

# **Diabetes and Audiological Monitoring of Ototoxic/Vestibulotoxic Medications**

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# **Webinar Outline – Part II**

**Types of HL with Diabetes**

**Pathophysiological  
Explanation of Diabetes-related  
Hearing Loss**

# **Webinar Outline – Part II**

**Incidence of HL with Diabetes**

**Duration of Diabetes and HL**

# **Webinar Outline – Part II**

**Effects of Age & Gender**

**Symptoms of HL**

# Webinar Outline – Part II

**Tinnitus**

**Degrees of HL**

# **Webinar Outline – Part II**

**Co-Morbidities**

**Drugs and Insulins  
for  
Diabetes Management**

# **Webinar Outline – Part II**

**Audiological Monitoring**

**Vestibular Monitoring**

# **Webinar Outline – Part II**

## **Communication Strategies for Persons with Hearing Loss**



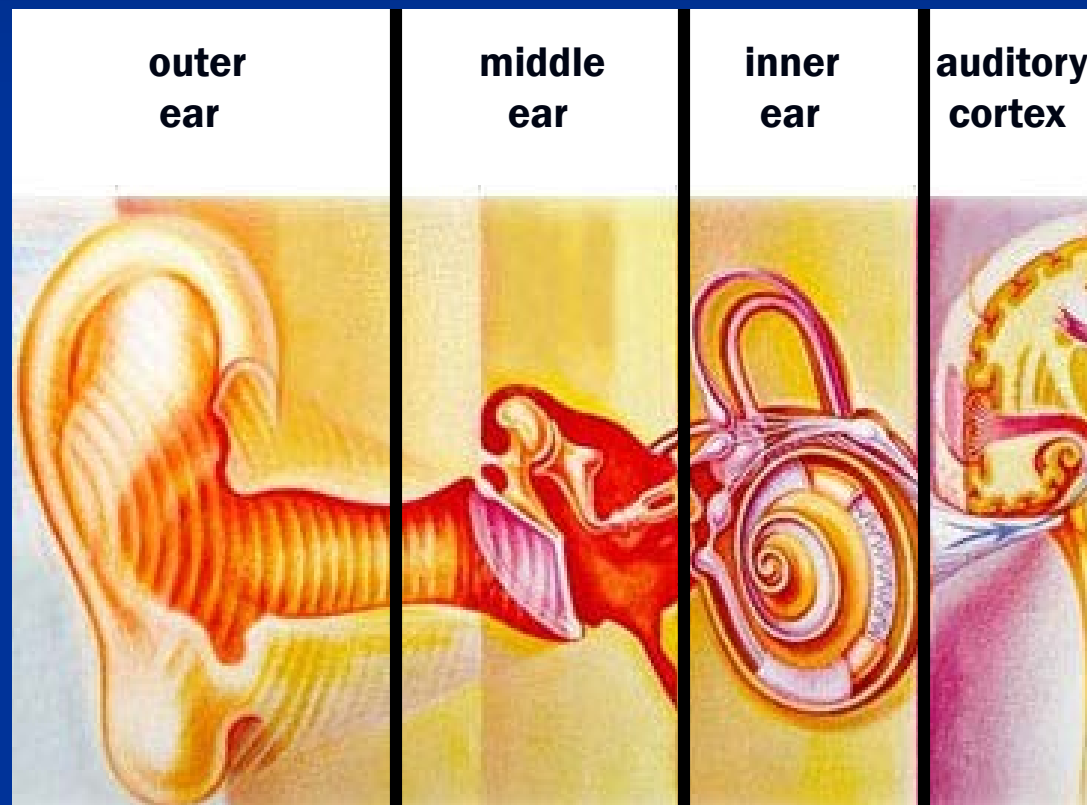


**Incidence**

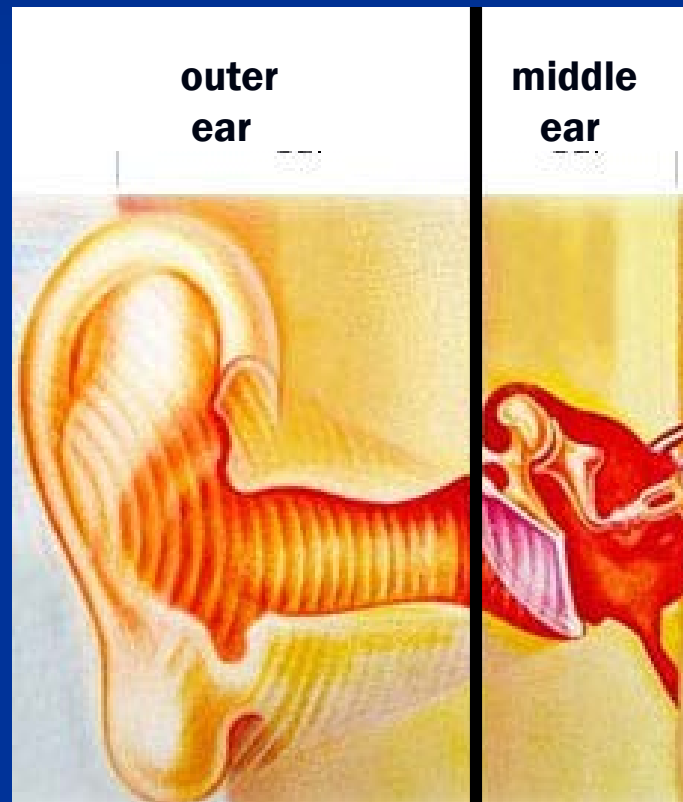
**Diabetes**  
~30 million

**HL**  
~35 million

# Diabetes and the Auditory System



# Diabetes and the Auditory System



# Types of Hearing Loss with Diabetes

## Conductive Hearing Loss

15 - 16% CHL

(Genevey Hlayisi, V. et al 2018, Thimmasettaiah,  
et al, 2012)

# Types of Hearing Loss



# Types of Hearing Loss with Diabetes

## Sensorineural Hearing Loss

**More common with diabetes pts  
than with non-diabetes patients**

(Kakarlapudi, V., et al., 2003; Genevey Hlayisi, V.  
et al, 2018)

