Office Hours with Doc Otoblock

An open Q&A with Brad Ingrao, AuD

HLAA Webinar
February 20, 2019

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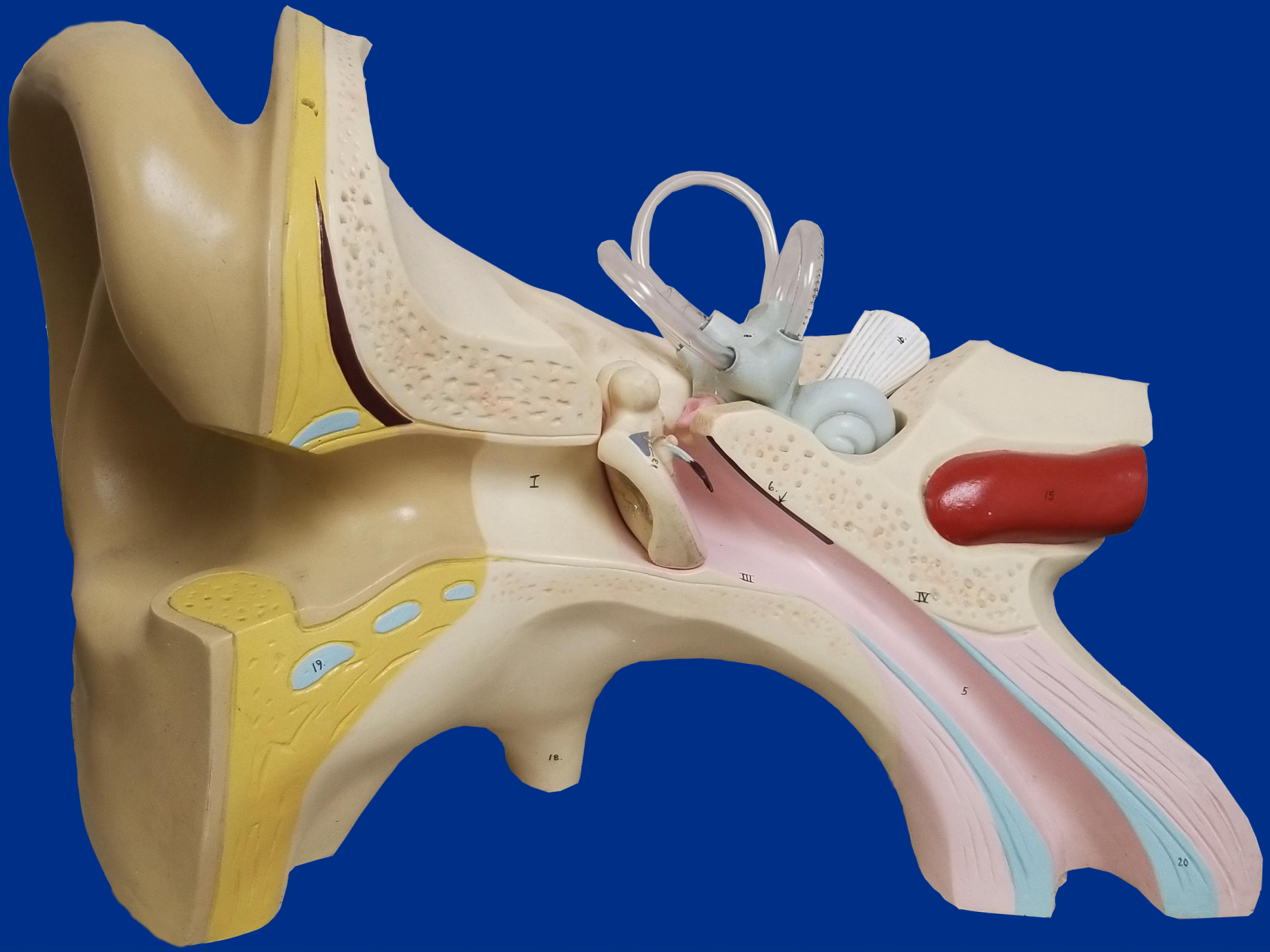

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What is a hearing aid?

Attributed to Samuel Lybarger Modified by Wayne Staab with Sam's approval, for Audiotone in 1979.

- "A hearing aid is an ultra-miniature electro-acoustical device that is always too large.
- It must amplify sound a million times, but bring in no noise.
- It must operate, without failure, in a sea of perspiration, a cloud of talcum powder, or both.
- It is a product that one puts off buying for ten years after he needs it, but cannot do without it for thirty minutes when it has to be serviced."

https://hearinghealthmatters.org/waynesworld/2015/hearing-quotes-and-sayings/

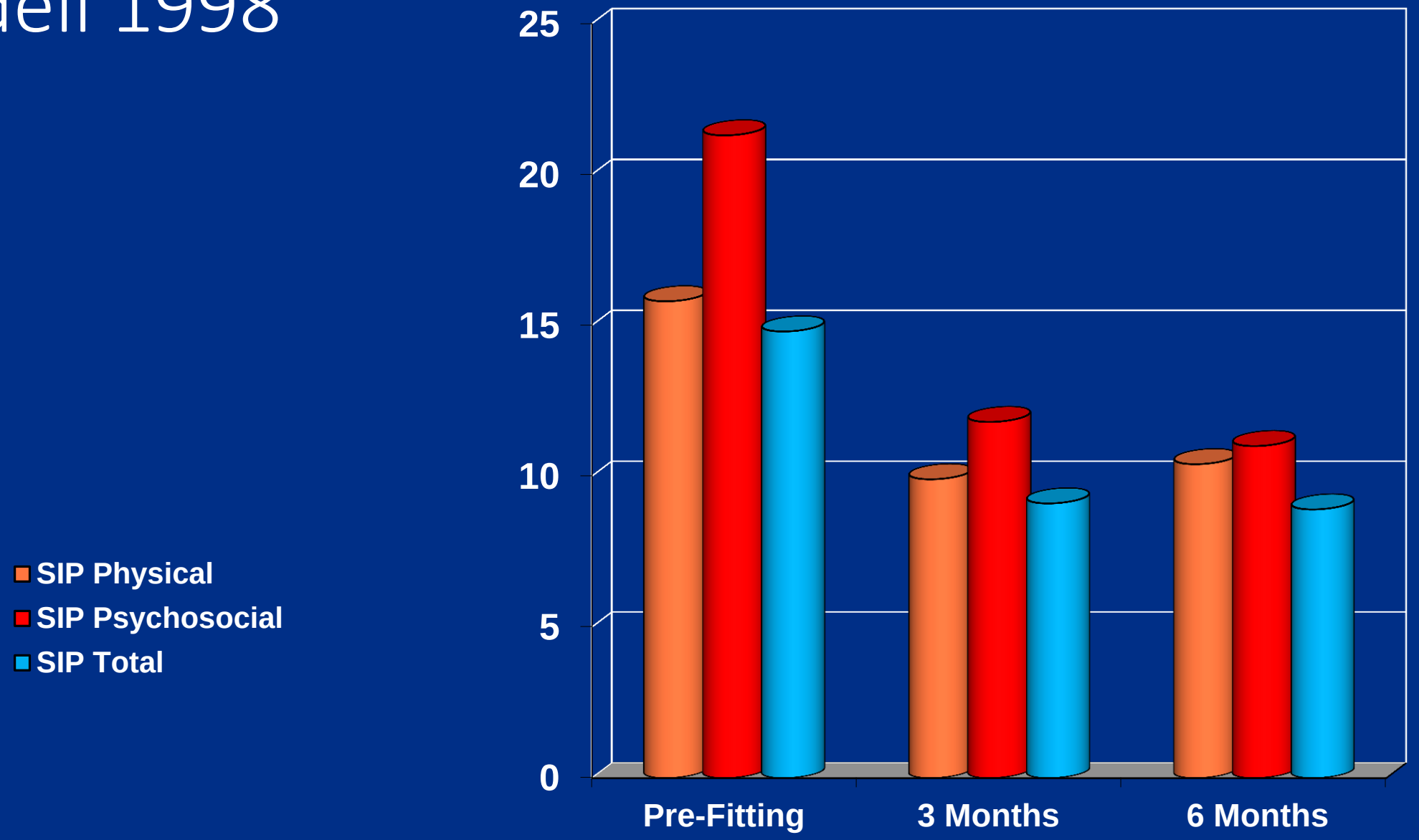
Crandell 1998

Hearing Aids and Functional Health Status

Audiology Today 10(4), 20-23.

- Affect of hearing loss (pre and post fitting) on health using the following scales:
- Sickness Impact Profile (SIP)
  - Physical Scale
  - Psychosocial Scale
- Short Form 36 Health Survey (SF-36)

Crandell 1998



Conclusions

- Hearing loss is very prevalent in the senior citizen cohort
- Untreated hearing loss negatively affects HRQoL
  - Chronic health concerns,
  - Increased managed care load
- Early evaluation and Treatment of HL has a net positive impact on HRQoL

- BUT…. How do patients feel about hearing aids?

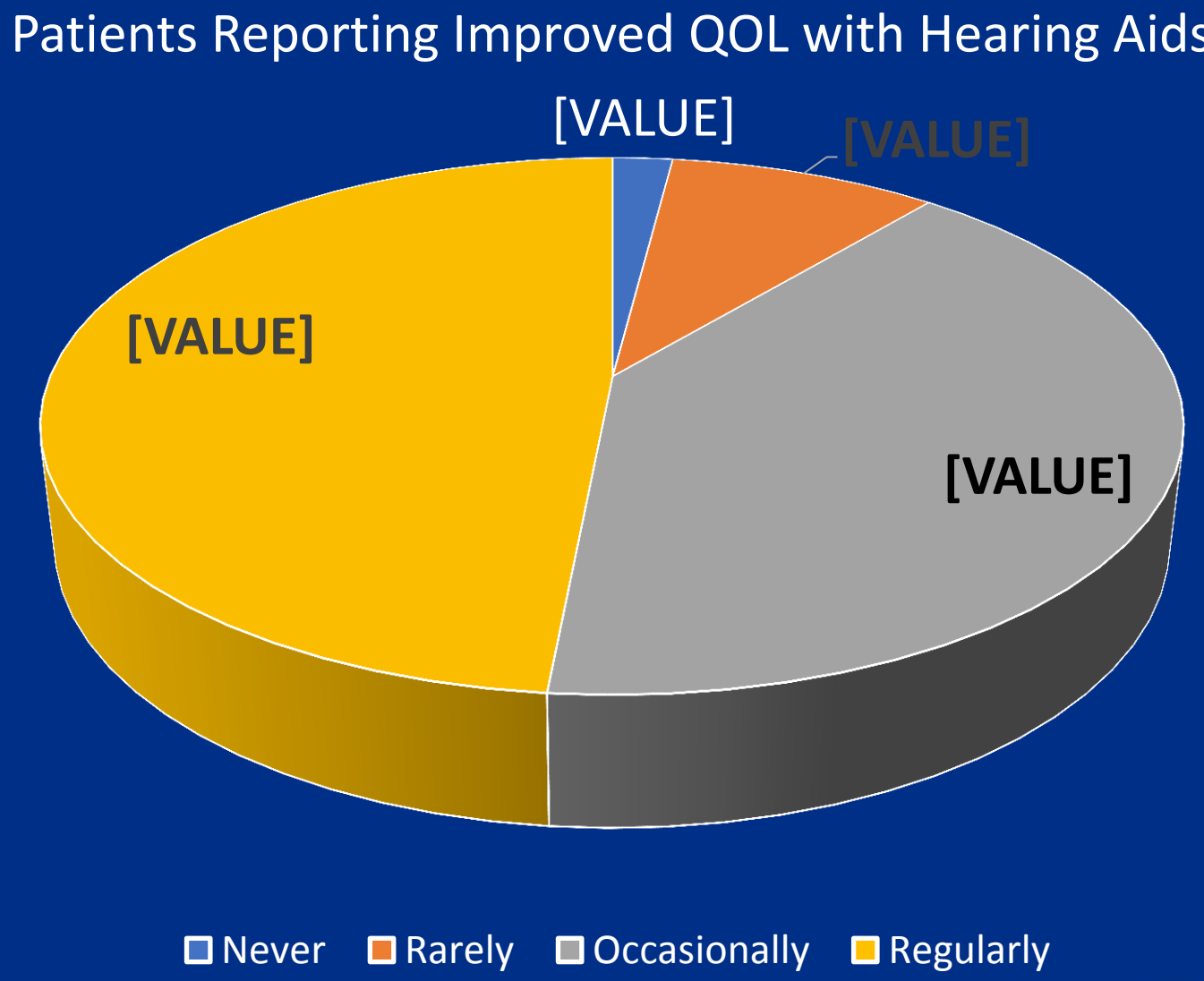
MarkeTRAK

- Consumer survey of hearing aid use and non-use
- Develop by Sergei Kochkin at Knowles Electronics in 1990
- Continued at Better Hearing Institute
- Most recent survey (IX) completed in 2015
- Tracks trends in who does and does not buy hearing aids and why

http://www.hearingreview.com/2015/05/introduction-marketrak-ix-new-baseline-hearing-aid-market/

MarkeTRAK IX

- Owners/users
- N=765’
- HAs < 5 years old



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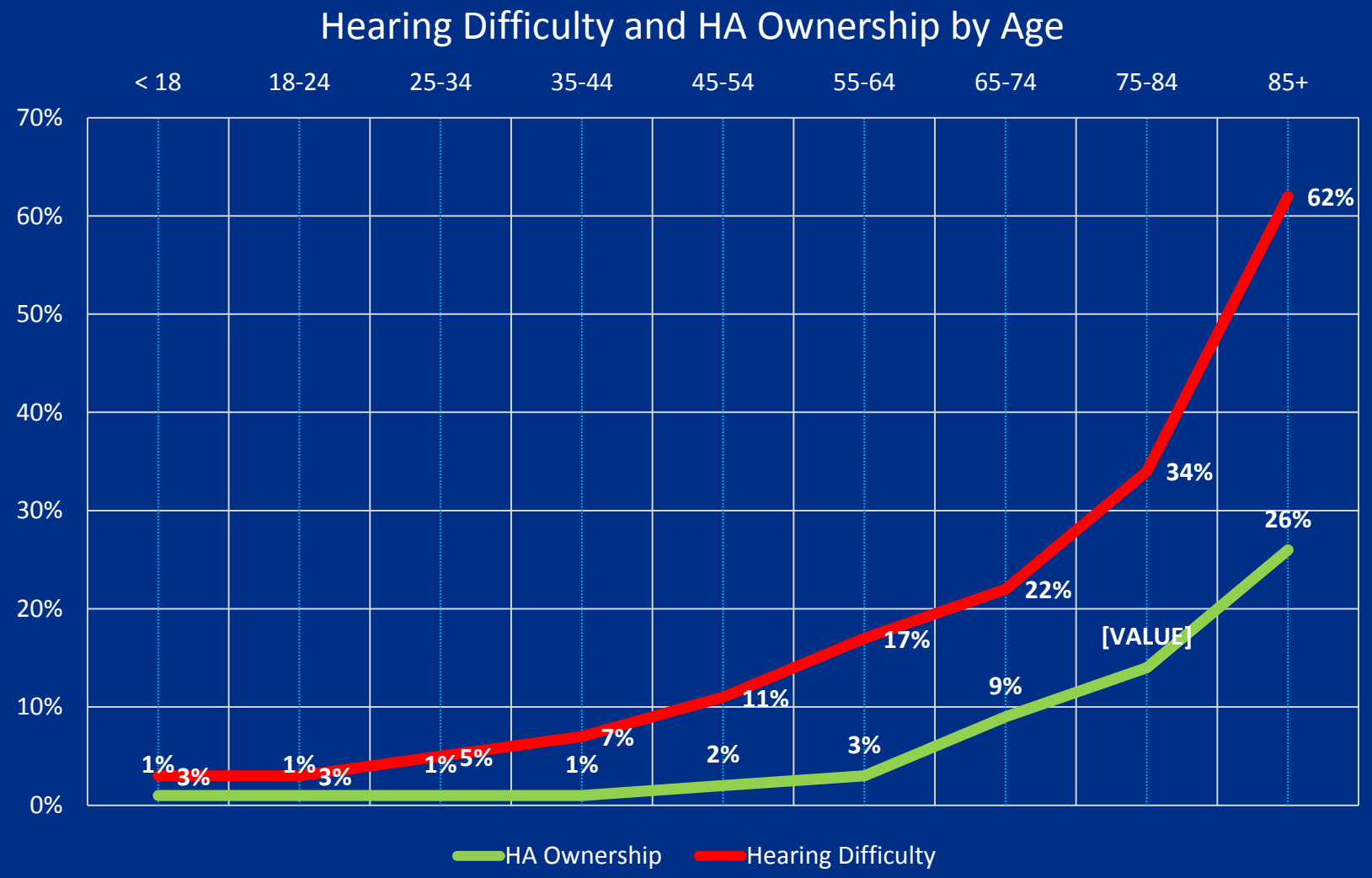
http://www.hearingreview.com/2015/05/introduction-marketrak-ix-new-baseline-hearing-aid-market/

MarkeTRAK IX – Who buys hearing aids?



http://www.hearingreview.com/2015/05/introduction-marketrak-ix-new-baseline-hearing-aid-market/

