

Hearing Loss in Older Adults: A Public Health Perspective

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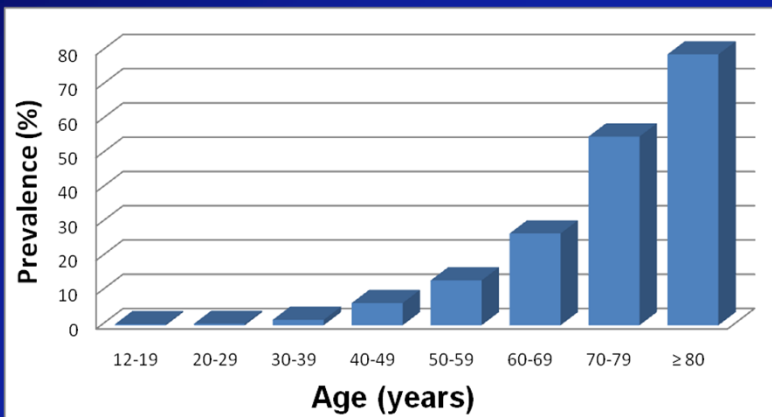
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Disclosures

- Research grants: NIH, Eleanor Schwartz Charitable Foundation, American College of Surgeons, Triological Society
- Consultant for Cochlear Ltd
- Scientific Advisory Board for Pfizer and Autifony Therapeutics
- Speaker honoraria from Amplifon & Med El
- Board of Trustees, Hearing Loss Association of America

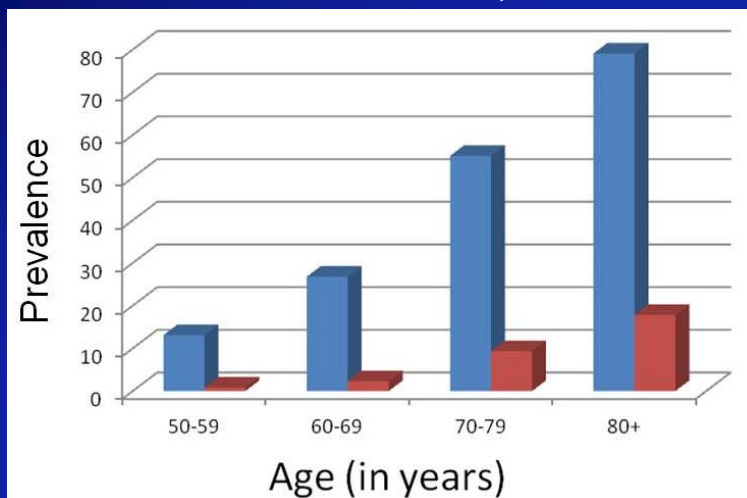
Prevalence of Hearing Loss in the United States, 2001-2008



Hearing loss defined as a better-ear PTA of 0.5-4kHz tones > 25 dB

Lin et al., Arch Int Med. 2011

Hearing Loss & Hearing Aid Use Prevalence in the U.S. , 1999-2006



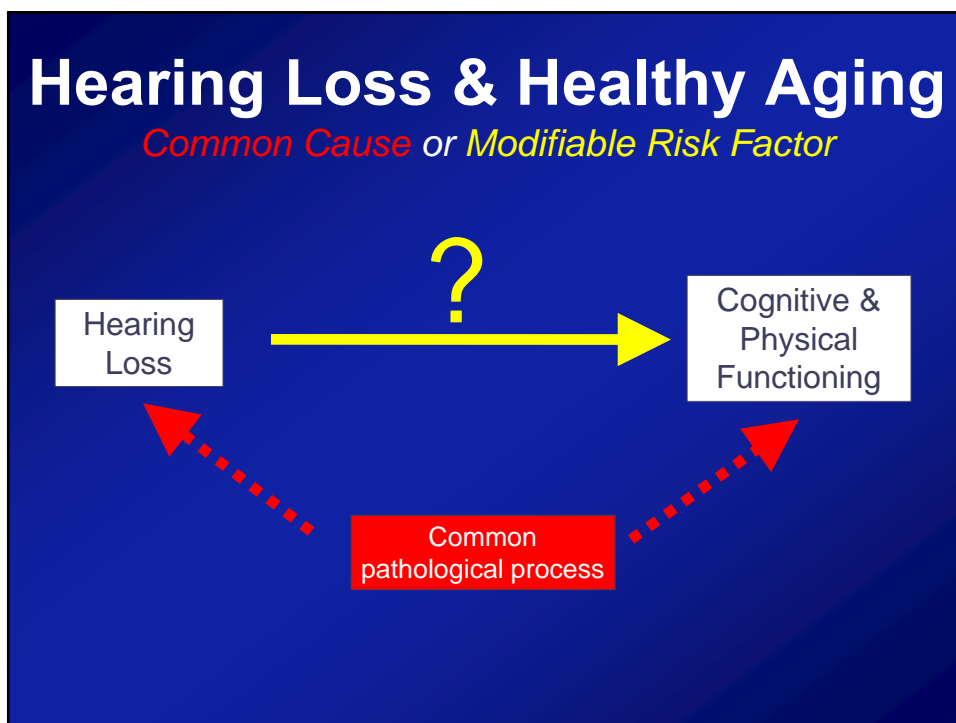
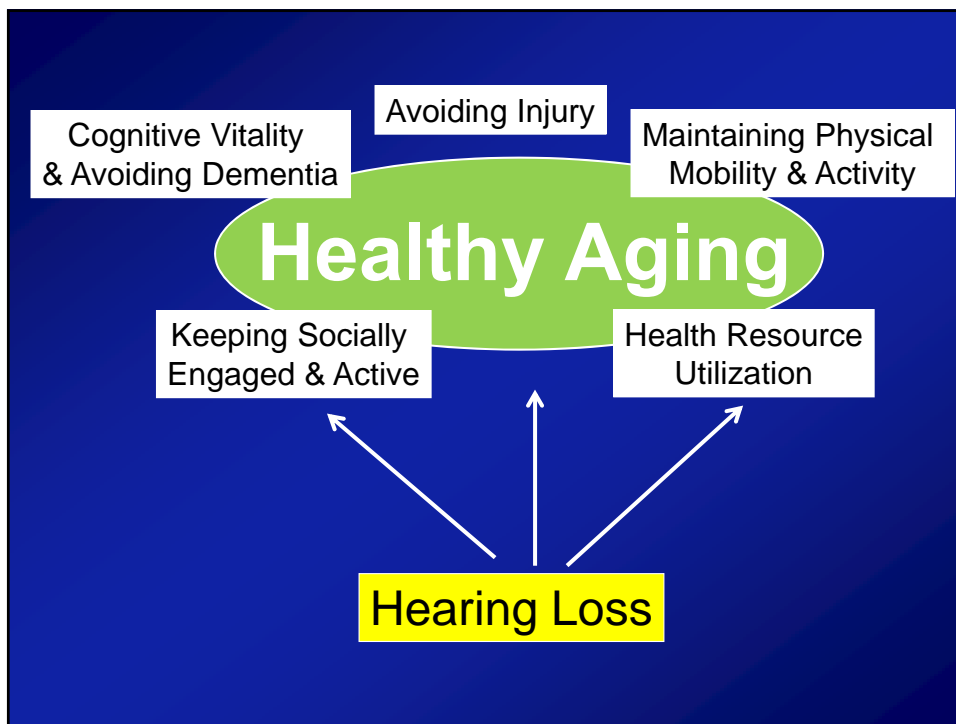
Chien & Lin, Arch Int Med, 2012

