Hearing Loss and Dementia

AuDacity

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Disclosures

- No relevant financial relationship with commercial interests

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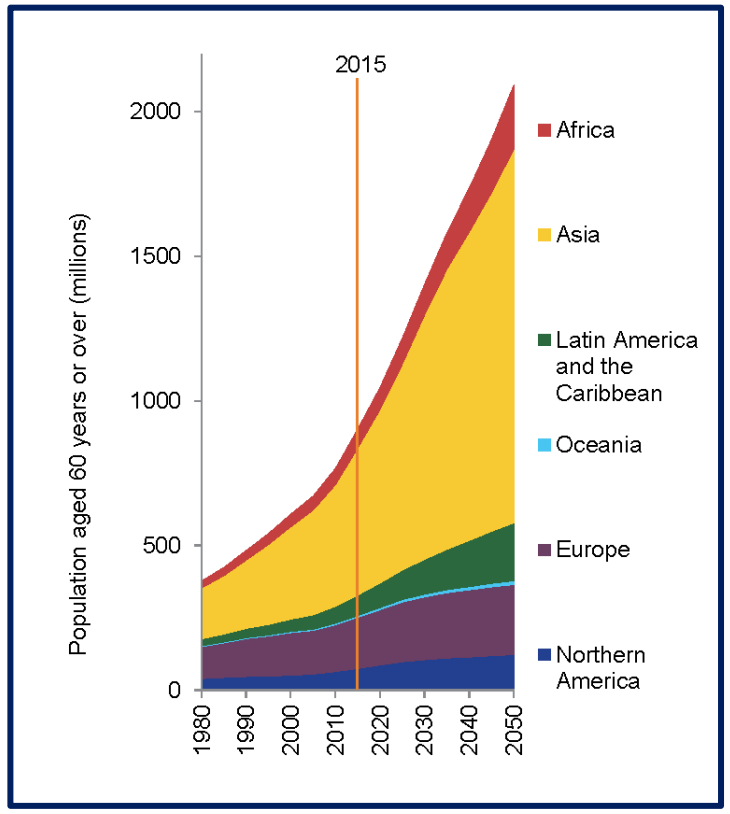
  - The Roberts Fund

Outline

- Epidemiology of hearing loss and Dementia (Alzheimer's disease)
- Hearing loss and dementia prevention
- Hearing loss in dementia population across health care system

Aging and Public Health

Population Ages 60+ by Region
1980 – 2050



Source: United Nations (2015). World Population Prospects

Eras of Public Health

1st – Infectious diseases (20th cent.)

2nd – Chronic diseases (mid 20th cent. – now)

3rd – Aging processes (21st cent. & on)

Hearing Loss and Dementia

Fries JF, 1982; Deaton A, 2013

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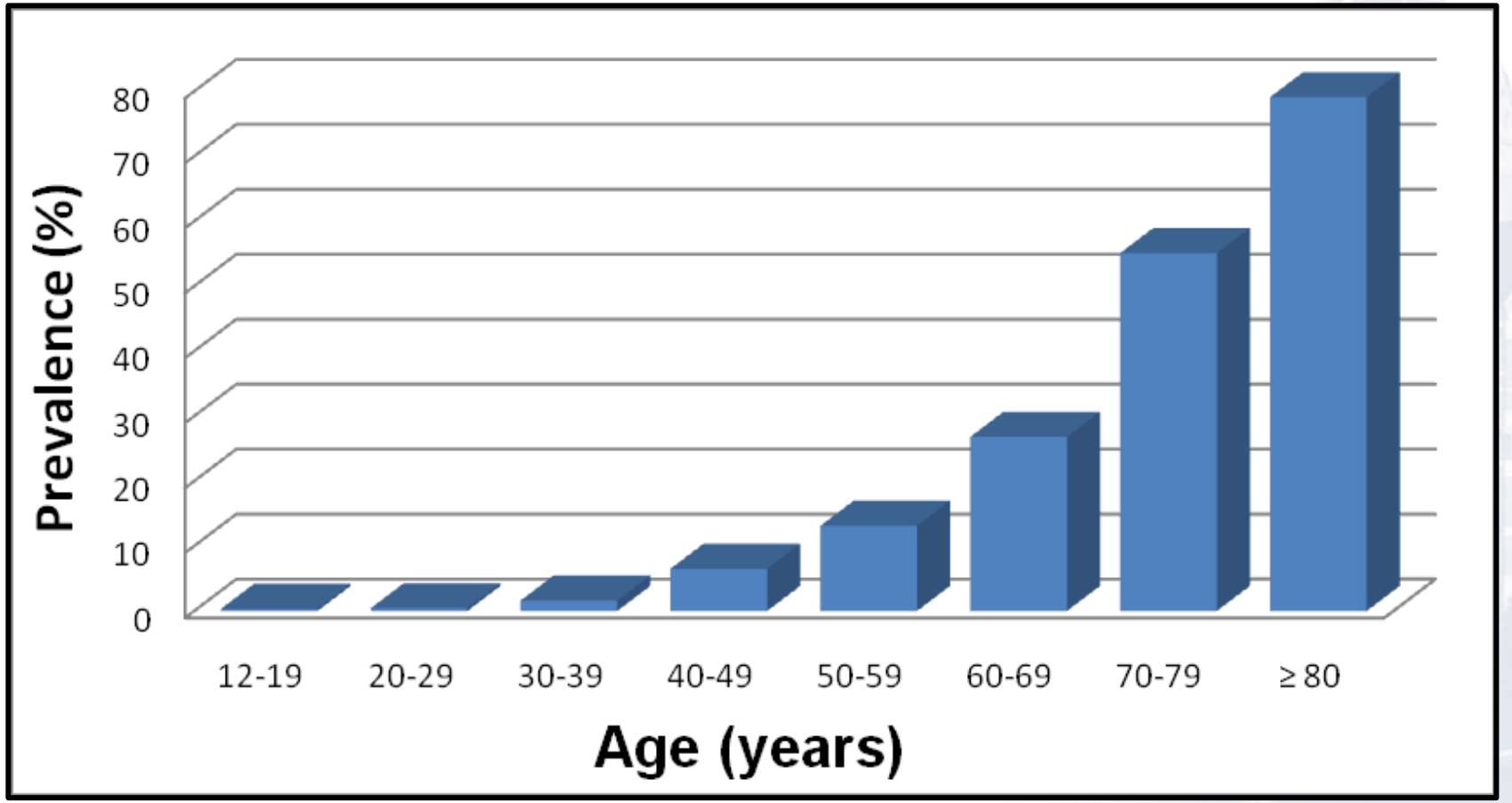
Prevalence of Hearing Loss by Age Decade



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

Arch Int Med. 2011

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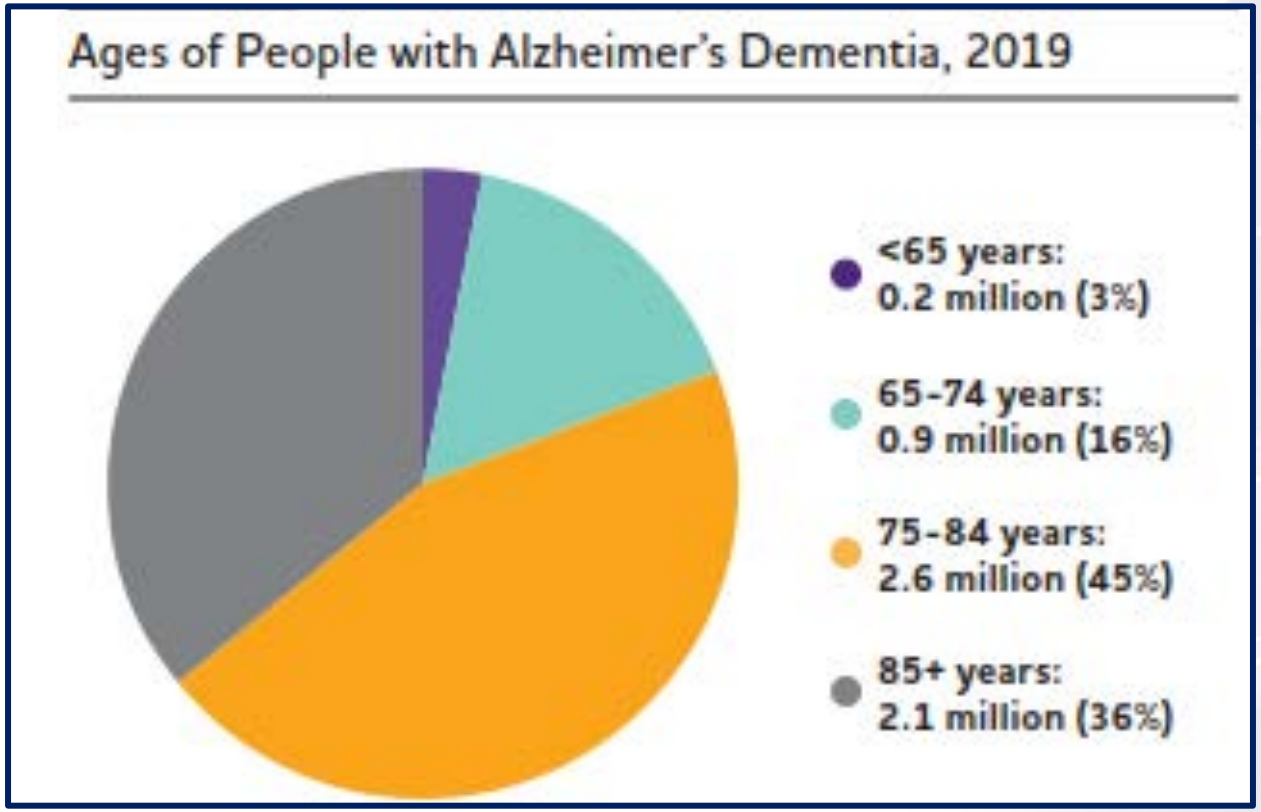
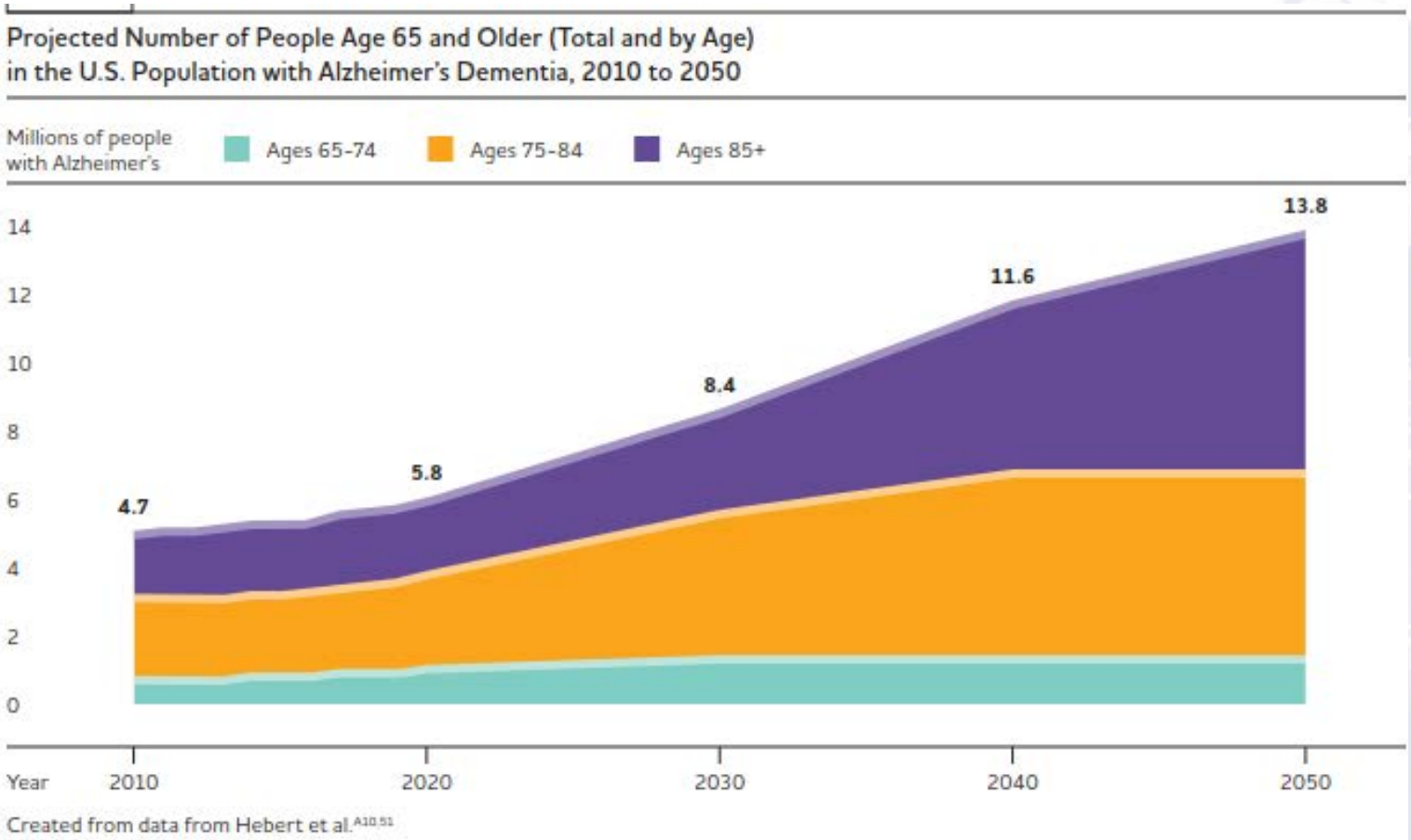
Prevalence of Alzheimer's disease (AD) by Age



97% of AD
Age ≥ 65

Estimated 5.8 Million Individuals with Alzheimer's disease in United States

Dementia Prevalence



Ages 85+

Ages 75-84

Ages 65-74

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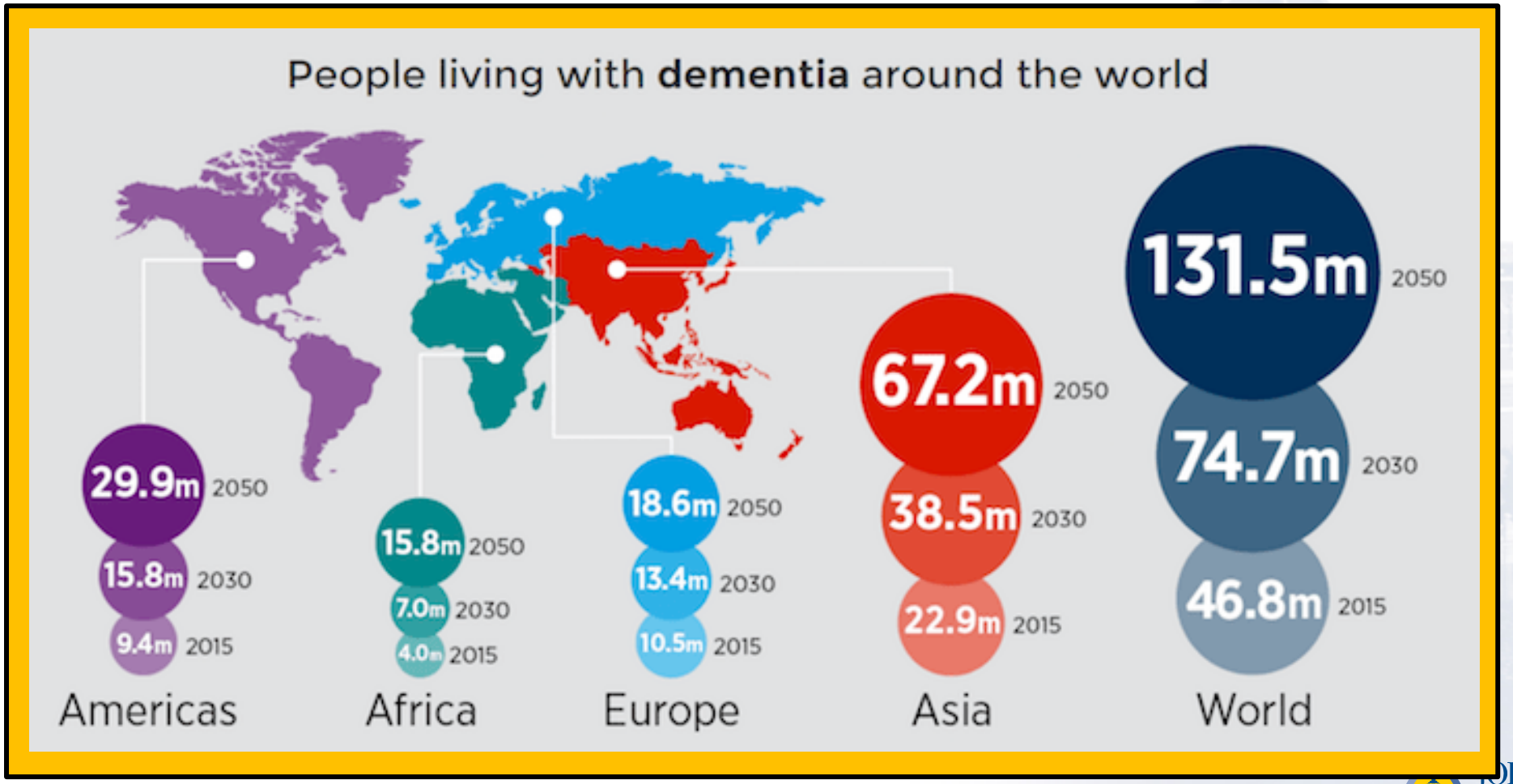
World Wide Dementia Prevalence and Projections



