

# Hearing Loss & Healthy Aging

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UNIVERSITY OF MINNESOTA

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# Communication is a cornerstone of healthy aging



# The burden of hearing loss

- The Global Burden of Disease Study measured years lived with disability and found that hearing loss is the fourth leading cause of disability globally, affecting 466 million people
- Hearing loss is among the most common chronic conditions of aging, with a 2-fold higher incidence than cardiovascular disease, a 5-fold higher incidence than diabetes, and a 10-fold higher incidence than cancer
- In the US, the prevalence of hearing loss doubles with every 10-year increase in age
- ~ 50% of persons in their seventh decade (60 to 69 years of age) and 80% who are 85 years of age or older have hearing loss severe enough to affect daily communication



# Hearing challenges develop over time



Noisy  
Environments



Multiple  
Talkers



Tones  
High > Low



Speech  
Perception

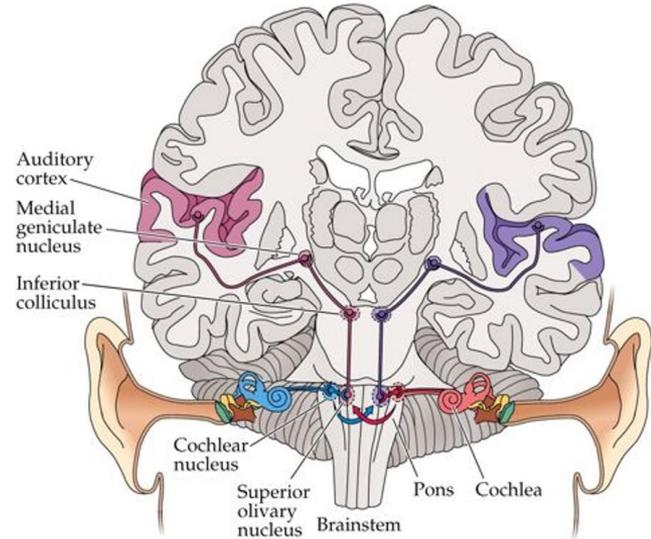
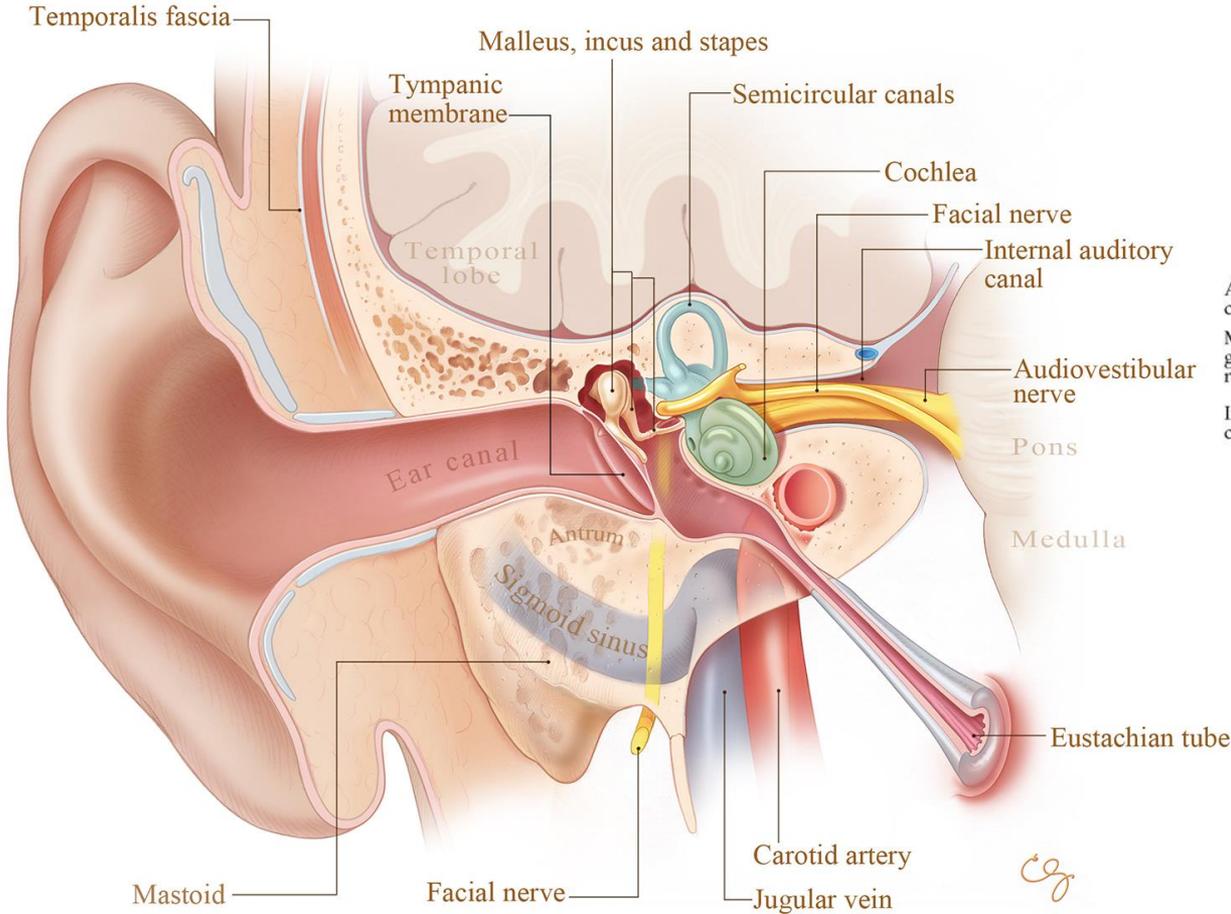


# Outline: Hearing Loss & Healthy Aging

- How do we hear?
- Why do we lose hearing as we age?
- Can we prevent hearing loss with age?
- How may hearing loss affect us?
- What can we do to treat hearing loss?



