The Honorable Richard A. Jones

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT SEATTLE

E.S., by and through her parents, R.S. and J.S., and JODI STERNOFF, both on their own behalf, and on behalf of all similarly situated individuals,

Plaintiffs,

v.

REGENCE BLUESHIELD; and CAMBIA HEALTH SOLUTIONS, INC., f/k/a THE REGENCE GROUP,

Defendants.

NO. 2:17-cv-01609-RAJ

**DECLARATION OF ELEANOR HAMBURGER IN SUPPORT OF PLAINTIFFS' OPPOSITION TO DEFENDANTS' MOTION TO DISMISS PLAINTIFFS' THIRD AMENDED COMPLAINT**

**Noted for Consideration: August 7, 2023**

I, Eleanor Hamburger, declare under penalty of perjury and in accordance with the laws of the United States and State of Washington that:

1. I am a partner at Sirianni Youtz Spoonemore Hamburger and am one of the attorneys for Plaintiffs in this action.

2. In the *Schmitt v. Kaiser* case, once we entered the discovery phase of the litigation, Kaiser produced evidence that it covered diagnostic hearing examinations. In discovery we learned that for Kaiser, "routine hearing examinations" referred to examinations related to the fitting of hearing aids. I anticipate we will find similar evidence in the discovery phase of this case.



SIRIANNI YOUTZ
SPOONEMORE HAMBURGER PLLC
3101 WESTERN AVENUE, SUITE 350
SEATTLE, WASHINGTON 98121
TEL. (206) 223-0303 FAX (206) 223-0246

3. Attached are true and correct copies of the following documents, with underlining where appropriate for the Court's convenience:

| Exhibit | Description | Date |
|---|---|---|
| ***1*** | Notice of tentative settlement, Docket Text, *Schmitt v. Kaiser Foundation Health Plan of Washington*, Case 2:17-cv-01611-RSL | 7/21/2023 |
| ***2*** | Declaration of Frank R. Lin, M.D., Ph.D. in Support of Plaintiffs' Motion for Partial Summary Judgment, with Exhibit A, Expert Report, Dkt. No. 131, *Schmitt v. Kaiser Foundation Health Plan of Washington*, Case 2:17-cv-01611-RSL | 6/1/2023 |
| ***3*** | Expert Rebuttal Report of Frank Lin, M.D., Ph.D., Exhibit F to the Declaration of Eleanor Hamburger in Support of Plaintiffs' Motion for Partial Summary Judgment Re: Violation of Affordable Care Act's Anti-Discrimination Law, Dkt. No. 158-7, *Schmitt v. Kaiser Foundation Health Plan of Washington*, Case 2:17-cv-01611-RSL | 7/10/2023 |

DATED: July 24, 2023, at Seattle, Washington.

*/s/ Eleanor Hamburger*

Eleanor Hamburger (WSBA #26478)
SIRIANNI YOUTZ SPOONEMORE HAMBURGER PLLC
3101 Western Avenue, Suite 350
Seattle, WA 98121
Tel. (206) 223-0303; Fax (206) 223-0303
Email: ehamburger@sylaw.com

# Exhibit 1

## Ele Hamburger

**From:** ECF@wawd.uscourts.gov
**Sent:** Friday, July 21, 2023 8:58 AM
**To:** ECF@wawd.uscourts.gov
**Subject:** [External] Activity in Case 2:17-cv-01611-RSL Schmitt v. Kaiser Foundation Health Plan of Washington et al Notice-Other



**U.S. District Court**

**United States District Court for the Western District of Washington**

## Notice of Electronic Filing

The following transaction was entered on 7/21/2023 at 8:58 AM PDT and filed on 7/21/2023
**Case Name:** Schmitt v. Kaiser Foundation Health Plan of Washington et al
**Case Number:** 2:17-cv-01611-RSL
**Filer:**
**Document Number:** No document attached

**Docket Text:**
**NOTICE TO THE PARTIES: The Court has been notified that the parties have reached a tentative settlement. All pending deadlines are suspended, to be reset if necessary if settlement is not perfected. (VE)**

**2:17-cv-01611-RSL Notice has been electronically mailed to:**

Richard E Spoonemore rspoonemore@sylaw.com, matt@sylaw.com, rspoonemore@hotmail.com, stacy@sylaw.com, theresa@sylaw.com

Medora A Marisseau mmarisseau@karrtuttle.com, jlikit@karrtuttle.com, lbrock@karrtuttle.com

Mark A Bailey mbailey@karrtuttle.com, asier@karrtuttle.com, mmunhall@karrtuttle.com, sanderson@karrtuttle.com

Eleanor Hamburger ehamburger@sylaw.com, matt@sylaw.com, stacy@sylaw.com, theresa@sylaw.com

Daniel S Gross dgross@sylaw.com, matt@sylaw.com, stacy@sylaw.com, theresa@sylaw.com

John F Waldo johnfwaldo@hotmail.com

Joshua Howard jhoward@karrtuttle.com, jhowarduw@gmail.com, rmoreau@karrtuttle.com

**2:17-cv-01611-RSL Notice will not be electronically mailed to:**

# Exhibit 2

The Honorable Robert S. Lasnik

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT TACOMA

ANDREA SCHMITT; ELIZABETH MOHUNDRO; and O.L. by and through her parents, J.L. and K.L., each on their own behalf, and on behalf of all similarly situated individuals,

Plaintiffs,

v.

KAISER FOUNDATION HEALTH PLAN OF WASHINGTON; KAISER FOUNDATION HEALTH PLAN OF WASHINGTON OPTIONS, INC.; KAISER FOUNDATION HEALTH PLAN OF THE NORTHWEST; and KAISER FOUNDATION HEALTH PLAN, INC.,

Defendants.

NO. 2:17-cv-01611-RSL

DECLARATION OF FRANK R. LIN, MD, PHD IN SUPPORT OF PLAINTIFFS' MOTION FOR PARTIAL SUMMARY JUDGMENT

I, FRANK R. LIN, declare:

1. I am over the age of 18 and competent to testify to all matters stated herein. All statements are made upon my personal knowledge.

2. Attached as *Exh. A* is the report I prepared for the Plaintiffs that presents a true and correct summary of my opinions in this matter, and to which my curriculum vitae is appended.



SIRIANNI YOUTZ
SPOONEMORE HAMBURGER PLLC
3101 WESTERN AVENUE, SUITE 350
SEATTLE, WASHINGTON 98121
TEL. (206) 223-0303 FAX (206) 223-0246

I declare under penalty of perjury under the laws of the State of Washington and the United States of America that the foregoing is true and correct.

DATED this 30 day of May, 2023, at Baltimore, Maryland.

Frank R. Lin, MD, PhD



SIRIANNI YOUTZ
SPOONEMORE HAMBURGER PLLC
3101 WESTERN AVENUE, SUITE 350
SEATTLE, WASHINGTON 98121
TEL. (206) 223-0303 FAX (206) 223-0246

# EXHIBIT A

*Schmitt, et al.*

*v.*

*Kaiser Foundation Health Plan of Washington, et al.*

**Case No. 2:17-cv-1611-RSL**

# Expert Report

**Frank R. Lin, MD, PhD**

**May 12, 2023**

**Frank R. Lin, MD PhD**
**Professor of Otolaryngology-HNS, Medicine, Mental Health, and Epidemiology**
**Johns Hopkins University**

## Expert Witness Summary of Hearing Loss

### Executive Summary

Sensorineural hearing loss, a condition that involves the gradual deterioration of inner ear sensory function, is an inevitable part of aging that affects everyone over time. This kind of hearing impairment has far-reaching effects, not only disrupting communication and day-to-day activities, but also potentially impacting cognitive, physical, and mental health. From a medical standpoint, individuals are considered to have a hearing disability if they meet two criteria: (1) they have a clinically confirmed, measurable loss of hearing, as evidenced by audiometric tests; and (2) this hearing loss significantly and adversely impacts their daily functioning and activities.

Hearing aids are the primary medical device used to treat hearing loss and are essentially only used for this purpose. There are virtually no other indications or instances when hearing aids are used, other than for treatment of a hearing disability. Consequently, with only exceedingly rare exceptions, individuals who use hearing aids would be considered to have a hearing disability from the medical perspective. Despite potential hurdles such as cost, societal stigma, and inconvenience, individuals who use hearing aids feel compelled to use them because, without them, their ability to function is significantly limited.

Treatment with cochlear implants ("CIs") and osseointegrated implants (often called "Bone Anchored Hearing Aids" or "BAHAs") meets the needs of only a tiny minority (<2-5%) of individuals with hearing disabilities. CIs are surgically implanted into the cochlea (inner ear), and the placement of the electrode effectively results in the loss of any residual acoustic hearing in the implanted ear. As such, CIs are only used in individuals with the most severe forms of sensorineural hearing loss and when the patient continues to have a hearing disability despite using high-powered hearing aids. In contrast, osseointegrated implants are most commonly indicated for individuals with a permanent conductive hearing loss (rare) and when the patient is unable to benefit from using a hearing aid. These surgically implanted devices are simply not appropriate, and would not be prescribed, for >95%-98% of the individuals with disabling hearing loss.

Health insurance policies that don't cover hearing aids nearly exclusively impact those living with a hearing disability. Medically speaking, the lack of coverage for hearing aids and related services deprives individuals with hearing disabilities of the necessary means to address their disability and to potentially mitigate the adverse impact that hearing loss and hearing disability can have on cognitive, social, physical, and mental health. In contrast, individuals without hearing impairments are generally well-served by health insurance policies. These policies cater

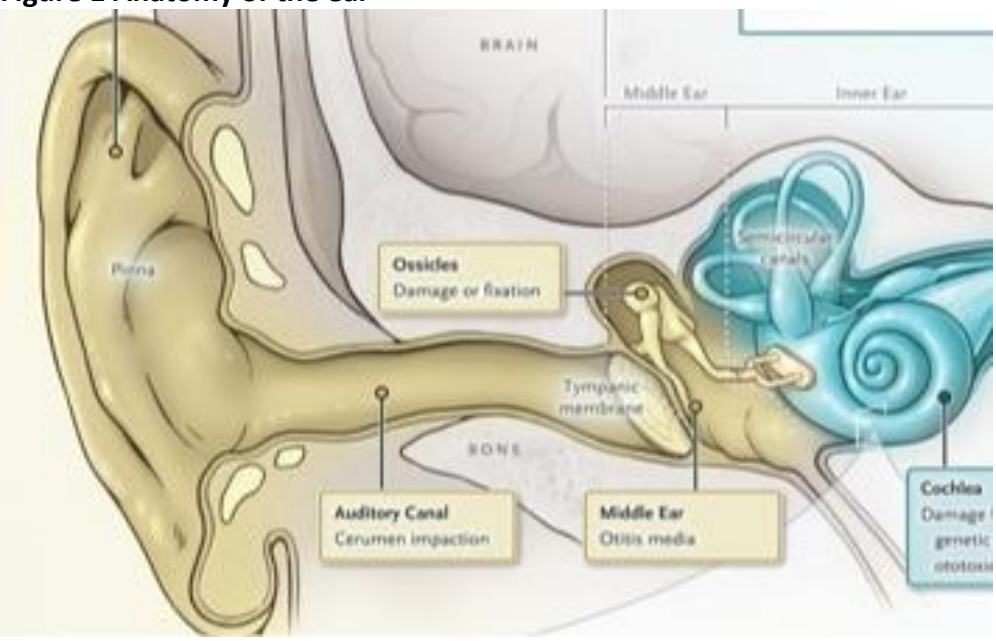
to their auditory health needs by allowing access to primary care physicians or offering referrals to audiologists and/or ENT specialists for diagnostic hearing tests and medical evaluations when needed. Thus, their hearing health requirements are fully met.

**A. Hearing and Hearing Loss**

A.1 Physiology of hearing and hearing loss

The physiological sense of hearing depends on special sense organs of the peripheral auditory system which encompasses the external (ear canal), middle (ear drum and ear bones), and inner ear (cochlea). Our ability to hear depends on the processing of sound in the peripheral auditory system that occurs in two sequential steps: 1) External & middle ear: sound waves are channeled through the ear canal to the middle ear where the ear drum (tympanic membrane) and ear bones (ossicles) convert the acoustic energy into mechanical energy that is transmitted into the inner ear; 2) Inner ear: the mechanical energy transferred into the cochlea is encoded and transduced into a neural signal by the sensory hair cells of the cochlea (Figure 1). These neural signals are then transmitted to the brain where the brain decodes the neural signal into meaning.

**Figure 1 Anatomy of the ear**




From Cunningham LL, Tucci DL. Hearing loss in adults. *N Engl J Med*. 2017; 377:2465-2473. doi: 10.1056/NEJMra1616601

Hearing loss can result from dysfunction at any one of these levels. Any physical process that affects the transmission of sound waves through the ear canal or the movement of the ear bones in the middle ear will affect hearing and lead to what is called a *conductive hearing loss* –

meaning that the sound can't be conducted into the inner ear. For example, if someone has a lot of occluding ear wax or an ear infection that leads to a hole in the ear drum or fluid being trapped in the middle ear, sound will not be able to get to the cochlea as efficiently. This type of conductive hearing loss is generally temporary until the underlying problem is resolved or fixed (e.g., cerumen removed, middle ear infection resolves, hole in the eardrum heals or is surgically corrected).

In contrast, the hearing loss that nearly all humans will experience to some degree over time results from gradual pathological changes that occur in the inner ear. The sensitive sensory hair cells in the cochlea that convert sound energy into a neural signal and other parts of the cochlea that are critical for sound transduction can be damaged progressively from aging, noise exposure, genetic predisposition, etc., and unlike other cells of the body, these sensory cells in the cochlea cannot regenerate. This type of hearing loss is termed *a sensorineural hearing loss* – meaning that the *sensory* hair cells and *neural* encoding of sound are impaired. Individuals with sensorineural hearing loss will note that speech often sounds unclear or as if the speaker is mumbling or garbling their words.

A.2 Prevalence of hearing loss

Hearing loss prevalence has been extensively studied in prior epidemiological studies that have utilized random samples of the U.S. population. These studies have been based on objective audiometric testing involving a calibrated audiometer and sound attenuating booth to capture valid estimates of audiometric hearing loss. These tests involve having a participant wear ear phones and testing the minimum level of loudness (threshold, generally ranges from 0 decibels [dB] to 100 dB) at which the participant can hear tones of various frequencies (between 250 Hz to 8000 Hz) in each ear.

Based on clinical convention and according to World Health Organization standards[1], classification of an individual's hearing level for epidemiological purposes is based on averaging an individual's hearing thresholds from 500-4000 Hz (the frequencies most important for speech) in the person's better-hearing ear. This resulting value is termed the four-frequency pure tone average (PTA). Prior to 2021[2], a PTA 25 dB or better was considered normal hearing, 26-40 dB mild/slight hearing loss, 41-60 dB moderate hearing loss, 61-80 dB severe hearing loss, and 81 dB or greater profound hearing loss. More recently, the World Health Organization has adopted an updated classification system to align with the Global Burden of Disease system (Figure 2) [1]: PTA <20 dB normal hearing, PTA 20-34.9 dB Mild, PTA 35-49.9 dB Moderate, PTA 50-64.9 dB Moderately Severe, 65-79.9 dB Severe, 80 dB or greater Profound/Complete. Given the relatively recent update to the classification system, both classification systems are still frequently in use. A recent estimate of hearing loss prevalence in the U.S. published by the expert witness in 2016 using the original WHO classifications of hearing loss severity is summarized in Figure 3.

**Figure 2 WHO Classification System for Hearing Loss**

| Grade | Hearing threshold‡ in better hearing ear in decibels (dB) | Hearing experience in a quiet environment for most adults | Hearing experience in a noisy environment for most adults |
|---|---|---|---|
| **Normal hearing** | Less than 20 dB | No problem hearing sounds | No or minimal problem hearing sounds |
| **Mild hearing loss** | 20 to < 35 dB | Does not have problems hearing conversational speech | May have difficulty hearing conversational speech |
| **Moderate hearing loss** | 35 to < 50 dB | May have difficulty hearing conversational speech | Difficulty hearing and taking part in conversation |
| **Moderately severe hearing loss** | 50 to < 65 dB | Difficulty hearing conversational speech; can hear raised voices without difficulty | Difficulty hearing most speech and taking part in conversation |
| **Severe hearing loss** | 65 to < 80 dB | Does not hear most conversational speech; may have difficulty hearing and understanding raised voices | Extreme difficulty hearing speech and taking part in conversation |
| **Profound hearing loss** | 80 to < 95 dB | Extreme difficulty hearing raised voices | Conversational speech cannot be heard |
| **Complete or total hearing loss/deafness** | 95 dB or greater | Cannot hear speech and most environmental sounds | Cannot hear speech and most environmental sounds |
| **Unilateral** | < 20 dB in the better ear, 35 dB or greater in the worse ear | May not have problem unless sound is near the poorer hearing ear. May have difficulty in locating sounds | May have difficulty hearing speech and taking part in conversation, and in locating sounds |

* The classification and grades are for epidemiological use and applicable to adults. The following points must be kept in mind while applying this classification:

- While audiometric descriptors (e.g. category, pure-tone average) provide a useful summary of an individual's hearing thresholds, they should not be used as the sole determinant in the assessment of disability or the provision of intervention(s) including hearing aids or cochlear implants.
- The ability to detect pure tones using earphones in a quiet environment is not, in itself, a reliable indicator of hearing disability. Audiometric descriptors alone should not be used as the measure of difficulty experienced with communication in background noise, the primary complaint of individuals with hearing loss.

Unilateral hearing loss can pose a significant challenge for an individual at any level of asymmetry. It therefore requires suitable attention and intervention based on the difficulty experienced by the person.

‡ "Hearing threshold" refers to the minimum sound intensity that an ear can detect as an average of values at 500, 1000, 2000, 4000 Hz in the better ear *(148, 156, 157)*.

From World Health Organization World Hearing Report, 2021

**Figure 3 Prevalence of and Numbers of Individuals With Hearing Loss, by Age and Severity in the United States**

| Hearing Loss Category and Age, y | Prevalence, % (95% CI) | | | | | Number With Hearing Loss (Millions) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Profound | Overall | Mild | Moderate | Severe | Profound | Overall |
| Bilateral[a] | | | | | | | | | | |
| 12–19 y | 0.14 (0.04, 0.24) | 0.03[b] (0.00, 0.06) | . . .[c] | 0.00[b] (0.00, 0.01) | 0.18 (0.07, 0.28) | 0.05 | 0.01 | . . .[c] | <0.01 | 0.06 |
| 20–29 y | 0.34[b] (0.00, 0.88) | 0.07[b] (0.00, 0.20) | . . .[c] | . . .[c] | 0.42[b] (0.00, 0.97) | 0.15 | 0.03 | . . .[c] | . . .[c] | 0.18 |
| 30–39 y | 1.01[b] (0.18, 1.84) | 0.55[b] (0.00, 1.21) | 0.08[b] (0.00, 0.25) | . . .[c] | 1.64 (0.23, 3.06) | 0.41 | 0.23 | 0.03 | . . .[c] | 0.68 |
| 40–49 y | 6.05 (3.71, 8.40) | 0.48[b] (0.00, 1.01) | . . .[c] | . . .[c] | 6.53 (4.19, 8.88) | 2.46 | 0.20 | . . .[c] | . . .[c] | 2.65 |
| 50–59 y | 10.48 (7.34, 13.62) | 2.13 (0.79, 3.46) | 0.35[b] (0.00, 0.78) | 0.34[b] (0.00, 0.99) | 13.29 (9.76, 16.81) | 4.57 | 0.93 | 0.15 | 0.15 | 5.80 |
| 60–69 y | 19.94 (15.03, 24.84) | 5.85 (3.53, 8.17) | 0.76[b] (0.00, 1.70) | 0.25[b] (0.00, 0.75) | 26.80 (22.25, 31.35) | 6.92 | 2.03 | 0.27 | 0.09 | 9.31 |
| 70–79 y | 35.62 (31.03, 40.22) | 15.83 (13.63, 18.04) | 2.86 (1.60, 4.12) | 0.30[b] (0.02, 0.59) | 54.62 (49.27, 59.97) | 6.84 | 3.04 | 0.55 | 0.06 | 10.49 |
| ≥80 y | 36.02 (32.03, 40.01) | 37.92 (33.40, 42.44) | 6.97 (4.94, 9.01) | 0.56[b] (0.01, 1.10) | 81.47 (78.12, 84.82) | 3.98 | 4.19 | 0.77 | 0.06 | 9.01 |
| Total | | | | | | 25.39 | 10.66 | 1.77 | 0.35 | 38.17 |

From Goman & Lin, American Journal of Public Health, Oct 2016 Vol 106, No 10. Hearing loss severity based on the 4-frequency PTA in the better hearing ear: mild (> 25 dB through 40 dB), moderate (> 40 dB through 60 dB), severe (> 60 dB through 80 dB), or profound (> 80 dB).

Among individuals with hearing loss, distinguishing between the prevalence of a sensorineural hearing loss versus a permanent conductive hearing loss (i.e., not from a transient cause such as ear wax or an ear infection) is difficult to estimate given that a permanent conductive hearing loss is rare compared to the much more common sensorineural hearing loss. Additional specialized audiometric equipment (calibrated bone oscillator) is also required to measure conductive hearing, and this equipment is not typically used in epidemiological studies. One study of adults has estimated that 8% of adults with hearing loss have a conductive hearing loss[3], but it's unclear how many of these individuals simply had a transient conductive hearing loss versus a permanent conductive hearing loss. From the expert witness's own clinical experience seeing patients in a busy tertiary care academic otology practice, I would estimate that <2-3% of adults with hearing loss have a component of a clinically significant permanent conductive hearing loss, and such a hearing loss is often super-imposed on an underlying sensorineural hearing loss.

A.3 Hearing disability

Hearing loss is typically diagnosed using audiometric testing, inspection of the ear canal and middle ear, and speech recognition tests. The goal of this evaluation is to determine whether there is an objective hearing loss and to rule out whether the hearing loss could be accounted for by other medical conditions. Once hearing loss is diagnosed through such objective studies and evaluation, a hearing care professional must also interview the patient to determine whether and how the measured hearing loss is impacting the patient's daily life.

An audiometric hearing loss as defined above in A.2 is not synonymous with hearing disability. The definition of disability adopted by the Centers for Disease Control [1] states "A disability is any condition of the body or mind (impairment) that makes it more difficult for the person with the

condition to do certain activities (activity limitation) and interact with the world around them (participation restrictions)."

From a medical perspective, this definition is often operationalized as meaning that a patient would be considered to have a hearing disability if (1) they self-report functional restrictions in everyday activities requiring hearing (e.g., verbal communication with others, environmental sound awareness needed for safety, etc.) and (2) there is evidence of objective audiometric hearing loss (e.g., hearing thresholds greater than 20 dB). Different individuals with the same audiometric hearing loss may or may not have a hearing disability (i.e., report functional limitations) given that some individuals may be able to better compensate for reduced peripheral hearing through central brain processes (i.e., the brain adapts by better decoding the degraded auditory signal coming from the ear) or their lifestyles or communication partners make functional limitations less likely to occur (e.g., an individual frequently needing to communicate in noisy environments versus an individual retired and living alone at home).

A.4 Impact of hearing loss and hearing loss treatment on health

The impact of hearing loss in childhood has been well established over the past 50 years with evidence demonstrating that hearing loss in children affects parent-child dyadic relationships and behaviors, language and cognitive development, socialization, educational attainment, and later vocational opportunities. Likewise, the beneficial role of early childhood hearing screening and prompt intervention for hearing loss in reducing these sequela have been consistently demonstrated (comprehensive summary provided in WHO World Report on Hearing[1]).

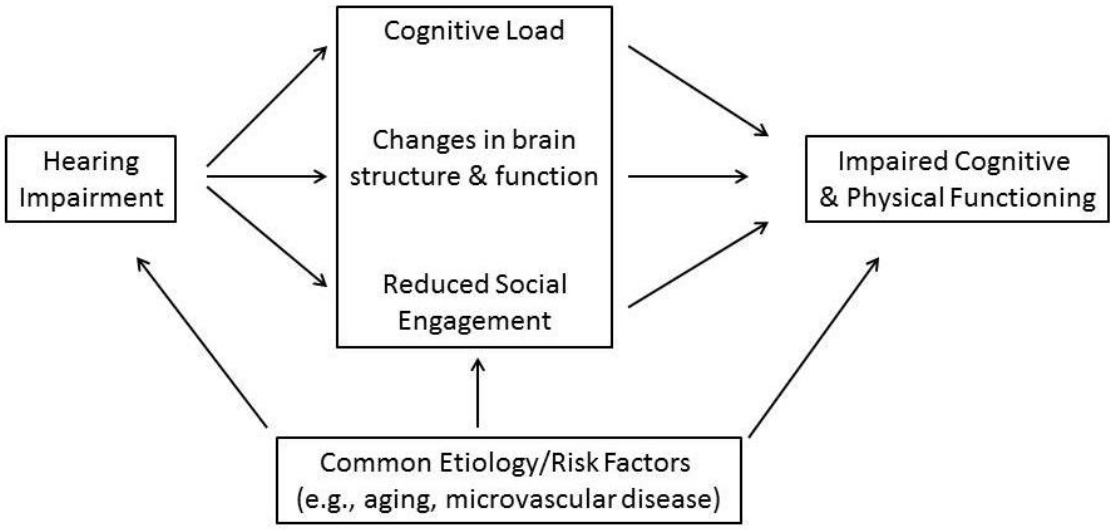
Over the past decade, similar research has also now established the impact of hearing loss on adults and the importance of hearing for maintaining optimal cognitive, physical, social, and mental functioning as we age. A conceptual model (Figure 4) developed by the expert witness and colleagues established the mechanisms through which hearing loss could affect these broad functional domains. This model demonstrates that while some common etiologies could underlie a simple correlation between hearing and poor health outcomes (e.g., age, vascular disease processes), there are 3 primary mechanistic pathways through which hearing loss could causally contribute to poorer health. These pathways are briefly summarized below[4]:

- *Cognitive load*: The brain has to recruit and use additional brain resources to compensate for the impoverished auditory encoding by the impaired cochlea. This process can place a 'load' on the brain and rob resources that would otherwise have been dedicated to thinking, memory, and other processes.
- *Changes to brain structure*: Experimental animal studies and observational studies of older adults demonstrate that parts of the brain that handle sound processing can begin to atrophy or shrink faster with hearing loss. Importantly, these parts of the brain are also important for cognitive and other abilities which can lead to cascading effects on other areas of brain function. At present, the two most common pathologic processes that can damage the brain as we age are from microvascular disease (e.g., from high blood pressure, diabetes, etc.) and from Alzheimer's disease neuropathology, and not coincidentally, these are the two leading causes of dementia in late life. Increasingly,

research is also indicating that hearing loss may act as an additional "hit" along with these other two processes to adversely affect the brain over time.

- *Social isolation*: The effects of hearing loss on someone's willingness to socially engage can often times be subtle. For example, some individuals may slowly give up going out

**Figure 4 Conceptual model of how hearing loss impacts the functioning of adults**




Reproduced from Lin & Albert, Aging and Mental Health 2014

with friends to restaurants, while others may completely withdraw and become introverted. This social isolation or loneliness is important—scientists have long known that social isolation in older adults is a direct risk factor for poorer health outcomes.

