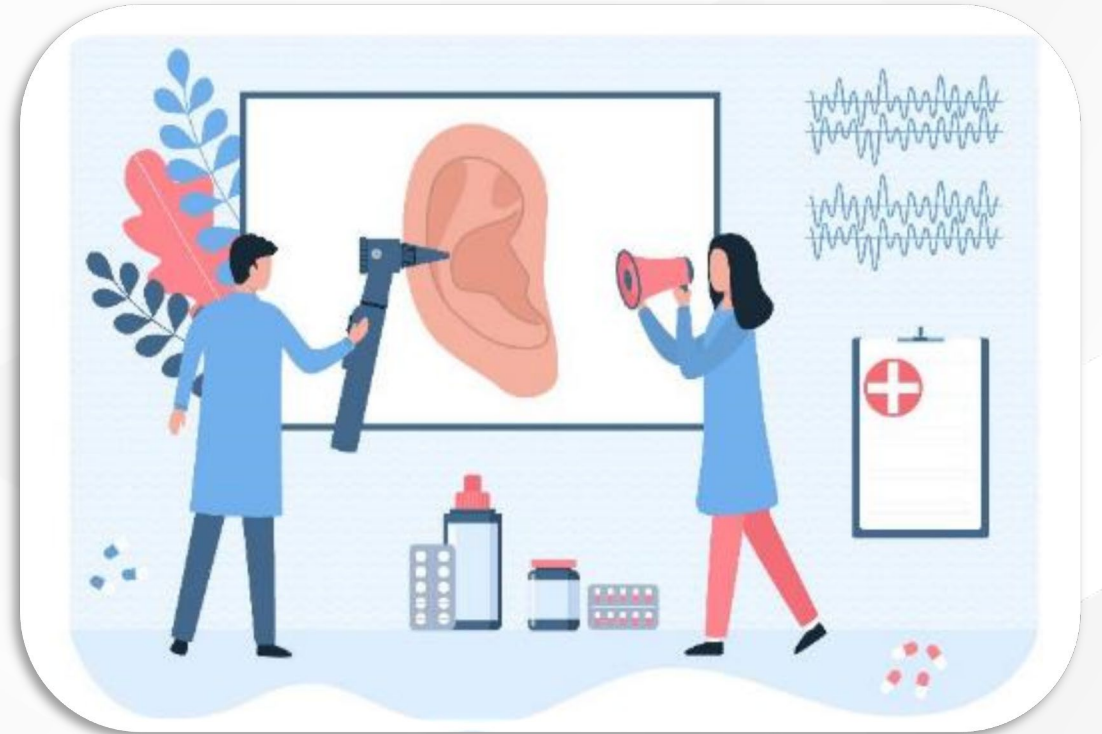
- Overall, the evidence indicates that diabetes is a significant determinant of hearing dysfunction
- Human and animal studies suggest both cochlear and neural deficits related to microangiopathy, oxidative stress, and glutamate excitotoxicity
- Diabetes can create earlier onset of hearing loss and increase risk for other hearing loss-related factors (e.g., noise)



# Screening and Diagnosis

# Diagnosis

- **Sensorineural Hearing Loss (SNHL)**
  - Damage to inner ear sensory and neural receptors
  - More common type of hearing loss expected
- **Conductive Hearing Loss (CHL)**
  - Limited data on CHL and diabetes
  - General increase for infections warrants exclusion
- **Mixed Hearing Loss**
  - Combination of SNHL and CHL
- **Tinnitus and Sound Sensitivity**
  - Commonly related to hearing loss and associated with diabetes even without hearing loss



# When to Screen/Considerations

- Upon diagnosis of diabetes, a baseline hearing evaluation is recommended (be aware of psychological status)
- Hearing loss can manifest early

## **High risk considerations:**

- Reduced hearing (particularly in noise)
- Tinnitus perception
- History of high noise exposure
- History of ototoxic drug use
  - e.g., aminoglycosides, platinum-based chemotherapy, furosemide (intravenous in particular)
- Sensitivity to sound
- Ear pain or drainage (Otolaryngology)
- Sudden hearing loss (Otolaryngology)
- Dizziness complaints

# Screening Recommendations

**Table 1.** Audiologic Screening Questions for Diabetes.<sup>a</sup>

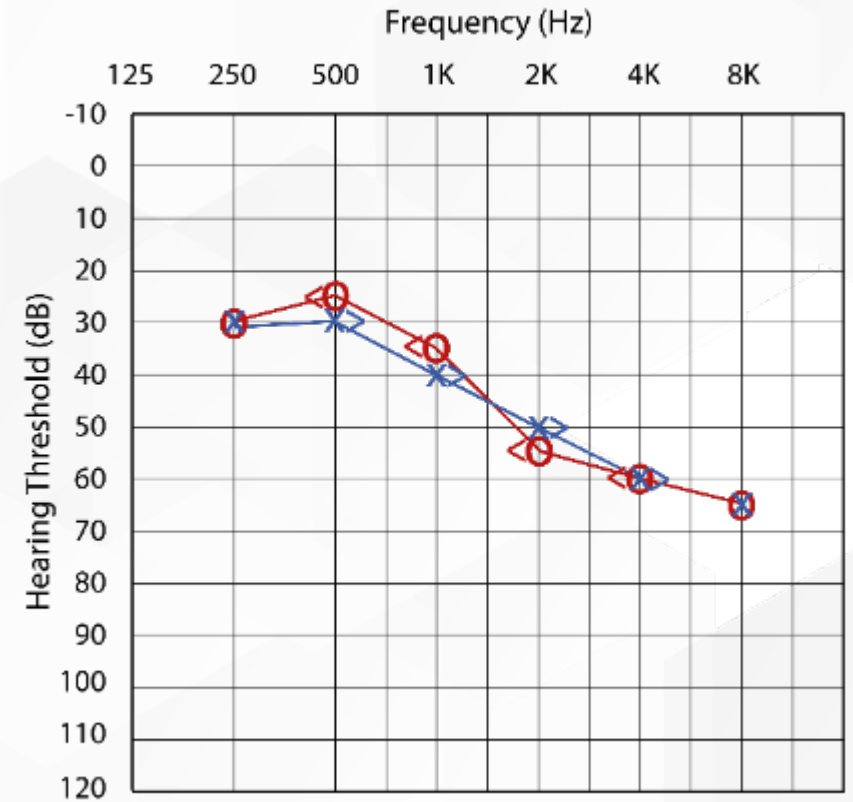
1. Do you or your family perceive any change in your hearing?
2. Do you have hearing difficulty in quiet or noise?
3. Have you had your hearing tested in the past 2 years?
4. Do you know how diabetes can affect your hearing?
5. Do you know what to do if you perceive a change in hearing?
6. Do you know how to reduce your risk for hearing loss?

<sup>a</sup>If the patient answers “yes” to question 1 or 2 or “no” to questions 3 through 6, it is recommended they be referred for a diagnostic audiological evaluation.