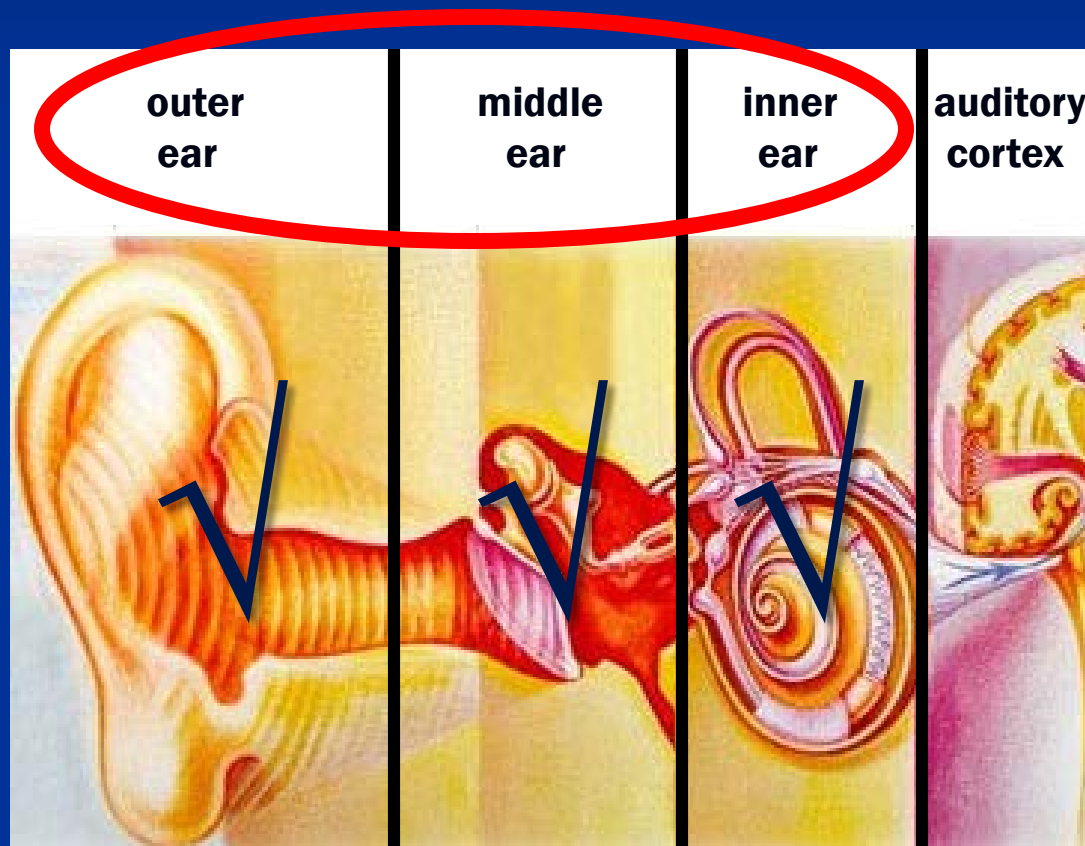
# Types of Hearing Loss with Diabetes

## Sensorineural Hearing Loss

### *Fluctuating Hearing Loss*

(altered sodium/potassium gradients  
and  
reduced endocochlear potentials)

# Diabetes and the Auditory System





# Types of Hearing Loss with Diabetes

**Mixed Hearing Loss**  
(combo. of CHL & SNHL)

**26% Mixed HL**

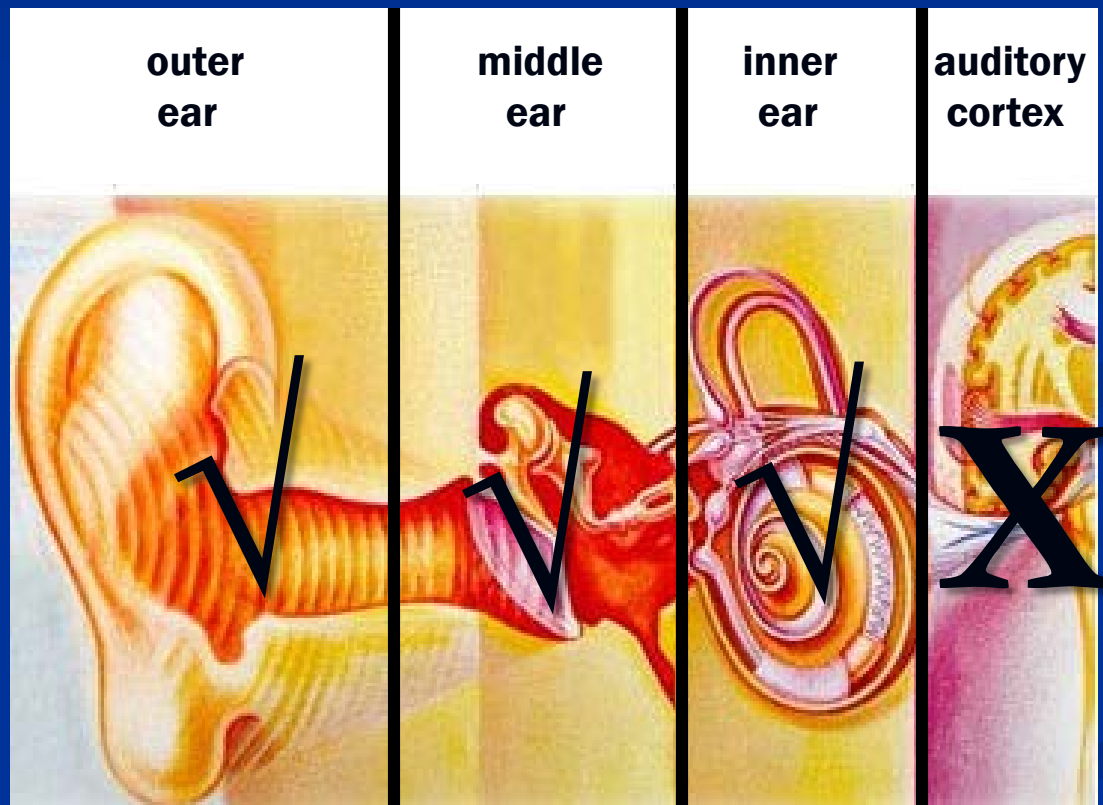
(Genevey Hlayisi, V. et al, 2018)