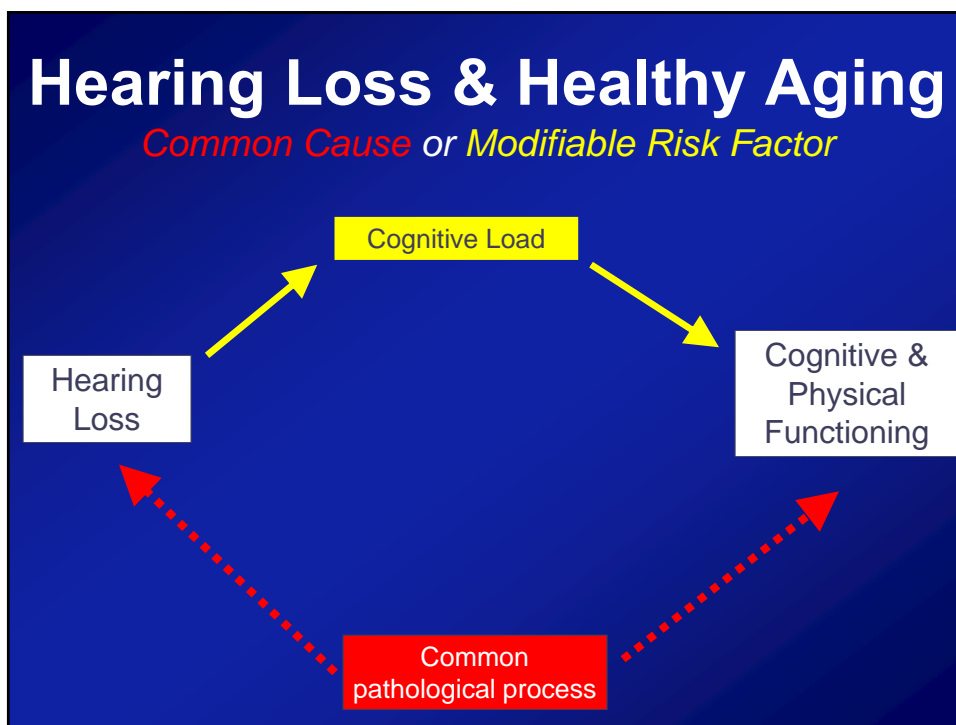
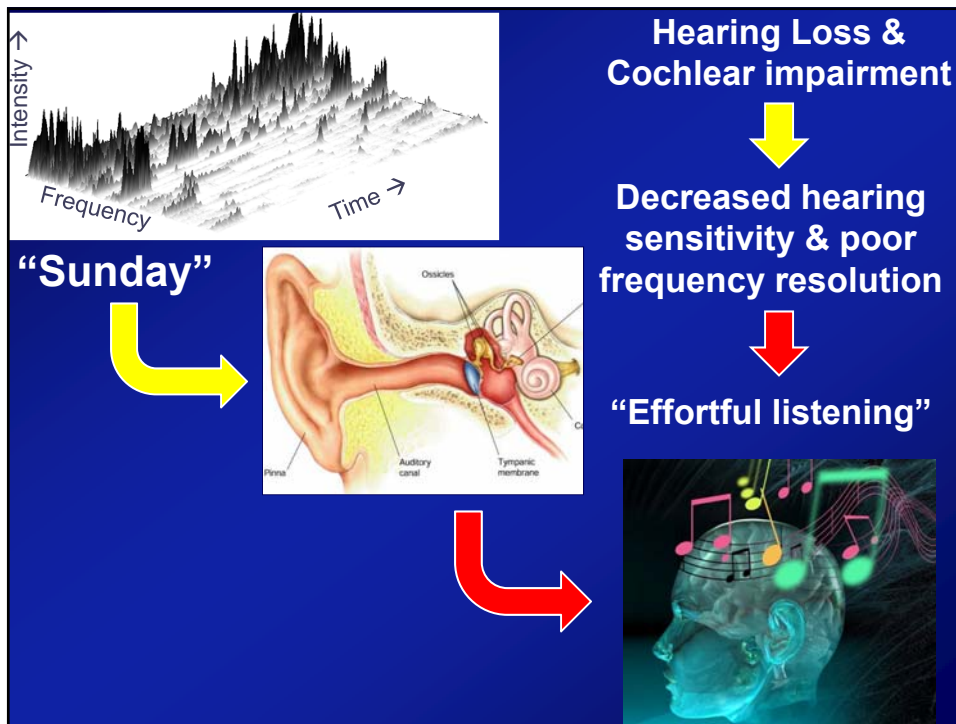
Age-Related Hearing Loss (ARHL)

Basic Questions

- What are the consequences of ARHL for older adults?
- What is the impact of treating ARHL on older adults?
- How can ARHL be effectively addressed in the community?



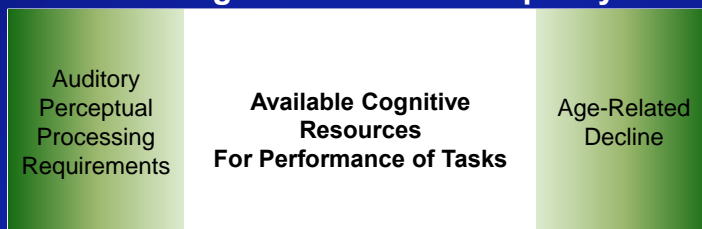




Hearing Loss & Cognitive Load

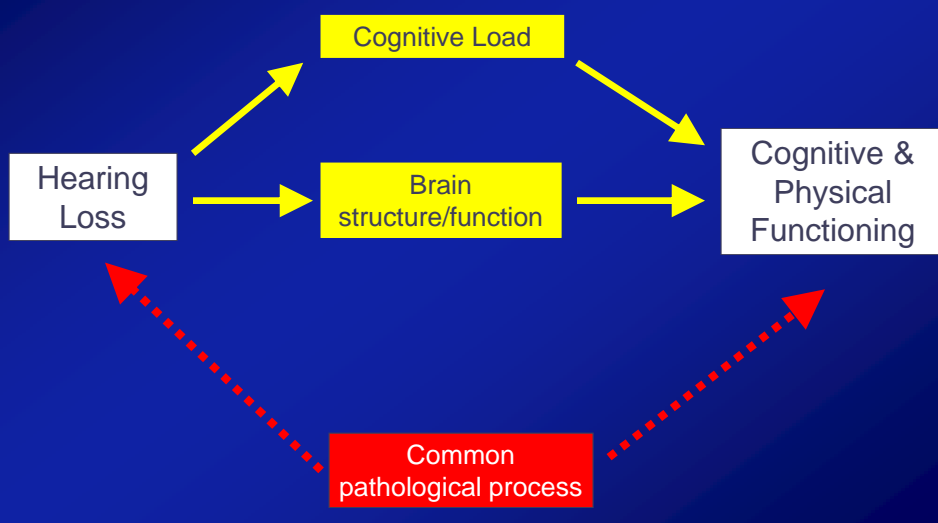
- Kahneman model of shared attention and resource capacity (D. Kahneman, Attention & Effort, 1973)