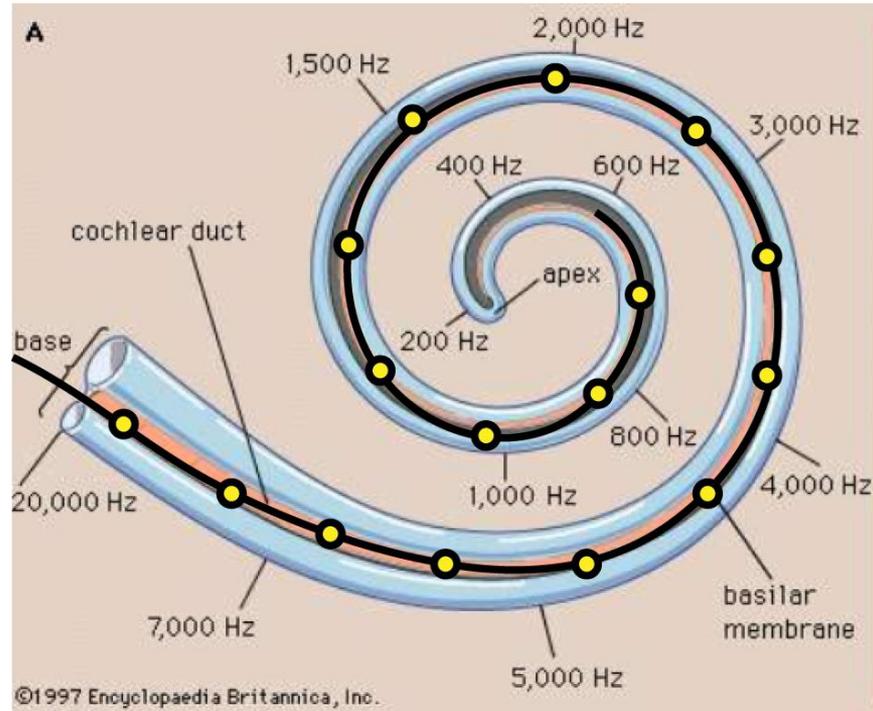
# ANATOMY OF HEARING



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# The cochlea is tonotopically organized



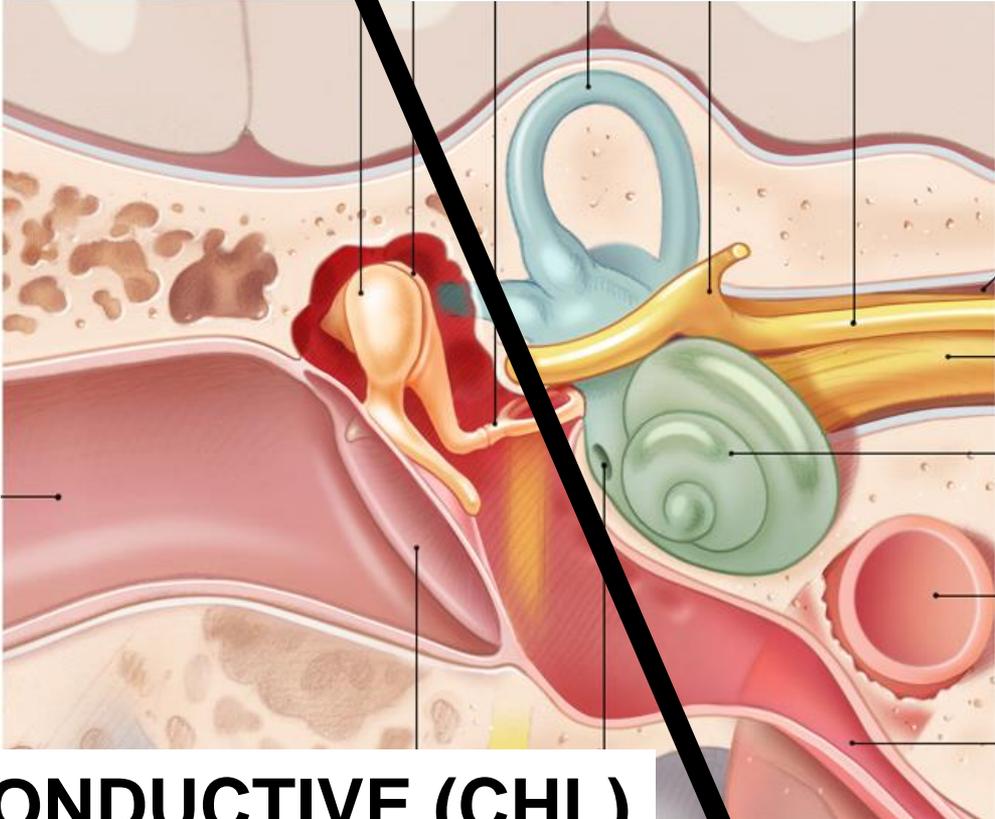
Why do we lose hearing as we age?



# Types of Hearing Loss

**SENSORINEURAL (SNHL)**

**> 90%**



**CONDUCTIVE (CHL)**

Age-related hearing loss involves a complex interplay between environmental (extrinsic) and genetic (intrinsic) factors



Noise



Health  
(HTN, DM)



Medications  
(ototoxins)