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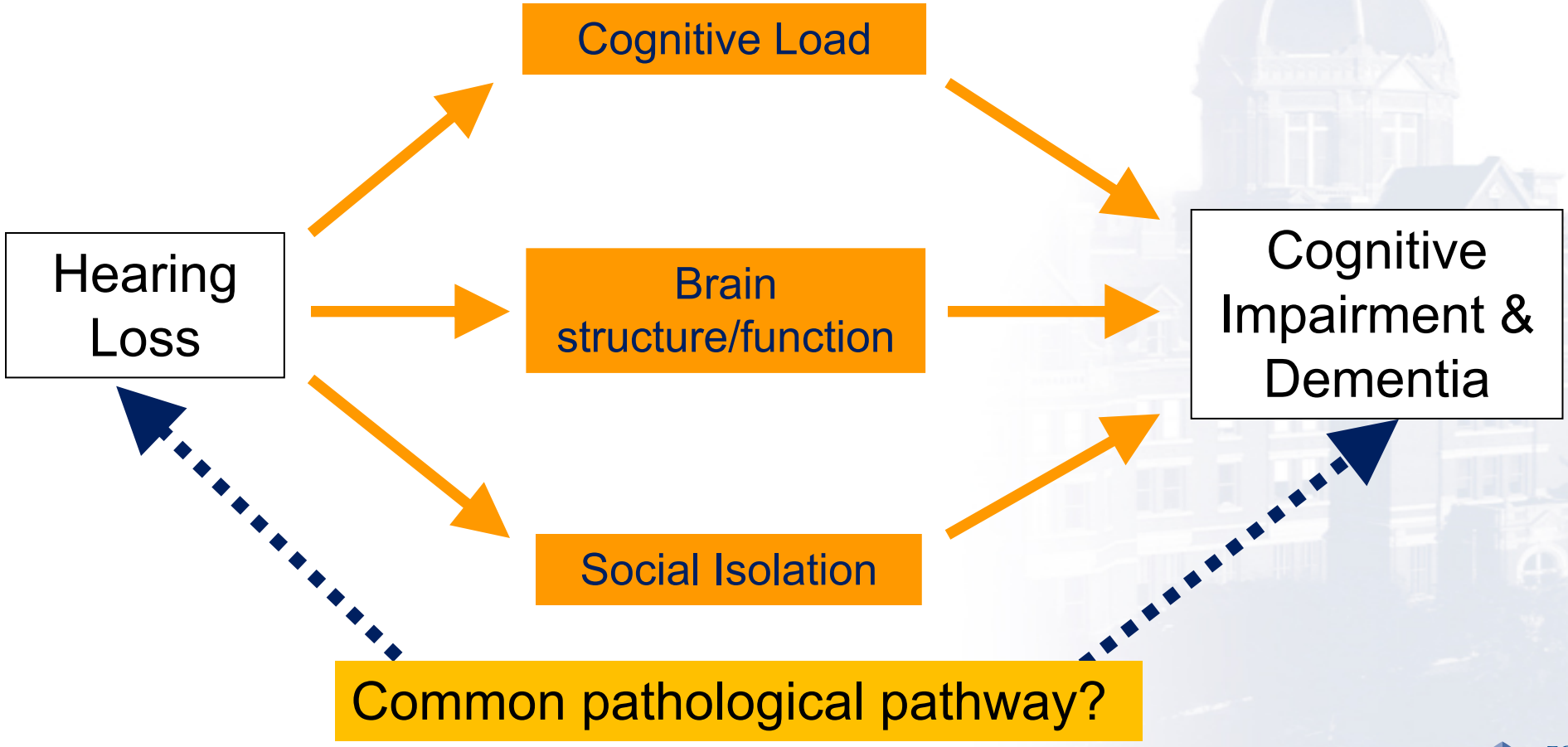
Hearing Loss & Cognition

Common Cause or Modifiable Risk Factor



F. Lin & M. Albert, Aging & Mental Health, 2014

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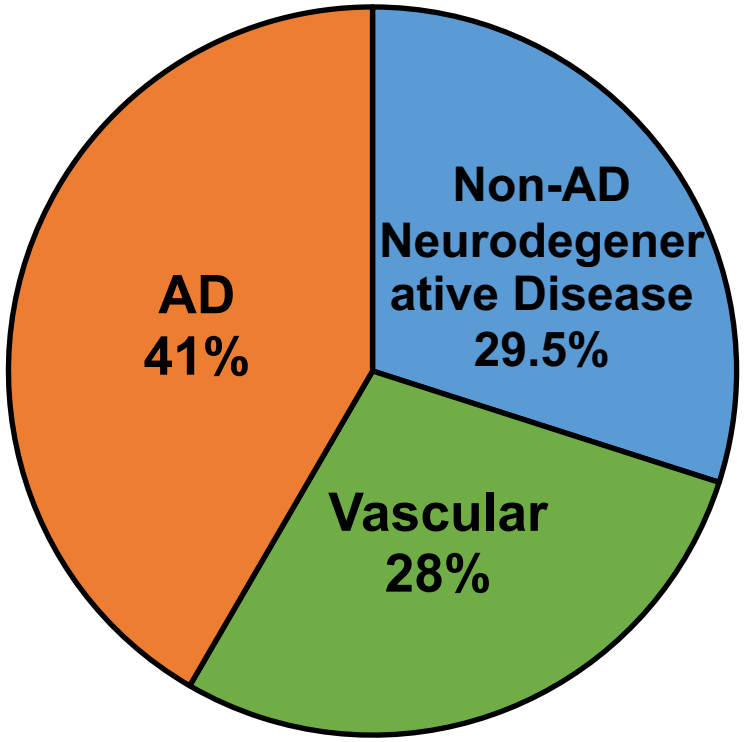
How Much of Clinical AD is Due to AD Pathology?



Non AD Neurodegenerative Disease

- Lewy Bodies
- Hippocampal Sclerosis
- TDP-43 Pathology

Vascular

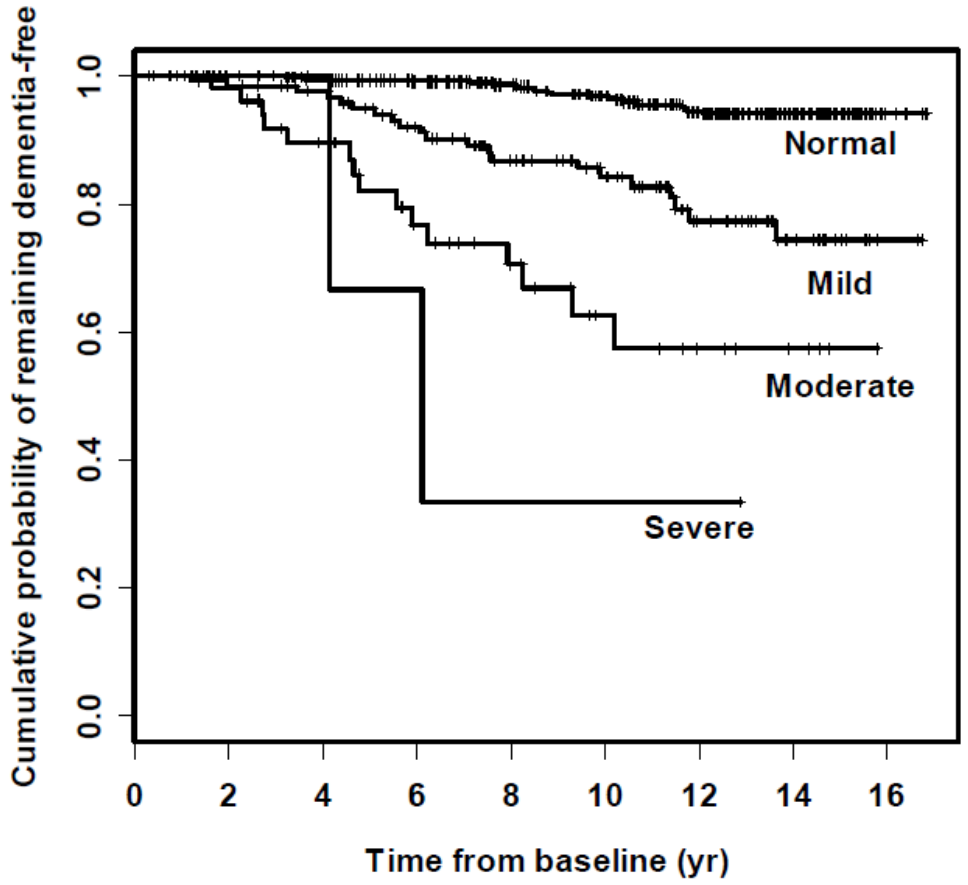
- Macroscopic Infarcts
- Cerebral Amyloid Angiopathy
- Artherosclerosis
- Arteriosclerosis

Attributable risk (%) derived from statistical modeling
Average age at the time of autopsy 91.0 (SD 5.9)
16 % of AD did not meet NIA-Reagan pathological AD criteria

Boyle et al, Annals of Neurology, 2019

Hearing Loss & Incident Dementia

Dementia incidence in 639 adults followed for >10 years in the Baltimore Longitudinal Study of Aging



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

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Hearing Loss & Incident Dementia

Dementia Incidence in 1057 Men Followed for 17 years in the Caerphilly Prospective Study (U.K.)

Cognitive impairment	Model 1: adjusted for age, OR[a] (95% CI), *p* value	Model 2: adjusted for age, social class, anxiety, OR[a] (95% CI), *p* value	Model 3: adjusted for age, social class, anxiety, premorbid intelligence, OR[a] (95% CI), *p* value
All dementia (n = 79)	4.07 (2.21-7.50), <0.001	3.26 (1.71-6.21), <0.001	2.67 (1.38-5.18), 0.004
Vascular dementia (n = 38)	3.83 (1.69-8.65), 0.001	2.93 (1.24-6.94), 0.015	2.40 (0.99-5.83), 0.05
Nonvascular dementia (n = 41)	4.20 (1.84-9.55), 0.001	3.58 (1.50-8.51), 0.004	2.96 (1.21-7.22), 0.017
CIND (n = 146)	2.32 (1.50-3.59), <0.001	1.72 (1.09-2.74), 0.021	1.24 (0.77-2.01), 0.38
All dementia (n = 46), omitting men with evidence of early cognitive decline	2.23 (1.04-4.77), 0.039	1.64 (0.72-3.73), 0.24	1.32 (0.57-3.12), 0.52

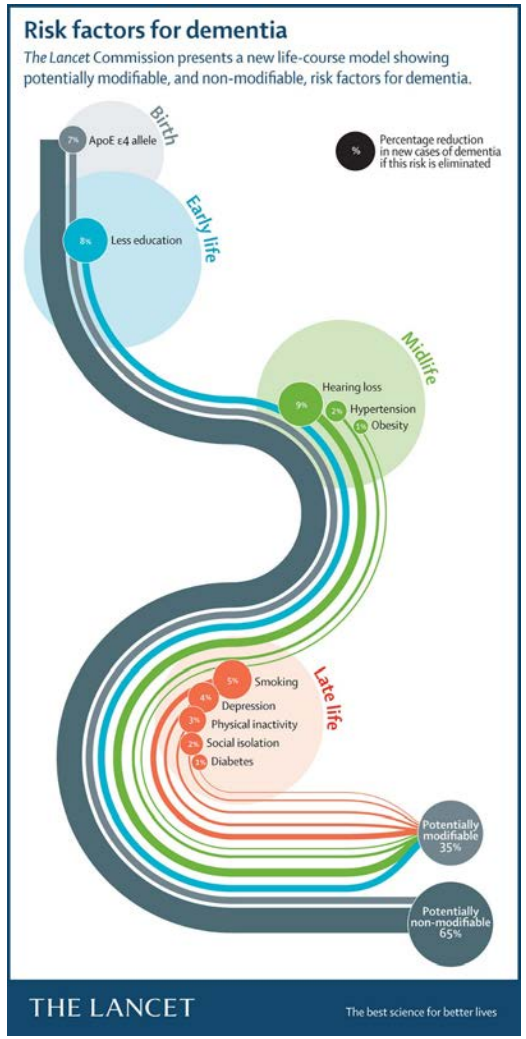
Abbreviations: CI = confidence interval; CIND = cognitive impairment no dementia; OR = odds ratio; PTA = pure-tone average (threshold).

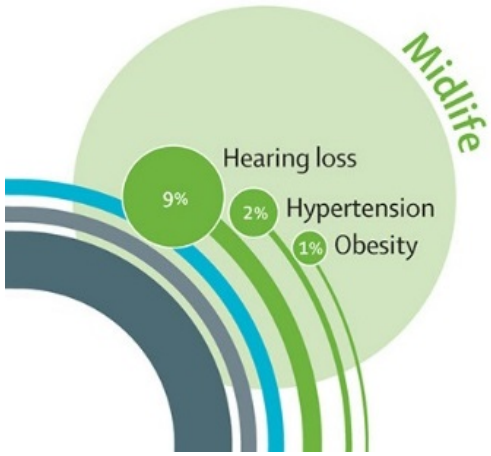
[a] Odds ratio is the effect per 10-dB_A rise in usual PTA.

Neurology 79 October 9, 2012

J. Gallacher et al., Neurology, 2012

Lancet Commission on Dementia Prevention, Intervention & Care





- Hearing loss in mid & late life identified as the single largest potential modifiable risk factor for dementia

G. Livingston et al., Lancet, 2017

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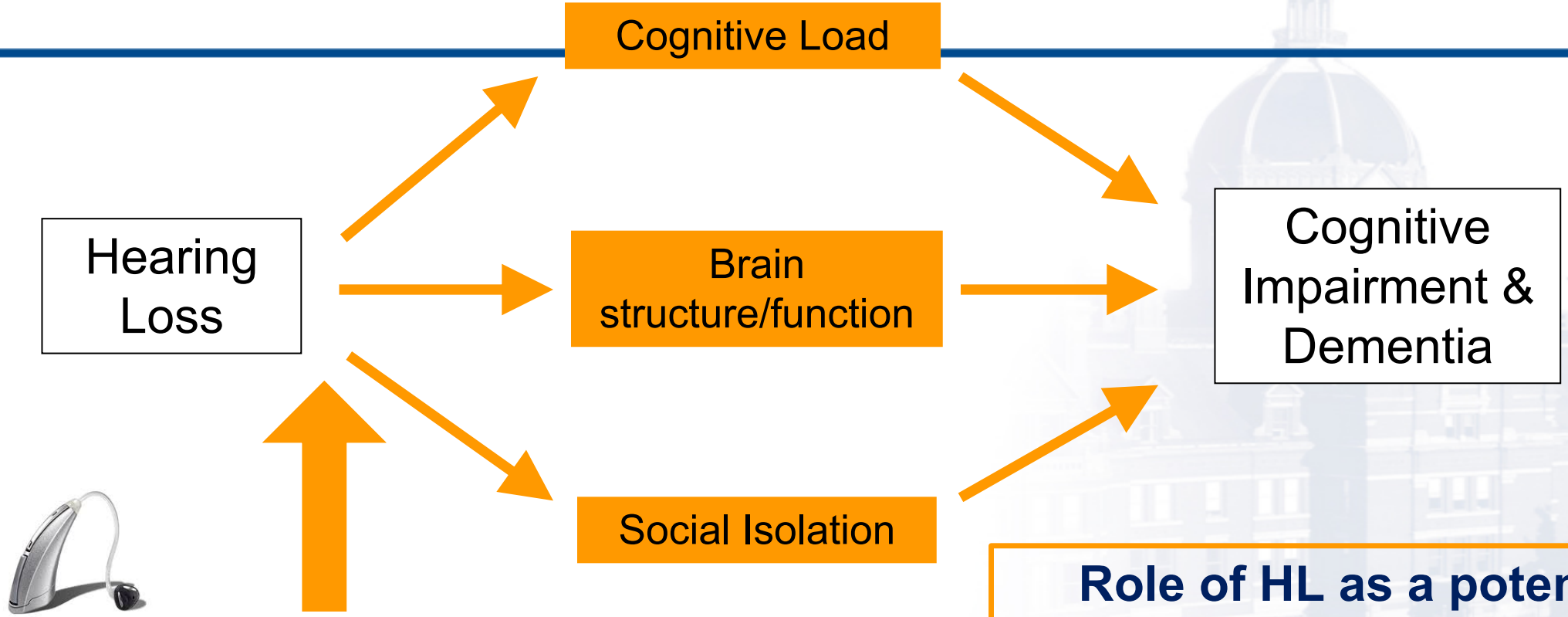
Hearing Loss & Dementia