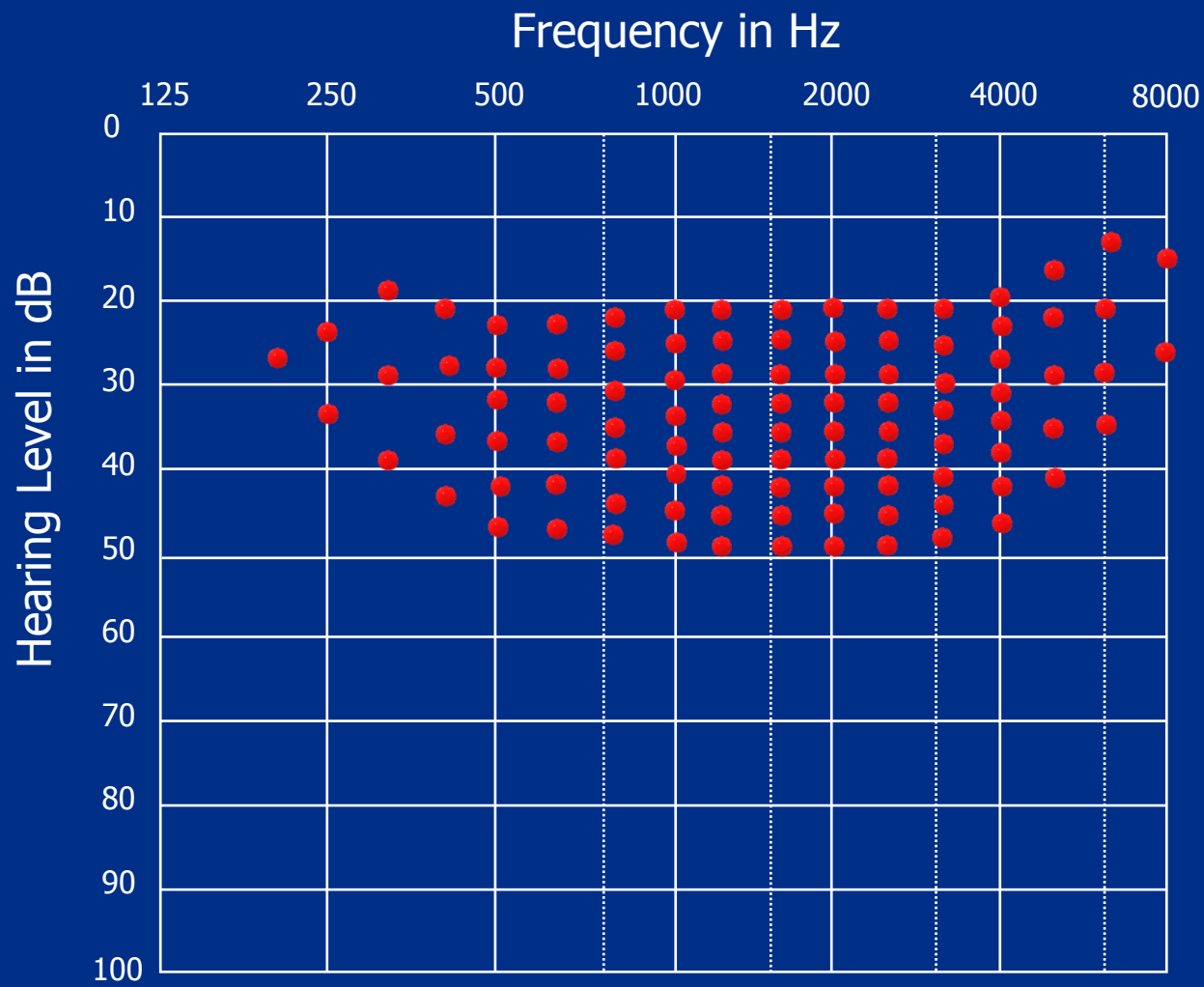
David Pascoe

- “Although it is true that mere detection of a sound does not ensure its recognition, it is even more true, that without detection the probabilities of correct identification are greatly diminished.”

- BUT…. What sounds are most important?

https://hearinghealthmatters.org/waynesworld/2015/hearing-quotes-and-sayings/

Where's the Speech? – Killion and Mueller 2010



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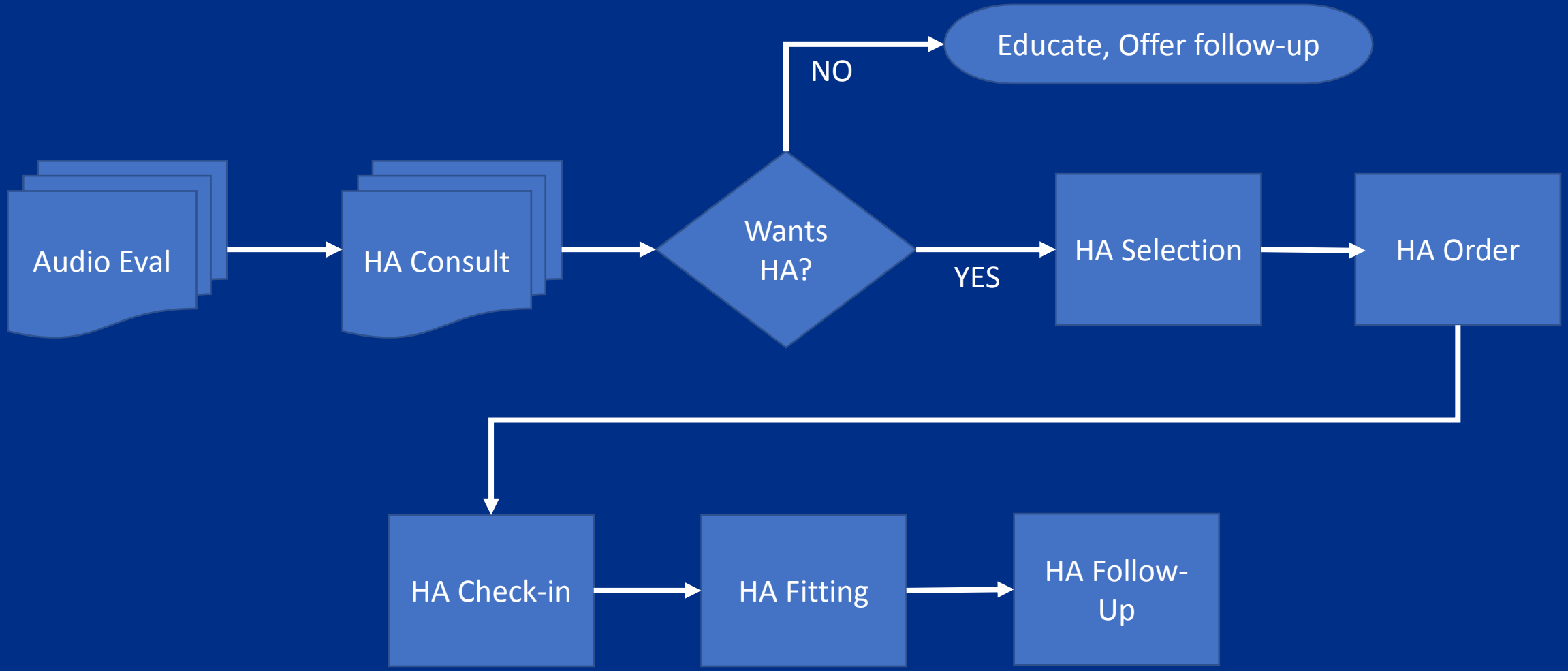
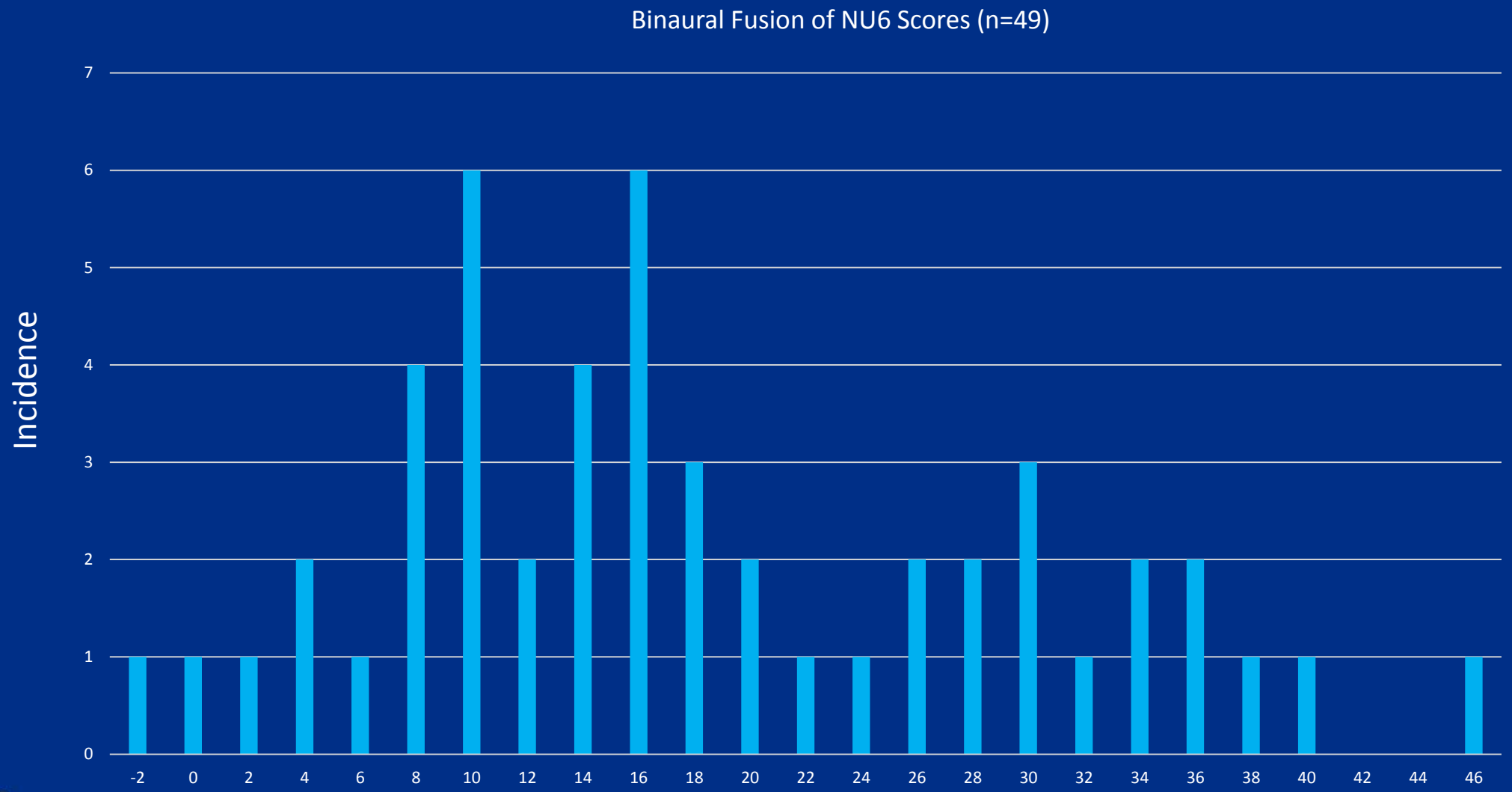
Killion, Mead C.; Mueller, H. Gustav Twenty years later: A NEW Count-The-Dots method. The Hearing Journal 63(1):10,12-14,16-17, January 2010.

Hearing Aid Fitting Process



Binaural Word Recognition

Ingrao 2018 Unpublished Clinical Data Collection



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Hearing Aid Candidacy

- “Hearing aids are not fitted based on the degree of hearing loss necessarily, but on the degree of hurt – and only when that hurt is great enough, whether socially, economically, emotionally, or psychologically, does this individual become a candidate for hearing aids.”

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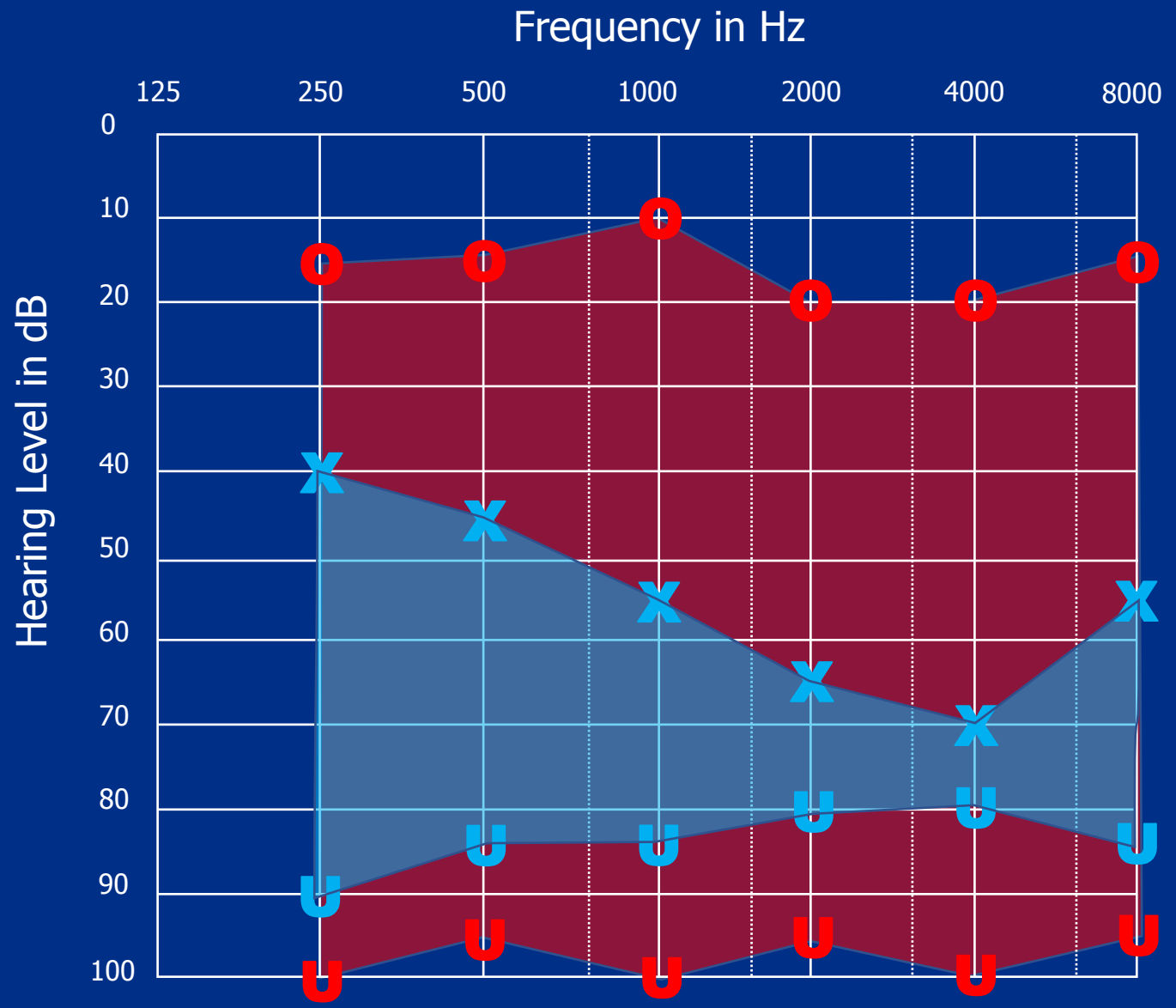
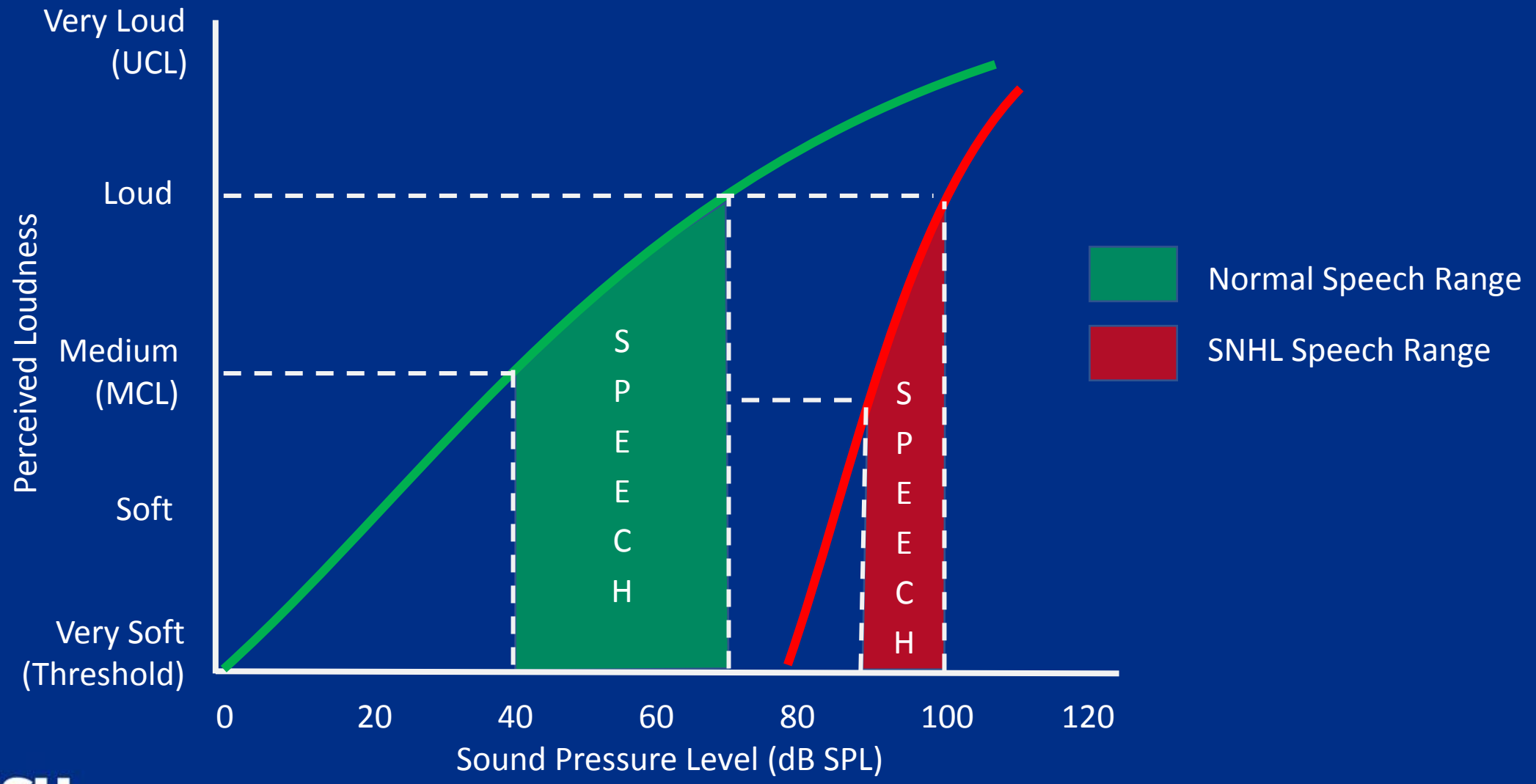
(*Attributed to Wayne J. Staab, Ph.D. Hearing Aid Amplification*, 2nd Edition, 2000, Robert E. Sandlin, Editor.