Epidemiologic research over the past decade has supported the hypothesized impact of hearing loss on these broader functional areas. The greatest amount of recent work has focused on cognitive decline and dementia in older adults. In these studies, hearing loss in older adults is consistently linked with the risk of dementia even after multiple other factors are accounted for in the analyses (e.g., effects of age, education, chronic diseases, etc.). These studies have demonstrated a direct 'dose-response' wherein the greater the severity of hearing loss, the greater the risk of being diagnosed with dementia over time. In 2017 and 2020, the results of a major convened review of risk factors for dementia published by the Lancet Commission[5,6] concluded that among all known modifiable risk factors for dementia (e.g., obesity, smoking, diabetes, early life education), hearing loss in mid- to late-life was the single risk factor accounting for the greatest proportion of dementia risk.

Consistent with the conceptual model, the implications and potential consequences of hearing loss also extend beyond dementia[7]. Recent epidemiologic research has also demonstrated that hearing loss in older adults is linked with an increased risk of falls, depressive symptoms, greater risk of hospitalization and requiring institutionalization, and poorer physical functioning. In particular, for falls and physical functioning, the cognitive load imposed by hearing loss may

affect the overall brain resources needed to maintain balance particularly in the setting of additional stressors that could affect balance function in older adults (e.g., visual problem, arthritis, etc.). Loss of hearing may also subtly affect our ability to monitor our auditory environment (e.g., person approaching from behind) or even hear our own footfalls with walking—both of which could affect fall risk and an individual's overall physical functioning.

Prior research has clearly demonstrated the positive effects of hearing loss intervention in adults on improving hearing and communication outcomes (summarized in multiple consensus reports[1,7,8]). Ongoing research is now extending our understanding of these proximal effects of hearing intervention on communication to potentially more distal effects on reducing risk of cognitive decline and dementia in late life[9]. An ongoing NIH-funded large scale randomized trial in the United States of treating hearing loss in adults that is being led by the expert witness will establish the definitive impact of hearing loss intervention on cognitive decline, brain health, and other functional outcomes in adults with trial results set to be made public in late 2023[10].

**B. Hearing Loss Treatment Modalities**

The overarching goal of treating hearing loss is to improve hearing and reduce communication impairments in order to optimize daily function and safety. From a medical and audiological perspective, hearing loss treatment typically comprises 3 primary components: 1) Diagnostic audiological testing of hearing (perhaps followed by otolaryngological evaluation if there are any medical or surgical indications); 2) Audiological counseling and rehabilitative services (often in conjunction with use of hearing technologies); and 3) Hearing technology.

B.1 Diagnostic audiological testing

Diagnostic testing typically comprises an audiologist performing a visual examination of the ear and ear canal followed by comprehensive audiometric testing. This testing includes testing audiometric hearing thresholds, speech testing, and possible additional tests based on clinical necessity (e.g., tests of middle ear function). Further evaluation with an otolaryngologist may be further indicated based on the patient's symptoms or results of the audiological testing.

B.2 Audiological counseling and rehabilitative services

For patients presenting for management of hearing loss, audiologists provide counseling and rehabilitative services focused on understanding the nature and extent of the individual's hearing and communicative needs and then helping the patient address these needs through learning communication and lifestyle strategies to optimize hearing and communication. In addition, the audiologist will often instruct and support the patient in the use of indicated hearing technologies to help with hearing. These technologies can include both medically prescribed technologies as well as everyday hearing technologies such as amplified telephones, use of closed captioning, etc. For medically prescribed technologies, the audiologist will customize, program, and configure these technologies for the patient.

B.3 Hearing technologies

The principal hearing technologies for hearing loss in the medical and audiological setting include hearing aids, osseointegrated implants (BAHA-bone anchored hearing aid), and cochlear implants. Other forms of prescribed hearing technologies also exist (e.g., other types of implantable and non-implantable bone conduction hearing devices) but these are very rarely considered and even more rarely used. Overwhelmingly, hearing aids are the primary and predominant device used by individuals with a hearing disability to treat their hearing impairment.

*B.3.a. Hearing aids* Prescription hearing aids (also referred to as air conduction hearing aids) are medical devices regulated by the Food and Drug Administration and as such can only be provided through a licensed provider. Hearing aids are designed to be worn in or on the ear and are custom programmed and fit by a hearing professional (typically an audiologist or hearing instrument specialist). These devices as well as the associated programming and counselling provided by a hearing professional are considered the gold standard for optimal hearing rehabilitative care for the vast majority of individuals with hearing loss. Hearing aids will selectively amplify and filter sounds according to the patient's precise degree of hearing loss in order to optimize speech understanding and environmental sound awareness.

Prescription hearing aids are indicated for individuals with objective diagnosis of hearing loss (e.g., individuals with audiometric hearing loss [sensorineural or permanent conductive]) who also notice functional impairments related to hearing and communication. Hearing aids can be medically necessary and are effective at treating hearing loss. They are not considered "experimental or investigational" when used to treat hearing loss.

Other indications for use of a prescription hearing aid outside this above indication are theoretically possible (e.g., use of a hearing aid by an individual with tinnitus *without* audiometric hearing loss or use of a hearing aid by an individual with a central auditory processing deficit *without* audiometric hearing loss) but these situations are extremely rare. For example, in nearly 14 years as a practicing otologist at a tertiary academic medical center, I do not recall ever encountering a patient using hearing aids for one of these latter indications. Hearing aids are used occasionally by individuals with tinnitus or with central auditory processing disorders, but in nearly all of these cases, an audiometric hearing loss is also concurrently present. In sum, virtually no one uses prescription hearing aids unless they are experiencing a hearing disability.

*B.3.b. Osseointegrated bone conduction implants* Osseointegrated implants (also called BAHA devices) are surgically implanted devices that can directly conduct sound from an external sound processor into the skull where it is in turn transmitted through bone vibrations to the cochlea. A portion of the implant termed the fixture is permanently implanted into the bone around the ear and is not able to be practically removed. The surgery involves local or general anesthesia where an incision is made behind the ear, a small opening drilled into the bone

behind the ear, followed by introduction of a titanium prosthetic fixture into the bone where it will osseointegrate into place over several weeks. Once healed, an external sound processor is connected to the implanted fixture which can conduct sound into the bone. The primary indication for an osseointegrated implant is a permanent conductive hearing loss that cannot be successfully treated with a hearing aid. This can occur because of medical contraindications (e.g., post-surgical changes to the ear preventing successful hearing aid use) or other reasons (e.g., degree of conductive hearing loss is too large to allow for hearing aid use). Osseointegrated implants are also indicated for individuals with single sided deafness. In these cases, the implant is placed on the side of the deaf ear so sound coming to that side of the head can be transmitted to the cochlea on the other side of the head. This allows the patient to still hear sounds from their deaf side and aids in environmental sound awareness and communication.

*B.3.c. Cochlear implants* Cochlear implants are surgically implanted neuroprosthetic devices that are indicated only for individuals who have severe or greater audiometric sensorineural hearing loss and who cannot derive adequate benefit from using a hearing aid (typically defined by understanding <60% of spoken words correctly under best aided conditions with well-fit hearing aids). A cochlear implant surgery takes place under general anesthesia and requires 2-3 hours. During the surgery, bone is removed from behind the ear to access the cochlea under an operative microscope. The surgeon will then make an opening into the cochlea to thread an electrode array directly into the cochlea which when connected later to the external sound processor will send electrical impulses directly to the hearing nerve which will then stimulate the brain. A cochlear implantation is an irreversible procedure in that once an electrode array is inserted into the cochlea, nearly all remaining residual hearing in that ear will be lost and the patient will be dependent on the cochlear implant to hear in that ear. As such, a cochlear implant would never be indicated or considered for a patient whose hearing and communication needs are being sufficiently met using a hearing aid or other non-invasive approaches.

As a general rule, ENTs and other hearing care professionals would always recommend the most conservative, non-invasive treatment option first (e.g., typically hearing aids) for individuals with a hearing disability. As a result, CIs or osseointegrated implants are often not considered for a patient until they have failed a hearing aid trial. Consistent with this conservative approach to hearing loss management, I have often observed that many insurance companies have such a policy requirement for a hearing aid trial before coverage for a CI or osseointegrated implant would be permitted.

<u>B.4 Comment on Kaiser coverage of hearing care treatment</u>

I have reviewed documentation of Kaiser hearing coverage policies, and my understanding from this review is that Kaiser covers diagnostic audiological testing for hearing loss evaluation and also covers services and procedures related to cochlear implantation and BAHA (osseointegrated implant) surgery. In contrast, hearing aids and exams/services related to hearing aids are not covered.

**C. U.S Regulatory Policies for Hearing Aids**

C.1 Food and Drug Administration (FDA) hearing aid regulations of 1977

Hearing aids first became regulated as medical devices by the FDA in 1977. These FDA hearing aid regulations established technical standards for hearing aids and, along with related state-level regulations, effectively stipulated that hearing aids could only be sold through a licensed hearing professional. These regulations made sense at that time given that the analog hearing aids of that era had to be manually programmed and fit by a hearing professional in order for them to be safe and effective. The implications of this regulatory model is that patients could not obtain a hearing aid without going through a licensed hearing professional who served as the gatekeepers to this technology. Since most health insurance precluded coverage for hearing aids and any related audiological rehabilitative services, hearing aids became an out-of-pocket cost to most consumers whereby the consumer is charged a bundled cost for the hearing aids as well as for the support services of the hearing professional. The bundled related services can include outpatient visits with a licensed hearing professional to understand the patient's communicative and hearing needs, fit the hearing aids to the patient's ear anatomy, adjust the hearing aids acoustic settings to meet the user's needs, and instruct patients in the use of the hearing aids and any related technologies. Such services are necessary for prescription hearing aids to be safe and effective at treating hearing loss. Under this regulatory model that has promoted a gatekeeper model of hearing care delivery, the National Academies in 2016 estimated that the average cost for a pair of hearing aids was $4700[7].

C.2 Updated FDA hearing aid regulations released October 17, 2022

In October 2022, prompted by bipartisan federal legislation and reports from the White House and National Academies to increase the affordability and accessibility of hearing aids (the expert witness served on the National Academies consensus study and advised the White House on their report)[7,12], the FDA issued new regulations for over-the-counter hearing aids intended for adults with mild-to-moderate hearing loss[13]. These regulations will now permit manufacturers producing hearing aids that meet certain technical standards to directly sell these devices to consumers OTC rather than having a hearing professional as an intermediary. Over the next few years, these regulations are poised to lead to a sea change in the hearing care marketplace with the entrance of new companies into the previously protected hearing aid market and broadening the accessibility and affordability of hearing aids for consumers. However, it will likely take until at least 2024-2025 for this market to mature fully and appreciably affect consumers at scale given the need for companies to develop and seek regulatory approval for these devices, market development of new retail and distribution models for how to sell these products to consumers, and implementation of market strategies for how to educate consumers about when to use, how to use, and who should use these OTC hearing aid technologies.

**D. Clinical Perspective and Recommendations for Hearing Aid Use**

From the medical perspective, the decision to recommend that a patient use hearing aids is principally guided by a clinical diagnosis of hearing loss that would be amenable to hearing aid amplification (based on the audiometric and clinical exam) and patient report of significant functional hearing and communication limitations in daily life. With children where it may not be possible to assess functional limitations, hearing aids would routinely be recommended solely based on an audiometric diagnosis of hearing loss that would be amenable to amplification with hearing aids.

Despite evidence of the impact of hearing loss on health outcomes and the potential benefits of hearing loss intervention, rates of hearing aid use remain consistently low in the U.S. with rates of hearing aid use varying by hearing loss severity and age. The most robust data on hearing aid usage come from representative samples of adults across the U.S. A previous estimate of these data from an analysis by the expert witness (Figure 4) demonstrates rates of hearing aid use being 2-3% among those with mild hearing and 11-48% among those with moderate or greater hearing loss with increased rates of hearing aid use among older individuals[15]. Given the very low prevalence of hearing loss in children, obtaining valid estimates of rates of hearing aid in children cannot be reliably estimated with representative U.S. data.

The reasons underlying this low rate of use are multifactorial and include ageism, ableism and stigma pertaining to hearing aid use (e.g., appearing ‘old’, ‘enfeebled’, ‘impaired’ as often perpetuated in tropes and the popular media), lack of accessibility and affordability of hearing aids and related services, inherent limitations of hearing aids in not being able to fully ‘correct’ hearing loss, and poor consumer awareness of the health importance of hearing loss[7]. Consistent with these barriers, previous studies have found that the average delay from hearing loss diagnosis and candidacy for hearing aids to patient adoption of hearing aids is 8.9 years[14].

**Figure 5 Prevalence of hearing aid use**

**Table. Prevalence and Number of Individuals 50 Years or Older With Hearing Loss[a] Using Hearing Aids in the United States[b]**

| | Prevalence of Hearing Aid Use Among Adults With Hearing Loss[a] ≥25 dB, % (95% CI)[c] | | | | | | |
|---|---|---|---|---|---|---|---|
| | Sex | | Hearing Loss Severity[d] | | Total | | |
| Variable | Male | Female | Mild (25-40 dB) | Moderate or Greater (>40 dB) | Overall Prevalence of Hearing Aid Use | No. With Hearing Aids (in Millions) | No. With Hearing Loss[a] ≥25 dB (in Millions) |
| Age, y | | | | | | | |
| 50-59 | 4.3 (0-9.5) | 4.5 (0-13.5) | 2.7 (0-6.6) | 11.8 (0-27.5) | 4.3 (0-8.8) | 0.2 | 4.5 |
| 60-69 | 7.3 (2.5-12.1) | 7.2 (1.4-13.0) | 2.6 (0-5.2) | 23.9 (10.6-37.2) | 7.3 (3.6-10.9) | 0.4 | 6.1 |
| 70-79 | 21.1 (14.5-27.6) | 12.7 (6.0-19.5) | 3.4 (0.3-6.5) | 47.8 (37.0-58.6) | 17.0 (12.4-21.6) | 1.5 | 8.8 |
| ≥80 | 28.1 (20.3-35.9) | 17.9 (11.2-24.7) | 3.4 (0-7.7) | 35.7 (28.7-42.7) | 22.1 (18.5-25.8) | 1.6 | 7.3 |
| Estimated total No. of individuals with hearing aids and with hearing loss (in millions) | | | | | | 3.8[d] | 26.7 |

[a] Hearing loss was defined as a speech frequency pure tone average of hearing thresholds at 0.5-, 1-, 2-, and 4-kHz tones presented by air conduction in the better hearing ear of 25 dB or greater.
[b] Data were derived from the 1999-2006 National Health and Nutrition Examination Survey.
[c] All values represent prevalence percentage unless otherwise noted.
[d] Numbers do not sum to group total because of rounding.

From Chien and Lin, Arch Int Medicine, 2012

**E. Conclusion**

An exclusion of all coverage for hearing aids and hearing aid examinations eliminates coverage of the essential treatment required by individuals with a hearing disability. After a hearing loss diagnosis, treatment with hearing aids is the service that the overwhelming majority of individuals with a hearing disability need and require to address their disability. For the vast majority of individuals with a hearing disability, hearing aids and related services would be considered medically necessary and effective at treating hearing loss. Prescription hearing aids should be covered when prescribed or recommended by licensed providers, just like other types of medical equipment.

**Expert Witness Review of Audiological Files**

I reviewed the audiological files provided by Plaintiffs' counsel for each of the three named plaintiffs. Based on the files reviewed I conclude that each plaintiff has a clinically significant hearing impairment based upon objective medical records including audiograms. Based upon the objective studies, I would expect that each named plaintiff would benefit from prescription hearing aids, which the records reflect that they have received. For Plaintiff Schmitt and Plaintiff O.L., based upon the records provided, hearing aids are essentially the only medical device that would be indicated to effectively treat their hearing loss. The records are insufficient for me to determine whether Plaintiff Mohundro could be eligible for a CI in her left worse-hearing ear; however, it appears from the records that her needs are presently met with hearing aids, such that a CI would not be clinically recommended.

**Patient name: Elizabeth Mohundro, DOB 2/10/1976**

**Files reviewed:**
**2/6/23 Pure tone audiogram with air and bone conduction testing and word recognition score testing**
**12/20/2017 Pure tone audiogram with air and bone conduction testing and word recognition score testing**

**Summary:**

In 2017, the patient's right ear had audiometric findings consistent with a low frequency mild downsloping to a moderately severe to severe sensorineural hearing loss from 1-8 kHz. Word recognition score in the R ear at 80dB is 92%. In contrast, the left ear demonstrates a mild downsloping to a profound/complete hearing loss. Bone conduction testing was not performed in the left ear so I'm unable to determine if there is a mixed conductive and sensorineural component to the Left hearing loss or whether it is primarily sensorineural in nature. The left ear has a word recognition score of 18% at 85 dB presentation level.

Her 2022 audiogram is generally stable compared to her 2017 audiogram with some interval minor progression (~5 dB) in the R ear and a more pronounced progression at the 4 kHz in he left. Speech discrimination scores are stable.

Based on only a review of her audiogram demonstrating a Right ear with essentially a moderate to moderately severe sensorineural hearing loss and nearly a non-hearing left ear (as indicated by the extremely poor speech discrimination score) , I would expect Ms. Mohundro to have functional difficulties with localizing sound, understanding speech with any background competing noise, and also noticing some difficulty even in quiet settings if she is not face to face with the speaker or the sound source is distant or of poor quality.

**Patient name: Olivia Leitich, DOB 7/23/2008**

**Files reviewed:**
**9/15/2022 Pure tone audiogram with air and bone conduction testing and tympanometry, otoscopic findings**

Summary: Both ears with symmetrical hearing. Both ears with normal to 1kHz downsloping to a flat 60 dB moderately severe sensorineural loss in both ears with some trace asymmetry at 2kHz (R ear worse at 75dB versus 60 dB in the left). Tympanometry demonstrating normal curves with no evidence of middle ear dysfunction. Speech discrimination testing results are not available.

Based on review of the limited audiological assessment (speech testing not available), I would expect Miss Leitich to have difficulty with speech understanding given the pronounced loss of audibility at the mid and higher frequencies. This would be most apparent with a distant speaker or with any type of background noise or in the presence of multiple talkers.

**Patient name: Andrea Schmitt, DOB 8/11/1978**

**Files reviewed:**
**3/13/2013 Pure tone audiogram with air conduction testing and word recognition score testing, otoscopic findings**
**11/23/2016 Pure tone audiogram with air and bone conduction testing**
**9/22/2021 Pure tone audiogram with air conduction testing and word recognition score testing, otoscopic findings**

**Summary:** Ms. Schmitt's most recent audiogram from 2021 demonstrates symmetrical air-conduction thresholds. Bone conduction testing was not completed but based on the symmetrical pattern, this is likely a bilateral sensorineural hearing loss. Both ears demonstrate normal low-frequency hearing to 750 Hz downsloping steeply to severe hearing loss from 1500 to 8000 Hz. Word recognition testing is 84% in the Right ear and 68% in the Left ear. There is progression in high-frequency hearing loss when comparing her 2013 to 2021 audiogram. Her 2016 audiogram is intermediate between the 2013 and 2021 audiogram except for a slight conductive component noted in the R ear at 500 Hz of unclear significance and possible transient in nature or related to testing artifact.

Based on review of her most recent 2021 audiogram demonstrating a bilateral mid-to-high frequency severe sensorineural hearing loss and word recognition scores demonstrating generally poorer speech understanding in the L ear greater than the R ear, I would expect that Ms. Schmitt would have significant difficulty understanding speech with distant speakers or with any type of background noise or multiple speakers.

DATED: May 12, 2023, at Albufeira, Portugal.

Frank R. Lin, MD, PhD

1.*See* https://www.cdc.gov/ncbddd/disabilityandhealth/disability.html#:~:text=A%20disability%20is%20any%20condition,around%20them%20(participation%20restrictions) (last visited May 9, 2023).
2. Olusanya BO, Davis AC, Hoffman HJ. Hearing loss grades and the. *Bull World Health Organ*. Oct 01 2019;97(10):725-728. doi:10.2471/BLT.19.230367
3. Cruickshanks KJ, Wiley TL, Tweed TS, et al. Prevalence of hearing loss in older adults in Beaver Dam, Wisconsin. The Epidemiology of Hearing Loss Study. *AmJEpidemiol*. 1998;148(9):879-886.
4. 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
5. Livingston G, Sommerlad A, Orgeta V, et al. Dementia prevention, intervention, and care. *Lancet*. Jul 19 2017;doi:10.1016/S0140-6736(17)31363-6
6. Livingston G, Huntley J, Sommerlad A, et al. Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. *Lancet*. 08 2020;396(10248):413-446. doi:10.1016/S0140-6736(20)30367-6
7. *Hearing health care: Priorities for improving access and affordability.* 2016.
8. *Product Narrative: Hearing Aids - A Market Landscape and Strategic Approach to Increasing Access to Hearing Aids and Related Services in Low and Middle Income Countries*. 2019. https://atscalepartnership.org/product-narratives
9. Jiang F, Mishra SR, Shrestha N, et al. Association between hearing aid use and all-cause and cause-specific dementia: an analysis of the UK Biobank cohort. *Lancet Public Health*. May 2023;8(5):e329-e338. doi:10.1016/S2468-2667(23)00048-8
10. Deal JA, Goman AM, Albert MS, et al. Hearing treatment for reducing cognitive decline: Design and methods of the Aging and Cognitive Health Evaluation in Elders randomized controlled trial. *Alzheimers Dement (N Y)*. 2018;4:499-507. doi:10.1016/j.trci.2018.08.007
11. De Lew N. Medicare: 35 Years of Service. *Health Care Financ Rev*. 2000;22(1):75-103.
12. *Aging America & Hearing Loss: Imperative of Improved Hearing Technologies*, (October 2015) (White House President's Council of Advisors on Science and Technology (PCAST)). https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/PCAST/pcast_hearing_tech_letterreport_final.pdf
13. Volume 87 Medical Devices; Ear, Nose, and Throat Devices; Establishing Over-the-Counter Hearing Aids (Federal Register) 50698-50762 (August 17, 2022).
14. Simpson AN, Matthews LJ, Cassarly C, Dubno JR. Time From Hearing Aid Candidacy to Hearing Aid Adoption: A Longitudinal Cohort Study. *Ear Hear*. 2019;40(3):468-476. doi:10.1097/AUD.0000000000000641
15. Chien W, Lin FR. Prevalence of hearing aid use among older adults in the United States. *Arch Intern Med*. Feb 13 2012;172(3):292-3. doi:172/3/292 [pii] 10.1001/archinternmed.2011.1408

# Exhibit A

**CURRICULUM VITAE**
**FRANK ROBERT LIN, M.D. Ph.D.**

**May 2023**

_____
Frank R. Lin

## DEMOGRAPHIC AND PERSONAL INFORMATION

**Current Appointments:**

| | |
|---|---|
| 2011-present | Core Faculty, Center on Aging and Health, Johns Hopkins University |
| 2014-present | Joint Appointment in Epidemiology, Johns Hopkins University Bloomberg School of Public Health |
| 2014-present | Joint appointment in Geriatric Medicine & Gerontology, Department of Medicine, Johns Hopkins University School of Medicine |
| 2014-present | Joint Appointment in Mental Health, Johns Hopkins University Bloomberg School of Public Health |
| 2014-present | Associate Faculty, Welch Center for Prevention, Epidemiology, and Clinical Research, Johns Hopkins University School of Medicine and Bloomberg School of Public Health |
| 2018-present | Director, Cochlear Center for Hearing and Public Health, Johns Hopkins Bloomberg School of Public Health |
| 2018-present | Professor of Otolaryngology-Head & Neck Surgery, Medicine, Mental Health, and Epidemiology, Johns Hopkins University |

**Personal Data:**

Johns Hopkins University School of Medicine
Department of Otolaryngology—Head & Neck Surgery
601 N. Caroline Street, 6th Floor
Baltimore, MD 21287
Tel: 443-287-6509 (Clinical)
410-502-0150 (Research)
Fax: 410-502-6713
Email: flin1@jhmi.edu
Website: https://www.jhsph.edu/cochlear-center

**Education and Training:**

| | |
|---|---|
| 1994 – 1998 | Bachelor of Science, Biochemistry, Brown University |
| 1998 – 1999 | Intensive Chinese language study, Taiwan Normal University, Beijing Language and Culture University |
| 1999 – 2003 | Doctor of Medicine, Johns Hopkins University School of Medicine |
| 2003 – 2004 | Intern in General Surgery, Johns Hopkins Hospital |
| 2004 – 2008 | Doctor of Philosophy, Clinical Investigation, Johns Hopkins University Bloomberg School of Public Health |
| 2004 – 2009 | Resident in Otolaryngology—Head & Neck Surgery, Johns Hopkins Hospital |
| 2010 | Visiting Fellow in Otology, Fisch International Microsurgery Foundation, Switzerland |

**Professional Experience**

| | |
|---|---|
| 2010 – 2014 | Assistant Professor, Department of Otolaryngology-Head & Neck Surgery, Johns Hopkins University School of Medicine |
| 2011-present | Core Faculty, Center on Aging and Health, Johns Hopkins Medical Institutions |
| 2014-2018 | Associate Professor, Departments of Otolaryngology-HNS, Geriatric Medicine, Mental Health, and Epidemiology; Johns Hopkins University |
| 2014-present | Associate Faculty Member, Welch Center for Prevention, Epidemiology, and Clinical Research, Johns Hopkins University School of Medicine and Bloomberg School of Public Health |
| 2018-present | Director, Cochlear Center for Hearing and Public Health, Johns Hopkins Bloomberg School of Public Health |
| 2018-present | Professor of Otolaryngology-Head & Neck Surgery, Medicine, Mental Health, and Epidemiology, Johns Hopkins University |