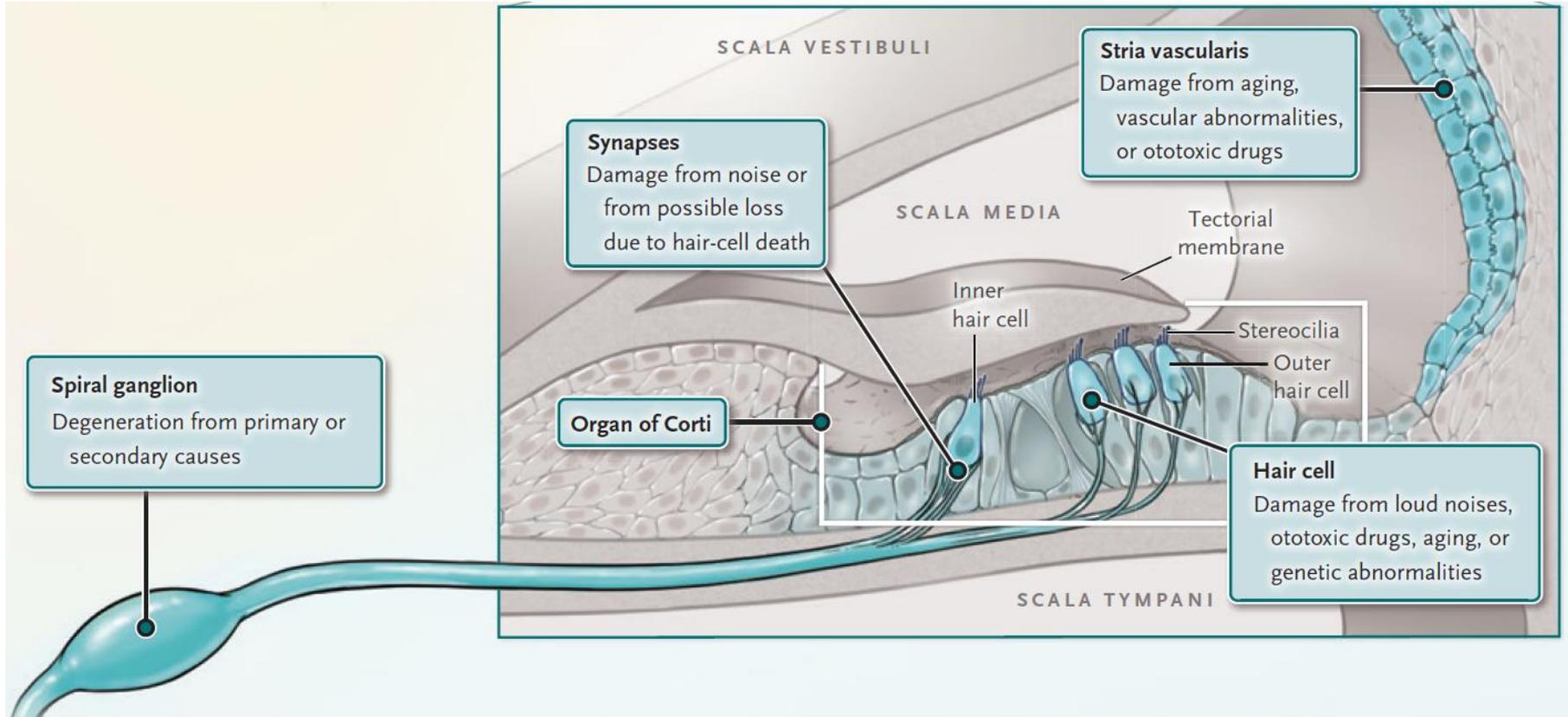


Genetics

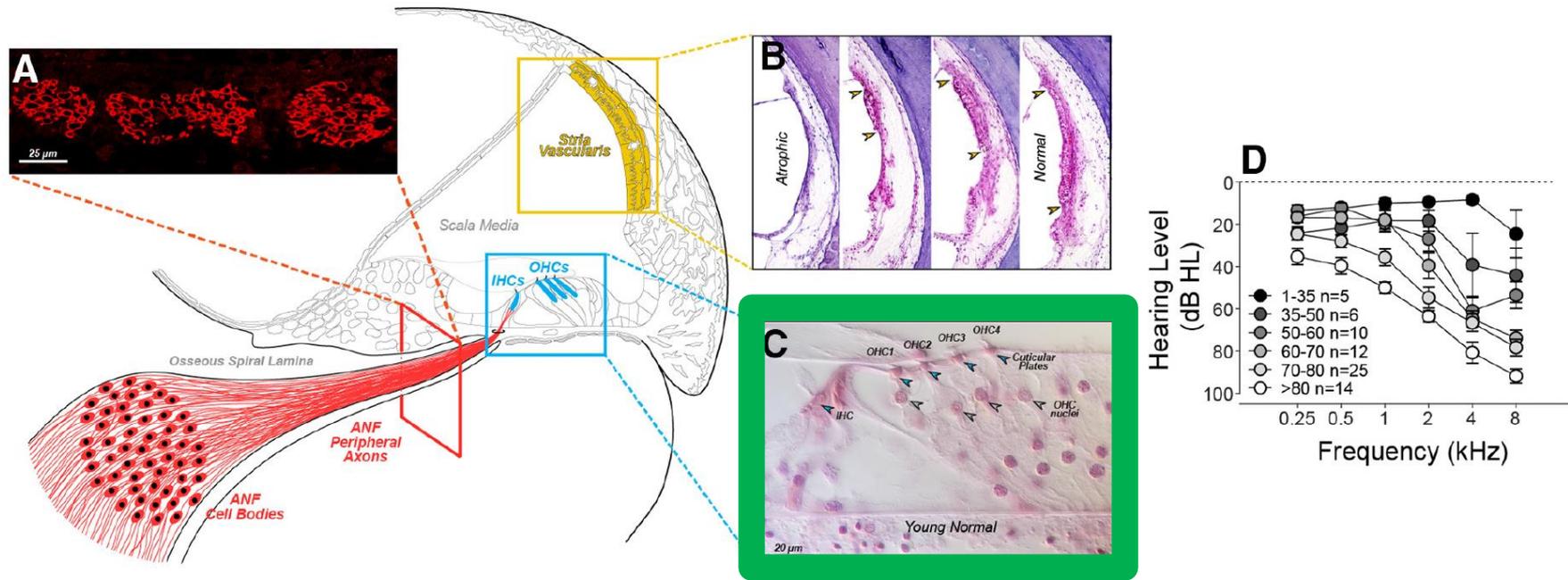
Although hearing worsens with age, the severity of the hearing problem at any given age **varies** greatly between individuals



# Mechanisms of Sensorineural hearing loss



# Human Temporal Bone Studies show inner ear changes with age



Hearing loss is well predicted by hair cell loss  $\gg$  strial atrophy or auditory nerve loss

When comparing those with and without a noise exposure history, the hair cell damage in the apex (low f) is inherently age-related, whereas the larger, and more functionally significant, basal loss (high f) in humans is largely noise-induced

Can we prevent hearing loss with age?



# While the prevalence increases with age, **hearing loss is not inevitable**

- The age-adjusted prevalence of hearing loss is **declining** in the United States.\*
  - Reduced occupational noise exposure from fewer manufacturing jobs, more hearing protection? *Less hearing loss confirmed in more isolated societal groups worldwide*
  - Better management of cardiovascular risk factors and cessation of smoking?
- NOISE - Be aware of the damaging, slowly cumulative effects of loud sound
- Use hearing protection: ear protectors ( earmuffs/earplugs), avoid or limit time spent in loud venues, use personal music systems at moderate volumes, and wear noise-canceling headphones or earphones.



# How about diet and exercise?

- Diet and exercise are often discussed in relation to healthy aging and *the inner ear is no exception*
- Aged animals have less hearing loss and cell degeneration with:
  - Caloric restriction beginning at a young age (rats, mice)
  - Antioxidant diets (dogs)
  - Exercise (mice)
- We need more data to make recommendations on supplements or other interventions in humans, but it seems reasonable to manage cardiovascular and metabolic disorders



How may hearing loss affect us over time?