Dynamic Range

- Useable range of hearing
- Threshold through discomfort



Loudness Perception Correction (Compression)



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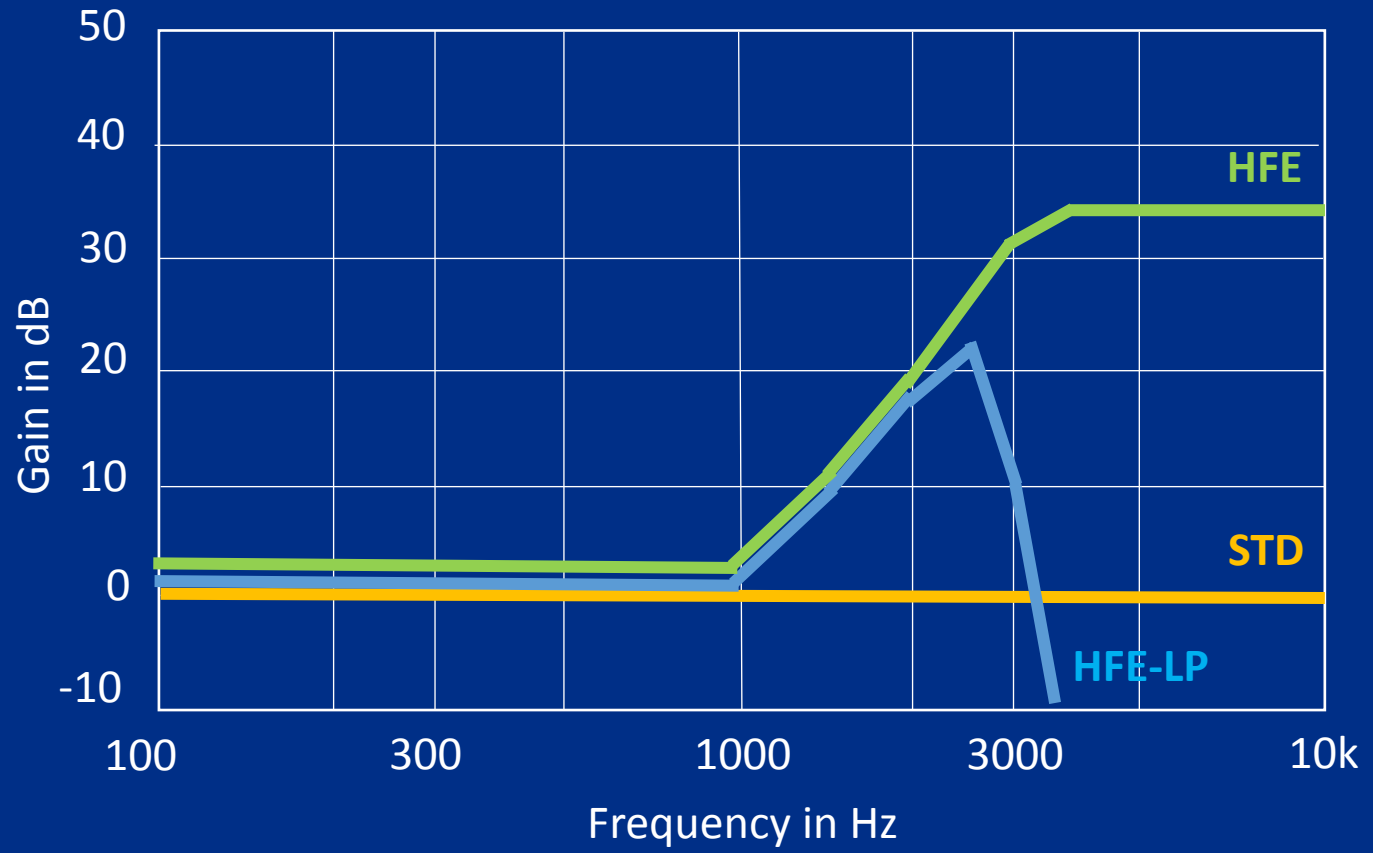
https://www.phon.ucl.ac.uk/courses/spsci/AUDL4007/HI%202014.pdf

Phonemic Regression

- Loss of frequency specificity
- OHC loss widens neural tuning
- IHC loss creates distortion
- Patient reports “I hear, but I don’t understand”
- More on this and tools to address it later…

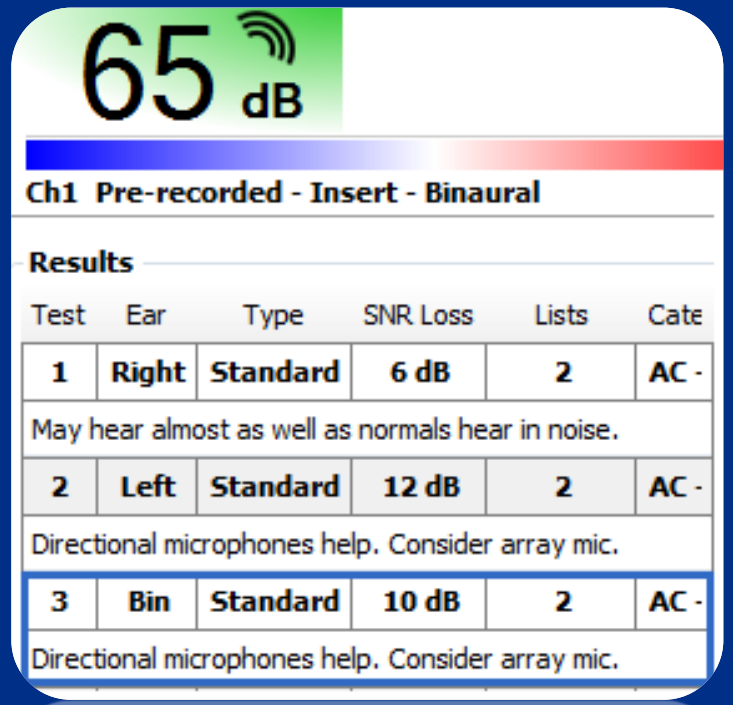
Quick SIN (Speech in Noise)

- Killion et al 2004
- Target sentences with multi-talker noise
  - Pre-mixed signal-to-noise ratios (SNR)
- Stimuli:
  - Standard lists (flat response)
  - High Frequency Emphasis
  - High Frequency Emphasis Low Pass



Quick SIN (Speech in Noise)

- Scoring:
  - 1 point for each key word correct
  - 25.5 – total correct = SNR Loss
  - SNR loss drives recommendation



SNR Loss	Degree of Loss	Recommendation
0-3 dB	Normal/Near normal	May hear better than normals hear in noise.
3-7 dB.	Mild SNR loss	May hear almost as well as normals hear in noise
7-15 dB	Moderate SNR loss	Directional microphones help. Consider array microphone.
> 15 dB	Severe SNR loss	Maximum SNR improvement is needed. Consider FM system

Quick SIN - Hands-On Exercise

- Pair up
- Score Quick SIN on your partner
- Instructor will play recordings

Group	HFE-LP	HFE	STD
1			
2			

Self-Report Questionnaires

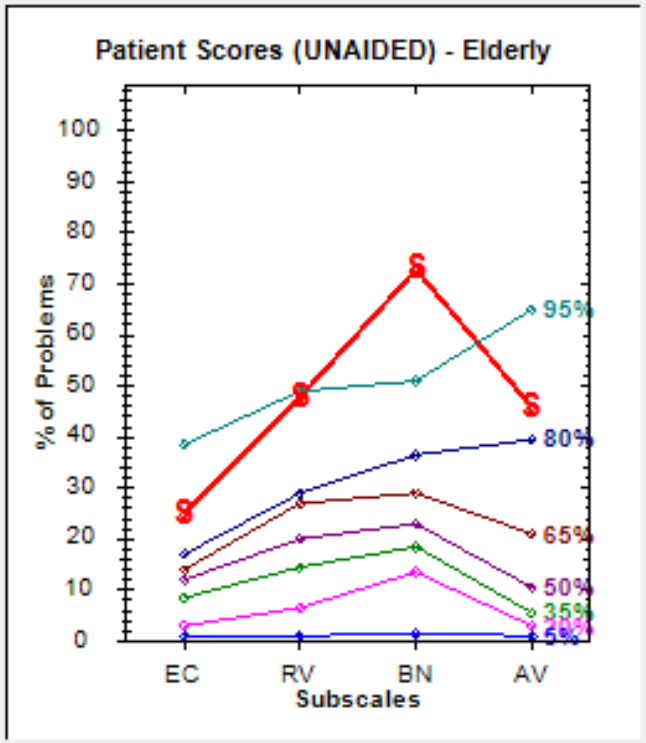
- Patient's "real-world" report of their hearing loss
- Closed Set
  - APHAB
- Open Set
  - COSI

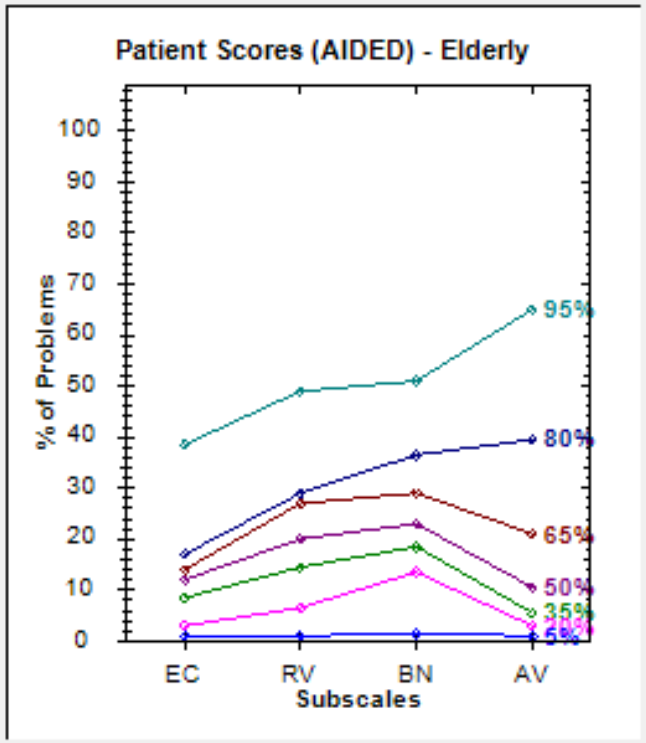
- There are several other questionnaires that will be covered in AMP 2 and Adult AR

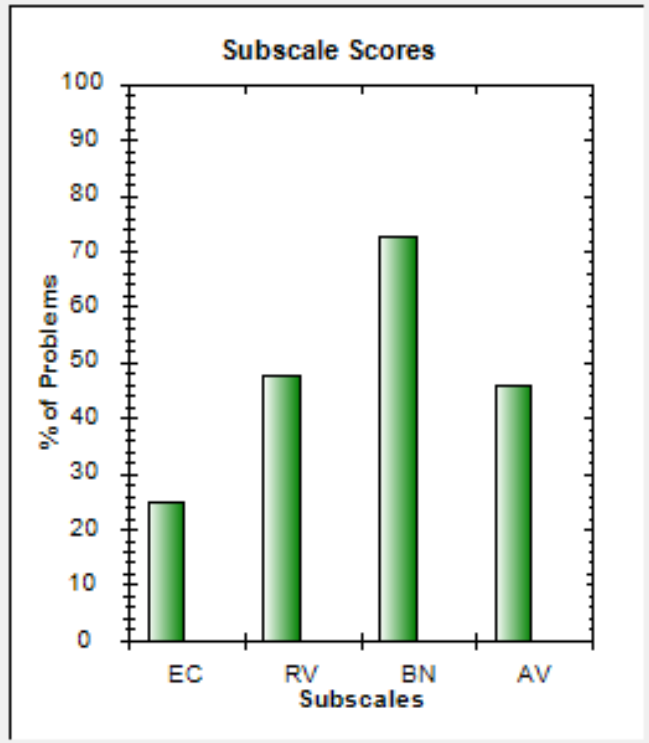
Abbreviated Profile of Hearing Aid Benefit (APHAB)

- Cox and Alexander, 1995
- Use cases:
  - Aided/Unaided
  - Hearing Aid 1/Hearing Aid 2
    - Can compare interventions as well
- Norms
  - Young
  - Elderly
  - Linear
  - WDRC

APHAB Noah Questionnaire Module - Results







Compared to unaided elderly listeners with few or no hearing problems:

Subscale	% Reporting Fewer Problems	% Reporting More Problems
EC	85.5	14.5
RV	94.1	5.9
BN	> 95	< 5
AV	83.7	16.3

Compared to unaided elderly listeners with few or no hearing problems:

Subscale	% Reporting Fewer Problems	% Reporting More Problems
EC	< 5	> 95
RV	< 5	> 95
BN	< 5	> 95
AV	< 5	> 95

	GBL	EC	RV	BN	AV
# of Items		0/6	0/6	0/6	0/6
U	48.5	24.8	47.8	72.8	45.8
A	-	-	-	-	-
B	-	-	-	-	-

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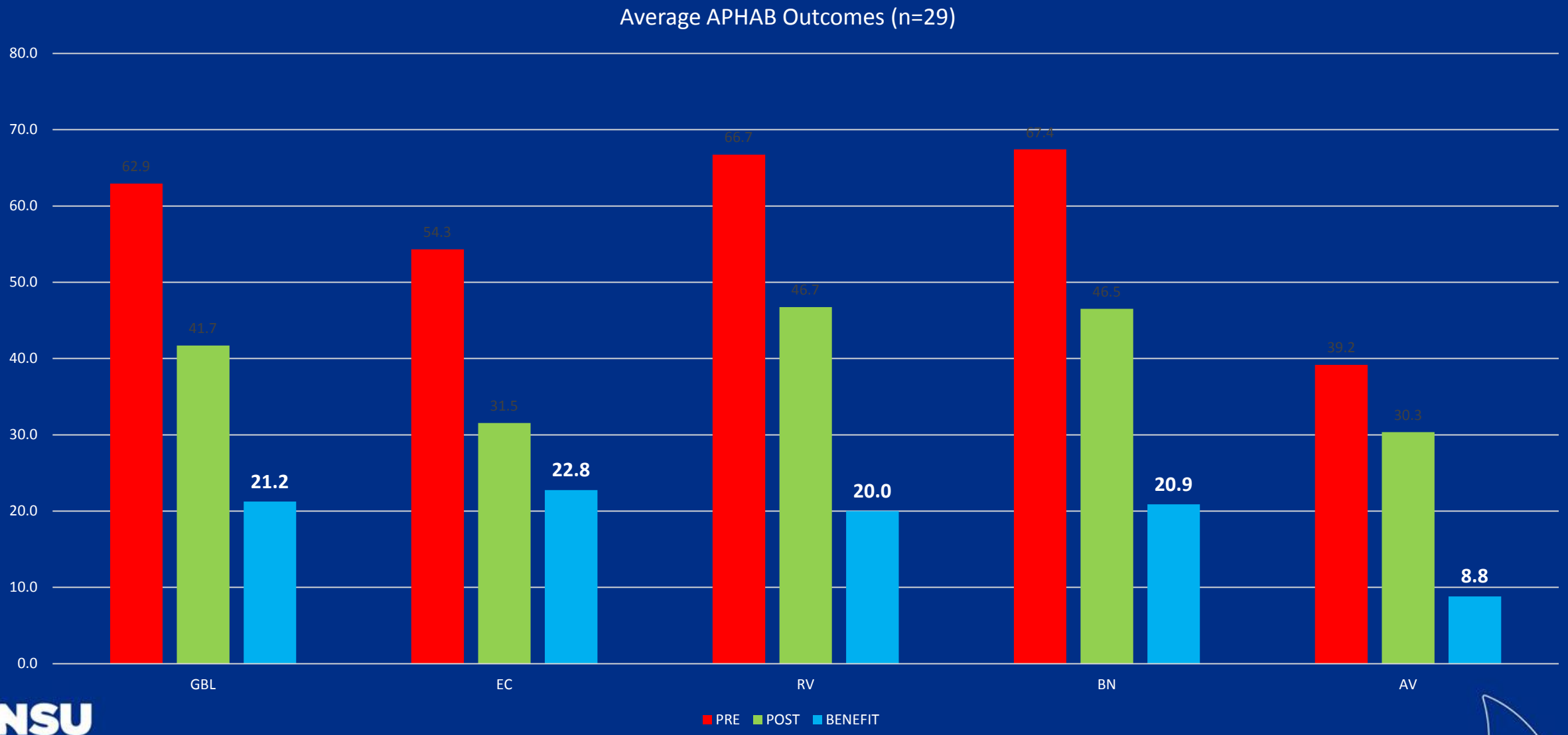
APHAB in Clinical Practice (Ingrao- Data collected at Long Beach VA 2018)



