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Optimizing Outcomes in Hearing Technology: Hearing Aids and Implantable Devices,

in partnership with American Cochlear Implant Alliance

René Gifford, Ph.D., CCC-A

Moderator: Donna Sorkin, MA,
Executive Director, American Cochlear Implant Alliance

René Gifford, PhD, CCC-A

René Gifford, Ph.D., CCC-A holds the Fred H. Bess Chair in Audiology and is a Professor in the Department of Hearing and Speech Sciences as well as the Director of the Cochlear Implant Research Laboratory at Vanderbilt University Medical Center. Her research focuses on the study of auditory perception, spatial hearing, and binaural development for children using combined electric and acoustic stimulation (EAS) via hearing aid and cochlear implant technology. Her primary professional goal is centered on improving auditory-based outcomes and ensuring that we are using data-driven recommendations for hearing and speech/language intervention for our patients. Dr. Gifford's research has been continuously NIH funded for 20 years, she has published over 130 peer-reviewed articles, multiple book chapters, and she authored a book, now in its second edition, entitled "Cochlear Implant Patient Assessment: Evaluation of Candidacy, Performance, and Outcomes." Dr. Gifford was a featured scientist on the National Public Radio, Science Friday broadcast entitled Breakthrough: Portraits of Women in Science—Hearing a Whole New World. Additionally, Dr. Gifford was awarded the 2015 Louis M. DiCarlo Award for Recent Clinical Achievement from the American Speech-Language-Hearing Association, the 2017 Vanderbilt University Chancellor's Award for Research, as well as the 2021 Jerger Career Award for Research in Audiology from the American Academy of Audiology.

Five Part Series on Adult Assessments in Hearing Healthcare

- Adult Assessments: Working Across the Continuum
- Roles of Audiologists and Dispensers Working with Hearing Aid Users on CI Candidacy
- Utility of the New CI Quality of Life Instruments to Personalize and Improve CI Care
- Adult Perceptions of Hearing Status and Options: Professionals Facilitating a Life-Long Hearing Journey
- Optimizing Outcomes in Hearing Technology: Hearing Aids and Implantable Devices

Why another organization in hearing health?

- Membership organization focused on cochlear implantation and access to care
- Members are audiologists, physicians, speech pathologists, educators and others on CI teams + consumers/parents, advocates, hearing aid specialists
- Website designed for those in and out of CI
- Highly collaborative with other organizations

Welcome your involvement!

www.acialliance.org

https://www.facebook.com/ACIALLIANCE.ORG/

Twitter@acialliance

American Cochlear Implant Alliance

- Mission: Advance access to the gift of hearing provided by cochlear implantation through research, advocacy and awareness
- Address factors contributing to underutilization of cochlear implants
- Improve awareness regarding candidacy and outcomes

Optimizing Outcomes in Hearing Technology: Hearing Aids and Implantable Devices,

René Gifford, Ph.D., CCC-A
Department of Hearing and Speech Sciences
Vanderbilt University Medical Center

Disclosures

- **Presenter Disclosure**: Financial: Rene Gifford is an employee of Vanderbilt University Medical Center. She is a paid consultant for Advanced Bionics, Cochlear, and Akouos. She serves on the clinical advisory board for Cochlear and Frequency Therapeutics. She receives grant/research support from NIH NIDCD, Advanced Bionics, Cochlear and Oticon Medical. She received an honorarium for this presentation. Non-financial: Rene Gifford has no relevant non-financial relationships to disclose.
- **Content Disclosure**: This learning event does not focus exclusively on any specific product or service.
- **Sponsor Disclosure**: This course is presented by AudiologyOnline in partnership with the American Cochlear Implant Alliance.

Learning Outcomes

After this course, participants will be able to:

- Describe expected auditory outcomes for various hearing technologies following evidence-based fitting.
- Describe candidacy indications for the following devices: hearing aids, bone anchored implants, cochlear implants, etc.
- Describe the possible hearing and fitting configurations and associated outcomes for the different hearing technologies currently available (e.g., hearing aid plus cochlear implant, cochlear implant plus active bone conduction implant).

World report on hearing: executive summary. (2021). Geneva: World Health Organization (WHO)

Hearing technologies

Audiometric CI criteria over time: adults

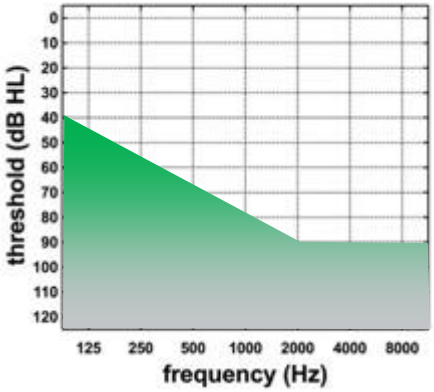
- **1985**: 18+ years, bilateral profound SNHL
- **1995**: 18+ years, bilateral severe-to-profound SNHL
- **2005**: 18+ years, bilateral moderate to profound SNHL
- **2014**: EAS/Hybrid, 18+ years, LF thresholds ≤ 60 dB HL, 2000+ Hz thresholds ≥ 70 dB HL
- **2019**: SSD & AHL (≥ 90 dB HL in poorer ear), 5+ yrs

Audiometric CI criteria over time: children

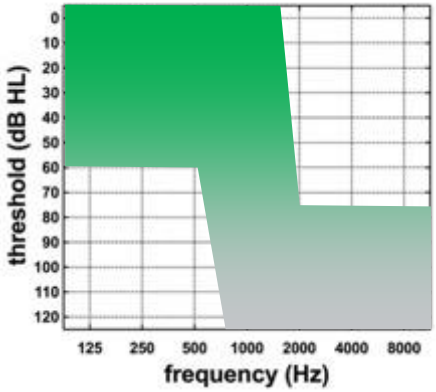
- **1990**: ≥ 24 months, bilateral profound SNHL
- **1998**: ≥ 18 months, bilateral profound SNHL
- **2000**: ≥ 12 months, bilateral profound SNHL; ≥ 24 months with severe-to-profound SNHL
- **2019**: SSD & AHL (≥ 90 dB HL in poorer ear), 5+ years of age
- **2020**: ≥ 9 months, bilateral profound SNHL; ≥ 24 months, bilateral severe-to-profound SNHL