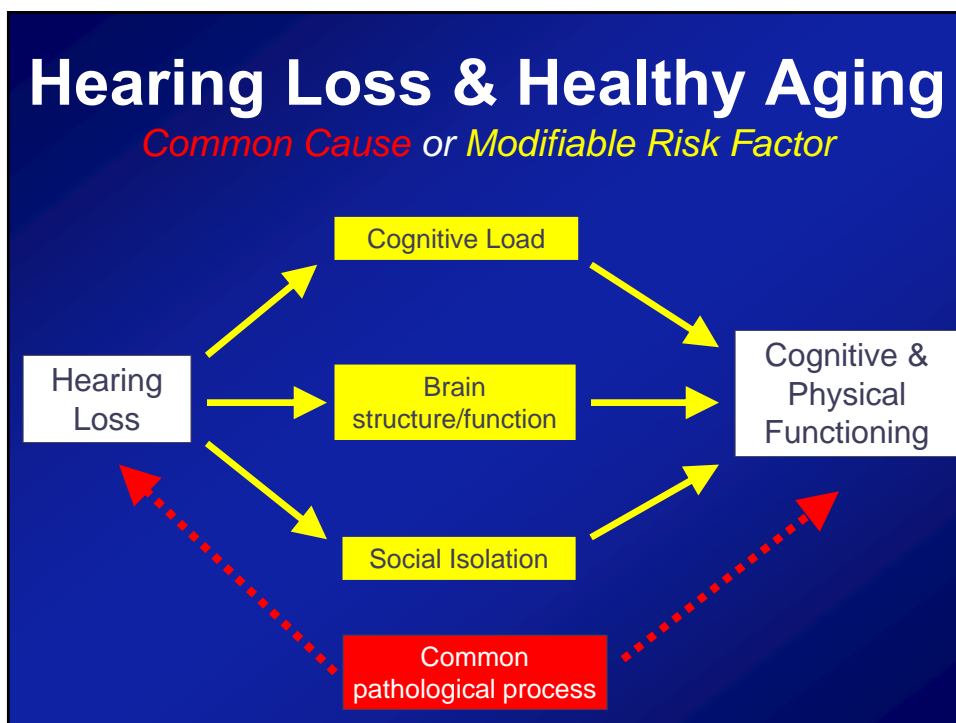
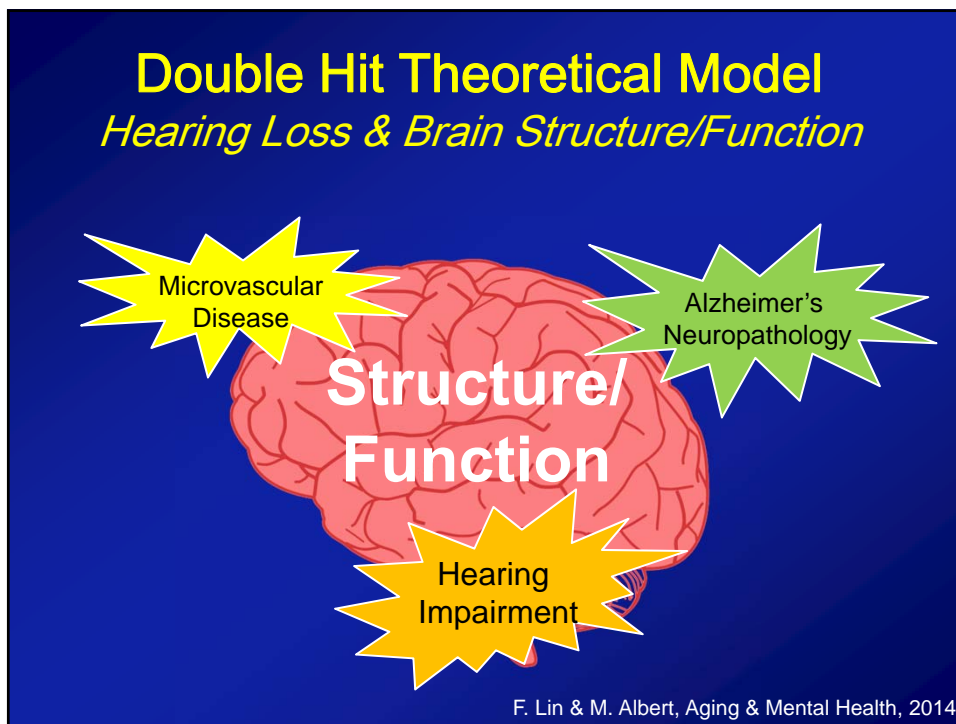
Cognitive Resource Capacity

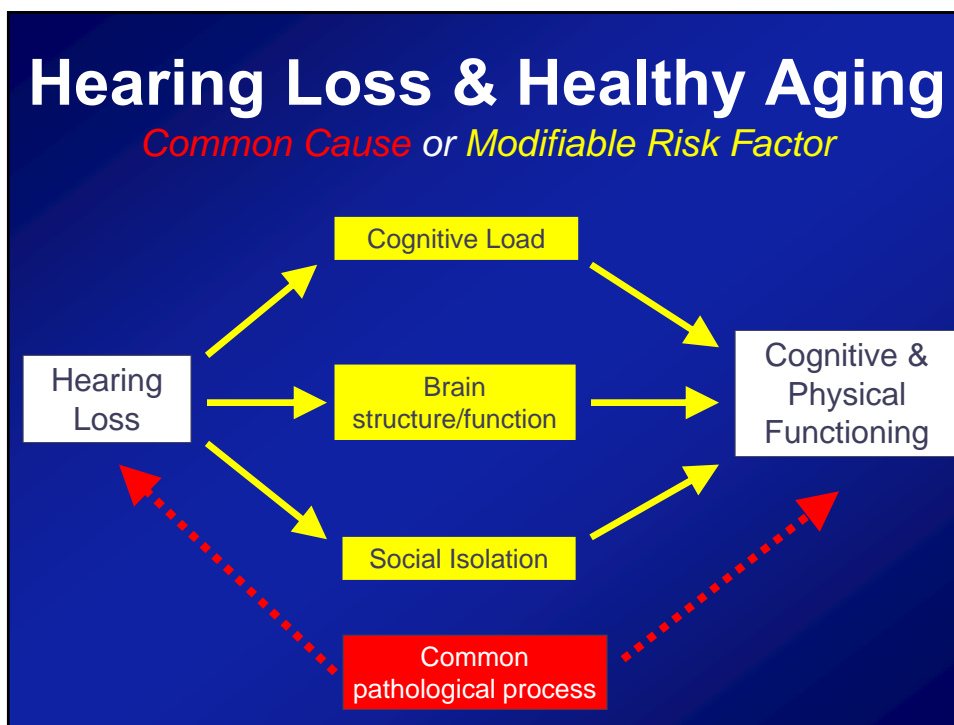
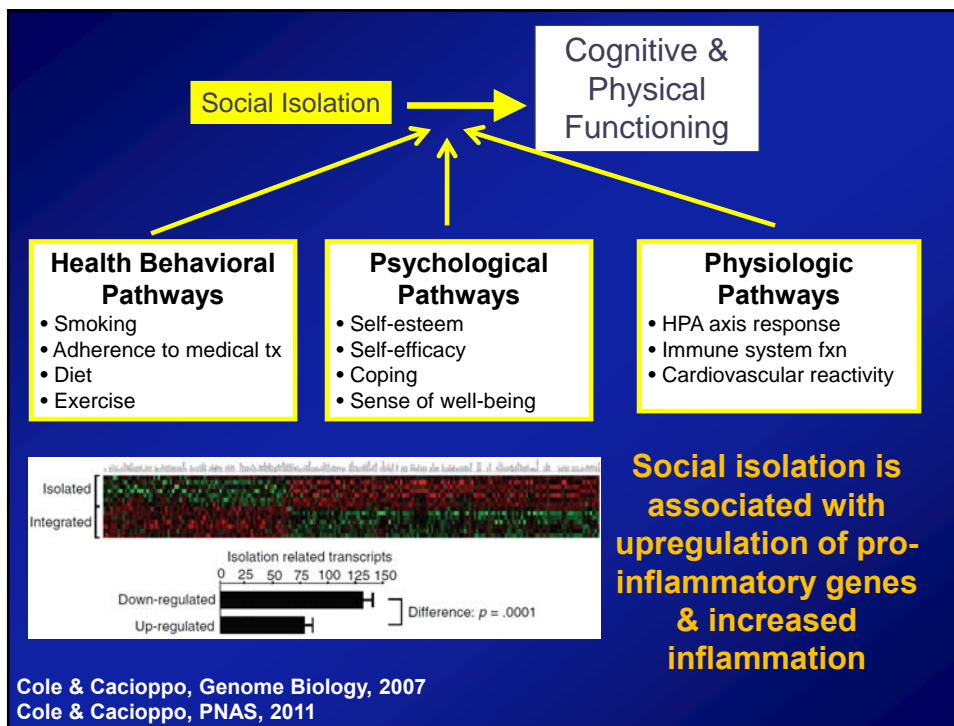