# Types of Hearing Loss with Diabetes

## Central Hearing Loss (cortical HL)

**No research identifying central  
HL with insulin dependent or  
non-insulin dependant patients**

# The Tour Continues...



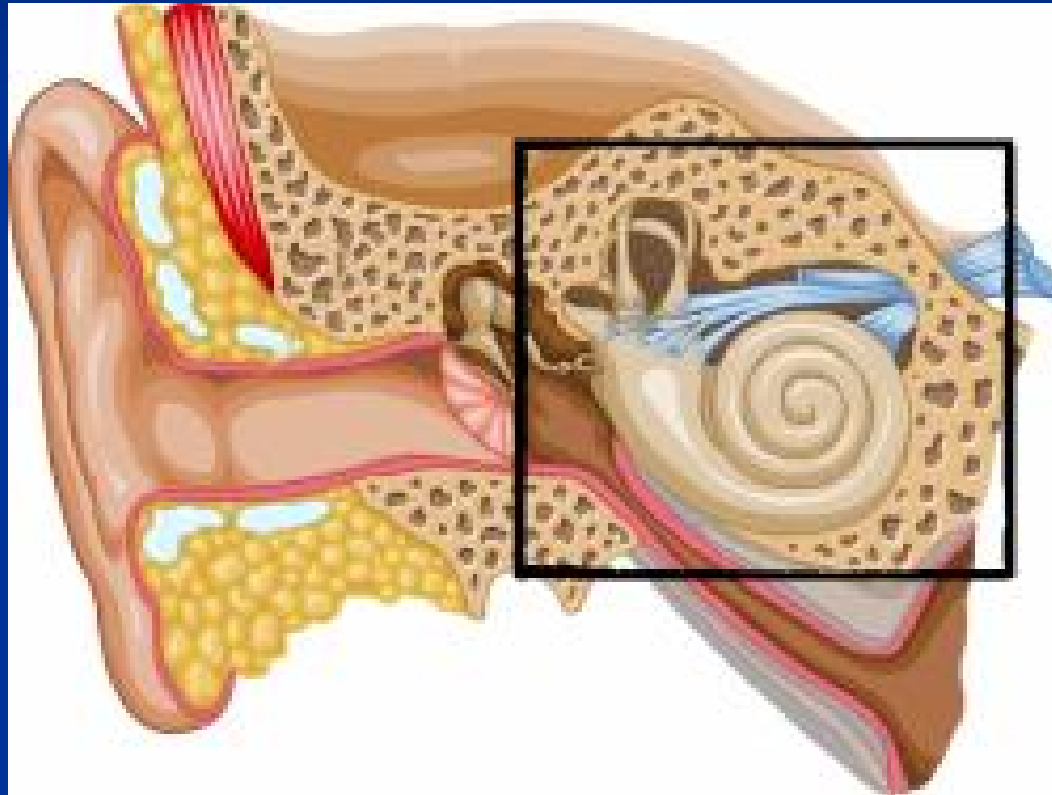
# Types of Hearing Loss with Diabetes


## Sudden S/N Hearing Loss

Cases of sudden HL  
have been reported

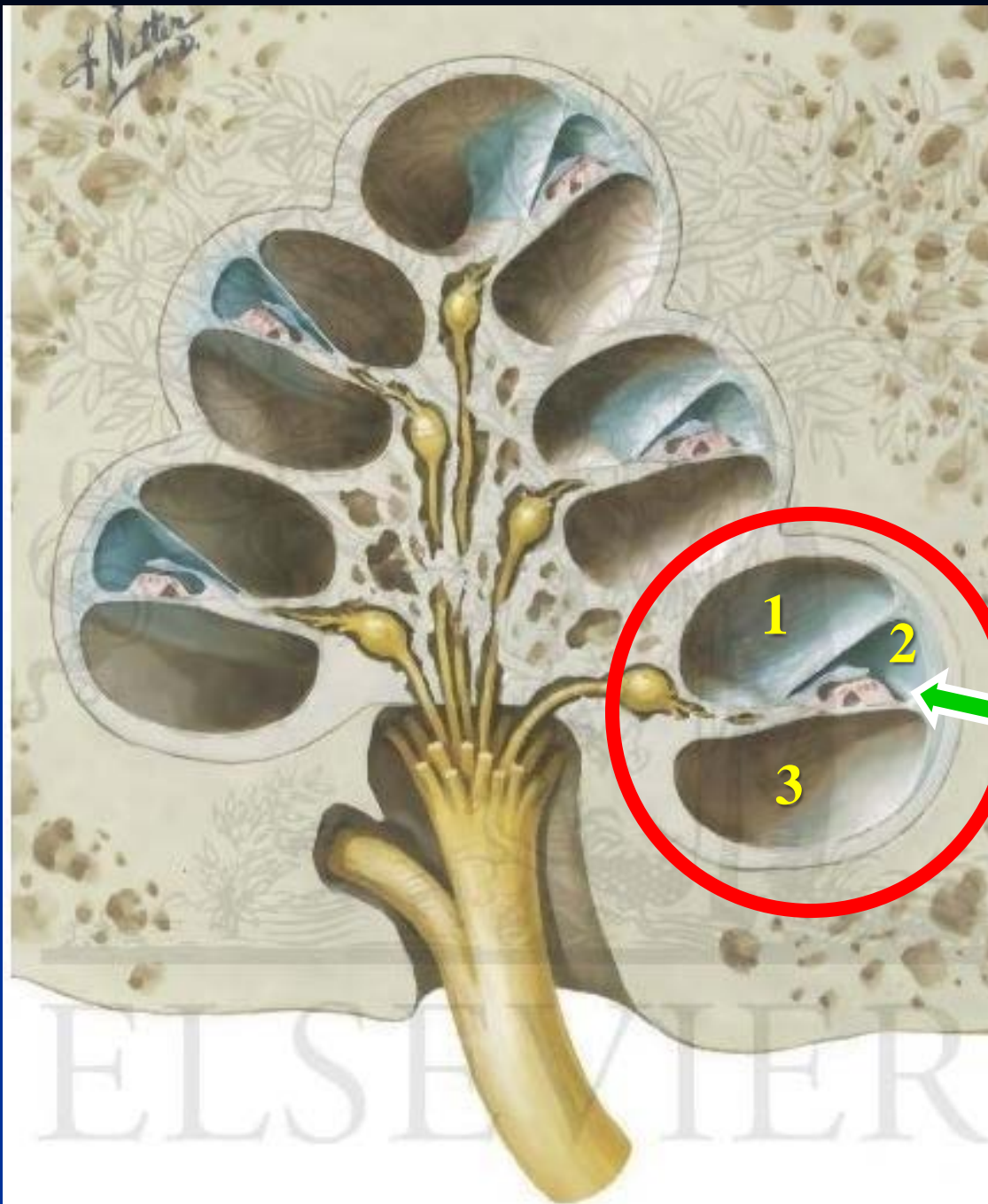
(Jung, et al. 2018, Weng, et al 2005)