Current audiometric CI criteria: adults

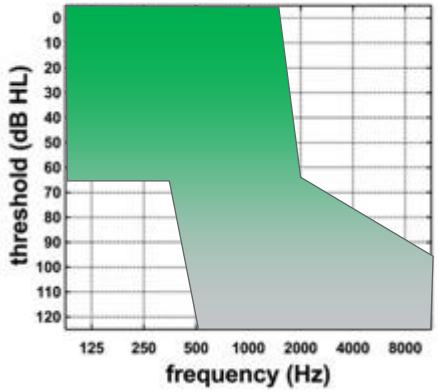
Conventional CI



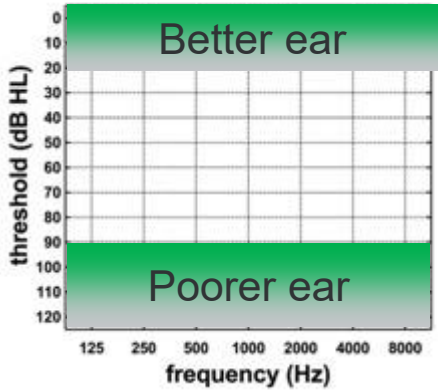
Cochlear Hybrid-L24



MED-EL EAS

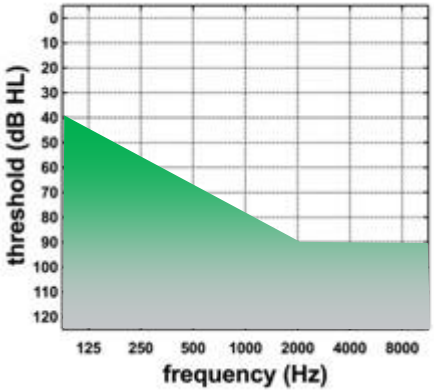


SSD
Cochlear & MED-EL

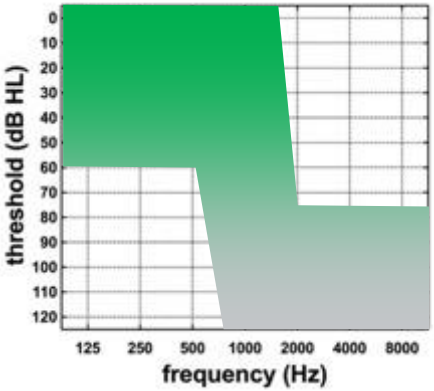


Current audiometric CI criteria: adults

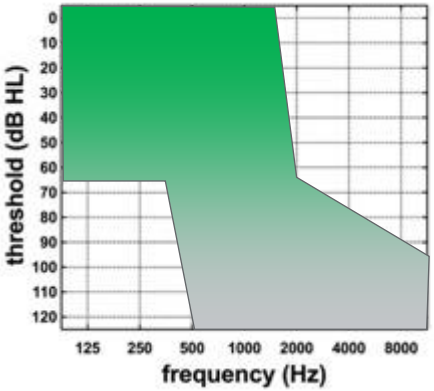
Conventional CI



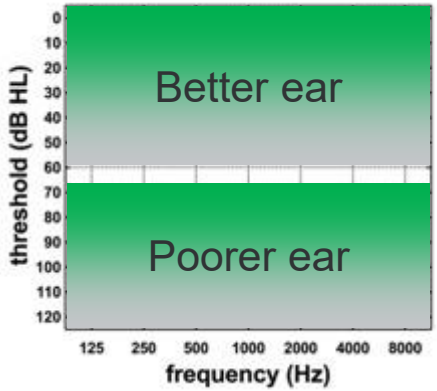
Cochlear Hybrid-L24



MED-EL EAS

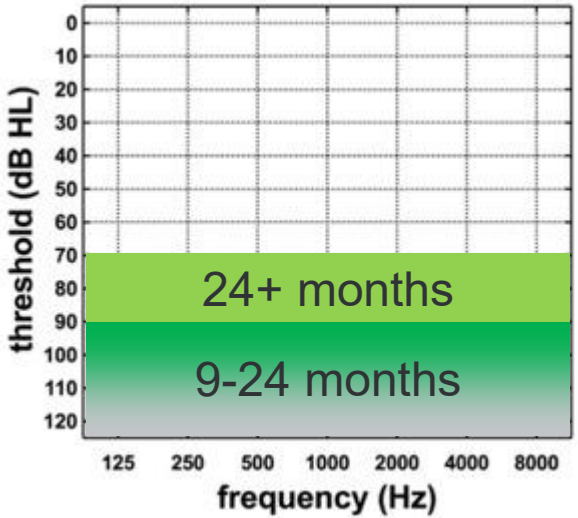


Asymmetric Cochlear & MED-EL

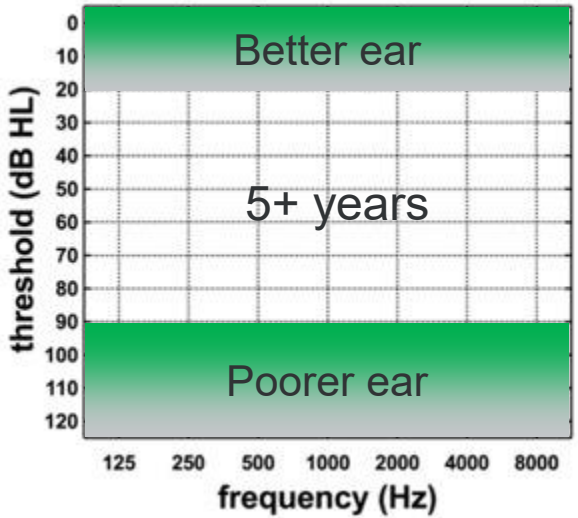


Current audiometric CI criteria: children

Conventional CI



SSD
Cochlear & MED-EL



Aided speech recognition CI criteria: adults

- **AB**: **≤ 50%** sentence rec in best-aided condition, *post-lingual onset of deafness*
- **Cochlear: ≤ 50%** sentence rec in ear to be implanted, **≤ 60%** sentence rec in best-aided condition
- **MED-EL: < 40%** sentence rec in best-aided condition
- **CMS: < 40%** sentence rec in best-aided condition

Aided speech recognition CI criteria: children

Lack of auditory progress with HAs (3 to 6 months)

Younger children: Failure to reach developmentally appropriate auditory milestones (IT-MAIS/MAIS, ESP)

Older children:

- **AB**: **< 12%** on difficult open-set word rec (e.g., PBK) or **< 30%** open-set sentences (HINT-C)
- **Cochlear:** **≤ 30%** MLNT/LNT in best aided condition
- **MED-EL:** **< 20%** MLNT/LNT in best aided condition

Bone anchored implants (BAI)
Bone conduction devices (BCD)
Bone anchored hearing systems (BAHS)
Bone anchored hearing devices (BAHD)
Bone anchored hearing aid (Baha)

Bone anchored implants (BAI)

Passive

Percutaneous

- Baha Connect
- Ponto
- Transcutaneous
- Baha Attract
- Alpha 2 MPO ePlusTM

Active

Transcutaneous

- Osia 2
- Bonebridge
- Vibrant Soundbridge

Audiometric BAI criteria: passive systems

SNHL indications

Percutaneous

Baha Connect
- 5+ years
- SSD

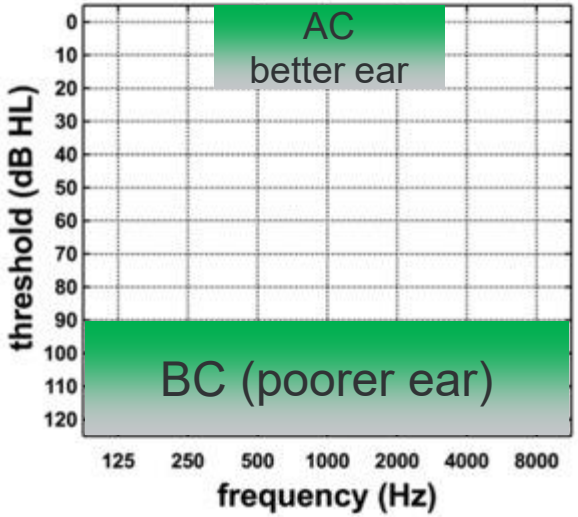
Ponto
- 5+ years
- SSD

Transcutaneous

Baha Attract
- 5+ years
- SSD

Alpha 2 MPO ePlus*
- 5+ years
- SSD

Overlaps with CI indications for SSD

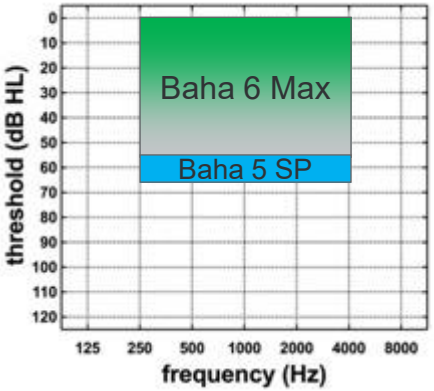


*formerly Sophono

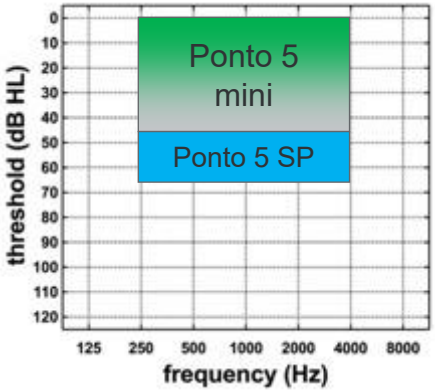
Audiometric BAI criteria: passive systems
Conductive and mixed indications

Percutaneous

Baha Connect
- 5+ years
- BC ≤ 65 dB HL

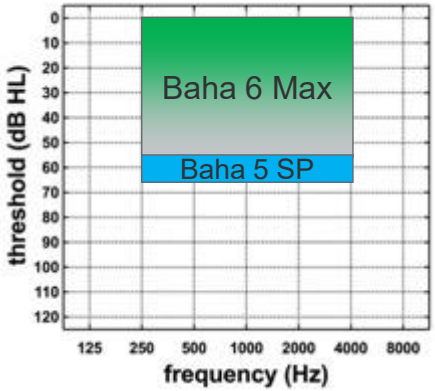


Ponto
- 5+ years
- BC ≤ 65 dB HL

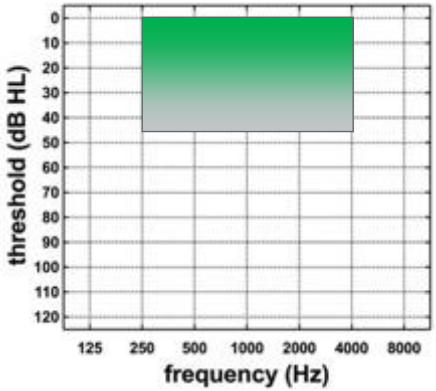


Transcutaneous

Baha Attract
- 5+ years
- BC ≤ 65 dB HL



Alpha 2 MPO ePlus
- 5+ years
- BC ≤ 45 dB HL



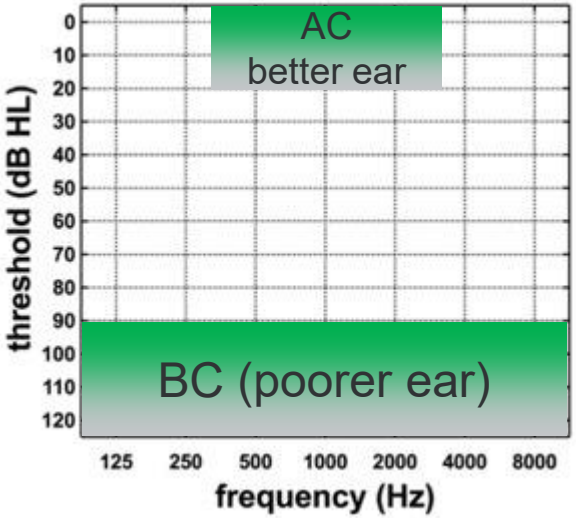
Audiometric BAI criteria: active
SNHL indications

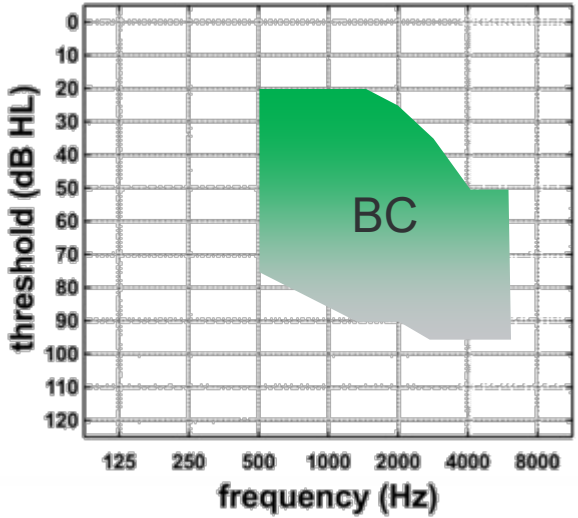
Overlaps with CI indications for SSD

Osia 2
- 12+ years
- SSD

Overlaps with EAS/Hybrid indications

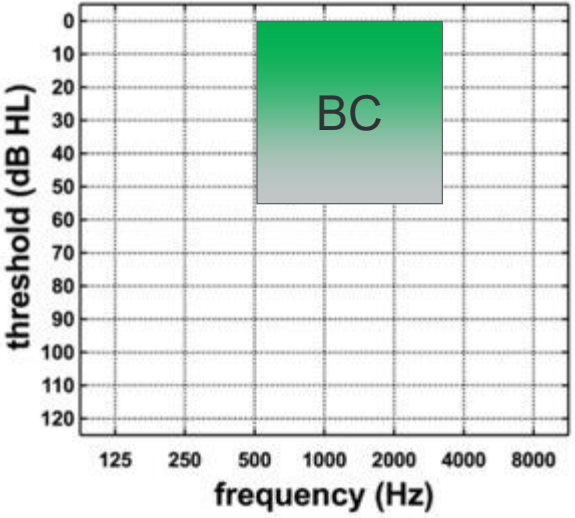
Vibrant Soundbridge
- 5+ years
- Mild to severe SNHL
- Normal ME function
- Word rec ≥ 50%
- No central component