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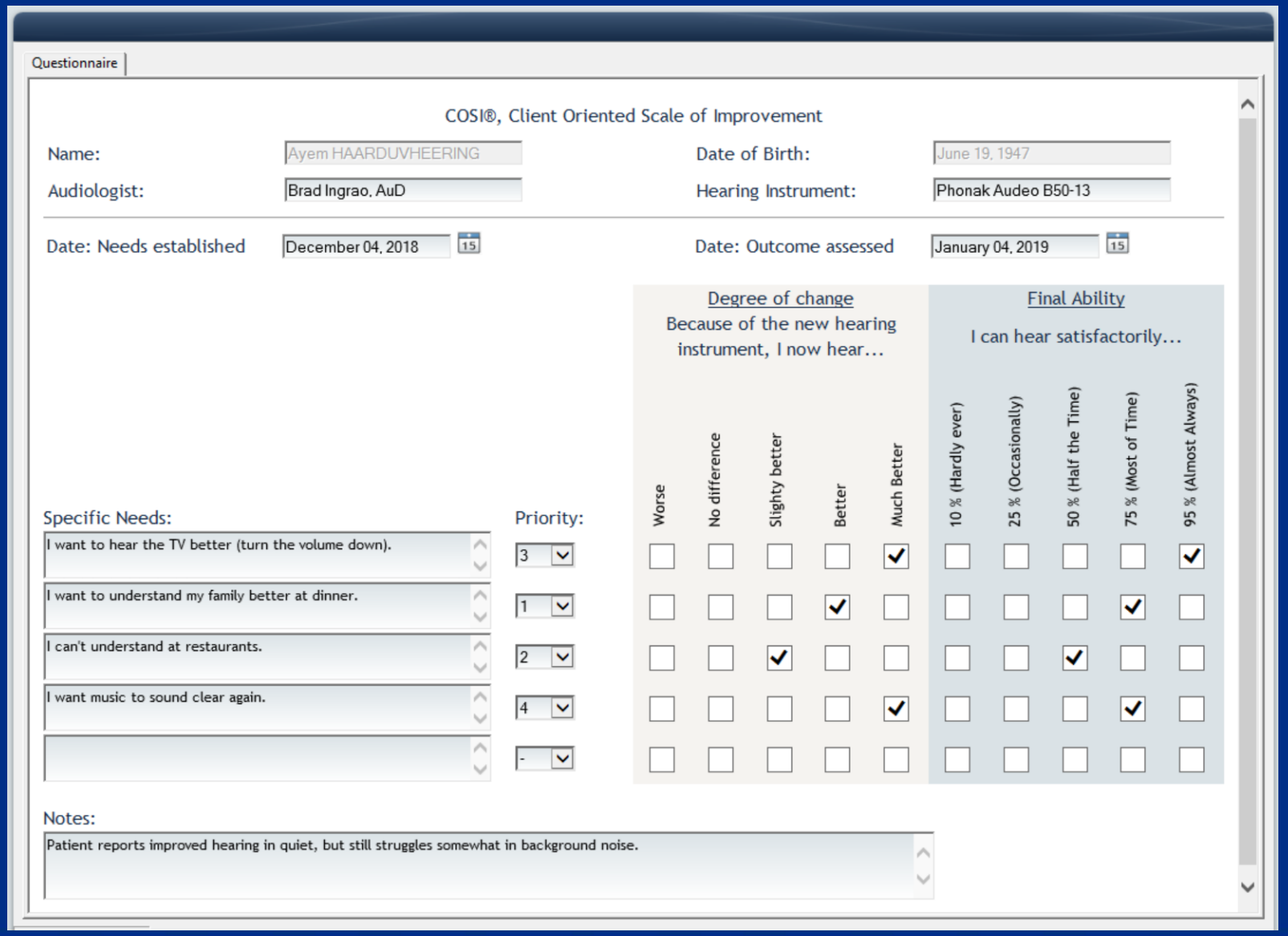
COSI – Noah Questionnaire Module



Questionnaire

COSI®, Client Oriented Scale of Improvement

Name: Ayem HAARDUVHEERING

Date of Birth: June 19, 1947

Audiologist: Brad Ingrao, AuD

Hearing Instrument: Phonak Audeo B50-13

Date: Needs established: December 04, 2018

Date: Outcome assessed: January 04, 2019

Specific Needs:	Priority:	Degree of change: Because of the new hearing instrument, I now hear...					Final Ability: I can hear satisfactorily...				
		Worse	No difference	Slighty better	Better	Much Better	10 % (Hardly ever)	25 % (Occasionally)	50 % (Half the Time)	75 % (Most of Time)	95 % (Almost Always)
I want to hear the TV better (turn the volume down).	3	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑
I want to understand my family better at dinner.	1	☐	☐	☐	☑	☐	☐	☐	☐	☑	☐
I can't understand at restaurants.	2	☐	☐	☑	☐	☐	☐	☐	☑	☐	☐
I want music to sound clear again.	4	☐	☐	☐	☐	☑	☐	☐	☐	☑	☐
	-	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Notes:

Patient reports improved hearing in quiet, but still struggles somewhat in background noise.

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IOI-HA

- Developed at HARL as a quick method to evaluate needs and outcome
- Intended to be used in conjunction with other questionnaires such as the APHAB
- Integrated into Noah (v 4.8 and higher)
- Integrated into VA's ROES system

IOI-HA

Questionnaire | Norms

INTERNATIONAL OUTCOME INVENTORY - HEARING AIDS (IOI-HA)

Score:

Date of HA fitting: December 19, 2018 Date of outcome measure:

1. Think about how much you used your present hearing aid(s) over the past two weeks. On an average day, how many hours did you use the hearing aid(s)?

none	less than 1 hours a day	1 to 4 hours a day	4 to 8 hours a day	more than 8 hours a day
☐	☐	☐	☐	☐

2. Think about the situation where you most wanted to hear better, before you got your present hearing aid(s). Over the past two weeks, how much has the hearing aid helped in that situation?

helped not at all	helped slightly	helped moderately	helped quite a lot	helped very much
☐	☐	☐	☐	☐

3. Think again about the situation where you most wanted to hear better. When you use your present hearing aid(s), how much difficulty do you STILL have in that situation?

very much difficulty	quite a lot of difficulty	moderate difficulty	slight difficulty	no difficulty
☐	☐	☐	☐	☐

4. Considering everything, do you think your present hearing aid(s) is worth the trouble?

not at all worth it	slightly worth it	moderately worth it	quite a lot worth it	very much worth it
☐	☐	☐	☐	☐

5. Over the past two weeks, with your present hearing aid(s), how much have your hearing difficulties affected the things you can do?

affected very much	affected quite a lot	affected moderately	affected slightly	affected not at all
☐	☐	☐	☐	☐

6. Over the past two weeks, with your present hearing aid(s), how much do you think other people were bothered by your hearing difficulties?

New Questionnaire

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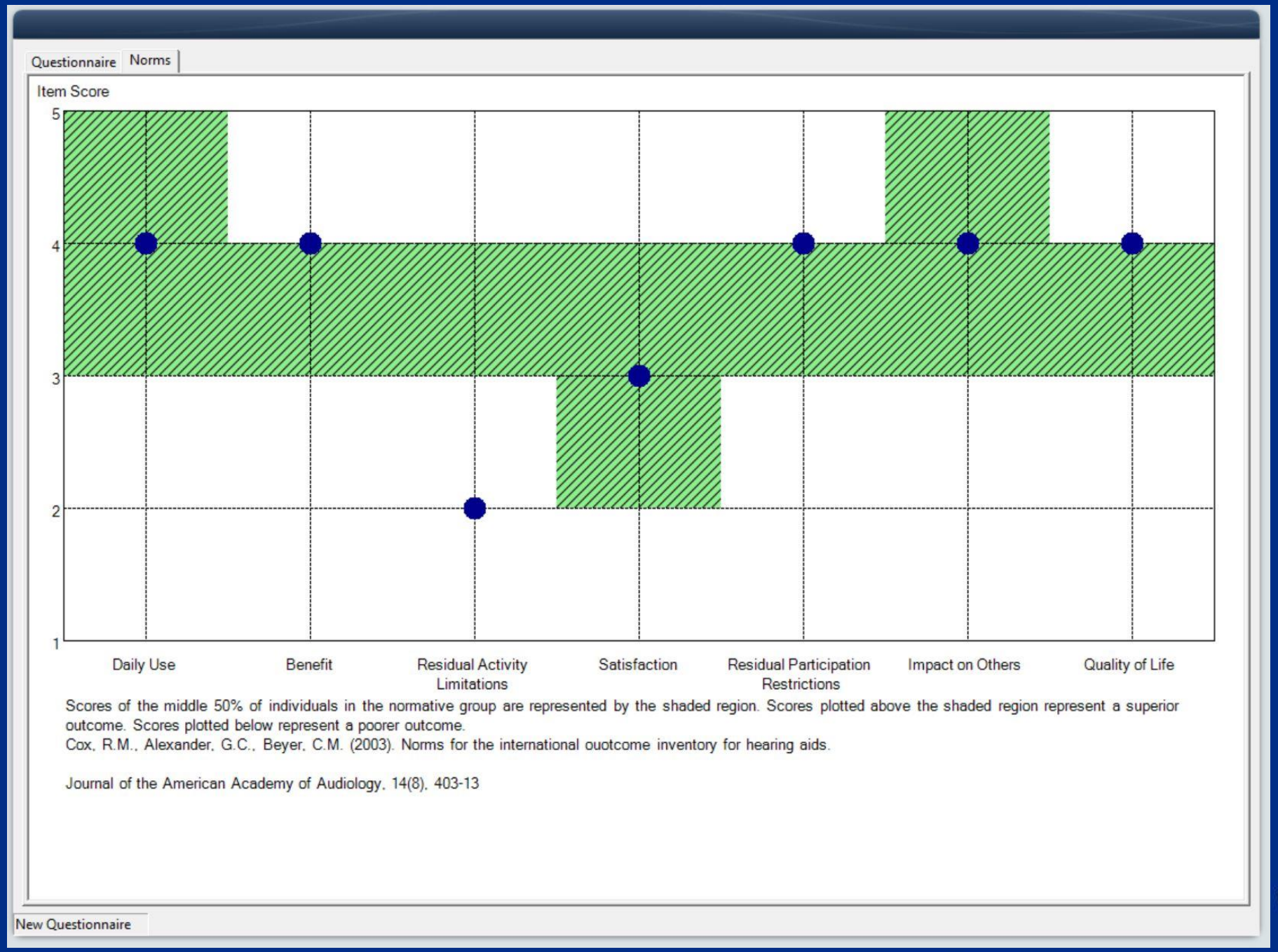
IOI-HA



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Satisfaction with Amplification in Daily Life (SADL)

- Evaluates the satisfaction that people feel with their current hearing aids.
- Quantifies the following scores:
  - Global
  - Positive Effect,
  - Service and Cost
  - Negative Features
  - Personal Image.
- Use cases:
  - Satisfaction with a new or current hearing aids
  - Differences between previous and new hearing aids.

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Cox, RM and Alexander, GC. "Measuring satisfaction with amplification in daily life: The SADL Scale", Ear and Hearing, 20: 306-320 (1999).
Cox, RM and Alexander, GC. "Validation of the SADL Questionnaire", Ear and Hearing, 22:151-160, 2001.

Hearing Aid Basic Electronics

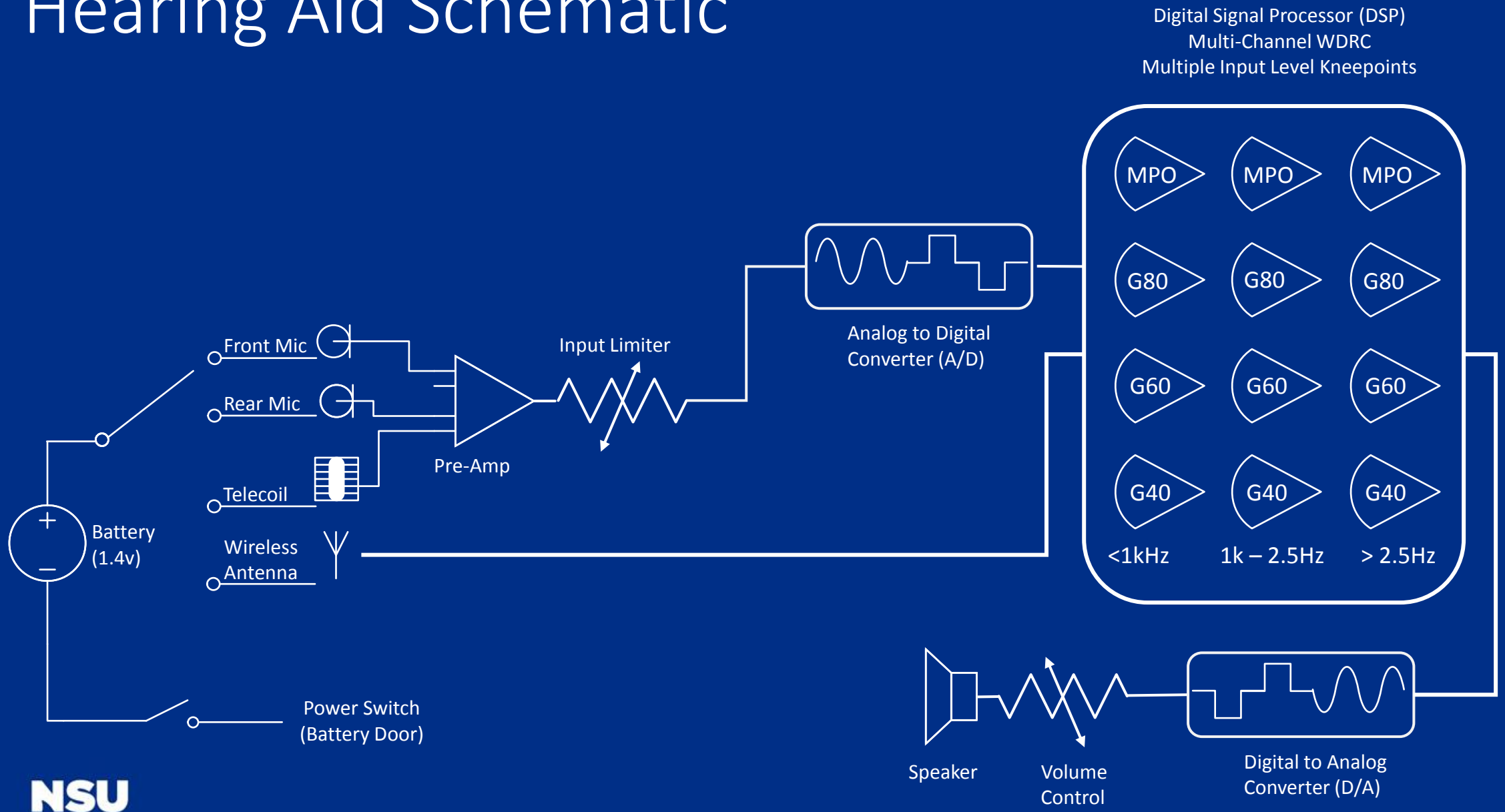
- Transducers: Energy Converters
  - Microphone: Acoustic to Electric
  - T-Coil: Magnetic to Electric
  - Receiver: Electric to Acoustic
- Amplifiers increase the signal's intensity
  - Filters modify the amount of signal in specific ranges
  - Current hearing aids use compression to correct for recruitment
- Potentiometers modify the signal intensity after it leaves the amplifier (i.e. Volume Control).