# Effects of Untreated Hearing Loss



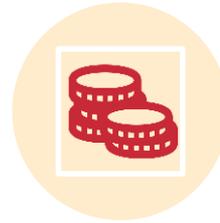
## COMMUNICATION

Relationships,  
Workplace



## PSYCHOSOCIAL

Isolation, loneliness  
Depression



## ECONOMIC

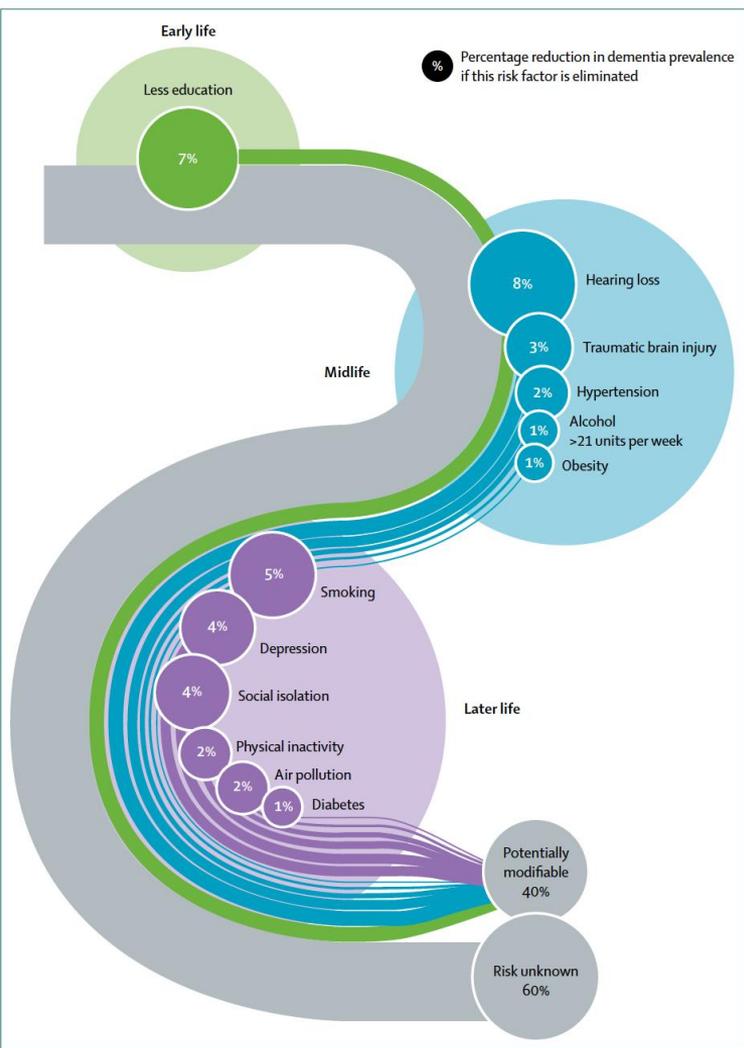
Healthcare costs,  
Unemployment



## HEALTH

Falls, hospitalization,  
Cognition/dementia





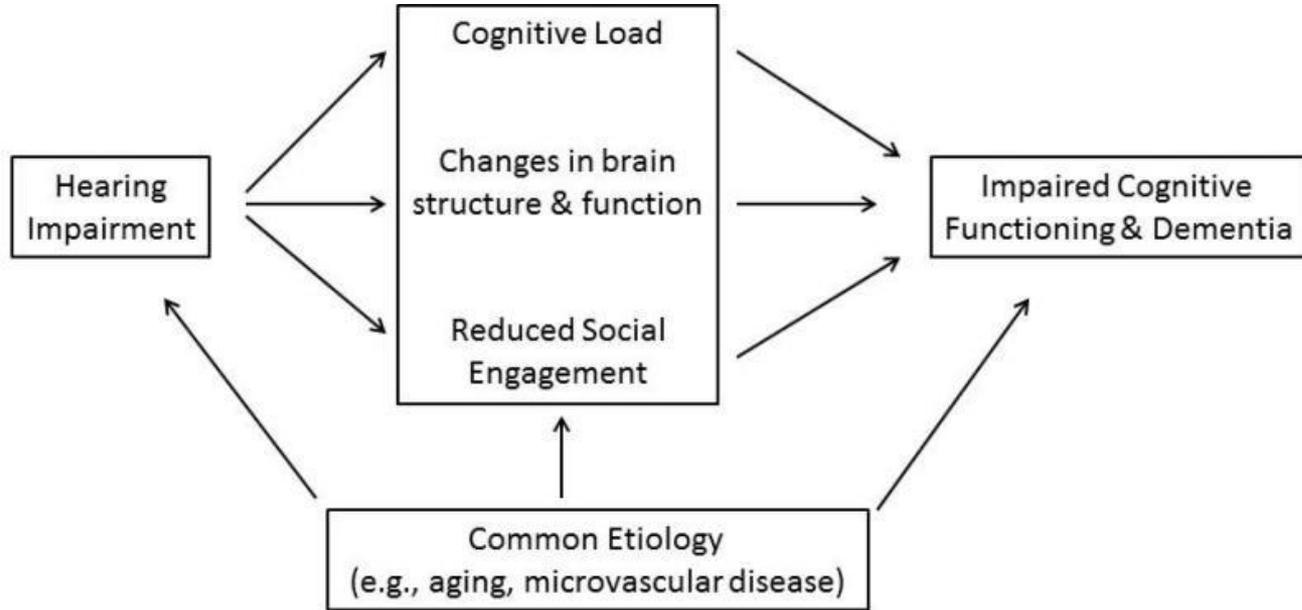
## Dementia prevention, intervention, and care: 2020 report of the *Lancet* Commission

Gill Livingston, Jonathan Huntley, Andrew Sommerlad, David Ames, Clive Ballard, Sube Banerjee, Carol Brayne, Alistair Burns, Jiska Cohen-Mansfield, Claudia Cooper, Sergi G Costafreda, Amit Dias, Nick Fox, Laura N Gitlin, Robert Howard, Helen C Kales, Mika Kivimäki, Eric B Larson, Adesola Ogunniyi, Vasiliki Orgeta, Karen Ritchie, Kenneth Rockwood, Elizabeth L Sampson, Quincy Samus, Lon S Schneider, Geir Selbæk, Linda Teri, Naaheed Mukadam

- **Hearing loss confers an independent risk of incident dementia in individuals that are cognitively intact but hearing impaired**
- Population attributable fraction (PAF) of hearing loss for dementia is higher than any other individual modifiable risk factor
- Risk (OR 1.3, 95% CI 1.0–1.6) per 10 dB of hearing loss, even below clinical threshold, implicating subclinical levels of hearing impairment (below 25 dB)

Figure 7: Population attributable fraction of potentially modifiable risk factors for dementia

# Conceptual model of the association of hearing impairment with cognitive functioning and dementia



Lin FR, Albert M. Hearing loss and dementia - who is listening? *Aging Ment Health*. 2014;18(6):671-3. doi: 10.1080/13607863.2014.915924. PMID: 24875093; PMCID: PMC4075051.