# The Cochlea



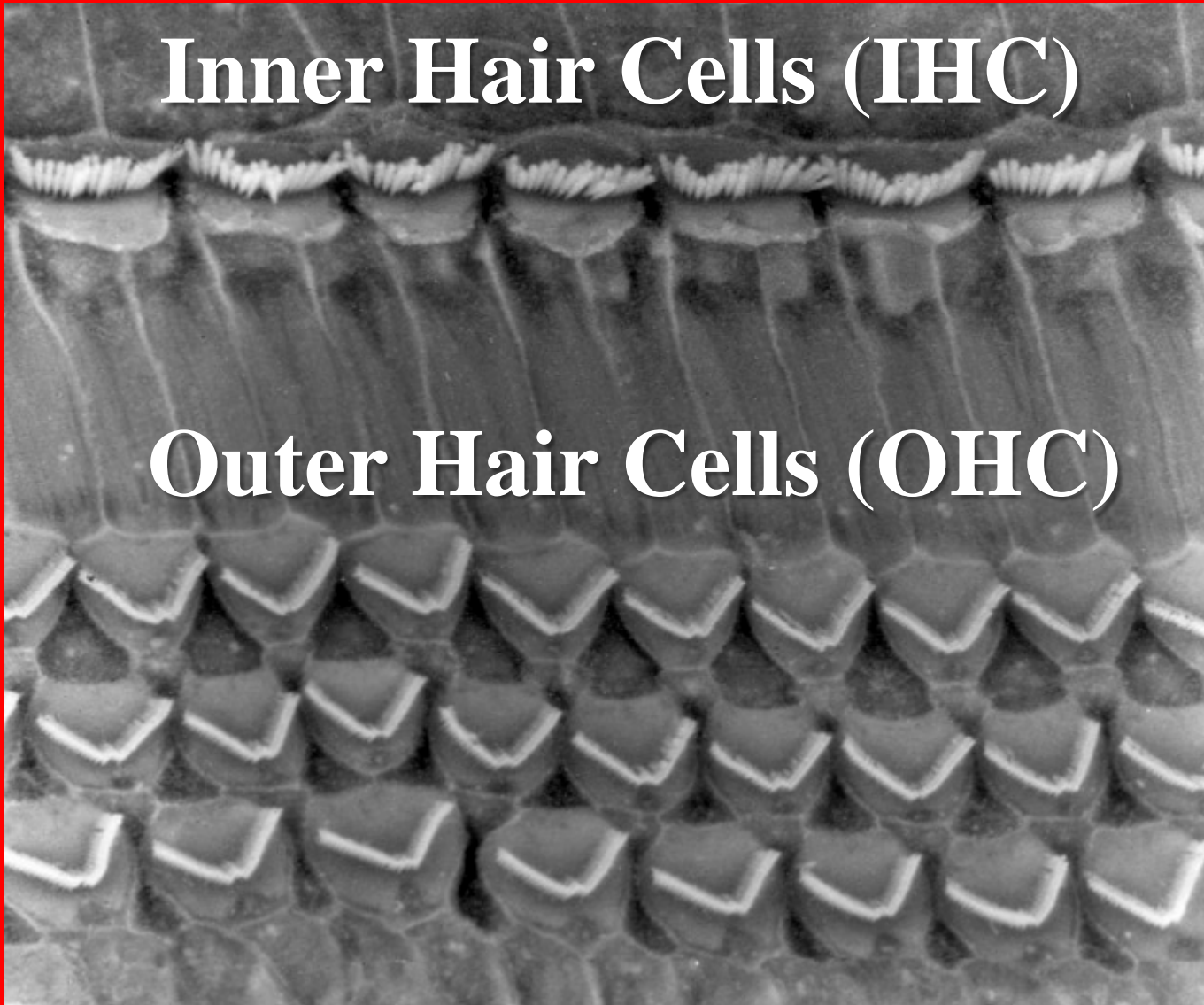


**Capillary network is  
extensive especially in the  
stria vascularis, medial and  
lateral walls of cochlea**



**Inner Hair Cells (IHC)**

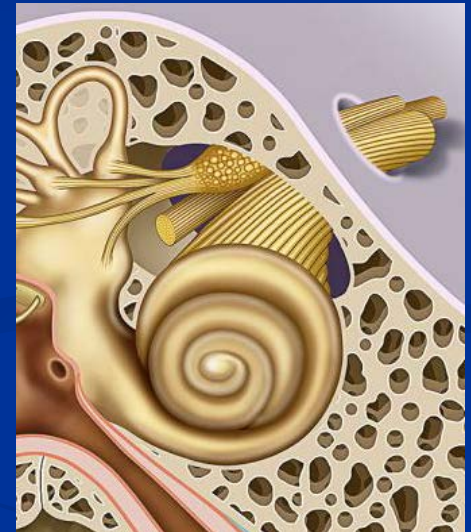
**Outer Hair Cells (OHC)**





# Pathophysiological Explanation of Hearing Loss

For Type II, the cochlea  
is the main structure  
affected



Fukushima, et al. Cochlear changes in patients with Type 1 diabetes mellitus. *Otol. Head Neck Surg.* Vol 133, No. 1 July 2005, pp. 100-106.

# Pathophysiological Explanation of Hearing Loss

## *MICROANGIOPATHY*

A disease of the  
blood vessels  
(arteries, veins, and  
capillaries)



# Pathophysiological Explanation of Hearing Loss

## *MICROANGIOPATHY*

**CAUSE:** build-up of sugar-based substances  
on vessel walls

**RESULT:** reduces blood flow throughout the  
body

# Pathophysiological Explanation of Hearing Loss

## *STRIA VASCULARIS*

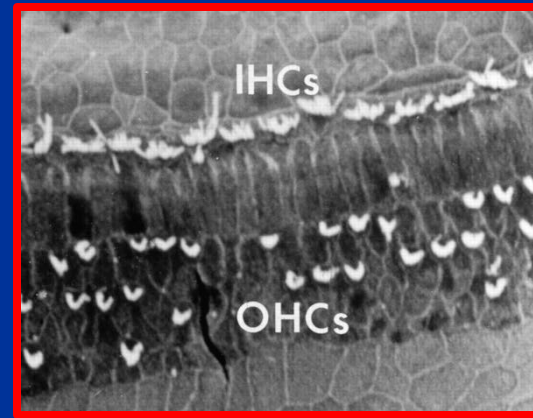
**Stria vascularis was 10-20 times  
thicker than usual in diabetes patients**

**Jorgensen MB, Buch NH. Studies on inner-ear and  
cranial nerves in diabetes. *Acta Otolaryngol.*  
1961;107:179-82.**

# Pathophysiological Explanation of Hearing Loss

## *HISTOPATHOLOGICAL STUDIES*

Loss of outer  
hair cells (OHC)

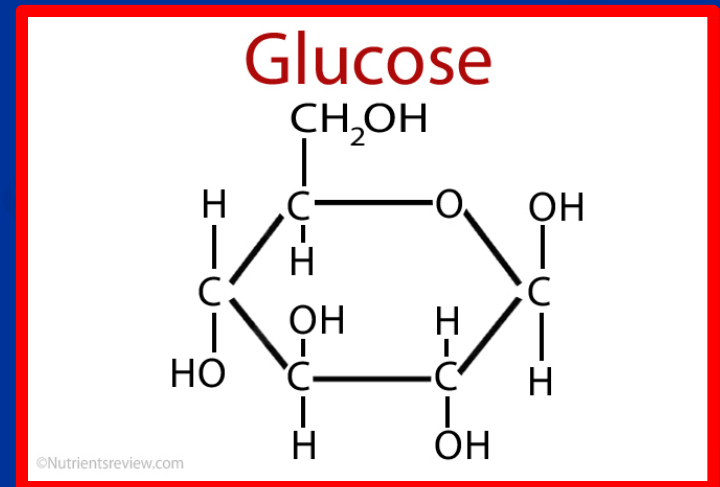


Fukushima, et al. Cochlear changes in patients with Type 1 diabetes mellitus. *Otol. Head Neck Surg.* Vol 133, No. 1 July 2005, pp. 100-106.