# Diagnostic Recommendations

- Comprehensive audiological evaluation (at minimum)
  - Air Conduction
  - Bone Conduction
  - Speech Audiometry
- At least every 2 years, annual or greater if high risk factors indicated or patient reports change in hearing status





# Diagnostic Considerations

- **Extended high frequencies**

- >8000 Hz may show early changes, consider testing based on patient subjective complaints if hearing below 8000 Hz within normal range

- **Otoacoustic emissions**

- Byproduct of active mechanism of cochlea
- Can show subtle changes due to alterations in cochlear active process prior to changes in thresholds

- **Auditory evoked potentials**

- Can show effects of sensitivity to neuropathology and glutamate excitotoxicity

- **Tinnitus evaluation**

- **Central auditory processing**

# Recap

- The most common type of hearing loss related to diabetes is sensorineural.
- Asking simple questions about hearing status, presence of tinnitus, or ability to understand speech in noise can serve as a useful screening.
- A comprehensive audiological evaluation can help set a baseline for hearing and allow for early counseling on prevention.
- Testing every 2 years is recommended, more often depending on risk factors (e.g., ototoxic drug use).
- Be familiar with high risk factors (such as history of high noise exposure)

# Prevention and Treatment

# Prevention 3 x 3

	Primary	Secondary	Tertiary
	Prevent hearing loss	Early identification and intervention	Management and rehabilitation
Individual	Patient counseling (e.g., hearing conservation)	Individual diagnostic evaluation and counseling	Amplification, cochlear implant, auditory rehab
Community	Media/public health campaign	Health fair, screening, referral	Living with hearing loss classes (group AR)
System	Improved access to preventative care	Improved access to hearing diagnostics	Improved access to hearing health care

# Prevention: Direct

## Patient Counseling

- Persons with diabetes have greater susceptibility to acquired hearing loss
  - Noise: Use hearing protection
  - Ototoxic medication: Careful monitoring
  - Earlier onset related to age: Difficulty understanding speech in background noise, tinnitus

## Evaluation is Important

- Baseline
  - Threshold assessment, speech in noise, otoacoustic emissions
  - Follow-up at least every 2 years, earlier if **at risk**
- Further counseling

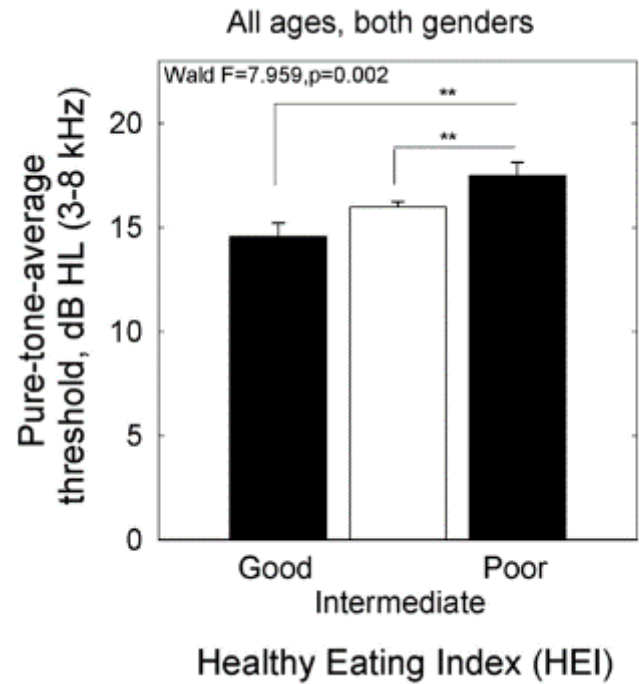
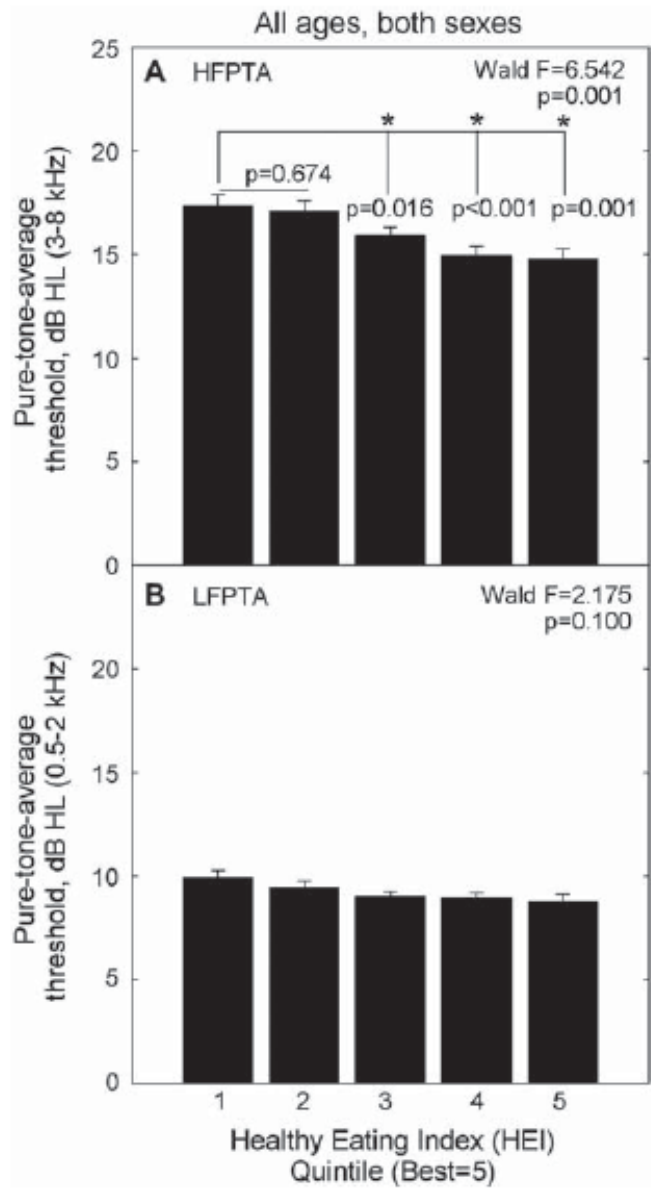


# Prevention: Indirect

## Patient Counseling

- Poorly managed diabetes and presence of co-morbidities is associated with greater incidence of cochlear and auditory neural pathology
  - Insulin control
- Level of physical activity and quality of diet are associated with risk of diabetes complications
- including hearing loss





**Figure 1.** A. High frequency (HFPTA) and B. low frequency pure-tone average (LFPTA) and healthy eating index quintiles.

## Manage your ABCs



Ask your health care team to help you set and reach goals to manage your blood sugar, blood pressure, and cholesterol and stop smoking—also known as the ABCs of diabetes.

- **A1C (a measure of your average blood sugar over 3 months):** The goal set for many people is less than 7% for this blood test, but your doctor might set a different goal for you.
- **Blood pressure:** High blood pressure causes heart disease. The goal is less than 140/90 mmHg for most people but check with your doctor to see what your goal should be.