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# Association between hearing aid use and all-cause and cause-specific dementia: an analysis of the UK Biobank cohort

*Fan Jiang, Shiva Raj Mishra, Nipun Shrestha, Akihiko Ozaki, Salim S Virani, Tess Bright, Hannah Kuper, Chengchao Zhou\*, Dongshan Zhu\**

Among people *with* hearing loss, hearing aid use was associated with a risk of dementia of a similar level to that of people *without* hearing loss

Inferences from observational studies are limited because measured (e.g., education and income) and unmeasured factors (e.g., health behaviors) may confound observed associations of hearing aid use with reduced cognitive decline.



# Hearing intervention versus health education control to reduce cognitive decline in older adults with hearing loss in the USA (ACHIEVE): a multicentre, randomised controlled trial

*Frank R Lin, James R Pike, Marilyn S Albert, Michelle Arnold, Sheila Burgard, Theresa Chisolm, David Couper, Jennifer A Deal, Adele M Goman, Nancy W Glynn, Theresa Gmelin, Lisa Gravens-Mueller, Kathleen M Hayden, Alison R Huang, David Knopman, Christine M Mitchell, Thomas Mosler, James S Pankow, Nicholas S Reed, Victoria Sanchez, Jennifer A Schrack, B Gwen Windham, Josef Coresh, for the ACHIEVE Collaborative Research Group*



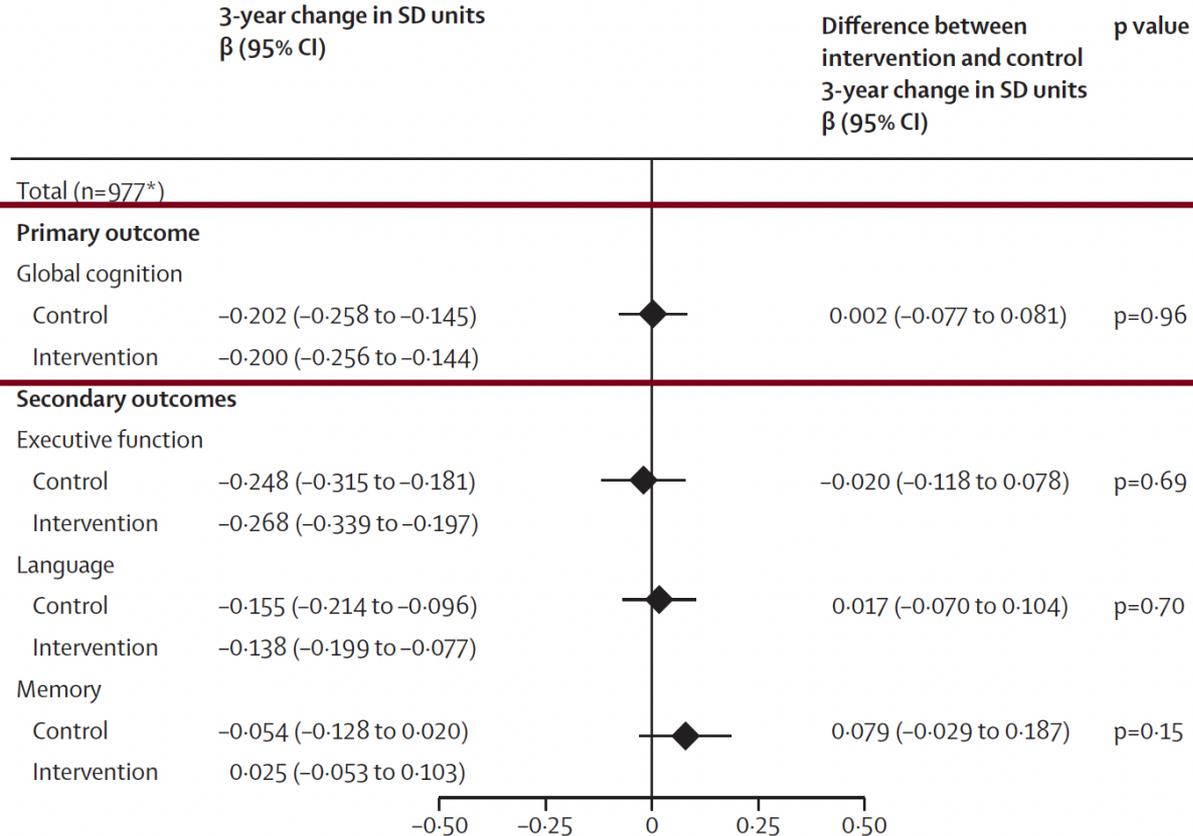
Atherosclerosis Risk in Communities Study

James Pankow, PhD  
Division of Epidemiology and Community Health  
University of Minnesota School of Public Health



# ACHIEVE Study, full cohort

## Primary and secondary outcomes



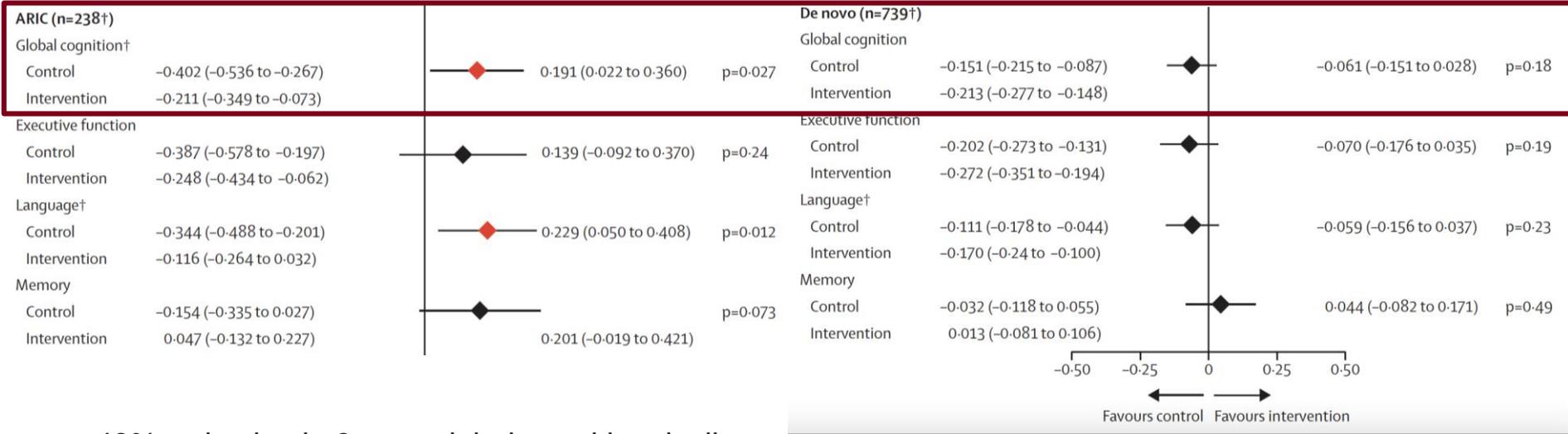
Neuro-cognitive battery

Hearing intervention had no effect at 3 years

# ACHIEVE Study, by subcohort

## ARIC cohort – higher risk, impairment

## De novo cohort – healthy



48% reduction in 3-year global cognitive decline

No effect of the hearing intervention

Hearing intervention in adults aged 70 years and older who are at **increased risk** for cognitive decline and dementia may have an important effect on reducing cognitive change within 3 years.