**PUBLICATIONS**

**Original Research [OR]**

1) Cirillo LA, **Lin FR**, Cuesta I, Friedman D, Jarnik M, Zaret KS. Opening of compacted chromatin by early developmental transcription factors HNF3 (FoxA) and GATA-4. Mol Cell. 2002 Feb;9(2):279-89. PMID: 11864602
2) **Lin FR**, Migliaccio AA, Haslwanter T, Minor LB, Carey JP. Angular vestibulo-ocular reflex gains correlate with vertigo control after intratympanic gentamicin treatment for Meniere's disease. Ann Otol Rhinol Laryngol. 2005 Oct;114(10):777-85. PMID: 16285268
3) Farrag TY, Samlan RA, **Lin FR**, Tufano RP. The utility of evaluating true vocal fold motion before thyroid surgery. Laryngoscope. 2006 Feb;116(2):235-8. PMID: 16467711
4) Nahas ZS, Farrag TY, **Lin FR**, Belin RM, Tufano RP. A safe and cost-effective short hospital stay protocol to identify patients at low risk for the development of significant hypocalcemia after total thyroidectomy. Laryngoscope. 2006 Jun;116(6):906-10. PMID: 16735895
5) Farrag TY, **Lin FR**, Cummings CW, Koch WM, Flint PW, Califano JA, Broussard J, Bajaj G, Tufano RP. Neck management in patients undergoing postradiotherapy salvage laryngeal surgery for recurrent/persistent laryngeal cancer. Laryngoscope. 2006 Oct;116(10):1864-6. PMID: 17003711
6) **Lin FR**, Niparko JK. Measuring health-related quality of life after pediatric cochlear implantation: a systematic review. Int J Pediatr Otorhinolaryngol. 2006 Oct;70(10):1695-706. Epub 2006 Jun 27. Review. PMID: 16806501
7) Farrag TY, **Lin FR**, Cummings CW, Sciubba JJ, Koch WM, Flint PW, Tufano RP. Importance of routine evaluation of the thyroid gland prior to open partial laryngectomy. Arch Otolaryngol Head Neck Surg. 2006 Oct;132(10):1047-51. PMID: 17043249
8) Farrag TY, **Lin FR**, Koch WM, Califano JA, Cummings CW, Farinola MA, Tufano RP. The role of pre-operative CT-guided FNAB for parapharyngeal space tumors. Otolaryngol Head Neck Surg. 2007 Mar;136(3):411-4. PMID: 17321869
9) **Lin FR**, Ceh K, Bervinchak D, Riley A, Miech R, Niparko JK. Development of a Communicative Performance Scale for Pediatric Cochlear Implantation. Ear Hear. 2007 Sep;28(5):703-712. PMID: 17804984
10) Boleas-Aguirre MS, **Lin FR**, Della Santina CC, Minor LB, Carey JP. Longitudinal results with intratympanic dexamethasone in the treatment of Ménière's disease. Otol Neurotol. 2008 Jan;29(1):33-8. PMCID: PMC2937266; PMID: 18199956
11) **Lin FR**, Wang NY, Fink NE, Quittner AL, Eisenberg LS, Tobey EA, Niparko JK; the CDaCI Investigative Team. Assessing the Use of Speech and Language Measures in Relation to Parental Perceptions of Development After Early Cochlear Implantation. Otol Neurotol. 2008 Feb;(29)1:33-8. PMCID: PMC2730755; PMID: 18309575
12) Kandil E, Tufaro AP, Carson KA, **Lin FR**, Somervell H, Farrag T, Dackiw A, Zeiger M, Tufano RP. Correlation of plasma 25-hydroxyvitamin D levels with severity of primary hyperparathyroidism and likelihood of parathyroid adenoma localization on sestamibi scan. Arch Otolaryngol Head Neck Surg. 2008 Oct;134(10):1071-5. PMID: 18936353
13) Farrag T, **Lin F**, Brownlee N, Kim M, Sheth S, Tufano RP. Is routine dissection of level II-B and V-A necessary in patients with papillary thyroid cancer undergoing lateral neck dissection for FNA-confirmed metastases in other levels. World J Surg. 2009 Aug;33(8):1680-1683. PMID: 19506945
14) Crane BT, **Lin FR**, Minor LB, Carey JP. Improvement in autophony symptoms after superior canal dehiscence repair. Otol Neurotol. 2010 Jan;31(1):140-6. PMID: 20050268
15) Tan M, Myrie OA, **Lin FR**, Niparko JK, Minor LB, Tamargo RJ, Francis HW. Trends in the management of vestibular schwannoma at Johns Hopkins 1997-2007. Laryngoscope. 2010 Jan;120(1):144-9. PMID: 19877188
16) **Lin FR**, Metter EJ, O'Brien RJ, Resnick SM, Zonderman A, Ferrucci L. Hearing loss and incident dementia. Arch Neurol. 2011 Feb;68(2):214-20. PMCID: PMC3277836; PMID: 21320988
17) Clark JH, Aggarwal P, Wang NY, Robinson R, Niparko JK, **Lin FR**. Measuring Communicative Performance with the FAPCI Instrument: Preliminary Results from Normal Hearing and Cochlear Implanted Int J Pediatr Otorhinolaryngol. 2011 Apr;75(4):549-53. PMCID: PMC3062731; PMID: 21296432
18) **Lin FR**, Thorpe R, Gordon-Salant S, Ferrucci L. Hearing loss prevalence and risk factors among older adults in the United States. J Gerontol A Biol Sci Med Sci. 2011 May;66(5):582-90. PMCID: PMC3074958; PMID: 21357188

19) **Lin FR.** Hearing loss and cognition among older adults in the United States. J Gerontol A Biol Sci Med Sci. 2011 Oct;66(10):1131-6. PMCID: PMC3172566; PMID: 21768501
20) **Lin FR**, Ferrucci L, Metter EJ, An Y, Zonderman AB, Resnick SM. Hearing loss and cognition in the Baltimore Longitudinal Study of Aging. Neuropsychology. 2011 Nov;25(6):763-70. PMCID: PMC3193888; PMID: 21728425
21) **Lin FR,** Niparko JK, Ferrucci L. Hearing loss prevalence in the United States. Arch Intern Med. 2011 Nov;171(20):1851-2. PMCID: PMC3564588; PMID: 22083573
22) **Lin FR,** Ferrucci L. Hearing loss and falls among older adults in the United States. Arch Intern Med. 2012 Feb;172(4):366-7. PMCID: PMC3518403; PMID: 22371929
23) **Lin FR,** Maas P, Chien W, Carey JP, Ferrucci L, Thorpe R. Association of skin color, race/ethnicity, and hearing loss among adults in the USA. J Assoc Res Otolaryngol. 2012 Feb;13(1):109-17. PMCID: PMC3254716; PMID: 22124888
24) Chien W, **Lin FR**. Prevalence of hearing aid use among older adults in the United States. Arch Intern Med, 2012 Feb;172(3):292-3. PMCID: PMC3564585; PMID: 22332170
25) Clark JH, Wang NY, Riley AW, Carson CM, Meserole RL, **Lin FR**, Eisenberg LS, Tobey EA, Quittner AL, Francis HW, Niparko JK, The CDaCI Investigative Team. Timing of cochlear implantation and parents' global ratings of children's health and development. Otol Neurotol. 2012 Jun;33(4):545-552. PMCID: PMC3677526; PMID: 22588232
26) **Lin FR**, Chien W, Li L, Niparko JK, Francis HW. Cochlear implantation in older adults. Medicine, 2012 Sep;91(5):229-41. PMCID: PMC3518393; PMID: 22932787
27) Clark JH, Yeagle J, Arbaje AI, **Lin FR,** Niparko JK, Francis HW. Cochlear implant rehabilitation in older adults: literature review and proposal of a conceptual framework. J Am Geriatr Soc. 2012 Oct;60(10):1936-45. PMCID: PMC3902638; PMID: 22974240
28) **Lin FR,** Yaffe K, Xia J, Xue QL, Harris TB, Purchase-Helzner, E, Satterfield S, Ayonayon HN, Ferrucci L, Simonsick EM. Hearing loss and cognitive decline in older adults. JAMA Intern Med, 2013 Feb;173(4):293-9. PMCID: PMC3869227; PMID: 23337978
29) Swenor BK, Ramulu PY, Willis JR, Friedman D, **Lin FR**. The prevalence of concurrent hearing and vision impairment in the United States. JAMA Intern Med, 2013 Feb;173(4):312-3. PMCID: PMC3875214; PMID: 23338042
30) Parham K, **Lin FR**, Coelho DH, Sataloff RT, Gates GA. Comprehensive management of presbycusis: central and peripheral. Otolaryngol Head Neck Surg. 2013 Apr;148(4):537-9. PMCID: PMC3860740; PMID: 23396589
31) Davalos-Bichara M, **Lin FR**, Carey JP, Walston JD, Fairman JE, Schubert MC, Barron JS, Hughes J, Millar J, Spar A, Weber KL, Ying HS, Zackowski KM, Zee D, Agrawal Y. Development and validation of a falls grading scale. J Geriatr Phys Ther, 2013 Apr-Jun 17;36(2):63-7. PMCID: PMC3867809; PMID: 22810170
32) Li L, Simonsick EM, Ferrucci L, **Lin FR**. Hearing loss and gait speed among older adults in the United States. Gait and Posture, 2013 May; 38(1):25-9. PMCID: PMC3845825; PMID: 23177614
33) Genther DJ, Frick KD, Chen D, Betz J, **Lin FR**. Association of hearing loss with hospitalization and burden of disease in older adults. JAMA, 2013 Jun;309(22):2322-4. PMCID: PMC3875309; PMID: 23757078
34) Loprinzi PD, Smit E, **Lin FR**, Gilham B, Ramulu PY. Accelerometer-assessed physical activity and objectively-determined dual-sensory impairment among U.S. adults. Mayo Clin Proc, 2013 Jul;88(7):690-6. PMID: 23751983
35) Mener DJ, Betz J, Genther DJ, Chen D, **Lin FR**. Hearing loss and depression in older adults. J Am Geriatr Soc, 2013 Sep;61(9):1627-9. PMCID: PMC3773611; PMID: 24028365
36) Chen DS, Clarrett DM, Li L, Bowditch SP, Niparko JK, **Lin FR**. Cochlear implantation in older adults: long-term analysis of complications and device survival in a consecutive series. Otol Neurotol 2013 Sep; 34(7): 1272-7. PMCID: PMC3744620; PMID: 23921942
37) Mick P, Kawachi I, **Lin FR**. The association between hearing loss and social isolation in older adults. Otolaryngol Head Neck Surg, 2014 Mar; 150(3):378-84. PMID: 24384545
38) Contrera KJ, Choi JS, Blake CR, Betz JF, Niparko JK, **Lin FR**. Rates of long-term cochlear implant use in children. Otol Neurotol, 2014 Mar;35(3):426-30. PMCID: PMC3927162; PMID: 24518403
39) **Lin FR**, Ferrucci L, An Y, Goh JO, Doshi J, Metter EJ, Davatzikos C, Kraut MA, Resnick SM. Association of hearing impairment with brain volume changes in older adults. Neuroimage, 2014 Apr 15;90:84-92. PMCID: PMC3951583; PMID: 24412398

40) Chen DS, Genther DJ, Betz J, **Lin FR**. Association between hearing impairment with self-reported difficulty in physical functioning. J Am Geriatr Soc, 2014 May;62(5):850-6. PMCID: PMC4084895; PMID: 24779559

41) Foley DM, Frick KD, **Lin FR**. Association between hearing loss and health care expenditures in older adults. J Am Geriatr Soc, 2014 Jun;62(6):1188-9. PMCID: PMC4058650; PMID: 24925555

42) Choi JS, Contrera KJ, Betz J, Blake CR, Niparko JK, **Lin FR**. Long-term use of cochlear implants in older adults: results from a large consecutive case series. Otol Neurotol, 2014 Jun;35(5):815-20. PMCID: PMC4090065; PMID: 24608374

43) Kamil RJ, Li L, **Lin FR**. Association between hearing impairment and frailty in older adults. J Am Geriatr Soc, 2014 Jun;62(6):1186-8. PMCID: PMC4141776; PMID: 24925554

44) Gispen FE, Chen DS, Genther DJ, **Lin FR**. Association of hearing impairment with lower levels of physical activity in older adults. J Am Geriatr Soc. 2014 Aug;62(8):1427-33. PMCID: PMC4134370; PMID: 25041032

45) Li L, Vikani AR, Harris GC, **Lin FR**. Feasibility study to quantify the auditory and social environment of older adults using a digital language processor. Otol Neurotol. 2014 Sep;35(8):1301-5. PMCID: PMC4133745; PMID: 25122146

46) Sun D, Zhou X, **Lin FR**, Francis HW, Carey JP, Chien W. Racial difference in cochlear pigmentation is associated with hearing loss risk. Otol Neurotol. 2014 Oct;35(9):1509-14. PMID: 25166018

47) Mick P, Foley DM, **Lin FR**. Hearing Loss is Associated with Poorer Ratings of Patient-Physician Communication and Healthcare Quality. J Am Geriatr Soc, 2014 Nov;62(11):2207-9 PMID: 2541319

48) Chen DS, Blake CR, Genther DJ, Li L, **Lin FR**. Assessing physical functioning in otolaryngology: feasibility of the short physical performance battery. Am J Otolaryngol. 2014 Nov-Dec;35(6):708-12. PMID: 25179123

49) Kamil RJ, Genther DJ, **Lin FR**. Factors associated with the accuracy of subjective assessments of hearing impairment. Ear and Hearing, Ear Hear. 2015 Jan;36(1), 164-7. PMID: 25158982

50) Genther DJ, Betz J, Pratt S, Kritchevsky SB, Martin KR, Harris TB, Helzner E, Satterfield S, Xue QL, Yaffe K, Simonsick EM, **Lin FR.** Association of Hearing Impairment and Mortality in Older Adults. J Gerontol A Biol Sci Med Sci. 2015 Jan;70(1):85-90. PMID: 25024235

51) Albers MW, Gilmore GC, Kaye J, Murphy C, Wingfield A, Bennett DA, Boxer AL, Buchman AS, Cruickshanks KJ, Devanand DP, Duffy CJ, Gall CM, Gates GA, Granholm AC, Hensch T, Holtzer R, Hyman BT, **Lin FR**, McKee AC, Morris JC, Petersen RC, Silbert LC, Struble RG, Trojanowski JQ, Verghese J, Wilson DA, Xu S, Zhang LI. At the interface of sensory and motor dysfunctions and Alzheimer's disease. Alzheimers Dement. 2015 Jan;11(1):70-98. PMID: 25022540

52) Kamil RJ, **Lin FR**. The effects of hearing impairment in older adults on communication partners: a systematic review. J Am Acad Audiol. 2015 Feb;26(2):155-82. PMID: 25690776

53) Deal JA, Sharrett AR, Albert MS, Coresh J, Mosley TH, Knopman D, Wruck LM, **Lin FR**. Hearing impairment and cognitive decline: a pilot study conducted within the atherosclerosis risk in communities neurocognitive study. Am J Epidemiol. 2015 May 1;181(9):680-90. PMID: 25841870

54) Chen DS, Betz J, Yaffe K, Ayonayon HN, Kritchevsky S, Martin KR, Harris TB, Purchase-Helzner E, Satterfield S, Xue QL, Pratt S, Simonsick EM, **Lin FR.** Association of hearing impairment with declines in physical functioning and the risk of disability in older adults. J Gerontol A Biol Sci Med Sci. 2015 May;70(5):654-61. PMID: 25477427

55) Genther DJ, Betz J, Pratt S, Martin KR, Harris TB, Satterfield S, Bauer DC, Newman AB, Simonsick EM, **Lin FR**; Health, Aging and Body Composition Study. Association Between Hearing Impairment and Risk of Hospitalization in Older Adults. J Am Geriatr Soc. 2015 Jun;63(6):1146-52. PMID: 26096388

56) Bednar MM, DeMartinis N, Banerjee A, Bowditch S, Gaudreault F, Zumpano L, **Lin FR**. The Safety and Efficacy of PF-04958242 in Age-Related Sensorineural Hearing Loss: A Randomized Clinical Trial. JAMA Otolaryngol Head Neck Surg. 2015 Jul;141(7):607-13. PMID: 25997115

57) Harrison Bush AL, Lister JJ, **Lin FR**, Betz J, Edwards JD. Peripheral Hearing and Cognition: Evidence From the Staying Keen in Later Life (SKILL) Study. Ear Hear. 2015 Jul-Aug;36(4):395-407. PMID: 25587666

58) Genther DJ, Laudenslager ML, Sung YK, Blake CR, Chen DS, **Lin FR**. Assessing Systemic Stress in Otolaryngology: Methodology and Feasibility of Hair and Salivary Cortisol Testing. J Nat Sci. 2015 Aug;1(8) pii: e152. PMID: 26436139

59) Contrera KJ, Betz J, Genther DJ, **Lin FR**. Association of Hearing Impairment and Mortality in the National Health and Nutrition Examination Survey. JAMA Otolaryngol Head Neck Surg. 2015 Oct;141(10):944-6. PMID: 26401904

60) Lowthian JA, Britt CJ, Rance G, **Lin FR,** Woods RL, Wolfe R, Nelson MR, Dillon HA, Ward S, Reid CM, Lockery JE, Nguyen TT, McNeil JJ, Storey E; ASPREE Investigators. Slowing the progression of age-related hearing loss: Rationale and study design of the ASPIRIN in HEARING, retinal vessels imaging and neurocognition in older generations (ASPREE-HEARING) trial. Contemp Clin Trials. 2016 Jan;46:60-6. PMID: 26611434

61) Mener DJ, Betz J, Yaffe K, Harris TB, Helzner EP, Satterfield S, Houston DK, Strotmeyer ES, Pratt SR, Simonsick EM, **Lin FR**. Apolipoprotein E allele and hearing thresholds in older adults. Am J Alzheimers Dis Other Demen, 2016 Feb;31(1):34-9. PMID: 24906966

62) Nieman CL, Marrone N, Szanton SL, Thorpe RJ Jr, **Lin FR**. Racial/Ethnic and Socioeconomic Disparities in Hearing Health Care Among Older Americans. J Aging Health. 2016 Feb;28(1):68-94. PMID: 25953816

63) Contrera KJ, Betz J, Deal J, Choi JS, Ayonayon HN, Harris T, Helzner R, Martin KR, Mehta K, Pratt S, Rubin SM, Satterfield S, Yaffe K, Simonsick EM, **Lin FR**; Health ABC Study. Association of Hearing Impairment and Anxiety in Older Adults. J Aging Health. 2016 Feb 24. pii: 0898264316634571. [Epub ahead of print]. PMID: 26916793

64) Edwards JD, Lister JJ, **Lin FR**, Andel R, Brown L, Wood JM. Association of Hearing Impairment and Subsequent Driving Mobility in Older Adults. Gerontologist. 2016 Feb 25. pii: gnw009. [Epub ahead of print]. PMID: 26916667

65) Mamo SK, Reed NS, Nieman CL, Oh ES, **Lin FR**. Personal Sound Amplifiers for Adults with Hearing Loss. Am J Med. 2016 Mar;129(3):245-50. PMID: 26498713

66) Kim K, Choi JS, Choi E, Nieman CL, Joo JH, **Lin FR**, Han HR. Effects of Community-Based Health Worker Interventions to Improve Chronic Disease Management and Care Among Vulnerable Populations: A Systematic Review. Am J Public Health. 2016 Apr, 106(4):671. PMID: 26959271

67) Deal JA, Betz J, Yaffe K, Harris T, Purchase-Helzner E, Satterfield S, Pratt S, Govil N, Simonsick EM, Lin FR; Health ABC Study Group. Hearing Impairment and Incident Dementia and Cognitive Decline in Older Adults: The Health ABC Study. J Gerontol A Biol Sci Med Sci. 2016 Apr 12. pii: glw069. [Epub ahead of print]. PMID: 27071780

68) Deal JA, Richey Sharrett A, Bandeen-Roche K, Kritchevsky SB, Pompeii LA, Gwen Windham B, **Lin FR**. Hearing Impairment and Physical Function and Falls in the Atherosclerosis Risk in Communities Hearing Pilot Study. J Am Geriatr Soc. 2016 Apr;64(4):906-8. PMID: 27100600

69) Contrera KJ, Betz J, Deal JA, Choi JS, Ayonayon HN, Harris T, Helzner E, Martin KR, Mehta K, Pratt S, Rubin SM, Satterfield S, Yaffe K, Garcia M, Simonsick EM, **Lin FR**; Health ABC Study. Association of Hearing Impairment and Emotional Vitality in Older Adults. J Gerontol B Psychol Sci Soc Sci. 2016 May;71(3):400-4. PMID: 26883806

70) Gadkaree, S K, Sun, DQ, Li, C, **Lin, FR**, Ferrucci,, L, Simonsick, EM, Agrawal, Y. Does Sensory Function Decline Independently or Concomitantly with Age? Data from the Baltimore Longitudinal Study of Aging. J Aging Research. 2016: doi:10.1155/2016/1865038

71) Contrera KJ, Wallhagen MI, Mamo SK, Oh ES, **Lin FR**. Hearing Loss Health Care for Older Adults. J Am Board Fam Med. 2016 May-Jun;29(3):394-403. PMID: 27170797

72) Kamil RJ, Betz J, Powers BB, Pratt S, Kritchevsky S, Ayonayon HN, Harris TB, Helzner E, Deal JA, Martin K, Peterson M, Satterfield S, Simonsick EM, **Lin FR**; Health ABC study. Association of Hearing Impairment With Incident Frailty and Falls in Older Adults. J Aging Health. 2016 Jun;28(4):644-60. PMID: 26438083

73) Choi JS, Betz J, Li L, Blake CR, Sung YK, Contrera KJ, **Lin FR.** Association of Using Hearing Aids or Cochlear Implants With Changes in Depressive Symptoms in Older Adults. JAMA Otolaryngol Head Neck Surg. 2016 Jul 1;142(7):652-7. PMID: 27258813

74) Huddle MG, Deal JA, Swenor B, Genther DJ, **Lin FR**. Association Between Dual Sensory Impairment, Hospitalization, and Burden of Disease. J Am Geriatr Soc. 2016 Jul 23. PMID: 27448758

75) Choi JS, Betz J, Deal J, Contrera KJ, Genther DJ, Chen DS, Gispen FE, **Lin FR**. A Comparison of Self-Report and Audiometric Measures of Hearing and Their Associations With Functional Outcomes in Older Adults. J Aging Health. 2016 Aug;28(5):890-910. PMID: 26553723

76) Choi JS, Nieman CL, Mamo SK, **Lin FR.** Understanding Hearing Loss and Barriers to Hearing Health Care Among Korean American Older Adults: A Focus Group Study. J Appl Gerontol. 2016 Aug 22. pii: 0733464816663554. [Epub ahead of print]. PMID: 27550062

77) Goman AM, **Lin FR.** Prevalence of hearing loss by severity in the United States. Am J Public Health. 2016 Aug;64(8):1735-7.

78) Sung YK, Li L, Blake C, Betz J, **Lin FR**. Association of Hearing Loss and Loneliness in Older Adults. J Aging Health. 2016 Sep;28(6):979-94. PMID: 26597841
79) Contrera KJ, Betz J, Li L, Blake CR, Sung YK, Choi JS, **Lin FR**. Quality of life after intervention with a cochlear implant or hearing aid. Laryngoscope. 2016 Sep;126(9):2110-5. PMID: 26775283
80) Erbele ID, **Lin FR,** Agrawal Y, Francis HW, Carey JP, Chien WW. Racial Differences of Pigmentation in the Human Vestibular Organs. Otolaryngol Head Neck Surg. 2016 Sep;155(3):479-84. PMID: 27165682
81) Mamo SK, Nieman CL, **Lin FR**. Prevalence of untreated hearing loss by income among older adults in the United States. J Health Care Poor Underserved. 2016;27(4):1812-1818. PMID: 27818440.
82) Nieman CL, Marrone N, Mamo SK, Betz J, Choi JS, Contrera KJ, Thorpe R, Gitlin L, Tanner E, Han HR, Szanton S, **Lin FR.** The Baltimore HEARS Pilot Study: An Affordable, Accessible, Community-Delivered Hearing Care Intervention. Gerontologist. 2016 Dec 7. [Epub ahead of print]. PMID: 27927734
83) Nirmalasari O, Mamo SK, Nieman CL, Simpson A, Buford-Blair JL, Nowrangi M, **Lin FR,** Oh ES. Hearing loss prevalence in a specialty memory disorders clinic. Internat Psychogeriatrics. 2016. In press.
84) Mamo SK, Nirmalasari O, Nieman CL, McNabney MK, Simpson A, Lyketsos C, Oh ES, **Lin FR.** Hearing care intervention for persons with dementia: a pilot study. Am J Geriatric Psych. 2017 Jan;25(1):91-101. PMID: 27890543.
85) Contrera KJ, Sung YK, Betz J, Li L, **Lin FR**. Change in loneliness after intervention with cochlear implants or hearing aids. Laryngoscope. 2017 Jan 6. [Epub ahead of print]. PMID: 28059448
86) Goman AM, Reed NS, **Lin FR**. Addressing Estimated Hearing Loss in Adults in 2060. JAMA Otolaryngol Head Neck Surg. 2017 Mar 2. Epub ahead of print. PMID: 28253386
87) Li L, Blake C, Sung Y, Shpritz B, Chen D, Genther DJ, Betz J, **Lin FR**. The Studying Multiple Outcomes After Aural Rehabilitative Treatment Study: Study Design and Baseline Results. Gerontol Geriatr Med. 2017 Apr 19. PMID: 28491918
88) Reed NS, Betz J, Kendig N, Korczak M, **Lin FR**. Personal Sound Amplification Products versus a Conventional Hearing Aid for Speech Understanding in Noise. JAMA. 2017 Jul 4;318(1): 89-90. PMID: 28672306
89) Reed NS, Betz J, **Lin FR**, Mamo S. Pilot Electroacoustic analyses of a sample of direct-to-consumer amplification products. Otol Neurotol. 2017 Jul;38(6): 804-808. PMID: 28595255
90) Nirmalasari O, Mamo SK, Nieman CL, Simpson A, Zimmerman J, Nowrangi MA, **Lin FR**, Oh ES. Age-related hearing loss in older adults with cognitive impairment. Int Psychogeriatr. 2017 Jan; 29(1): 115-121. PMID: 27655111
91) Huddle MG, Goman AM, Kernizan F, Foley DM, Price C, Frick KD, **Lin FR**. The economic impact of adult hearing loss: a systematic review. JAMA Otolaryngology. 2017 Aug 10. [Epub ahead of print]. PMID: 28796850
92) Deal JA, Albert MS, Arnold M, Bangdiwala SI, Chisolm T, Davis S, Eddins A, Glynn NW, Goman A, Minotti M, Mosley T, Rebok GW, Reed NS, Rodgers E, Sanchez V, Sharrett AS, Coresh J, **Lin FR**. A randomized feasibility pilot trial of hearing treatment for reducing cognitive decline: results from the Aging and Cognitive Health Evaluation in Elders Pilot (ACHIEVE-P) Study. Alzheimer's & Dementia: Translational Research & Clinical Interventions. 2017. PMID: 29067347
93) Nieman CL, **Lin FR.** Increasing access to hearing rehabilitation for older adults. Curr Opin Otolayngol Head Neck Surg. 2017 Jul 5; [Epub ahead of print]. PMID: 28682821
94) Golub JS, **Lin FR,** Lustig LR, Lalwani AK. Prevalence of adult unilateral hearing loss and hearing aid use in the United States. Laryngoscope. 2017 Nov 29. [Epub ahead of print] PubMed PMID: 29193112.
95) Sterling MR, **Lin FR**, Jannat-Khah DP, Goman AM, Echeverria SE, Safford MM. Hearing Loss Among Older Adults With Heart Failure in the United States: Data From the National Health and Nutrition Examination Survey. JAMA Otolaryngol Head Neck Surg. 2018 Jan 25. [Epub ahead of print] PubMed PMID: 29372239.
96) Goman AM, Dunn CC, Gantz BJ, **Lin FR**. Prevalence of potential hybrid and conventional cochlear implant candidates based on audiometric profile. Otol Neurotol. 2018 Mar 1. [Epub ahead of print]. Pubmed PMID 29498962.
97) Mamo SK, Mayhew SJ, Nirmalasari O, Oh ES, McNabney MK, Rund J, **Lin FR**.Age-related hearing loss and communication at a PACE Day Health Center. J Am Med Dir Assoc. 2018 May;19(5):458-459. PMID: 29526596