# Pathophysiological Explanation of Hearing Loss

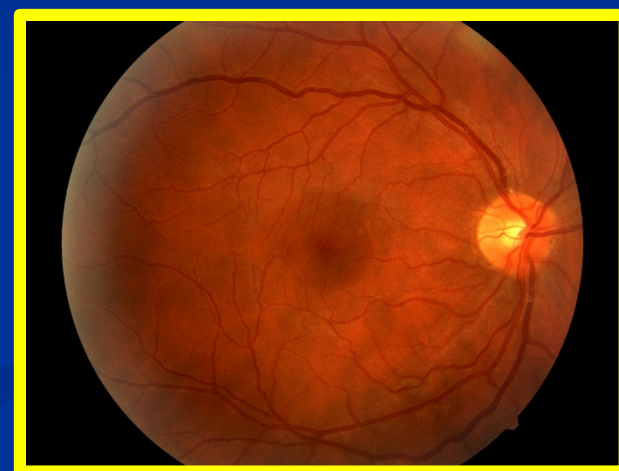
## *GLUCOSE*

Cochlear function is  
affected  
by hyperglycemia



# Incidence of HL and Diabetes

HL is *twice as common*  
in diabetic pts  
with proliferative  
retinopathy

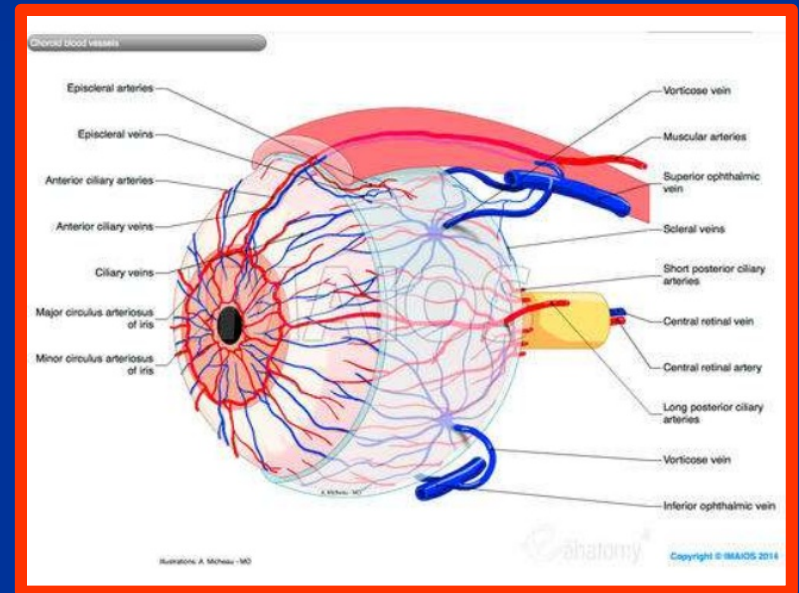


Jorgensen MB, Buch NH. Studies on inner-ear  
function and cranial nerves in diabetes. *Acta  
Otolaryngol.* 1961;53:350-64.

# Incidence of HL and Diabetes

Microvascular blood supply of the **EAR** is similar to that of the **EYE**

**Retinopathy =  
Hearing Loss**





# Incidence of HL and Diabetes

**Type I: 32%**

**Botelho CT, e al. Increased prevalence of early cochlear damage in young patients with type 1 diabetes detected by distortion product otoacoustic emissions. *Int J Auidiol.* 2014 Jun;53(6):402-8.**

# Incidence of HL and Diabetes

**Type I: Significant HF SNHL  
(n=63)**

Elamin A, et al. Hearing loss in children with type 1 diabetes. *Indian Pediatr.* 2005 Jan;42(1):15-21.

# Incidence of HL and Diabetes

Type II: 44% - 69%

Mais CA, Campos, CA. Diabetes mellitus as etiological factor of hearing loss. *Braz J Otolaryngol.* 2005 Mar-Apr;71(2):208-14.

# Duration of Diabetes and HL

**Neuronal and  
vascular function**  
of the auditory pathways  
change in addition to changes  
from presbycusis

# Age

Under 60



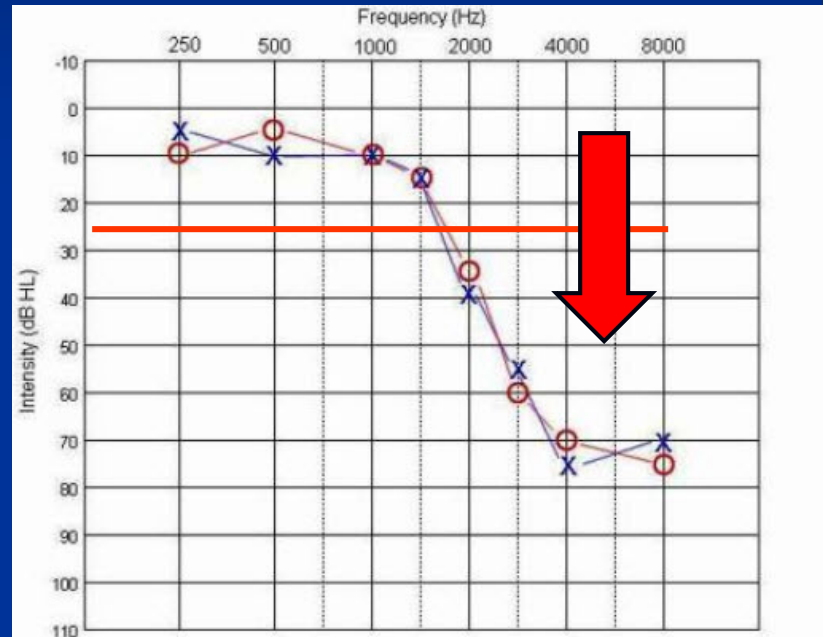
**Unexplained HF HL might lead to a  
diabetes diagnosis (after lab tests)**

# Age

## Under 60

**55% with diabetes  
have HF SNHL**

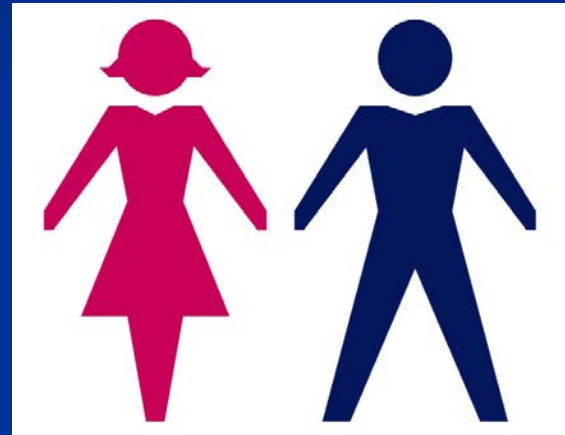
**9% have HL  
w/o diabetes**



Vera-Genevey Hlayisi, et al. High prevalence of disabling hearing loss in young to middle – aged adults with diabetes. *Int J Diabetes in Devel Countries*. Published online, June, 2018.

# Gender

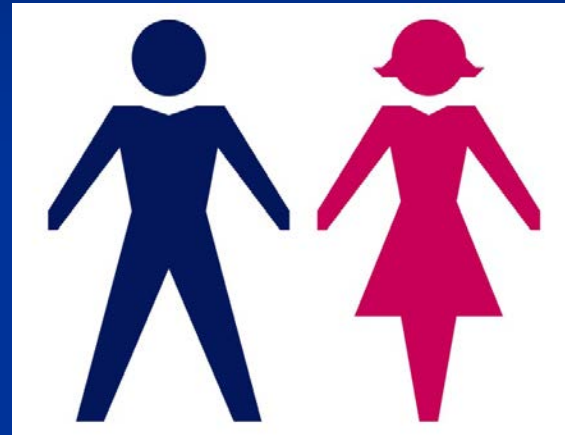
**Females > males**



Sharashennidz N, et al. Age related hearing loss: gender differences. *Georgian Med News*. 2007;144:14-8.

# Gender

**“No difference  
between the  
sexes”**

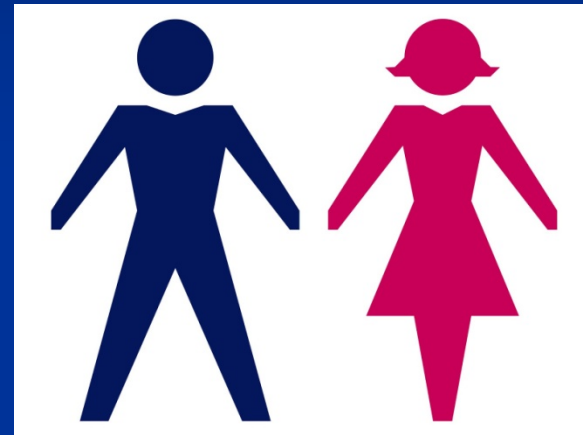


**Liu. B. et al. Investigation and analysis of tinnitus in diabetic patients. *Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi*, 2018 Apr;32(8):566-569.**



# Gender

**Males > females**



Vera-Genevey Hlayisi, et al. High prevalence of disabling hearing loss in young to middle – aged adults with diabetes. *Int J Diabetes in Devel Countries*. Published online, June, 2018.