What can we do to treat hearing loss?



# Do you have a hearing problem?

## Revised Hearing Handicap Inventory

1. Does a hearing problem cause you difficulty when listening to TV or radio?
2. Does a hearing problem cause you difficulty when attending a party?
3. Does a hearing problem cause you to feel frustrated when talking to members of your family?
4. Does a hearing problem cause you to feel left out when you are with a group of people?
5. Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?
6. Do you feel challenged by a hearing problem?
7. Do you feel that any difficulty with your hearing limits or hampers your personal or social life?
8. Does a hearing problem cause you to feel uncomfortable when talking to friends?
9. Does a hearing problem cause you to avoid groups of people?
10. Does a hearing problem cause you to visit friends, relatives, or neighbors less often than you would like?

YES to 2+ or SOMETIMES to 3+ : may have hearing loss, have your hearing tested



# How can friends and family help?

## **COMMUNICATION COURTESY (2-way process)**

- Tell your friends and family about your hearing loss.
- Explain which listening situations are hard.
- Ask them to face you when speaking so you can see their expressions and lip movements
- Ask people to speak louder, but not shout
- Ask them to speak clearly and unhurriedly (slow down)

## **ENVIRONMENTAL OPTIMIZATION**

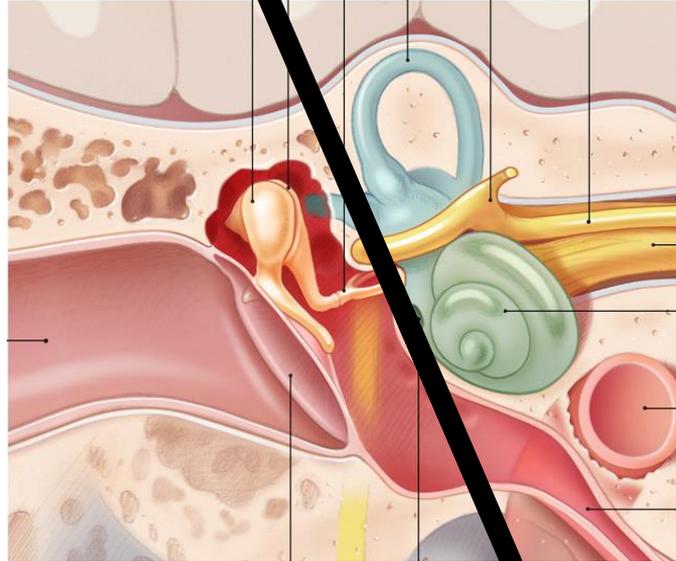
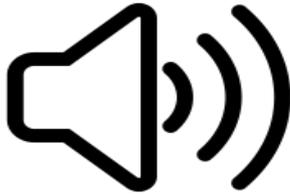
- Be aware of noise around you that can make hearing more difficult
- Turn off or turn down the volume of background noise, such as the TV, when conversing
- When you go to a restaurant, for example, don't sit near the kitchen or near a band playing music. Ask for seating in a quiet area. Sitting in a booth can help soften or block noise.