- **Cholesterol:** LDL or “bad” cholesterol builds up and clogs your blood vessels. HDL or “good” cholesterol helps remove the “bad” cholesterol from your blood vessels. Ask your doctor what your cholesterol numbers should be.
- **Smoking:** If you smoke or use other tobacco products, take steps to quit. Call 1-800-QUIT-NOW (1-800-784-8669) for support.

**Teach your family about your diabetes and the ABCs so they can help you.**

# Aural Rehabilitation and Communication

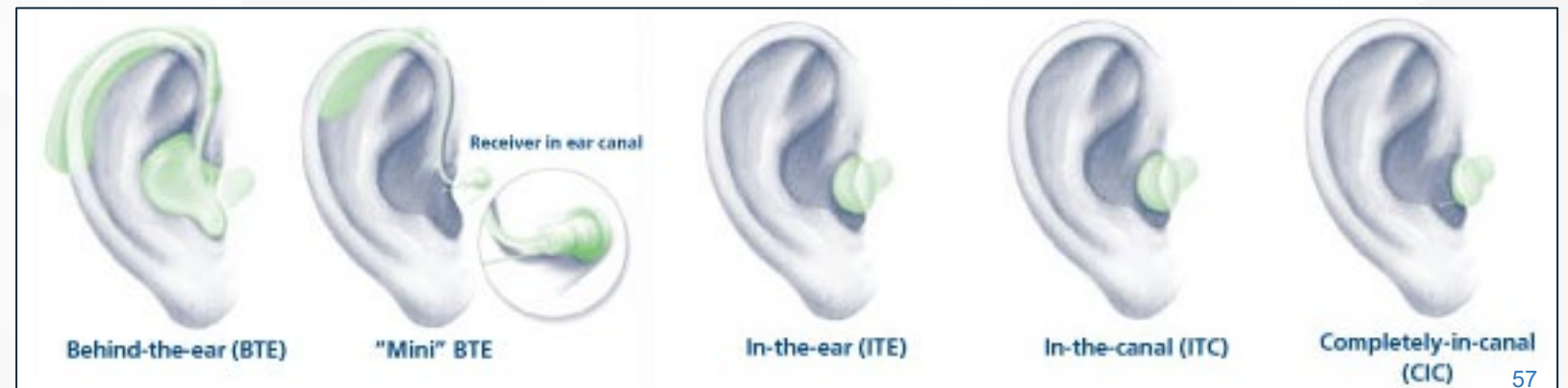
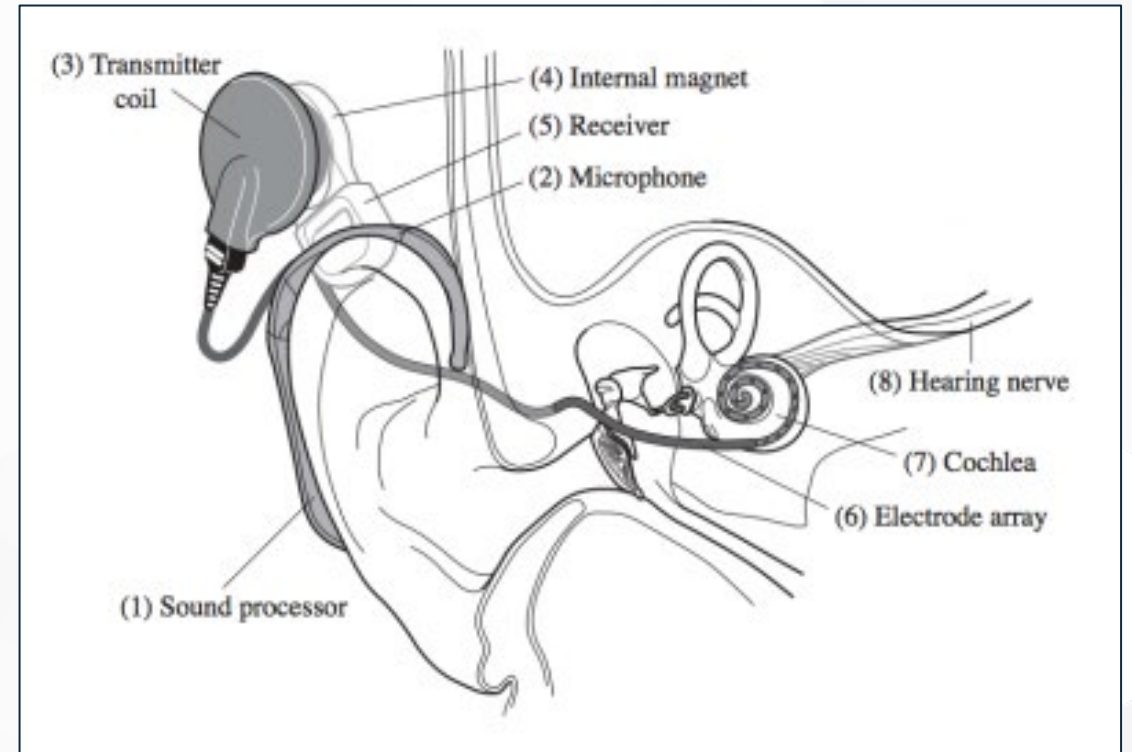
- Communication strategies (patient-provider interaction)
- Assistance listening devices (pocket talker and smart devices during clinical encounters)
- Speech reading

Attention	Say people's names before beginning conversation to get their attention.
Face the speaker	Though you may not get visual clues from the patient's mouth, facing the person will improve the signal-to-noise ratio.
Use clear speech	Talk slightly slower and louder, articulate speech sounds, and take pauses. This is not exaggerated speech or shouting.
Reduce noise	Reduce competing noise; move to a quieter space or turn off unnecessary noise sources.
Use repair strategies	If you do not understand, ask for clarification by repeating the information heard, and ask for repetition or rephrasing of the communication.
Use technology	Use amplifying devices if available (eg, hearing aids). Consider smartphone-based apps (eg EarMachine app).
Have patience	Try not to get frustrated or blame the other person.



# Management

- Hearing Aids
  - Non-surgical
  - Slight to profound hearing loss
- Cochlear Implants
  - Severe to profound hearing loss





# Recap: Diabetes and Hearing

## Prevention 1,2,3 is

- Auditory and diabetes management
- Hearing conservation, lifestyle (diet + physical activity), ABCs
- Improved access to preventive care

## Early Identification



- Thresholds including extended high frequencies
- Otoacoustic emissions; auditory brainstem response
- Improved access to hearing diagnostics

## Management

- Auditory rehabilitation
- Amplification/cochlear implant
- Improved access to health care

# Any questions? Email: [cspankovich@umc.edu](mailto:cspankovich@umc.edu)

## References

- Fukushima et al. (2006). Effects of type 2 diabetes on cochlear structures in humans, *Arch Otolaryngol Head Neck Surg*, 132 (9), 934-938.
- Austin et al. (2009). Diabetes-related hearing changes, *Laryngoscope* 119 (9) 1788-1796.
- Spankovich & Yerraguntla (2019). Evaluation and management of patients with diabetes and hearing loss, *Seminars Hear*, 40, 292-299.
- Spankovich & Le Prell (2013). Healthy diets, healthy hearing: National Health and Nutrition Examination Survey, 1999-2002, 52 (6), 369-376.
- Piker et al. (2020). What you need to know about the hearing and vestibular consequences of diabetes, *ADCES in Practice*, September Issue, 20-27.