98) Goman AM, **Lin FR**. Hearing loss in older adults - From epidemiological insights to national initiatives. Hear Res. 2018 Apr 3. PMID: 29653842
99) Mudie LI, Varadaraj V, Gajwani P, Munoz B, Ramulu P, **Lin FR**, Swenor BK, Friedman DS, Zebardast N. Dual sensory impairment: The association between glaucomatous vision loss and hearing impairment and function. PLoS One. 2018 Jul 6;13(7):e0199889. PMID: 29979753
100) McKee MM, **Lin FR**, Zazove P. State of research and program development for adults with hearing loss. Disabil Health J. 2018 Jul 31. pii: S1936-6574(18)30141-9. doi: 10.1016/j.dhjo.2018.07.010. [Epub ahead of print] PubMed PMID: 30087082.
101) Reed NS, Deal JA, Huddle MG, Betz JF, Bailey BE, McGlumphy EJ, Eghrari AO, Riazuddin SA, **Lin FR,** Gottsch JD. Pilot Study of Audiometric Patterns in Fuchs Corneal Dystrophy. J Speech Lang Hear Res. 2018 Oct 26;61(10):2604-2608. PMID: 30286242.
102) Mamo SK, Reed NS, Price C, Occhipinti D, Pletnikova A, **Lin FR,** Oh ES. Hearing Loss Treatment in Older Adults With Cognitive Impairment: A Systematic Review. J Speech Lang Hear Res. 2018 Oct 26;61(10):2589-2603. PMID: 30304320.
103) Deal JA, Goman AM, Albert MS, Arnold ML, Burgard S, Chisolm T, Couper D, Glynn NW, Gmelin T, Hayden KM, Mosley T, Pankow JS, Reed N, Sanchez VA, Richey Sharrett A, Thomas SD, Coresh J, **Lin FR**. Hearing treatment for reducing cognitive decline: Design and methods of the Aging and Cognitive Health Evaluation in Elders randomized controlled trial. Alzheimers Dement (N Y). 2018 Oct 5;4:499-507. PMID: 30364572; PubMed Central PMCID: PMC6197326.
104) Reed NS, Altan A, Deal JA, Yeh C, Kravetz AD, Wallhagen M, **Lin FR.** Trends in Health Care Costs and Utilization Associated With Untreated Hearing Loss Over 10 Years. JAMA Otolaryngol Head Neck Surg. 2018 Nov 8. PMID: 30419131.
105) Deal JA, Reed NS, Kravetz AD, Weinreich H, Yeh C, **Lin FR**, Altan A. Incident Hearing Loss and Comorbidity: A Longitudinal Administrative Claims Study. JAMA Otolaryngol Head Neck Surg. 2018 Nov 8. PMID: 30419134.
106) Brenowitz WD, Kaup AR, **Lin FR**, Yaffe K. Multiple sensory impairment is associated with increased risk of dementia among black and white older adults. J Gerontol A Biol Sci Med Sci. 2018 Nov 18. PMID: 30452551.
107) Armstrong NM, An Y, Ferrucci L, Deal JA, **Lin FR,** Resnick SM. Temporal Sequence of Hearing Impairment and Cognition in the Baltimore Longitudinal Study of Aging. J Gerontol A Biol Sci Med Sci. 2018 Nov 30. PMID: 30500877.
108) Reed NS, Betz JF, Kucharska-Newton AM, **Lin FR**, Deal JA. Hearing loss and satisfaction with healthcare: An unexplored relationship. J Am Geriatr Soc. 2018 PMID: 30512196.
109) Armstrong NM, Deal JA, Betz J, Kritchevsky S, Pratt S, Harris T, Barry LC, Simonsick EM, **Lin FR**. Associations of Hearing Loss and Depressive Symptoms With Incident Disability in Older Adults: Health, Aging, and Body Composition Study. J Gerontol A Biol Sci Med Sci. 2018 Dec 17. PMID: 30561511.
110) Horne AJ, Chiew KS, Zhuang J, George LK, Adcock RA, Potter GG, Lad EM, Cousins SW, **Lin FR**, Mamo SK, Chen NK, Maciejewski AJ, Duong Fernandez X, Whitson HE. Relating Sensory, Cognitive, and Neural Factors to Older Persons' Perceptions about Happiness: An Exploratory Study. J Aging Res. 2018 Dec 16;2018 PMID: 30652033; PMCID: PMC6311777.
111) Willink A, Reed NS, **Lin FR**. Cost-Benefit Analysis of Hearing Care Services: What Is It Worth to Medicare? J Am Geriatr Soc. 2019 Jan 14. PMID: 30641615.
112) Willink A, Reed NS, **Lin FR**. Access To Hearing Care Services Among Older Medicare Beneficiaries Using Hearing Aids. Health Aff (Millwood). 2019 Jan;38(1):124-131. PMID: 30615534.
113) Croll PH, Voortman T, Vernooij MW, Baatenburg de Jong RJ, **Lin FR**, Rivadeneira F, Ikram MA, Goedegebure A. The association between obesity, diet quality and hearing loss in older adults. Aging (Albany NY). 2019 Jan 4;11(1):48-62. PMID: 30609412; PMCID: PMC6339793.
114) Villavisanis DF, **Lin FR**, Deal JA. Quantification of Hearing Loss Research on Children Compared With Older Adults. JAMA Otolaryngol Head Neck Surg. 2019 Jan 17. PMID: 30653206.
115) Horne AJ, Chiew KS, Zhuang J, George LK, Adcock RA, Potter GG, Lad EM, Cousins SW, **Lin FR**, Mamo SK, Chen NK, Maciejewski AJ, Duong Fernandez X, Whitson HE. Relating Sensory, Cognitive, and Neural Factors to Older Persons' Perceptions about Happiness: An Exploratory Study. J Aging Res. 2018 Dec 16;2018:4930385. doi: 10.1155/2018/4930385. eCollection 2018. PubMed PMID: 30652033; PubMed Central PMCID: PMC6311777.

116) Shukla A, Cudjoe TKM, **Lin FR**, Reed NS. Functional Hearing Loss and Social Engagement Among Medicare Beneficiaries. J Gerontol B Psychol Sci Soc Sci. 2019 Jul 30. pii: gbz094. doi: 10.1093/geronb/gbz094. [Epub ahead of print] PubMed PMID: 31359056.

117) Armstrong NM, Espeland MA, Chen JC, Masaki K, Wactawski-Wende J, Li W, Gass MLS, Stefanick ML, Manson JE, Deal JA, Rapp SR, **Lin FR**, Resnick SM. Associations of Hearing Loss and Menopausal Hormone Therapy with Change in Global Cognition and Incident Cognitive Impairment among Postmenopausal Women. J Gerontol A Biol Sci Med Sci. 2019 Jul 20. pii: glz173. doi: 10.1093/gerona/glz173. [Epub ahead of print] PubMed PMID: 31326978.

118) Armstrong NM, An Y, Doshi J, Erus G, Ferrucci L, Davatzikos C, Deal JA, **Lin FR**, Resnick SM. Association of Midlife Hearing Impairment With Late-Life Temporal Lobe Volume Loss. JAMA Otolaryngol Head Neck Surg. 2019 Jul 3. doi: 10.1001/jamaoto.2019.1610. [Epub ahead of print] PubMed PMID: 31268512; PubMed Central PMCID: PMC6613307.

119) Choi JS, Shim KS, Shin NE, Nieman CL, Mamo SK, Han HR, **Lin FR**. Cultural Adaptation of a Community-Based Hearing Health Intervention for Korean American Older Adults with Hearing Loss. J Cross Cult Gerontol. 2019 Jul 1. doi: 10.1007/s10823-019-09376-6. [Epub ahead of print] PubMed PMID: 31264090.

120) Applebaum J, Hoyer M, Betz J, **Lin FR**, Goman AM. Long-term subjective loneliness in adults after hearing loss treatment. Int J Audiol. 2019 Aug;58(8):464-467. doi: 10.1080/14992027.2019.1593523. Epub 2019 Mar 31. PubMed PMID: 30929531.

121) Bishop CE, Spankovich C, **Lin FR**, Seals SR, Su D, Valle K, Schweinfurth JM. Audiologic profile of the jackson heart study cohort and comparison to other cohorts. Laryngoscope. 2019 Mar 19. doi: 10.1002/lary.27920. [Epub ahead of print] PubMed PMID: 30889290.

122) Suen JJ, Marrone N, Han HR, **Lin FR**, Nieman CL. Translating Public Health Practices: Community-Based Approaches for Addressing Hearing Health Care Disparities. Semin Hear. 2019 Feb;40(1):37-48. doi: 10.1055/s-0038-1676782. Epub 2019 Feb 5. Review. PubMed PMID: 30728648; PubMed Central PMCID: PMC6363549.

123) Reed NS, Oliver A, Srinivasan NK, **Lin FR**, Korczak PA. Pilot Comparison of Adjustment Protocols of Personal Sound Amplification Products. Semin Hear. 2019 Feb;40(1):26-36. doi: 10.1055/s-0038-1676781. Epub 2019 Feb 5. Review. PubMed PMID: 30728647; PubMed Central PMCID: PMC6363538.

124) Reed NS, Huddle MG, Betz J, Power MC, Pankow JS, Gottesman R, Richey Sharrett A, Mosley TH, **Lin FR**, Deal JA. Association of Midlife Hypertension with Late-Life Hearing Loss. Otolaryngol Head Neck Surg. 2019 Dec;161(6):996-1003. doi: 10.1177/0194599819868145. Epub 2019 Aug 6. PubMed PMID: 31382849.

125) Croll PH, Bos D, Vernooij MW, Arshi B, **Lin FR**, Baatenburg de Jong RJ, Ikram MA, Goedegebure A, Kavousi M. Carotid Atherosclerosis Is Associated With Poorer Hearing in Older Adults. J Am Med Dir Assoc. 2019 Dec;20(12):1617-1622.e1. doi:10.1016/j.jamda.2019.06.022. Epub 2019 Aug 6. PubMed PMID: 31399361.

126) Shukla A, Reed N, Armstrong NM, **Lin FR**, Deal JA, Goman AM. Hearing Loss, Hearing Aid Use and Depressive Symptoms in Older Adults - Findings from the Atherosclerosis Risk in Communities Neurocognitive Study (ARIC-NCS). J Gerontol B Psychol Sci Soc Sci. 2019 Oct 19. pii: gbz128. doi: 10.1093/geronb/gbz128. [Epub ahead of print] PubMed PMID: 31628485.

127) Yong M, Willink A, McMahon C, McPherson B, Nieman CL, Reed NS, **Lin FR**. Access to adults' hearing aids: policies and technologies used in eight countries. Bull World Health Organ. 2019 Oct 1;97(10):699-710. doi: 10.2471/BLT.18.228676. Epub 2019 Aug 20. PubMed PMID: 31656335; PubMed Central PMCID: PMC6796668.

128) Goman AM, Reed NS, **Lin FR**, Willink A. Variations in Prevalence and Number of Older Adults With Self-reported Hearing Trouble by Audiometric Hearing Loss and Sociodemographic Characteristics. JAMA Otolaryngol Head Neck Surg. 2019 Nov 21. doi: 10.1001/jamaoto.2019.3584. [Epub ahead of print] PubMed PMID: 31750866.

129) Varadaraj V, Wang Y, Reed NS, Deal JA, **Lin FR**, Swenor BK. Trends in Employment by Dual Sensory Impairment Status. JAMA Ophthalmol. 2019 Dec 5. doi: 10.1001/jamaophthalmol.2019.4955. [Epub ahead of print] PubMed PMID: 31804660.

130) Mamo SK, Reed NS, Sharrett AR, Albert MS, Coresh J, Mosley TH, Knopman D, **Lin FR**, Deal JA. Relationship Between Domain-Specific Cognitive Function and Speech-in-Noise Performance in Older Adults: The Atherosclerosis Risk in Communities Hearing Pilot Study. Am J Audiol. 2019 Dec 11:1-9. doi: 10.1044/2019_AJA-19-00043. [Epub ahead of print] PubMed PMID: 31825642.

131) Kim SJ, Reed N, Betz JF, Abraham A, Lee MJ, Sharrett AR, **Lin FR**, Deal JA. Association Between Microvascular Retinal Signs and Age-Related Hearing Loss in the Atherosclerosis Risk in Communities Neurocognitive Study (ARIC-NCS). JAMA Otolaryngol Head Neck Surg. 2019 Dec 26;146(2):152–9. doi: 10.1001/jamaoto.2019.3987. Epub ahead of print. PMID: 31876936; PMCID: PMC6990841.

132) Ha J, Cho YS, Kim SJ, Cho SH, Kim JP, Jung YH, Jang H, Shin HY, **Lin FR**, Na DL, Seo SW, Moon IJ, Kim HJ. Hearing loss is associated with cortical thinning in cognitively normal older adults. Eur J Neurol. 2020 Mar 3. doi: 10.1111/ene.14195. Epub ahead of print. PMID: 32125747.

133) Shukla A, Harper M, Pedersen E, Goman A, Suen JJ, Price C, Applebaum J, Hoyer M, **Lin FR**, Reed NS. Hearing Loss, Loneliness, and Social Isolation: A Systematic Review. Otolaryngol Head Neck Surg. 2020 May;162(5):622-633. doi: 10.1177/0194599820910377. Epub 2020 Mar 10. PMID: 32151193.

134) Sanchez VA, Arnold ML, Reed NS, Oree PH, Matthews CR, Clock Eddins A, **Lin FR**, Chisolm TH. The Hearing Intervention for the Aging and Cognitive Health Evaluation in Elders Randomized Control Trial: Manualization and Feasibility Study. Ear Hear. 2020 Apr 2. doi: 10.1097/AUD.0000000000000858. Epub ahead of print. PMID: 32251012.

135) Armstrong NM, Williams OA, Landman BA, Deal JA, **Lin FR**, Resnick SM. Association of Poorer Hearing With Longitudinal Change in Cerebral White Matter Microstructure. JAMA Otolaryngol Head Neck Surg. 2020 Sep 3;146(11):1035–42. doi: 10.1001/jamaoto.2020.2497. Epub ahead of print. PMID: 32880621; PMCID: PMC7489397.

136) Armstrong NM, Croll PH, Oosterloo BC, **Lin FR**, Ikram MA, Goedegebure A, Vernooij MW. Association of Speech Recognition Thresholds With Brain Volumes and White Matter Microstructure: The Rotterdam Study. Otol Neurotol. 2020 Oct;41(9):1202-1209. doi: 10.1097/MAO.0000000000002739. PMID: 32925839.

137) Kim AS, Garcia Morales EE, Amjad H, Cotter VT, **Lin FR**, Lyketsos CG, Nowrangi MA, Mamo SK, Reed NS, Yasar S, Oh ES, Nieman CL. Association of Hearing Loss With Neuropsychiatric Symptoms in Older Adults With Cognitive Impairment. Am J Geriatr Psychiatry. 2020 Oct 14:S1064-7481(20)30510-8. doi: 10.1016/j.jagp.2020.10.002. Epub ahead of print. PMID: 33168388.

138) Kim AS, Betz JF, Nieman CL, Hoyer MR, Applebaum J, **Lin FR**, Goman AM. Long-term Impact of Hearing Aid Provision or Cochlear Implantation on Hearing Handicap. Laryngoscope. 2020 Nov 2. doi: 10.1002/lary.29175. Epub ahead of print. PMID: 33135838.

139) Shukla A, Cudjoe TKM, **Lin FR**, Reed NS. Functional Hearing Loss and Social Engagement Among Medicare Beneficiaries. J Gerontol B Psychol Sci Soc Sci. 2021 Jan 1;76(1):195-200. doi: 10.1093/geronb/gbz094. PMID: 31359056; PMCID: PMC7756723.

140) Reed NS, Boss EF, **Lin FR**, Oh ES, Willink A. Satisfaction With Quality of Health Care Among Medicare Beneficiaries With Functional Hearing Loss. Med Care. 2021 Jan;59(1):22-28. doi: 10.1097/MLR.0000000000001419. PMID: 32925460; PMCID: PMC7736070.

141) Suen JJ, Betz J, Reed NS, Deal JA, **Lin FR**, Goman AM. Prevalence of Asymmetric Hearing Among Adults in the United States. Otol Neurotol. 2021 Feb 1;42(2):e111-e113. doi: 10.1097/MAO.0000000000002931. PMID: 33332857.

142) Suen JJ, Han HR, Peoples CY, Weikert M, Marrone N, **Lin FR,** Nieman CL. A Community Health Worker Training Program to Deliver Accessible and Affordable Hearing Care to Older Adults. J Health Care Poor Underserved. 2021;32(1):37-49. doi: 10.1353/hpu.2021.0006. PMID: 33678679.

143) Kuo PL, Huang AR, Ehrlich JR, Kasper J, **Lin FR**, McKee MM, Reed NS, Swenor BK, Deal JA. Prevalence of Concurrent Functional Vision and Hearing Impairment and Association With Dementia in Community-Dwelling Medicare Beneficiaries. JAMA Netw Open. 2021 Mar 1;4(3):e211558. doi: 10.1001/jamanetworkopen.2021.1558. PMID: 33739429.

144) Deal JA, Gross AL, Sharrett AR, Abraham AG, Coresh J, Carlson M, Griswold M, Mosley T, Power MC, Ramulu P, Reed NS, **Lin FR**, Swenor BK. Hearing impairment and missing cognitive test scores in a population-based study of older adults: The Atherosclerosis Risk in Communities neurocognitive study. Alzheimers Dement. 2021 Apr 12. doi: 10.1002/alz.12339. Epub ahead of print. PMID: 33844443.

145) Kuo PL, Di J, Ferrucci L, **Lin FR**. Analysis of Hearing Loss and Physical Activity Among US Adults Aged 60-69 Years. JAMA Netw Open. 2021 Apr 1;4(4):e215484. doi: 10.1001/jamanetworkopen.2021.5484. PMID: 33871617; PMCID: PMC8056278.

146) Goman AM, Gao T, Betz J, Reed NS, Deal JA, **Lin FR**; ACHIEVE-P Study Group. Association of Hearing Loss with Physical, Social, and Mental Activity Engagement. Semin Hear. 2021 Feb;42(1):59-65. doi: 10.1055/s-0041-1726001. Epub 2021 Apr 15. PMID: 33883792; PMCID: PMC8050419.

147) Pittman CA, Roura R, Price C, **Lin FR**, Marrone N, Nieman CL. Racial/Ethnic and Sex Representation in US-Based Clinical Trials of Hearing Loss Management in Adults: A Systematic Review. JAMA Otolaryngol Head Neck Surg. 2021 Apr 22. doi: 10.1001/jamaoto.2021.0550. Epub ahead of print. PMID: 33885733.
148) Nichols E, Deal JA, Swenor BK, Abraham AG, Armstrong NM, Carlson MC, Griswold M, **Lin FR**, Mosley TH, Ramulu PY, Reed NS, Resnick SM, Sharrett AR, Gross AL. Assessing Bias in Cognitive Testing for Older Adults with Sensory Impairment: An Analysis of Differential Item Functioning in the Baltimore Longitudinal Study on Aging (BLSA) and the Atherosclerosis Risk in Communities Neurocognitive Study (ARIC-NCS). J Int Neuropsychol Soc. 2021 Apr 26:1-12. doi: 10.1017/S1355617721000400. Epub ahead of print. PMID: 33896441.
149) Reed NS, Assi L, Horiuchi W, Hoover-Fong JE, **Lin FR**, Ferrante LE, Inouye SK, Miller Iii ER, Boss EF, Oh ES, Willink A. Medicare Beneficiaries With Self-Reported Functional Hearing Difficulty Have Unmet Health Care Needs. Health Aff (Millwood). 2021 May;40(5):786-794. doi: 10.1377/hlthaff.2020.02371. PMID: 33939509.
150) Martinez-Amezcua P, Kuo PL, Reed NS, Simonsick EM, Agrawal Y, **Lin FR**, Deal JA, Ferrucci L, Schrack JA. Association of hearing impairment with higher level physical functioning and walking endurance: Results from the Baltimore Longitudinal Study of Aging (BLSA). J Gerontol A Biol Sci Med Sci. 2021 May 18:glab144. doi: 10.1093/gerona/glab144. Epub ahead of print. PMID: 34003883.
151) Ting J, Jiang K, Du S, Betz J, Reed N, Power MC, Gottesman R, Sharrett AR, Griswold M, Walker KA, Miller ER, **Lin FR**, Deal JA. Longitudinal Blood Pressure Patterns from Mid-to-Late Life and Late-life Hearing Loss in the Atherosclerosis Risk in Communities Study. J Gerontol A Biol Sci Med Sci. 2021 May 27:glab153. doi: 10.1093/gerona/glab153. Epub ahead of print. PMID: 34043799.
152) Jiang K, Spira AP, Reed NS, **Lin FR**, Deal JA. Sleep Characteristics and Hearing Loss in Older Adults: The National Health and Nutrition Examination Survey 2005-2006. J Gerontol A Biol Sci Med Sci. 2021 Jul 24:glab214. doi: 10.1093/gerona/glab214. Epub ahead of print. PMID: 34302481.
153) Wu HC, Thallmayer T, Deal JA, Betz JF, Reed NS, **Lin FR**. Prevalence Trends in Hearing Aid Use Among US Adults Aged 50 to 69 Years With Hearing Loss-2011 to 2016 vs 1999 to 2004. JAMA Otolaryngol Head Neck Surg. 2021 Sep 1;147(9):831-832. doi: 10.1001/jamaoto.2021.1572. PMID: 34323926; PMCID: PMC8323044.
154) Assi L, Ehrlich JR, Zhou Y, Huang A, Kasper J, **Lin FR**, McKee MM, Reed NS, Swenor BK, Deal JA. Self-reported dual sensory impairment, dementia, and functional limitations in Medicare beneficiaries. J Am Geriatr Soc. 2021 Sep 3. doi: 10.1111/jgs.17448. Epub ahead of print. PMID: 34478566.
155) Irace AL, Armstrong NM, Deal JA, Chern A, Ferrucci L, **Lin FR**, Resnick SM, Golub JS. Longitudinal associations of subclinical hearing loss with cognitive decline. J Gerontol A Biol Sci Med Sci. 2021 Sep 13:glab263. doi: 10.1093/gerona/glab263. Epub ahead of print. PMID: 34516645.
156) Arnold ML, Haley W, **Lin FR**, Faucette S, Sherry L, Higuchi K, Witherell K, Anderson E, Reed NS, Chisolm TH, Sanchez VA. Development, assessment, and monitoring of audiologic treatment fidelity in the aging and cognitive health evaluation in elders (ACHIEVE) randomised controlled trial. Int J Audiol. 2021 Sep 17:1-11. doi: 10.1080/14992027.2021.1973126. Epub ahead of print. PMID: 34533430.
157) Nicholas SO, Koh EJ, Wee SL, Eikelboom RH, Jayakody DMP, **Lin F**, Ng TP, Heywood RL. Peripheral Hearing Loss and Its Association with Cognition among Ethnic Chinese Older Adults. Dement Geriatr Cogn Disord. 2021;50(4):394-400. doi: 10.1159/000519291. Epub 2021 Sep 30. PMID: 34592737.
158) Armstrong NM, Wang H, E JY, **Lin FR**, Abraham AG, Ramulu P, Resnick SM, Tian Q, Simonsick E, Gross AL, Schrack JA, Ferrucci L, Agrawal Y. Patterns of Prevalence of Multiple Sensory Impairments among Community-Dwelling Older Adults. J Gerontol A Biol Sci Med Sci. 2021 Oct 5:glab294. doi: 10.1093/gerona/glab294. Epub ahead of print. PMID: 34608938.
159) Powell DS, Brenowitz WD, Yaffe K, Armstrong NM, Reed NS, **Lin FR**, Gross AL, Deal JA. Examining the Combined Estimated Effects of Hearing Loss and Depressive Symptoms on Risk of Cognitive Decline and Incident Dementia. J Gerontol B Psychol Sci Soc Sci. 2021 Oct 16:gbab194. doi: 10.1093/geronb/gbab194. Epub ahead of print. PMID: 34655295.
160) Martinez-Amezcua P, Suen JJ, **Lin F**, Schrack JA, Deal JA. Hearing impairment and objectively measured physical activity: A systematic review. J Am Geriatr Soc. 2021 Oct 28. doi: 10.1111/jgs.17529. Epub ahead of print. PMID: 34713440.
161) Kim AS, Betz JF, Albert M, Deal JA, Faucette SP, Oh ES, Reed NS, **Lin FR**, Nieman CL. Accuracy of self- and proxy-rated hearing among older adults with and without cognitive impairment. J Am Geriatr Soc. 2021 Nov 23. doi: 10.1111/jgs.17558. Epub ahead of print. PMID: 34813080.

162) Willink A, Reed NS, Boisvert I, McMahon CM, **Lin FR**. Changes in US hearing aid regulations: possible benefits and risks to Australia. Public Health Res Pract. 2021 Dec 2;31(5):3152132. doi: 10.17061/phrp3152132. PMID: 34873617.

163) Willink A, Assi L, Nieman C, McMahon C, **Lin FR**, Reed NS. Alternative Pathways for Hearing Care May Address Disparities in Access. Front Digit Health. 2021 Nov 25;3:740323. doi: 10.3389/fdgth.2021.740323. PMID: 34901925; PMCID: PMC8655113.

164) Kuo PL, Moore AZ, **Lin FR**, Ferrucci L. Epigenetic Age Acceleration and Hearing: Observations From the Baltimore Longitudinal Study of Aging. Front Aging Neurosci. 2021 Dec 15;13:790926. doi: 10.3389/fnagi.2021.790926. PMID: 34975461; PMCID: PMC8714776.

165) Garcia Morales EE, Ting J, Gross AL, Betz JF, Jiang K, Du S, Power MC, Reed NS, Sharrett AR, **Lin FR**, Deal JA. Association of Cigarette Smoking Patterns Over 30 Years With Audiometric Hearing Impairment and Speech-in-Noise Perception: The Atherosclerosis Risk in Communities Study. JAMA Otolaryngol Head Neck Surg. 2022 Mar 1;148(3):243-251. doi: 10.1001/jamaoto.2021.3982. PMID: 35084441; PMCID: PMC8796063.

166) Pupo DA, Small BJ, Deal JA, Armstrong NM, Simonsick EM, Resnick SM, **Lin F**, Ferrucci L, Tian Q. Hearing and Mobility in Aging - the Moderating Role of Neuropsychological Function. J Gerontol A Biol Sci Med Sci. 2022 Feb 28:glac047. doi: 10.1093/gerona/glac047. Epub ahead of print. PMID: 35226729.

167) Yi JS, Garcia Morales EE, Betz JF, Deal JA, Dean LT, Du S, Goman AM, Griswold ME, Palta P, Rebok GW, Reed NS, Thorpe RJ, **Lin FR**, Nieman CL. Individual Life-Course Socioeconomic Position and Hearing Aid Use in the Atherosclerosis Risk in Communities Study. J Gerontol A Biol Sci Med Sci. 2022 Mar 3;77(3):645-653. doi: 10.1093/gerona/glab273. PMID: 35239947; PMCID: PMC8893260.

168) Armstrong NM, Vieira Ligo Teixeira C, Gendron C, Brenowitz WD, **Lin FR**, Swenor B, Deal JA, Simonsick EM, Jones RN. Associations of dual sensory impairment with incident mobility and ADL difficulty. J Am Geriatr Soc. 2022 Mar 28. doi: 10.1111/jgs.17764. Epub ahead of print. PMID: 35343588.

169) Nichols E, Deal JA, Swenor BK, Abraham AG, Armstrong NM, Bandeen-Roche K, Carlson MC, Griswold M, **Lin FR**, Mosley TH, Ramulu PY, Reed NS, Sharrett AR, Gross AL. The effect of missing data and imputation on the detection of bias in cognitive testing using differential item functioning methods. BMC Med Res Methodol. 2022 Mar 27;22(1):81. doi: 10.1186/s12874-022-01572-2. PMID: 35346056; PMCID: PMC8961895.

170) Garcia Morales EE, Lin H, Suen JJ, Varadaraj V, **Lin FR**, Reed NS. Labor Force Participation and Hearing Loss Among Adults in the United States: Evidence From the National Health and Nutrition Examination Survey. Am J Audiol. 2022 May 27:1-9. doi: 10.1044/2022_AJA-21-00266. Epub ahead of print. PMID: 35623104.

171) Myers C, Reed NS, **Lin FR**, Willink A. A Broad Examination of Health Policy Barriers to Access and Affordability of Hearing Treatment for Medicare Beneficiaries. Semin Hear. 2022 Jun 15;43(1):13-19. doi: 10.1055/s-0042-1743122. PMID: 35719747; PMCID: PMC9200460.