# Treating Hearing Loss

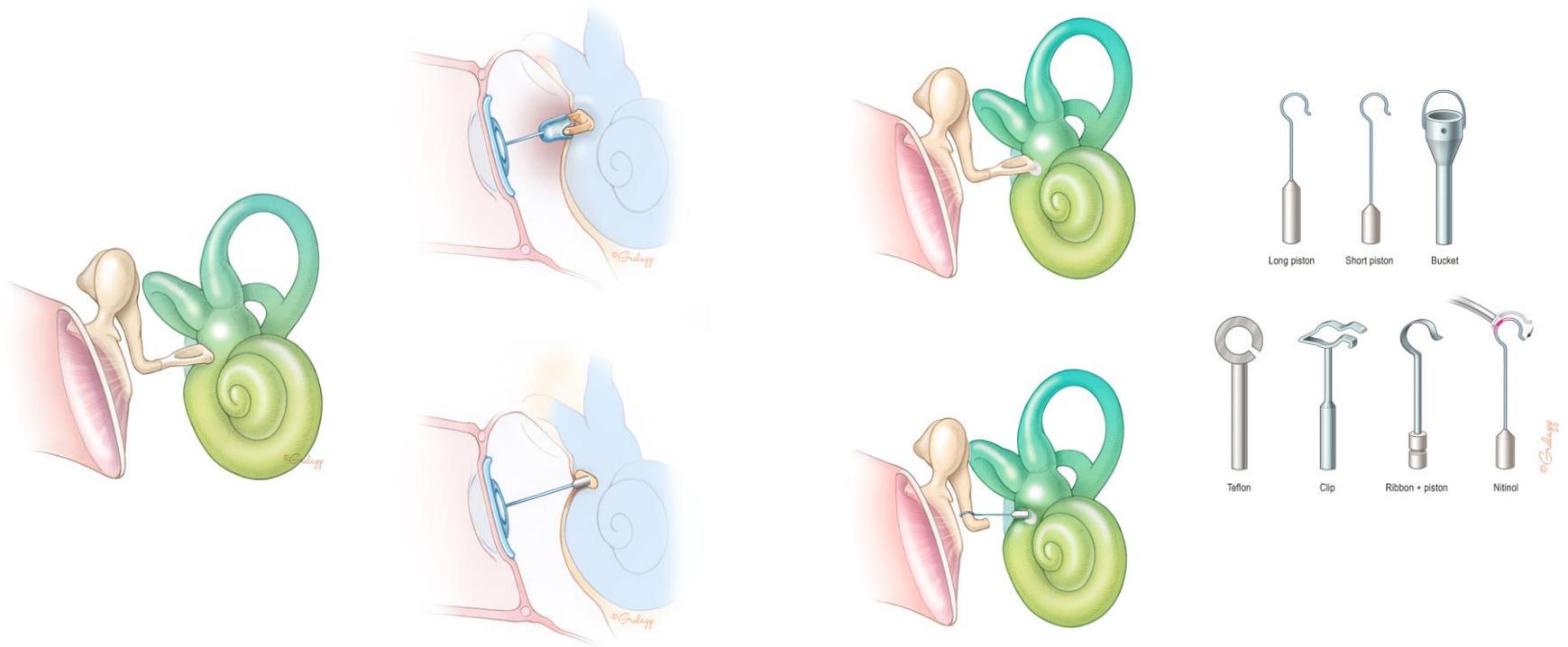
**SENSORINEURAL (SNHL)**

Hearing aids



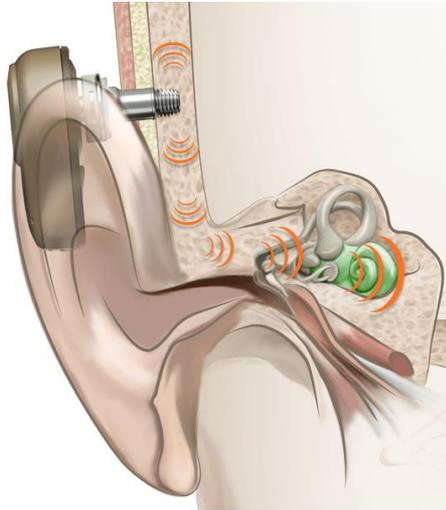
**CONDUCTIVE (CHL)**  
mechanical solutions

# Conductive Hearing Loss: Ossiculoplasty

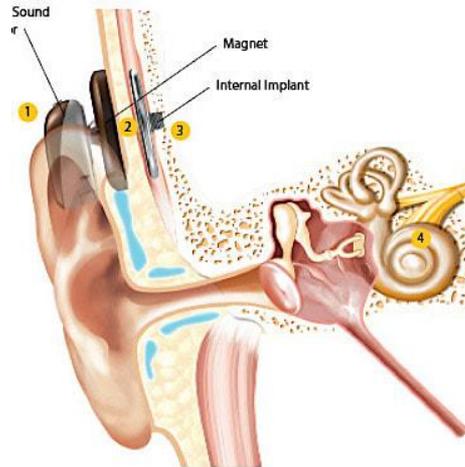


# Bone anchored hearing aids

- Best for conductive hearing losses not amenable to a traditional hearing aid
- Need sufficient sensorineural hearing to benefit
- Can combine with a contralateral traditional hearing aid



Ponto (Oticon)



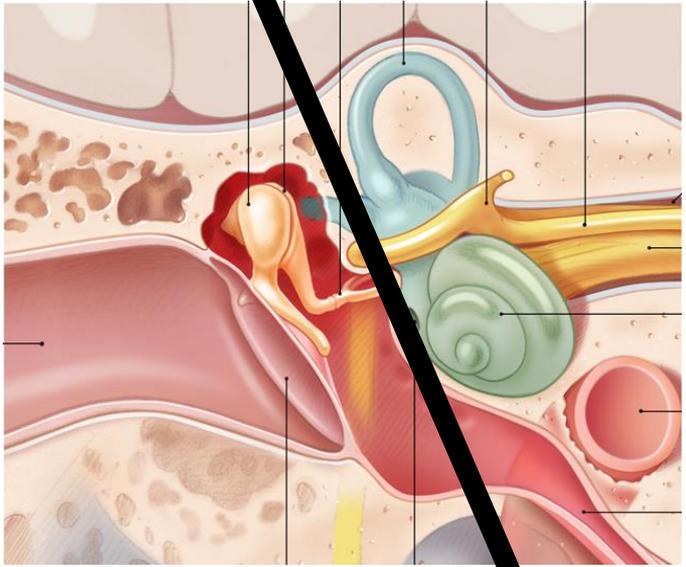
Osia (Cochlear)



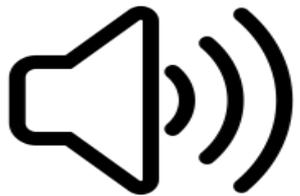
BONEBRIDGE (MED-EL)

# Treating Hearing Loss

**SENSORINEURAL (SNHL)**  
cell/neural solutions



Hearing aids



**CONDUCTIVE (CHL)**  
mechanical solutions



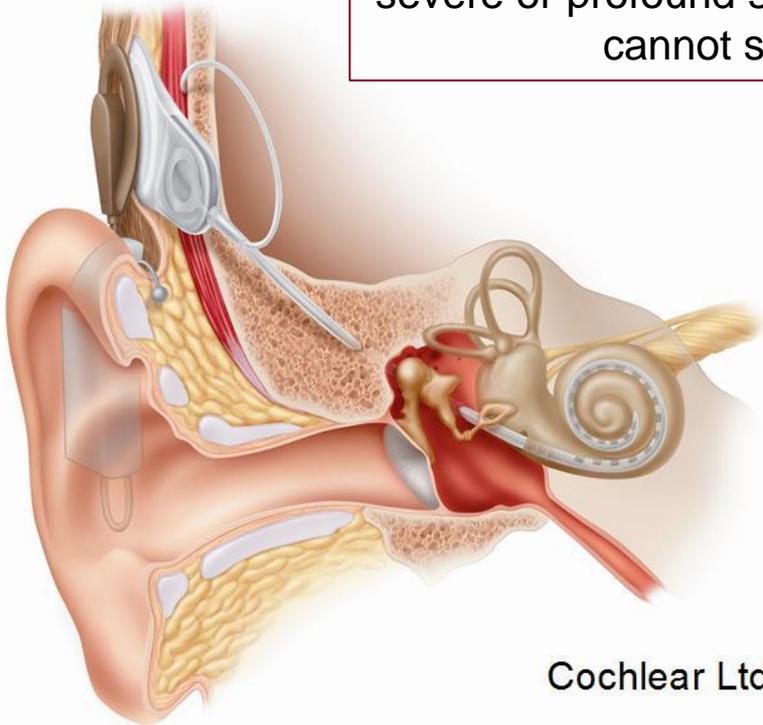
Repair or regrow cells



Electrically  
stimulate nerves

# Cochlear Implantation

Hearing aids often do not adequately benefit persons with severe or profound sensorineural HL because the hair cells cannot stimulate the auditory nerve