# DIABETES AND BALANCE

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JAMES MADISON UNIVERSITY



# Risk of Falls

- Each year 3 million older people are treated in emergency departments for fall injuries
- 1 out of 5 falls causes serious injury
  - broken bones, head injury
  - 95% of hip fractures caused by falling
- 2015: total medical costs for falls > \$50 billion
- Many who fall, even if not injured, become afraid of falling



# Risk Factors for Falls

## **EXTRINSIC** | Factors

- Lack of stair handrails
- Poor stair design
- Lack of bathroom grab bars
- Dim lighting or glare
- Obstacles & tripping hazards
- Slippery or uneven surfaces
- Psychoactive medications
- Improper use of assistive device

## **INTRINSIC** | Factors

- Advanced age
- Previous falls
- Muscle weakness
- Gait & balance problems
- Poor vision
- Postural hypotension
- Chronic conditions including arthritis, stroke, incontinence, diabetes, Parkinson's, dementia
- Fear of falling



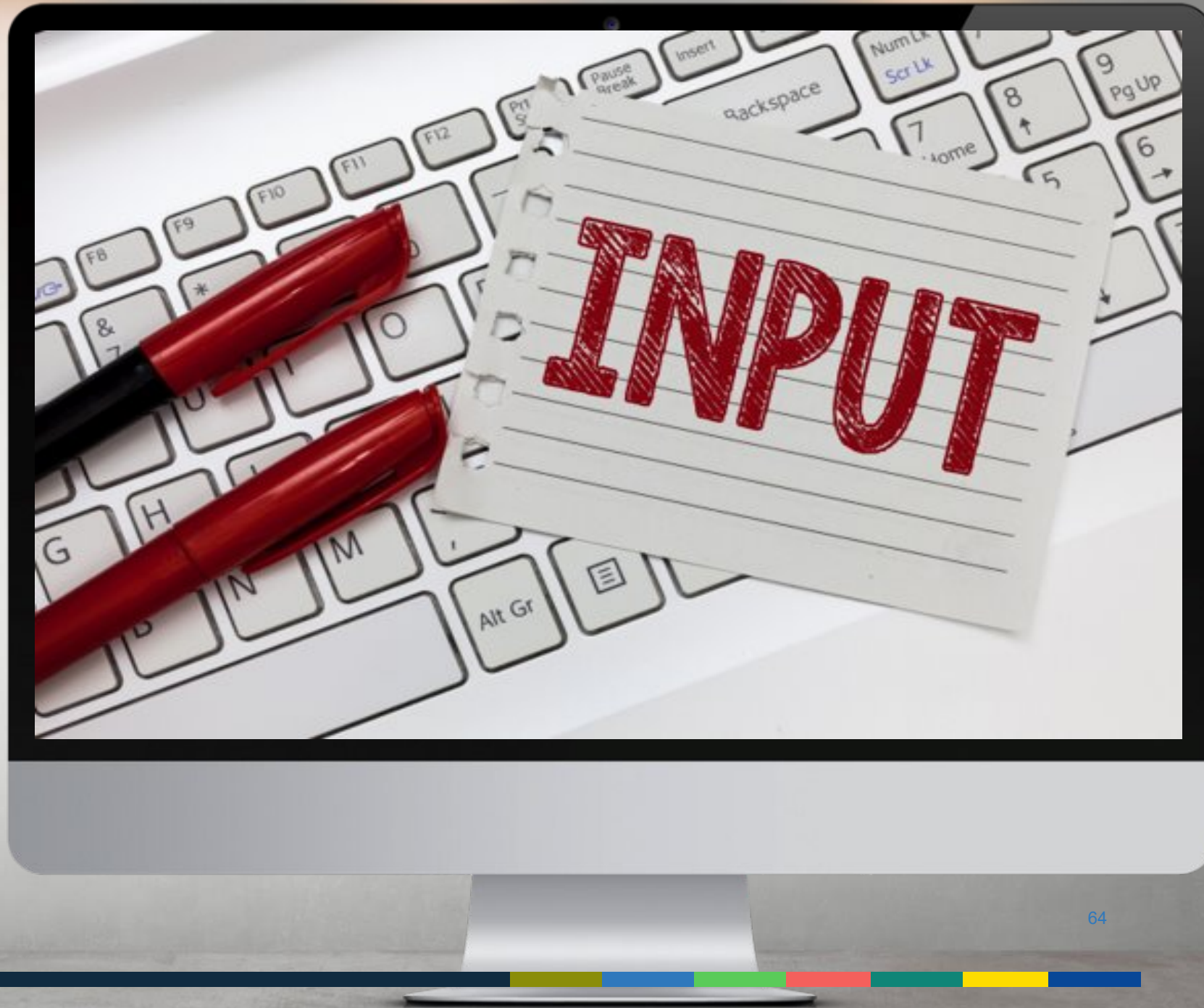
# Risk Factors for Falls (cont.)

Effective clinical and community interventions exist for the following fall risk factors:

- Vestibular disorder/poor balance
- Vitamin D insufficiency
- Medications linked to falls
- Postural hypotension
- Vision impairment
- Foot or ankle disorder
- Home hazards



## Poll Question #4



# Risk of Falls and Vestibular Impairments

- Abnormal gait, dizziness<sup>1</sup>
- Independent risk factor for falling
  - Increase odds of falling over 12-fold<sup>2</sup>

J Am Acad Audiol 19:799–807 (2008)

## Significant Vestibular System Impairment Is Common in a Cohort of Elderly Patients Referred for Assessment of Falls Risk