Hearing Loss as a Modifiable Risk Factor



Hearing loss intervention could:

- Reduce the cognitive load of processing degraded sound
- Provide increased brain stimulation
- Improve social engagement

Role of HL as a potentially modifiable risk factor in late-life for cognitive decline & dementia

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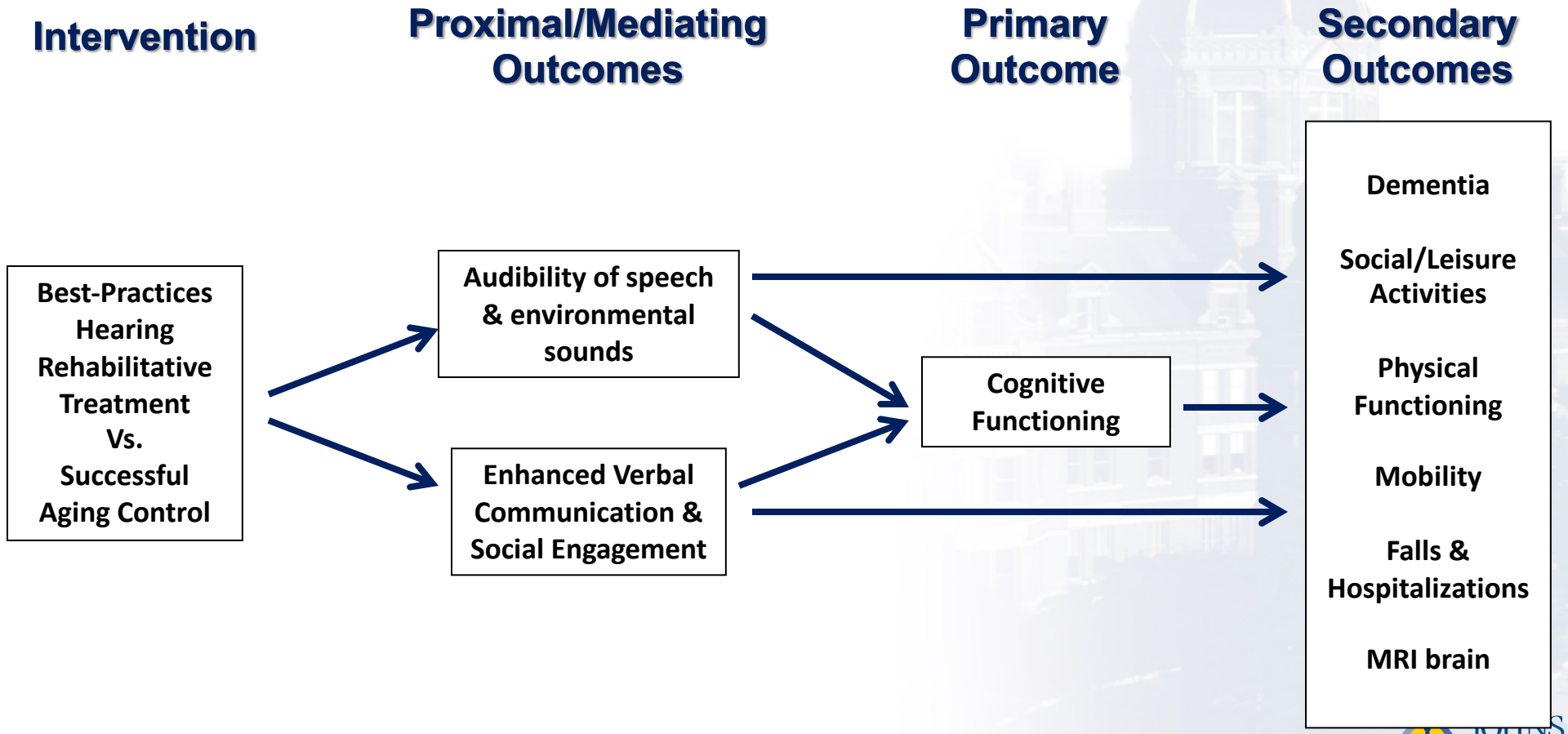
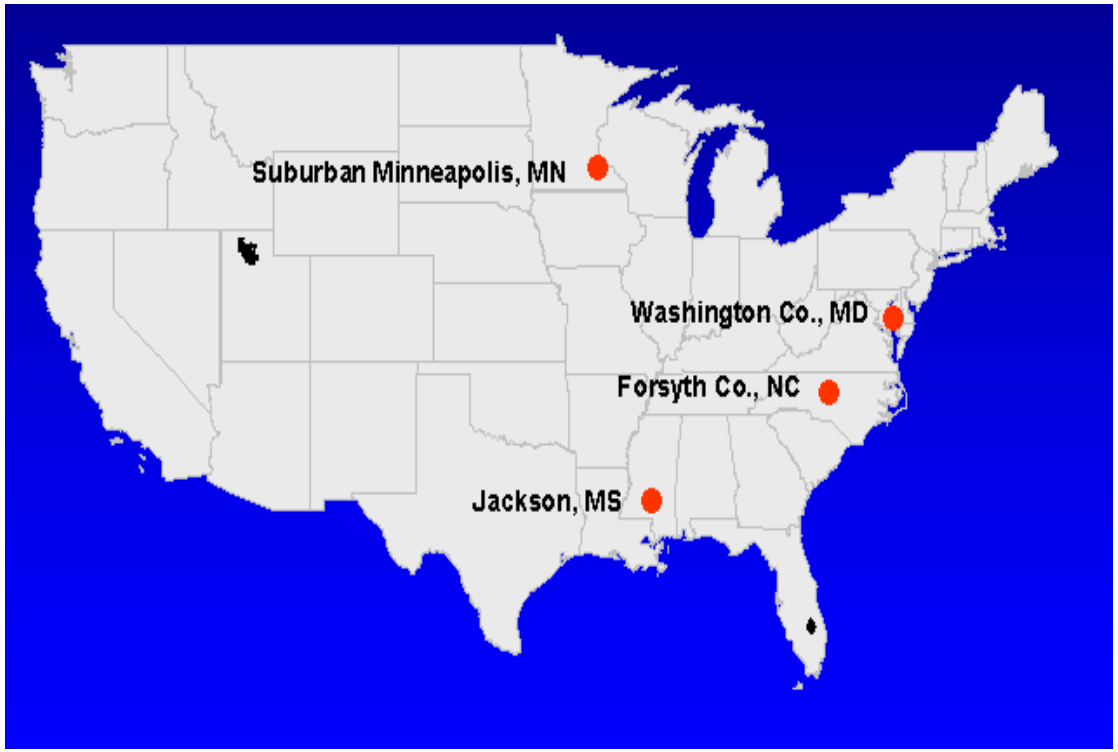
Aging & Cognitive Health Evaluation in Elders Randomized Trial (N = 850)

2017-2022



R01AG055426, R01AG060502, R34AG046548

Aging and Cognitive Health Evaluation in Elders Trial (ACHIEVE)



Study Sites & Inclusion Criteria

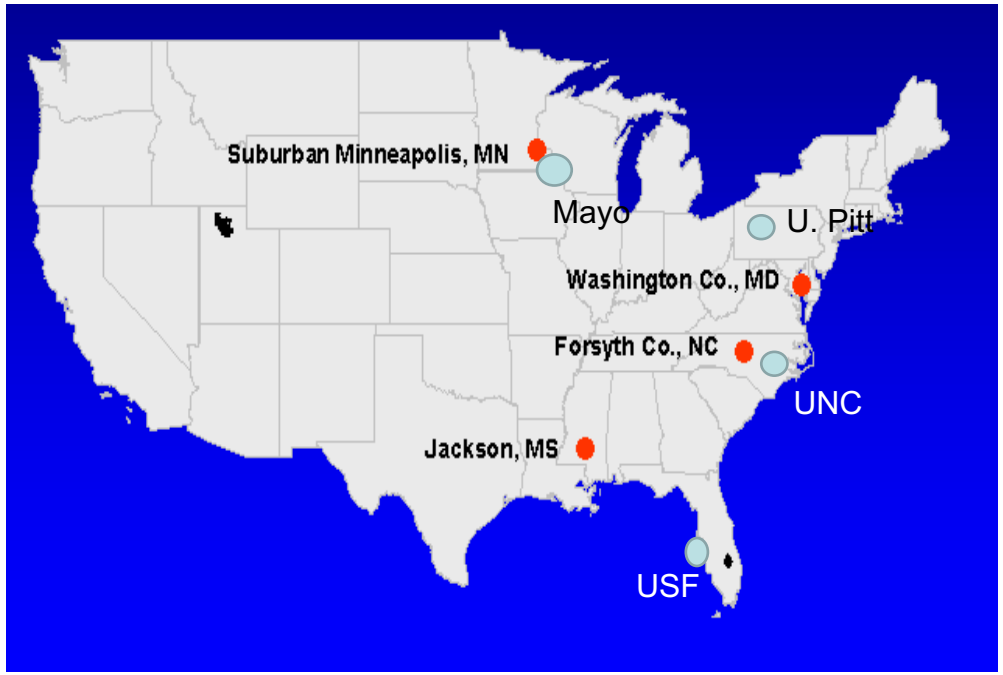
Main study inclusion criteria:

- 70-84 y.o. community-dwelling adults
- Mild-moderate hearing loss
- No cognitive impairment
- No self-reported disability in >1 ADL
- No self-reported hearing aid use in the past year

R01AG055426, R01AG060502, R34AG046548

Pragmatic Considerations for Operational Efficiency & Scientific Power in a Large RCT

Synergy with the Atherosclerosis Risk in Communities (ARIC) Study



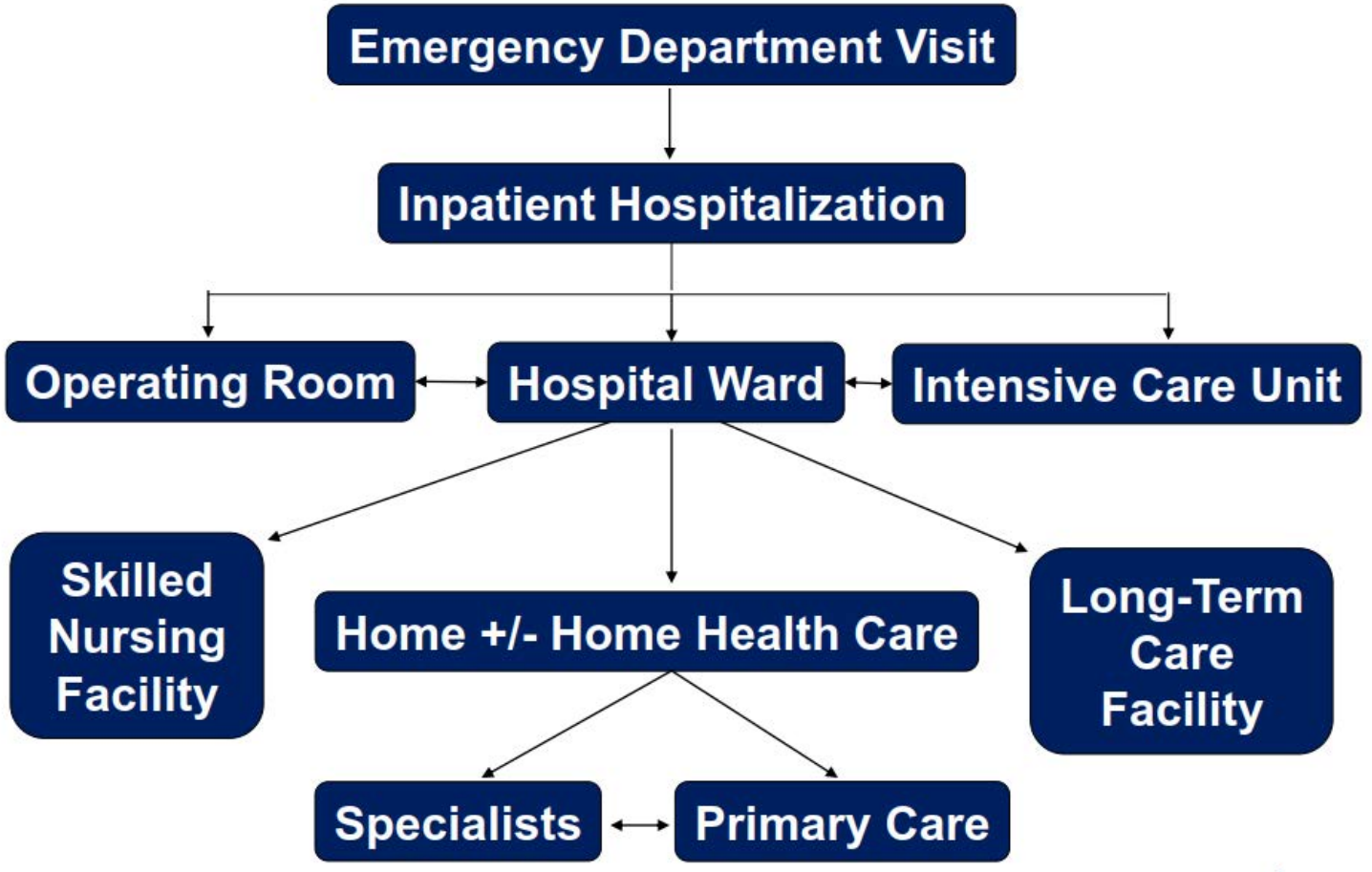
- ACHIEVE Field sites:
  - Johns Hopkins (Washington County)
  - Univ. of Mississippi
  - Univ. of Minnesota
  - Wake Forest Univ.
- ACHIEVE Coordinating Center: Univ North Carolina
- ACHIEVE Hearing Intervention Site: Univ. of S. Florida
- Successful Aging Intervention Site: U. Pittsburgh
- MRI Reading/Processing Site: Mayo Clinic

ACHIEVE Trial Design

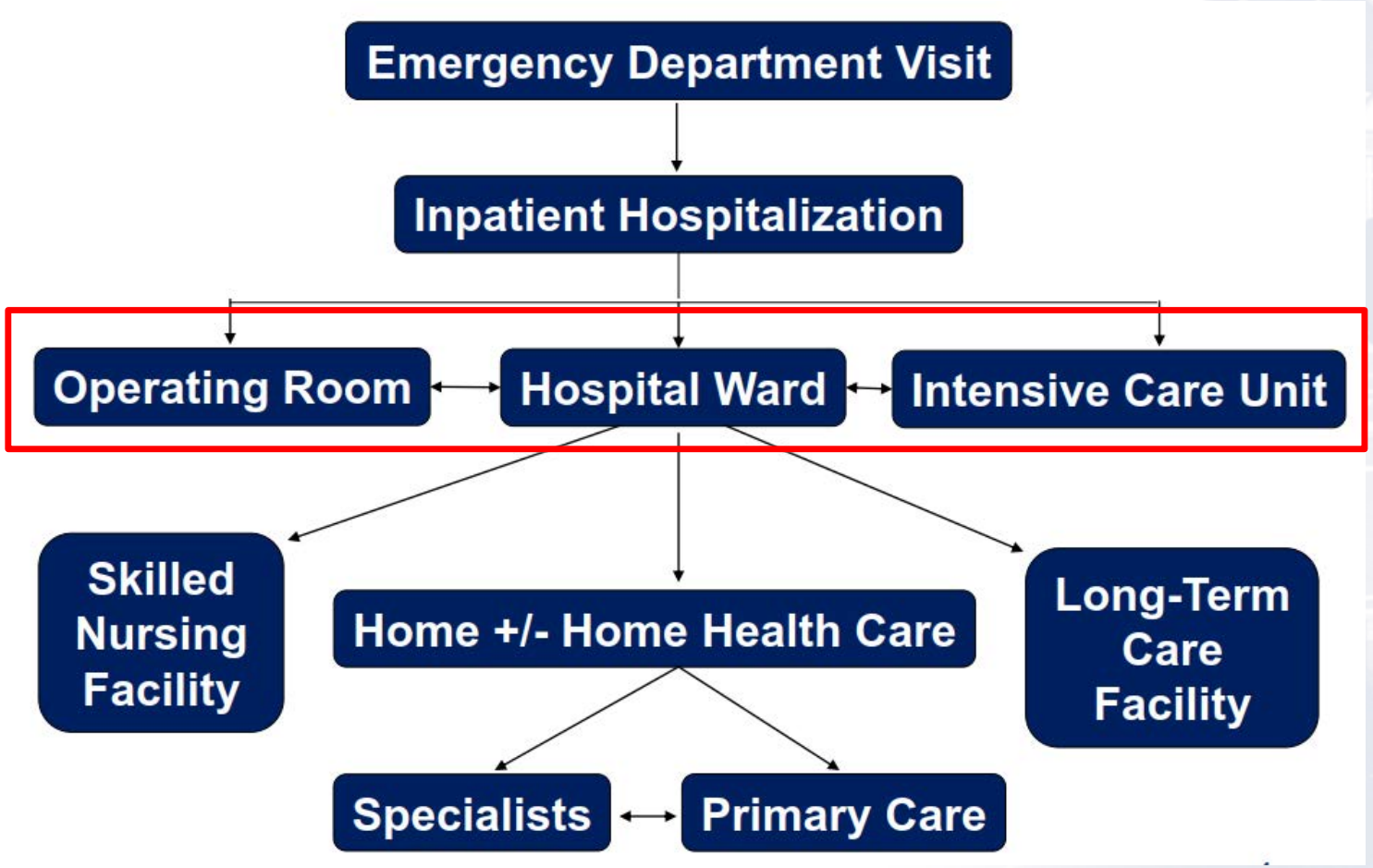
Outcomes & Analysis

- Baseline & semiannual visits for intervention delivery & outcome assessments
- Primary outcome – Global cognitive function
  - Comprehensive neurocognitive battery including tests of memory, executive function, etc.
- Secondary outcomes
  - Adjudicated dementia/MCI diagnoses, depression, communicative & social function, physical functioning, actigraphy, falls, hospitalizations, HRQL, hearing aid data logging, structural brain MRI

