



Hearing loss & Aging

- Lancet Study 2017
 - Untreated hearing loss is one of the top risk factors for dementia.
 - Even mild degrees of hearing loss increase longterm risk of cognitive decline and dementia.
 - In individuals older than 55 years, approximately 32% have some degree of hearing loss.
 - Deemed a mid-life risk factor for cognitive decline.



- hearing cohort vs. 11.4% in self-reported hearing loss cohort. (Li et al., 2014)
- Higher healthcare costs
 - 33% higher in patients with HL over a 1.5 year period) $({\mbox{Simpson et al., 2018}})$

PHEARTS IN HEAR

Co-morbidities and HL

- Diabetes
 - 1.4 odds ratio of developing hearing loss (Kim et al., 2017)
- Hypertension & Stroke
 - 85% of stroke victims had a flat or low-frequency hearing loss (Friedland, 2009).
- Higher Mortality
 - Hearing loss associated with higher mortality rates
 - Especially in men (Fisher et al., 2014).

Dementia and Hearing Loss (HL)

- Incident all-cause dementia

 Increases 1.27 times for each 10 dB of HL
- Incident Alzheimer's Disease
 Increases 1.2 per 10 dB of HL
- Hazard Ratios by degree of hearing loss
 - 1.89 for mild hearing loss
 - 3.00 for moderate hearing loss
 - 4.94 for severe hearing loss
 - (Frank Lin et al., 2011)

Estimates of Hearing Device Use

- 1.2 million children & adults with severe to profound HL
- Hearing aid use in general ~ 20% (NIH, 2010).
 90% use in profound HL
 - 70% use in severe losses
 - 10-30% in mild to moderate hearing losses
- ~0.03% report severe hearing loss that limits aided benefit (iData)

Cochlear Implant Use (2012)

- Worldwide: 324,200 cochlear implantations
- United States: (As of 2012, based on registered devices reported to FDA)
 38,000 children
 - 58,000 adults
- Estimated utilization/provisions of cochlear implants in the US for all age groups ~6%
 - Pediatrics: 50% in US (90% in parts of Europe)
 - Adults:

Why don't more people receive CIs?

- Low general awareness
- Low awareness of candidacy and outcomes - Even among hearing healthcare professionals
- Political issues associated with deafness
- Clinic and hospital financial issues
- No "standard of care" best practices guidelines
- · Lack of data indicating cost-effectiveness

(Sorkin, 2013)

Profiles of current CI referrals

A very recent study (2018) revealed that individuals being referred for CI evaluations present with an average PTA of 89 dB HL and are, on average, very poor performers with hearing aids.

Further, average scores on CNC words were 10% and AZ Bio Sentences were 13% which are much poorer than scores required to qualify for CIs through current insurance and FDA indications. (Holder et al., 2018)

Profiles of current CI referrals

- Only 29% of patients had HAs that met NAL-NL2 targets.
- Well over half didn't have HAs on when they came for CI eval, claiming limited benefit.
- 82% received a CI
 - Of those who did not, only 27% (n=14) exceeded criteria.
- This suggests people are not being referred soon enough for optimal benefit with Cl. (Holden et al., 2018)

What if provision of CI could reason reduce cognitive decline?

- Provision of a cochlear implant can positive impact a patient's mental flexibility and impact memory. (Mosnier & colleagues, 2015)
- You could speculate that:
 - Improved hearing increases likelihood that a patient is less socially isolated and as a result, less likely to suffer depression.
 - Being able to engage in a conversation reduces mental decline and actively engages the brain in activity that supports mental health.





Cochlear implants...

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- Bypass damaged OHC & IHCs in the cochlea
- Directly stimulate the auditory nerve fibers, which sends the signal to the brain
- Electric hearing vs acoustic hearing
- Requires aural rehabilitation for best outcomes
- CIs can be successful for many patients who do not benefit adequately from appropriately fit hearing aids.