DOI: 10.3766/jaaa.19.10.7

Gary P. Jacobson\*  
Devin L. McCaslin\*  
Sarah L. Grantham\*  
Erin G. Piker\*

**73% vestibular impairment**

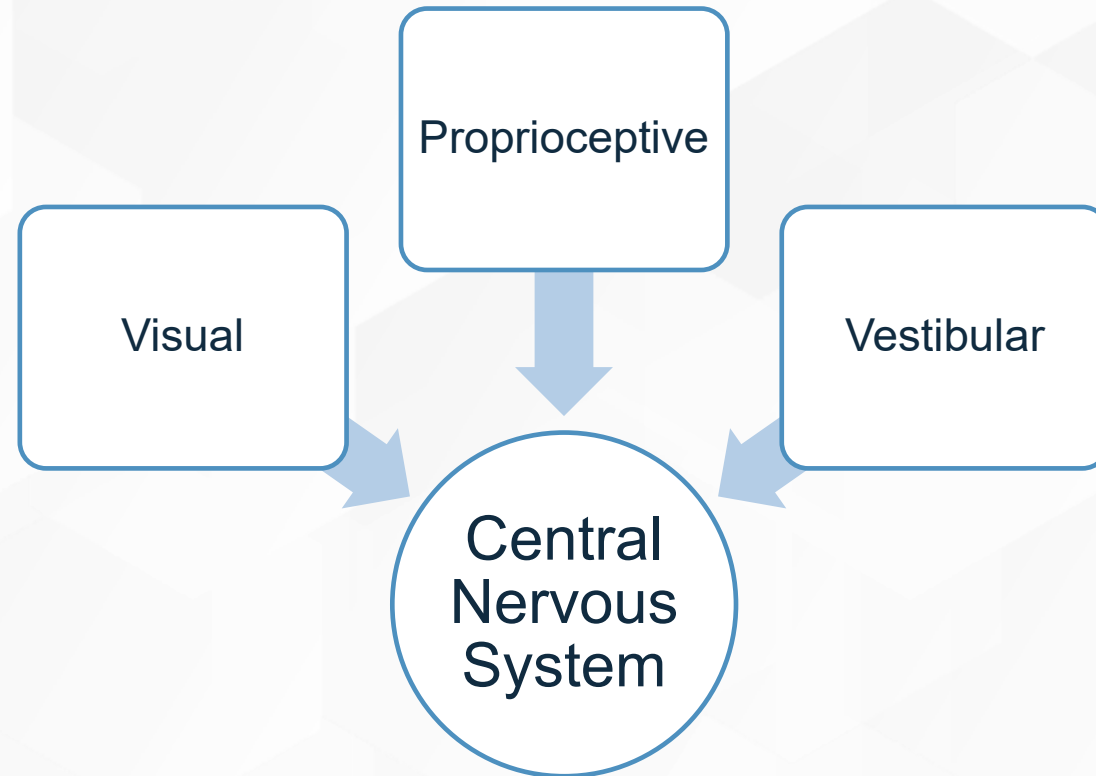
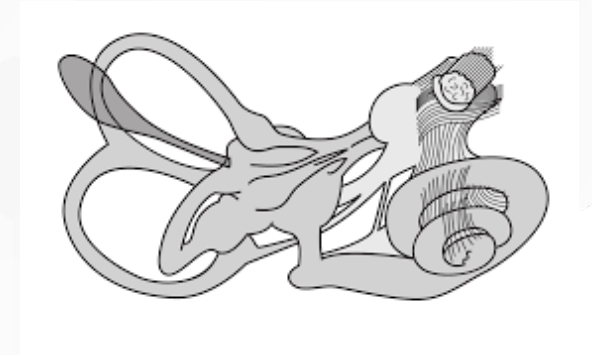
<sup>1</sup>Anson *et al.* (2019); <sup>2</sup>Agrawal *et al.* (2020)

# Risk of Falls and Diabetes

- Independent risk factor for falling
- Annual incidence of falls 39%<sup>3</sup>
- **Can affect vision, proprioception, and vestibular**



<sup>3</sup>Yang et al. (2016)



# Diabetes and Vestibular Pathology

- National Health and Nutrition Examination Survey (NHANES)<sup>4</sup>
- N = 1,136; 17% had diabetes
- Peripheral neuropathy
  - Mild 19%
  - Severe 7.1%
- Retinopathy
  - Mild 54%
  - Severe 22%
- **Vestibular dysfunction 54%**

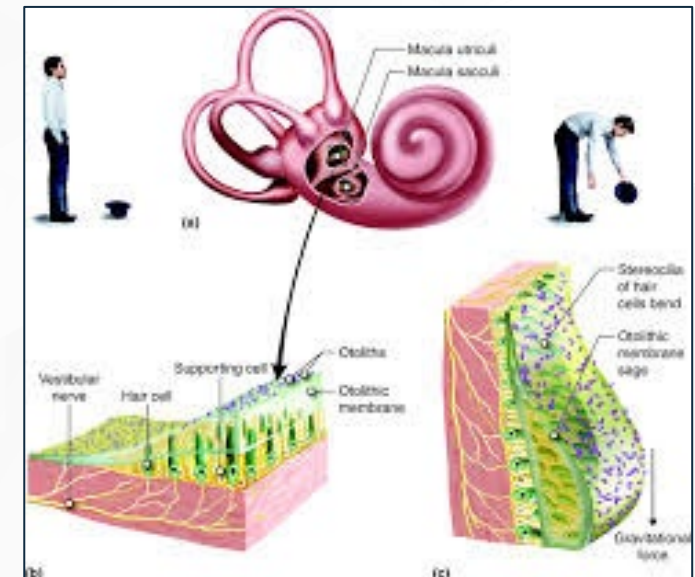
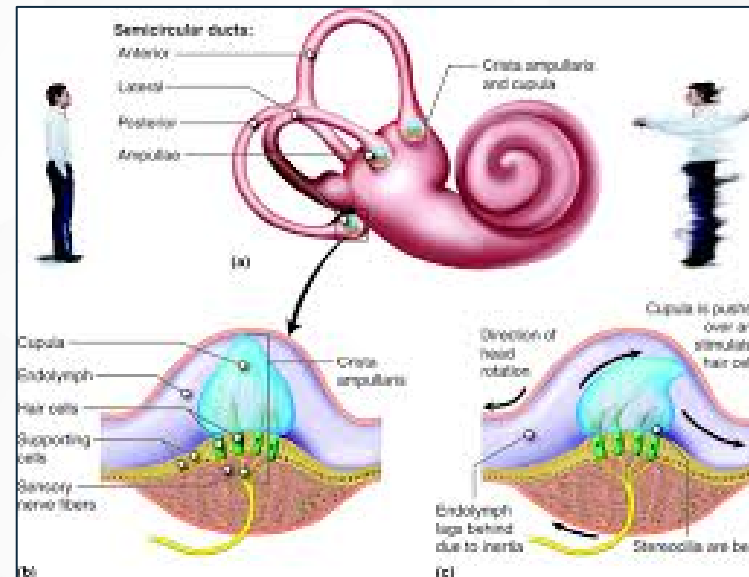
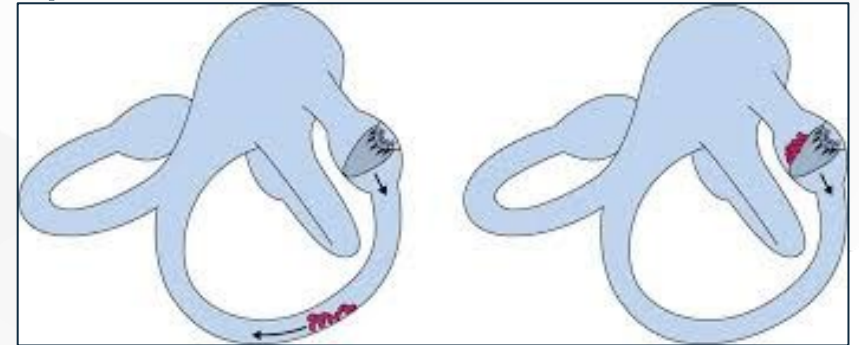
<sup>4</sup>Agrawal et al. (2010)