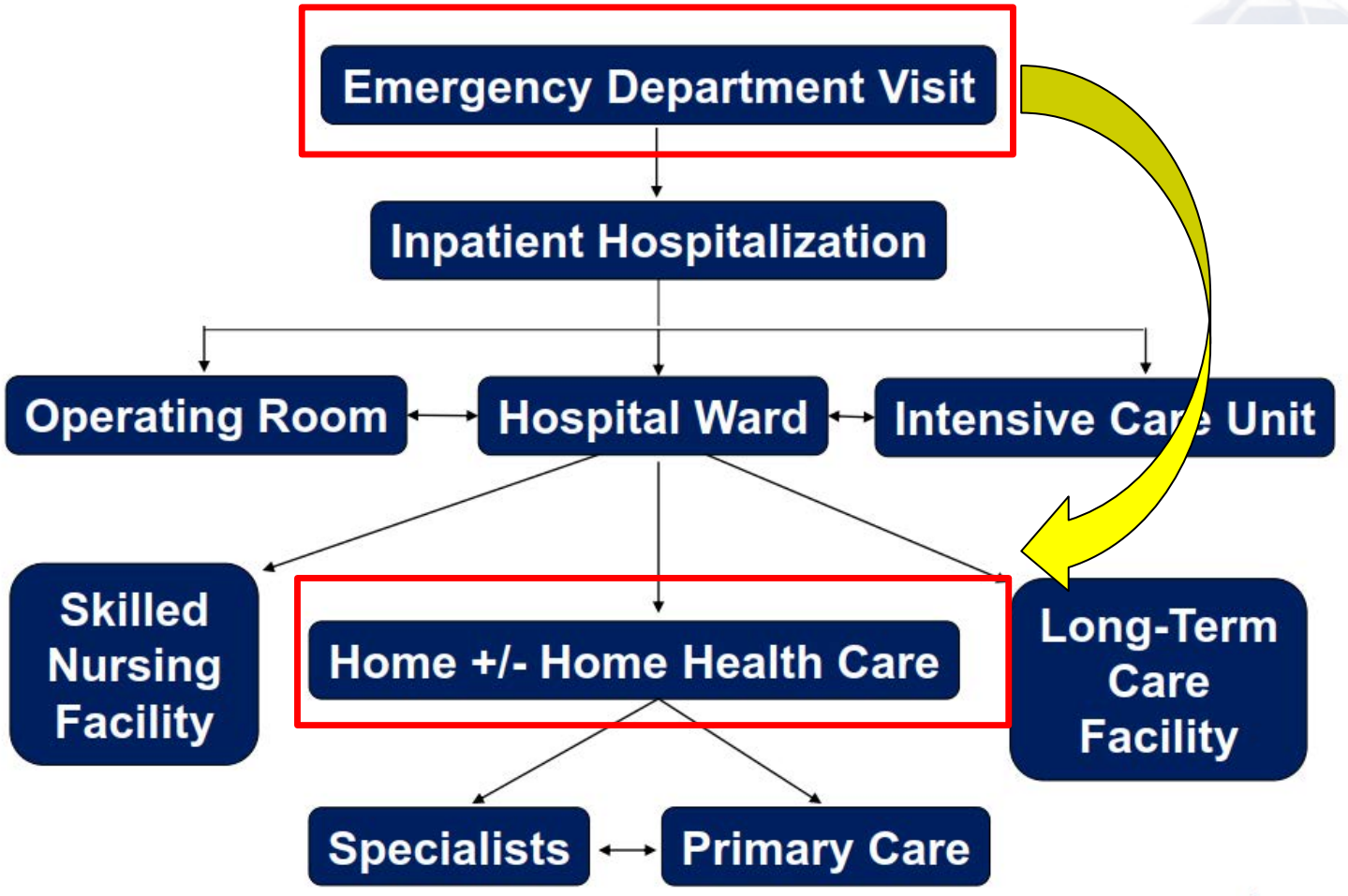
Hearing Loss, Dementia and Health Care System



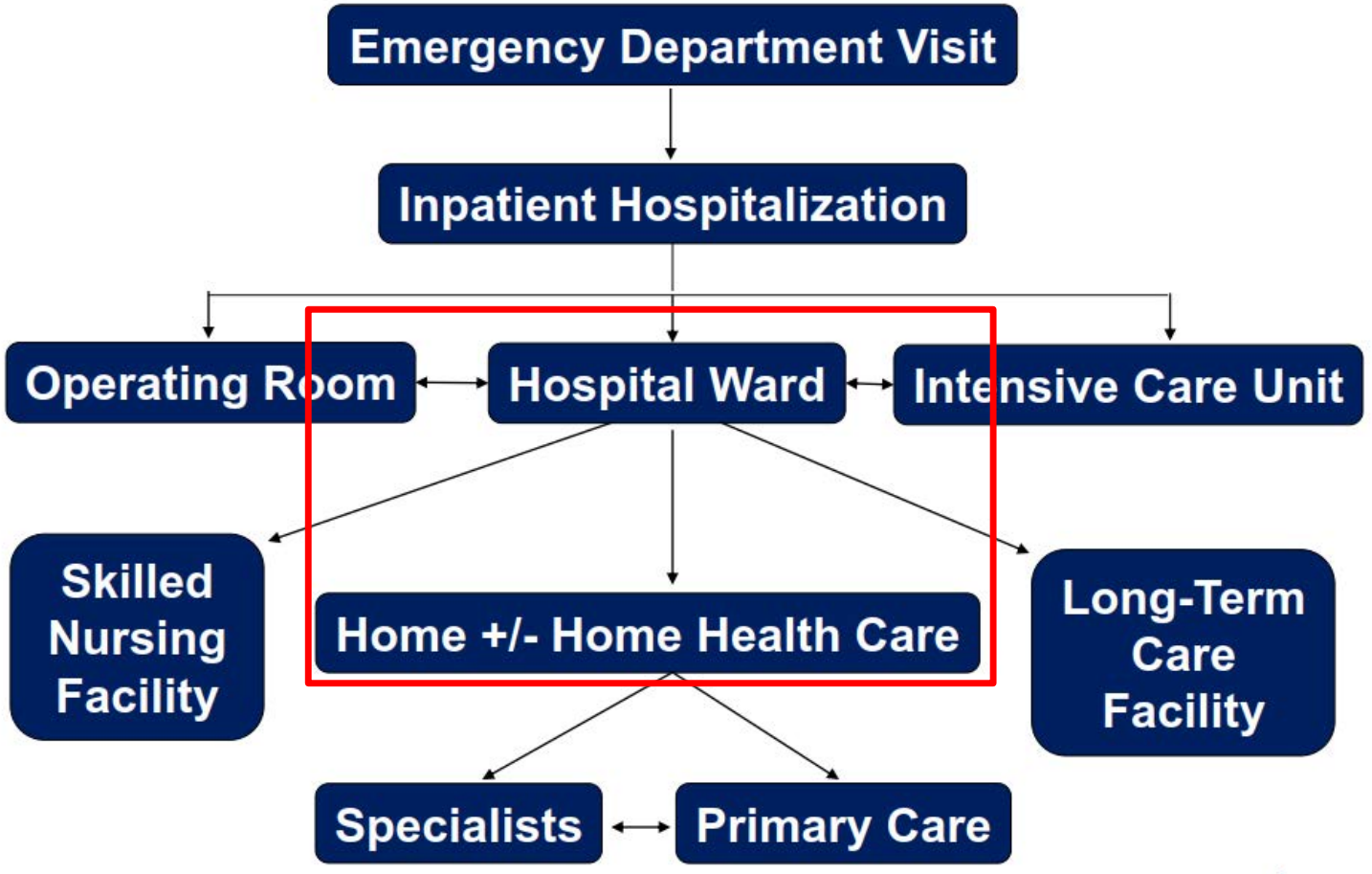
Hearing Loss and Inpatient Settings



Emergency Department to Home



Hospital to Home



Case: Admission

- Mrs. S is a 78 year old woman with hypertension, coronary artery disease, and congestive heart failure (CHF)
- She lives alone with help from her daughter who visits her weekly
- The patient is admitted to the hospital for shortness of breath. Her daughter who is frustrated that her mother has been admitted to the hospital 4 times in the past 3 months for the same problem. Last hospitalization was 2 weeks ago.

Case: Hospital Stay

- The patient is treated for CHF exacerbation.
- During the 2 day hospitalization, the staff notices that the patient asks the same question repeatedly and is also “hard of hearing.”
- At the time of discharge, the daughter states that she cannot get off from work and asks the case manager to send the patient back home with a cab voucher.
- The nurse gives the patient discharge instructions and the patient goes home.

Case: Discharge

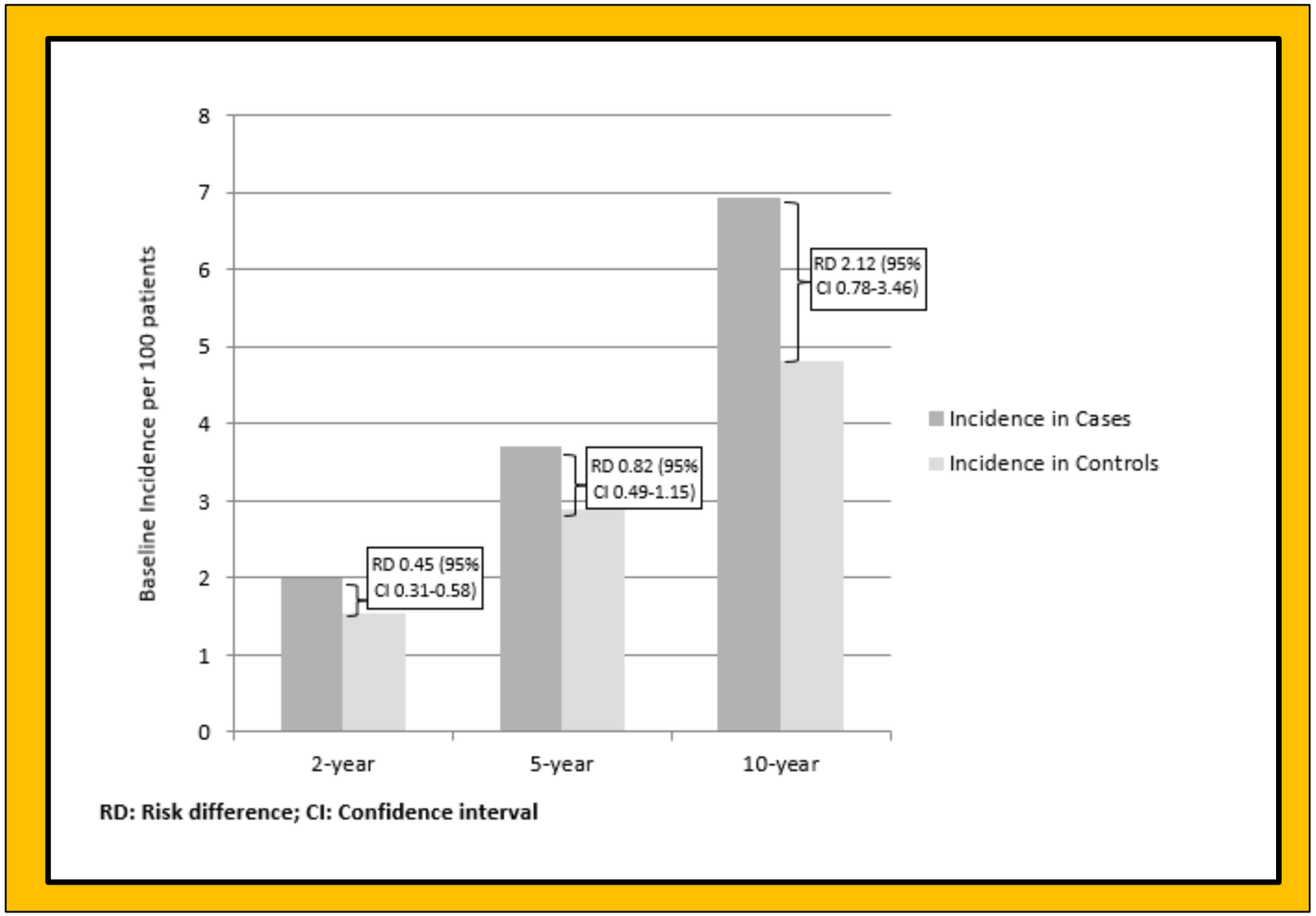
- The nurse who came in for the afternoon shift reviews the discharge instructions with the patient
- Mrs. S is in a shared hospital room where her roommate has the TV on high volume due to her hearing problems
- The nurse reviews a long list of new medications and changes in the timing of her old medications
- She is given an instruction to follow a low sodium diet, and to weigh herself everyday. She is instructed to call her PCP if she gains a few pounds. She is given an appointment with her PCP, a new referral to a cardiologist, CHF clinic, additional studies to be done on outpatient basis

Hearing Loss and Patient-Provider Communication

- 100 adults (>60 years) semi-structured interviews following medical appointments
  - Hearing loss was associate with reports of difficulty with mishearing/or misinterpreting illness or treatment-related content (diagnosis, prognosis, medication dose/regimen)
- Very few studies consider hearing loss in patient-provider communication
  - Only 23.9% of patient-provider communication papers involving older adults included any mention of hearing loss
    - Only 6% included hearing loss in analyses

Cudmore et al., JAMA Otolaryngol Head Neck Surg, 2017; Cohen et al. (2017) JAGS

Hearing Loss is Associated with Higher 30-day Readmission Rate



Hearing loss associated with a 44% increase in risk of 30-day readmissions over 10-years

*The Hospital Readmissions Reduction Program (HRRP) - Medicare reduces payments to hospitals with excess readmissions (CHF)