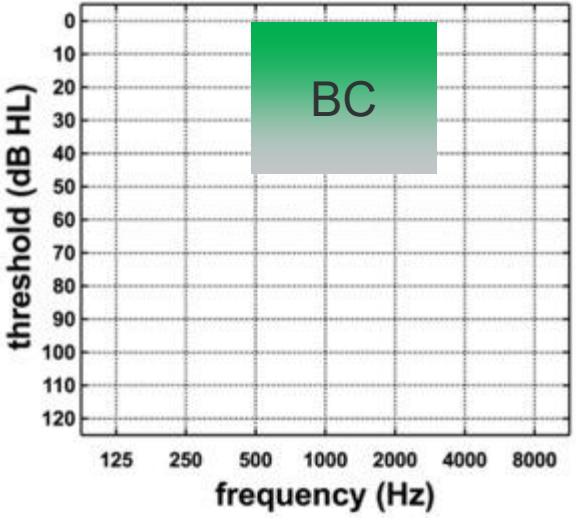


Audiometric BAI criteria: active systems
Conductive and mixed indications

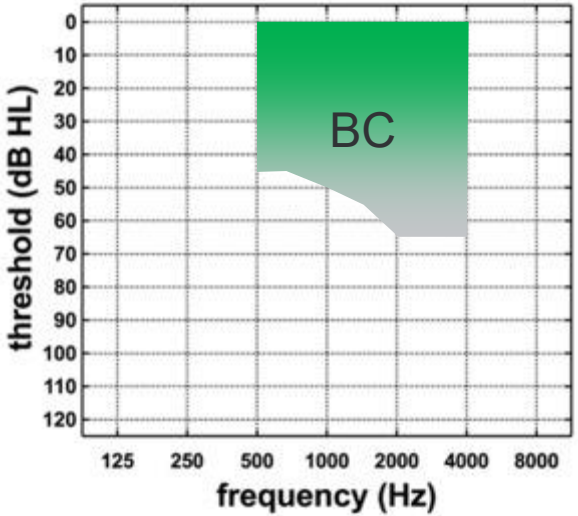
Osia 2
- 12+ years
- BC ≤ 55 dB HL



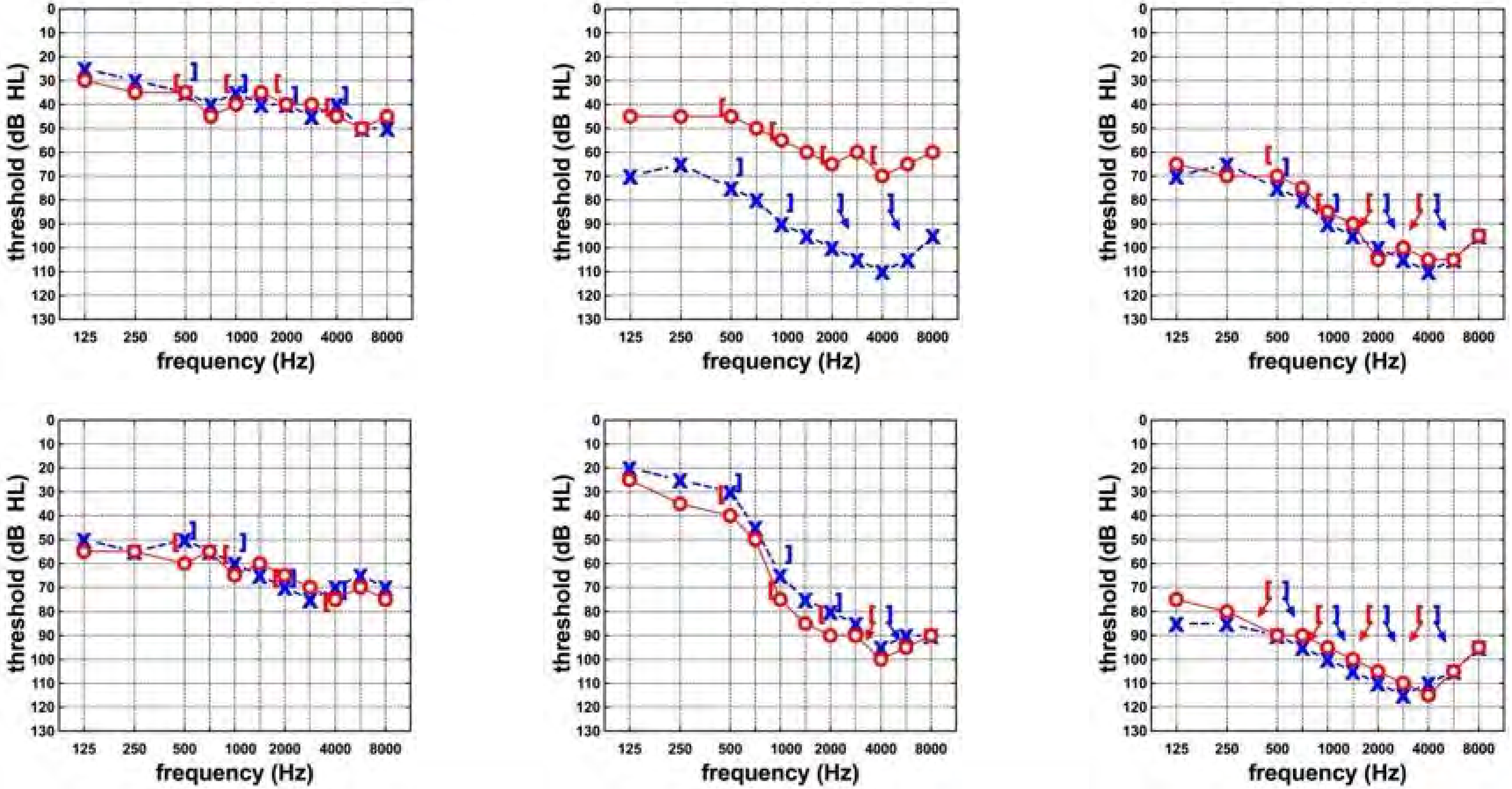
Bonebridge
- 12+ years
- BC ≤ 55 dB HL



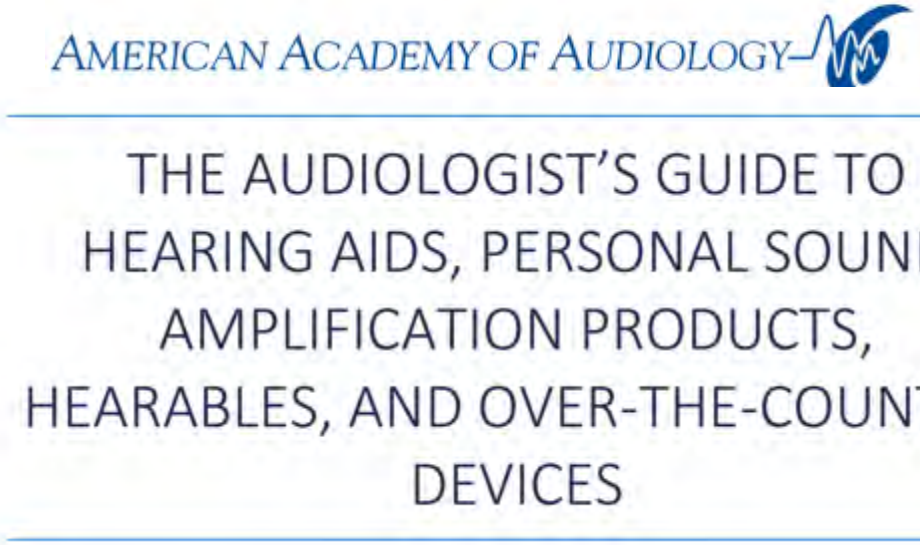
Vibrant Soundbridge
- 18+ years



Audiometric HA criteria: Bilateral SNHL



Audiometric HA criteria: Bilateral SNHL



AAA (2023). The audiologist's guide to hearing aids, personal sound amplification products, hearables, and over-the-counter devices. www.audiology.org

Audiometric HA criteria: Bilateral SNHL

AAA (2013). American Academy of Audiology Clinical Practice Guidelines: Pediatric Amplification. www.audiology.org

Audiometric HA criteria: Bilateral SNHL

Turton et al. (2020). Guidelines for best practice in the audiological management of adults with severe and profound hearing loss. Semin Hear, 41:141–246.

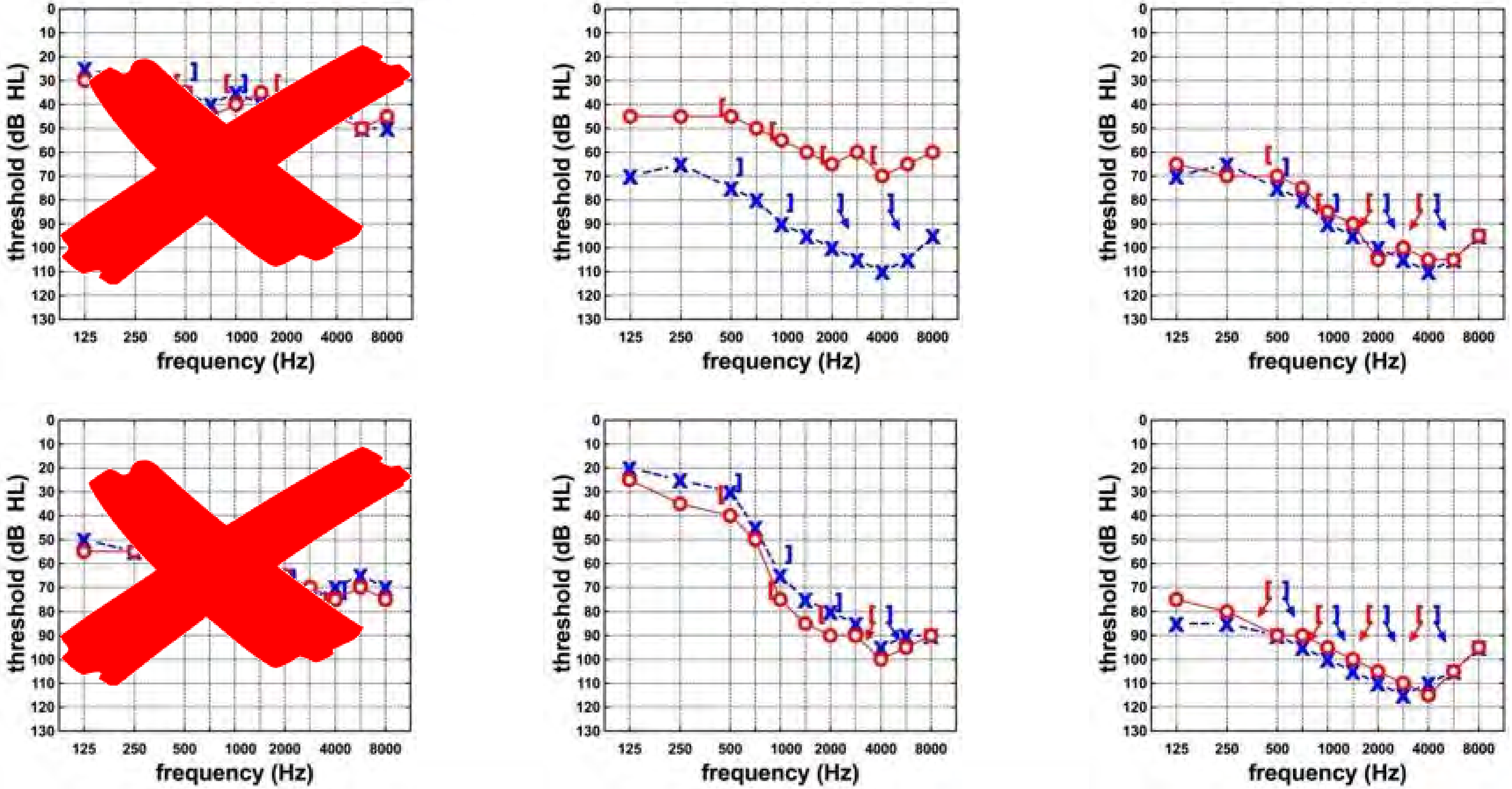
doi: 10.1055/s-0040-1714744.