172) Arnold ML, Haley W, **Lin FR**, Faucette S, Sherry L, Higuchi K, Witherell K, Anderson E, Reed NS, Chisolm TH, Sanchez VA. Development, assessment, and monitoring of audiologic treatment fidelity in the aging and cognitive health evaluation in elders (ACHIEVE) randomised controlled trial. Int J Audiol. 2022 Sep;61(9):720-730. doi: 10.1080/14992027.2021.1973126. Epub 2021 Sep 17. PMID: 34533430.

173) Gao J, Zhu D, Deal JA, **Lin FR**, He P. Hearing impairment, family financial support, and depressive symptoms among Chinese middle-aged and older adults. Int J Geriatr Psychiatry. 2022 Sep;37(9). doi: 10.1002/gps.5788. PMID: 36004947.

174) Martinez-Amezcua P, Garcia Morales E, Gabriel KP, Dooley EE, Hornikel B, Coresh J, **Lin FR**, Pankow JS, Sharrett AR, Schrack JA, Sullivan KJ, Reed N, Deal JA, Palta P. The Association Between Midlife Leisure-Time Physical Activity and Hearing Loss in Late-life in the Atherosclerosis Risk in Communities (ARIC) Study. J Gerontol A Biol Sci Med Sci. 2022 Sep 18:glac194. doi: 10.1093/gerona/glac194. Epub ahead of print. PMID: 36124822.

175) Armstrong NM, Wang H, E JY, **Lin FR**, Abraham AG, Ramulu P, Resnick SM, Tian Q, Simonsick E, Gross AL, Schrack JA, Ferrucci L, Agrawal Y. Patterns of Prevalence of Multiple Sensory Impairments Among Community-dwelling Older Adults. J Gerontol A Biol Sci Med Sci. 2022 Oct 6;77(10):2123-2132. doi: 10.1093/gerona/glab294. PMID: 34608938; PMCID: PMC9536434.

176) Pupo DA, Small BJ, Deal JA, Armstrong NM, Simonsick EM, Resnick SM, **Lin FR**, Ferrucci L, Tian Q. Hearing and Mobility in Aging-The Moderating Role of Neuropsychological Function. J Gerontol A Biol Sci

Med Sci. 2022 Oct 6;77(10):2141-2146. doi: 10.1093/gerona/glac047. PMID: 35226729; PMCID: PMC9536448.

177) Hicks CW, Wang D, **Lin FR**, Reed N, Windham BG, Selvin E. Peripheral Neuropathy and Vision and Hearing Impairment in US Adults With and Without Diabetes. Am J Epidemiol. 2022 Nov 7:kwac195. doi: 10.1093/aje/kwac195. Epub ahead of print. PMID: 36345076.

178) Armstrong NM, Vieira Ligo Teixeira C, Gendron C, Brenowitz WD, **Lin FR**, Swenor B, Powell DS, Deal JA, Simonsick EM, Jones RN. Associations of dual sensory impairment with long-term depressive and anxiety symptoms in the United States. J Affect Disord. 2022 Nov 15;317:114-122. doi: 10.1016/j.jad.2022.07.067. Epub 2022 Aug 3. PMID: 35932940.

179) Jiang K, Armstrong NM, Agrawal Y, Gross AL, Schrack JA, **Lin FR**, Ferrucci L, Resnick SM, Deal JA, Powell DS. Associations of audiometric hearing and speech-in-noise performance with cognitive decline among older adults: The Baltimore Longitudinal Study of Aging (BLSA). Front Neurol. 2022 Dec 9;13:1029851. doi: 10.3389/fneur.2022.1029851. PMID: 36570462; PMCID: PMC9784219.

180) Nieman CL, Betz J, Garcia Morales EE, Suen JJ, Trumbo J, Marrone N, Han HR, Szanton SL, **Lin FR**. Effect of a Community Health Worker-Delivered Personal Sound Amplification Device on Self-Perceived Communication Function in Older Adults With Hearing Loss: A Randomized Clinical Trial. JAMA. 2022 Dec 20;328(23):2324-2333. doi: 10.1001/jama.2022.21820. PMID: 36538311.

181) Choi JS, Gathman TJ, **Lin FR**, Adams ME. Performance of Smartphone Automated Audiogram Image Recognition for Personalized Sound Amplification. JAMA Otolaryngol Head Neck Surg. 2023 Jan 5. doi: 10.1001/jamaoto.2022.4383. Epub ahead of print. PMID: 36602783.

182) Garcia Morales EE, Croll PH, Palta P, Goedegebure A, Reed NS, Betz JF, **Lin FR**, Deal JA. Association of Carotid Atherosclerosis With Hearing Loss: A Cross-sectional Analysis of the Atherosclerosis Risk in Communities Study. JAMA Otolaryngol Head Neck Surg. 2023 Mar 1;149(3):223-230. doi: 10.1001/jamaoto.2022.4651. PMID: 36656574; PMCID: PMC9857750.

183) Cai Y, Schrack JA, Gross AL, Armstrong NM, Swenor BK, Deal JA, **Lin FR**, Wang H, Tian Q, An Y, Simonsick EM, Ferrucci L, Resnick SM, Agrawal Y. Sensory impairment and algorithmic classification of early cognitive impairment. Alzheimers Dement (Amst). 2023 Apr 14;15(2):e12400. doi: 10.1002/dad2.12400. PMID: 37063388; PMCID: PMC10103182.

184) Smith JR, Huang AR, **Lin FR**, Reed NS, Deal JA. The population attributable fraction of dementia from audiometric hearing loss among a nationally representative sample of community-dwelling older adults. J Gerontol A Biol Sci Med Sci. 2023 May 4:glad117. doi: 10.1093/gerona/glad117. Epub ahead of print. PMID: 37139951.

**Review Articles [RA]**

1) Linder TE, **Lin F**. Temporal bone surgery: surgical sequelae and complications. HNO. 2011Oct;59(10):974-9

2) **Lin FR**. Implications of hearing loss for older adults. Audiol Neurotol 2012; 18(suppl 1): 3-25.

3) Yamasoba, T, **Lin FR**, Someya S, Kashio A, Sakamoto T, Kondo K. Current concepts in age-related hearing loss: epidemiology and mechanistic pathways. Hearing Res. 2013 Sep;303:30-8. PMID: 23422312

4) Parham K, **Lin FR**, Coelho DH, Sataloff RT, Gates GA. Comprehensive management of presbycusis: Central and peripheral. Otolaryngol Head Neck Surg. 2013 Apr;148(4):537-9.

5) Bernabei R, Bonuccelli U, Maggi S, Marengoni A, Martini A, Memo M, Pecorelli S, Peracino AP, Quaranta N, Stella R, **Lin FR**; participants in the Workshop on Hearing Loss and Cognitive Decline in Older Adults. Hearing loss and cognitive decline in older adults: questions and answers. Aging Clin Exp Res. 2014 Dec;26(6):567-73. PMID: 25281432

6) Davis A, McMahon CM, Pichora-Fuller KM, Russ S, **Lin F**, Olusanya BO, Chadha S, Tremblay KL. Aging and Hearing Health: The Life-course Approach. Gerontologist. 2016 Apr;56 Suppl 2:S256-67. PubMed PMID: 26994265.

7) Mamo SK, Oh E, **Lin FR**. Enhancing communication in adults with dementia and age-related hearing loss. Seminars in Hearing. 2017 May; 38(2): 177-183. PMC5435474.

8) Shukla A, Nieman CL, Price C, Harper M, Lin FR, Reed NS. Impact of Hearing Loss on Patient-Provider Communication Among Hospitalized Patients: A Systematic Review. Am J Med Qual. 2018 Sep 9:1062860618798926. doi: 10.1177/1062860618798926. [Epub ahead of print] PubMed PMID: 30196712.

9) Whitson HE, Cronin-Golomb A, Cruickshanks KJ, Gilmore GC, Owsley C, Peelle JE, Recanzone G, Sharma A, Swenor B, Yaffe K, **Lin FR**. American Geriatrics Society and National Institute on Aging Bench-to-

Bedside Conference: Sensory Impairment and Cognitive Decline in Older Adults. J Am Geriatr Soc. 2018 Nov;66(11):2052-2058. PMID: 30248173.
10) Nieman CL, Reed NS, **Lin FR**. Otolaryngology for the Internist: Hearing Loss. Med Clin North Am. 2018 Nov;102(6):977-992. PMID: 30342615.
11) Carpenter CR, McFarland F, Avidan M, Berger M, Inouye SK, Karlawish J, **Lin FR**, Marcantonio E, Morris JC, Reuben DB, Shah RC, Whitson HE, Asthana S, Verghese J. Impact of Cognitive Impairment Across Specialties: Summary of a Report From the U13 Conference Series. J Am Geriatr Soc. 2019 Oct;67(10):2011-2017. doi: 10.1111/jgs.16093. Epub 2019 Aug 22. PubMed PMID: 31436318; PubMed Central PMCID: PMC6800784.
12) **Lin FR**. Hear and Now. Cerebrum. 2020 Oct 1;2020:cer-07-20. PMID: 33216829; PMCID: PMC7664819.
13) Jilla AM, Reed NS, Oh ES, **Lin FR.** A Geriatrician's Guide to Hearing Loss. J Am Geriatr Soc. 2021 May;69(5):1190-1198. doi: 10.1111/jgs.17073. Epub 2021 Mar 9. PMID: 33687733.
14) Deal JA, Betz J, **Lin FR**, Reed NS. Interpreting Results from Epidemiologic Studies. Semin Hear. 2021 Feb;42(1):3-9. doi: 10.1055/s-0041-1725996. Epub 2021 Apr 15. PMID: 33883787; PMCID: PMC8050417.
15) Powell DS, Oh ES, **Lin FR**, Deal JA. Hearing Impairment and Cognition in an Aging World. J Assoc Res Otolaryngol. 2021 May 18. doi: 10.1007/s10162-021-00799-y. Epub ahead of print. PMID: 34008037.
16) Powell DS, Oh ES, Reed NS, **Lin FR**, Deal JA. Hearing Loss and Cognition: What We Know and Where We Need to Go. Front Aging Neurosci. 2022 Feb 28;13:769405. doi: 10.3389/fnagi.2021.769405. PMID: 35295208; PMCID: PMC8920093.
17) Martinez-Amezcua P, Suen JJ, **Lin F**, Schrack JA, Deal JA. Hearing impairment and objectively measured physical activity: A systematic review. J Am Geriatr Soc. 2022 Jan;70(1):301-304. doi: 10.1111/jgs.17529. Epub 2021 Oct 28. PMID: 34713440; PMCID: PMC8742764.
18) Brewster KK, Deal JA, **Lin FR**, Rutherford BR. Considering hearing loss as a modifiable risk factor for dementia. Expert Rev Neurother. 2022 Sep;22(9):805-813. doi: 10.1080/14737175.2022.2128769. Epub 2022 Sep 27. PMID: 36150235; PMCID: PMC9647784.

**Case Reports [CR]**

1) Clark JH, **Lin FR**, Salaria S, Stewart CM, Francis HW. Malignant otitis externa caused by Aspergilus Fumigatus: A Case Report. Otol Neurotol, 2011 Apr;32(3):e22-3. PMID: 21765381.

**Book chapters [BC]**

1) **Lin FR**, Niparko JK. *Complications of Lateral Skull Base Surgery*. In: Eisele D, Smith R (eds) Complications in Head and Neck Surgery. Elsevier, 1998.
2) **Lin FR**, Niparko JK, Francis HW. *Outcomes in cochlear implantation: assessment of quality of life impact and economic evaluation of the cochlear implant*. In: Eisenberg L (ed). Clinical Management of Children with Cochlear Implants. Plural Publ, 2009
3) **Lin, FR**, Niparko, JK, Francis, HW. Outcomes in Cochlear Implantation: Assessment of Quality-of-Life Impact and Economic Evaluation of the Benefits of the Cochlear Implant in Relation to Costs. Cochlear Implants: In Principles & Practices. Lippincott Williams & Wilkins, 2009.
4) **Lin FR**. *Hearing loss and aging*. In: Goldman M, Troisi R, Rexrode K (eds). Women and Health, Elsevier, 2012.
5) Genther D, **Lin FR.** *Epidemiology and clinical management of hearing loss in older adults*. In: Landefeld S, Chang A, Williams B (eds) Current Geriatrics Diagnosis and Treatment, 2nd Ed. McGraw-Hill, 2013
6) Parham K, **Lin FR**, Blakley BW. *Age-Related Hearing Loss*. In: Sataloff RT, Johns MM, Kost KM (eds) Geriatric Otolaryngology. Thieme, 2015.
7) Kamil RJ, Nieman C, **Lin FR**. *Geriatric Otolaryngology*. In: Busby-Whitehead J, Arenson C, Durso SC, Swagerty D, Mosqueda L, Singh M, Reichel W (eds). Reichel's Care of the Elderly. Cambridge Univ Press, 2016.
8) Semenov YR, **Lin FR**, Francis HW, Niparko JK. *Outcomes in cochlear implantation: assessment of quality of life impact and economic evaluation of the cochlear implant*. In: Eisenberg L (ed). Clinical Management of Children with Cochlear Implants. Plural Publ 2016
9) Mamo SK, Chisolm TH, **Lin FR**. Hearing impairments and their treatments. In Michel JP, Beattie BL, Martin FC, Walston J (eds). *Oxford Textbook of Geriatric Medicine* (Ch 155). Oxford Univ Press. In Press.

**Other Publications**

*JAMA Viewpoints & Other Peer-Reviewed Editorials [ED]*

1) **Lin FR.** Hearing loss in older adults: who's listening? JAMA. 2012 Mar; 307(11):1147-1148. PMCID: PMC3518399
2) Whitson HE, **Lin FR**. Hearing and Vision Care for Older Americans: Sensing a Need to Update Medicare Policy. JAMA. 2014 2014 Nov 5;312(17):1739-40. PMID: 25369486
3) **Lin FR**, Albert M. Hearing loss and dementia - who is listening? Aging Ment Health, 2014 Aug; 18(6):671-3. PMID: 24875093
4) **Lin FR,** Hazzard WR, Blazer DG. Priorities for Improving Hearing Health Care for Adults: A Report From the National Academies of Sciences, Engineering, and Medicine. JAMA. 2016 Aug 23-30;316(8):819-20. PMID: 27254725
5) **Lin FR,** Whitson HE. The Common Sense of Considering the Senses in Patient Communication. J Am Geriatr Soc. 2017 Apr 24. Epub ahead of print. PMID: 28436020
6) **Lin, FR.** Time for a Top-Down Approach to Hearing Aid Affordability and Accessibility. Am J Public Health. 2018 Feb;108(2):166-168. PubMed PMID: 29320290.
7) Reed NS, **Lin FR**, Willink A. Hearing Care Access?: Focus on Clinical Services, Not Devices. JAMA. 2018 Oct 23;320(16):1641-1642. doi: 10.1001/jama.2018.11649. PubMed PMID: 30242394.
8) **Lin FR**. Making Sense of the Senses in Aging Research. *J Gerontol A Biol Sci Med Sci*. 2020;75(3):529-530. doi:10.1093/gerona/glaa028
9) **Lin FR**, Reed NS. The Pure-Tone Average as a Universal Metric-Knowing Your Hearing. JAMA Otolaryngol Head Neck Surg. 2020 Dec 23. doi: 10.1001/jamaoto.2020.4862. Epub ahead of print. PMID: 33355634.
10) Deal JA, **Lin FR.** USPSTF Recommendations for Hearing Loss Screening in Asymptomatic Older Adults-A Case of Missing Evidence and Missing Treatment Options. JAMA Netw Open. 2021 Mar 1;4(3):e210274. doi: 10.1001/jamanetworkopen.2021.0274. PMID: 33755162.
11) **Lin FR**, Reed NS. Over-The-Counter hearing aids: How we got here and necessary next steps. J Am Geriatr Soc. 2022 May 5. doi: 10.1111/jgs.17842. Epub ahead of print. PMID: 35512226.
12) **Lin F**, Sheehan M, Reed N, Sampson I. Web Exclusive. Annals Graphic Medicine - Medicare Hearing Policy: A Path Forward. Ann Intern Med. 2022 Oct;175(10):W120-W135. doi: 10.7326/G21-0092. Epub 2022 Oct 11. PMID: 36215710.

*National Academies of Science, Engineering, and Medicine Summaries & Consensus Statements [GL]*

1) IOM (Institute of Medicine) and NRC (National Research Council). Hearing loss and healthy aging: Workshop summary. Washington, DC, National Academies Press 2014. * I was the Co-Chair of this two-day workshop for the IOM and was a co-author of this summary
2) National Academies of Science, Engineering, and Medicine. Hearing health care: Priorities for improving access and affordability. Washington, DC, National Academies Press 2016. * I was a member of the NASEM expert committee that wrote this consensus study report.
3) National Academies of Science, Engineering, and Medicine. The Promise of Assistive Technology to Enhance Activity and Work Participation. Washington, DC, National Academies Press 2017. * I was a member of the NASEM expert committee that wrote this consensus study report.
4) National Academies of Science, Engineering, and Medicine. Evaluating Hearing Loss for Individuals with Cochlear Implants. Washington, DC, National Academies Press 2021. * I was a member of the NASEM expert committee that wrote this consensus study report.

*Congressional Testimony*

1) **Lin FR**. "Examining Improvements to the Regulation of Medical Technologies."Oral and written testimony delivered before the Health Subcommittee of the House of Representatives on the Over-the-Counter Hearing Aid Act of 2017 (H.R. 1652). May 2, 2017. https://docs.house.gov/Committee/Calendar/ByEvent.aspx?EventID=105908

*Books*

1) **Lin, Frank**, author. Hearing Loss For Dummies / Frank Lin, Nicholas Reed. 1st. Indianapolis : John Wiley & Sons inc., 2022.

**FUNDING**
**EXTRAMURAL Funding**
**Research Extramural Funding- Current (total costs)**

9/26/19 – 8/31/23
ARIC Neurocognitive Study (ARIC-NCS) Renewal
NIA/NHLBI/NIDCD/NINDS/NIH
~$35,000,000
MPI: Josef Coresh & Rebecca Gottesman
Role: Co-I, Chair of the hearing committee for the collective ARIC-NCS study group

6/1/17 – 5/31/23
Aging, Cognition, and Hearing Evaluation in Elders (ACHIEVE) Randomized Trial
NIA/NIH
R01AG055426
$15,426,522
Role: MPI: Frank Lin (35%)/Josef Coresh; Note: This grant is the culmination of my foundational epidemiological studies linking hearing loss with cognitive decline and dementia from 2010-2013 which then led to the R34 clinical trial planning grant from 2014-2016 that resulted in the development and funding for this clinical trial. This is the largest trial ever funded by the NIH related to hearing.

9/30/19 – 5/31/23
Admin. Suppl. To R01AG055426 Aging, Cognition, and Hearing Evaluation in Elders Randomized Trial
NIA/NIH
3R01AG055426-03S1
$1,159,601
Role: PI. This supplement funds the expansion of the ACHIEVE sample size from N=850 to N=977.

9/1/18 – 5/31/23
Hearing loss, brain aging, and speech-in-noise performance in the ACHIEVE study
NIA/NIH
R01AG060502
$3,165,191
Role: PI (10%); Note: This grant will fund the addition of an MRI ancillary to the parent ACHIEVE and ARIC studies

2/1/19 – 1/31/23
Contribution of sensorimotor function to risk and pathogenic mechanisms of Alzheimer's disease and related dementias
NIA/NIH
R01AG061786
$3,164,651
Role: MPI (10%)

9/1/21 – 5/31/26
Randomized trial of telehealth vs conventional hearing care delivery in the ACHIEVE Study
NIDCD/NIA
R01DC019408
$3,154,952
Role: MPI (10%)

8/15/22 – 7/31/27
Long-term effects of hearing intervention on Brain Health in the Aging and Cognitive Health Evaluation in Elders (ACHIEVE) randomized study [Official award notice pending]
R01AG076518
$16,753,830

Role: MPI (10%)

6/15/22 – 5/31/27 Addressing Hearing Loss as a Common Unmet Contributor to Neuropsychiatric Symptoms
R01AG076525
$4,091,967
MPI: Carrie Nieman, Esther Oh
Role: Co-I

9/1/22-8/31/27 Extending Capacity for Affordable, Accessible Hearing Care through Peer Mentorship
R21/R33DC020149
$2,538,125
PI: Carrie Nieman
Role: Co-I

9/15/22 – 8/31/27 Early Age-Related Hearing Loss Investigation (EARHLI): A Randomized Controlled Trial to Assess Mechanisms Linking Early Age-Related Hearing Loss and Alzheimer's Disease and Related Dementias
R01AG075083
PI: Justin Golub
Role: Co-I

**Research Extramural Funding- Previous**

7/1/04 – 6/30/06 Quality of Life after Early Childhood Cochlear Implantation
Clinical Research Loan Repayment Award
NIDCD/NIH
Role: PI (no effort)

6/1/10 – 11/30/10 Hearing Loss and Frailty
Research Career Development Award
Johns Hopkins Pepper Older Americans' Independence Center. NIA/NIH
$33,788
Role: PI (15% effort)

12/1/10 – 11/30/15 Hearing Loss and Aging
K23 Career Development Award
K23DC011279
$1,095,620
Role: PI, (75% effort); Note: No cost extension from 12/1/15 – 11/30/16

10/1/11 – 9/31/15 Hearing Loss and Aging
Triological Society/American College of Surgeons Clinician Scientist Award
$320,000
Role: PI, (no effort)

5/12 – 4/13 Double-blind, randomized, placebo-controlled, single-dose, crossover study of the safety and efficacy of two fixed doses of PF-04958242 in subjects with age-related sensorineural hearing loss
Pfizer Pharmaceutical Contract
$ 423,674
PI: John Carey
Role: Co-I (10% effort)

9/10/14 – 8/31/15 Reducing the Symptom Burden of Cognitive Impairment through Affordable and Accessible Hearing Health Care
Johns Hopkins Alzheimer's Disease Research Center. NIA/NIH

| | |
|---|---|
| | $28,060<br>Role: PI, (no effort) |
| 9/1/14 – 5/31/16 | Planning a trial of hearing rehabilitative treatment to reduce cognitive decline in older adults (R34)<br>NIA/NIH<br>$467,564<br>Role: Co-PI: Frank Lin (10%) and Josef Coresh; Note: This 2 year grant from the NIA funded the planning and development of a RCT to investigate if hearing loss treatment can reduce the risk of cognitive decline and dementia in older adults. The grant for the full-scale ACHIEVE clinical trial was submitted in June 2016. |
| 7/1/15 – 6/30/17 | Strengthening Informal Support Resources with Strategic Methodological Advances<br>P30AG048773<br>NIA/NIH<br>$1,181,267<br>PI: David Roth<br>Role: Pilot Project PI, 2% |
| 12/1/17 – 11/30/18 | Admin. Suppl. to U01AG052445-01 Stress, Mental Disorders, Accelerated Aging, and Dementia: a 35-year Cohort Study<br>NIA/NIH<br>3U01AG052445-02S1<br>$99,075<br>PI: Adam Spira, William Eaton<br>Role: Co-I (4%); Note: This supplement funds the addition of hearing testing into the Epidemiologic Catchment Area study which my group will help implement and oversee. |
| 9/1/15 – 8/31/19 | ARIC Neurocognitive Study (ARIC-NCS)<br>NIA/NHLBI/NIDCD/NINDS/NIH<br>$3,495,835<br>PI: Josef Coresh<br>Role: Co-I (23% effort), Chair of the hearing committee for the collective ARIC-NCS study group; Note: The ARIC-NCS renewal grant funds a Visit 6 and 7 for the ~5000 participants followed in the ARIC-NCS study. I lead the hearing subunit which is implementing hearing testing across the 4 study sites and have an R01-sized allocation off the parent award. |
| 12/16/19 – 11/20/21 | Extending Affordable, Accessible, Community-Delivered Hearing Care to Home Care (Exploratory Development Award/Supplement to R33DC015062)<br>3R33DC015062-05S1<br>$87,749<br>Role: PI. This supplement funds an underrepresented minority trainee to develop an extension of the HEARS intervention. |
| 12/1/15 – 11/30/22 | Implementing a Community Health Worker Model of Providing Hearing Health Care Services to Older Adults<br>R21/R33DC015062<br>NIDCD/NIH<br>$2,494,615<br>Role: PI; (40% effort); Note: The intellectual property and materials developed as part of this award are being licensed to a non-profit organization, AccessHEARS, that I co-founded. |
| 12/1/17 – 11/30/22 | Admin. Suppl. to R33DC015062 Community-Delivered Affordable, Accessible Hearing Care to Reduce Symptom Burden in Alzheimer's Disease: Adaptation of the HEARS Intervention |

3R33DC015062-03S1
$404,580
Role: PI. This supplement funds the adaptation of the HEARS intervention to patients with Alzheimer's disease and related dementias.

**Education Extramural Funding**

**Clinical Extramural**

3/1/16 – 11/30/16 A clinical trial protocol to determine the effects of cochlear implantation on cognitive functioning in older adults
Cochlear America
$79,482
Role: PI, (15%)

**System Innovation or Quality Improvement Extramural Funding**

**Other Extramural Funding – Current Philanthropy**

7/1/22 – 6/30/25 Understanding and Addressing the Impact of Hearing Loss on Older Adults
Eleanor Schwartz Charitable Foundation
Total gift: $600,000
Role: PI (15%)

4/1/18 – 3/31/28 Funding for the Cochlear Center for Hearing and Public Health
Cochlear Ltd
$10,000,000
Role: Center Director

**Other Extramural Funding – Previous Philanthropy**

2012 -2022 Understanding and Addressing the Impact of Hearing Loss on Older Adults
Eleanor Schwartz Charitable Foundation
$1,290,000
Role: PI, (no effort) Note: This foundation has funded my research program since 2012 with $890K through 2020.

2014 Miriam Hardy Estate
Total gift: $250,000
Role: PI, (no effort); Note: This was a gift to support my ongoing research at the Bloomberg School of Public Health

**Other Extramural Funding - Current**

2016-2020 AARP
$400,000 grant to Access HEARS
PI: N/A – grant awarded to AccessHEARS; Note: This grant was awarded to AccessHEARS, a nonprofit 501(c)3 that I co-founded with my mentee, Carrie Nieman, and which is dedicated to ensuring accessibility and affordability of hearing care for older adults. This grant supports the non-profit in disseminating the hearing intervention developed under R33DC015062.

**INTRAMURAL Funding**

**Research Intramural Funding - Previous**

7/1/14 – 6/30/15 Providing hearing health care to patients at the Johns Hopkins Memory Clinic
Johns Hopkins Advanced Translational Incubator Pilot Program Grant
$35,000
Role: PI

**Education Intramural Funding**

**Clinical Intramural Funding**

**System Innovation or Quality Improvement Intramural Funding**

**Other Intramural Funding**

**CLINICAL ACTIVITIES**

**Clinical focus**:

My clinical expertise is in the medical and surgical management of hearing loss in adults and other otologic conditions. In particular, I am an expert in how hearing loss impacts the cognitive functioning of older adults, treatment strategies for mitigating the effects of hearing loss on cognitive decline and dementia, and surgical approaches (e.g., cochlear implantation) toward treating hearing loss.

**Medical Licensure**

2010-present Maryland Board of Medicine, License # D0069781

**Board Certification**

2010-present Board Certified, American Board of Otolaryngology-Head & Neck Surgery

**Clinical (Service) Responsibilities**

2010-present Attending surgeon in Otolaryngology-HNS with subspecialty expertise in Otology (20%)

**Clinical Productivity**

2010-present My targeted clinical effort is between 10-20%. On average, I see patients during one day of clinic per week generating 1-2 surgical cases/month

**Clinical Draw**

2010-present The vast majority of my patients come from the mid-Atlantic region including Pennsylvania, Delaware, West Virginia, and Virginia.