Hearing Loss & Healthy Aging

Common Cause or Modifiable Risk Factor



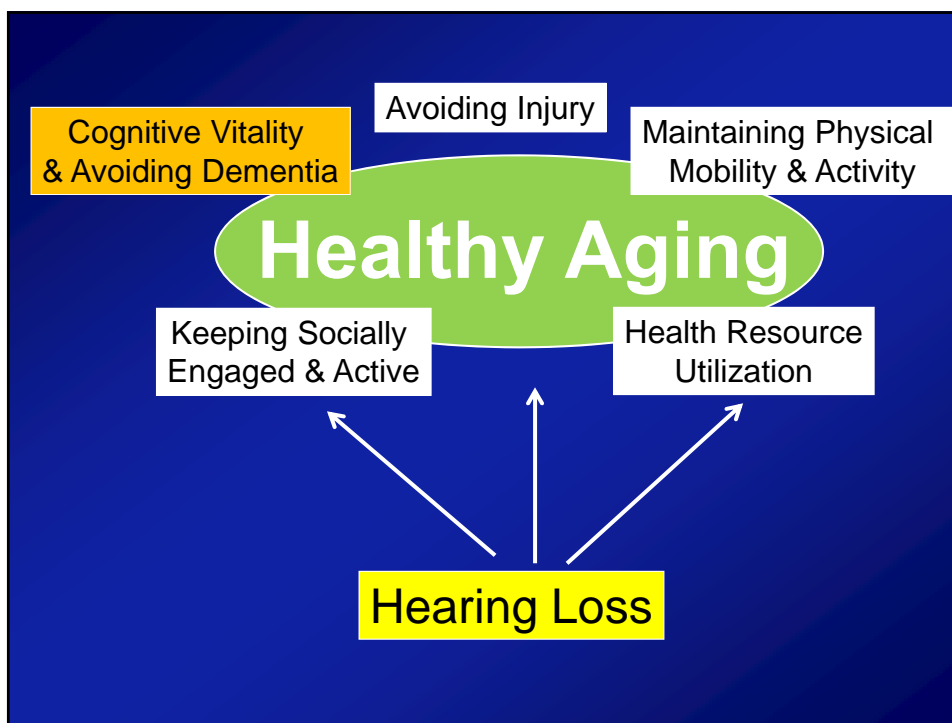


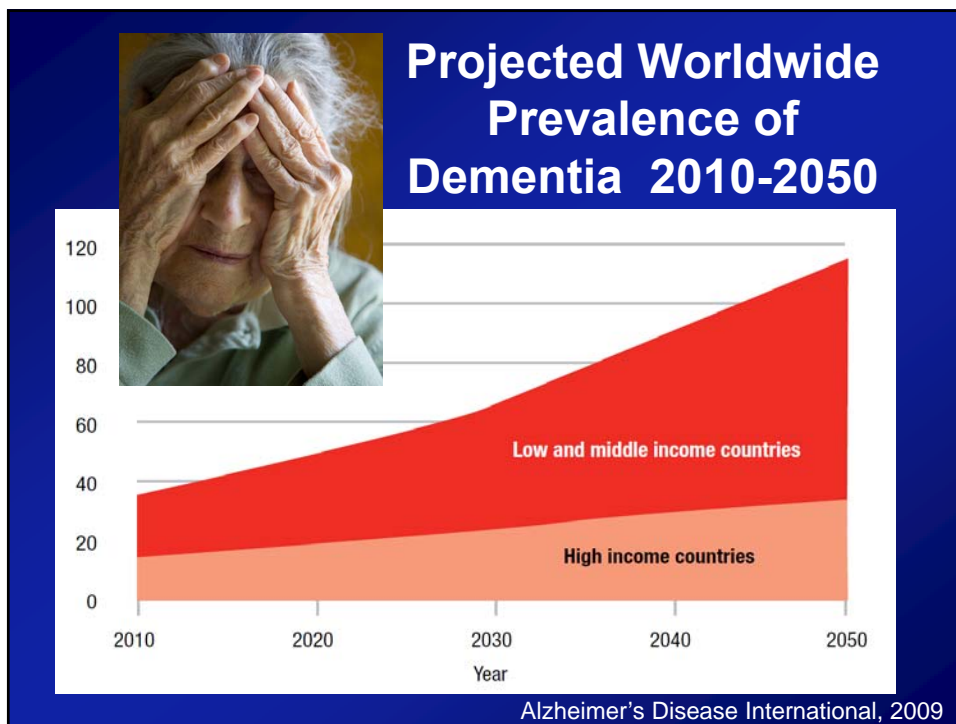


Hearing Loss & Healthy Aging

Datasets for Epidemiologic Analyses

- **NHANES**: National Health and Nutritional Examination Surveys
 - Cross-sectional, representative sample of U.S. population
- **BLSA**: Baltimore Longitudinal Study of Aging
 - Ongoing prospective study of older adults since 1958
- **HealthABC**: Health, Aging, & Body Composition Study
 - Prospective, population-based study of ~3000 adults 70 years and older





Hearing Loss & Cognition

Background

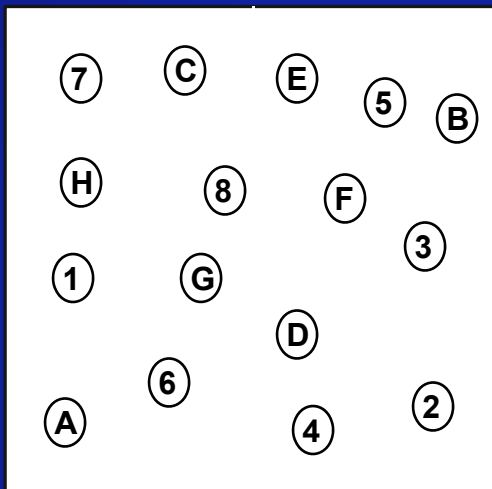
- **Memory**
 - Free and cued selective reminding test (FCSRT)
- **Executive Function**
 - Trail Making B
 - Stroop Mixed
 - Digit symbol substitution
- **Psychomotor/processing speed**
- **Verbal function & language**

These tests are not dependent on hearing.

Hearing Loss & Cognition

Executive Function: Trail Making B

Trail Making B



Hearing Loss & Cognition

Executive Function: Stroop Mixed

Stroop Mixed

GREEN	RED
RED	YELLOW
RED	BLUE
GREEN	BLUE
BLUE	GREEN
BLUE	YELLOW
GREEN	BLACK

Hearing Loss & Cognition

Executive Function: Digit Symbol Substitution Test (DSS)

DSS: Digit Symbol Substitution Test

1	2	3	4	5	6	7	8	9
∇	□	±	∧	X	∩	⊃	⊖	∩

2	1	3	1	2	1	3	1	4	2	4	2	5	1	4	3	5	2	6	2
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1	6	5	2	4	7	3	5	1	7	6	3	8	5	3	6	4	2	1	8
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

9	2	7	6	3	5	8	3	6	5	4	9	7	1	8	5	3	6	8	2
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

7	1	9	3	8	2	5	7	4	1	6	7	4	5	8	2	9	6	4	3
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Hearing Loss and Cognition

Cross-Sectional Studies

NHANES

N = 605 adults 60-69 years

Lin, J. Geront. Med. Sci., 2011

	β^a (95% CI)	Age (per year) <i>P</i>	Hearing loss (per 25 dB) β^b (95% CI)	<i>P</i>	Δ Age (years) equivalent to 25 dB of hearing loss
Digit Symbol Substitution Test	-0.55 (-0.92 – -0.18)	<.01	-3.86 (-7.15 – -0.56)	.02	7.0

BLSA

N = 347 adults >60 years

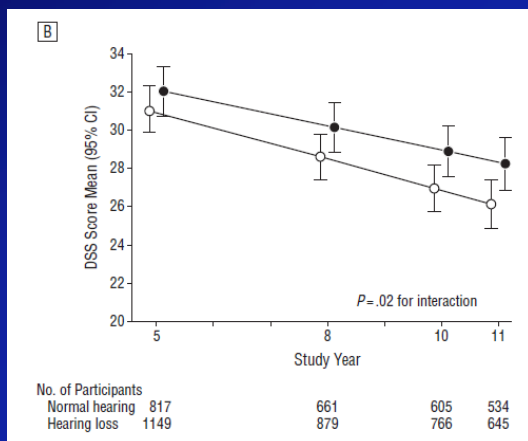
Lin et al., Neuropsych., 2011

Stroop Mixed	-0.33 (-0.48 – -0.18)	<.001	-2.27 (-4.14 – -0.40)	.02	6.8
Trail Making B	-0.00011 (-0.00018 – -0.000044)	.001	-0.00074 (-0.0015 – 2.74x10 ⁻⁶)	.05	6.7

Models adjusted for age, sex, race, education, diabetes, smoking, hypertension

Hearing Loss & Cognitive Decline

Adjusted **3MS** & **DSS** scores by years of follow-up and hearing loss status in 1,966 adults > 70 years followed for 6 years



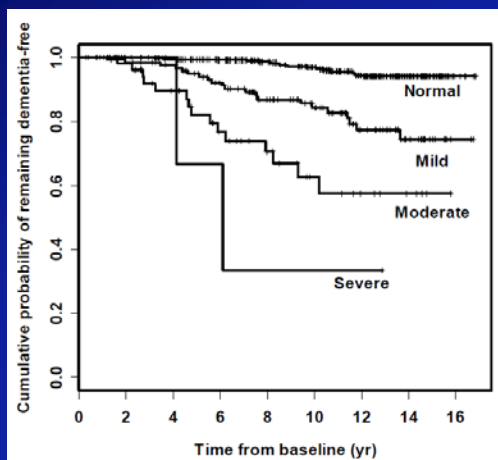
41% faster rate of cognitive decline in **3MS scores in HL vs. NH**