Audiometric HA criteria: Bilateral SNHL

Fitzpatrick et al. (2019). Candidacy for amplification in children with hearing loss: a review of guidelines and recommendations. Am J Audiol, 28(4): 1025-1045.

doi: 10.1044/2019_AJA-19-0061.

Audiometric CI criteria: Bilateral SNHL



Verification and validation of HA, BAI, and CI programming/fitting

Verification of fitting/programming

HA: Real-ear measures (REM)

CI: CI-aided thresholds (lower stim levels)

BAI: Unmasked BC thresholds, aided thresholds, and REM via skull simulator (for percutaneous systems)

Verification: threshold-based measures

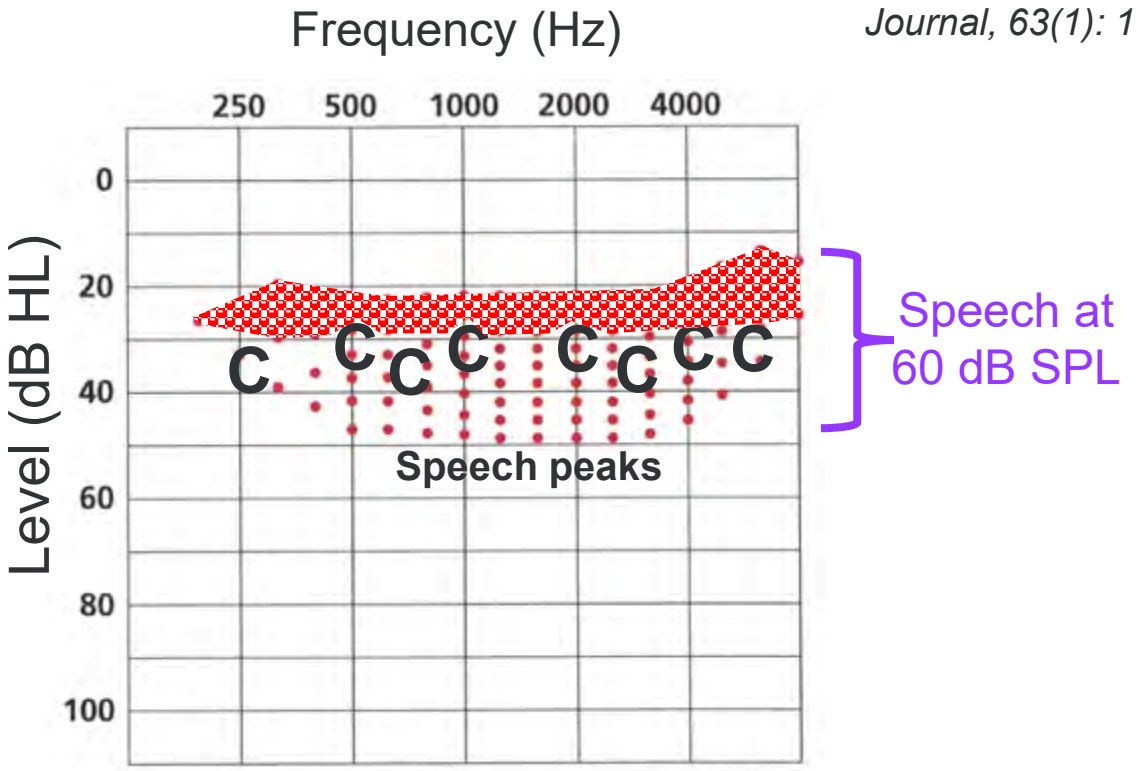
ASHA *(1998). Guidelines for Hearing Aid Fitting for Adults.*
AAA *(2013). Clinical Practice Guidelines: Pediatric Amp.*
Maier et al. (2022). Otol Neurotol, 43: 513–529.
BSA *(2018). Practice Guidance: Guidance on the verification of hearing devices using probe microphone measurements.*

Skinner *et al. (1999). J Speech Lang Hear Res, 42: 814–828.*
Skinner *(2003). Ann Otol Rhinol Laryngol Suppl, 191: 4-13.*
Turton *et al. (2020). Semin Hear, 41(3):141–246.*

CI & BAI programming & verification

Image courtesy of The REM Cookbook (2016). Oticon.

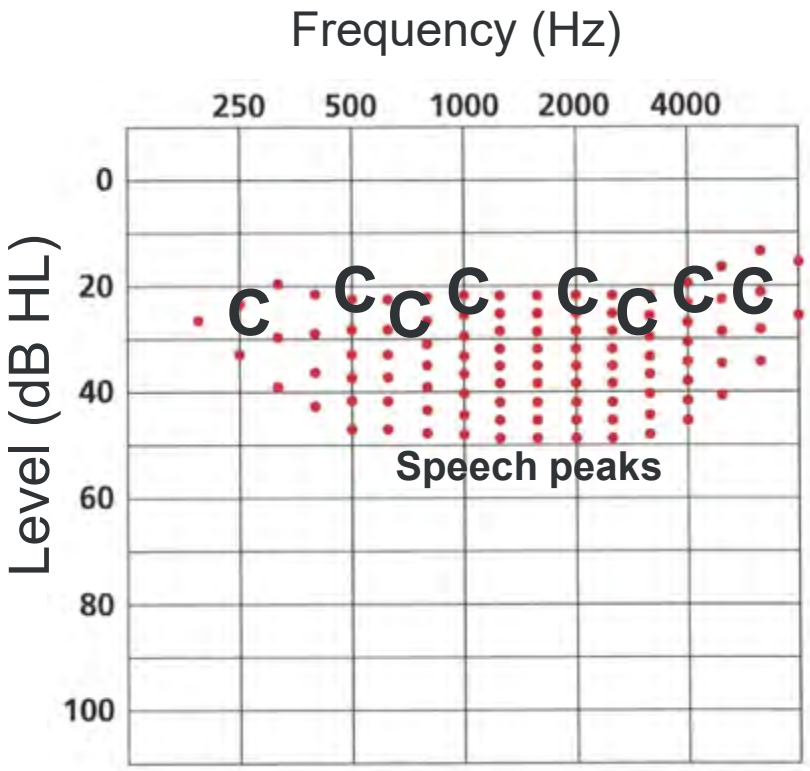
Killion & Mueller (2010). Hearing Journal, 63(1): 1-6.



CI & BAI programming & verification

Image courtesy of The REM Cookbook (2016). Oticon.

Killion & Mueller (2010). Hearing Journal, 63(1): 1-6.



Skinner et al. (1999). J Speech Lang Hear Res, 42: 814–828.

Skinner (2003). Ann Otol Rhinol Laryngol Suppl, 191: 4-13.

Validation of fitting/programming

Speech recognition testing (quiet & noise)

- HA & BAI: aided vs. unaided
- CI: aided post-op vs. aided pre-op

Suprathreshold measures

Patient reported outcome measures (PROMs)

- Satisfaction
- General communication difficulty
- Quality of life
- Fatigue and/or listening effort
- Individualized goal setting

Functional, qualitative measures

Validation of fitting/programming
Speech recognition testing (quiet & noise)

MSTB (2011) and BSA (2019): adults

- MSTB: CNC, AzBio (quiet & noise), BKB-SIN
- BSA: QuickSIN, HINT, BKB-SIN, CUNY

PMSTB (Uhler et al., 2017): children w/ all hearing tech

- **Closed set:**
  - VRISD, ESP (low verbal & standard), PSI words/sentences
- **Open set:**
  - MLNT/LNT, CNC, BKB-SIN (quiet & noise), BabyBio, AzBio

British Society of Audiology (2019), Practice Guidance Assessment of speech understanding in noise in adults with hearing difficulties .

Uhler et al. (2017). J Am Acad Audiol, 28(3):232-247.

Validation of fitting/programming
Patient reported outcome measures (PROMs)

MSTB (2011): adult CI recipients

No PROMs listed, but revised MSTB coming soon!

- **CIQOL-10 & CIQOL-35** (McRackan et al., 2017, 2018abc, 2019, 2021)
- **SSQ/SSQ12** (Gatehouse & Noble, 2004; Noble et al., 2012)
- **Vanderbilt Fatigue Scale (VFS)** (Hornsby et al., 2021)

PMSTB (Uhler et al., 2017): children w/ all hearing tech

- **LittlEARS & Auditory Skills Checklist (ASC)**

AAA (2013): pediatric amplification

- Developmental Index of Audition and Listening (**DIAL**), Functional Auditory Performance Indicators (**FAPI**), Infant-Toddler Meaningful Auditory Integration Scale (**IT-MAIS/MAIS**), **LittlEARS**, Parents' Evaluation of Aural/oral Performance of Children (**PEACH**), Auditory Behavior in Everyday Life (**ABEL**), Children's Home Inventory of Listening Difficulties (**CHILD**), Meaningful Use of Speech Scale (**MUSS**), Children's Abbreviated Profile of Hearing Aid Benefit (**CA-PHAB**)

Factors influencing HA, CI, and BAI fitting & outcomes

Bilateral fittings: HA, CI, and BAI

Bilateral HA fittings are recommended and considered standard of care

Audiology Practice Standards Organization (APSO)

"Fitting of bilateral hearing aids is the recommended protocol if the patient is a candidate for hearing aids in both ears and it is supported by the needs assessment." *(Ahlstrom et al. 2008; Boymans et al. 2008; Köbler et al. 2001)*

American Academy of Audiology (AAA):

Guidelines for the Audiologic Management of Adult Hearing Impairment (2006)
Clinical Practice Guidelines: Pediatric Amplification (2013)

Ahlstrom et al. (2009). Ear and Hearing, 30(2), 203-218.
Boymans et al. (2008). Ear and Hearing, 29(6), 930-941.
Köbler et al. (2001). Scandinavian audiology, 30(4), 223-235.