**Membership in or examiner for specialty board**

**Clinical Program Building/Leadership**

**Clinical Demonstration Activities**

**Development of nationally/internationally recognized clinical standard of care**

**EDUCATIONAL ACTIVITIES**

**Educational Focus**

My educational efforts focus on training the next generation of clinicians and researchers to conduct interdisciplinary research spanning the fields of otolaryngology, audiology, geriatrics, epidemiology, and public health. In my research group, I mentor multiple pre- and post-doctoral fellows and junior faculty from both the School of Medicine and Bloomberg School of Public Health. I co-founded an epidemiology course on sensory loss and aging at the Bloomberg School of Public Health. I also continue to teach and mentor otolaryngology residents who work with me in my clinic and operative cases.

**Teaching**

***Classroom Instruction***

*JHMI/Regional*

2011 Small group instructor, 1st year medical students, Clinical Epidemiology. Johns Hopkins School of Medicine

11/11 Lecturer, Community adults, Mini Med School on Aging and Health. "Hearing loss and healthy aging," Johns Hopkins Odyssey Program in partnership with Center on Aging and Health

2013-present Lecturer, Bloomberg School of Public Health students, Epidemiology of Aging Course,

"Epidemiology of hearing loss and healthy aging" - Course is held annually, Johns Hopkins Bloomberg School of Public Health

2013-present Lecturer, School of Medicine graduate students, Structure and Function of the Auditory System, "Hearing loss epidemiology in older adults"- Course is held biennially, Johns Hopkins School of Medicine

2015-2018 Course Co-founder & Co-director, Bloomberg School of Public Health students, Epidemiology of Sensory Loss in Aging (340.699.01, 3 credits) course held annually, Johns Hopkins Bloomberg School of Public Health

*National*
*International*

7/2019 Course director, "East Asians Fellows Program in Aging, Hearing and Public Health", Johns Hopkins Bloomberg School of Public Health (1 week intensive course based in Baltimore)

6/21-8/21 Course co-director, "Latin American Fellows Program in Aging, Hearing, and Public Health", Johns Hopkins Bloomberg School of Public Health (virtual program prepared in collaboration with JHBSPH Center for Teaching and Learning)

***Clinical Instruction***

*JHMI/Regional*

2010-present Attending, 3rd and 4th year medical students rotating on OHNS service, Teaching in clinic and the operating room, Johns Hopkins School of Medicine

2011-present Lab instructor, Otolaryngology-HNS residents, Temporal Bone Dissection Course, Annual course, Johns Hopkins School of Medicine

*National*
*International*

***CME Instruction***

*JHMI/Regional*

7/08 Lecturer, Practicing otolaryngologists, Second Annual Johns Hopkins Update in Otolaryngology - Head & Neck - "Outcomes after early pediatric cochlear implantation: current & future perspectives" -Johns Hopkins School of Medicine

8/08 Recorded lecturer, Practicing otolaryngologists, Practical Reviews in Otolaryngology, "Optimizing outcomes after pediatric cochlear implantation," "Bilateral pediatric cochlear implantation," "Socioeconomic and parental impact on language learning after pediatric cochlear implantation," "Developing measures of real-world communication" - Oakstone Medical Publ

5/12 Lecturer, Primary care physicians, Johns Hopkins Philip A. Tumulty Topics in Clinical Medicine, "Epidemiologic Impact and Clinical Management of Hearing Loss"-Johns Hopkins School of Medicine

2/14 Lecturer, Primary care physicians and geriatricians, 41st Johns Hopkins Annual Current Topics in Geriatrics - "Can you hear me now? What hearing changes we need to know about in older adults" - Johns Hopkins School of Medicine

2/15 Lecturer, Primary care physicians and geriatricians, 42nd Johns Hopkins Annual Current Topics in Geriatrics -"Hearing loss in Older Adults: Why it Matters and What to Do?" - Johns Hopkins School of Medicine

1/19 Lecturer, "Hearing loss and Dementia – What Do We Know and What Do We Tell Our Patients", Updates in Otolaryngology Meeting, Pennsylvania State University Milton S. Hershey Medical Center, Marco Island, FL

1/19 Lecturer, "Single Sided Deafness – What to Do?", Updates in Otolaryngology Meeting, Pennsylvania State University Milton S. Hershey Medical Center, Marco Island, FL

1/19 Lecturer, "Over-the-Counter Hearing Aids: What's Already Happened and What's About to Come?", Updates in Otolaryngology Meeting, Pennsylvania State University Milton S. Hershey Medical Center, Marco Island, FL

National

2/20 Lecturer, "Hearing Loss, Cognition & Dementia - From Epidemiology to Clinical Trials & Public Policy", Ultimate Colorado Mid-Winter Meeting in Otology-Audiology, University of Colorado, Vail, CO

1/23 Lecturer, "OTC Hearing Aids – What's Happened & What's Coming Next for U.S. Hearing Care Policy", Ultimate Colorado Mid-Winter Meeting in Otology-Audiology, University of Colorado, Vail, CO

*International*

8/13 Lecturer, Primary care physicians, New Zealand Medical Association General Practice Conference and Medical Exhibition ,"Epidemiology and Clinical Management of Hearing Loss in Older Adults," "Hearing Loss In Older Adults: Implications for Healthy Aging"- University of Otago, Dunedin, New Zealand

***Workshop/Seminars***

*JHMI/Regional*
*National*
*International*

**Mentoring** **indicates first-authored publication by my mentee*

***Pre-Doctoral Advisees/Mentees***

6/11– 8/11 Danisa Clarrett, M.D., Currently: Internal medicine resident at University of Alabama at Birmingham; Role: Primary mentor for MSTAR summer program. I mentored Danisa when she was an NIA MSTAR (Medical Student Training in Aging Research) Summer Student at Johns Hopkins; Co-Authored Publications: OR 36

8/11-present Lingsheng Li, Currently: Internal Medicine resident, Johns Hopkins Bayview Medical Center; Role: Primary mentor. Lingsheng was formerly my clinical research coordinator from 2011-2012, and I have continued to mentor her since she started medical school in 2012. She returned to work with me for a summer as a MSTAR student in 2013. Co-Authored Publications: OR 26, 32*, 36, 43, 45*, 48, 73, 78, 79, 85, 87* Awards: 3rd place for poster in "Patient-oriented and Epidemiology Projects" at American Medical Student Association National Convention, 2014 AGS Annual Scientific Meeting Presidential Poster Award

6/12 – 6/16 Kevin Contrera, M.D., Currently: Otolaryngology-HNS resident at Cleveland Clinic; Role: Primary mentor. I first worked with Kevin for his scholarly concentration project after his first year of medical school in summer 2012. I continued mentoring him for the rest of medical school including during the year off when he pursued an MPH between his 3rd and 4th years of medical school. Awards: Excellence in Medical Student Research at Johns Hopkins Medical Student Research Day 2012, Watt-Hansell Award and J. Howard Beard Fellowship, TL1 Trainee Award by the Predoctoral Clinical Research Training Program (PCRTP), AMA Foundation's 2014 Leadership Award. Co-Authored Publications: 38*, 42, 59*, 63*, 69*, 71*, 73, 75, 79*, 82, 85*

6/12 – 6/16 Janet Choi, M.D., Currently: Otolaryngology-HNS resident at University of Southern California; Role: Primary mentor. Similar to Kevin, I also first worked with Janet for her scholarly concentration project after her first year of medical school in summer 2012. I continued mentoring her for the rest of medical school including during the year off when she did an MPH between her 3rd and 4th years of medical school. Awards: 2013 AOA Carolyn L. Kuckein Student Research Fellowship, 3rd place in 2014 Johns Hopkins Research on Aging Showcase, TL1 Trainee Award by the Predoctoral Clinical Research Training Program (PCRTP). Co-Authored Publications: OR 38, 42*, 63, 66, 69, 73*, 75*, 76*, 79, 82

7/12 – 6/13 David Chen, M.D., Currently: Otolaryngology-HNS resident at Johns Hopkins; Role: Primary mentor. David was a 3rd year medical student who took a year off from medical school to do research with me. Awards: 1st place in 2013 Johns Hopkins Research on Aging Showcase. Co-Authored Publications: OR 33, 35, 36*, 40*, 44, 48*, 54*, 58, 75, 87

9/12 – 6/13 Danielle Foley, M.H.S.; Currently: Statistician at Center for Medicare and Medicaid Services Role: Co-mentor. I co-mentored Danielle along with Kevin Frick as she was pursuing her MHS

in Health Policy and Management. Co-Authored Publications: 41*, 47, 91

6/13 - 7/14 Yoon-kyu Sung, Currently: Medical student at Drexel University College of Medicine. Role: Primary mentor. Yoon-Kyu joined my research group after completing his undergraduate degree with a plan to gain research experience before going to medical school. Co-Authored Publications: OR 58, 73, 78*, 79, 85, 87

6/13 – 8/13 Fiona Gispen, M.D., Currently: Resident in Psychiatry, Massachusetts General Hospital; Role: Primary mentor. I mentored Fiona for her summer scholarly concentration project after her first year of medical school; Co-Authored Publications: OR 44*, 75

7/13 – 5/15 Rebecca Kamil, M.D., Currently: Johns Hopkins Otolaryngology-HNS resident; Role: Primary mentor. I mentored Rebecca when she took a year off after her 3rd year of medical school at Einstein to do research with me at JHU. Co-Authored Publications: OR 43*, 49*, 52*, 72*; BC 7

5/15 – 5/16 Nicole Kendig, Currently: Private Practice; Role: Co-mentor. I served as a co-mentor to Nicole on her Au.D. thesis which investigated the performance of a conventional hearing aid vs. other-the-counter hearing devices on speech-in-noise performance; Co-Authored Publications: OR 88

5/16 – 5/17 Meredith Frank; Currently: 4th year Au.D. student at Towson University; Role: Co-mentor. I served as a co-mentor to Meredith on her Au.D. thesis which is using qualitative research methods to ascertain audiologists' knowledge and perspectives on hearing devices and alternative hearing delivery models.

5/16 – 5/17 Toni Greene-Oliver; Currently: 4th year Au.D. student at Towson University; Role: Co-mentor. I served as a co-mentor to Toni on her Au.D. thesis which is investigating performance of over-the-counter hearing devices when fit by an audiologist versus by the user.

6/16 – 8/16 Tess Gao; Currently:Medical student at University of Toledo; Role: Primary mentor. Tess joined my research group as part of the NIA MSTAR program.

2/17 – 8/17 Jeremy Applebaum; Currently: 2nd year medical student at Johns Hopkins; Role: Primary mentor. Jeremy worked in my research group full-time over the summer gathering follow-up data on long-term social function and loneliness after cochlear implantation in adults

2/17 – 8/17 Matthew Hoyer, Currently: 2nd year medical student at Johns Hopkins; Role: Primary mentor. Matthew worked in my research group full-time over the summer gathering follow-up data on long-term quality of life and depressive symptoms after cochlear implantation in adults. Awards: Johns Hopkins Dept of Otolaryngology Student Research Award

3/17 – 8/17 Michael Harper; Currently: 2nd year medical student at Johns Hopkins; Role: Primary mentor. Michael worked in my research group full-time over the summer conducting a systematic review of hearing loss and social isolation/loneliness.

3/17-6/19 Aishwarya Shukla; Currently: 2nd year medical student at Johns Hopkins; Role: Co-mentor. Aishwarya worked in my research group over the 2017 summer conducting a systematic review of the impact of hearing loss on patient-provider communication. She took year off between 2018-2019 to work with me and pursue an MPH.

5/17-5/18 Christina Downs, Currently: 2nd year Au.D. student at Towson University; Role: Co-mentor. I was a co-mentor to Christina on her Au.D. thesis which will investigate the use of audiologist-fit hearing aids vs. OTC hearing devices on spatial localization.

5/17-5/18 Tiffany Conaster, Currently: 2nd year Au.D. student at Towson University; Role: Co-mentor. I was a co-mentor to Tiffany on her Au.D. thesis which will investigate the use of audiologist-fit hearing aids vs. OTC hearing devices on speech-in-noise in reverberant conditions.

6/17 – 8/17 Luke Zhu; Currently: 4th year biomedical engineering undergraduate at Johns Hopkins; Role: Mentor. Luke worked with my research group during summer 2017 on various projects research projects and will also shadow me in clinic/surgery.

6/17- 8/17 Brenda Oduola; Currently: 1st year Au.D. student at Towson University; Role: Mentor. Brenda worked with my research group during summer 2017 on a QI/QA initiative at Bayview Medical Center to screen for hearing loss in inpatients and to then provide a hearing/communicative intervention.

***Post-Doctoral Advisees/Mentees***

1/12 – 5/13 Bonnielin Swenor, Ph.D.; Currently: Assistant Professor, Johns Hopkins Wilmer Department of Ophthalmology; Role: Secondary mentor. I mentored Bonnie as her T32 epidemiology of aging

| | |
|---|---|
| | mentor during her last year of her graduate studies (Ph.D. in Epidemiology at Johns Hopkins received 5/13); Co-Authored Publications: OR 29*, 74 |
| 7/12 – 6/14 | Dane Genther, M.D., Currently: Facial plastic surgery fellow at Johns Hopkins; Role: Primary mentor. Dane worked with me for 2 years supported by our department's T32-supported research block. His research focused on the association of hearing loss with broader health economic outcomes and physiologic stress. Co-Authored Publications: OR 33*, 35, 40, 44, 48, 49, 50*, 55*, 58*, 59, 74, 75, 87; BC 5* |
| 10/12 – 6/13 | Paul Mick, M.D., Currently: Clinical otologist and clinical Assistant Professor, Department of Surgery, Faculty of Medicine, University of British Columbia, Canada; Role: Primary mentor. Paul is an otolaryngologist from Canada who took a year off to pursue an MPH at Harvard. I served as his primary mentor on an epidemiologic study of hearing loss and social isolation during his MPH year and have continued to mentor him informally since he graduated with his MPH; Co-Authored Publications: OR 37*, 47* |
| 1/13 – 7/13 | David Mener, M.D.; Currently: Private practice otolaryngologist; Role: Primary mentor. I worked with Dave during a dedicated 6 month research block in his 3rd year of his otolaryngology residency. Co-Authored Publications: OR 35*, 61* |
| 7/13-present | Carrie Nieman, M.D. M.P.H.; Currently: Johns Hopkins Otolaryngology-HNS instructor; Assistant Professor effective 7/1/18; Role: Primary mentor. Carrie initially worked with me for 2 years as part of a T32-supported postdoctoral research block. Her research focused on implementing a novel, low cost hearing intervention in underserved, minority neighborhoods in Baltimore. I continue to mentor her on her ongoing research and on academic career development as she prepares to transition from residency. In 2015, we co-founded Access HEARS, a 501(c)3 non-profit organization which is disseminating the hearing intervention that we previously developed during her T32 block and which we are continuing to work on. Our non-profit was recently awarded a $250K grant from the AARP Foundation. Awards: American Academy of Otolaryngology-Head & Neck Surgery CORE grant 2013, Butler-Williams Scholars Program 2014, AARP Foundation Prize for Best Business Plan, 2nd place at the 2014 Johns Hopkins University Business Plan Competition, Johns Hopkins Center for Innovative Care in Aging Pilot Grant 2014, American Auditory Society Mentored Student Award 2014, American Academy of Otolaryngology Resident Leadership Grant 2013 & 2014. Regional semi-finalist Global Social Venture Competition 2015; First place, Maryland Society of Otolaryngology Resident Research Symposium, 2015; Semi-finalist, Global Action Business Plan Competition, 2015; First place, Johns Hopkins Otolaryngology-HNS Resident Research Symposium, 2016; The Triological Society's Southern Section James Harrill MD Resident Research Award, 2016; Her K23 submission on which I am her primary mentor recently received a perfect score (10) on the first submission. Co-Authored Publications: OR 62*, 65, 66, 76, 81, 82*, 83, 84, 90; BC 7 |
| 11/13-present | Jennifer Deal, Ph.D., Currently: Assistant Scientist, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health; Role: Primary mentor. I have mentored Jennifer since 2013 on studies of hearing loss and cognitive/physical functioning. She is now funded by a K01 award with my being her primary mentor. Co-Authored Publications: OR 53*, 63, 67*, 68*, 69, 72, 74, 75, 92* |
| 8/14 – 5/15 | Deema Almutawa, M.B.B.S., Currently: Research Specialist, Department of Otolaryngology, UCSF; Role: Capstone mentor. I served as Deema's capstone mentor while she was doing her MPH at Johns Hopkins. |
| 8/14 – 5/15 | Razan Basonbul, M.B.B.S., Currently: Postdoctoral research fellow, Massachusetts Eye & Ear Infirmary; Role: Capstone mentor. I served as Razan's capstone mentor while she was doing her MPH at Johns Hopkins. |
| 8/14-present | Sara Mamo, Au.D., Ph.D., Currently:Assistant Professor, Department of Communication Disorders, School of Public Health and Health Sciences, University of Massachusetts, Amherst. Role: Primary mentor. Sara joined me as a postdoctoral fellow in 2014 and was promoted to Instructor in 2016. She submitted a K23 award with my being her primary mentor in 2/16. Shortly after submitting her K award, however, she was recruited by U. Mass Amherst and was offered a job opportunity which we could not match at Hopkins. She accepted a tenure-track Assistant Professor position that began 1/17. As a result, she later withdrew her K23 application. This was later submitted at U Mass Amherst and was funded on the first submission, and I continue to be a co-mentor for her on this K23 award. Co-Authored Publications: 65*, 71, 76, 81*, 82, 83, 84*, 89, 90; RA 7; BC 9 |

| | |
|---|---|
| 6/15-present | Nicholas Reed, Au.D. Currently: Instructor. Department of Otolaryngology-HNS, Johns Hopkins School of Medicine. Promotion to Assistant Professor effective 7/1/18. Ph.D. student at Johns Hopkins Bloomberg School of Public Health. Role: Primary mentor. Nick joined me as a postdoctoral fellow in 2015. He was promoted to Instructor in 7/16 and has started a Ph.D. in Clinical Investigation at the Bloomberg School of Public Health where I continue to serve as his primary mentor. Awards: Awarded NIH KL2 award covering 90% of his salary, tuition, and research costs to support his Ph.D. in the GTPCI program. Nick is the first audiologist in the U.S. to ever receive an NIH KL2 award. Current NIA K23 awaredee on which I am his primary mentor. Co-Authored Publications: 65, 86, 88*, 89*, 92 |
| 6/15 – 12/15 | Matthew Huddle, M.D., Currently: Consultant at Boston Consulting Group; Role: Primary mentor. Matt joined my research group during his 6 month research block during his 3rd year of otolaryngology residency. Recently, he has decided to leave clinical medicine to pursue health care consulting. Publication: 74*, 91* |
| 9/15-5/20 | Sara Alcorn, M.D., Currently:Fellow, Department of Radiation Oncology, Johns Hopkins; Ph.D candidate, Graduate Training Program in Clinical Investigation (GTPCI); Role: I was Sara's academic advisor in the GTPCI program |
| 10/15-6/18 | Adele Goman, Ph.D., Currently: Postdoctoral fellow, Department of Otolaryngology-HNS, Johns Hopkins; Role: Primary mentor. Adele completed her Ph.D. in Psychology at the University of York in the United Kingdom and joined me initially as a postdoctoral fellow in 2015 to acquire additional training in epidemiology and clinical trials. She is now an Instructor in SOM and is the project manager for the ACHIEVE trial. Co-Authored Publications: 77*, 86*, 91, 92 |
| 10/15-present | Jon Suen, Au.D. Currently: Postdoctoral fellow, Department of Otolaryngology-HNS, Johns Hopkins; He is presently in Ph.D. program at the Johns Hopkins School of Nursing pursuing research on community-based programs for hearing loss. Jon is the first audiologist to ever pursue a Ph.D. at the JHUSON. Role: Primary mentor. Jon joined my research group after completing his Au.D. at Gallaudet. Before starting his PhD at the School of Nursing in 2018, he worked with me on implementation of the HEARS intervention in the community and is learning principles of community-engaged research and social design with our partners at the Maryland Institute College of Art. |
| 5/16 – 12/17 | Heather Weinreich, M.D., M.P.H., Currently: Assistant Professor, Department of Otolaryngology - HNS Johns Hopkins. Role: Secondary mentor. I have begun to meet regularly with Heather since early 2016 to help guide her early academic career development in otology and epidemiologic research. |
| 5/16-present | Justin Golub, M.D., Currently: Assistant Professor, Department of Otolaryngology-HNS Columbia University; Role: Secondary mentor. I am mentoring Justin and helping him develop an academic plan to study hearing and cognitive/brain functioning. He submitted a K23 award in 2/17 on which I am a co-mentor. |
| 9/16-present | Perry Kuo, M.D., Currently: Postdoctoral fellow, National Institute on Aging; Role: Secondary mentor. Perry is currently a first-year Ph.D. student and his thesis will involve studying the association of hearing loss with physical activity and mobility measured with actigraphy. |
| 9/16-6/19 | Courtenay Holscher, M.D., Currently: Resident, Department of Surgery, Johns Hopkins; Ph.D candidate, Graduate Training Program in Clinical Investigation (GTPCI); Role: I am Courtenay's academic advisor in the GTPCI program |
| 9/16-6/19 | Christine Haugen, M.D., Currently: Resident, Department of Surgery, Johns Hopkins; Ph.D candidate, Graduate Training Program in Clinical Investigation (GTPCI); Role: I am Christine's academic advisor in the GTPCI program |
| 11/16-6/2020 | Nicole Armstrong, Ph.D., Currently: Post-doctoral fellow, National Institute on Aging; Role: Primary Co-mentor. Nicole and I first started working together during her last year of graduate school in epidemiology at Johns Hopkins from 2016-2017. She has been a post-doctoral fellow since 5/17 at the NIA where I co-mentor her with Susan Resnick on studies of how hearing loss is associated with brain structure and function in the Baltimore Longitudinal Study of Aging. |
| 1/17-1/19 | Madeline Sterling, M.D., Currently: T32/AHRQ research fellow at Cornell Medical College; Role: Secondary mentor. Madeline is a general internist doing a research fellowship at Cornell with an interest in studying how hearing loss may affect patient-provider communication in patients with |

heart failure. I am mentoring her on epidemiological studies of how hearing loss affects patients with heart failure.

6/17-5/21 Danielle Powell, Au.D. Currently: Ph.D. candidate, Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health; Role: Secondary mentor. Danielle is the first Au.D. to ever pursue a Ph.D. in epidemiology at the Bloomberg School of Public Health.

**Thesis Committees**

1/13 Kim Kiely, Ph.D. candidate in Developmental Psychology and Aging, Australian National University, Canberra - "Out of sight, out of mind: population estimates and dynamic interplay between age-related decline in hearing and cognitive functioning during late life" - Role: Thesis reviewer

5/16 Nicole Kendig, Au.D. candidate; Towson University - "Objective and subjective comparative analysis of personal sound amplification products and a hearing aid" - Role: Thesis committee member

4/17 Toni Greene-Oliver Au.D. candidate, Towson University - "Objective comparative analysis of self-fit personal sound amplification products using three types of fitting protocols: out-of-the-box self-fit, advanced-user self-fit, and audiologist-fit" - Role: Thesis committee member

5/17 Meredith Frank Au.D. candidate, Towson University; "Developing a community health model for delivering audiology services" - Role: Thesis committee member

1/19 Courtenay Holscher, Ph.D candidate in Clinical Investigation, Johns Hopkins Bloomberg School of Public Health, "Understanding Post-Donation Kidney Function in Living Kidney Donors" - Role: Thesis committee member

3/19 Christine Haugen, Ph.D. candidate in Clinical Investigation, Johns Hopkins Bloomberg School of Public Health, "Liver Transplantation and Older Adults" - Role: Thesis committee member

5/19 Sara Alcorn, Ph.D candidate in Clinical Investigation, Johns Hopkins Bloomberg School of Public Health, "Improving Providers' Survival Estimates and Selection of Prognosis- and Guidelines-Appropriate Radiotherapy Regimens for Patients with Symptomatic Bone Metastases: Development and Evaluation of the BMETS Model and Decision Support Platform" - Role: Thesis committee member

5/20 Pauline Croll, Ph.D candidate in epidemiology, Erasmus Medical College, Rotterdam, Netherlands "Hearing Function and Brain Health in the Elderly: Interrelations and risk factors" – Role: Thesis committee member

11/20 Nattawan Utoomprurkporn, Ph.D.candidate in Auditory Science , University College London, "Validation of a cognitive screening tool for hearing impaired older adults" – Role: Thesis committee member

4/21 Pablo Amezcua, Ph.D. candidate in epidemiology, Johns Hopkins Bloomberg School of Public Health, "The Association of Hearing Impairment with Physical Activity and Function in Older Age" – Role: Thesis committee member

5/21 Danielle Powell, Ph.D. candidate in epidemiology, Johns Hopkins Bloomberg School of Public Health, "Hearing Loss and Late-Life Mental Health" – Role: Thesis committee member

**Educational Program Building/Leadership**

**Educational Demonstration Activities to External Audience**

**RESEARCH ACTIVITIES**

**Research Focus**

The foundational epidemiologic studies that I led from 2010-2014 investigating the impact of hearing loss on older adults has pioneered our current worldwide public health understanding of hearing loss in adults. These results have led to the funding of a >$20M randomized trial that I lead which will determine if treating hearing loss in older adults can reduce the risk of cognitive decline and dementia. My research also served as the primary basis for the 2017 and 2020 Lancet Commission reports on dementia which concluded that hearing loss (a heretofore unrecognized risk factor for dementia) was the single largest modifiable risk factor for dementia which carried the greatest

attributable risk for dementia compared to all other known risk factors (e.g., cardiovascular risk factors, low education, etc.)

In parallel, I have assumed national leadership roles for initiatives focused on hearing loss, aging, and public health. I co-chaired a National Academies of Science, Engineering, and Medicine (NASEM) workshop on hearing loss in 2014, and subsequently, from 2015-16, I served on an expert NASEM committee that developed consensus recommendations on hearing loss, and I also directly advised the White House on their parallel initiative to broaden access to hearing care. These efforts directly led to current national initiatives on hearing loss from Congress (Over-the-Counter Hearing Aid Act of 2017), the Food and Drug Administration, and the Federal Trade Commission. I have been called on to meet with legislators, legislative staff, and/or ministry/department of health officials in the United States, France, Japan, and New Zealand.

My broader academic research and advocacy efforts directly led to federal passage of the Over-the-Counter Hearing Aid Act of 2017 which was passed as part of the broader FDA Reauthorization bill. This law will result in a sea change in how hearing aids can be made available to consumers/patients. This law directly overturns 40 years of established regulatory precedent and will vastly affect manufacturing, distribution channels, insurance coverage, etc, and will carry worldwide ramifications since the U.S. will be the first country in the world to allow for regulated OTC sales of hearing aids. This federal law reflects the result of my prior research and work with the White House, National Academies, and with Senator Warren's office (including my testimony before Congress).

**Research Program Building/Leadership**

2011-present Research group leader, Johns Hopkins Center on Aging and Health (COAH)
Role: I oversee the leading research group in the world studying questions at the interface of hearing loss, gerontology, and public health. My research group (www.linresearch.org) is based at COAH where I am responsible for mentoring, advising, overseeing, and funding 10-15 predoctoral/postdoctoral trainees, junior faculty, and research staff.