The screenshot shows the NHANES website interface. At the top, there is a search bar and the CDC logo. The main header reads 'National Center for Health Statistics'. The left sidebar contains a navigation menu with items like 'About NHANES', 'What's New', 'Questionnaires, Datasets, and Related Documentation', 'Survey Participants', 'Biospecimen Program', 'New Content and Proposal Guidelines', 'Publications and Products', 'Tutorials', 'Listserv', and 'Contact Us'. The main content area is titled 'National Health and Nutrition Examination Survey' and is divided into four columns: 'Survey Participants' (with a photo of a group of people), 'Survey Data and Documentation' (with a photo of a server rack), 'Publications and Products' (with a photo of a person at a computer), and 'Data Analysis Tutorials' (with a photo of a person at a computer). Below these columns is a section for 'NHANES Data Visualizations' featuring a bar chart and the text 'Explore new interactive'. To the right of this section is a 'What's New' section with a list of recent publications, including 'Osteoporosis or Low Bone Mass in Older Adults: United States, 2017-2018' and 'Dietary Supplement Use Among Adults: United States'.



# Diabetes and Vestibular Pathology (cont.)

- SCC dysfunction<sup>5-7</sup>
- Otolith dysfunction<sup>8-10</sup>
- BPPV<sup>11-14</sup>





# Diabetes, Vestibular Pathology, and Risk of Falls

- Patients with diabetes 70% more likely to have vestibular loss and/or balance problem
- Vestibular loss in patients with diabetes increases odds of falling 2-fold (Odds Ratio 2.3)
- Diabetes risk associated with BPPV

Longer duration of diabetes, greater serum hemoglobin A1C levels

# Vestibular/Balance Screening Strategies Overview

## Functional balance:

- Romberg on foam
- Timed Up and Go



# Vestibular/Balance Screening Strategies: Timed Up and Go

**ASSESSMENT**

## Timed Up & Go (TUG)

[https://www.cdc.gov/steady/pdf/TUG\\_test-print.pdf](https://www.cdc.gov/steady/pdf/TUG_test-print.pdf)

[https://www.cdc.gov/steady/pdf/TUG\\_test-print.pdf](https://www.cdc.gov/steady/pdf/TUG_test-print.pdf)

# Vestibular/Balance Screening Strategies

## Self-report

- “Have you fallen”, “do you have a fear of falling”
- Dizziness Symptom Profile – can pick up cases of BPPV
- Counseling and information

### The Dizziness Symptom Profile

The following pages contain statements with which you can agree or disagree. To what extent do you personally agree or disagree with these statements in regards to your dizziness? Use the following scale: 0 = Strongly disagree, 1 = Disagree, 2 = Not sure, 3 = Agree, 4 = Strongly Agree

		Strongly Disagree		Not Sure		Strongly Agree
1	My dizziness is intense but only lasts for seconds to minutes.	0	1	2	3	4
2	I have had a single severe spell of spinning dizziness that lasted days or weeks.	0	1	2	3	4
3	I have spells where I get dizzy and also have irregular heartbeats (palpitations).	0	1	2	3	4

[https://www.vumc.org/balance-lab/sites/vumc.org.balance-lab/files/public\\_files/Dizziness%20Symptom%20Profile%20-%20Vanderbilt%20UMC.pdf](https://www.vumc.org/balance-lab/sites/vumc.org.balance-lab/files/public_files/Dizziness%20Symptom%20Profile%20-%20Vanderbilt%20UMC.pdf)

[https://www.vumc.org/balance-lab/sites/vumc.org.balance-lab/files/public\\_files/Dizziness%20Symptom%20Profile%20-%20Vanderbilt%20UMC.pdf](https://www.vumc.org/balance-lab/sites/vumc.org.balance-lab/files/public_files/Dizziness%20Symptom%20Profile%20-%20Vanderbilt%20UMC.pdf)

# Key Takeaways - Vestibular

- Risk of falls
  - Vestibular impairment = risk of falls
  - Diabetes = risk of falls
  - **Vestibular and Diabetes = GREATER risk of falls**
- Effects of diabetes on vestibular system
  - Epidemiologic evidence of strong association
  - Clinical evidence emerging
- Screening
  - Self-report
  - Functional
  - Counseling

# References and Resources

## References

- <sup>1</sup>Anson, E., Pineault, K., Bair, W., Studenski, S., Agrawal, Y. (2019). Reduced vestibular function is associated with longer, slower steps in healthy adults during normal speed walking. *Gait Posture*, 68:340 – 345.
- <sup>2</sup>Agrawal, Y., Merfeld, D.M., Horak, F.B. et al. (2020). Aging, vestibular function, and balance: proceedings of a National Institute on Aging/National Institute on Deafness and Other Communication Disorders Workshop. *J Gerontol A Biol Sci Med Sci*. 13;75(12):2471 – 2480.
- <sup>3</sup>Yu Yang, Xinhua Hu, Qiang Zhang, Rui Zou, Diabetes mellitus and risk of falls in older adults: a systematic review and meta-analysis, *Age and Ageing*, Volume 45, Issue 6, 2 November 2016, Pages 761–767
- <sup>4</sup>Agrawal, Y., Carey, J.P., Della-Santina, C.C., et al. (2010). Diabetes, vestibular dysfunction, and falls: Analyses from the National Health and Nutrition Examination Survey. *Otol and Neuro*, 31:1445-1450
- <sup>5</sup>Ward, BK, Wenzel A, Kalyani RR. et al.(2015). Characterization of vestibulopathy in individuals with type II diabetes mellitus. *Oto Head Neck Surg*, 153(1):112-118.
- <sup>6</sup>Klagenberg, KF, Zeigelboim, BS, et al. (2007). Vestibulocochlear manifestations in patients with type I diabetes mellitus. *Braz J Oto*, 73(3):353-358.
- <sup>7</sup>Rigon, R., Rossi AG, Coser PL. (2007). Otoneurologic findings in type I diabetes mellitus patients. *Braz J Oto*. 73(1):100 – 105.
- <sup>8</sup> Jáuregui-Renaud, K., Aranda-Moreno, C., & Herrera-Rangel, A. (2017). Utricular hypofunction in patients with type 2 diabetes mellitus. Ipofunzione utricolare in pazienti con diabete mellito di tipo 2. *Acta otorhinolaryngologica Italica : organo ufficiale della Societa italiana di otorinolaringologia e chirurgia cervico-facciale*, 37(5), 430–435. <https://doi.org/10.14639/0392-100X-1243>
- <sup>9</sup>Konukseven, O., Polat SB, Karahan, S. et al. (2015). Electrophysiologic vestibular evaluation in type 2 diabetic and prediabetic patients: air conduction ocular and cervical vestibular evoked potentials. *Int J Audiol*, 54(8):536 – 543.