Bilateral fittings: HA, CI, and BAI

Bilateral CIs are considered standard of care

British Cochlear Implant Group (BCIG)
BCIG (2008). BCIG Position Paper on Bilateral Cochlear Implants
Craddock et al. (2008). Cochlear Implants Int, 9(2):65-69. doi: 10.1002/cii.352

William House Cochlear Implant Study Group (WHCISG)
Balkany et al. (2008). 29(2): 107-108. doi: 10.1097/mao.0b013e318163d2ea

Canadian Society of Otolaryngology—Head & Neck Surgery
Schramm D. (2010). J Otolaryngol Head Neck Surg, 39(5):479–85

Bilateral fittings: HA, CI, and BAI

Bilateral vs. unilateral BAI

Davis & Gifford (in prep)

Participants

- n = 11 (conductive & mixed losses)
- Mean age = 34.6 (range 9 to 66 years)
- 5 bilateral, 6 unilateral
- 10 percutaneous, 1 transcutaneous

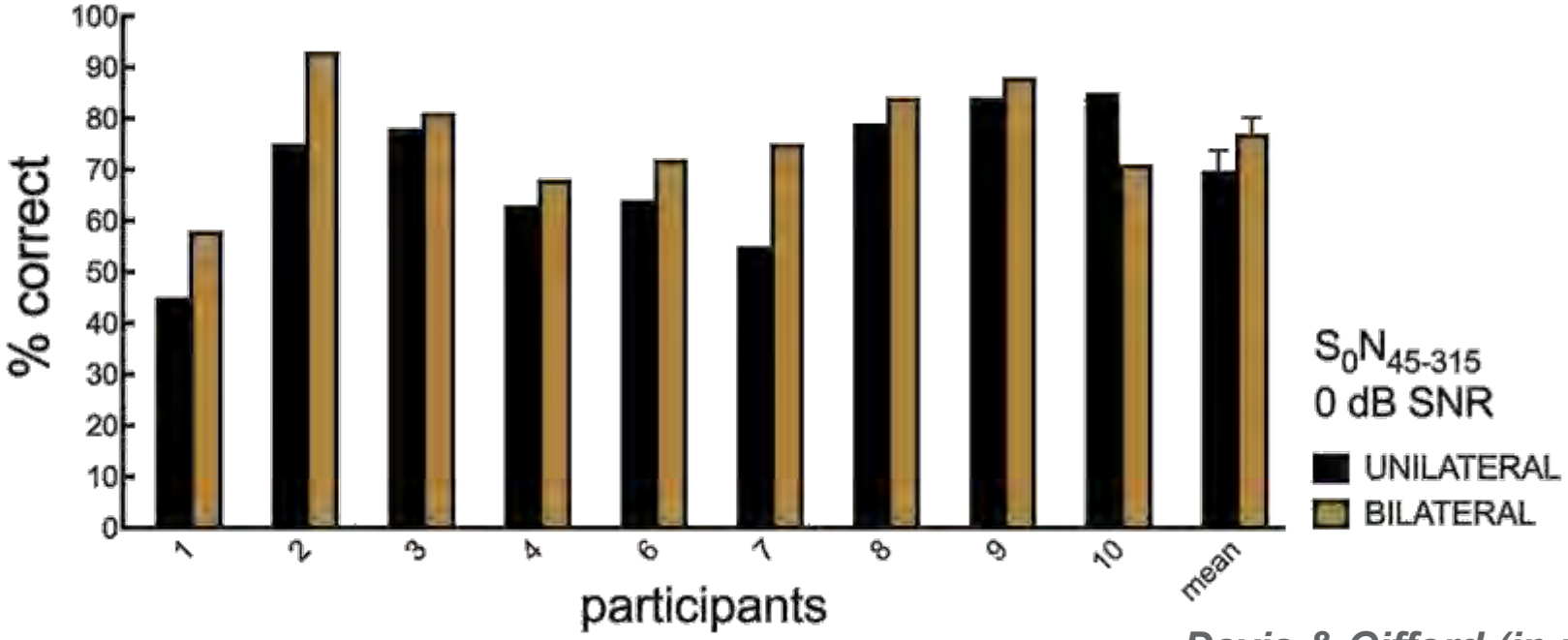
Tasks

- Speech recognition in noise (co-located and spatially separated)
- Localization via minimum audible angle (MAA)

Bosman et al. (2001). Audiology, 40(3): 158-67.
Janssen et al. (2012). Otolaryngol Head Neck Surg. 147(3): 412-22.
Shiraishi (2021). Audiol Res, 11(4): 508-523.

Bilateral fittings: BAI

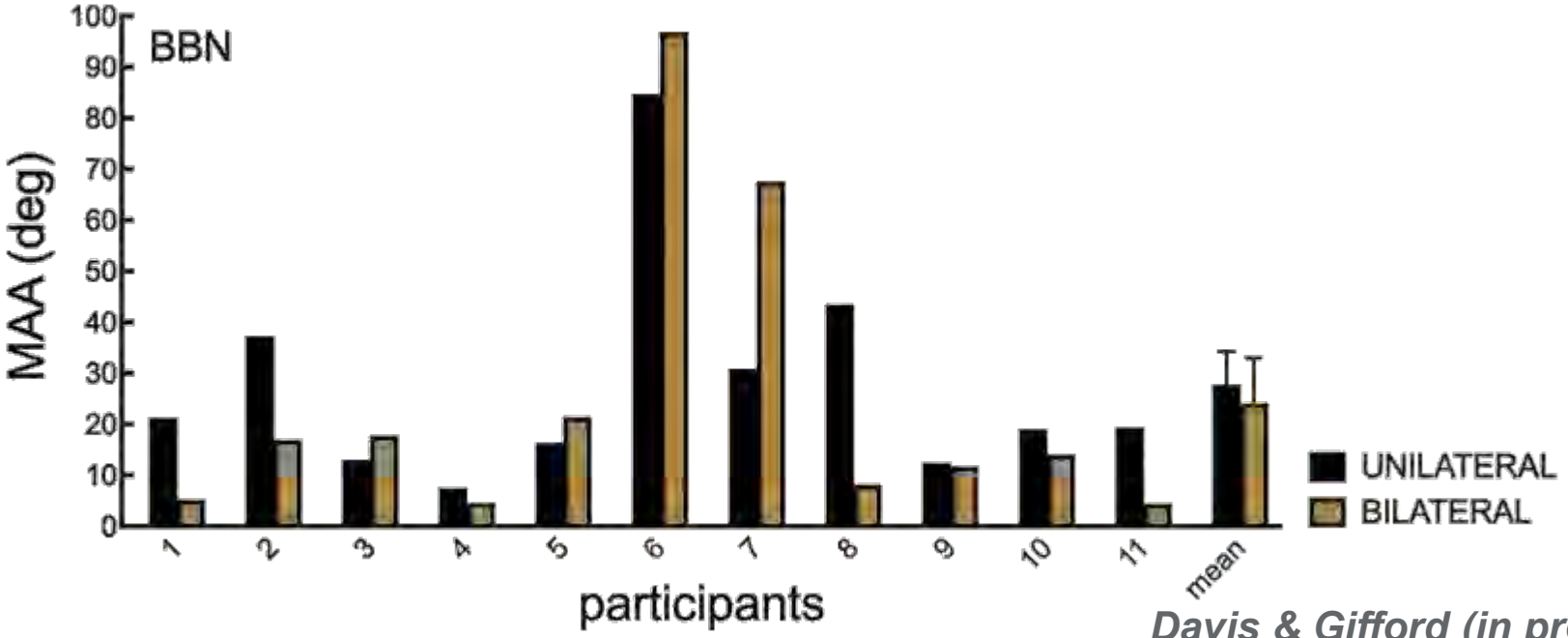
Impact of bilateral vs. unilateral BAI



Davis & Gifford (in prep)

Bilateral fittings: BAI

Impact of bilateral vs. unilateral BAI



Davis & Gifford (in prep)

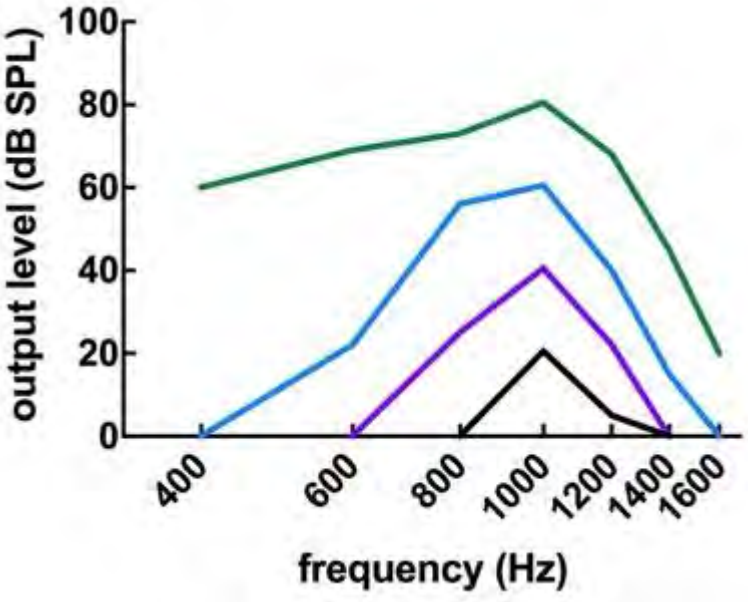
Severity of hearing loss: HA & BAI

Diminishing amplification benefit for spectral regions with thresholds ≥ 70 dB HL

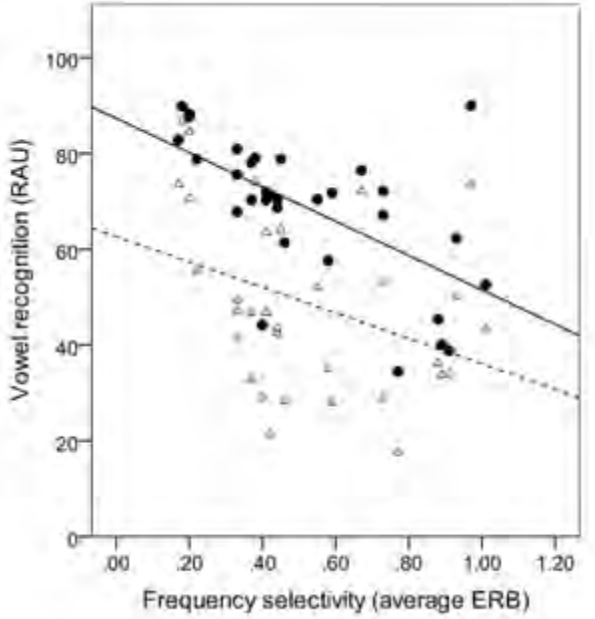
Ching et al., 1998; Hogan and Turner, 1998; Turner and Cummings, 1999; Baer et al., 2002; Hornsby et al., 2003, 2006, 2011; Amos et al., 2007; Turner, 2006; Vickers et al., 2001