2018-present Director, Cochlear Center for Hearing and Public Health, Johns Hopkins Bloomberg School of Public Health - The Cochlear Center is the first center of its kind at any school of public health that is focused on addressing the impact of hearing loss on public health. This Center reflects the direct outgrowth of my academic trajectory from 2010-2017 where I was able to establish the impact of hearing loss on older adults through epidemiologic studies, launch a definitive randomized trial to develop evidence for the impact of hearing loss treatment, and catalyze federal legislative change in the U.S. The funding for this Center ($10M gift from Cochlear Ltd as well as >$20M in existing funded NIH grants to Center faculty focused on hearing and Center mission areas) will provide me the opportunity to project the progress that I've been able to make from 2010-2017 in the U.S. on a broader international scale.

The development of this Center evolved over a year of discussions between me, University leadership, and Cochlear Limited, an Australian company that exclusively develops cochlear implants and other implantable hearing technologies. The executive leadership at Cochlear has long been interested in my research because of the foundational case it makes for why hearing is important to public health (despite the fact that my research is not directly focused on cochlear implants or other technologies that Cochlear manufactures). Cochlear and the Center share the belief that hearing and effective communication are fundamental to human health and functioning but that hearing loss (particularly among older adults) remains poorly addressed in society and not yet a priority in the spheres of public health and public policy. Cochlear's $10M gift to the Johns Hopkins Bloomberg School of Public Health to create this Center reflects this shared vision. This funding provides support for the core Center infrastructure and for Center faculty and student recruitment and support as a fraction of the overall funding that supports the mission areas of this Center, the vast majority of which (>$20M) comes from NIH funding.

**Research Demonstration Activities**

**Inventions, Patents, Copyrights**

**Technology Transfer Activities**

2017-present Licensing of intellectual property for the HEARS intervention and curriculum that is currently being tested in NIH R33DC015062 (PI: Lin). In 2015, I co-founded a nonprofit organization, Access

HEARS (www.accesshears.com), that is licensing the HEARS intervention from Johns Hopkins to allow for commercialization and dissemination of this intervention.

## SYSTEM INNOVATION AND QUALITY IMPROVEMENT ACTIVITIES

**System Innovation and Quality Improvement Efforts within JHMI**

4/12 - 12/12 Initiated/implemented project to install hearing induction loops throughout the OHNS clinic in JHOC 6 to improve accessibility for patients with hearing loss per the American with Disabilities Act.

11/16-6/19 Co-leading a project with my trainee, Nick Reed, and Peter Pronovost to implement hearing screening and provision of a hearing intervention to older adult inpatients at the Johns Hopkins Hospital and Bayview Medical Center

**System Innovation and Quality Improvement Efforts outside of JHMI**

**System Innovation and Quality Improvement Program Building/Leadership**

## ORGANIZATIONAL ACTIVITIES

**Institutional/Administrative Appointments**

2012 – 2013 Subject matter expert for Neurotology, EPIC Specialty Validation

2016 – 2019 Member, Curriculum and Academic Standards Committee, Graduate Training Program in Clinical Investigation

2016 – 2019 Member (representing Graduate Training Program in Clinical Investigation), Schoolwide Committee on Academic Standards, Johns Hopkins Bloomberg School of Public Health

2020- 2021 Member, Task Force on Diversity, Equity and Inclusion in Research at Johns Hopkins

**Editorial Activities**

***Editorial Board Appointments***

2014-2020 Member of Editorial Board, Journal of Gerontology: Medical Sciences

2021-present Associate Editor, Journal of Gerontology: Medical Sciences

***Journal Peer Review Activities***

2006–present Archives of Otolaryngology-Head & Neck Surgery
Otology & Neurotology
International Journal of Pediatric Otorhinolaryngology

2007-present Ear and Hearing

2011-present Journal of Clinical Epidemiology
American Journal of Audiology
The Laryngoscope
Journal of the American Medical Association
Journal of Gerontology: Medical Sciences
Canadian Medical Association Journal
Journal of Speech, Language, and Hearing Research

2012-present American Journal of Public Health
Hearing Research

2014-present New England Journal of Medicine
Neurology
Journal of the American Geriatrics Society
Journal of Geriatric Psychology and Neurology

2015-present American Journal of Preventive Medicine
Nature Reviews Neurology

***Other Peer Review Activities***

***Advisory Committees, Review Groups/Study Section***

6/11 Ad hoc study section member, NIDCD/NIH Special Emphasis Panel on Translational Research

11/12 Ad hoc study section member, NIDCD/NIH Special Emphasis Panel

| | |
|---|---|
| 5/13 | Ad hoc study section member, NIDCD/NIH Special Emphasis Panel |
| 9/13-2/14 | Co-Chair and planning committee member, Workshop on Hearing Loss and Healthy Aging, Institute of Medicine of the National Academies |
| 1/14 | Ad hoc study section member, NIDCD/NIH Special Emphasis Panel |
| 10/14 | Ad hoc study section member, NIDCD/NIH Special Emphasis Panel |
| 11/14 | Ad hoc study section member, NIH Academic Research Enhancement: Healthcare Delivery and Methodologies Study Section |
| 4/15- 6/16 | Committee member, Committee on Accessible and Affordable Hearing Health Care, Health and Medicine Division, National Academies of Sciences, Engineering, and Medicine |
| 2/16 | Ad hoc study section member, NIA GEMSTAR Special Emphasis Panel |
| 3/16-3/17 | Member, Committee on the Use of Selected Assistive Products and Technologies in Eliminating or Reducing the Effect of Impairments, Health and Medicine Division, National Academies of Sciences, Engineering, and Medicine |
| 6/16 | Ad hoc study section member, NIDCD/NIH U01 Clinical Trial Special Emphasis Panel |
| 7/18-present | Member, Board on Health Sciences Policy, Health and Medicine Division, National Academies of Sciences, Engineering, and Medicine, Washington, DC |
| 3/2020 | Ad hoc study section member, NIDCD/NIH Special Emphasis Panel |
| 5/2020 | Ad hoc study section member, NIDCD/NIH Special Emphasis Panel |
| 6/2020 | Ad hoc study section member, NIDCD/NIH Special Emphasis Panel |
| 6/20-3/21 | Member, Committee on Evaluating Hearing Loss for Individuals with Cochlear Implants, Health and Medicine Division, National Academies of Sciences, Engineering, and Medicine |
| 3/21-6/21 | Member, Invited Workgroup Member, National Alzheimer's Project Act Subcommittee on Risk Reduction |
| 3/21 | Ad hoc study section member, NIA GEMSTAR Special Emphasis Panel |
| 10/21-present | Member, Forum on Aging, Disability, and Independence, National Academies of Sciences, Engineering, and Medicine, Washington, DC |
| 3/22 | Ad hoc study section member, NIA GEMSTAR Special Emphasis Panel |
| 7/22 | Ad hoc study section member, NIH |

**Professional Societies**

| | | |
|---|---|---|
| 2004-present | American Academy of Otolaryngology—Head & Neck Surgery | |
| | 2004-present | Member |
| | 10/09-1/12 | Member, Subcommittee on Implantable Hearing Devices, |
| | 9/12-8/15 | Member, Hearing Committee |
| | 9/12-present | Member, Geriatric Otolaryngology Committee |
| 2010-present | Gerontological Society of America | |
| | 2010-present | Member |
| | 10/10-11/11 | Member, Health Sciences Planning Committee |
| 2010-present | Association for Research in Otolaryngology | |
| | 2010-present | Member |
| | 3/11-3/14 | Member, Diversity and Minority Affairs Committee |
| 2010-present | Member, American Auditory Society | |
| 2015-present | Member, Alzheimer's Association | |

**Conference Organizer**

***JHMI/Regional***

***National***

| | |
|---|---|
| 10/17 | Co-Chair of planning committee and conference; Workshop on Sensory Impairment and Cognitive Decline, National Institute of Aging/American Geriatrics Soc U13-sponsored meeting; Bethesda, MD |

***International***

| | |
|---|---|
| 7/2019 | Director, 1st Annual Johns Hopkins East Asian Fellow Program in Aging, Hearing, and Public Health, Johns Hopkins Bloomberg School of Public Health |
| 8/2022 | Co-director, Chulalongkorn University-Johns Hopkins Cochlear Center Joint Asia Fellows Program in Aging, Hearing, and Public Health, Bangkok, Thailand |

**Session Chair**
***JHMI/Regional***

***National***

| | |
|---|---|
| 8/11-5/12 | Steering Committee Member and Session Moderator, 12th International Conference on Cochlear Implants, Baltimore, MD |
| 11/11 | Symposium Chair, Symposium on "Age-Related Hearing Loss: Epidemiology, Impact, and Treatment"- Gerontological Society of America Conference, Boston, MA |
| 10/13 | Session Co-Chair, American Cochlear Implant Alliance Annual Meeting CI 2013, Washington, D. |
| 11/13 | Symposium Co-Chair, Symposium on "Aging of the hearing and vestibular system – significance to older adults and what to do"- Gerontological Society of America Conference, New Orleans LA |
| 11/13 | Symposium Co-Chair, Symposium on "Functional consequences of age-related hearing loss for older adults" - Gerontological Society of America Conference, New Orleans, LA |
| 1/14 | Workshop Co-Chair, Workshop on Hearing Loss and Healthy Aging - Institute of Medicine/ National Academy of Sciences, Washington, DC - www.iom.edu/hearingloss-aging |
| 11/14 | Symposium Chair, Symposium on "Hearing impairment, cognition, and brain function – insights from epidemiologic and clinical studies" - Gerontological Society of America Conference, Washington, DC |
| 11/14 | Symposium Chair, Symposium on "Innovative and disruptive approaches toward hearing health care delivery in the community" - Gerontological Society of America Conf, Washington, DC |
| 11/14 | Symposium Chair, Symposium on "Implications of hearing impairment for physical and mental functioning in older adults" - Gerontological Society of America Conference, Washington, DC |
| 3/15 | Symposium Chair, Symposium on "Hearing Loss in Older Adults: Public Health Implications & Management" - American Academy of Audiology, San Antonio, TX |
| 5/16 | Symposium chair and moderator, Scientific symposium on "Novel Approaches toward Addressing Hearing Loss – Ideas on the Cutting Edge" - International Federation of the Hard of Hearing/Hearing Loss Association of America Annual Convention, Washington DC |
| 11/16 | Symposium Chair, Symposium on "Addressing hearing loss in older adults to improve cognitive, social, and physical functioning" - Gerontological Society of America, New Orleans, LA |
| 7/17 | Symposium Co-Chair, Symposium on "Hearing loss initiatives from the National Academies and the White House – recommendations and progress" - International Association for Geriatrics and Gerontology, San Francisco, CA |
| 11/17 | Chair, Clinical Roundtable on "Hearing loss, brain function, and healthy aging" - Society for Neuroscience, Washington, DC |

***International***

| | |
|---|---|
| 6/14 | Conference Chair, Hearing and Cognition Symposium; Amplifon Centre for Research & Studies, Krakow, Poland |

**Consultantships**

| | |
|---|---|
| 4/11–12/11 | Pfizer Inc. Role: Consultant for clinical trial planning and design |
| 7/12–6/15 | Cochlear Americas; Role: Consultant for clinical trial and research study planning for topics related to hearing loss in older adults |
| 7/12–7/16 | Autifony Inc, Role: Scientific Advisory Board member and consultant for clinical trial planning, DSMB since 2015 |
| 6/13–5/16 | Pfizer Inc. Role: Scientific Advisory Board for Pfizer's Neuroscience Research Unit portfolio programs and clinical studies in support of the hearing loss platform. |
| 5/17-4/19 | Boerhinger-Ingelheim; Role: Consultant for epidemiology of hearing loss and pharmacologic approaches toward hearing loss |
| 6/19-2/23 | Frequency Therapeutics; Role: Consultant for epidemiology of hearing loss and pharmacologic approaches toward hearing loss treatment |
| 10/22-present | Apple Inc; Role: Consultant for topics related to hearing loss and hearing technologies |

**Board Membership**

| | |
|---|---|
| 4/14-present | Hearing Loss Association of America |

| | |
|---|---|
| 4/14 – 3/15 | Member, Board of Trustees |
| 1/17 – 3/18 | Member, Board of Trustees |
| 3/18 – present | Professional Advisory Board |
| 1/16-present | Co-founder and member of Board of Trustees, AccessHEARS |
| 3/16-3/23 | Member, Scientific Advisory Board, Fondation Pour L'Audition, Paris, France |
| 4/23-present | Member, Scientific Advisory Board, Sharper Sense |

**RECOGNITION**

**Honors/Awards**

| | |
|---|---|
| 1997 | Junior Prize in Biochemistry, Brown University |
| 1998 | Leallyn B. Clapp Prize for best senior thesis, Brown University |
| 1998 | William Gaston Premium Scholarship to the best biochemistry concentrator, Brown University |
| 1998 | *Magna Cum Laude* with Honors, Brown University |
| 1999 - 2003 | Maryland State Senatorial Scholarship |
| 2003 | Travel award, Association for Research in Otolaryngology |
| 2005 | Maryland State Senatorial Scholarship |
| 2008 | AAO-HNS Resident Leadership Grant |
| 2009 | AAO-HNS Resident Leadership Grant |
| 2009 | Trainee Scholarship, Symposium on Cochlear Implants in Children |
| 2010 | Awarded Tilghman Traveling Fellowship for support of surgical sabbatical and training with the Fisch International Microsurgery Foundation. |
| 2011 | First place, Johns Hopkins 4th Annual Research on Aging Showcase |
| 2012 | Eleanor Roosevelt Humanitarian Award for Pioneering Research in Hearing and Aging, Center for Hearing and Communication, New York |
| 2013 | Awarded honorary membership in the British Cochlear Implant Group (BCIG) |
| 2013 | Jack Abramson Memorial Lecturer; North Shore Long Island Jewish Medical Center |
| 2014 | Awarded the Dr. James B. Snow, Jr. Award for furthering scientific research in the field of hearing loss, Hearing Loss Association of America |
| 2014 | Herbert S. Birkett Memorial Lecturer, McGill University |
| 2015, 2017 | Recognition for Excellence in Teaching for Epidemiology of Sensory Loss in Aging, Johns Hopkins Bloomberg School of Public Health |
| 2016 | Matthew-Rubins Endowed Lectureship, University of Pittsburgh |
| 2017 | Guest of Honor, American Society for Geriatric Otolaryngology Annual Meeting |

**Invited Talks**

***JHMI/Regional***

| | |
|---|---|
| 10/10 | Invited Speaker, "Hearing Loss and Aging" - Hearing Loss Association of Baltimore Meeting; Hearing and Speech Agency, Baltimore, MD |
| 4/11 | Invited Speaker, "Hearing Loss and Aging" - Baltimore Longitudinal Study of Aging Conference; National Institute on Aging |
| 12/11 | Invited Speaker, "Hearing loss and dementia" - Baltimore Taiwanese Medical Association Annual Meeting |
| 2/12 | "Hearing loss and aging"- Johns Hopkins Bloomberg School of Public Health Epidemiology Seminar Series, Baltimore |
| 10/12 | Invited Speaker, "Hearing loss and healthy aging" - Hearing and Speech Agency, Baltimore |
| 1/13 | "Hearing loss and healthy aging"- Welch Center for Prevention, Epidemiology, and Clinical Research, Johns Hopkins, Baltimore |
| 5/13 | Invited Speaker, "Hearing loss and cognitive functioning in older adults" - Waxter Wisdom Workshop on Memory Loss, Baltimore |
| 5/13 | Invited Speaker, "Hearing loss and healthy aging" - Baltimore County Department of Aging Senior Solutions Conference, Baltimore |
| 1/14 | Grand Rounds Speaker, "Hearing loss in older adults – a public health perspective" - Division of Geriatrics and Gerontology, Johns Hopkins Department of Medicine, Baltimore, MD |
| 2/14 | Invited Seminar Speaker, "Hearing and dementia – insights from epidemiologic studies: Johns Hopkins Memory and Alzheimer's Treatment Center, Baltimore, MD |

| | |
|---|---|
| 2/16 | Invited Speaker, "Hearing Loss in Older Adults- a public health perspective" - 5th Annual Towson University Medical Audiology Symposium, Towson, MD |
| 3/17 | Invited Speaker, "Hearing, cognition, and brain aging" - Alzheimer's Disease Research Center; Johns Hopkins University, Baltimore, MD |
| 3/17 | Invited Speaker, "Hearing, cognition, and brain aging"- Alzheimer's Association Regional Meeting, Hunt Valley, MD |
| 5/17 | Invited Speaker "Hearing loss in older adults: translating epidemiologic findings to national policy" Johns Hopkins Center on Aging and Health Scientific Seminar Series; Baltimore, MD |
| 10/17 | Seminar Speaker, "Hearing loss in older adults: from epidemiologic insights to clinical trials & public policy" - Johns Hopkins Wilmer Dana Center for Preventative Ophthalmology, Baltimore, MD |
| 9/18 | Seminar Speaker, "Hearing loss in the third era of public health" – Johns Hopkins Cochlear Center for Hearing and Public Health, Baltimore MD |
| 11/18 | Invited Speaker, "Hearing loss in the third era of public health – where we're headed with the Cochlear Center" – Maryland Commission on Aging, Laurel, MD |
| 3/21 | Seminar Speaker, "Hearing, aging, and public health – from epidemiology to public policy in the U.S." – University Maryland at Baltimore Gerontology Program (Virtual presentation) |
| 5/21 | Seminar Speaker, "Hearing loss in older adults", Johns Hopkins Division of Geriatrics |

***National***

| | |
|---|---|
| 8/10 | Invited speaker and panel member, "Hearing loss and incident dementia," Workshop on Sensory and Motor Dysfunction in Aging and Alzheimer's Disease, Sponsor: National Institute on Aging |
| 5/11 | Invited Speaker, "Bilateral Cochlear Implantation" - Alexander Graham Bell Society Meeting, Washington, D.C. |
| 9/11 | Invited speaker and panel member, "Hearing loss and cognition" -Prevention of Blindness Society Convened Expert Panel on "How Aging Sight and Hearing Loss Impact Cognition," Washington DC |
| 3/12 | Panel Seminar Speaker, "Issues in Cognition, Audition, and Amplification: A Panel Discussion" - American Academy of Audiology Annual Meeting, Boston, MA |
| 5/12 | Panel Seminar Speaker, "Hearing Impairment: Strategies to Promote Increased Safety and Quality of Care"- American Geriatrics Society Annual Meeting, Seattle, WA |
| 6/12 | Invited Speaker, "Hearing loss and healthy aging" - Hearing Loss Association of America Annual Convention, Providence, RI |
| 6/12 | Invited Speaker, "Hearing loss and healthy aging" - National Institute on Aging Summer Retreat, Bethesda, MD |
| 8/12 | Keynote Speaker, "Hearing loss and healthy aging"- International Hearing Aid Conference (IHCON), Tahoe, CA |
| 9/12 | Panel Seminar Speaker, "Comprehensive Management of Presbycusis: Central and Peripheral"- American Academy of Otolaryngology-HNS Annual Meeting, Washington, D.C. |
| 6/13 | Invited Speaker, Cochlear Limited Annual Board of Directors Meeting, "Hearing loss and healthy aging" – Denver CO |
| 9/13 | Invited Speaker, "Hearing loss and cognitive decline" - New York University Brain Plasticity and Cochlear Implant Workshop, New York, NY |
| 10/13 | Invited Speaker, "Hearing loss, cognitive decline, and brain aging: a public health perspective" - Indiana University Aging and Speech Communication Conference, Bloomington, IN |
| 12/13 | Invited seminar speaker, "Hearing loss in older adults – a public health perspective" - Administration on Community Living, U.S. Department of Health and Human Services; Washington, D.C. |
| 1/14 | Invited Speaker, "Hearing loss, dementia, and public health"- Med El Meeting on Hearing Implants for Older Adults, New York City, NY |
| 3/14 | Invited keynote speaker, "Hearing loss in older adults - a public health perspective"- Joint Defense Veteran Audiology Conference; Las Vegas, NV |
| 5/14 | Invited keynote speaker, "Hearing loss in older adults - a public health perspective"- Friends of the Congressional Hearing Health Caucus Luncheon, United States House of Representatives; Washington, D.C. |
| 7/14 | Invited seminar speaker, "Hearing loss in older adults – a public health perspective"- National Center for Rehabilitative Auditory Research, Veterans Administration, Portland, Oregon |

| | |
|---|---|
| 11/14 | Keynote speaker, "Hearing Loss and Aging: Consequences, Implications, and Creating Better Outcomes through Alternative Models of Care" - Academy of Doctors of Audiology Annual Convention, Las Vegas, NV |
| 9/15 | Invited Speaker, "Hearing Loss in Older Adults- a public health perspective"- California Academy of Audiology, San Jose, CA |
| 9/15 | Invited Speaker, "Hearing Loss in Older Adults- a public health perspective" - National Center for Rehabilitative Auditory Research, Veterans Administration, Portland, Oregon |
| 9/15 | Invited Speaker, "Hearing Loss in Older Adults- a public health perspective"- North Carolina Speech, Hearing and Language Association, Inc, Wilmington, NC |
| 10/15 | Invited Speaker, "Hearing Loss in Older Adults- a public health perspective"- Massachusetts Academy of Audiology, Natick, MA |
| 10/15 | Invited Speaker, "Hearing and Dementia—a public health perspective" - Hearing and Communication Neuroscience Symposium, University of Southern California, Los Angeles, CA |
| 11/15 | Invited Speaker, "Hearing Loss and Healthy Aging –a public health perspective"- American Speech-Language Hearing Association Research Symposium - Denver, CO |
| 1/16 | Invited Symposium Speaker for AAAS Symposium on "At a Loss for Words, or Losing My Mind? New Views on Language Problems in Aging" - "Hearing Loss and Dementia – Who's Listening" - American Association for the Advancement of Science, Washington, D.C. |
| 5/16 | Invited Special Speaker, "Hearing Loss in Older Adults- a public health perspective"- American Otological Society, Chicago, IL |
| 5/16 | Invited Symposium Speaker, "Hearing & Vision Services for Older Adults – Barriers and Potential Solutions" - American Geriatrics Society, Long Beach, CA |
| 2/17 | Invited Speaker for John K. Niparko Tribute Session - "Hearing loss in older adults – a public health perspective" - Association for Research in Otolaryngology Annual Meeting, Baltimore, MD |
| 3/17 | Invited Speaker, "Overview of hearing loss in adults – what we know and what needs to be done"- Stanford Center on Longevity, Stanford, CA |
| 3/17 | Invited speaker/panelist, Panel on "The Costs and Benefits of Hearing Health Care Regulations" - Federal Trade Commission Workshop on Now Hear This: Competition, Innovation, and Consumer Protection Issues in Hearing Health Care, Washington, D.C. |
| 5/17 | Invited Oral Congressional Testimony before the Health Subcommittee of the Energy and Commerce Committee of the House of Representatives, "Examining Improvements to the Regulation of Medical Technologies" - Washington, D.C. |
| 7/17 | Invited Speaker/Panelist, "Hearing Loss and Cognitive Decline – Observational Results and Embedding of a Randomized Trail in ARIC" - International Association for Geriatrics and Gerontology, San Francisco, CA |
| 9/17 | Miniseminar Speaker, "Hearing Loss & Cognition in Older Adults – From Epidemiology to the ACHIEVE Randomized Trial" - American Academy of Otolaryngology-Head & Neck Surgery, Chicago, IL |
| 11/17 | Invited Speaker and Clinical Roundtable Chair, "Hearing Loss, Cognition, and Dementia"- Society for Neuroscience, Washington, DC |
| 12/17 | Invited Speaker, "Hearing Loss & Cognition in Older Adults – From Epidemiologic Insights to Public Health Action" – Aging and Speech Communication Conference, Tampa FL |
| 9/18 | Miniseminar speaker, "Hearing Loss in Older Adults – From Epidemiology to Clinical Trials & Public Policy in the U.S.", - American Academy of Otolaryngology-Head & Neck Surgery, Atlanta, GA |
| 2/19 | Seminar Speaker, "Hearing Loss, Cognition, & Dementia - From Epidemiologic Insights to Clinical Trials" – Association for Research in Otolaryngology, Baltimore, MD |
| 3/19 | Seminar discussant, "Age-Related Hearing Loss as a Risk Factor for Late Life Depression & Cognitive Decline" – American Association of Geriatric Psychiatry, Atlanta, GA |
| 3/19 | Seminar Speaker, "Hearing Loss in the Third Era of Public Health: From Epidemiology to Public Policy" – American Academy of Audiology, Columbus, OH |
| 6/19 | Invited Speaker, "Hearing, Aging & Public Health: From Epidemiology to Public Policy" – NIDCD/NIH, Bethesda, MD |
| 10/19 | Invited Speaker, "Hearing, Aging, & Public Health: From Epidemiology to Public Policy" – Knowles Hearing Center Symposium on Hearing and Cognition, Northwestern University, Evanston, IL |

| | |
|---|---|
| 11/19 | Invited Speaker, "Over-the-Counter Hearing Aid Act – From Research to Public Policy in the U.S." – American Speech, Language, and Hearing Association Annual Meeting, Orlando, FL |
| 6/20 | Invited Grand Rounds Speaker, "Hearing, Aging, & Public Health: From Epidemiology to Public Policy" - House Ear Clinic, Los Angeles, CA (Grand Rounds held virtually because of the COVID-19 pandemic) |
| 9/20 | Invited Speaker, "Hearing Loss and Dementia" – NIDCD Advisory Council, Bethesda, MD (meeting held virtually because of the COVID-19 pandemic) |
| 11/20 | Seminar Speaker, "Hearing Loss in Older Adults: Implications for Cognitive Load and Brain Structure/Function" - Gerontological Society of America Annual Conference (conference held virtually because of the COVID-19 pandemic) |
| 4/21 | Invited Speaker, "Sensorineural hearing loss" – Externally-Led Patient-Focused Drug Development Meeting hosted by the Hearing Loss Association of America in collaboration with the Food and Drug Administration (Virtual) |
| 9/21 | Invited Franklin M. Rizer Memorial Lecturer, "Hearing loss and dementia – from epidemiological insights to the ACHIEVE trial" – American Neurotology Society (Virtual) |
| 11/21 | Invited Speaker, "Hearing Loss, Cognition, & Dementia From Epidemiologic Insights to the ACHIEVE Trial" – Florida Combined Otolaryngology Meeting, Naples, Florida |
| 1/22 | Invited Speaker, "Medicare Hearing Care Policy" – Center for Medicare Advocacy National Webinar |
| 5/22 | Invited Speaker, "Hearing Loss and Medicare" – 2022 National Voice of Medicare Summit (Virtual Conference) |
| 9/22 | Invited Speaker, "Converting Need into Demand – the Hearing Number Initiative" – Consumer Technology Association Health Standards Meeting, San Diego |
| 11/22 | Invited Speaker, "Update on Over-the-Counter Hearing Aids in the U.S." – Gerontological Society of America Corporate Leaders Meeting, Indianapolis |
| 1/23 | Invited Panelist, Panel on "The New World of Over-the-Counter Hearing Aids" – Consumer Electronics Show, Las Vegas |
| 3/23 | Invited Speaker, "Hearing, Aging & Public Health" – Joint Defense Veterans Audiology Conference, Las Vegas |
| 4/23 | Invited Speaker, "Hearing Loss & Dementia" – Association for Chemoreception Sciences Annual Conference, Bonita Springs (Virtual presentation) |
| 4/23 | Invited Speaker, "Hearing Loss & Dementia" – Indiana University Clinical and Translational Sciences Institute Annual Meeting |