<sup>10</sup> Kamali , H.B., Fatahi, F., Esfahani, N. et al. (2013). Effects of diabetes mellitus type I with or without neuropathy on vestibular evoked myogenic potentials. *Acta Med Iran*, 51(2):107 – 112

<sup>11</sup>Cohen, H.S., Kimball, K.T., Steward, M.G. (2004). Benign paroxysmal positional vertigo and comorbid conditions. *ORL J Otorhinolaryngol Relat Spec*, 66(1):11 – 15.

<sup>12</sup>Yoda, S., Cureoglu, S., Yildirim-Baylan, M. et al. (2011). Association between Type I diabetes mellitus and deposits in the semicircular canals. *Otolaryngology Head and Neck Surgery*.

<sup>13</sup>D’Silva, L.J., Staecker, H., Lin, J., Stykes, K.J. et al. (2016). Retrospective data suggests that the higher prevalence of benign paroxysmal positional vertigo in individuals with type 2 diabetes is mediated by hypertension. *J Vestib Res*, 25(5-6):233-239

<sup>14</sup>Webster G, Sens PM, Salmito MC, et al. (2015). Hyperinsulinemia and hyperglycemia: risk factors for recurrence of benign paroxysmal positional vertigo. *Braz J Oto*, 81(4):347 – 351.

## Resources

- Risk of falls facts: <https://www.cdc.gov/falls/facts.html>
- Risk factors for falls: <https://www.cdc.gov/steady/pdf/STEADI-FactSheet-RiskFactors-508.pdf>
- Timed Up and Go: [https://www.cdc.gov/steady/pdf/TUG\\_test-print.pdf](https://www.cdc.gov/steady/pdf/TUG_test-print.pdf)
- Dizziness Symptom Profile: [https://www.vumc.org/balance-lab/sites/vumc.org.balance-lab/files/public\\_files/Dizziness%20Symptom%20Profile%20-%20Vanderbilt%20UMC.pdf](https://www.vumc.org/balance-lab/sites/vumc.org.balance-lab/files/public_files/Dizziness%20Symptom%20Profile%20-%20Vanderbilt%20UMC.pdf)



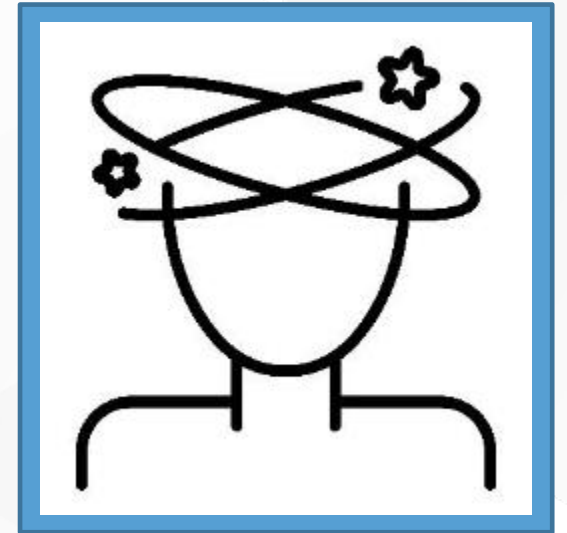
# VESTIBULAR THERAPY

ANJULYN M. BALLARD, PHD, ORISE FELLOW  
CENTERS FOR DISEASE CONTROL AND PREVENTION  
DIVISION OF DIABETES TRANSLATION



# Vestibular Therapy Overview

- **Goal** - to alleviate symptoms
  - ~ Dizziness
  - ~ Imbalance
  - ~ Vertigo
  - ~ Visual Disturbance
- **Vestibular system damage** - damage is normally permanent, restoration of vestibular function tends to be small
- **Compensation from other senses** - vision/sight, sensory from lower limbs
  - Needed to reduce symptoms



# Prescription and Administration of Activities

## Facilitated by an Occupational Therapist or Physical Therapist

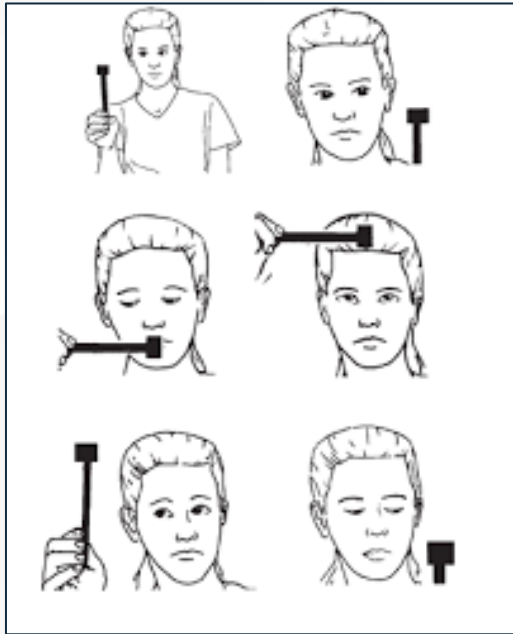
- Trained to identify the problem(s) related to the vestibular disorder
- Critical for prescribing exercises that target individual symptoms



# Prescribed Exercise Methods

## Habituation

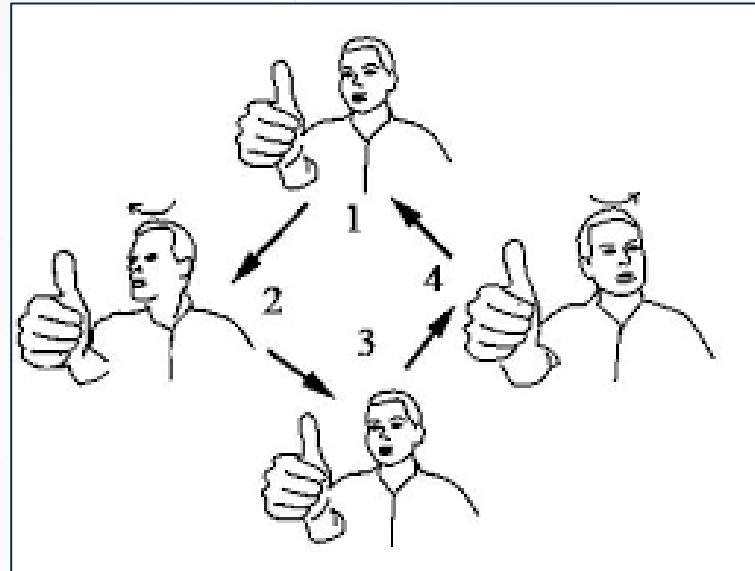
Used to reduce dizziness through repeated exposure to visual stimulation