- Cochlear dead regions
  - Moore et al., 2000; Baer et al., 2002; Vickers et al., 2001; Zhang et al., 2014
- Suprathreshold distortion (broader AFs at levels ~ HA output)
  - Dorman et al., 1981; Leek and Summers, 1993; Ching et al., 1998, 2004; Studebaker et al., 1999; Hornsby et al., 2001
- HA compression characteristics
  - Hohmann et al., 1995; Boike et al., 2000; Hornsby & Ricketts, 2001; Chung et al., 2007

Auditory filter width



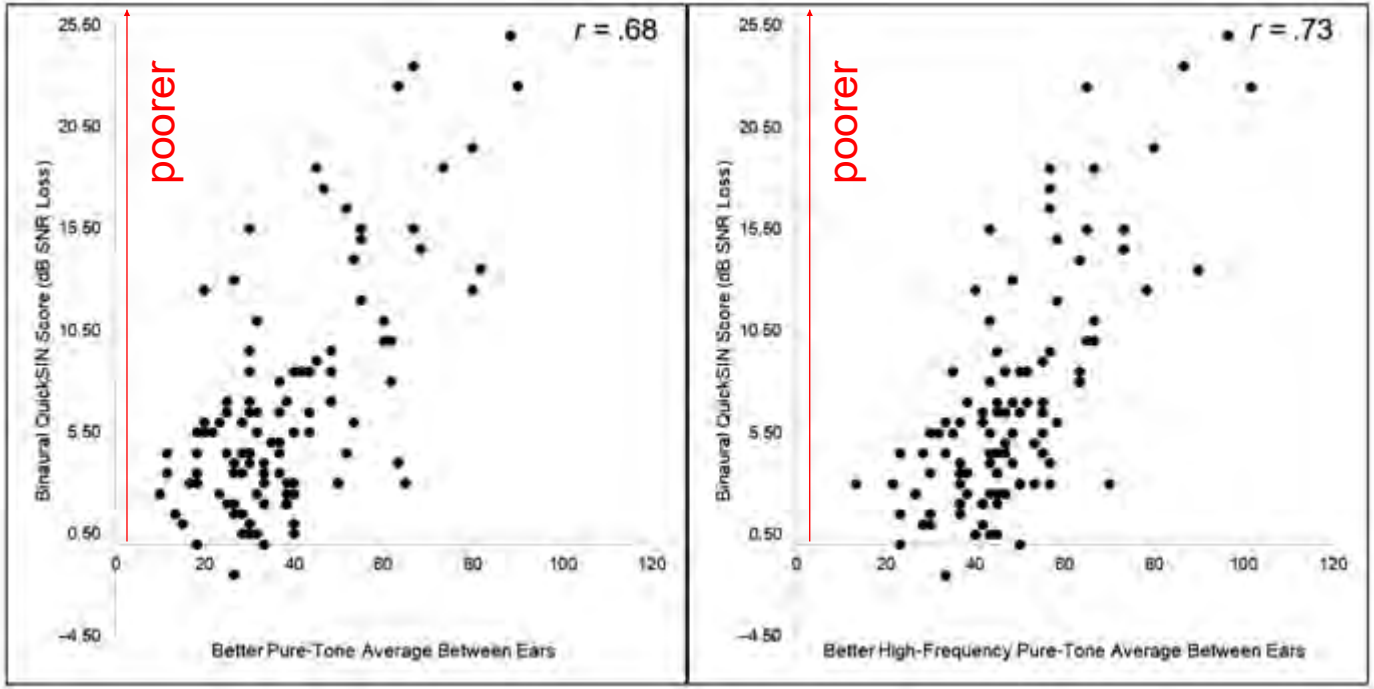
Moore BCJ. (1995). Frequency Analysis and Masking. In Handbook of Perception and Cognition, Hearing. Academic Press, San Diego, CA



Souza et al. (2012). J Speech Lang Hear Res, 55(2): 474-486. doi:10.1044/1092-4388(2011/10-0238

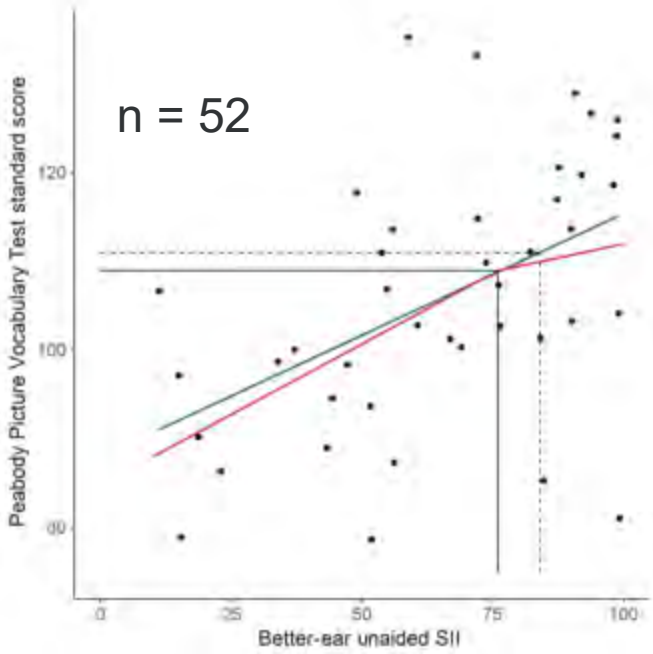
Audibility

Davidson et al. (2022). Am J Audiol, 31:21-31.

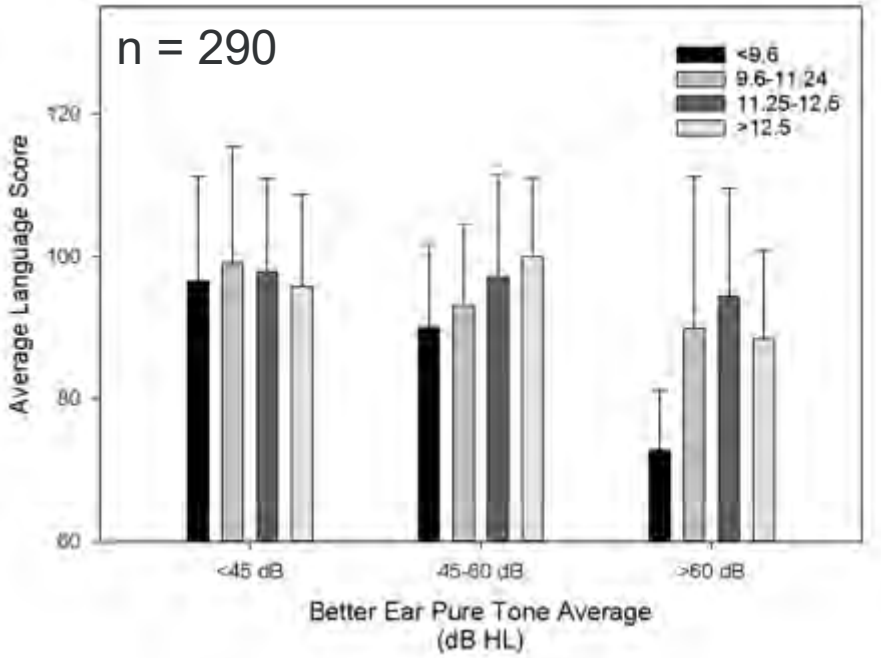


n = 107 adults with HAs

Audibility



McCreery et al. (2022). Lang Speech Hearing Serv Sch. 51(1):55-67.



Tomblin et al. (2015). Ear Hear, 36:76S–91S.

Frequency lowering technology

Frequency-lowering technology: significant benefit

- High-frequency audibility: *Auriemmo et al. 2009; Glista et al., 2009; Wolfe et al. 2015*
- Plurals: *Glista et al. 2009; Wolfe et al. 2010, 2011, 2017*
- Speech production /s/ & /z/: *Auriemmo et al. 2009; Smith et al. 2009*
- Speech & Phoneme perception: *Smith et al., 2009; Wolfe et al., 2010, 2011, 2015, 2017; Hopkins et al., 2014*
- Receptive and expressive language: *Ching et al. 2013*

Frequency-lowering technology: no benefit

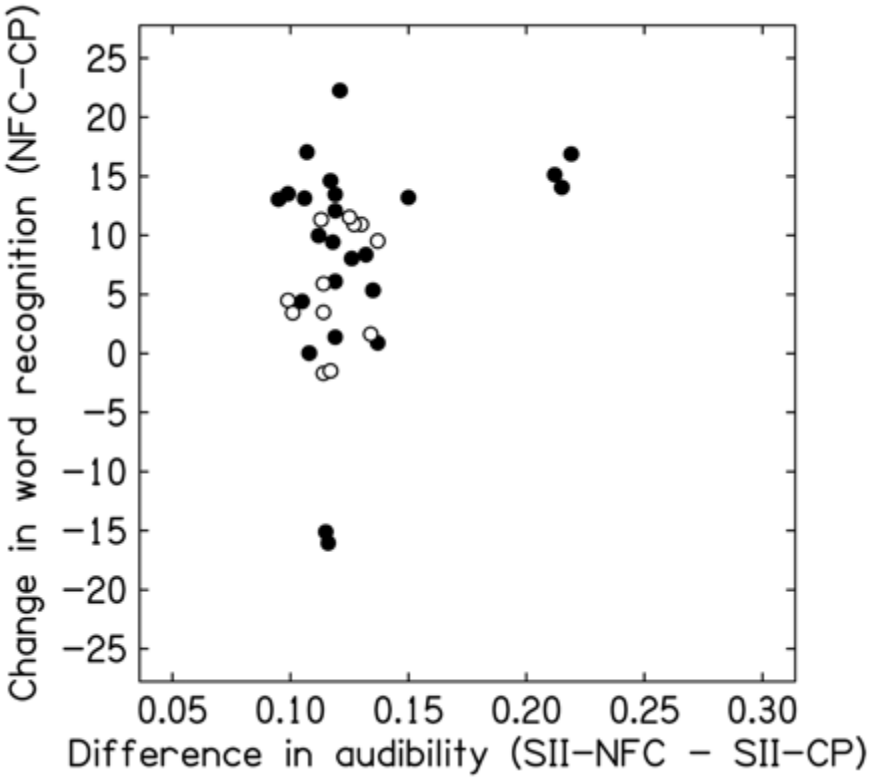
- Consonant perception: *Glista et al. 2009; Auriemmo et al. 2009; Ching et al. 2013; Wolfe et al. 2015*
- Vowel perception: *Glista et al., 2009*
- Parental reports: PEACH—*Ching et al. 2013*
- Speech production: *Ching et al. 2013*
- Global language & receptive vocabulary: *Ching et al. 2013*

Frequency-lowering technology—systematic reviews

McCreery et al. (2012):
"The majority of research in this area contains methodological limitations that restrict our ability to draw strong conclusions; however, outcomes were generally positive across outcome measures."