# Symptoms of Hearing Loss with Diabetes

**“I hear but can’t understand  
the words”**

**Tinnitus** “Aural fullness”

**Bilateral**

**Progressive**



# **Tinnitus**

## **Descriptors**



**Ringing**

**Humming**

**Buzzing**

**Whooshing**

**Roaring**

**Hissing**

**Chirping**

**Crickets**

**Clicks**



# Tinnitus

## Causes



**Age**

**Hearing Loss**

**Rx Side Effects**

**Head Trauma**

**Caffeine**

**>Sodium**

**TMJ problems**

**Circulatory Disorders**

**NOISE ESPOSURE!**

# Tinnitus with Diabetic Patients

**Greater incidence of tinnitus which may  
be related to the age  
(n = 112)**

**51-60 year: 43%**

**>60 year: 55%**

Liu B. et al. Investigation and analysis of tinnitus in diabetic patients. *Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi*, 2018 Apr;32(8):566-569

# Thorough Case History



# Get to know your pharmacist





# Refer to Audiologist for Testing

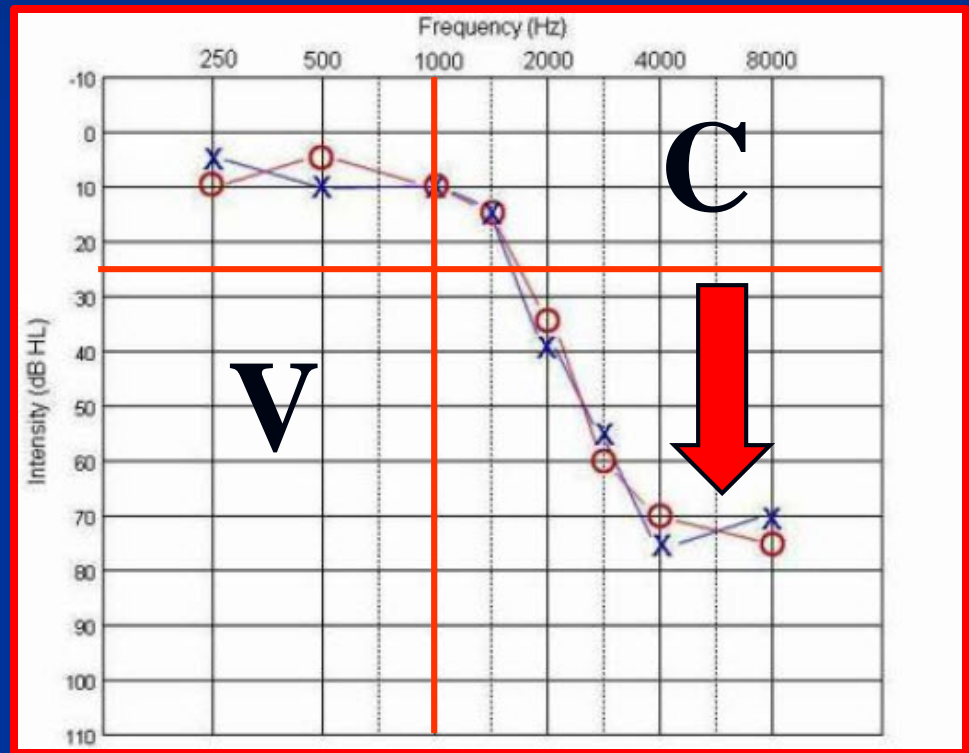




# Degree of Hearing Loss

>25dB in the poorer ear

Usually mild to moderate



# Frequency Range

## Low to Mid Frequency (Type I & II)

Peripheral neuropathy (foot)  
associated with  
*low/mid frequency SNHL*  
(but not high frequency SNHL)

# Frequency Range

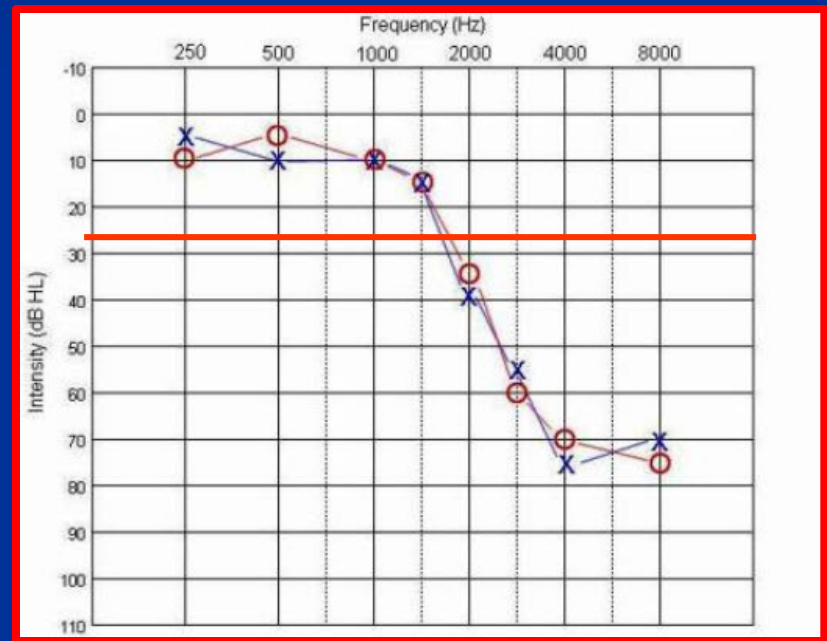
**Before 1981 the literature showed  
that diabetes-related HL was:**

**Mild-Moderate  
and  
High Frequency**

# Frequency Range

## High Frequencies

Type II patients  
(Tay, et al, 1995)



# Frequency Range

## High Frequencies

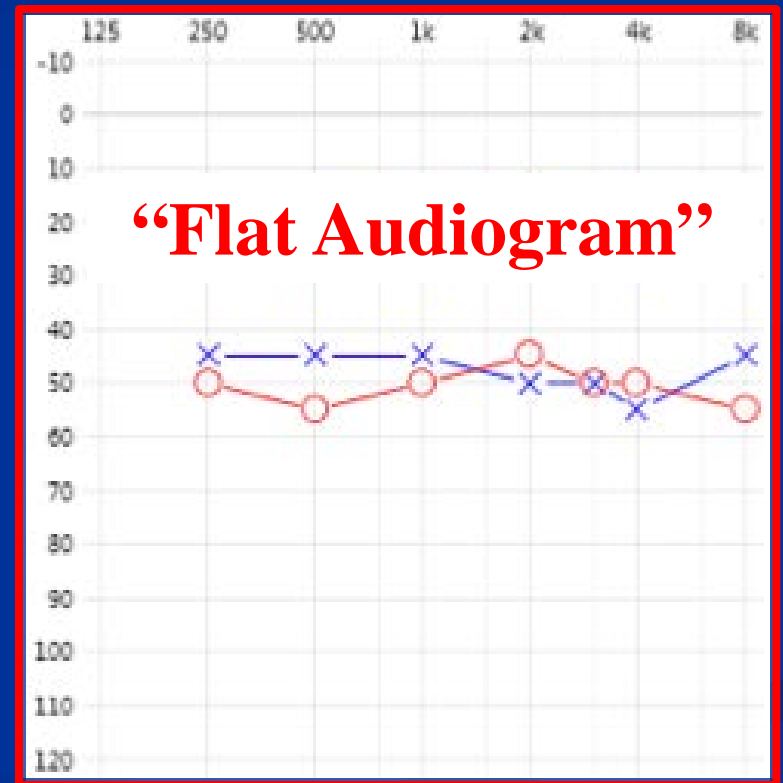
Follows a similar pattern that of  
age-related HL (presbycusis)