Cochlear Ltd



Receiver-Stimulator

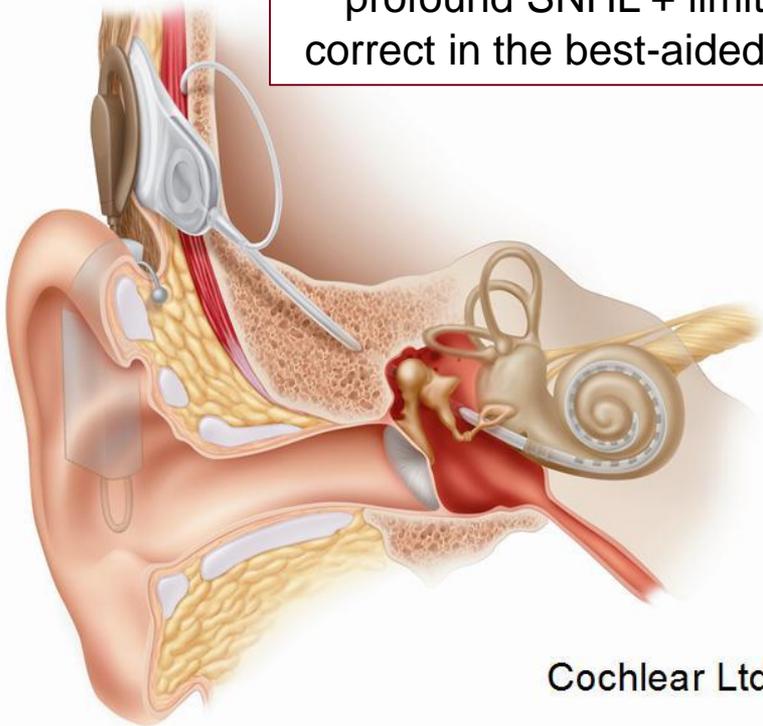


Speech Processor



# Cochlear Implantation

Medicare Criteria (updated 2022): bilateral moderate-to-profound SNHL + limited benefit from amplification (< 60% correct in the best-aided condition on open-set sentence tests)



Cochlear Ltd



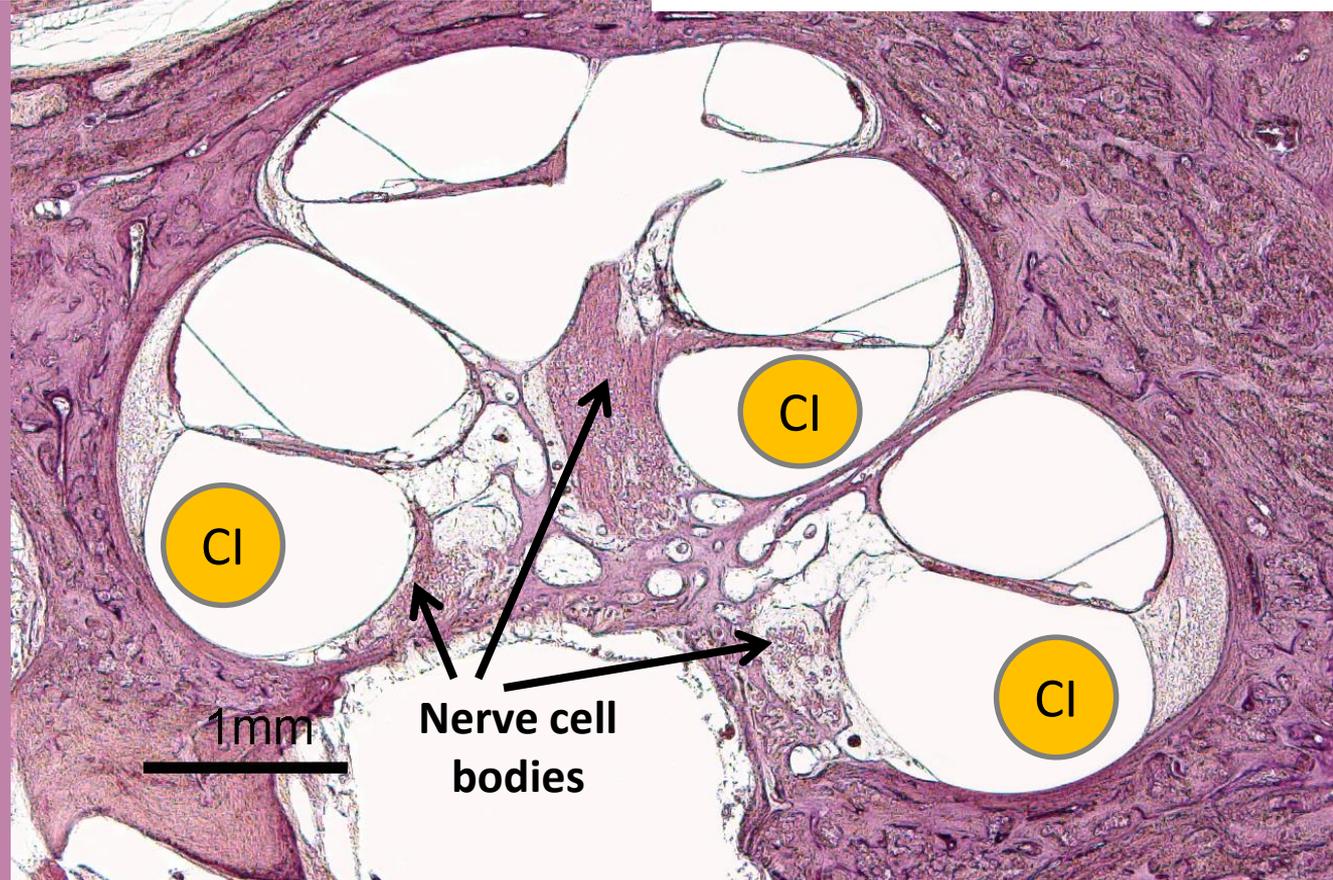
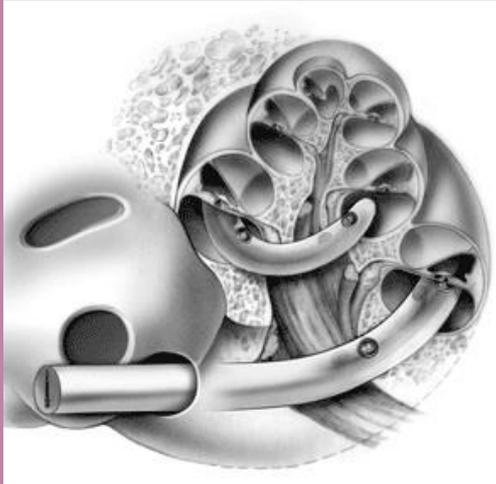
Receiver-Stimulator



Speech Processor



Cochlear implants bypass hair cells to electrically stimulate the auditory nerve



UMN Otopathology Lab  
otopatholgy@umn.edu

# Cochlear Implantation

## Benefits

- Hearing and speech perception
- Quality of life, vocational, social, psychological functioning
- No age limit
- Outpatient procedure

## Limitations

- Not “natural” hearing
- Hearing in Noise
- Range of pitch perception, emotion, music, languages
- Practice needed for performance



Learn more at:

[www.acialliance.org](http://www.acialliance.org)



Thank you!





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