Traditional, FDA approved Contract of Annual Adult Cochlear Implant Candidacy

- Bilateral, moderate to profound SNHL
- Limited benefit from amplification
 - Commercial insurances (Varies)
 - Pre-operative test scores ≤ 50% sentence recognition in the ear to be implanted and ≤60% in the opposite ear or binaurally.
 - Medicare:
 - 40% or poorer in best aided condition on speech perception testing

Hybrid Audiometric Considerations

- Low Frequency: Normal to Moderate SNHL – <u><6</u>0 dB HL at 500 Hz and lower
- Mid to High Frequency: Severe to profound − ≥ 75 dB (2000, 3000, 4000 Hz)
- CNC Scores:
 - 10-60%

In ear to be implanted

Hybrid Audiometric Candidacy Moderately severe to profound mid to high frequency HL – ≥ 60 dB HL (average at 2000, 3000, & 4000 Hz) CNC words – ≤ 80% correct In contralateral ear

PHEARTS IN HEA Adult (18 yrs +) CI Candidacy Company Audiometric Criteria General Criteria Speech Perception Abilities Advanced Bionics < 50% sentence Cochlear Moderate to Limited benefit profound SNHL from well-fit recognition in ear amplification to be implanted and <60% in the opposite ear or binaurally. Med-El

CHEARTS / HEARI

- Improvements in cochlear implant electrode arrays, surgical techniques, speech processing technologies and sound processors means more people will benefit.
- How do surgical and audiological decisions get made after the patient is determined to be a candidate?

Medical considerations • Pertinent factors - Age - Etiology • Expectations • Motivation • Reservations with certain types of medical issues • Dementia • Brittle diabetes • Progressive loss • Autoimmune

• These patients are still implant candidates, but may change device recommendation

Candidacy Considerations

- Stable or progressive loss?
- Patient age
- Duration of profound high frequency hearing loss
- Cognitive status?
- Patient expectations and lifestyle should be considered key factors
- Quality of life and subsequent life demands are key components to determining the importance/need for LF hearing





Diagnostics and Outcomes

- Standard Diagnostic Test Battery
 - Immittance Testing
 - Acoustic Reflex Thresholds
 - Pure tone air and bone conduction testing
- Provision of appropriate, well-fit hearing technology.
 - You have to measure (verify) it, to validate it!



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Speech perception testing

Earphones or Hearing Aids?
 Standard protocol for unaided word recognition testing

Testing for all patients

- Unaided speech perception testing is okay for intakes, but what about following HA fit?
- Following a HA fitting (2-4 weeks post)
- All patients should have <u>recorded</u> word recognition testing completed, at the very least, in the binaural condition.
- COSI: Did patients perceive improvement?

RECORDED Speech testing

- MLV: Variability that often overestimates a patient's listening abilities.
- Recorded testing eliminates variability in talker characteristics allowing for a valid comparison of scores obtained across time (Roeser & Clark, 2008).
- Recorded material resulted in a 13% decrease in performance on compared to results w/ MLV

(Uhler, Biever, & Gifford, 2016)

You've done the hearing aid fitting and validation testing...

- Now, consider CI eval for...
 ANY patient with a severe to profound hearing loss
- ANY patient with a normal to profound hearing loss with limited benefit from HAs
- ANY patient who is struggling with hearing aids (has tried multiple sets/unsatisfied)
- When in doubt, refer! We will send them back if they aren't a candidate!!!!

What's next for the patient?

- Audiological candidacy evaluation

 Full diagnostic evaluation, including use of MSTB
- Medical candidacy evaluation

 Medical work up, including imaging

*** Often best to start with audiology, but may need referral from physician.

Minimal Speech Test Battery

• AZ Bio

- In quiet
- In noise (+10 dB continuous noise/speech babble)
- Right ear, left ear, binaurally aided (Best aided condition)
- CNC words
 - Right ear, left ear, binaurally aided
- QuickSIN or other SIN (If a patient experiences significant decrease in performance in noise, a CI may be an option)

















– Options

Surgery Center of Oklahoma

Why is Implant Selection so important?