Measuring Amplification

- Input
  - Sound pressure level entering the hearing aid
- Output
  - Sound pressure level exiting the hearing aid
- Gain
  - Output – Input

- We will look at tools and procedures for measuring these later

Hearing Aid Schematic



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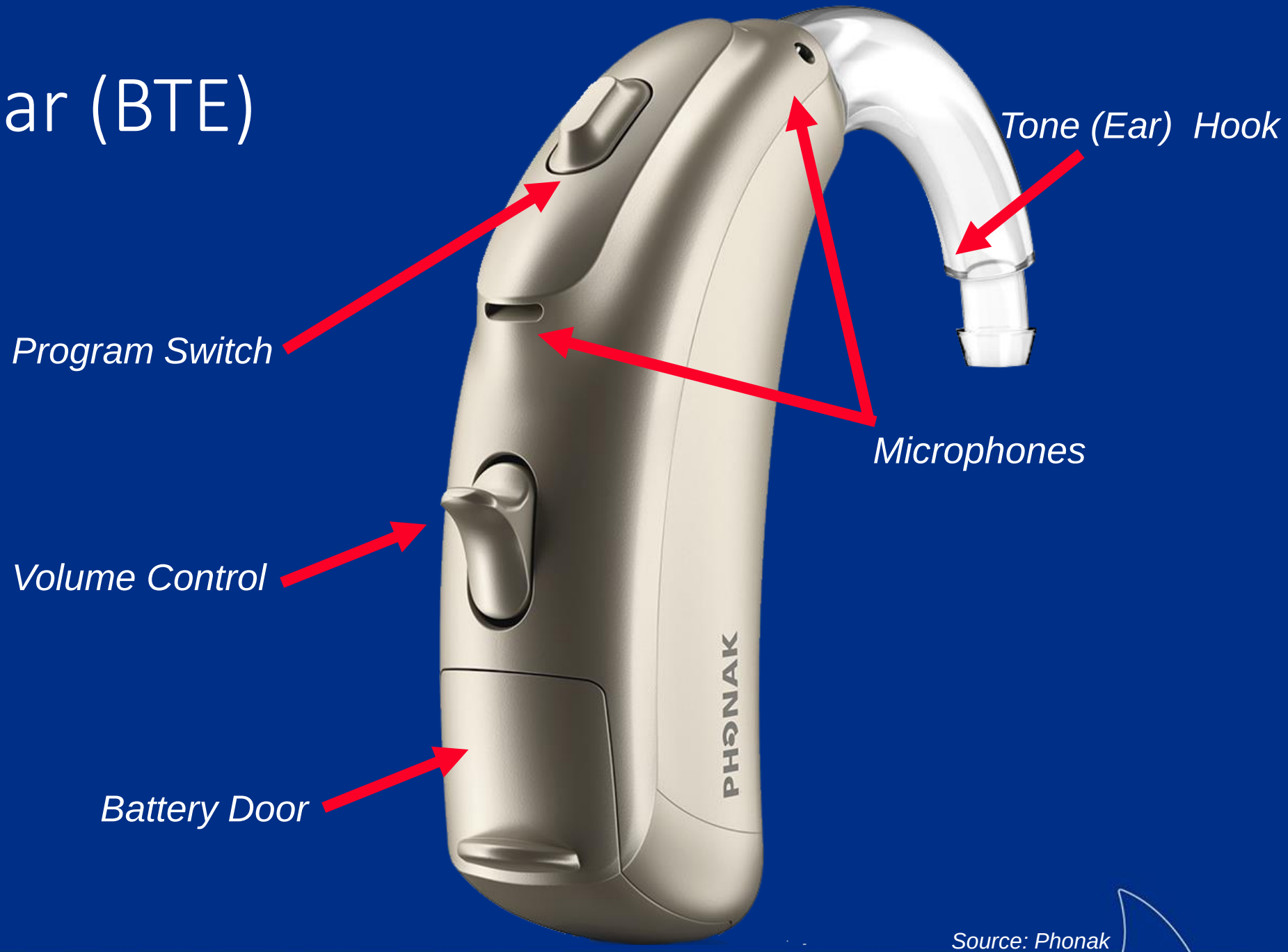
BTE Hearing Aids

- All components inside housing
- Typically fit on children and severe + losses
- Coupling to ear via tube and earmold (more on them later)
- Durable
- Connectivity
  - Telecoil
  - Wireless
  - Direct Audio Input

Behind The Ear (BTE)

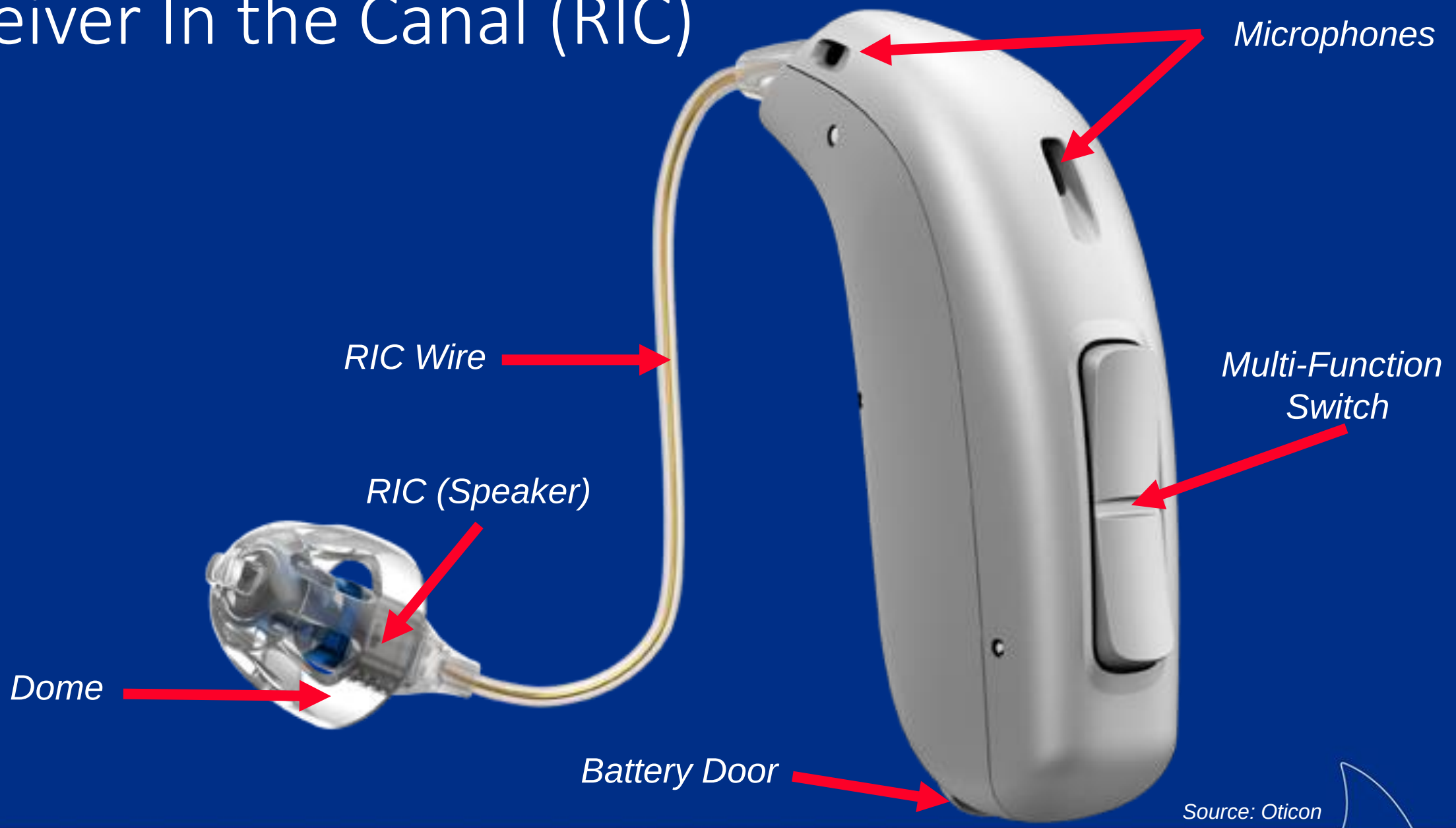


Source: Phonak

RIC Hearing Aids

- Majority of components inside housing
- Speaker (Receiver) in the ear connected by a wire
  - This component can be replaced in the office
- Mild to severe losses
- Coupling to ear via dome or earmold (more on them later)
- Connectivity
  - Telecoil
  - Wireless
  - Direct Audio Input

Receiver In the Canal (RIC)

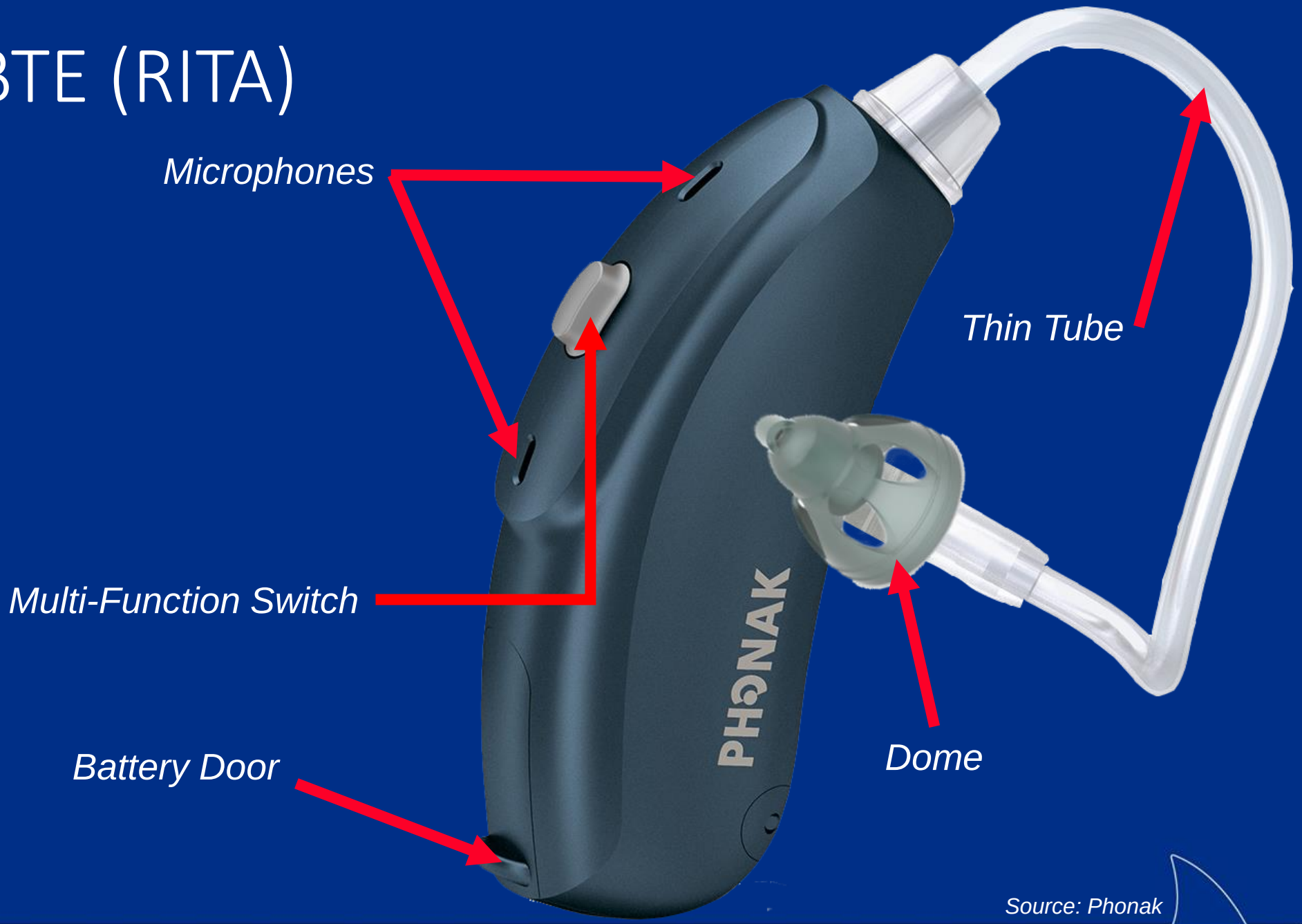


Source: Oticon

Slim Tube/RITA Hearing Aids

- All components inside housing (essentially a BTE)
- Mild to severe losses
- Thin tube (~2mm) sized to patient's ear coupled to ear via dome or earmold (more on them later)
- Connectivity
  - Telecoil
  - Wireless
  - Direct Audio Input

Slim Tube BTE (RITA)



Source: Phonak

Behind The Ear Styles

Power BTE

Mini BTE/Thin Tube/RITA

RIC/RITE

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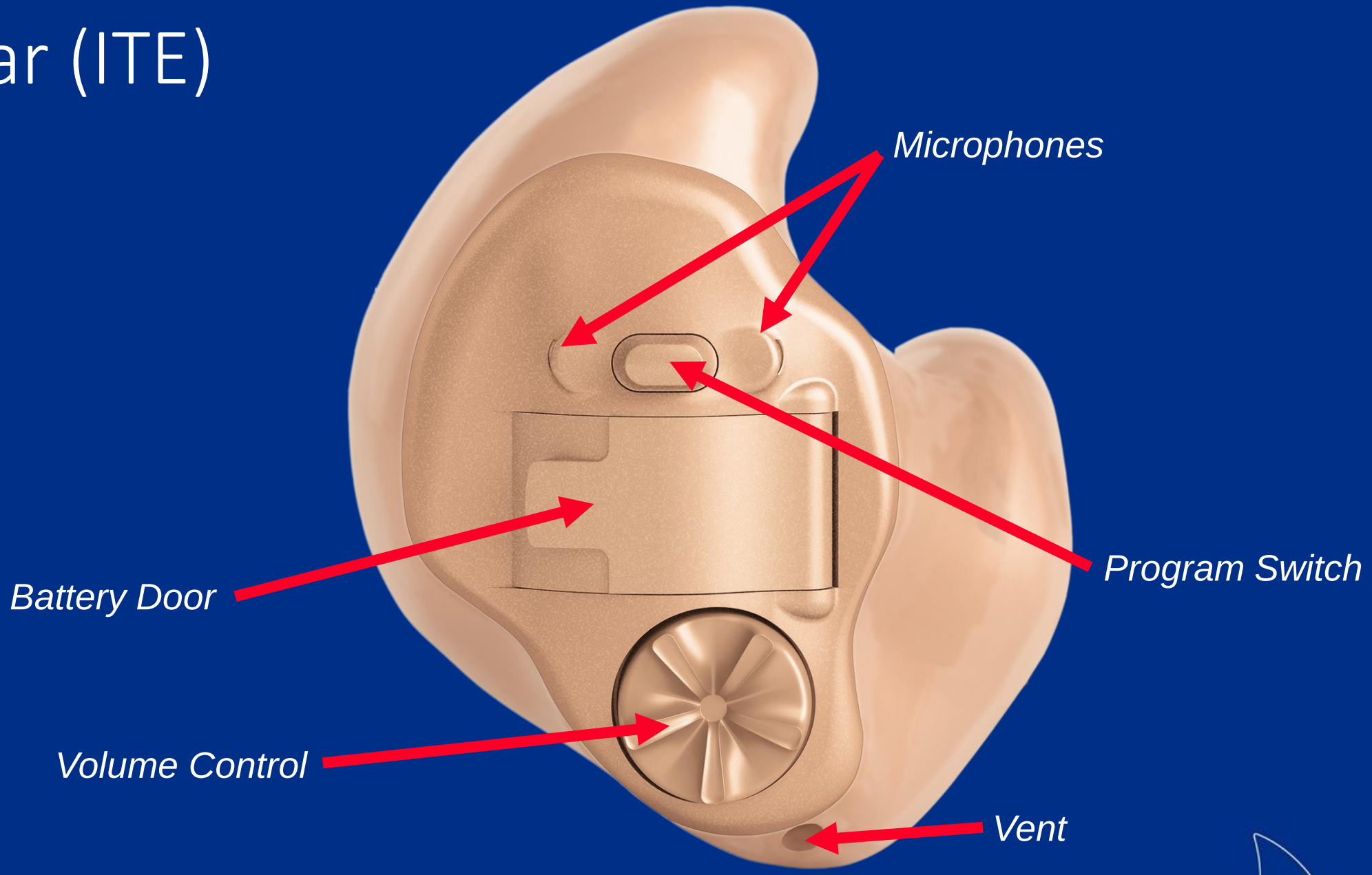
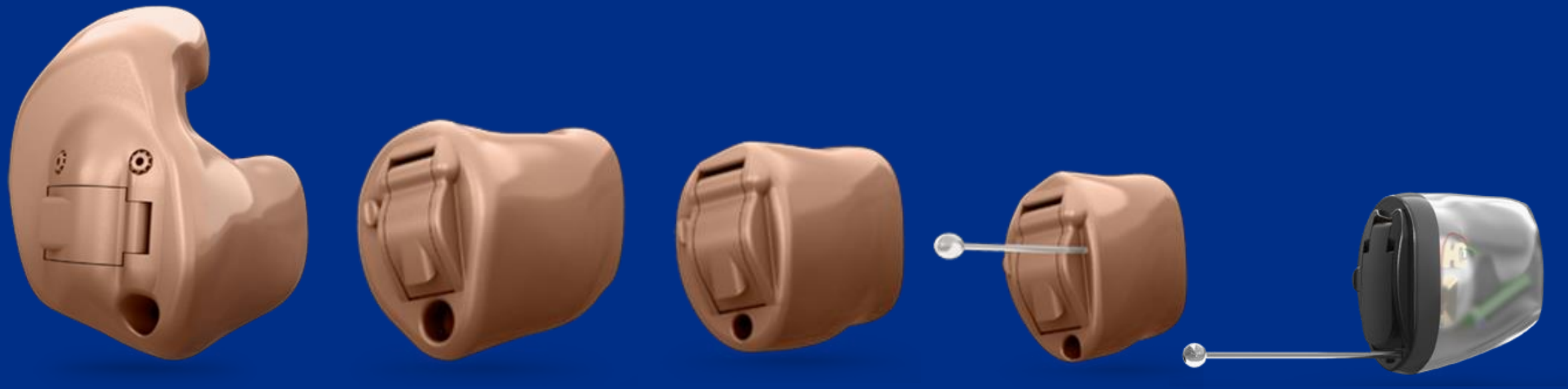
Source: Phonak

In The Ear (ITE)



Source: Phonak

In The Ear (Custom) Styles



Full Shell *Half Shell* *ITC* *CIC* *IIC*

Source: Oticon

In The Ear (Custom) Styles

Full Shell

Half Shell

ITC

CIC/IIC

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Source: Phonak

Zinc Air Hearing Aid Batteries

- **675** – Power BTE, Cochlear Implants
- **13** – RIC, RITA and Full Shell ITE (Orange)
- **312** – Mini RIC, RITA, Half Shell ITE (Brown)
- **10A** – ITC, CIC, IIC (Yellow)
- **5A** - IIC (Red)