Akinseye et al. (2018):
"Thus, further high-quality studies for all populations is required to give a conclusive answer as to whether NLFC is beneficial for individuals with hearing loss."

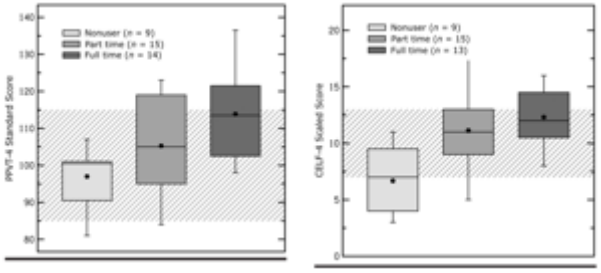
McCreery et al. (2014). Ear Hear, 35(4): 440–447.



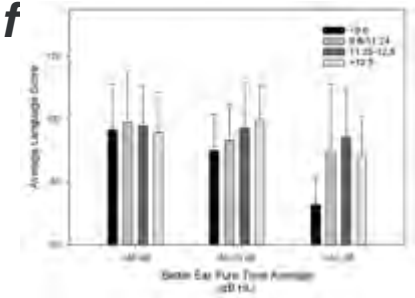
24 adults
12 children
Mild to severe SNHL

Daily use (data logging)

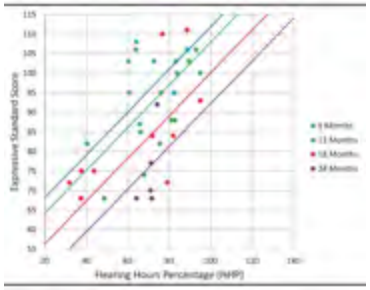
Significant correlation between "auditory dosage" and language f



Walker et al. (2015). J Speech Lang Hear Res, 58:1611-1625.
McCreery & Walker (2022). Ear Hear, 43(2): 347–360.

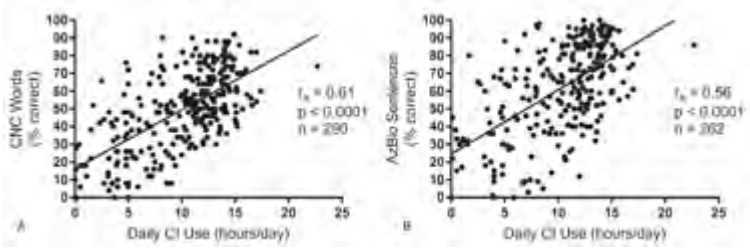


Tomblin et al. (2015). Ear Hear, 36:76S–91S.

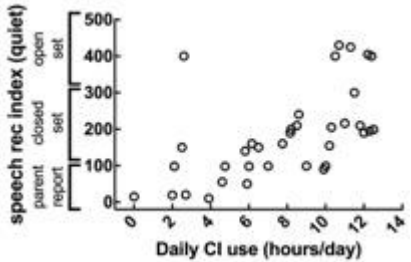


Gagnon et al. (2021). J Speech Lang Hear Res, 64: 1369-1375

Significant correlation between CI daily use and auditory skills for adults & children



Holder et al. (2020). Otol Neurotol, 41(2):e227-e231.
Schvartz-Leyzac et al. (2019). Otol Neurotol, 40:e686–93.



Wiseman et al. (2021). Ear Hear, 42:1042-1053.
Easwar et al. (2018). J Am Acad Audiol, 29(9):835-846.

Research-proven guidance for technology recommendations

Single-sided deafness (SSD)

Prevalence of SSD

Adults:

- 12 to 27 individuals in every 100,000 people in the general population
- prevalence of UHL in adult Americans is ~7%
- 0.14% to 1.5% of adult Americans have moderate (or poorer) UHL (SSD)
  - Liu et al. (2020). *J Int Med Res*, 48(1):300060519896912;
  - Kay-Rivest et al. (2022). *Laryngoscop*e, 132(8):1652-1656.

Children:

- ~1 in 1000 children born in the U.S. have UHL
- Barsky-Firkser et al. (1997). Pediatrics, 99(6):E4;
  - Lieu et al. (2018). *Curr Otorhinolaryngol Rep*. 2018;6(1):74-81.

Intervention options for SSD

- Remote microphone system
- Contralateral routing of signal (CROS)
- Bone anchored implant (BAI)
- Cochlear implant
- “Do nothing”

High prevalence of individuals with SSD/AHL seeking cochlear implantation.

Patro et al. (2022). Otol Neurotol, 43(9): e992-9. doi: 10.1097/MAO.0000000000003670.

774 adults seen at VUMC for preoperative evaluation from 2015-2020

745 met CI criteria

- 83.9% met conventional CI criteria
- 18.5% met Hybrid/EAS criteria
- 32.1% met SSD/AHL criteria (5.5% SSD, 26.6% AHL)

Clinical decision making

BAI: *Unilateral auditory stimulation*

→ Poor localization (e.g., Arndt et al., 2011; Grantham et al., 2012)

→ Cross-modal neuroplastic changes (Sharma et al., 2016)

→ aural preference syndrome (Kral et al., 2013; Gordon et al., 2015)

CI: *Bilateral auditory stimulation*

Access to *high-frequency ILDs*

→ Significantly better localization & speech rec benefits in complex conditions (e.g., Arndt et al., 2011; Dorman et al., 2016; Dillon et al., 2020; Park et al., 2021, 2023; Arras et al., 2022; Thompson et al., 2022)

→ Qualitative reports of better speech & spatial hearing abilities (Arndt et al., 2011; Dillon et al., 2017, 2020; Lindquist et al., 2022; Olze et al., 2023)

→ Tinnitus suppression (Arndt et al., 2011; Lindquist et al., 2022)

Assessing outcomes for CI recipients with SSD

Adult SSD CI

Dillon et al. (2022). American Cochlear Implant Alliance task force guidelines for clinical assessment and management of adult cochlear implantation for single-sided deafness. Ear Hear, 43: 1605-1619. doi: 10.1097/AUD.0000000000001260.

Assessing outcomes for CI recipients with SSD

Pediatric SSD CI

Park et al. (2022). American Cochlear Implant Alliance task force guidelines for clinical assessment and management of cochlear implantation in children with single-sided deafness. Ear Hear, 43: 255-267. doi: 10.1097/AUD.0000000000001204.

Dillon et al. (2022). Ear Hear, 43: 1605-1619.
Park et al. (2022). Ear Hear, 43: 255-267.

Validation of SSD CI fittings—speech recognition testing

Considerations

- Listening condition
- Loudspeaker configuration

Dillon et al. (2022). Ear Hear, 43: 1605-1619.
Park et al. (2022). Ear Hear, 43: 255-267.

Validation of SSD CI fittings – speech recognition testing

Considerations

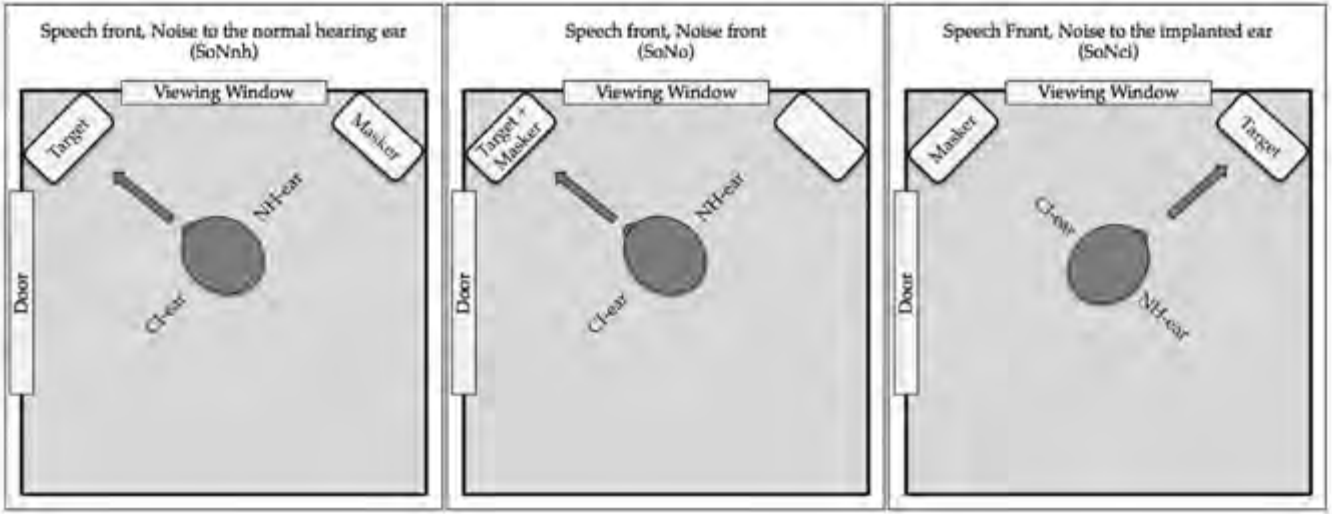
- **Listening condition**
  1) **Direct audio input**
  2) **“Plug and muff”**
  3) **Mask non-CI ear**

Park et al. (2021). Cochlear Implant Intl, 22(5):283-290.

Dillon et al. (2022). Ear Hear, 43: 1605-1619.
Park et al. (2022). Ear Hear, 43: 255-267.

Validation of SSD CI fittings—speech recognition testing Considerations

- **<u>Loudspeaker configuration</u>**



Mild to moderate SNHL

Prescription and OTC HAs: **Adults**

Ferguson et al. (2017). Hearing aids for mild to moderate hearing loss in adults. Cochrane Database Syst Rev, 9(9):CD012023.
doi: 10.1002/14651858.CD012023.pub2.

Mild to moderate SNHL

Prescription and OTC HAs: **Adults**

Sereda et al. (2015). Consensus on hearing aid candidature and fitting for mild hearing loss, with and without tinnitus: delphi review. Ear Hear, 36;417–429 doi: 10.1097/AUD.0000000000000140.