Reed et al. JAMA Otolaryngol Head Neck Surg 2019

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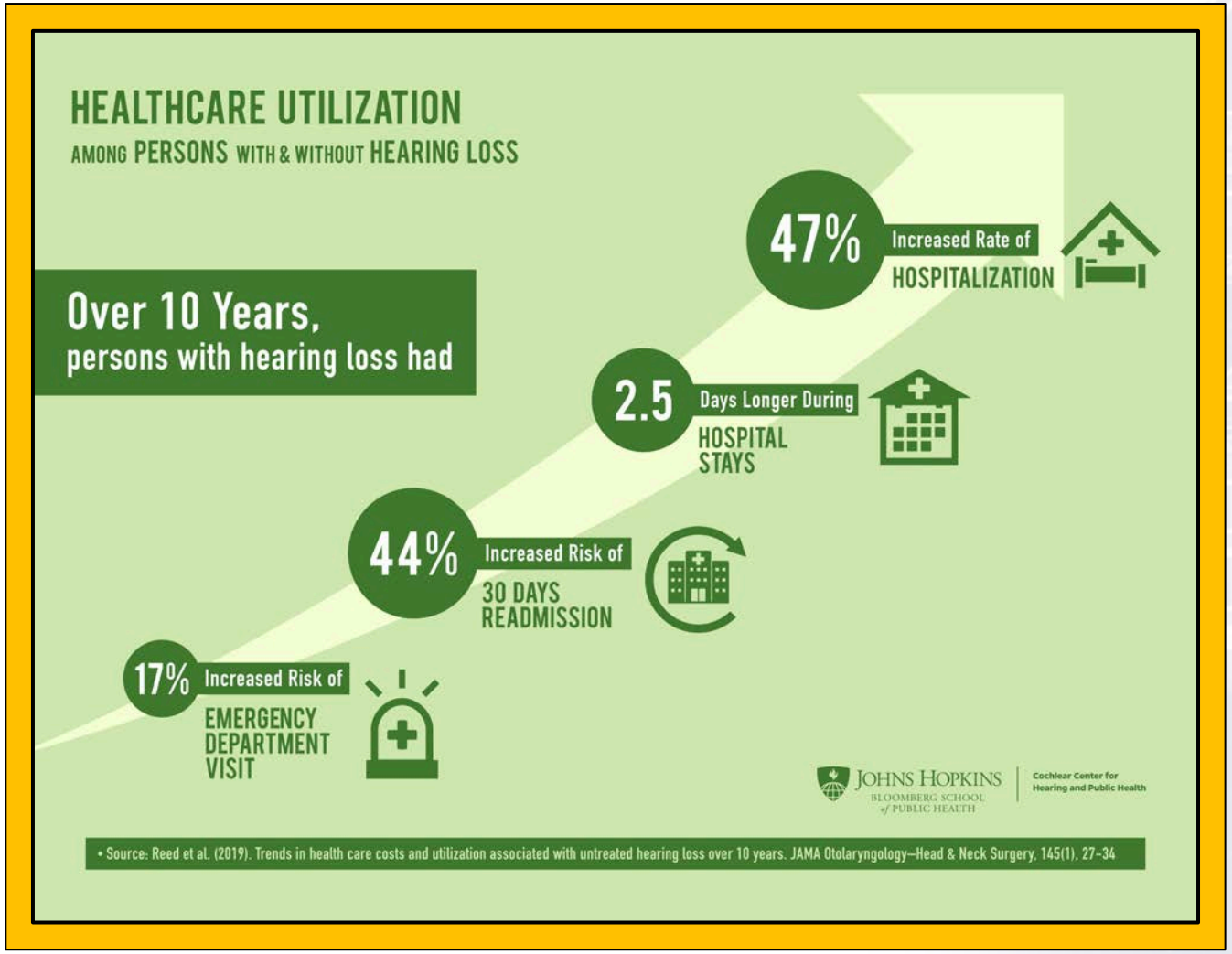
Hearing Loss and Health Care Utilization: Public Consumption



Reed et al. JAMA Otolaryngol Head Neck Surg 2019

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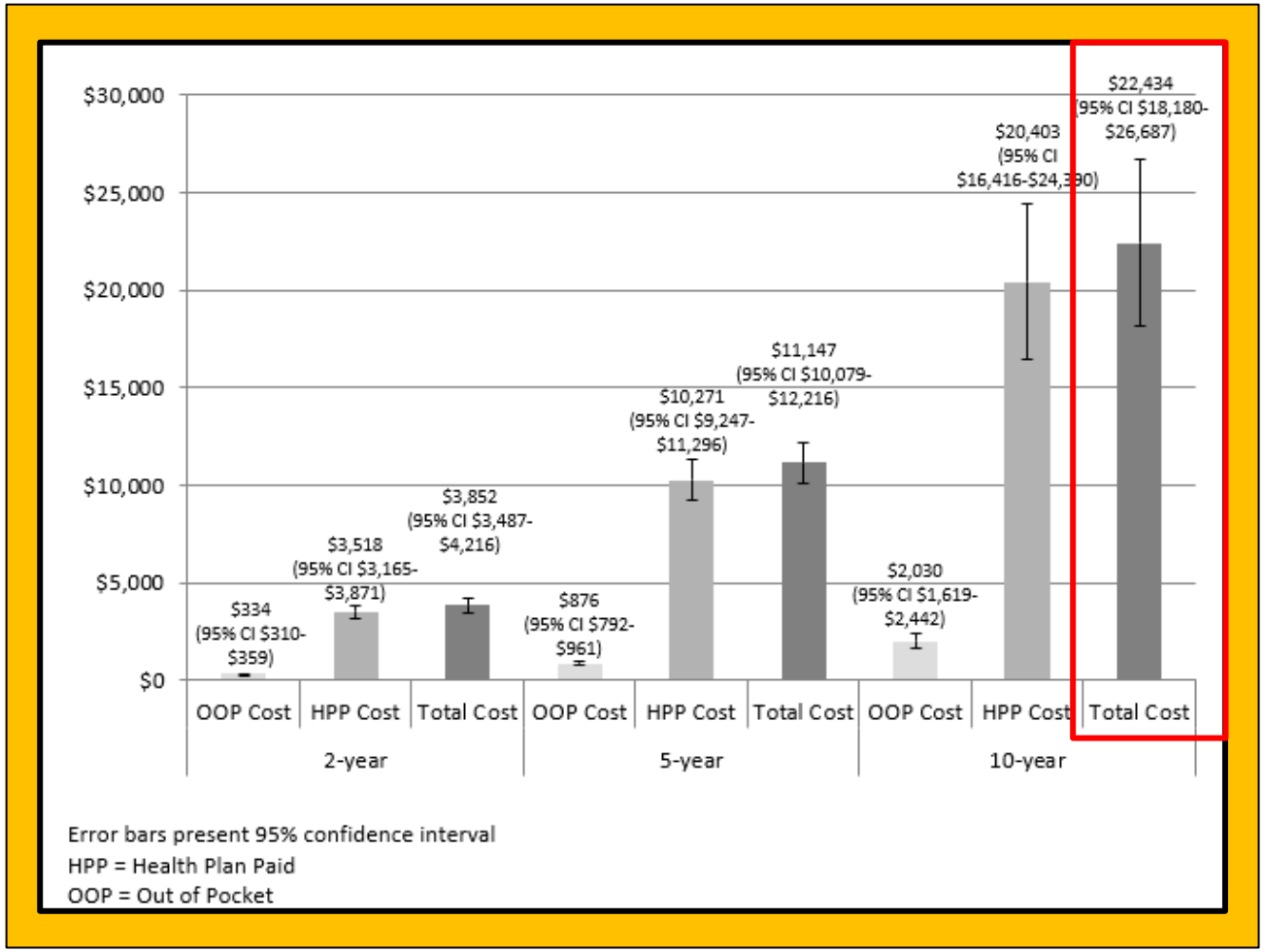
Hearing Loss is Associated with Higher Health Care Costs



Hearing loss is associated with a 46% ($22,434) increase in total health care costs over a 10-year period

Reed et al. JAMA Otolaryngol Head Neck Surg 2019

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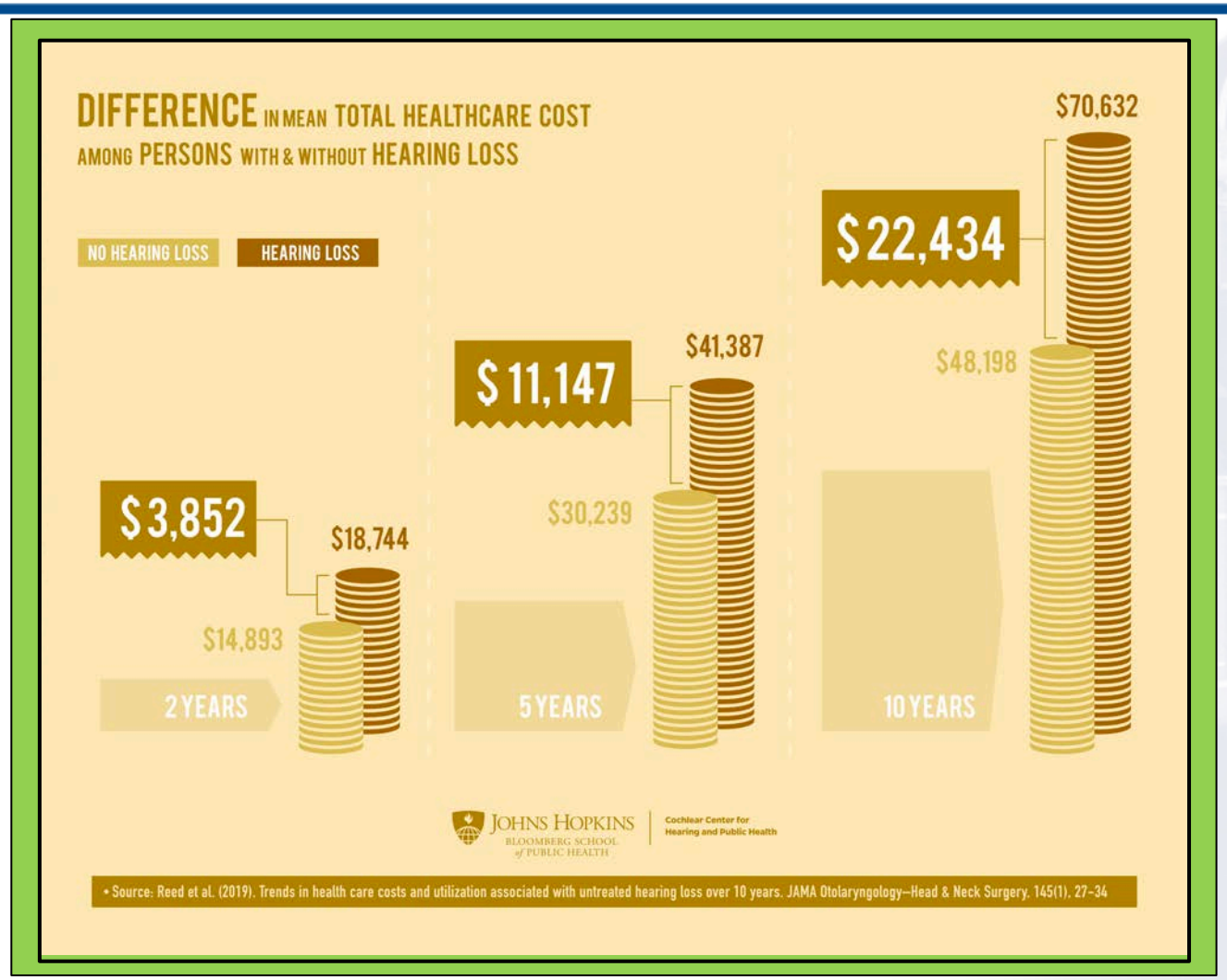
Hearing Loss and Health Care Utilization: Public Consumption



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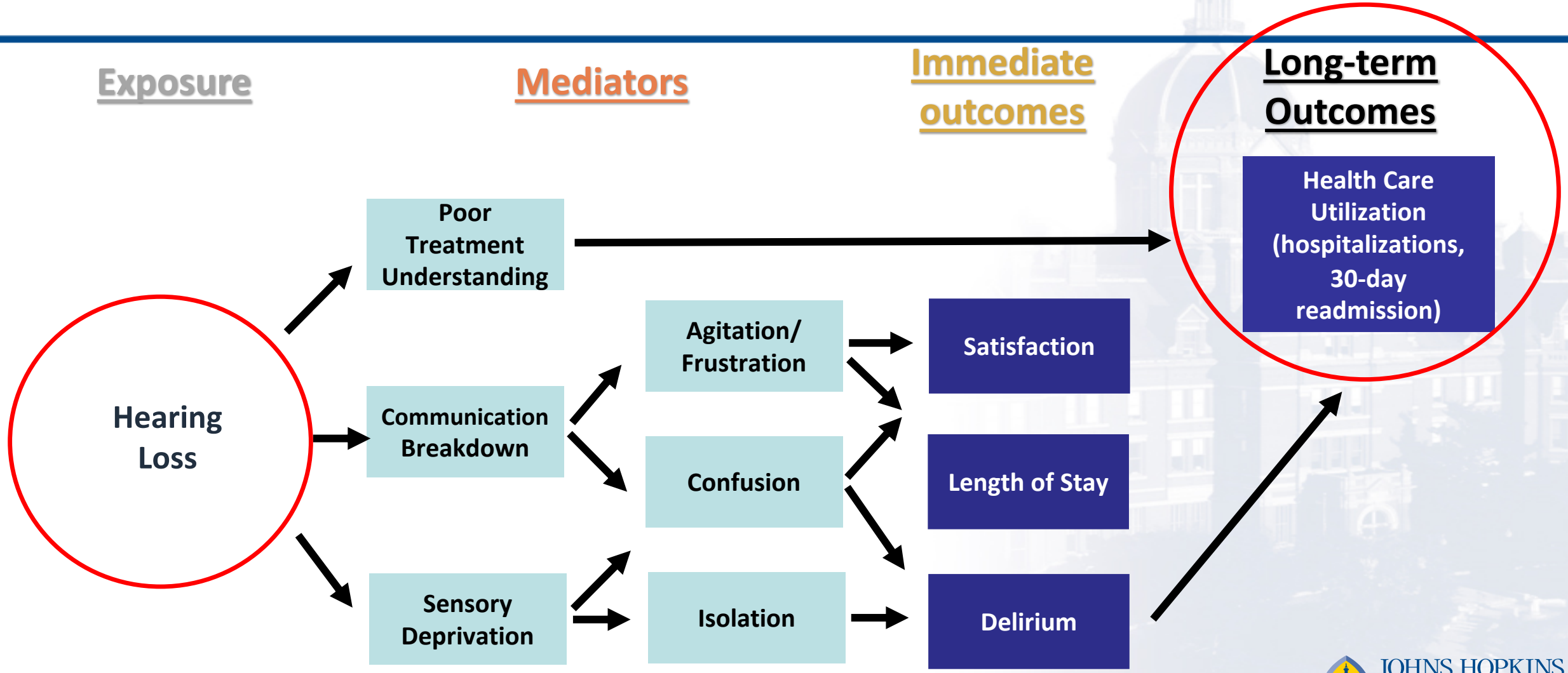
Conceptual Framework



Reed N., et al

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In-patient Hearing Loss Intervention

Reed et al., (in-prep

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Dementia and Patient-Provider Communication

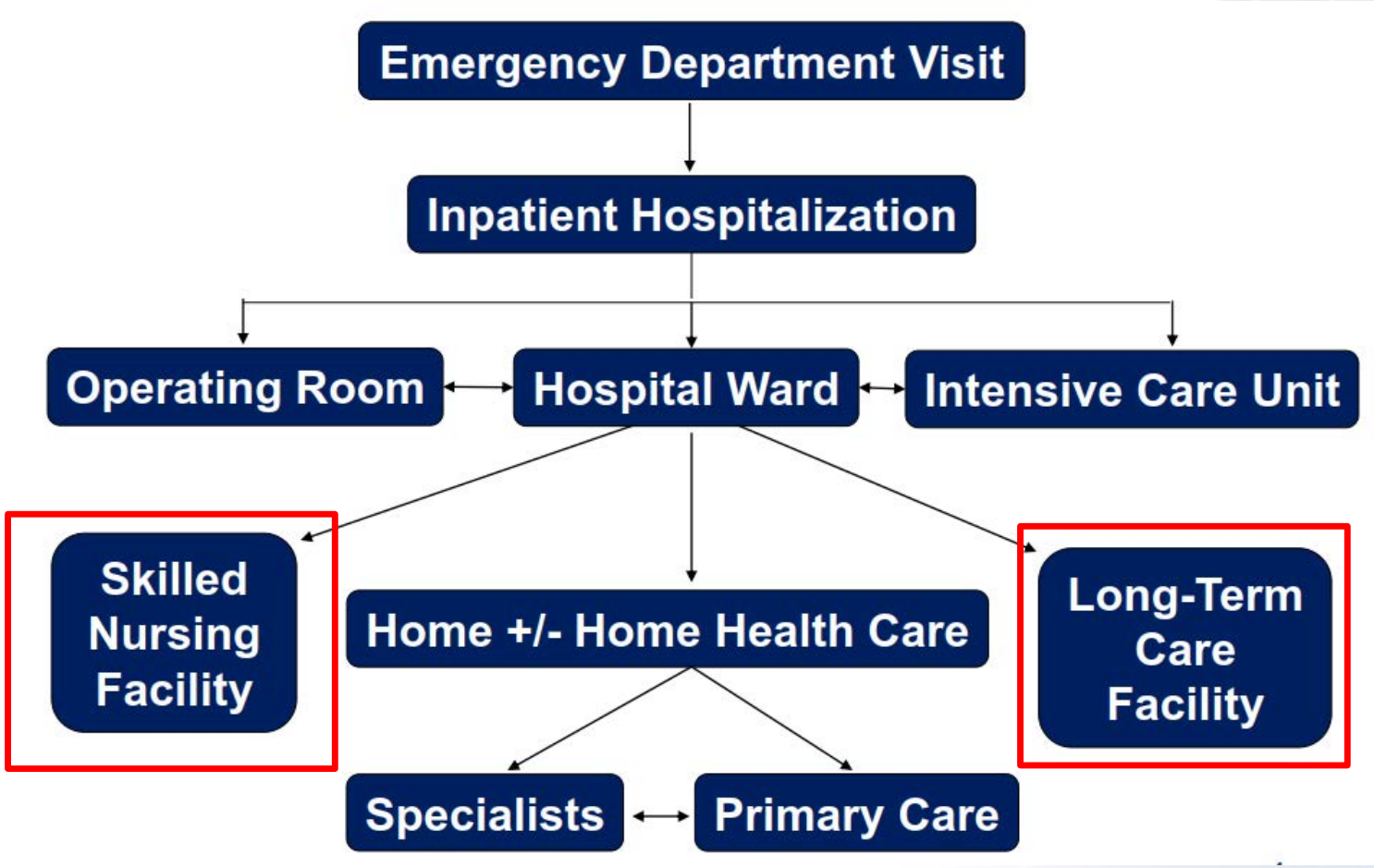
- Universal hearing screening
- Universal dementia screening? (ex. Medicare Wellness Visit)
  - IU-CHOICE (Indiana University)
  - N = 4,005, age ≥ 65, randomized to dementia screening or no screening
  - No between group differences in the primary outcomes (health-related quality of life, depression, and anxiety) or secondary outcomes (health care use and advance care planning) at 12 months