**Treated Symptom:**  
Dizziness

## Gaze Stabilization

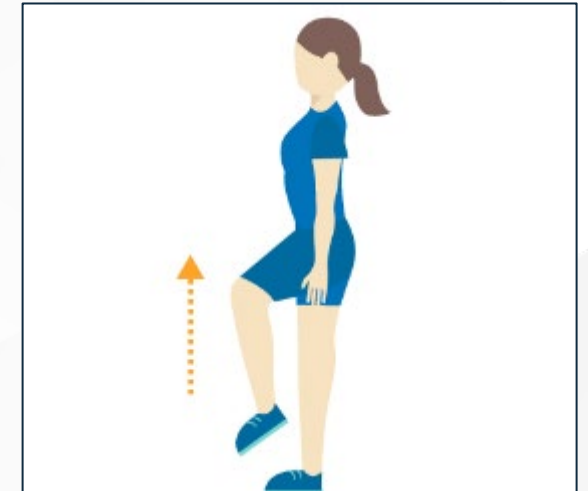
Used to improve control of eye movement to make vision clear during head movement



**Treated Symptoms:**  
Things appear to bounce or jump around with head movement

## Balance Training

Used to improve steadiness so that daily activities for self-care, work, and leisure can be performed successfully



**Treated Symptoms:**  
Difficulty walking on uneven surfaces or walking in the dark

# Tai Chi

- Used by the general public
- Recommended by therapists
  - Balance training
  - *Does not directly target symptoms of dizziness or unstable vision*
- Best to have someone consult with a therapist or medical professional
- Uninsured/under-insured?
  - Identify local pro bono services
  - Locate other community resources





# A Few Things to Remember...

Vestibular therapy is used to treat symptoms that result from inner ear damage

- Administered by Occupational Therapists and Physical Therapists
- Best to seek therapy from either professional
  - Trained to identify the symptoms and prescribe specific therapeutic activities

## Tai Chi

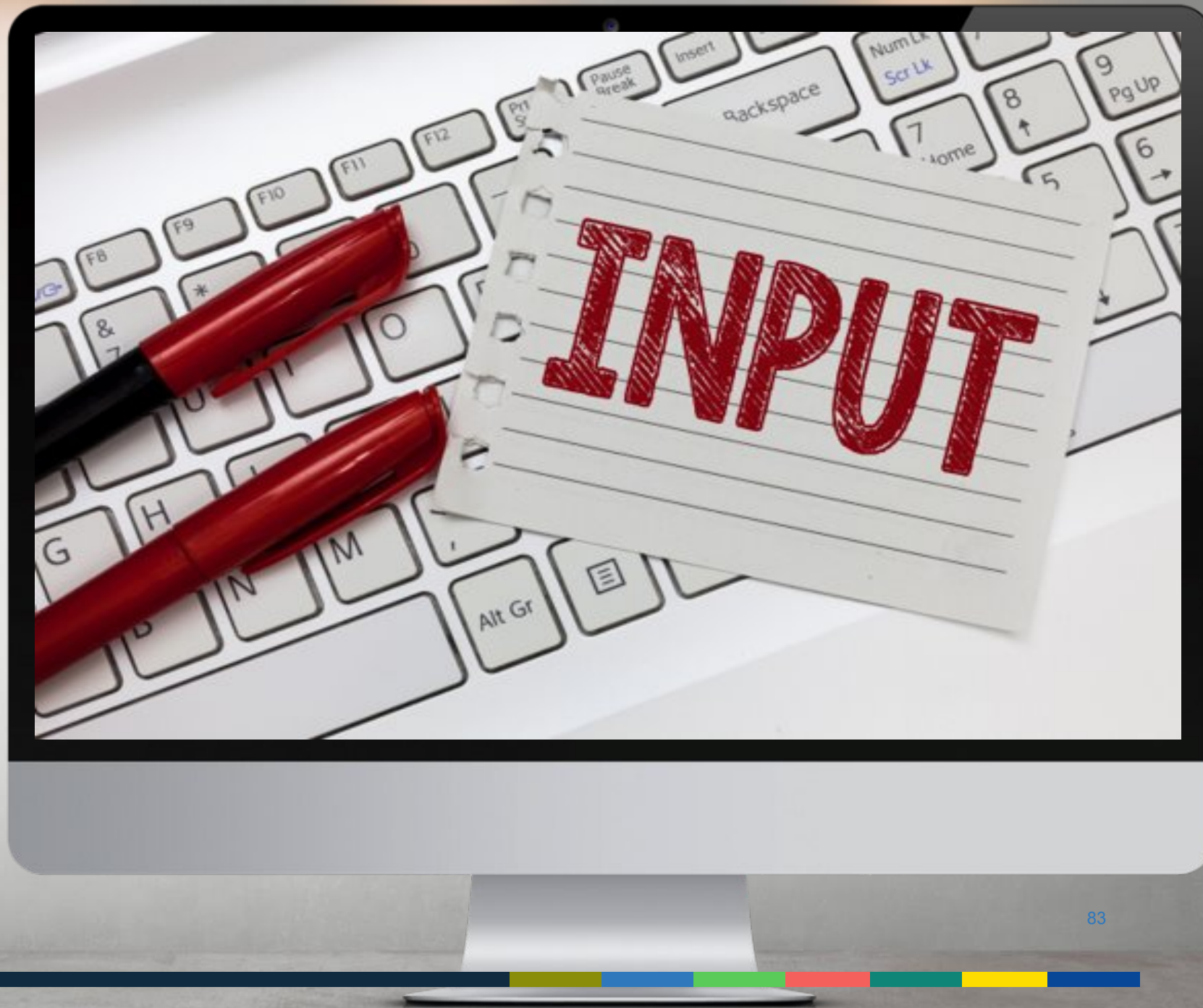
- Exercise activity that's generally been used to help restore balance
- Does not directly treat dizziness, vertigo, and visual disturbance
  - It *may* help alleviate these symptoms in some capacity

# In Summary...

- Impacts of diabetes on the ear are often not addressed
- Refer to an audiologist for problems with hearing and balance
- Prevention is key because hearing and vestibular loss are permanent:
  - Manage the ABCs of diabetes
  - Early identification of hearing and balance problems
- Audiologists can help manage hearing loss by fitting for hearing aids
- Vestibular impairment and diabetes both create an increased risk of falls
  - Screenings for vestibular impairment are short, simple, and can help identify someone who may need further evaluation
- Vestibular therapy by trained professionals is used to treat symptoms from inner ear damage
- Tai Chi is an example of an activity that is generally used to help restore balance

## Use the Chat Box!

What resources (handouts, webinars, etc.) would be helpful to you so that you feel more comfortable talking about this topic?




# Take Charge of Your Diabetes: Healthy Ears

Share CDC's new resource for people with diabetes!

<https://www.cdc.gov/diabetes/library/factsheets/healthy-ears.html>


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.

Regular exams help your audiologist find and treat ear problems early to protect your hearing and balance. Find a provider in your area at the [American Academy of Audiology website](#).

 Centers for Disease Control and Prevention  
National Center for Chronic Disease Prevention and Health Promotion

# QUESTION AND ANSWER

Please type your questions into the Q&A box



# Thank You

Send questions after the webinar to:

[DDT\\_DiabetesWebinar@cdc.gov](mailto:DDT_DiabetesWebinar@cdc.gov)

**Centers for Disease Control and Prevention**  
**National Center for Chronic Disease Prevention and Health Promotion**

Division of Diabetes Translation

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