Rechargeable Hearing Aid Batteries

Nickle Metal Hydride (NiMH)

Life Span: ~ 1year

Can use Zinc Air?: Usually

Current Models: Signia (Siemens) Primax

Source: Signia.com

Rechargeable Hearing Aid Batteries

Lithium-ion (LiON)

Life Span: ~ 3 years

Can use Zinc Air? Usually not

<u>Current Hearing Aid Models:</u>

Phonak: B-R, Marvel (in release cycle now)

Signia: Cellion and Charge n Go

Starkey: Muse iQR

ReSound Linx Quattro

<u>Current Cochlear Implant Models:</u>

Advanced Bionics: Naida Q70ci and Naida Q90ci

Cochlear: Nucleus 7

MedEl: Sonnet, Rondo2

Rechargeable Hearing Aid Batteries

Silver-zinc (AgZn)

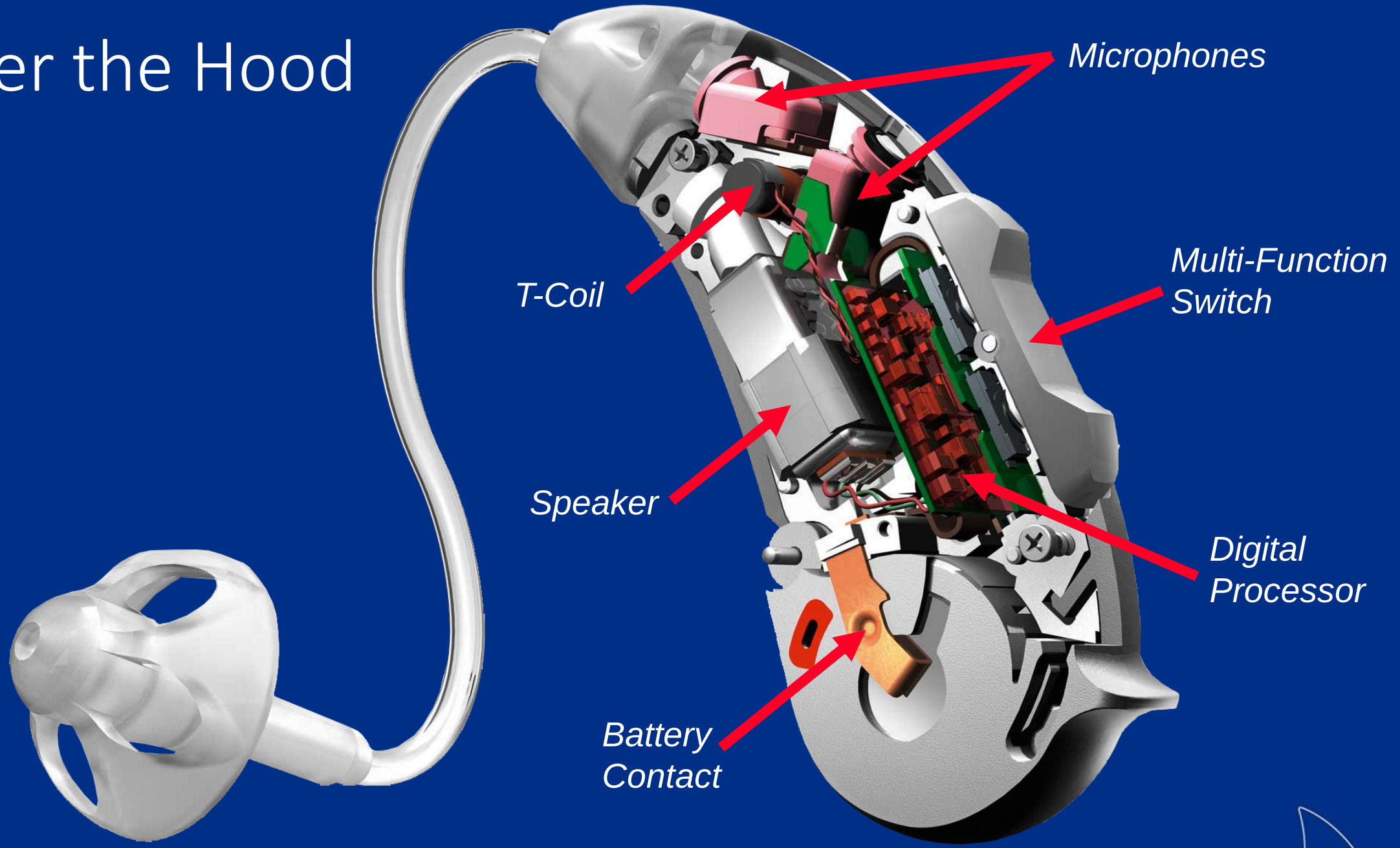
Life Span: ~ 1year

Can use Zinc Air? Usually

Brand: Z-Power

- ReSound Linx 3D-61 (312 battery)
- Oticon OPN
- Starkey Muse Micro 312 R
- Widex Unique
- Unitron Moxi All and Stride R

Under the Hood



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Source: Signia

Hearing Aid Features

- Noise Reduction
- Directional Microphones
- Signal Classification (Scene analysis)
- Wireless Connectivity
- Special amplifier features

Digital Noise Reduction

- Steady-State Noise
  - Machine noise
  - Wind Noise
- High intensity impulse sounds
- Reverberation
- Modulated noise between speech peaks

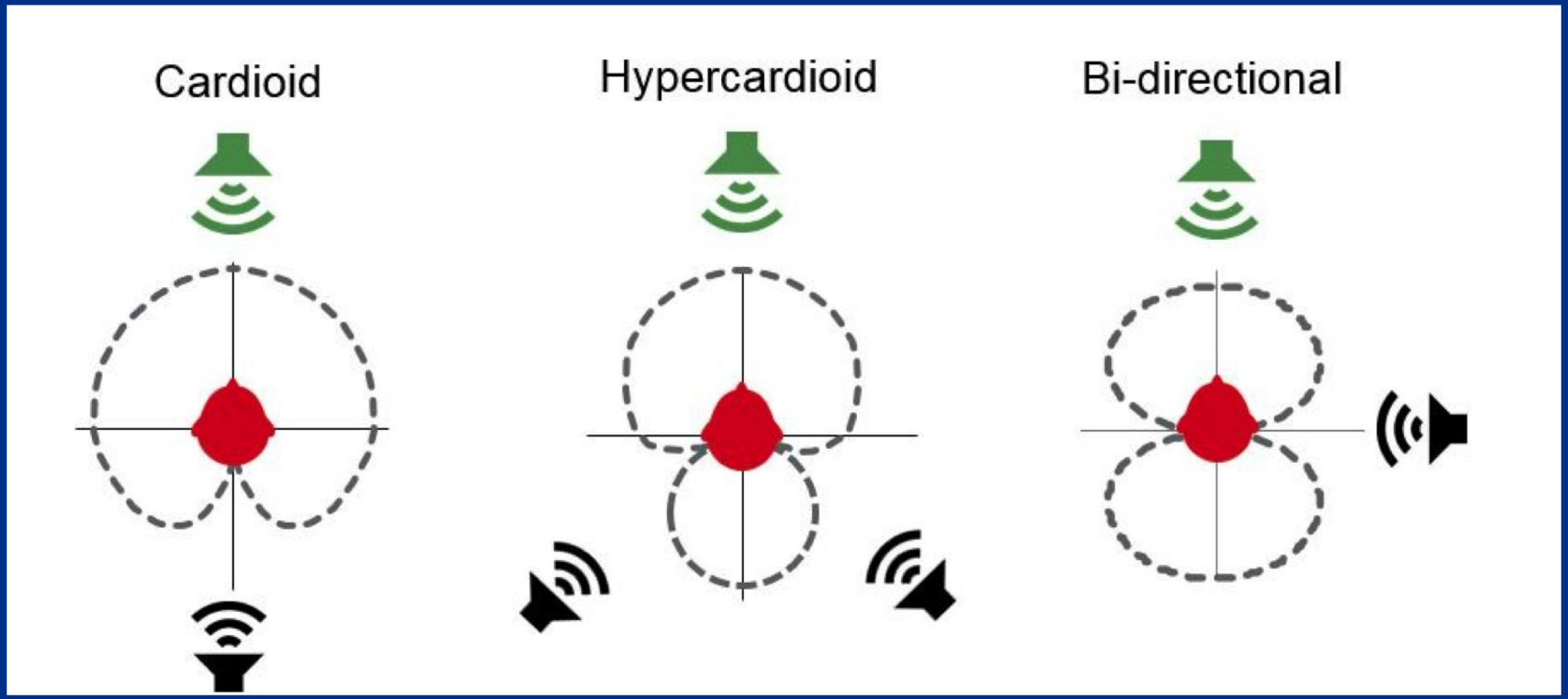
Reverberation Reduction

- Attempts to identify specific acoustic signatures
- Anecdotal reports of listening preference, but little data on improved word recognition
- EEG studies show some reduction in listening effort with reverberation reduction
  - Froehlich et al 2017
  - Littmann et al 2017

Directional Microphones

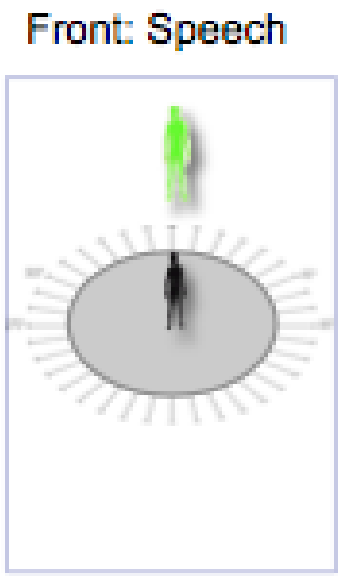
- Attempt to reduce something signals by steering microphone sensitivity toward desired signal (usually speech)
- Sensitivity graphed on Polar Plots
- May be fixed or adaptive
- Modern hearing aids offer several polar plot options

Examples of Fixed Polar Plots

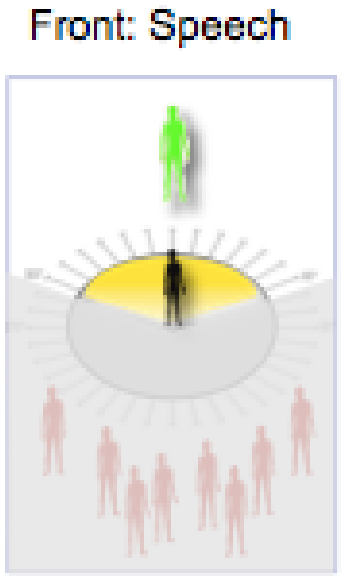


https://www.audiologyonline.com/articles/resound-226-128-153-s-16798

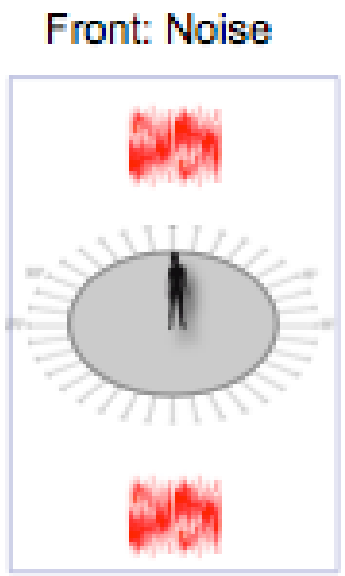
Examples of Adaptive Polar Plots



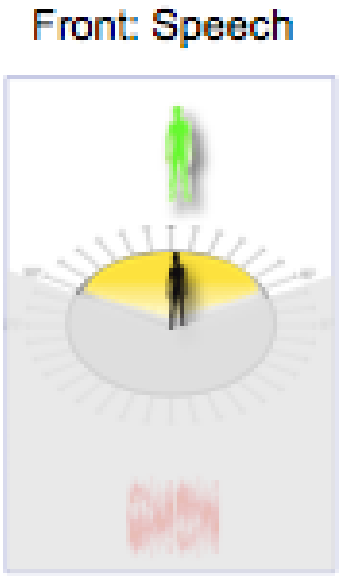
Omni



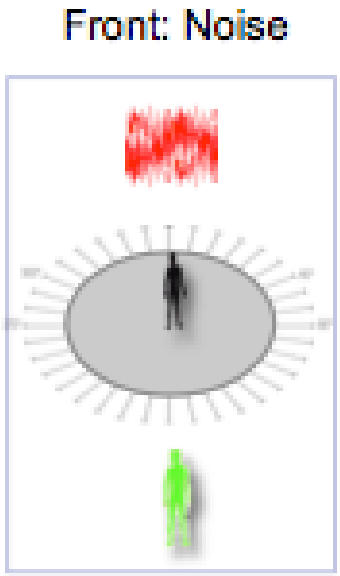
Adaptive Directional



Omni



Adaptive Directional



Omni

https://www.audiologyonline.com/articles/resound-226-128-153-s-16798

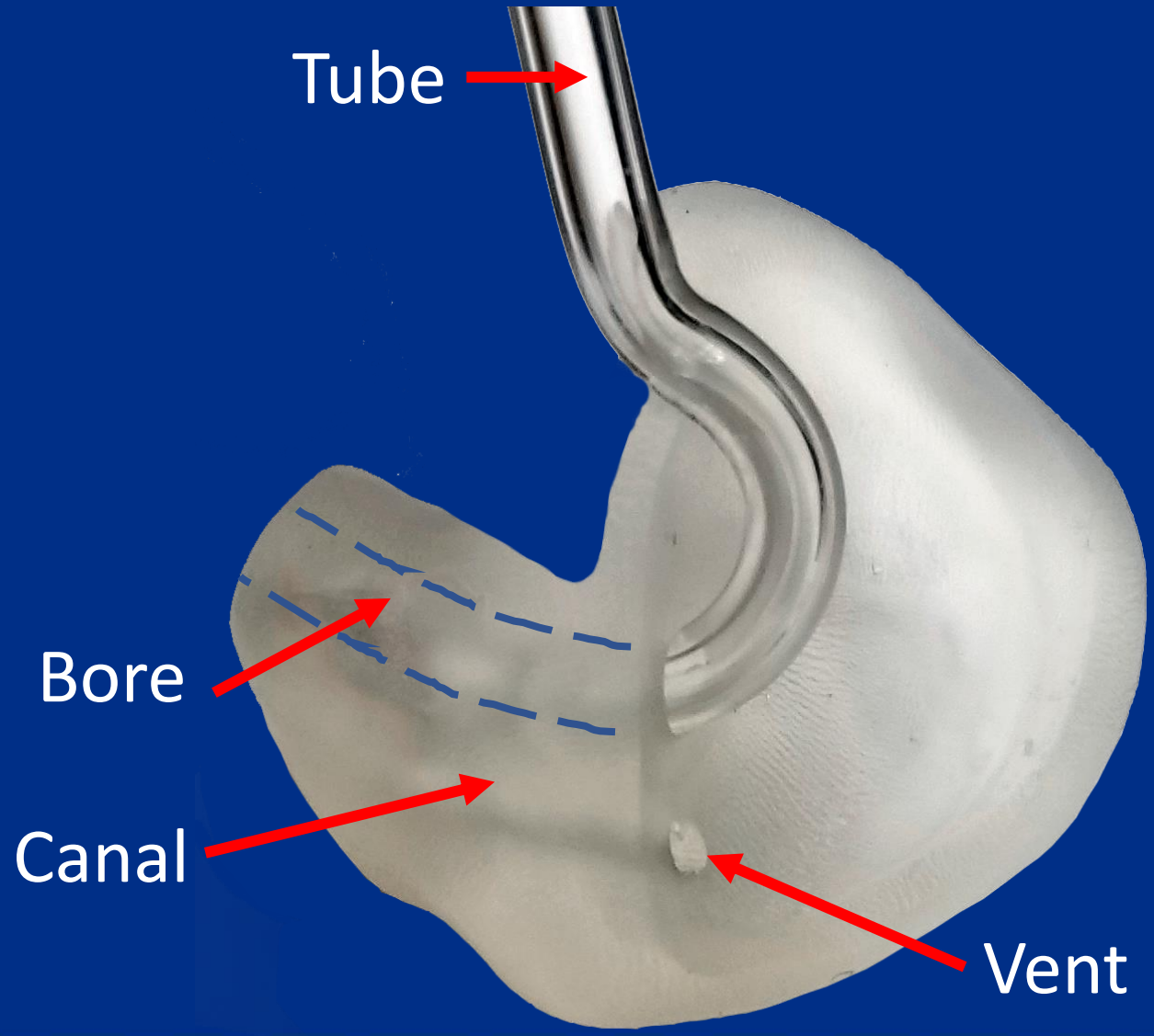
Signal Classification (Scene analysis)

- Attempts to identify the key acoustic content arriving at the hearing aid microphones
- Typical “scenes” include:
  - Quiet
  - Speech
  - Noise
  - Speech in Noise
  - Music
- https://www.youtube.com/watch?v=6tDNtANdTrE

Earmolds

- Provide coupling from hearing aid to ear canal
- Used with BTEs, RICs and RITAs
- Can also be used for non-amplification use cases
  - In the ear monitors
  - Hearing protection
  - Custom molds for audio players
  - Communication systems
  - Medical monitoring

Anatomy of a Hearing Aid Earmold



Earmold Styles

- Basic styles are somewhat standard
- Manufacturers may use different names
  - Order forms generally have drawings
- Style selection depends on several factors
  - Anatomy of ear
  - Hearing loss severity
  - Patient dexterity
  - Patient age
  - Audiologist preference

Shell

- Most problem free style
- Appropriate for all losses
- Most labs will guarantee against feedback
- Excellent retention and concealment
- Available in all materials

Half Shell

- Easier insertion due to removed helix
- Appropriate for up to severe losses
- Excellent retention and concealment
- Available in all materials

Skeleton or Silhouette

- Designed to fit the contour of the concha
- Appropriate for up to moderate losses
- Excellent retention and concealment
- Available in all materials

Semi Skeleton

- Designed to fit the contour of the concha
- Appropriate for up to moderate losses
- Excellent retention and concealment
- Available in all materials

Canal Lock

- Designed for maximum concealment
- Appropriate for up to moderate losses
- Good retention with porous materials
- Longer canal is advised to reduce feedback

Canal Only

- Designed for maximum concealment
- Appropriate for up to moderate losses
- Good retention with porous materials
- Longer canal is advised to reduce feedback

Material Selection

- Recent studies indicate that the earmold material per se will not reduce feedback (C. Perzanski)
- Traditionally, softer materials have been used for children
- Individual preferences, for both patients and audiologists will often drive typical material selection.