Selective Cognitive Screening: Case Identification

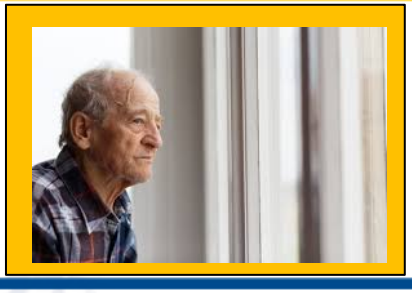
- Review of records of 297 patients with CHF
- Cognitively impaired patients with CHF had higher 30-day readmission compared to other diagnosis
- Cognitively impaired patients with CHF and documented caregiver education during discharge had lower readmission rate

Agrawal et al., JAGS 2016

Hearing Loss and Long Term Care Settings

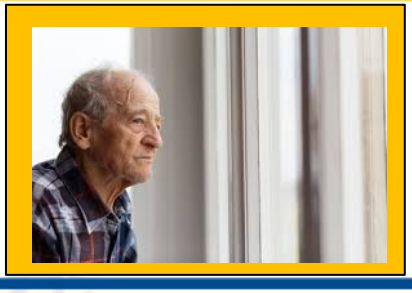


Case



- 82 year old gentleman with diagnosis of Dementia of Lewy Bodies (DLB) with **visual hallucinations**, **motor symptoms** and aggression (MMSE 19/30 in 2017)
- Sertraline (antidepressant), quetiapine (antipsychotic), rivastigmine (acetylcholinesterase inhibitor)
- Hearing screening revealed severe hearing loss in R ear and moderate hearing loss in L
- Referred to audiology and recommended a pocket talker

Case



- Moved to an assisted living facility (ALF) with his wife
- ALF sent the patient to ED for repeated falls; sent to a medical behavioral unit for worsening of behavioral symptoms for 2 months
- Currently living in a Memory Care Unit (separate from his wife)
- Talks to deceased relatives all day, no longer “testable”

Neuropsychiatric Symptoms (NPS) (Non-cognitive aspects of dementia)

- Irritability
- Loss of Interest
- Delusions
- Hallucinations
- Agitation or Aggression (screaming, physical aggression)
- Resistance to help (bath,etc)
- Anxiety
- Apathy or Indifference
- Depression
- Aberrant motor symptoms
- Disinhibition,
- Sleep disturbance
- Appetite changes

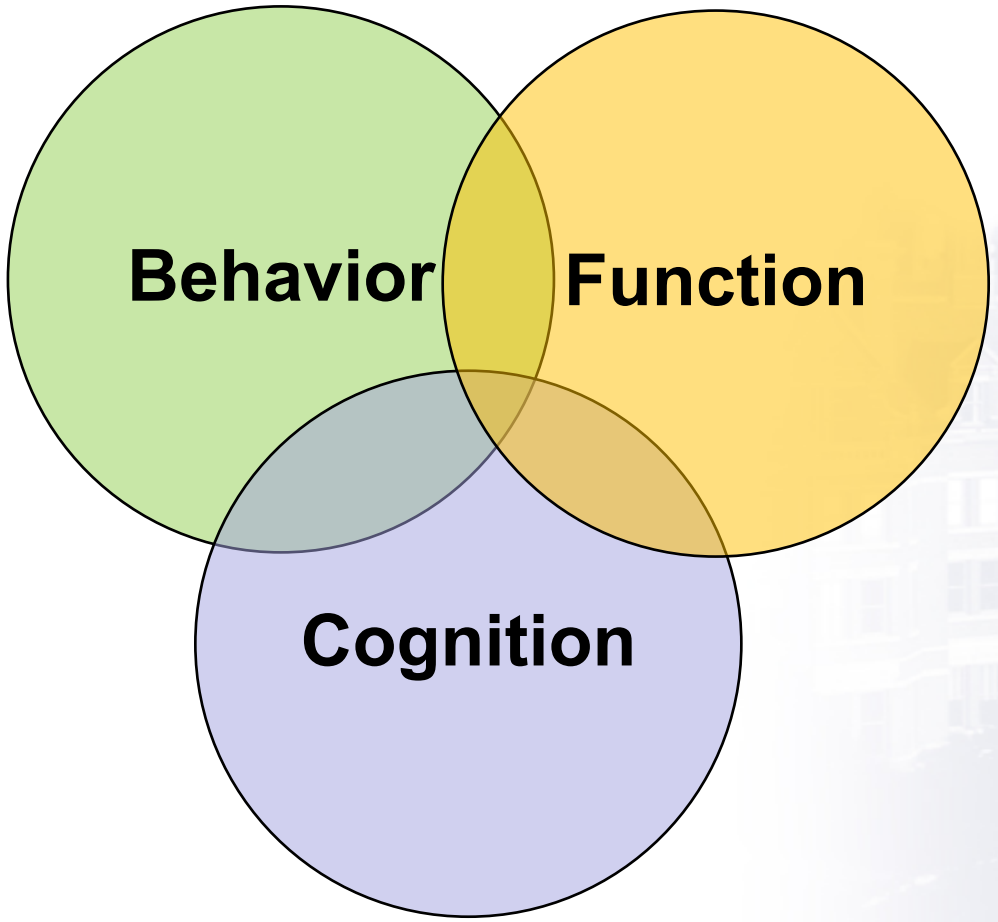
Significance of NPS

- Five year prevalence of NPS (at least one symptom) – 97%
- Associated with caregiver burden and predict caregiver decision to institutionalize the patient

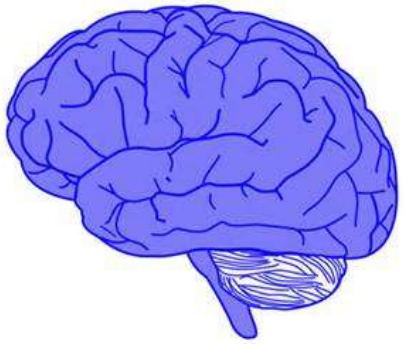
- As much as 35% of direct care costs for AD are attributable to NPS

(Steinberg et al., Int J Geriatr Psychiatry, 2008)
(Brodaty and Arasaratnam, Am J Psychiatry 2012)

Different Facets of Dementia



Factors Associated with Neuropsychiatric Symptoms

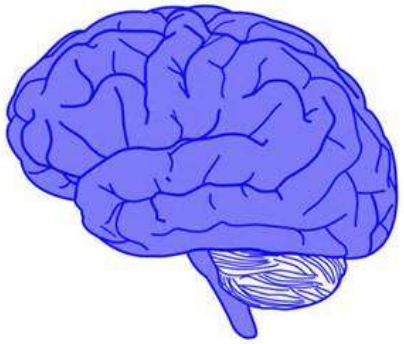


Neurodegenerative disease

Increased Vulnerability to Stressors

Neuropsychiatric symptoms

Factors Associated with Neuropsychiatric Symptoms



Neurodegenerative disease

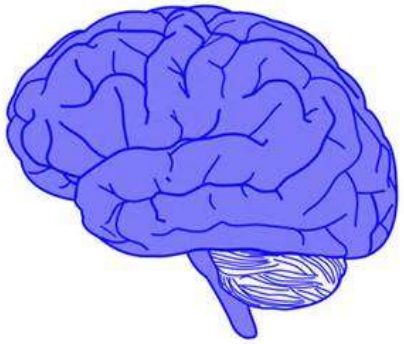
Increased Vulnerability to Stressors

Neuropsychiatric symptoms

Side effects:

Anticholinergic properties
Higher rate of stroke
Higher mortality

Factors Associated with Neuropsychiatric Symptoms



Increased Vulnerability to Stressors

Neurodegenerative disease

Neuropsychiatric symptoms

Patient

Acute medical problems, **boredom**, sleep problems, etc.

Caregiver

Stress, burden, depression **communication issues**

Environment

Overstimulation or **understimulation**

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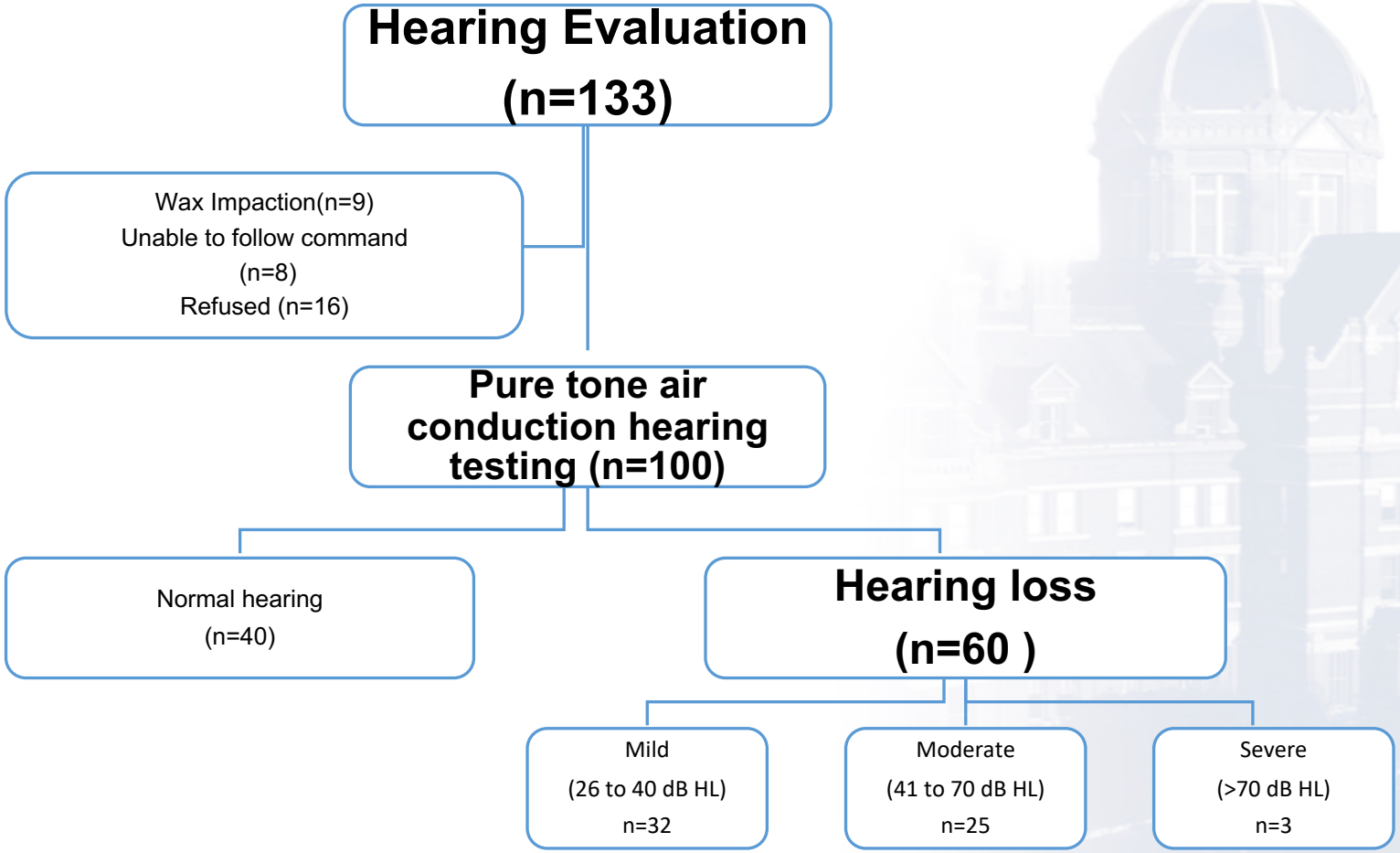
Hearing Loss Prevalence in the Memory Clinic



Nirmalasari et al., Int Psychogeriatr, 2017

Hearing Intervention: Setting a Goal

Your Baltimore HEARS Goal

1. Set a goal

Think about what ***you*** want to be able to do or learn by being part of Baltimore HEARS.

What is the most important listening situation you want to improve by doing this training?

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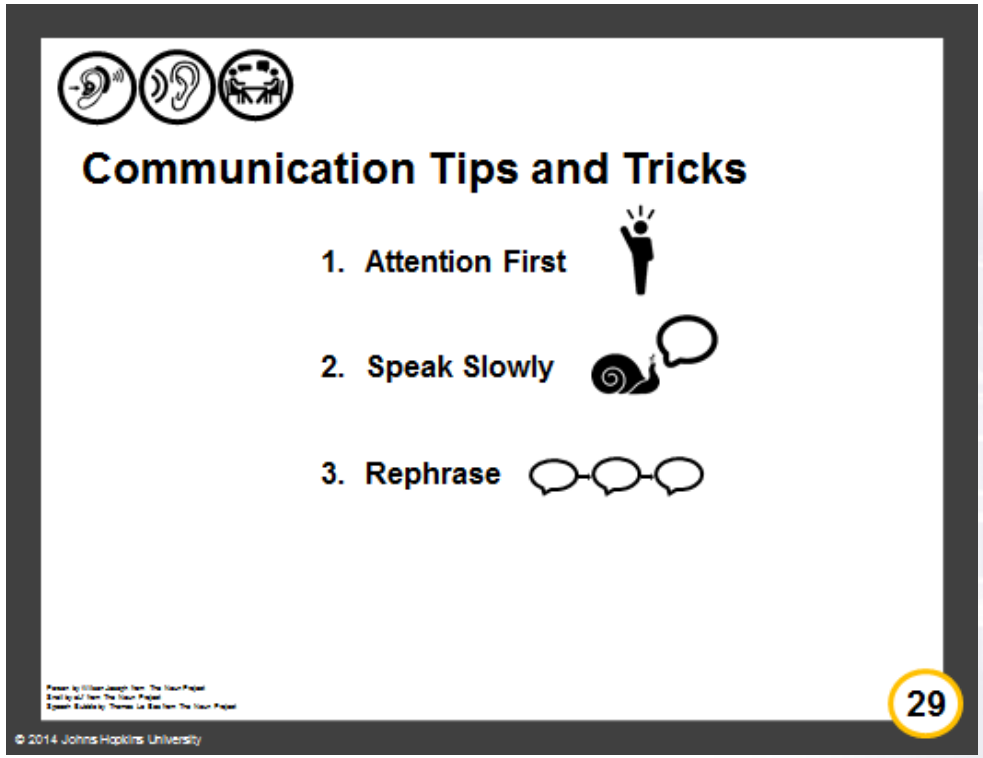
Hearing Intervention: Choosing a Device