- Audiometric Criteria
- Depth of Insertion
- Ease of Insertion
- Functional Hearing
- Reliability
- Compatibility
- Performance

Which ear to implant?

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Fielden, Mehta, & Kitterick (2016) recommended the following considerations for ear to implant:

- 1) Duration of deafness?
- 2) Device use prior to CI?

3) Can the patient make use of bimodal technologies?

4) Consider CI in better ear in situations where worse ear likely wont benefit.

5) What options promote binaural hearing?

• Typical cases: - 2 hour outpatient surgery - Follow up with surgeon next day - Activation set 2-4 weeks after surgery

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• Several appointments designed to maximize

- hearing abilities as the brain adjusts to electrical stimulation delivered via CI.
- Specific measurements are conducted to set appropriate stimulation levels:
 - Threshold level measurements
 - Most comfortable level measurements
 - Frequency specific adjustments

Post-activation follow ups

- Clinic protocols vary, but Hearts for Hearing is as follows:
 - Day 1, Day 2
 - 1 week post-activation
 - 1 month post-activation
 - Every 3 months thereafter for $1^{\mbox{\scriptsize st}}$ year
 - Every 6 months to once a year after the first year
 Patient and progress dependent

HEARTS IN HEAR PHEARTS IN HEA New CI Delivery Models? Managing the CI patient • Teleaudiology: Cochlear Implant Audiologist Remote programming opportunities - Manages patient's MAP which changes quite a bit over the first 3-6 months · New clinical models for CI activation and - Manages residual hearing on the implant ear follow up care? Hearing Aid Audiologist – Use of artificial intelligence? - Can manage contralateral ear - One in the same? - Provision of remote microphone technology?

Progress & Outcomes with a CI

- Affected by a variety of factors:
 - Attitude, including perceived benefit
 - Duration of Deafness, especially HF deafness
 - Hearing history
 - Patients with significant trauma (blast noise exposure, extensive noise exposure) are less likely to do as well.
 - Cognitive Status
 - Processing vs. hearing
 - Counseling regarding benefit is important in these situations







 Options exist for all CI companies to enhance residual hearing with an acoustic component on the sound processor.









Hearing Healthcare Providers

- Frontline providers best suited to refer for CI evaluation.
- When you see a patient who may be a CI candidate, refer them on (upserving), rather than selling them new hearing aids that may not improve their condition.
- Postponing a CI referral may result in:
 - Poorer outcomes
 - Longer acclimatization periods
 - Increased chance of cognitive decline despite HA use.



Speech perception testing

- Unaided speech perception testing is okay for intakes, but what about after HA fit or to make CI referral?
 - Speech testing under earphones was shown to overestimate aided abilities. For patients with word recognition under earphones ≥ 50% were actually CI candidates based on AZ Bio +10 dB SNR scores.
- All patients should have <u>aided</u> word recognition testing completed, at the very least, in the binaural (best aided) condition using <u>recorded</u> stimuli.

(Assuming appropriately fit hearing aids), refer for CI evaluation when patient.. has difficulty hearing on the telephone. has family members make phone calls for them. is unable to understand without visual cues

- has difficulty hearing in background noise
- has difficulty hearing in home, work, group situations (patient or family reported)
- has normal to severe or profound HL with limited benefit from HAs.

When in doubt, refer! We will send them back if they aren't a candidate!!!!

Referring is serving!

- Discussing your efforts to help the patient
- Considerations of their goals and hopes
- Sending them for an evaluation does not mean they are already a candidate, but it means that you care enough to find out and that patient can be routinely monitored so that as soon as they are a candidate, they can benefit sooner than later and have better outcomes.