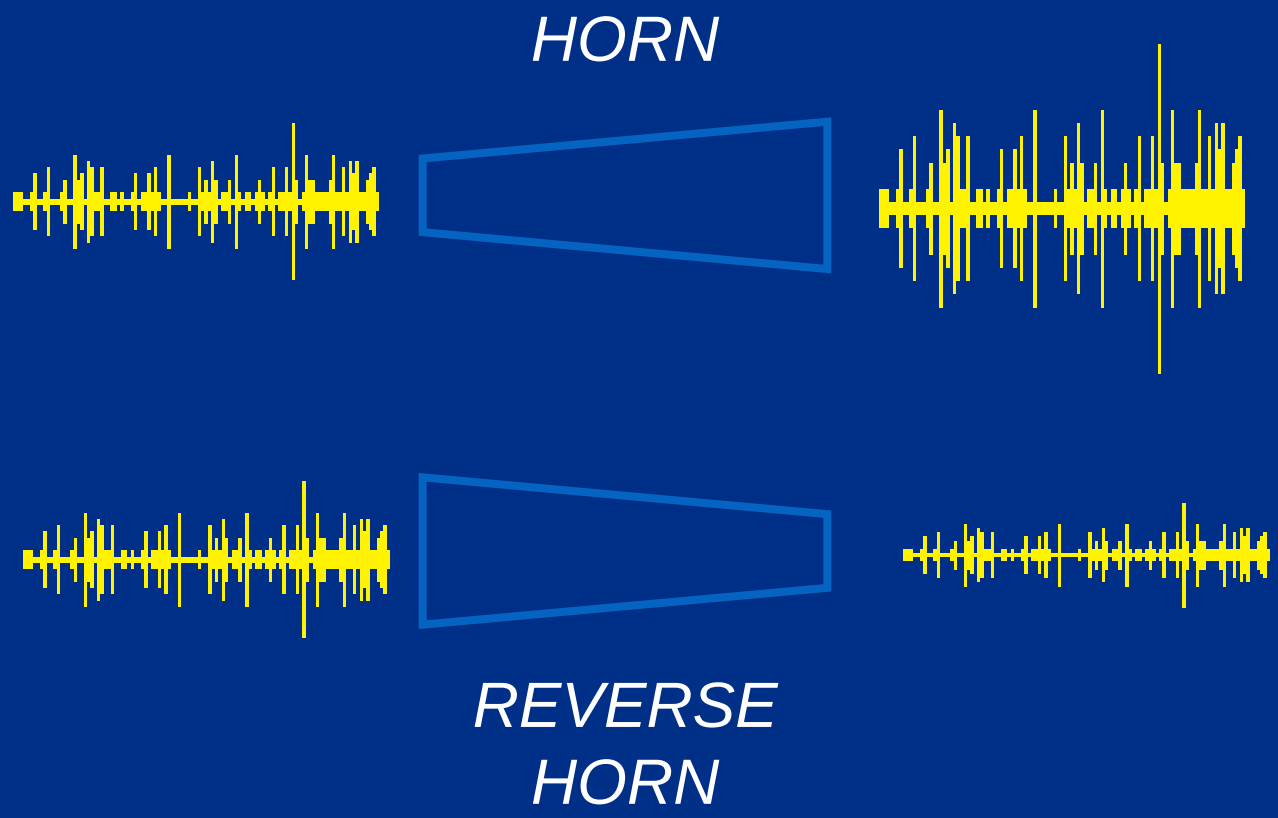
Earmold Materials

Material	Texture	Applications and Notes
Lucite	Hard	Poor Dexterity, Collapsing Canals, CROS Transmitters
Flexible Plastic	Softens in Canal	Balance of ease of insertion and comfort
Vinyl	Soft	All Losses. TMJ Mold ejection
Silicone	Soft	All Losses, Requires special tools and techniques to grind & buff

Comfort and Fit

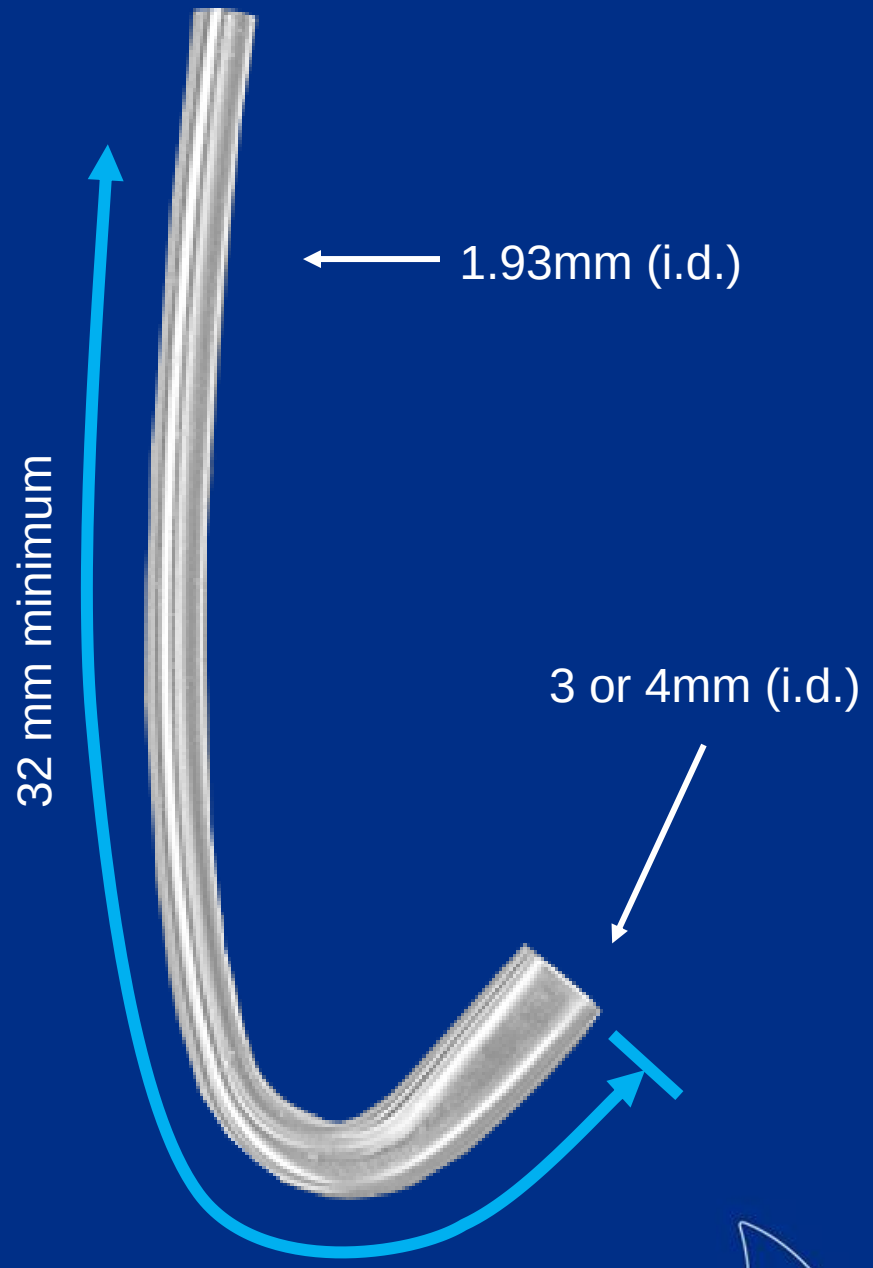
- Earmolds should be snug not tight
- *Accuracy* of shape is critical
- A properly fitting hard mold is more comfortable than a poorly fitting soft mold

Acoustic Modifications



Libby Horn

- Pre-formed tubing
- Specific dimensions must be maintained for desired effect
- Available in 3mm and 4mm sizes



Continuous Flow Adapter

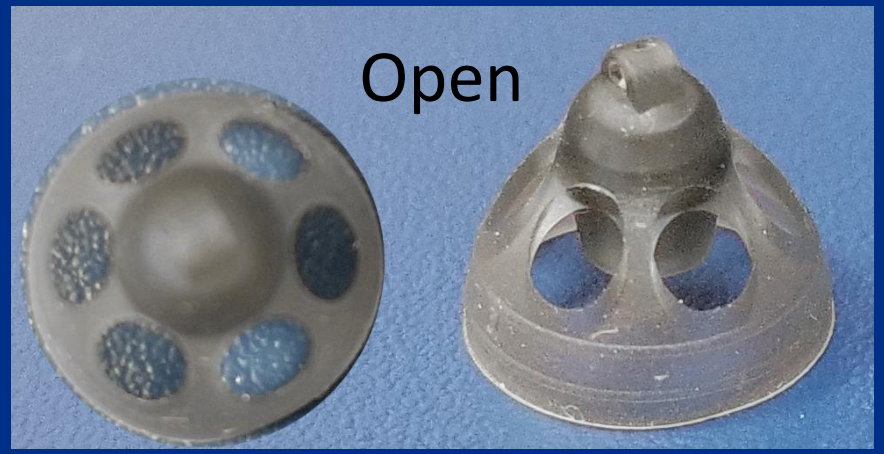
- Developed by Norm Schlagel at Pacific Coast Labs
- More predictable bore configurations
- Prevents gradual tubing shrinkage caused by glued in tube

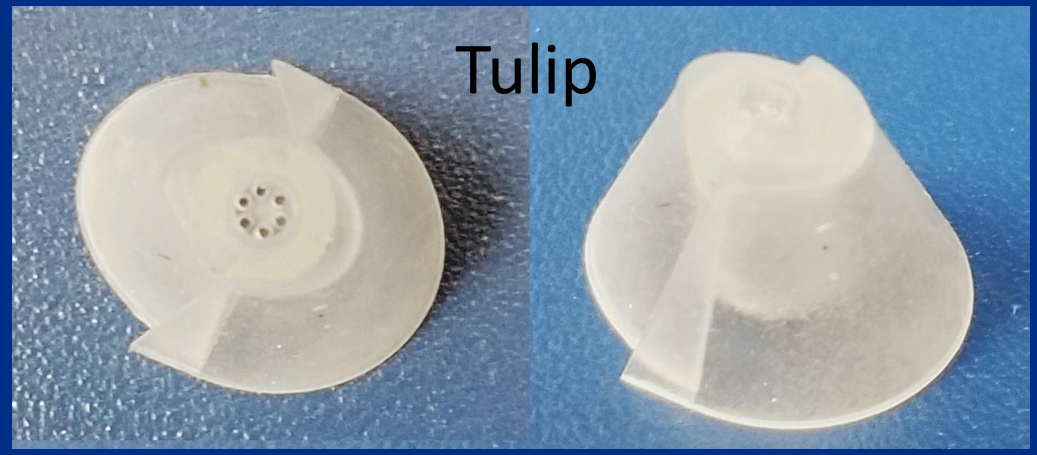
Domes

- Designed to address several issues with custom earmolds
  - Instant fit
    - Earmolds generally have a 7 to 14 day turn-around
  - Preferred by many users, particularly new users with mild loss
    - Less occlusion
    - More comfortable
  - General sizes and types
    - 6mm to 12mm diameter
    - Open, closed, Tulip, Power

Winkler, A., Latzel, M., & Holube, I. (2016). Open Versus Closed Hearing-Aid Fittings: A Literature Review of Both Fitting Approaches. Trends in Hearing.

Domes





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Winkler, A., Latzel, M., & Holube, I. (2016). Open Versus Closed Hearing-Aid Fittings: A Literature Review of Both Fitting Approaches. Trends in Hearing.

RIC Earmolds

- "Micro Mold"
  - Minimal size
  - Standard RICs snap in (LP, MP, HP)
  - Designed for comfort and cosmetics
  - RICs can still be changed in the office
- Encased Mold
  - Used for either severe losses (HP, UP receivers) or very curvy ears
  - RIC is disassembled and placed inside a CIC-type shell
  - Speaker and mold must go to manufacturer for repair or replacement

Wireless Connectivity

- NFMI
- 2.4 kHz
  - BTLE
- 900 MHz
- Combined systems
  - SWORD, Signia
- Telecoil

NFMI

- Near Field Magnetic Inductance
  - Low power
  - Small size
  - Limited range (~30 cm)

- Use Cases
  - Hearing Aid Programming
  - Bluetooth and Accessory Gateways
  - “Ear-to-Ear” hearing aid communication

- Current Examples
  - Oticon Epoch to AltaPro
  - Phonak Spice to Beyond
  - Widex Clear →
  - Siemens/Signia Orion 2 to Primax

2.4 GHz

- Direct connection to instrument
  - Low power
  - Small size
  - Long range (~60 feet)

- Use Cases
  - Hearing Aid Programming
  - Bluetooth and Accessory Gateways
  - “Ear-to-Ear” hearing aid communication

- Current Examples
  - GN ReSound Alera →
  - Oticon OPN
  - Phonak Marvel
  - Signia Nx
  - Widex Evoke

Bluetooth LE (Made for iOS)

- Direct connection to instrument
  - Low power
  - Small size
  - Medium range (~30 feet)

- Use Cases
  - Hearing Aid Programming
  - Direct streaming from iOS devices (iPhone, iPad, Apple Watch)
  - “Ear-to-Ear” hearing aid communication

- Current Examples
  - GN ReSound Linx 2→
  - Oticon OPN
  - Phonak Marvel
  - Signia Nx
  - Starkey Halo, Livio AI
  - Widex Evoke

900 MHz

- Direct connection to instrument
  - Low power
  - Small size
  - Medium range (~30 feet)
- Use Cases
  - Hearing Aid Programming
  - Direct streaming to media streamers
  - Bluetooth connection via gateway
  - “Ear-to-Ear” hearing aid communication
- Current Examples
  - Starkey Z series to Muse IQ

Combined Systems

- Direct connection to instrument
  - Low power
  - Small size
  - Medium range (~30 feet)

- Use Cases
  - Hearing Aid Programming
  - Direct streaming to media streamers and some phones
  - Bluetooth connection via gateway
  - “Ear-to-Ear” hearing aid communication

- Current Examples
  - Signia PX, NX
  - Phonak B-Direct

Telecoil

- Converts magnetic signals into electronic signals
- Available in BTE and some ITE hearing aids as well as most Cochlear Implant processors

Why Do I Need a Telecoil?

- "Universal" Assistive Device Receiver
  - Telephone, Neck Loop, Silhouette Inductors, Loop Pad, Room Loop
- Growing movement to loop more public venues
  - Theatres, houses of worship, public transit, grocery stores

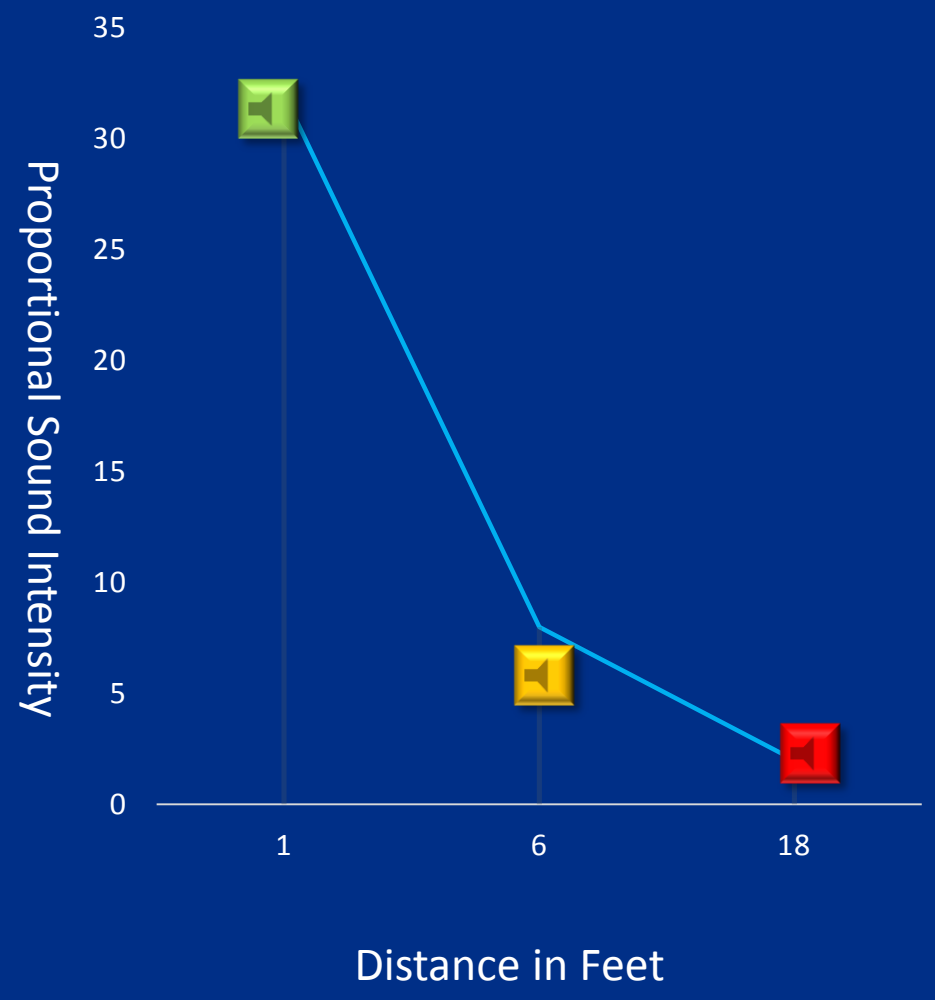
Why do we need all this tech?