Adjusted for age, sex, race, education, study site, smoking status, hypertension, diabetes, and stroke history

Lin et al. JAMA Int Med. 2013

Hearing Loss & Incident Dementia

Dementia incidence in 639 adults followed for >10 years in the **BLSA**



Risk of incident all-cause dementia (compared to normal hearing)^a

	HR	95% CI	P
Mild	1.89	1.00 – 3.58	0.05
Moderate	3.00	1.43 – 6.30	.004
Severe	4.94	1.09 – 22.4	.04

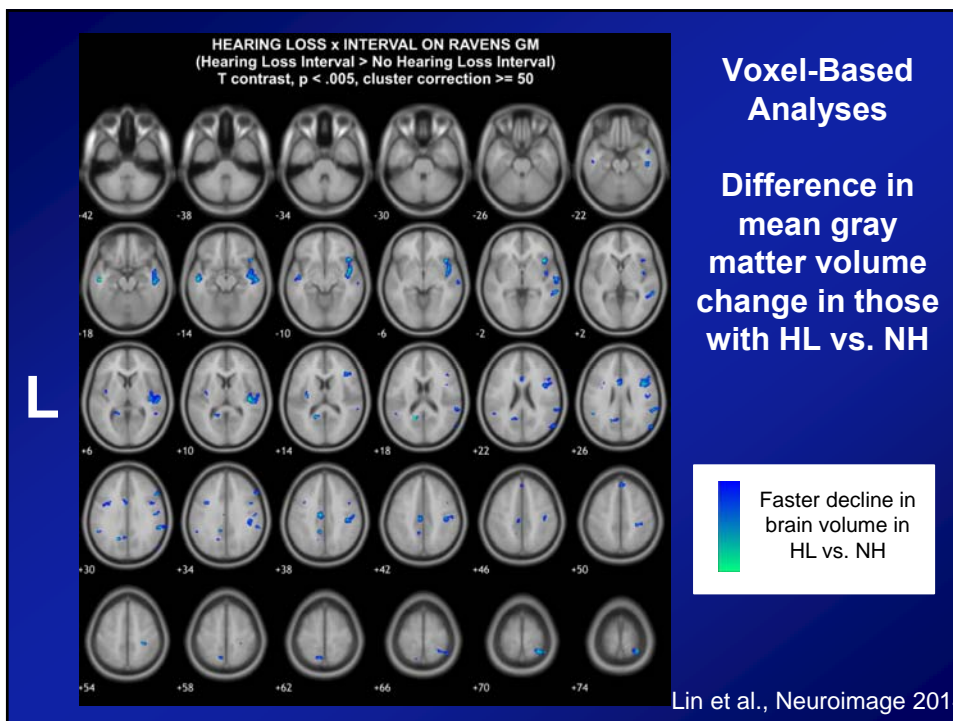
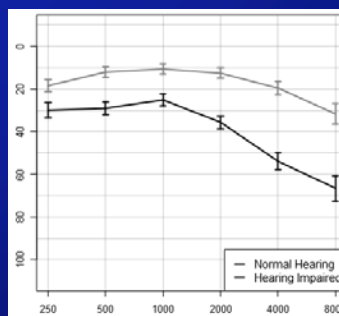
^a Adjusted for age, sex, race, education, DM, smoking, & hypertension

Lin et al., Arch Neuro., 2011

Hearing Loss & Accelerated Brain Volume Decline

BLSA

- **Hypothesis:** Hearing loss is associated with accelerated atrophy in the superior, middle, and inferior temporal gyri
- 126 participants (56-86 yrs) in the neuroimaging substudy of the BLSA
 - Mean follow-up duration of 6.4 years
 - 1.5T MRI performed annually



Healthy Aging

- Cognitive Vitality & Avoiding Dementia
- Avoiding Injury
- Maintaining Physical Mobility & Activity
- Keeping Socially Engaged & Active
- Health Resource Utilization/Mortality

Avoiding injury

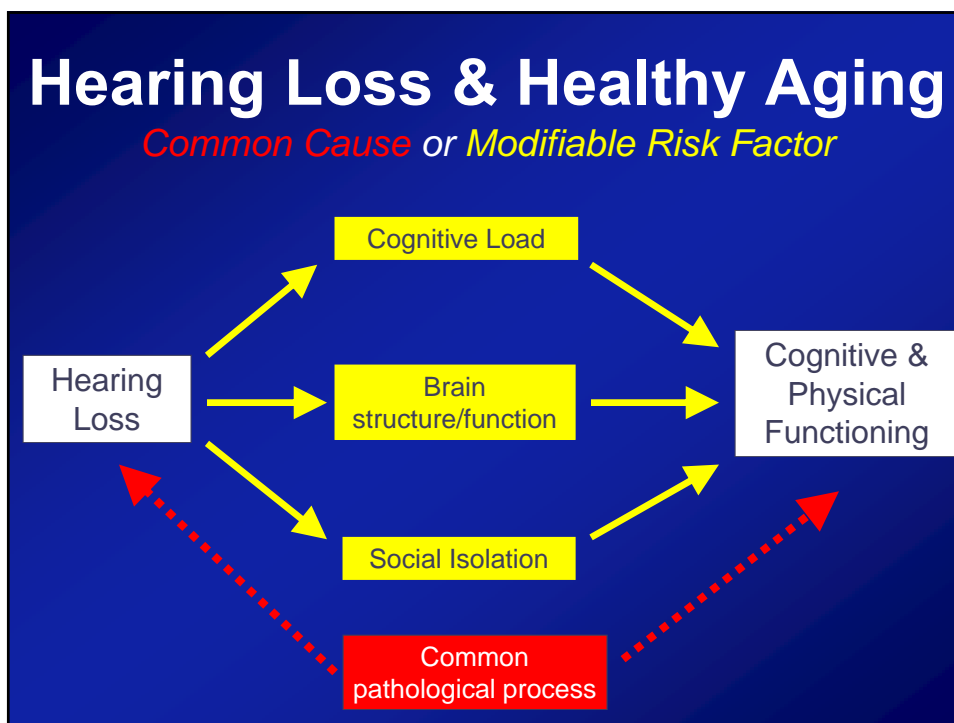
- Increased falls (Viljanen et al. , JGMS 2009; Lin et al. Arch Int Med 2012)

Physical mobility/functioning

- Reduced walking speed (Viljanen et al. JAGS 2009; Li et al., Gait & Posture 2012)
- Accelerated decline in physical functioning (Chen et. al. JAGS, in press)
- Driving ability (Hickson et al. JAGS 2009; Picard et al 2008)

Health resource utilization/mortality

- Increased odds of hospitalization (Genther et al, JAMA, 2013)
- Increased mortality (Karpa et al Ann Epi 2010; Fisher et al. 2013; Genther et al, JGMS 2014)



Age-Related Hearing Loss (ARHL)

Basic Questions

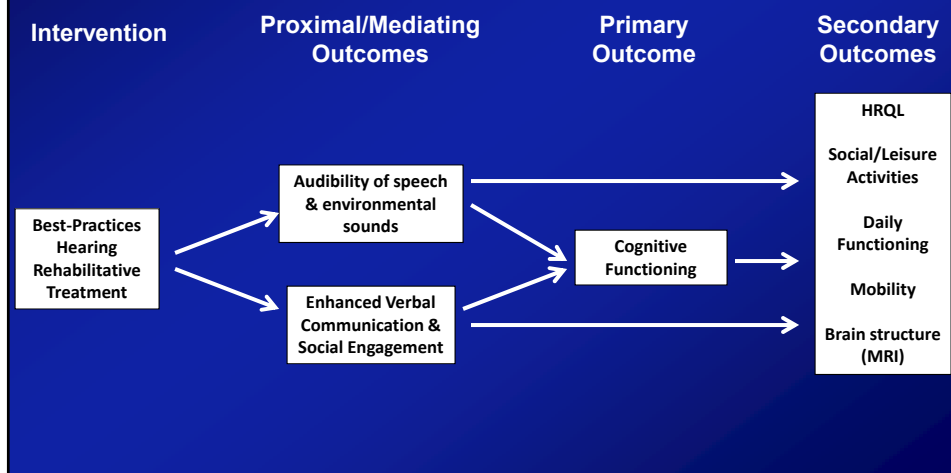
- What are the consequences of ARHL for older adults?
- **What is the impact of treating ARHL on older adults?**
- How can ARHL be effectively addressed in the community?