CS-50

Pocket Talker

Hearing Intervention: Communication Tips and Tricks



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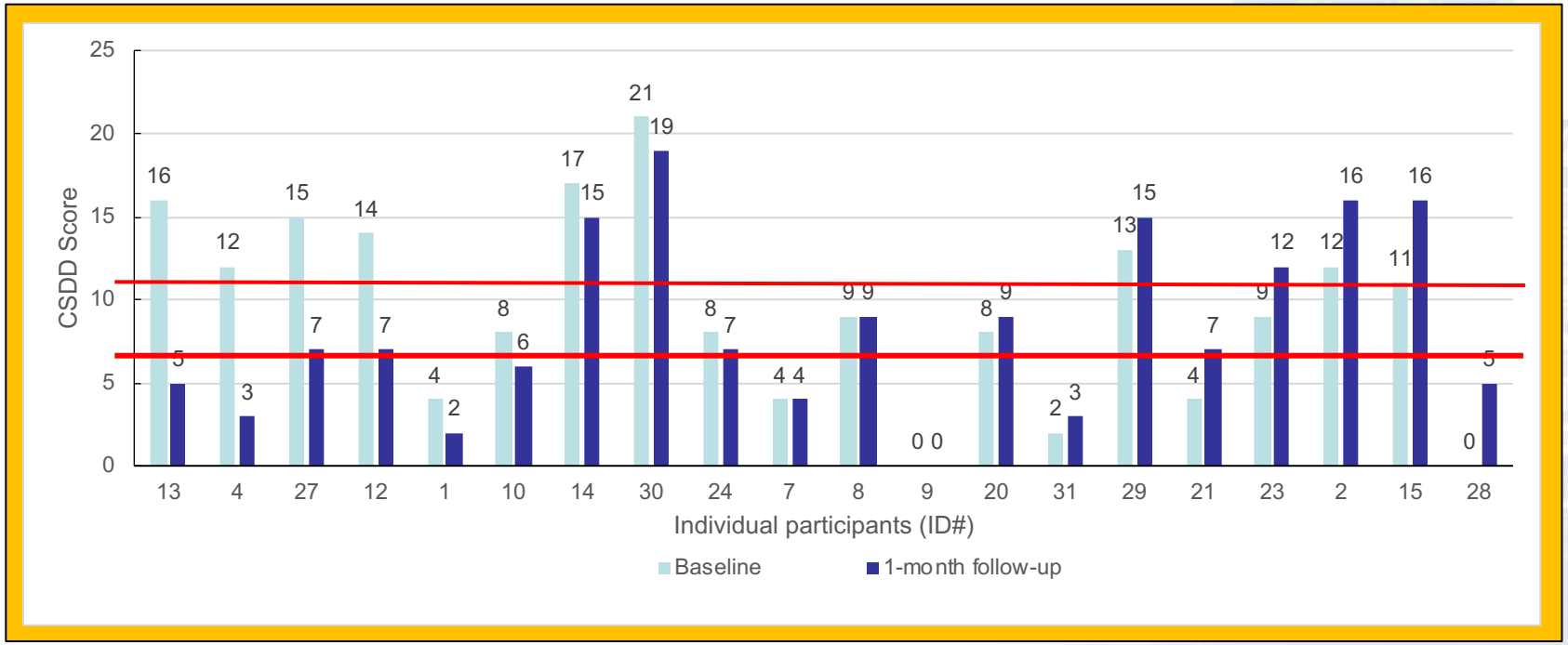
Depressive Symptoms Before and After Hearing Intervention



Mamo et al., AJGP 2017

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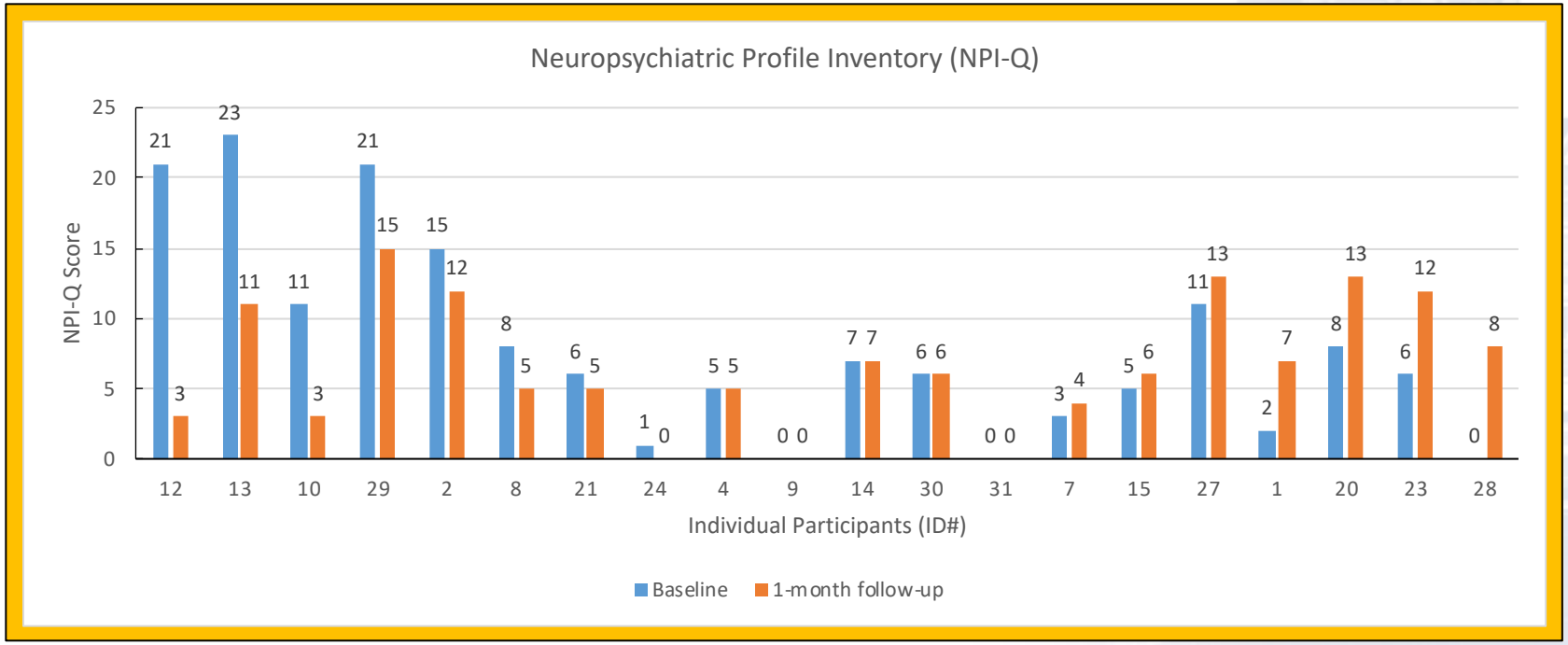
Neuropsychiatric Symptoms Before and After Hearing Intervention



Mamo et al., AJGP 2017

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Caregiver's Assessment

- "She began telling her historical stories more accurately. She asked questions in smoother sentences…Her willingness to make decisions is stronger. Such decisions have made more sense. Note: The dimensha [sic] is still there, but it seems to take more of a back seat in her life."

Caregiver's Assessment

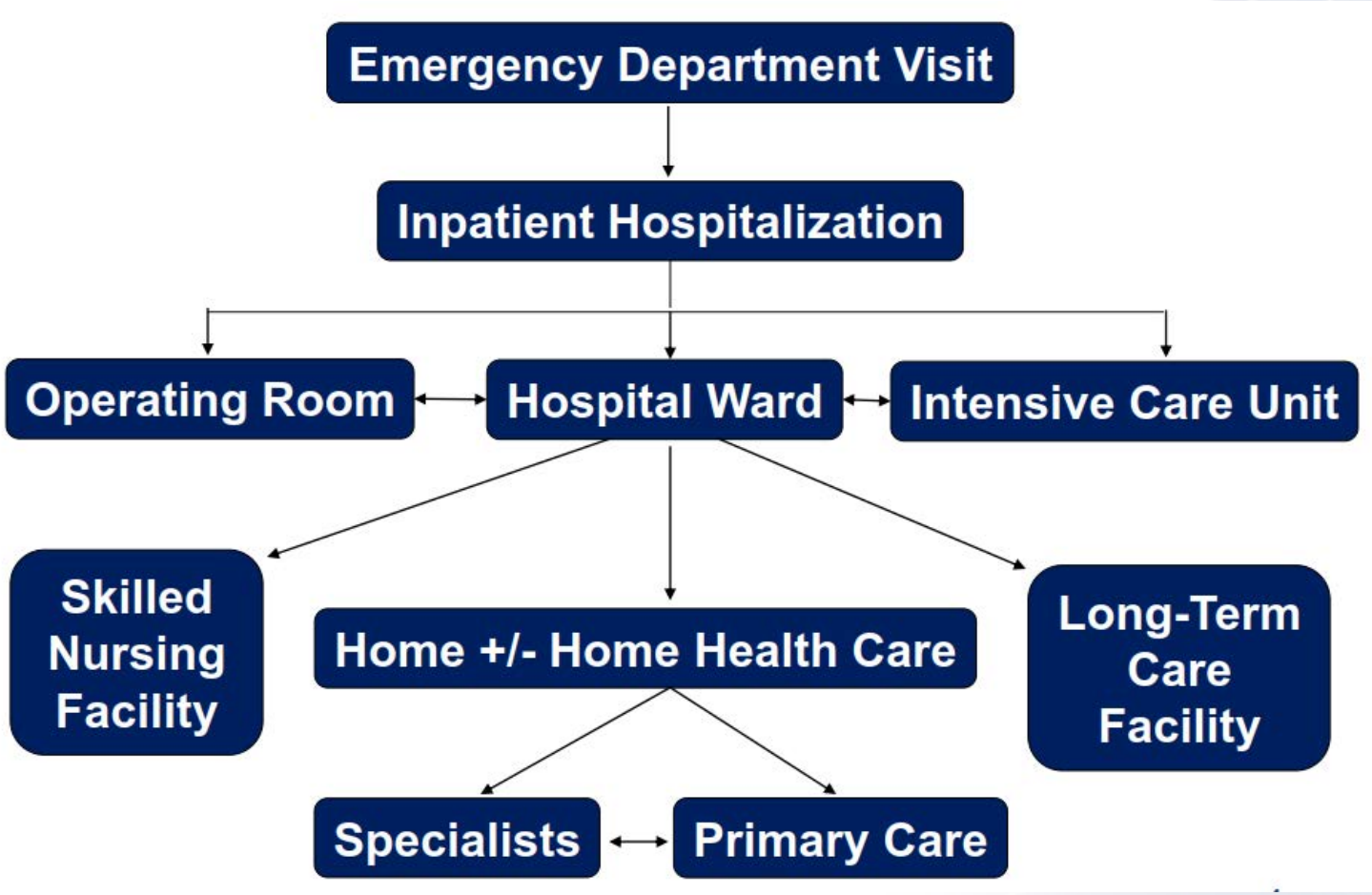
- "My mother listens to music more and when she's watching television she seems to understand what she's watching and laughs or smiles at appropriate times. She also speaks louder, asks more questions, and seems to follow the conversation better. She is reading more often."

Interventions

- acetylcholinesterase inhibitors
- memantine

- sensory loss
- exercise
- diet
- socialization
- caregiver support
- co-morbidities

Hearing Loss and Dementia Care Across Health Care Settings



Care Team

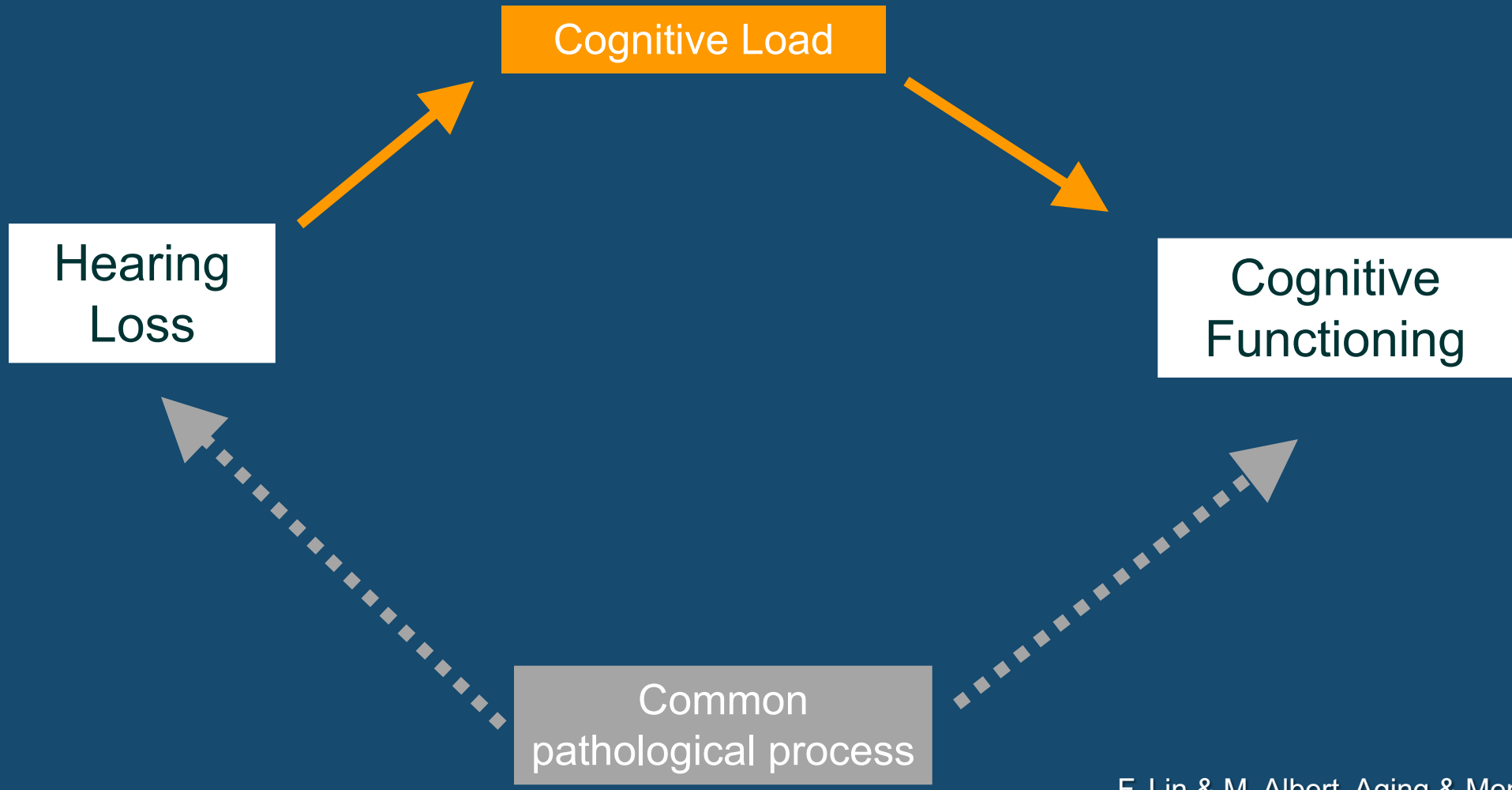
Multi-disciplinary team rounds

Physician
Residents
Medical students
Charge nurse
Social worker
Case manager
PT/OT
Home care coordinator
Pharmacist
Librarian

Audiologist?

Hearing Loss & Cognition

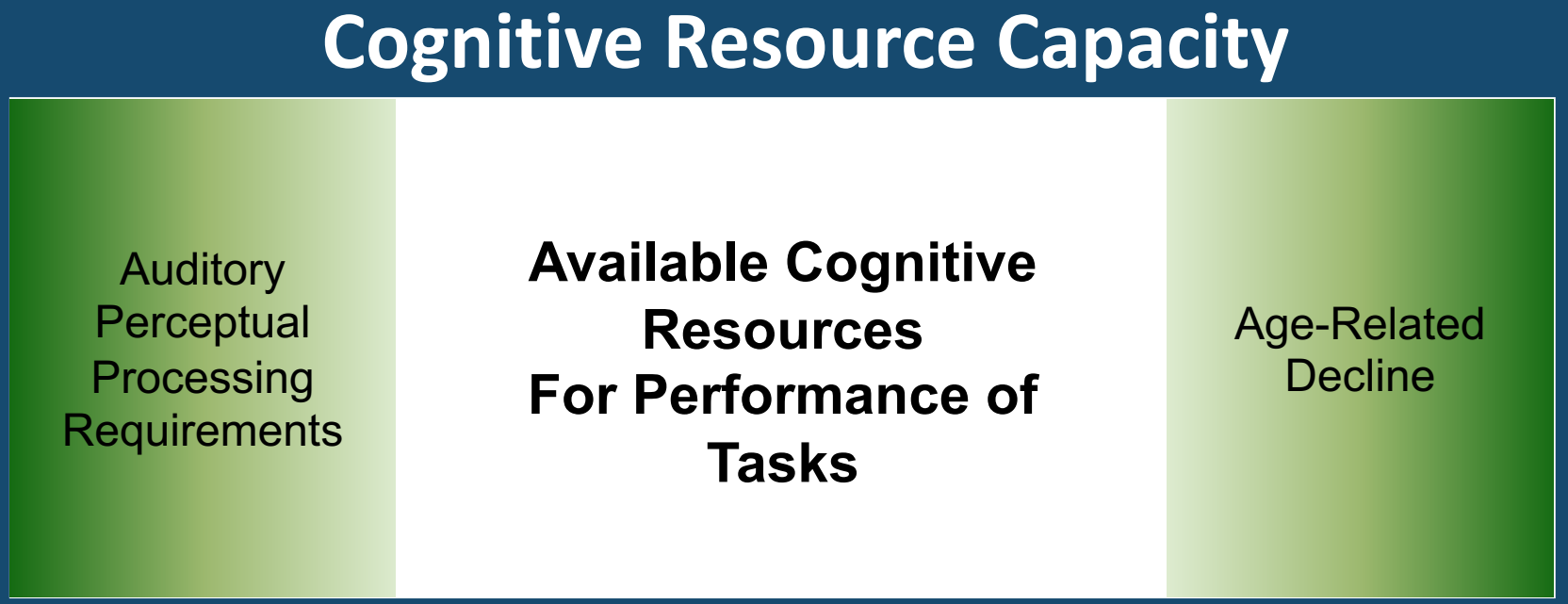
Common Cause or *Modifiable Risk Factor*