***International***

| | |
|---|---|
| 6/10 | Invited Speaker, "Classification of inner ear malformations"- Cochlear Implantation Forum on Inner Ear Malformations, Lucerne, Switzerland |
| 10/11 | Keynote speaker, "Hearing loss and dementia" - Cochlear symposium at Politizer Society Meeting, Athens, Greece |
| 3/12 | Invited International Speaker and Moderator, "Implications of hearing loss for older adults" - Ge Cochlear Science and Research Seminar: Symposium on aging and implantable hearing devices, Paris, France |
| 8/12 | Keynote speaker, "Hearing loss and healthy aging"- Oticon Outlook International Conference, Copenhagen, Denmark |
| 2/13 | Invited International Speaker, "Hearing loss and healthy aging" - Elite Hearing Network Annual Meeting, Punta Cana, DR |
| 3/13 | Invited International Speaker and Panelist, "Hearing loss and healthy aging" - Israeli Academy of Otolaryngology-Head & Neck Surgery, Eilat Israel |
| 3/13 | Invited International Speaker, "Hearing loss and dementia"- British Cochlear Implant Group Annual Meetings, Ayrshire, Scotland |
| 5/13 | Invited International Speaker, "Hearing loss and healthy aging" - Swedish Association of Otorhinolaryngology-Head and Neck Surgery, Lund, Sweden |

| | |
|---|---|
| 8/13 | Invited International Speaker, "Hearing loss in older adults: a public health perspective"- Amplifon Hearing Seminar, Auckland, New Zealand |
| 10/13 | Opening Keynote Speaker, "Hearing loss and healthy aging: a public health perspective"- Canadian Academy of Audiology, St. Johns, Newfoundland, Canada |
| 11/13 | Invited International Keynote Speaker - "Hearing loss and cognition: insights from epidemiologic studies"- Société Française de Réflexion Sensori-Cognitive, Paris, France |
| 2/14 | Invited International Speaker, "Hearing loss in older adults – a public health perspective"- Ida Institute, Copenhagen, Denmark |
| 4/14 | Invited keynote speaker, "Hearing loss in older adults - a public health perspective" - Giovanni Lorenzini Foundation International Workshop on "Hearing Loss and Cognitive Decline – Is there a Link?"- Bologna, Italy |
| 4/14 | Invited speaker, "Hearing loss in older adults - a public health perspective" - Cochlear Science and Research Seminar: Cochlear Implantation in the Elderly – Overview, Practice, and Discussion, Paris, France |
| 5/14 | Invited international speaker, "Hearing loss, cognitive decline, and brain aging" - Symposium on "Hearing and the Brain: Translating research into practice" - Macquarie University, Sydney, Australia |
| 6/14 | Conference chair and keynote speaker, "Hearing loss and dementia – insight from epidemiologic studies"- Amplifon Centre for Research and Studies Hearing and Cognition Symposium, Krakow, Poland |
| 9/14 | Invited Panel Moderator, Special Panel on Implantation in the Elderly, 8th International Symposium on Objective Measures in Auditory Implants - Toronto, Canada |
| 9/14 | Invited speaker, "Hearing loss in older adults – a public health perspective"- World Health Summit, Berlin, Germany |
| 6/15 | Invited Speaker, "Hearing loss in older adults – a public health perspective"- Johns Hopkins Saudi Aramco Community Outreach Lecture, Dammam, Saudi Arabia |
| 6/15 | Invited Presidential Lecture Keynote Speaker, "Hearing loss, cognition, and dementia – a public health perspective"- Swiss Society of Oto-Rhino-Laryngology-Head and Neck Surgery Annual Meeting, Lugano, Switzerland |
| 1/16 | Invited Speaker, "Hearing Loss in Older Adults- a public health perspective"- Elite Hearing Network Annual Conference, Cancun, Mexico |
| 4/16 | Invited International Speaker, "The ACHIEVE (Aging, Cognition, and Hearing Evaluation in Elders") Trial; Cochlear Symposium on Aging and Implantable Hearing Solutions, Madrid, Spain |
| 5/16 | Invited Keynote Plenary Speaker,"Understanding the Association of Hearing Loss & Dementia" - Audiology Australia, Sydney, Australia. *Note: Prior to my scheduled talk, I had to cancel this trip for family reasons that prevented me from a making an extended overseas trip in 5/16. As a result, I delivered my address via a prerecorded presentation that was shown at the conference.* |
| 9/16 | Invited International Keynote Speaker, "Hearing loss and healthy aging – a public health perspective" "Public Health Approaches to Addressing Hearing Loss in Older Adults – Early Results & Future Directions, Tel Aviv University, Tel Aviv, Israel |
| 10/16 | Invited International Speaker, "Hearing, Cognition, & Brain Aging" - Cochlear Global Research Symposium, Sydney, Australia |
| 1/17 | Invited International Keynote Speaker, "Hearing loss, cognition, and brain aging"- International Symposium on Dementia/Depression, Convened by Diet Member Keizo Takemi; Tokyo, Japan |
| 6/17 | Invited International Keynote Speaker, "Hearing loss, cognition, and dementia – insights from epidemiologic studies"- International Federation of Otolaryngology Societies Congress, Paris, France |
| 9/17 | Invited Seminar Speaker, "Hearing loss in older adults – from epidemiologic insights to clinical trials & public policy" - Macquarie University Hearing Hub, Sydney, Australia |
| 9/17 | Invited International Keynote Speaker, "Age-Related Hearing Loss, Cognition, Dementia, & Brain Aging: Insights from Epidemiologic Studies" - University of Chile International Workshop on "From Presbycusis to Dementia: A Basic and Clinical Approach" -Valparaiso, Chile |
| 12/17 | Invited International Speaker, "Hearing loss, aging, and public health" - Cochlear Think Tank, London, UK |
| 3/18 | Invited Keynote Speaker, "Hearing loss, aging, and public health" – Amplifon Ageing and Hearing Loss: State of the Art and New Steps, Milan, Italy |

| | |
|---|---|
| 5/18 | Invited Keynote Speaker, "Hearing loss in older adults – a public health perspective" – East Asian Society of Otology, Seoul, Korea |
| 7/18 | Invited Keynote Speaker "Aging, Hearing, and Public Health – From Epidemiology to Clinical Trials and Public Policy in the U.S.", British Society of Otology, Manchester, UK |
| 10/18 | Invited Speaker, "Hearing loss, Aging and Public Health", "Hearing loss in Older Adults in the United States – Role of Over-the-Counter Hearing Aids", "Addressing Hearing loss in Older Adults – Innovative Approaches" - Brazilian Academy of Otolaryngology Meeting, Joao Pessoa, Brazil |
| 1/19 | Invited Keynote Speaker, "Aging, Hearing loss and Public Health" - Cochlear Nordic Symposium, Malmo, Sweden |
| 2/19 | Invited Keynote Speaker, "Hearing loss, Cognition and Dementia – From Epidemiologic Insights to Clinical Trials and Public Policy" - KIND Foundation Symposium on Hearing and Cognition, Berlin, Germany |
| 5/19 | Invited Keynote Speaker, "Hearing, Aging & Public Health: From Epidemiology to Public Policy"- Macquarie University, Sydney, Australia |
| 6/19 | Invited Keynote Speaker, "Hearing Loss, Aging & Dementia: From Epidemiology to the ACHIEVE Trial" – Cognitive Hearing Science for Communication Conference, Linkoping University, Linkoping, Sweden |
| 7/19 | Invited Keynote Speaker, "Hearing Loss, Aging, & Public Health"; "Addressing Hearing Loss from the Public Health Perspective" – New Zealand Audiological Society Annual Conference, Queenstown, New Zealand |
| 7/19 | Invited Keynote Speaker, "Hearing, Aging & Public Health: From Epidemiology to Public Policy" - Triton Hearing Annual Conference, Queenstown, New Zealand |
| 9/19 | Invited Keynote Speaker, "Hearing, Aging, & Public Health" - Hearing Forum Andermatt, Andermatt, Switzerland |
| 11/19 | Invited Keynote Speaker, "Hearing, Aging, & Public Health – From Epidemiology to Public Policy in the U.S."- Pindrop Foundation Adult Cochlear Implant Forum, Auckland, New Zealand |
| 2/20 | Invited Keynote Speaker, "Hearing Loss in Older Adults – A Public Health Perspective"- Hearing and Balance 2020, Sao Paulo, Brazil |
| 3/20 | Invited Speaker, "Hearing Loss, Cognition, and Brain Aging"- University College London Auditory Processing Disorder Master Class, London (Virtual lecture given COVID-19 pandemic) |
| 6/21 | Invited Grand Rounds Speaker, "Hearing Loss and Dementia" - Chinese University Hong Kong Department of Otolaryngology, Hong Kong (Virtual lecture) |
| 6/21 | Invited Speaker, "Hearing Loss and Dementia" - Scientific Meeting of the Otorhinolaryngology Department of Hospital de Clínicas de Porto Alegre (hospital of the Federal University, Porto Alegre, Rio Grande do Sul, Brazil) (Virtual lecture) |
| 8/21 | Invited Speaker, "Hearing Loss and Dementia" - International Symposium on Auditory and Audiological Research, Denmark (Virtual lecture) |
| 10/21 | Invited Speaker, "Hearing Loss in Older Adults - A Public Health & Policy Perspective from the United States"- Chilean ENT National Meeting (Virtual lecture) |
| 12/21 | Invited Speaker, "Hearing Loss, Cognition, & Dementia - From Epidemiologic Insights to the ACHIEVE Trial" – Asia Pacific Symposium on Cochlear Implants and Related Sciences, Australia (Virtual lecture) |
| 3/22 | Invited Speaker, "Hearing Loss & Dementia - From Epidemiologic Insights to the ACHIEVE Trial" – 2022 Rotman Research Institute Annual Conference on Aging & Brain Health (Virtual Conference) |
| 4/22 | Invited Speaker, "Hearing Loss & Dementia" and "Hearing Loss in Older Adults – A Public Health and Policy Perspective from the United States" – Brazil Academy of Audiology Annual Conference (Virtual lecture) |
| 4/22 | Invited Speaker, "Hearing Loss & Dementia - From Epidemiologic Insights to the ACHIEVE Trial" – GICCA 2022 (Congress of the Iberoamerican Group of Cochlear Implants and Related Sciences), Punta del Este, Uruguay |
| 5/22 | Invited Seminar Speaker, "Hearing Loss & Dementia - From Epidemiologic Insights to the ACHIEVE Trial" - Department of Logopedics, Phoniatrics and Audiology, Lund University, Sweden (Virtual lecture) |

6/22 Invited Speaker, "Hearing Loss & Dementia" – Symposium on 'What do we mean by population-based approaches to dementia risk reduction?'; Alzheimer's Disease International Conference 2022 (Virtual lecture)
8/22 Invited Speaker, "Public Health Approaches to Address Hearing Loss in Older Adults" – Macquarie University/Australian Hearing Hub, Sydney, Australia
8/22 Invited Speaker, "Success Through Collaboration – The Story of Hearing Loss, Aging, & Public Health" – Chulalongkorn University MDCU 75th Anniversary Congress, Bangkok, Thailand
12/22 Invited Speaker, "Addressing Hearing Loss in Adults Through a Public Health and Market Perspective" - International Centre for Evidence in Disability (ICED) at the London School of Hygiene & Tropical Medicine (Virtual lecture)
3/23 Invited Speaker, "Hearing Loss, Aging & Public Health" – Tel Aviv University Healthy Longevity Research Center Symposium (Virtual lecture)

***Visiting Professorships***

***Regional***

7/12 "Hearing loss and healthy aging"- University of Maryland Pepper Older Americans Independence Center, Baltimore, MD

***National***

9/12 "Hearing loss and public health"- CUNY Department of Audiology, New York City
11/12 "Hearing loss and healthy aging—Parts 1 and 2"- University of North Carolina Department of Otolaryngology-HNS
12/12 "Hearing loss and healthy aging"- Grand Rounds speaker, Department of Epidemiology; University of Miami
12/12 "Hearing loss and dementia"- Grand Rounds speaker, Departments of Otolaryngology-HNS and Neurosurgery, University of Miami
1/13 "Hearing loss and healthy aging"- University of South Florida, Tampa
9/13 "Hearing loss in older adults: a public health perspective"- University of Pennsylvania Department of Otolaryngology-HNS
10/13 "Hearing loss in older adults – a public health perspective"- Visiting Professor and Grand Rounds Speaker, University of Florida Department of Otolaryngology-HNS; Gainesville, Florida
10/13 "Hearing loss in older adults – implications for healthy aging"- Visiting Professor and Seminar Speaker, University of Florida Institute of Aging, Gainesville, FL
12/13 "Hearing loss and healthy aging – a public health perspective"- Visiting Professor and Invited Dean's Seminar Speaker, Bouvé College of Health Sciences, Northeastern University, Boston, MA
12/13 "Hearing loss in older adults – a public health perspective"- Visiting Professor for Jack Abramson Memorial Lecture, Department of Otolaryngology-Head & Neck Surgery, North Shore Long Island Jewish Medical Center, New Hyde Park, NY
3/15 "Hearing loss in older adults—a public health perspective"- Visiting Professor and Grand Rounds Speaker -Duke University Department of Otolaryngology-Head & Neck Surgery, Durham, NC
12/15 "Hearing Loss in Older Adults- a public health perspective"- Visiting Professor and Grand Rounds Speaker, Department of Otolaryngology-HNS- University of Iowa, Iowa City, IA
9/16 "Hearing loss and healthy aging – a public health perspective"- Visiting Professor for Matthew-Rubins Endowed Lectureship and Department of Communication Science and Disorders, University of Pittsburgh- Pittsburgh, PA
1/17 "Hearing loss and healthy aging – a public health perspective"- Department of Otolaryngology-Head & Neck Surgery, University of Colorado; Denver, CO

***International***

3/12 "Hearing loss in older adults – who's listening?"- UCL Ear Institute, London, UK
3/12 "Hearing loss in older adults – who's listening?"- MRC Institute of Hearing Research, Nottingham, UK
8/12 "Hearing loss and healthy aging"- Eriksholm Research Center, Copenhagen, Denmark

| | |
|---|---|
| 5/14 | "Hearing loss in older adults - a public health perspective"- Centre for Research on Aging, Health & Well-Being, Australian National University, Canberra, Australia |
| 11/14 | "Hearing loss in older adults – a public health perspective"-Visiting Professor and Invited Speaker for Annual Birkett Lectureship; McGill University, Montreal, Canada |
| 3/17 | "Hearing loss and healthy aging – a public health perspective"- University of Otago, Wellington, New Zealand |
| 3/17 | "Hearing loss and healthy aging – a public health perspective"- University of Auckland, New Zealand |
| 5/18 | "Aging, Hearing & Public Health – From Epidemiologic Insights to Clinical Trials & Public Policy in the United States" – National Yang Ming University, Taipei, Taiwan |
| 9/18 | "Aging, Hearing, and Public Health – From Epidemiology to Clinical Trials and Public Policy in the U.S.", Peking University School of Public Health, Beijing, China |
| 9/18 | "Aging, Hearing, and Public Health – From Epidemiology to Clinical Trials and Public Policy in the U.S.", Tongren Hospital, Beijing, China |
| 2/19 | "Hearing Loss, Aging, and Public Health", Hannover Medical School, Hannover, Germany |
| 10/19 | Multiple lectures on "Hearing, Aging, and Public Health" and "Hearing Loss, Cognition, and Brain Aging". Eisdell Moore Center Invited Visiting Professor at the University of Auckland, University of Canterbury, and University of Otago, New Zealand |

# Exhibit B

**EXHIBIT B**

***Schmitt v. Kaiser Foundation Health Plan of Washington, et al.***
**USDC (W.D. Wash.), No. 2:17-cv-01611-RSL**

**Documents Reviewed for Expert Report by Frank R. Lin, MD, PhD**

Source Documents

- ATscale Global Partnership for Assistive Technology, *Product Narrative: Hearing Aids, A Market Landscape and Strategic Approach to Increasing Access to Hearing Aids and Related Services in Low and Middle Income Countries*, December 2019
- Frank R. Lin & Marilyn Albert (2014), *Hearing loss and dementia – who is listening?*, Aging & Mental Health, 18:6, 671-673, DOI: 10.1080/13607863.2014.915924
- Gill Livingston, et al., *Dementia prevention, intervention, and care*, The Lancet Commissions, www.thelancet.com, published online July 20, 2017 http://dx.doi.org/10.1016/S0140-6736(17)31363-6
- National Academies of Sciences, Engineering, and Medicine (2016), *Hearing health care for adults: Priorities for improving access and affordability*, Washington, DC: The National Academies Press. doi: 10.17226/23446
- Bolajoko O. Olusanya, et al., *Hearing loss grades and the International classification of functioning, disability and health*, Bull World Health Organ. 2019; 97:725–728 | doi: http://dx.doi.org/10.2471/BLT.19.230367
- *World report on hearing*, Geneva: World Health Organization; 2021. Licence: CC BY-NC-SA 3.0 IGO.

Case Documents

- KAISER_001860-1862
- KAISER_002056-2061
- KAISER_002073-2076
- KAISER_003796-3815
- KAISER_003816-3875
- KAISER_003876-3916
- KAISER_003917-3922
- KAISER_003923-3937
- KAISER_003938-3941
- KAISER_003970
- KAISER_003973-4009
- KAISER_004010-4019
- MUNSON_0001-0004
- SCH_0001-0665
- SCHMITT 000200-0201 CONFIDENTIAL
- SCHMITT 000203-0204 CONFIDENTIAL
- SCHMITT 000211-0212 CONFIDENTIAL

**EXHIBIT B (continued)**

***Schmitt v. Kaiser Foundation Health Plan of Washington, et al.***
**USDC (W.D. Wash.), No. 2:17-cv-01611-RSL**

**Documents Reviewed for Expert Report by Frank R. Lin, MD, PhD**

Additional Source Documents:


- *Aging America & Hearing Loss: Imperative of Improved Hearing Technologies,* (October 2015) (White House President's Council of Advisors on Science and Technology (PCAST)). https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/PCAST/pcast_hearing_tech_letterreport_final.pdf
- CDC, *Disability and Health Overview: Impairments, Activity Limitations, and Participation Restrictions*, https://www.cdc.gov/ncbddd/disabilityandhealth/disability.html#:~:text=A%20disability%20is%20any%20condition,around%20them%20(participation%20restrictions) (last visited May 9, 2023).
- Chien W, Lin FR. Prevalence of hearing aid use among older adults in the United States. *Arch Intern Med.* Feb 13 2012;172(3):292-3. doi:172/3/292 [pii] 10.1001/archinternmed.2011.1408
- Cruickshanks KJ, Wiley TL, Tweed TS, et al. Prevalence of hearing loss in older adults in Beaver Dam, Wisconsin. The Epidemiology of Hearing Loss Study. *AmJEpidemiol.* 1998;148(9):879-886.
- Cunningham LL, Tucci DL. *Anatomy of the ear*. Hearing loss in adults. N Engl J Med. 2017; 377:2465-2473. doi:10.1056/NEJMra1616601
- De Lew N. Medicare: 35 Years of Service. *Health Care Financ Rev.* 2000;22(1):75-103.
- Deal JA, Goman AM, Albert MS, et al. Hearing treatment for reducing cognitive decline: Design and methods of the Aging and Cognitive Health Evaluation in Elders randomized controlled trial. *Alzheimers Dement (N Y).* 2018;4:499-507. doi:10.1016/j.trci.2018.08.007
- Goman & Lin, *Prevalence of and Numbers of Individuals With Hearing Loss, by Age and Severity in the United States*. American Journal of Public Health, Oct 2016 Vol 106, No 10.
- Jiang F, Mishra SR, Shrestha N, et al. Association between hearing aid use and all-cause and cause-specific dementia: an analysis of the UK Biobank cohort. *Lancet Public Health.* May 2023;8(5):e329-e338. doi:10.1016/S2468-2667(23)00048-8
- Livingston G, Huntley J, Sommerlad A, et al. Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. *Lancet*. 08 2020;396(10248):413-446. doi:10.1016/S0140-6736(20)30367-6
- Simpson AN, Matthews LJ, Cassarly C, Dubno JR. Time From Hearing Aid Candidacy to Hearing Aid Adoption: A Longitudinal Cohort Study. *Ear Hear.* 2019;40(3):468-476. doi:10.1097/AUD.0000000000000641

# Exhibit 3

*Schmitt, et al.*

*v.*

*Kaiser Foundation Health Plan of Washington, et al.*

**Case No. 2:17-cv-1611-RSL**

# Expert Rebuttal Report

**Frank R. Lin, MD, PhD**

**June 9, 2023**

**Frank R. Lin, MD PhD**
**Professor of Otolaryngology-HNS, Medicine, Mental Health, and Epidemiology**
**Johns Hopkins University**

**Expert Witness Rebuttal to Report of Scott Carr**

I have reviewed the Expert Report of Scott Carr, PhD dated May 12, 2023. In this report, he kindly cites many of my studies of the epidemiological prevalence of hearing loss and hearing aid use. However, the two key conclusions he draws from the review of my publications and other areas of the medical and scientific literature are incorrect.

1. **Dr. Carr wrongly asserts that a hearing disability is defined by an audiometric cutoff of 40 dB or greater.**

Dr. Carr states that he is using a four-frequency pure tone average threshold of "40 dB, as the threshold level above which hearing loss is disabling". This is an incorrect definition of a hearing disability from a medical perspective. From the medical perspective and as defined by the U.S. Centers for Disease Control and Prevention, a disability requires both an impairment of the body (i.e., audiometric evidence of a hearing loss) and limitations/restrictions in life activities[1].

From a medical perspective, this definition is operationalized as meaning that a patient would be considered to have a hearing disability if (1) there is evidence of objective audiometric hearing loss (e.g., hearing thresholds greater than 20 dB) and (2) they self-report functional restrictions in everyday activities requiring hearing (e.g., verbal communication with others, environmental sound awareness needed for safety, etc.). Individuals with hearing thresholds less than 40 dB can certainly have a hearing disability. Results of audiometric testing, standing alone, are not sufficient to define disability at the individual patient level.

Dr. Carr's reliance on the 40 dB cutoff misapplies a cutoff that was historically used for population-wide epidemiological purposes. Specifically, this 40 dB cutoff was previously used by the World Health Organization to describe the epidemiological prevalence of hearing loss that would be considered to be more impactful (i.e., 'disabling') at the population-wide level. It is improper to use the 40 dB level as a threshold for determining whether any individual patient's hearing loss is disabling. As described above and more fully in my report, many individuals with hearing loss lower than 40 dB could still have a hearing disability.

Moreover, Dr. Carr ignores that even the WHO no longer uses the 40 dB cutoff to describe 'disabling hearing loss' since its 2021 WHO World Report on Hearing[2]. In the 2021 report, the WHO defines different grades of hearing loss severity by the audiometric pure tone average (e.g., mild, moderate, etc.) and also explicitly states that:

The classification and grades are for epidemiological use and applicable to adults. The following points must be kept in mind while applying this classification:

- While audiometric descriptors (e.g. category, pure-tone average) provide a useful summary of an individual's hearing thresholds, they should not be used as the sole determinant in the assessment of disability or the provision of intervention(s) including hearing aids or cochlear implants.

- The ability to detect pure tones using earphones in a quiet environment is not, in itself, a reliable indicator of hearing disability. Audiometric descriptors alone should not be used as the measure of difficulty experienced with communication in background noise, the primary complaint of individuals with hearing loss.

**2. <u>Dr. Carr's conclusion that there are significant categories of individuals with a hearing disability who would not benefit from hearing aids is vastly overstated.</u>**

In his report, Dr. Carr states: "there are four (potentially overlapping) categories of hearing-disabled people who would not benefit from aid conduction hearing aids: (1) people with conductive, rather than sensorineural, hearing loss; (2) people treated with cochlear implants (according to the Plaintiffs, "5.6 percent of the 9.2 million people under 65 with self-reported hearing losses" are potentially eligible for cochlear implants ("CI")); (3) people treated with bone-conduction hearing aids; and (4) people who are deaf and get no benefit from air conduction hearing aids."

From my perspective as a board-certified, fellowship-trained otologic surgeon who has been seeing and treating patients with hearing loss since 2010 at the Johns Hopkins School of Medicine, these conclusions are misleading and, in some instances, incorrect. Briefly,

1) **Patients with conductive, rather than sensorineural, hearing loss** – Individuals with a permanent conductive hearing loss (i.e., not from a transient cause such as an ear infection) and who are experiencing a hearing disability are in fact generally offered an air conduction hearing aid as a first line therapy before invasive surgical options are considered. The vast majority of permanent conductive hearing loss could be treated with an air conduction hearing aid. There are certain very rare cases that would not be amenable to an air conduction hearing aid (e.g., congenital cases of complete aural atresia [lack of development of the ear and ear canal]), but nearly all other cases of permanent conductive hearing loss could still be amenable to treatment with an air conduction hearing aid. As a surgeon, I would certainly recommend at minimum a hearing aid trial before I considered any type of surgical therapy for these types of permanent conductive hearing loss.

2) **People treated with CIs** – The vast majority of adults who could benefit from a CI do <u>not</u> in fact get a CI, and conservatively this estimate is around 95% of potential CI candidates. There are many reasons these individuals do not get a CI. One of the key reasons is that nearly all individuals who are CI candidates have been long-time hearing aid users, and many are functioning sufficiently well with their hearing aids that they don't feel the need to obtain a CI.

3) **People treated with bone-conduction hearing aids** – I'm assuming that what is meant here by Dr. Carr are individuals' who have received a surgically-implantable osseointegrated bone conduction implant system (also historically called a BAHA device). Depending on the indication for an osseointegrated implant, some of these patients could also have benefited from a conventional hearing aid. For example, many individuals with a permanent conductive hearing loss from fixation of the middle ear ossicles would benefit from a conventional hearing aid, and based on my personal clinical experience, I would estimate that the majority experiencing a hearing disability from ossicular fixation do in fact use a hearing aid rather than proceeding with surgery for placement of an osseointegrated implant.

4) **People who are deaf and get no benefit from aid conduction hearing aids** – The term 'deaf' does not have a direct medical or audiological definition and is generally understood to mean individuals who have a profound or greater hearing loss. The term 'deaf' may be a term the patient applies to him or herself to indicate the degree to which they feel impaired or restricted in their daily life. Many of these individuals may in fact use hearing aids while others may choose to pursue a cochlear implant. Another interpretation of 'deaf' is for those individuals who use American Sign Language (ASL) and who identify as culturally Deaf with a capital 'D'. Individuals who are culturally Deaf identify themselves as a linguistic minority shaped by their language (ASL) and other cultural norms. Some individuals who are Deaf do in fact still use hearing aids to aid in lip-reading when communicating with hearing individuals and also to help with environmental sound awareness for safety reasons.

Drafting this rebuttal report took 2 hours 15 minutes.

DATED: June 9, 2023, at Lutherville, MD

Frank R. Lin, MD, PhD

Sources:

1. https://www.cdc.gov/ncbddd/disabilityandhealth/disability.html. Accessed June 9, 2023.
2. World Report on Hearing. 2021. Geneva. World Health Organization.

## CERTIFICATE OF SERVICE

I hereby certify that on June 12, 2023, I caused the foregoing document to be served by electronic mail on the following counsel of record:

Medora A. Marisseau
Mark A. Bailey
Joshua M. Howard
KARR TUTTLE CAMPBELL
701 Fifth Avenue, Suite 3300
Seattle, WA 98104
mmarisseau@karrtuttle.com
mbailey@karrtuttle.com
jhoward@karrtuttle.com

*Attorneys for Defendants*

DATED: June 12, 2023, at Seattle, Washington.

*/s/ Eleanor Hamburger*
Eleanor Hamburger (WSBA #26478)
ehamburger@sylaw.com