The question of whether treating hearing loss could delay cognitive/physical decline or dementia remains unknown

There has never been a randomized clinical trial of treating hearing loss to explore effects on reducing the risk of cognitive decline/dementia

Conceptual Model for HL-Cognition RCT

In collaboration with Marilyn Albert, Joe Coresh, Richey Sharrett, ARIC Study Team (T. Mosley, D. Knopman, C. Jack), and U. South Florida (T. Chisolm, A. Eddins)



Trial Design

Timeline & Overview of RCT

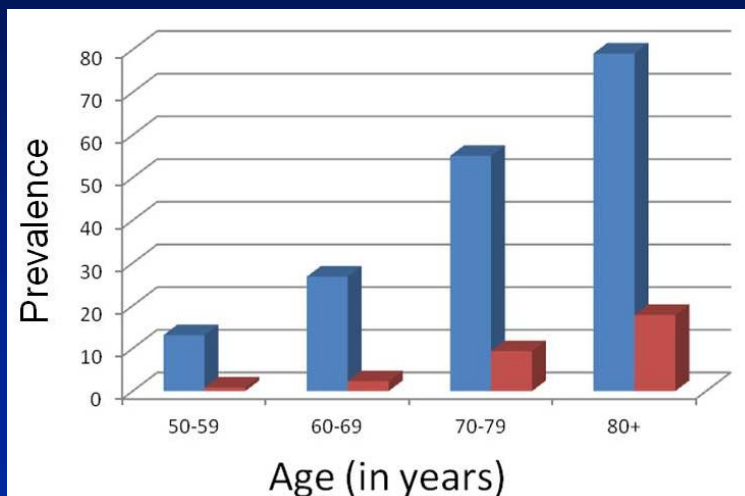
- Timeline:
 - 2014-2016 RCT planning process (R34AG046548)
 - Pilot study, development of protocol/operations manual, etc.
 - 2016 Trial grant submission
 - 2017-18 Recruitment at ARIC field sites
 - 2018-21 Follow-up
- Participants: ~766 70-84 y.o., healthy, cognitively normal community-dwelling adults with untreated mild-moderate HL recruited
- Intervention: Randomization to best-practices hearing rehabilitative treatment vs. successful aging intervention control
- Outcome: Study powered to detect 0.25 effect-size difference in rates of cognitive decline between the two groups at 3 years post-randomization

Age-Related Hearing Loss (ARHL)

Basic Questions

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- **How can ARHL be effectively addressed in the community?**

Hearing Loss & Hearing Aid Use Prevalence in the U.S. , 1999-2006



Arch Int Med, 2012

Prevalence of Hearing Aid Use

- **United States** (Arch Int Med, 2012)
 - 26.7M adults \geq 50 years with hearing loss
 - 3.8M use hearing aids
 - **Overall rate of HA use: 14.2%**
- **England and Wales** (NICE Report, 2000)
 - 8.1M with hearing loss
 - 1.4M use hearing aids
 - **Overall rate of HA use: 17.3%**

Barriers to Hearing Health Care (HHC)

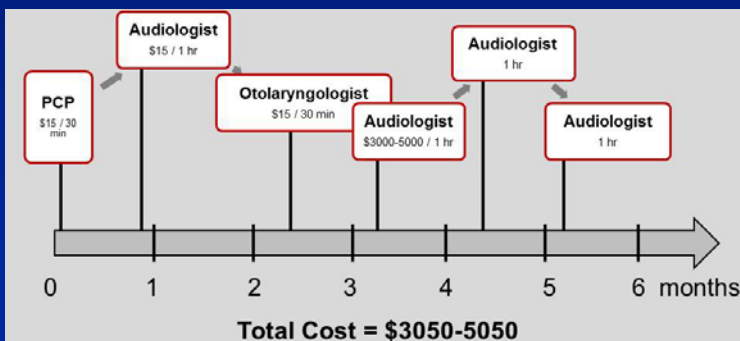
Cost/Affordability

Access to Services
& Technology

Access to Services & Technology

Current (only) gold-standard model of HHC:

- Repeat clinic-based visits with audiologist/dispenser for evaluation, counseling, sensory management, fitting
- FDA/state regulations restrict direct access to hearing aids

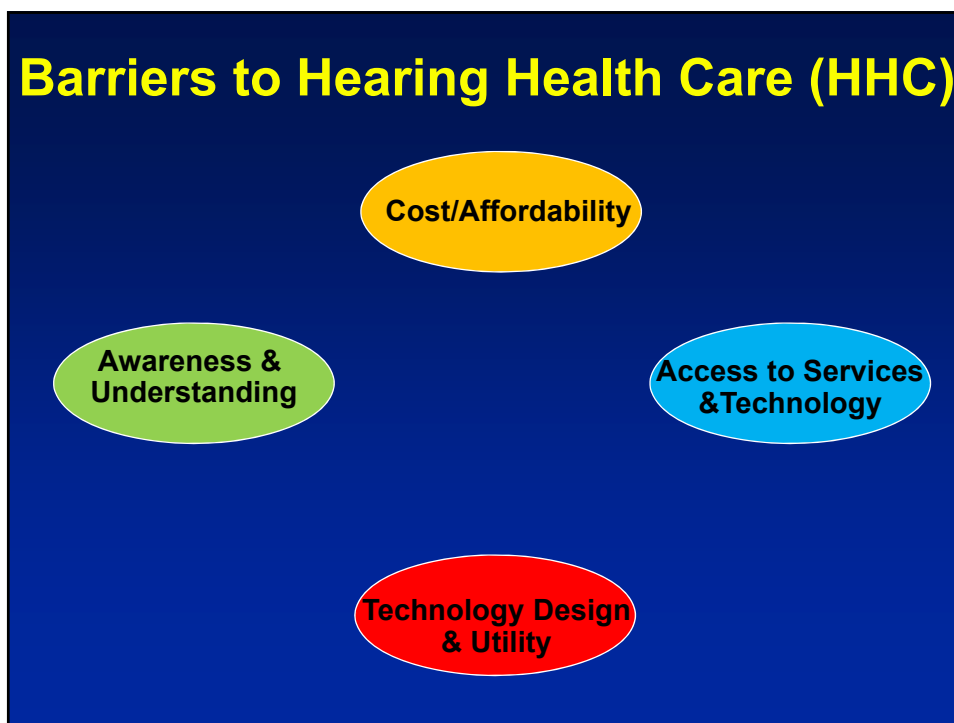
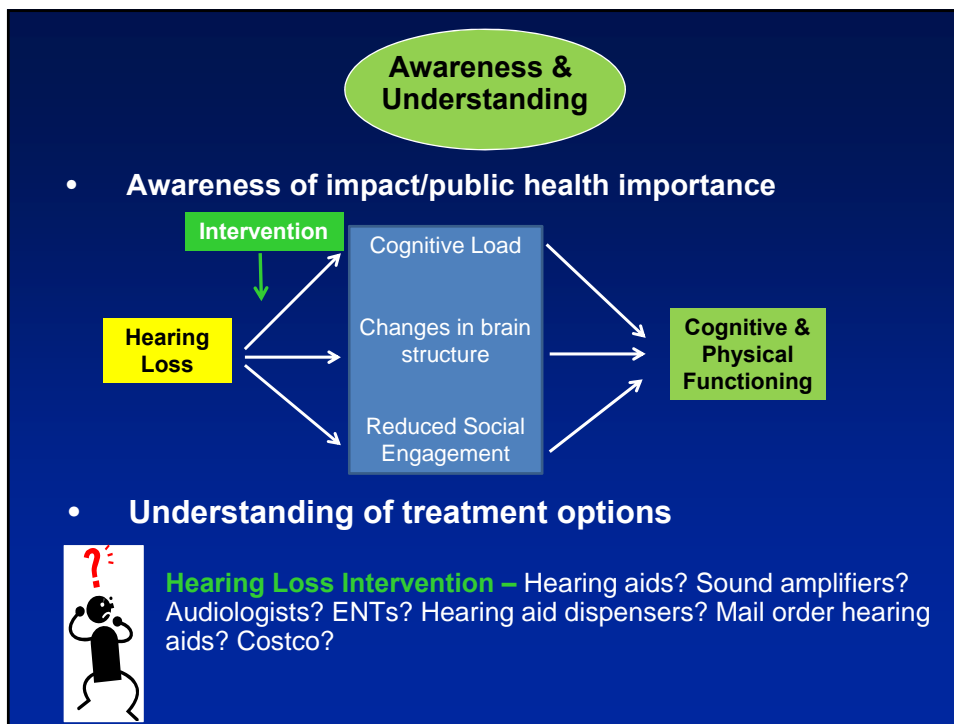