F. Lin & M. Albert, Aging & Mental Health, 2014

Hearing Loss & Cognitive Load

Kahneman model of shared attention and resource capacity



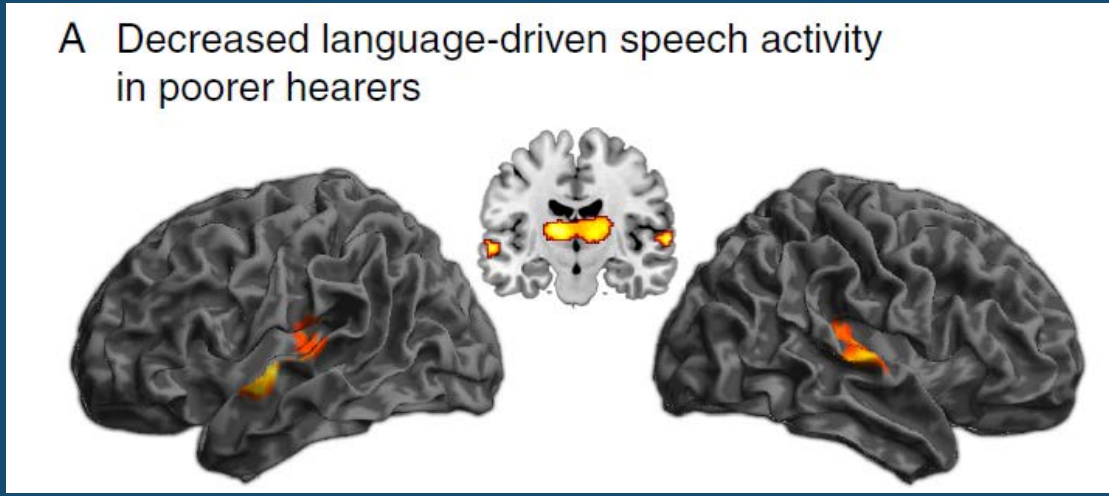
D. Kahneman, Attention & Effort,1973

Hearing Loss & Cognitive Load

Poorer hearing is associated with:

A. Reduced language-driven activity in primary auditory pathways

B. Increased compensatory language-driven activity in pre-frontal cortical areas

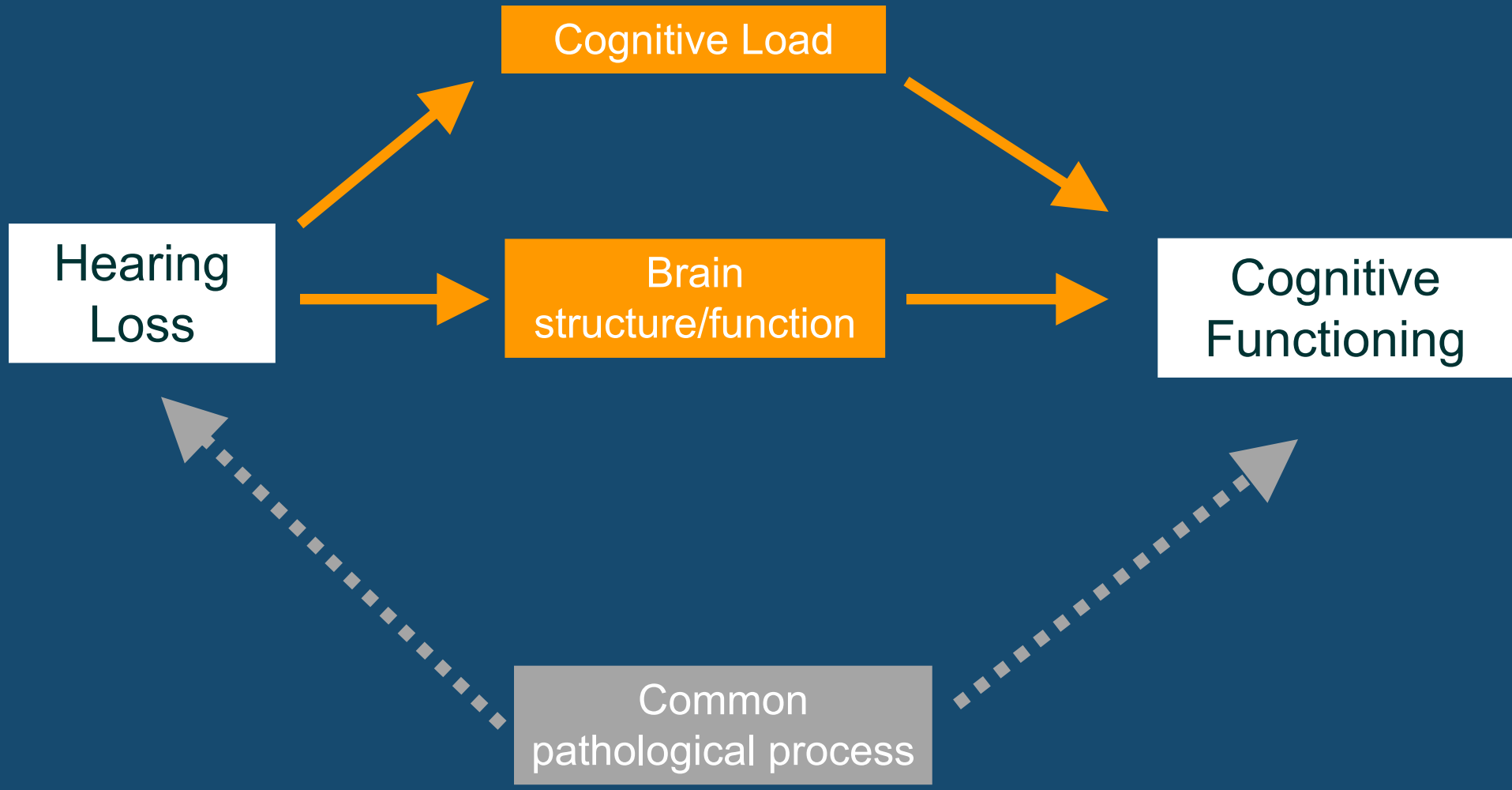


Peelle et al, J. Neurosci, 2011

Grossman et al, Brain Lang, 2002

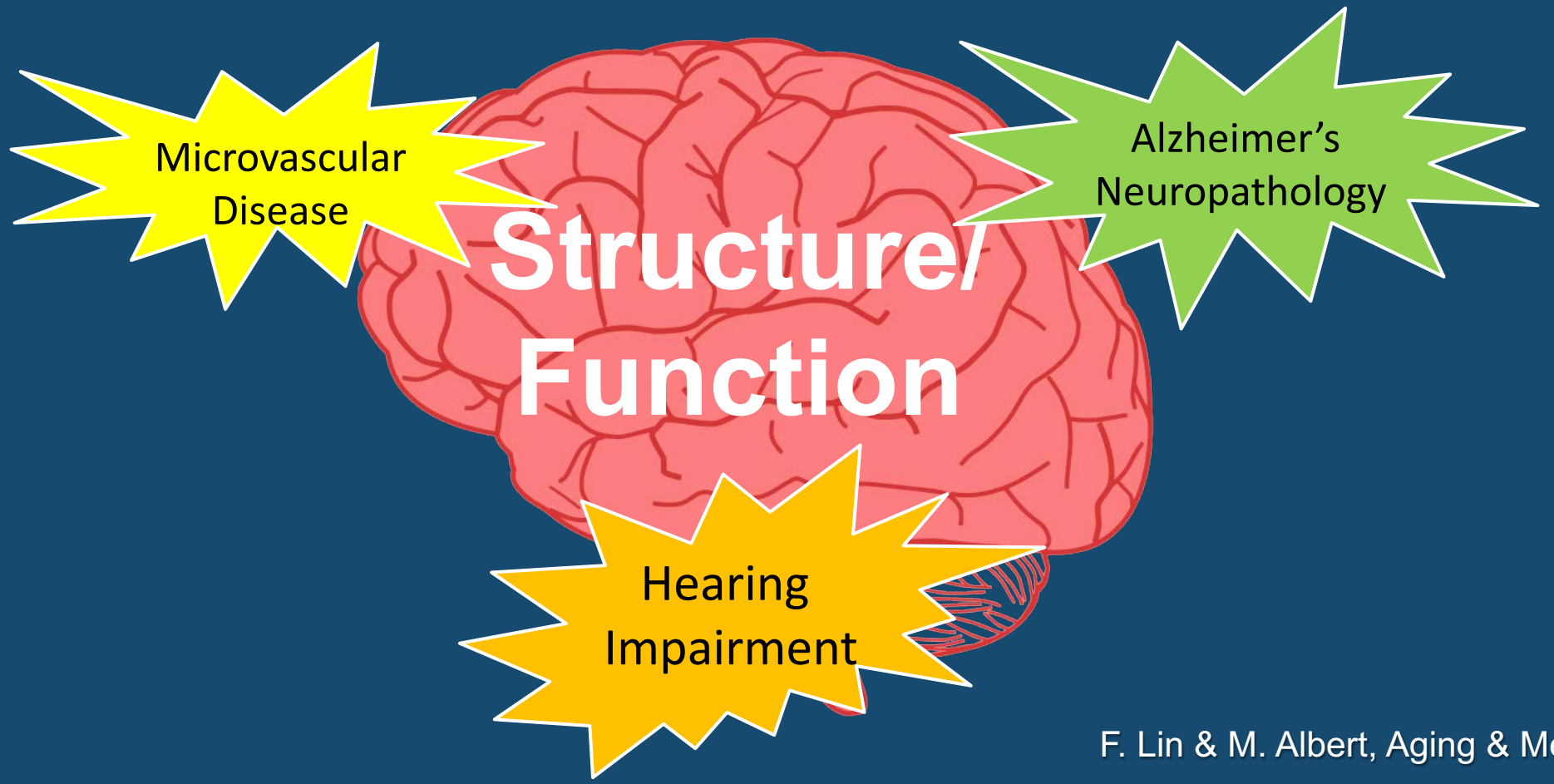
Hearing Loss & Cognition

Common Cause or *Modifiable Risk Factor*



Risk Factors for Dementia – Multi-Hit Theoretical Model

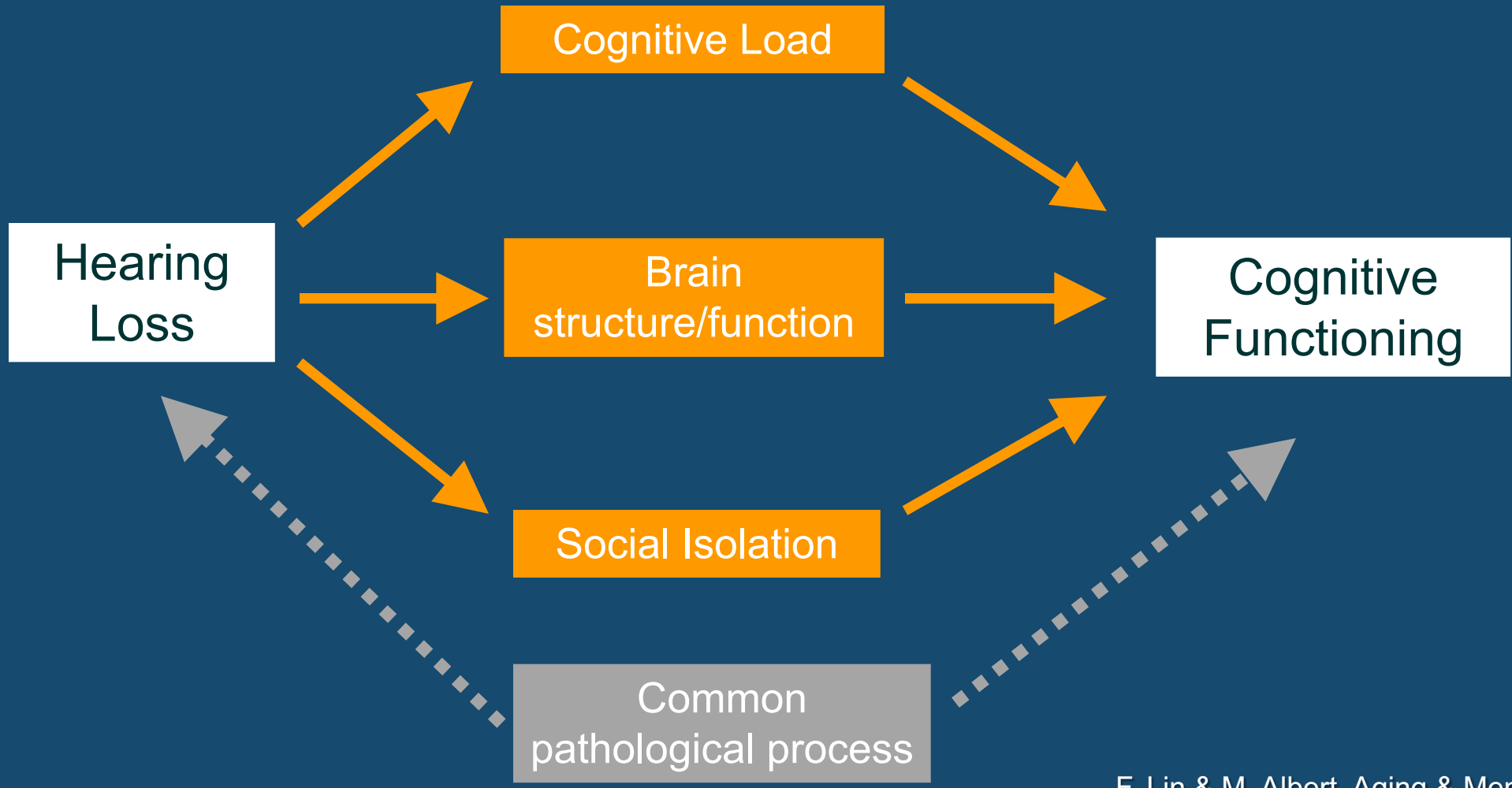
Hearing Loss & Brain Structure/Function



F. Lin & M. Albert, Aging & Mental Health, 2014

Hearing Loss & Cognition

Common Cause or *Modifiable Risk Factor*



F. Lin & M. Albert, Aging & Mental Health, 2014

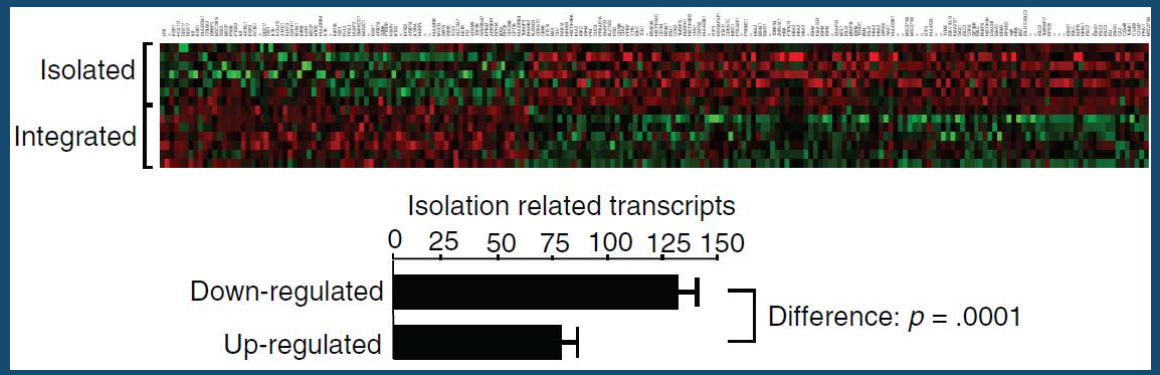
Social Isolation

Cognitive Functioning

Health Behavioral Pathways
- Smoking
- Adherence to medical tx
- Diet
- Exercise

Psychological Pathways
- Self-esteem
- Self-efficacy
- Coping
- Sense of well-being

Physiologic Pathways
- HPA axis response
- Immune system fxn
- Cardiovascular reactivity



Social isolation is associated with upregulation of pro-inflammatory genes & increased inflammation

Cole & Cacioppo, Genome Biology, 2007
Cole & Cacioppo, PNAS, 2011

ACHIEVE Trial Design

Interventions


Terry Chisolm

Hearing Loss Intervention

Univ S. Florida


Vicky Sanchez

-Could help increase auditory/neural stimulation, reduce cognitive load, and improve social engagement

- 4 sessions with a study audiologist to receive hearing loss education & hearing devices

- Semiannual visits thereafter for 3 years to receive booster sessions & trac cognitive/physical health


Michelle Arnold

Successful Aging Education Intervention

Univ Pittsburgh


Nancy Glynn

- Established program that helps promote better understanding of key health topics (diet, exervise, immunizations, etc.) important for healthy aging

- 4 sessions with a health educator to cover the 10 Keys™ program

- Semiannual visits thereafter for 3 years to receive booster sessions & track cognitive/physical health