Referral checklist

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- Degree & type of hearing loss?
- Appropriately fit hearing aids (RECD & REMs)?
- Hearing aid trial?
- Aided speech perception testing (w/well-fit hearing aids)? (CNC words/AZ Bio/QuickSIN)
- Poor performance w/HAs
 - Multiple sets with limited satisfaction
 - Limited ability to understand on the telephone
 - Limited ability to hear in noisy environments

Understanding Changing Changing Changing

Also consider referring patients with:

- Asymmetric Losses
- Single-Sided Deafness
- Severe to profound high frequency hearing loss
- Hearing aids may not be enough, but are cochlear implants the answer?
 - Careful consideration
 - Not a candidate? We will refer them back!



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References
Blackwell, D.L., Lucas, J.W., Clarke, T.C. (2014). Summary health statistics for U.S. adults: National health interview survey, 2012; <i>National Center for Health Statistics. Vital</i>
Fielden, C.A., Mehta, R.L., Kitterick, P.T. (2016). Choosing which ear to implant in adult candidates with functional residual hearing. <i>Cochlear Implants International</i> , (71):1175-1175.
1/(s1), 4/-50. Fisher, et al., (2014). Impairments in hearing and vision impact on mortality in older people: The AGES-Reykjavik Study. Age and Ageing, 43.69-76.
Friedland, D.R., Cederberg, C., & Tarima, S. (2009). Audiometric pattern as a predictor of cardiovascular status: Development of a model for assessment of risk. <i>Laryngoscope</i> , 119(3), 473-486.
Holder, J.T., Reynolds. S.M., Sunderhaus, L.W. & Gifford, R. (2018). Current profile of adults presenting for preoperative cochlear implant evaluation. <i>Trends in Hearing</i> , 22, 116
iData Research Inc. 2010. US Market for Hearing Aids and Audiology Devices. www.idataresearch.net.

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References
Kim, M-B, Zhang, Y., Chang, Y., Ryu, S, Choi, Y., Kwon, M-J,Cho, J. (2017). Diabetes mellitus and the incidence of hearing loss: A cohort study. <i>International Journal of Epidemiology</i> , 717-726.
Lin, F. & Ferrucci, L. (2018). Hearing loss and falls among older adults in the United States. Archives of Internal Medicine, 172(4), 369-371.
Lin, F.R., Metter, E.J., O'Brien, R.J., Resnick, S.M., Zonderman, A.B., Ferrucci, L. (2011).
 Li, C. & Hoffman, H. (2014) Untangling the link between hearing loss and depression. <i>The Hearing Journal</i>, 67(7), 6.
Livingston, G., Sommerlad, A., Orgeta, V., Costafreda, S.G., Huntley, J Mukadam, N. (2017). Dementia prevention, intervention, and care. <i>Lancet</i> , 390, 2673-2734.
McRackan, T. R., Fabie, J.E., Burton, J.A., Munawar, S., Holcomb, M.A., & Dubno, J.R. (2018). Earphone and aided word recognition differences in cochlear implant candidates. Otology & Neurotology, 39, 3543-549.

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THEARTS # HEARING
References
Mosnier, I., Bebear, J., Marx, M., Fraysse, B., Truy, E., Lina-Granade, G., Sterkers, O. (2015).
Improvement of cognitive function after cochlear implantation in elderly
patients. JAMA Otolaryngology Head & Neck Surgery, 141(5), 442-450.
National Institute on Deafness and Other Communication Disorders. (2004).
Heathy hearing 2010: Where are we now? DATA2010, the healthy people 2010
database.
National Institute on Deafness and Other Communication Disorders (2016). Cochlear Implants. Bethesda, MD: NIH Public
Simpson, A.N., Simpson, K.N., & Dubno, J.R. (2018). Higher health care costs in middle-aged
adults with hearing loss. JAMA Otoloaryngology Head and Neck Surgery, 142(6), 607-609.
Sladen, D.P., Gifford, R.H., Haynes, D., Kelsall, D., Benson , A., Lewis, K Driscoll, C.L. (2017).
Evaluation of a revised indication for determining adult cochlear implant candidacy. <i>Laryngoscope</i> , 127(10), 2368-2374
Evaluation of a revised indication for determining adult cochlear implant candidacy. <i>Laryngoscope</i> , 127(10), 2368-2374