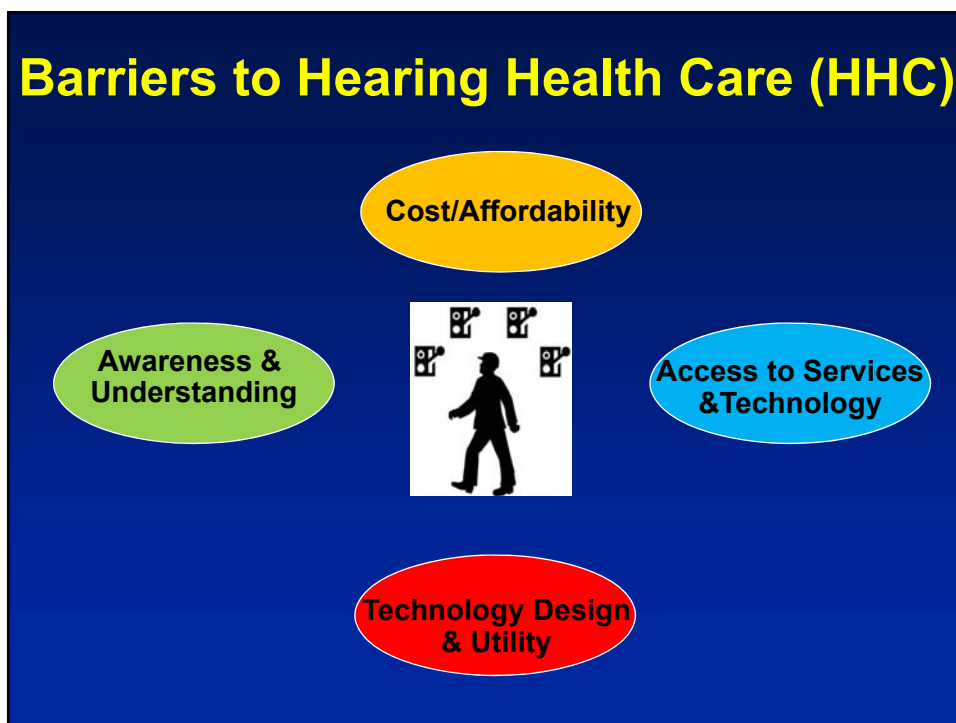
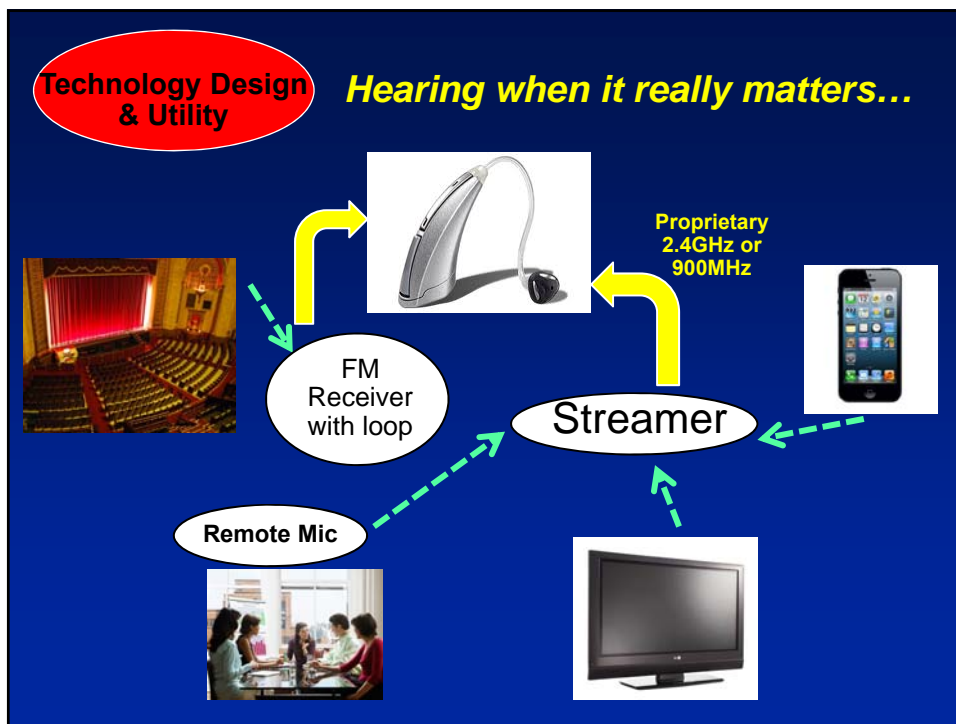
Barriers to Hearing Health Care (HHC)

Cost/Affordability

Awareness & Understanding

Access to Services & Technology





How can ARHL be effectively addressed in the community?

Future Trends

- Understanding & approaching hearing loss in the context of healthy aging/public health
 - Institute of Medicine Workshop in the U.S. addressing 3 basic questions on HL & healthy aging

IOM Workshop on Hearing Loss & Healthy Aging

January 13-14, 2014 Washington, D.C.

- Two-day workshop addressing:
 - Implications of HL for healthy aging/public health & needed areas of research
 - Developing innovative models of care & technologies to address HL
 - Short & long-term collaborative strategies to approach HL as a public health priority in the U.S.

www.iom.edu/hearingloss-aging



How can ARHL be effectively addressed in the community?

Future Trends

- Understanding & approaching hearing loss in the context of healthy aging
 - Jan 2014 Institute of Medicine Workshop in the U.S.
- Innovations in hearing health care/technology
 - Accessible services & affordable technology

Innovations in Hearing Health Care

Affordable & Accessible Options are Needed

- **Technology – Personal sound amplifiers (PSAP)**
 - Over-the-counter “hearing aids” with in-situ testing & verification
 - Cost < \$100-300

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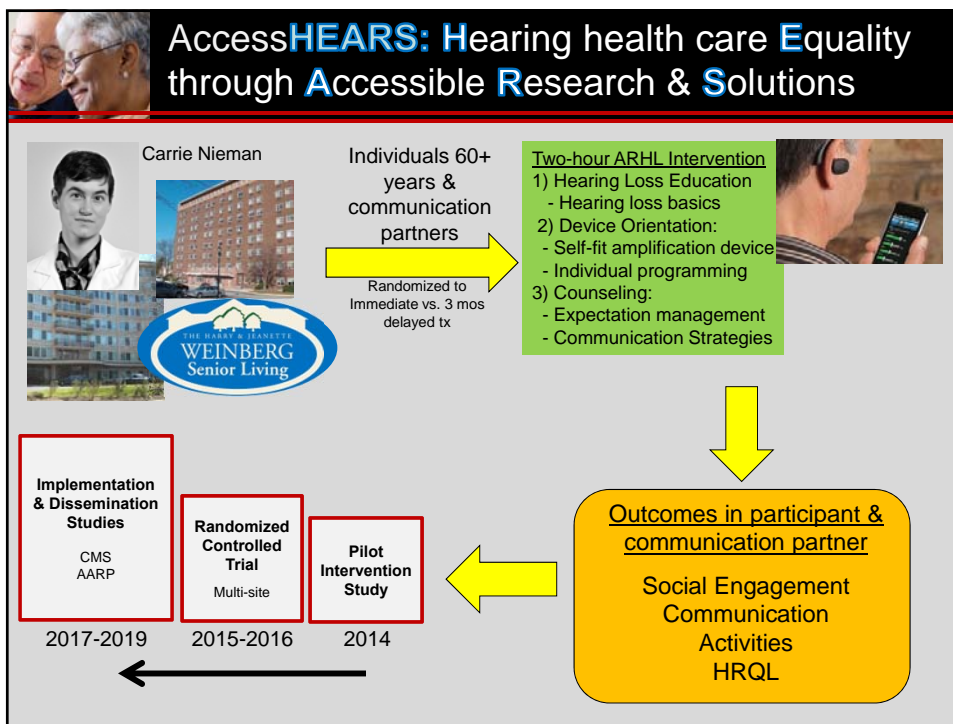
Resources
 > Quick Start Guide
 > User Guide
 > Included Accessories