# Frequency Range

## All Frequencies

Celik (1996)  
showed elevated  
thresholds at *all*  
*test frequencies*  
with **Type I**  
diabetic patients



# Frequency Range

## All Frequencies

Celik (1996)  
showed elevated  
thresholds at *all*  
*test frequencies*  
with **Type I**  
diabetic patients

## Microangiopathy



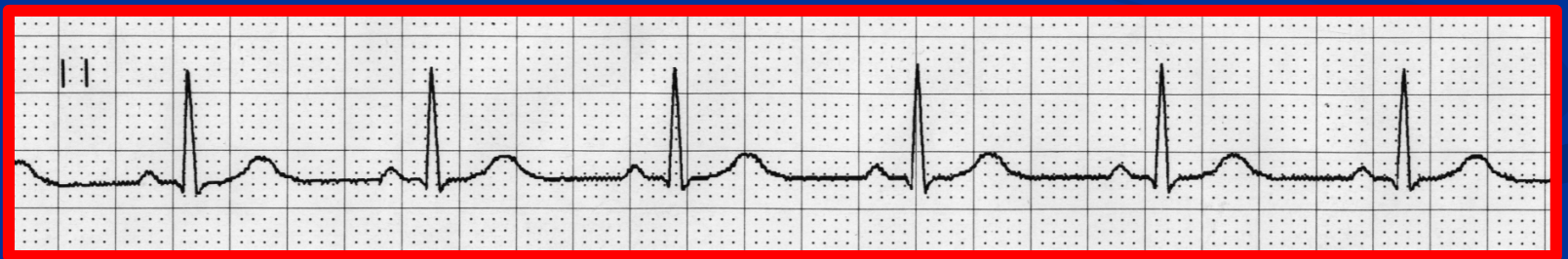
wiseGEEK

# Co-Morbidities

Hx of cardiovascular disease

Hypertension

Duration of the diabetes





# **Co-Morbidities**

**Blood sugar control**

**Presence of pre-existing HL**

**Severe peripheral neuropathy**

# **Co-Morbidities**

**Retinopathy**

**Increased body mass index (BMI)**

**Noise exposure**



# **Drugs and Insulins for Diabetes Management**

# 59 Drugs for Diabetes

46



13



DiSogra, RM. The audiology project.  
*[www.theaudiologyproject.com](http://www.theaudiologyproject.com)*, 2018

# Auditory - Vestibular - Cognitive Side Effects



# **Drugs and Insulins for Diabetes Management**

**[www.drbobdisogra.com](http://www.drbobdisogra.com)**

**Click “More”**

**Click “Diabetes Rx Side Effects”**

# Rx Side Effects – Oral (incl. combination drugs) (n = 46)



**Auditory** 14 30.4%

**Vestibular** 43 93.5%

**Cognitive** 31 67.4%

# Rx Side Effects – **Insulin**

(incl. Neutral Protamine Hagedorn – NPH)  
(n = 13)



**Auditory**    1    8%

**Vestibular**    7    54%

**Cognitive**    5    38%



# Rx Side Effects Summary

(n = 59)

<b>Vestibular</b>	<b>50</b>	<b>85%</b>
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<b>Cognitive</b>	<b>36</b>	<b>61%</b>
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<b>Auditory</b>	<b>15</b>	<b>25%</b>
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# Rx Side Effects Summary (n = 59)

<b>Vestibular</b>	<b>50</b>	<b>85%</b>
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**WEBINAR: May 22, 2018 - *Risk of falls with diabetes: screening, diagnosis and treatment; monitoring.* Dr. Richard Gans, American Institute of Balance.**



# **Audiometric Monitoring for Patients with Diabetes**

# **Audiometric Monitoring for Patients with Diabetes**

**No formal guidelines exist for  
monitoring hearing loss and/or  
tinnitus for patients with diabetes**

**DiSogra, RM. The audiology project,  
[www.theaudiologyproject.com](http://www.theaudiologyproject.com), 2018.**

# **Audiometric Monitoring for Patients with Diabetes**

## **Initial visit (baseline)**

- **Review findings**
- **Review symptoms suggesting changes in hearing**

# **Audiometric Monitoring for Patients with Diabetes**

## **Initial visit (baseline)**

- Tinnitus Handicap Inventory (THI)  
(if warranted)**

# **Audiometric Monitoring for Patients with Diabetes**

## **3 months after baseline**

- to monitor any progression of the loss; THI if warranted
- review symptoms of changes in hearing

# **Audiometric Monitoring for Patients with Diabetes**

**6 months after 1<sup>st</sup> follow-up**

- to monitor any progression of  
the loss**
- Repeat THI – if warranted**



# **Audiometric Monitoring for Patients with Diabetes**

**Annually (or sooner if further  
changes are suspected)**

- to monitor stability or any  
progression of the loss**
- Repeat THI – if warranted**

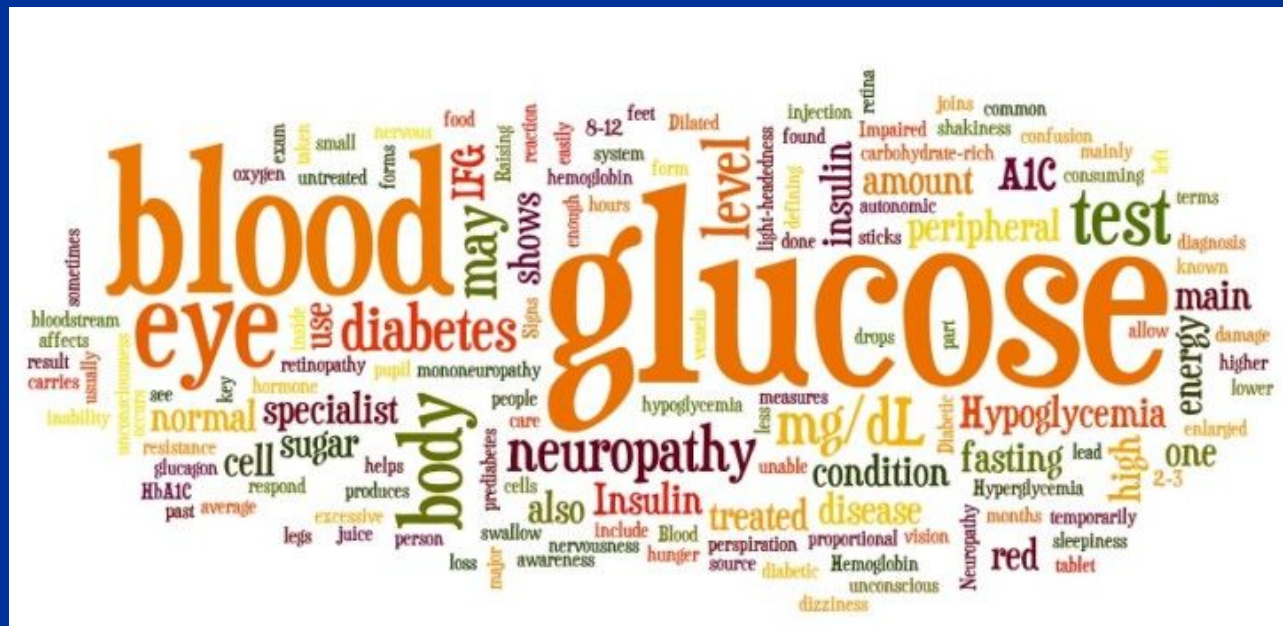
# Vestibular Monitoring for Patients with Diabetes