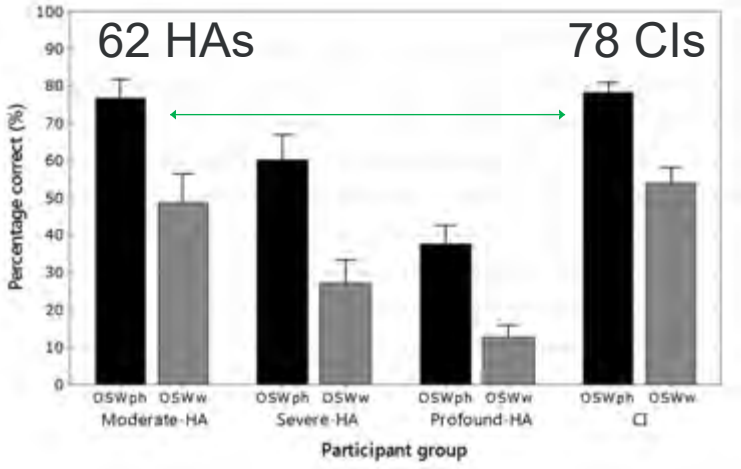
Mild to moderate SNHL

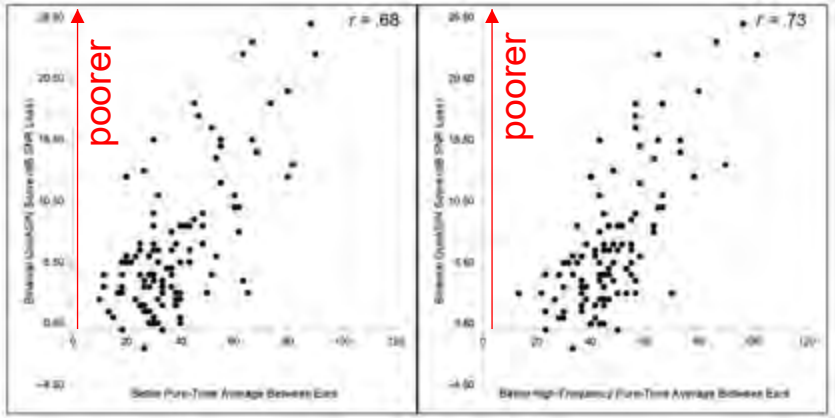
Prescription ~~and OTC~~ HAs: **Children**

Children

AAA (2013). American Academy of Audiology Clinical Practice Guidelines: Pediatric Amplification.
www.audiology.org

Moderate to severe SNHL





107 adult HA users

Leigh et al. (2016). Int J Audiol, 55: S9–S18.

Davidson et al. (2022). Am J Audiol, 31: 21-31.

Severe-to-profound SNHL

Buchman et al. (2020). Unilateral cochlear implants for severe, profound, or moderate sloping to profound bilateral sensorineural hearing loss: a systematic review and consensus statements. JAMA Otolaryngol Head Neck Surg, 146(10):942-953.

30 specialists
13 countries
4 continents

Turton et al. (2020). Guidelines for best practice in the audiological management of adults with severe and profound hearing loss. Semin Hear, 41:141–246. doi: 10.1055/s-0040-1714744.

Adult CI referrals

Zwolan et al. (2020). Development of a 60/60 guideline for referring adults for traditional CI candidacy evaluation. Otol Neurotol, 41:895–900. doi: 10.1097/MAO.0000000000002664.

60/60 criterion for adult CI referrals

Zwolan et al. (2020). Otol Neurotol, 41:895–900.

60/60 referral guidance → measures routinely collected by audiologists

- **PTA** (.5, 1, and 2 kHz) in better hearing ear ≥ **60 dB HL** AND
- **unaided word rec** in better hearing ear ≤ **60%**

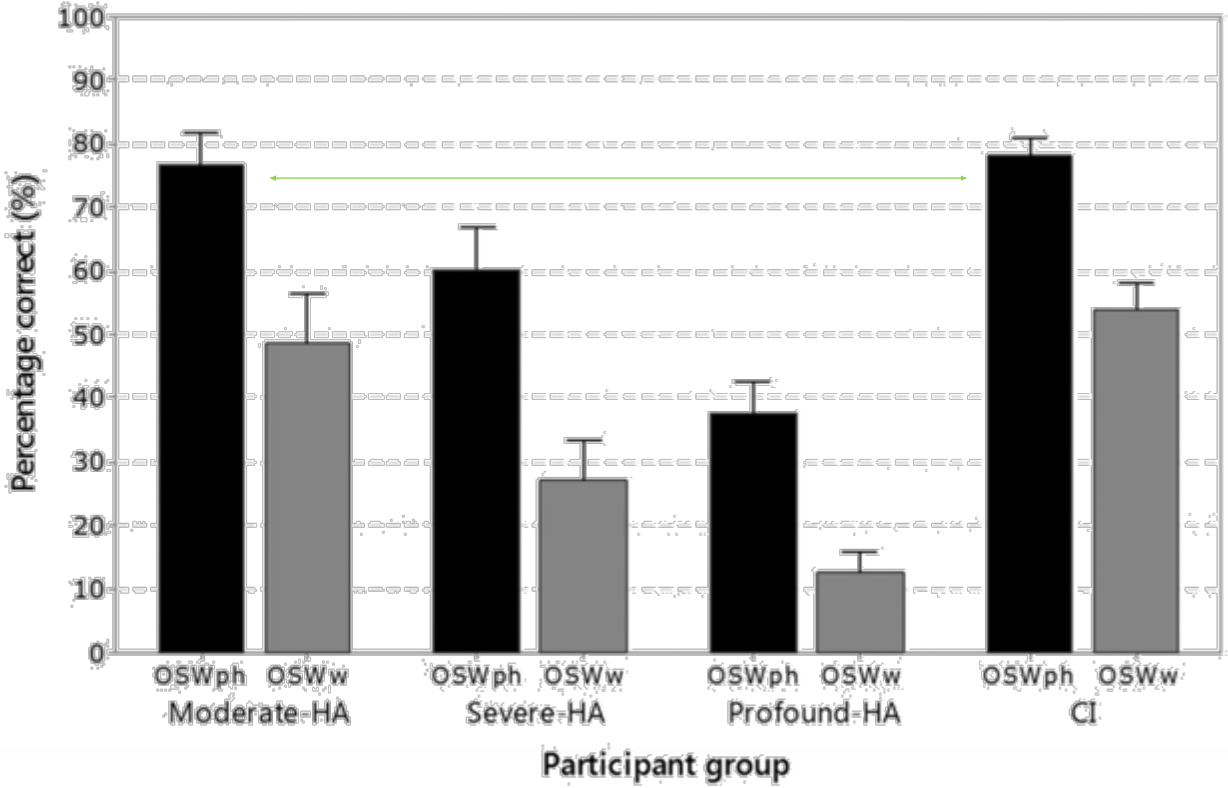
RESULTS

- 95% of CI candidates → better ear PTA ≥ 60 dB HL
- 92% of candidates → word score ≤ 60%
  - **Hit Rate**: 60/60 was accurate for 340 of 415 **(82%)**
  - **Miss Rate**: 75 of 415 **(18%)** meeting 60/60 guideline did not qualify for a cochlear implant

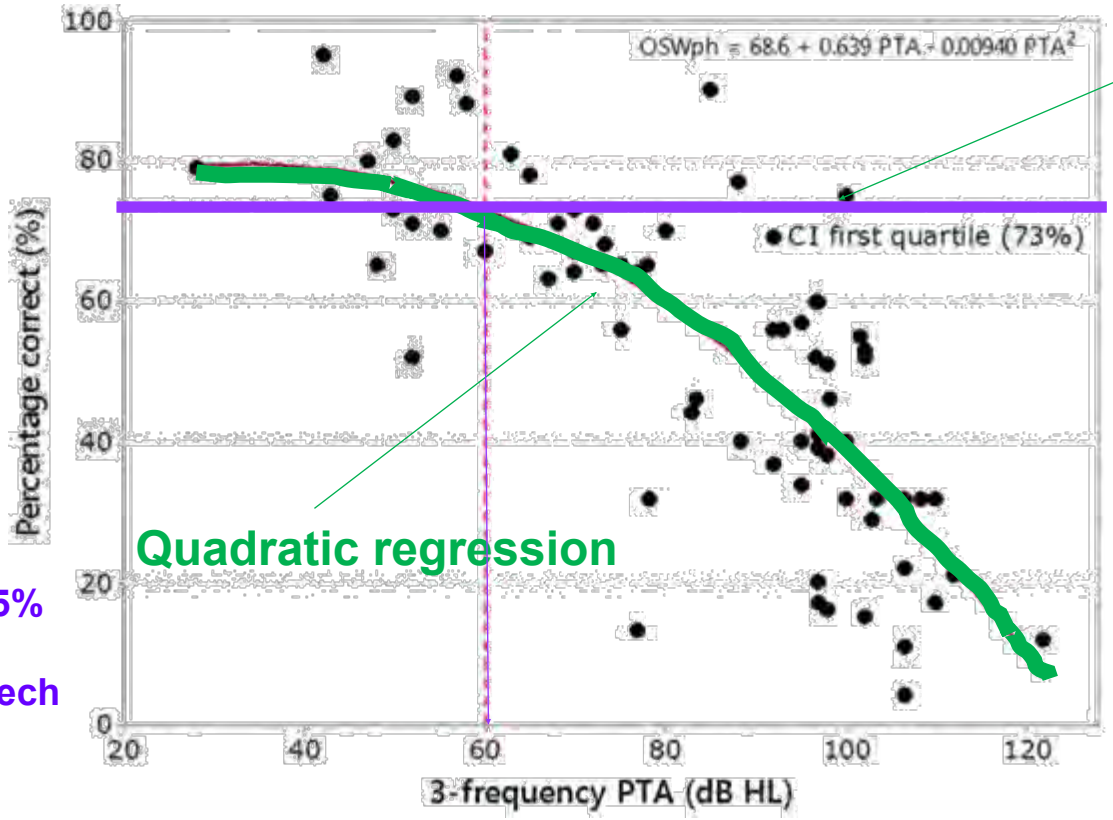
Pediatric CI referrals

Leigh et al. (2016). *Intl J Audiol*, 55: S9–S18.

OSW:
open-set
words



Leigh et al. (2016). *Intl J Audiol*, 55: S9–S18.



Lower limit of IQR

Quadratic regression

PTA > 60 dB HL → 75% of children with CI achieved higher speech rec outcomes

Summary

- Hearing loss is the 3rd most common chronic condition in U.S. (CDC) and 4th leading cause of disability globally (WHO)
- Multiple hearing technologies available, many of which have overlapping indications and fitting ranges
- Best practices: verification & validation of all fittings
  - Verification: REMs for HAs, functional gain for CI & BAI
  - Validation: Aided speech recognition & PROMs for all technologies
- Data-driven recommendations for hearing technology
  - Individual considerations

Thank you for your attention.

rene.gifford@vumc.org

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