CS10
Personal Sound Amplifier \$299.99

Innovations in Hearing Health Care

Affordable & Accessible “Stepping Stones” are Needed for Hearing Health Care

- **Technology – Personal sound amplifiers (PSAP)**
 - Over-the-counter “hearing aids” with in-situ testing & verification
 - Cost < \$100-300
- **Services - Community health care workers**
 - Community-based hearing screening
 - Counseling, education, & provision of sound amplifiers & other assistive technologies
 - Referral as needed



Training Workbook

Baltimore HEARS

Access HEARS
Hearing Health through Accessible Research & Solutions

CS-50




Text

Contrast

Icons

Reading Level

Baltimore HEARS

-  Learn to Use a Listening Device
-  Understanding Hearing
-  Communication Tips and Tricks

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Principles of Instruction


1. Engage in solving meaningful problems
2. Activate relevant previous experience
3. Demonstration
4. Use new skill to solve problems
5. Integrate new skill into daily life


How We Hear

There are 3 main steps in how we hear.





Sound enters ear





Signal goes to brain





Brain interprets signal

Checklist




Explain the 3 steps of hearing

Listen by Mister Pixel from The Noun Project
Brain by Marek Polakovic from The Noun Project




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

Normal Hearing

Some Hearing Loss


A lot of Hearing Loss







Listen by Mister Pixel from The Noun Project
Brain by Marek Polakovic from The Noun Project

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Communication Tips and Tricks

1. Attention First 
2. Get Face to Face 
3. Speak Slowly 
4. Big Ideas and Key Words 
5. Repeat then Reword 
6. Summarize 

Person by Wilson Joseph from The Noun Project
 People by Irene Hoffman from The Noun Project
 Snail by AJL from The Noun Project
 Speech Bubbles by Thomas Le Bes from The Noun Project
 Talking by Lorian Ows from The Noun Project
 Head by Jens Tarning from The Noun Project


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Tip #1: Attention First

The conversation can't start until you are in the same room and both of you are aware you want to share something.



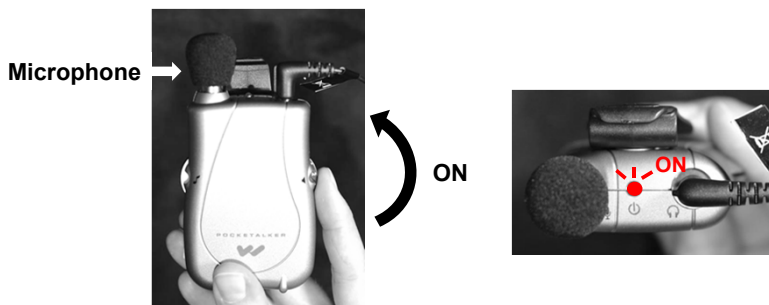
Example
Talking across a room

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Person by Wilson Joseph from The Noun Project

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 **Turn ON the Pocket Talker**



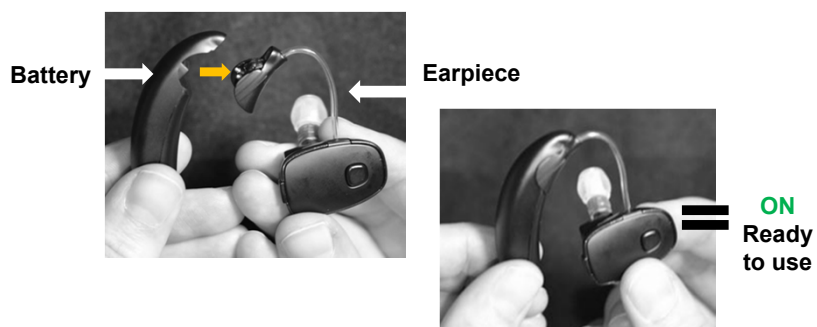
Checklist

- Turn ON Pocket Talker
- Note red ON light

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 **Place the Battery, Turn on CS-50**

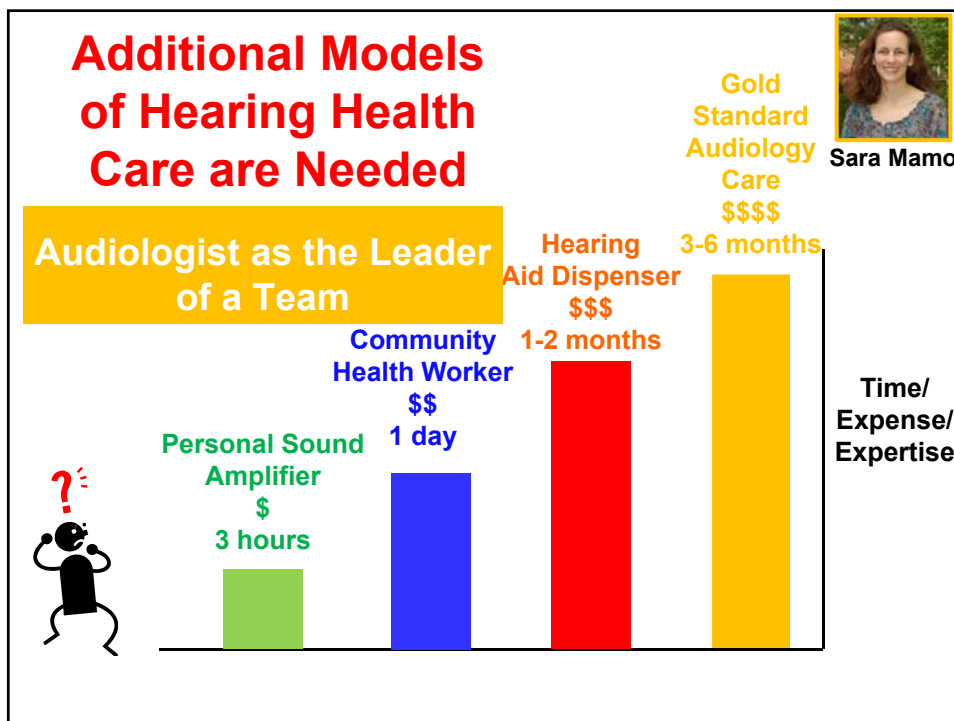


Checklist

- Connect battery to earpiece
- Indicate when CS-50 is ON

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How can ARHL be effectively addressed in the community?

Future Trends

- Understanding & approaching hearing loss in the context of healthy aging
 - Jan 2014 Institute of Medicine Workshop in the U.S.
- Innovations in hearing health care/technology
 - Accessible services & affordable technology
 - Open wireless standards

Open Wireless Standards

- Fundamental limitation of all hearing aids?
- How to increase signal-to-noise ratio?
- Options:
 - Post-microphone
 - Algorithmic processing of sound
 - Pre-microphone
 - Hearing loop systems
 - Proprietary wireless systems (2.4Ghz, 900Mhz)



Convergence of medical devices with consumer electronics



How can ARHL be effectively addressed in the community?

Future Trends

- Understanding & approaching hearing loss in the context of healthy aging
- Innovations in hearing health care/technology
 - Accessible services & affordable technology
 - Open wireless standards
- Third-party reimbursement of hearing health care
 - Unbundling of hearing health care
 - Coverage for audiologic rehabilitative services (not devices)





“Are you telling me that I’m going to develop dementia?”

- Consequences of hearing loss on older adults?
- Impact of treating hearing loss on older adults?
- How can hearing loss be effectively addressed in the community?
- **Hypertension** → Heart attack & stroke
 - Intervention: Medication, Lifestyle modification
- **Hearing loss** → Cognitive decline, dementia, poorer physical functioning
 - Intervention: Comprehensive hearing tx?

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- Johns Hopkins
 - Carrie Nieman
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