No formal guidelines exist for  
monitoring vestibular function for  
patients with diabetes

DiSogra, RM. The audiology project,  
[www.theaudiologyproject.com](http://www.theaudiologyproject.com), 2018.

# Vestibular Monitoring for Patients with Diabetes

Obtain a comprehensive baseline to rule out any co-morbidities

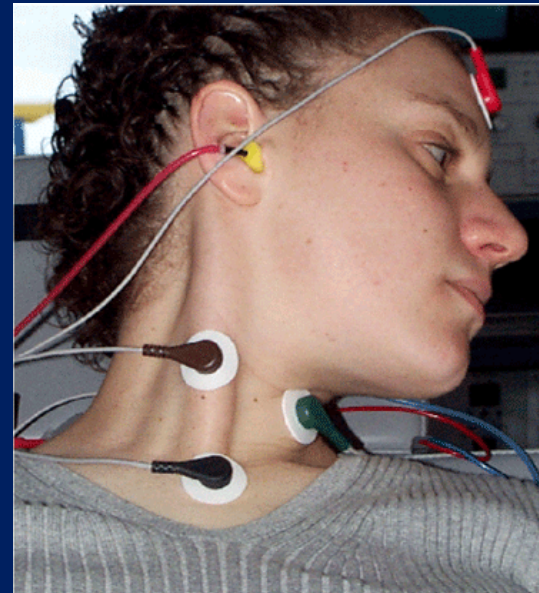


# Balance Assessment

**V**ideo **N**ystag-  
**m**o**G**raphy (caloric)

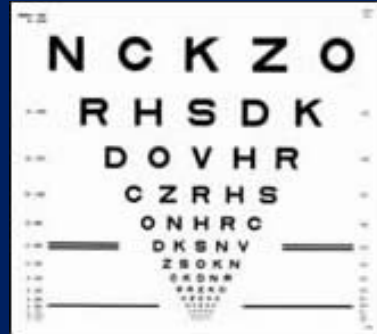


**V**estibular **E**voked  
**M**yogenic **P**otentials  
(VEMP)



# Balance Assessment

**Dynamic Visual  
Acuity Test (DVAT)**



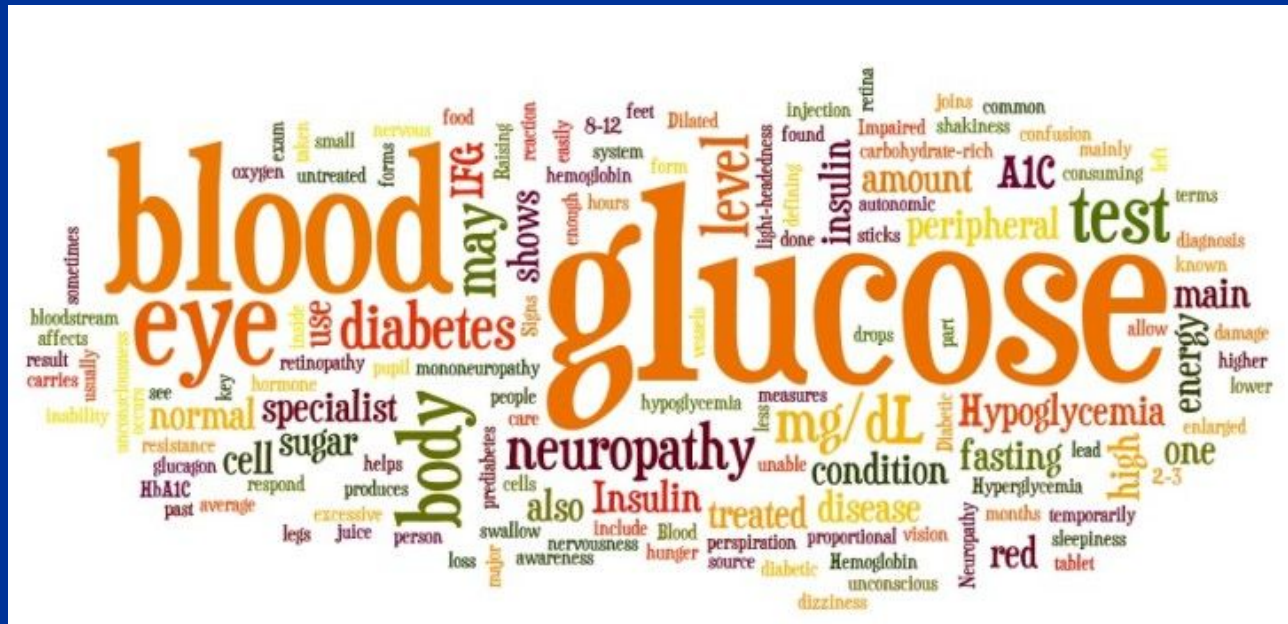
**Rotary Chair**

**Computerized  
Dynamic  
Posturography**





## Re-evaluation if symptoms increase



# Amplification or Hearing Assistance Technology Evaluation

*At any time* if the communication  
problems increase



The background of the slide is a blurred photograph of a group of people in what appears to be a social gathering or event. The colors are muted and out of focus, with some blue and purple tones visible. A solid blue rectangular box is centered over the image, containing the title text in white.

# **Communication Strategies for Persons with Hearing Loss**



MARCH 2017

A PUBLICATION OF THE AMERICAN ASSOCIATION OF DIABETES EDUCATORS

diabeteseducator.org



ISSN: 2325-1603

# IN PRACTICE

Can You Hear Me Now?  
Communication  
Strategies for the  
Hearing Impaired

*In this issue:*

- ~ A back-up plan to prevent DKA
- ~ Same-day multidisciplinary team visits
- ~ Getting a grip on gastroparesis
- ~ Messages received from unlikely places

**March 2017**  
**pp. 32-37**

**Includes**  
*Hearing*  
*Handicap*  
*Inventory for*  
*Adults*  
**(HHIA)**

# Communication Strategies

[www.drbobdisogra.com](http://www.drbobdisogra.com)

Click “More”

Click “Communication Strategies”



[www.theaudiologyproject.com/  
educational-materials](http://www.theaudiologyproject.com/educational-materials)



[www.drbobdisogra.com](http://www.drbobdisogra.com)