Primary “Hearing Hazards”

- Distance
- Reverberation
- Background Noise

These factors reduce speech understanding for **ALL** people, regardless of how well they hear. Those with hearing loss are affected to a MUCH greater degree.

Distance

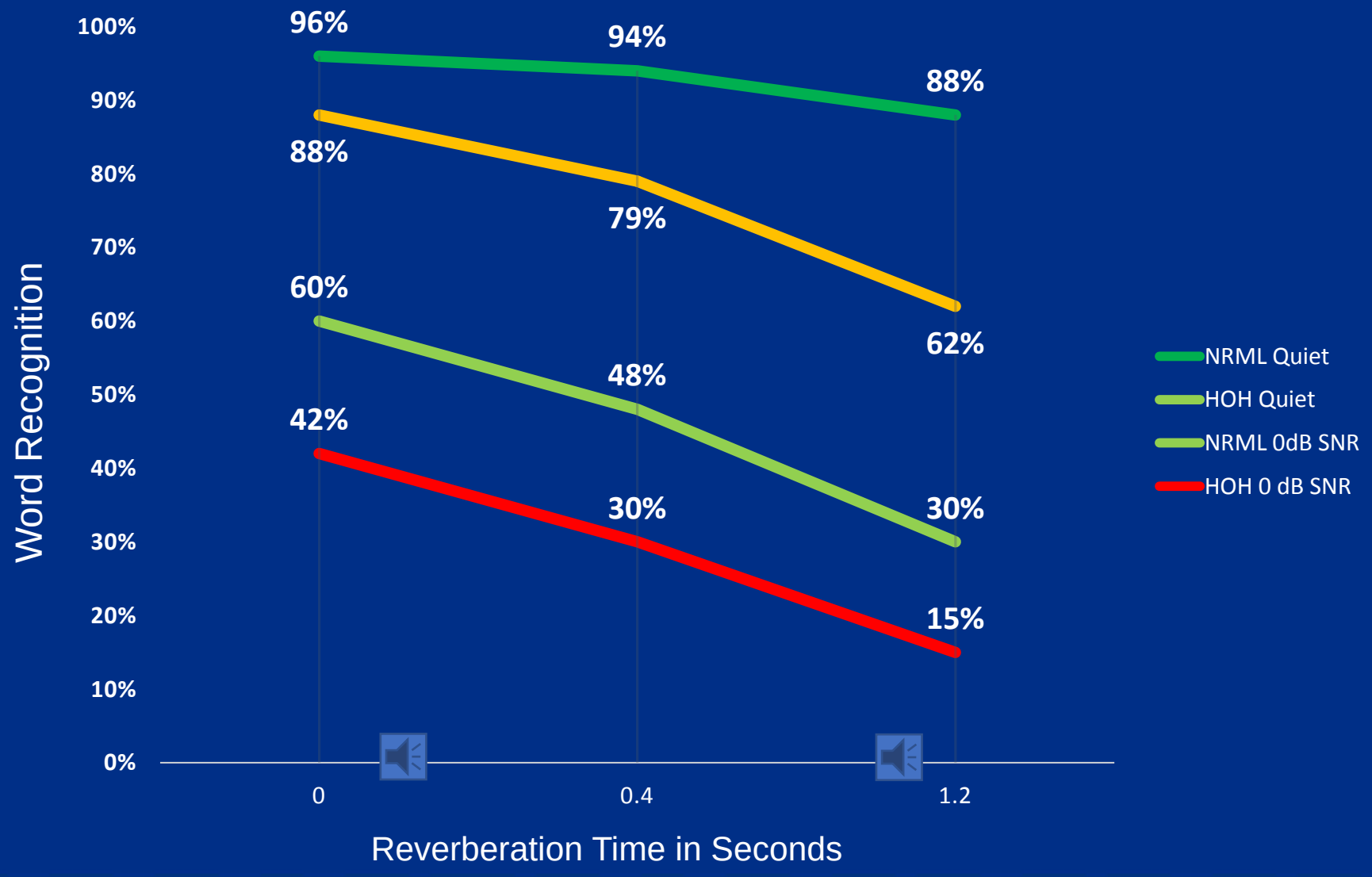


Inverse square law applies

- 2x the distance = ¼ the intensity
- Conversely, halving the distance, increases intensity 4x
- This works to both improve and worsen hearing…

Reverberation Time

Data Source: AVR Sonovation
Recordings: Brad Ingrao, AuD



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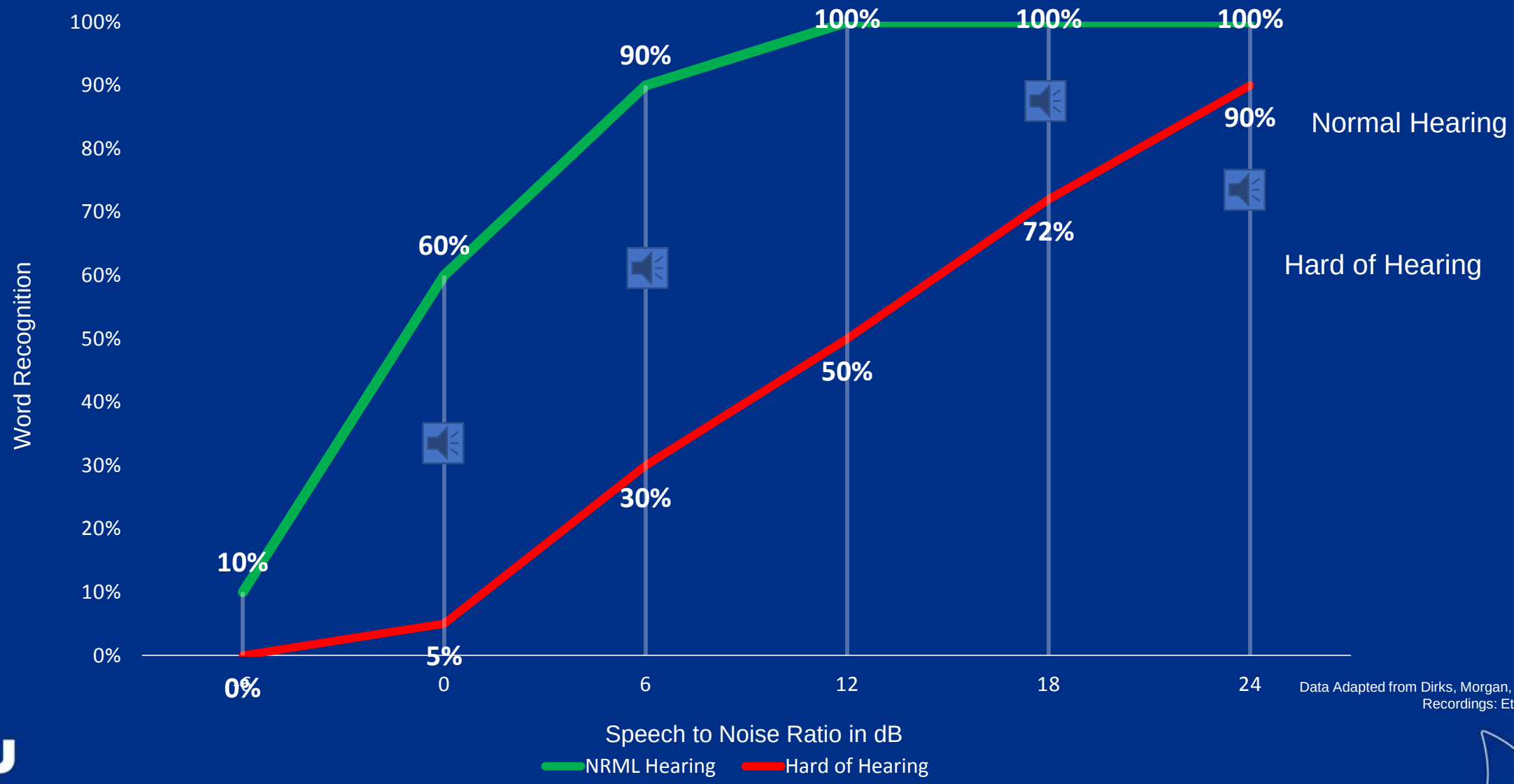
Hearing in Noise



Data Adapted from Dirks, Morgan, and Dubno 1982
Recordings: Etymotic Research

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Combating Hearing Hazards

Capture

Collect signal with the best Signal to Noise ratio

Microphone technique is key (GIGO)

Carry

Deliver signal over distance without losing quality

Couple

Connect to HA or CI without losing quality

Carry Options

- Magnetic Induction
- Infrared
- FM
- Bluetooth
- Non-Bluetooth Wireless

Non-Bluetooth RF

Some hearing aids and cochlear implants use a radio frequency to:

- Control the devices (volume, programs, etc.)
- Connect to Remote Mics
- Connect to Media Streamers and Bluetooth phones

Coupling Options

- Direct Audio Input (DAI)
- Telecoil (T-Coil)
- NFMI and other “Ear to Ear Wireless”

Alerting Devices

- Make us aware of significant event in our life:
  - Waking up
  - Informational notifications
  - The Arrival of visitors
  - Hazardous conditions

Can You Hear Me Now?

Traditional telephones are difficult for several reasons:

- Limited bandwidth (300 – 3000 Hz)
- Insufficient volume
- Monaural hearing
- No visual information

Under-utilized tools

- Real World Validation (APHAB)
- Expanded Word Recognition Testing
- Frequency Lowering
- Dedicated Noise Reduction Programs
- Impulse noise reduction

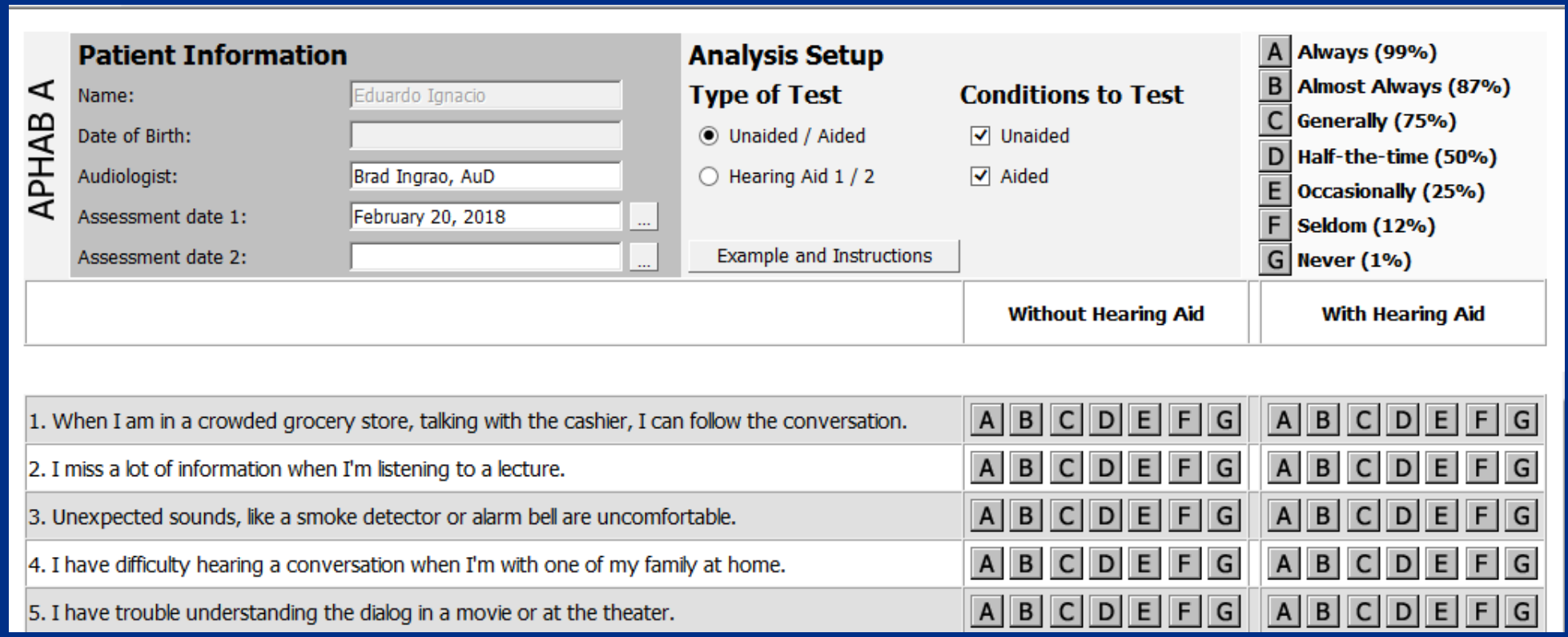
APHAB

- Abbreviated Profile of Hearing Aid Benefit (Cox and Alexander 1995)
- Identifies frequency of listening difficulty in 4 areas:
  - Ease of Communication (Quiet settings)
  - Reverberation
  - Background Noise
  - Aversiveness (Sensitivity to sudden loud sound)

APHAB

- Included in Noah hearing aid fitting framework used by nearly all hearing care professionals
- Takes less than 5 minutes to complete
- Can compare function to others in similar normative groups and between interventions

APHAB Question Samples



APHAB A

Patient Information

Name: Eduardo Ignacio

Date of Birth:

Audiologist: Brad Ingrao, AuD

Assessment date 1: February 20, 2018

Assessment date 2:

Analysis Setup

Type of Test

- (•) Unaided / Aided
- ( ) Hearing Aid 1 / 2

Conditions to Test

- [x] Unaided
- [x] Aided

Example and Instructions

- A Always (99%)
- B Almost Always (87%)
- C Generally (75%)
- D Half-the-time (50%)
- E Occasionally (25%)
- F Seldom (12%)
- G Never (1%)

	Without Hearing Aid	With Hearing Aid
1. When I am in a crowded grocery store, talking with the cashier, I can follow the conversation.	A B C D E F G	A B C D E F G
2. I miss a lot of information when I'm listening to a lecture.	A B C D E F G	A B C D E F G
3. Unexpected sounds, like a smoke detector or alarm bell are uncomfortable.	A B C D E F G	A B C D E F G
4. I have difficulty hearing a conversation when I'm with one of my family at home.	A B C D E F G	A B C D E F G
5. I have trouble understanding the dialog in a movie or at the theater.	A B C D E F G	A B C D E F G

Expanded Word Recognition Tests

- Binaural Unaided Testing
- Aided Testing at 60 dB SPL

Ear	Test	dB	%		SNR			
R	WRS	80	44%	44%		AC		NU No. 6 CNC List 2A
L	WRS	80	32%	32%		AC		NU No. 6 CNC List 3A

Frequency Lowering

- Addresses “dead hair cell” regions
- Can provide 15 to 20% improved word understanding with 4-6 weeks practice
- Available from all major manufacturers

Ear	Test	dB	%		SNR			
L	WRS	48	56%	56%		SF		NU No. 6 No FreqLower
L	WRS	48	72%	72%		SF		NU No. 6 FreqLow

Noise Reduction Programs

- Automatic scene analysis programs are great but…
  - Several factors produce greater difficulty than can be addressed by these programs:
    - Severity of loss
    - Slower processing due to age
    - Attention issues
- Dedicated, fixed directional programs can often provide more control and predictability in noise

Impulse Noise Control

- Many people have hyper sensitivity to high intensity, short duration (loud impact) sounds.
- Often reported as “hearing aids are too loud”
  - Incorrect lowering of overall amplification
  - Sacrificing dynamic range and audibility
- Most current instruments have a specific control for this type of sound

Improved IP Ratings

- IP = Ingress Protection
- Many current hearing aids and cochlear implant processors have IP67 or 68 ratings
- IP 67
  - Completely sealed against dust entering the device
  - Can be submerged in water for up to 30 minutes at a depth of 1 meter
- IP68
  - Completely sealed against dust entering the device
  - Can be submerged in water for more than 30 minutes at a depth greater than 1 meter. Specifics are detailed by manufacturers.

NOTE: this is NOT an indicator of long term durability or quality

Rechargeable Hearing Aid Batteries

Nickle Metal Hydride (NiMH)

Life Span: ~ 1year

Can use Zinc Air?: Usually

Current Models: Signia (Siemens) Primax

Rechargeable Hearing Aid Batteries

Lithium-ion (LiON)
Life Span: ~ 3 years
Can use Zinc Air? Usually not

<u>Current Hearing Aid Models:</u>
Phonak: B-R, Marvel (in release cycle now)
Signia: Cellion and Charge n Go
Starkey: Muse iQR

<u>Current Cochlear Implant Models:</u>
Advanced Bionics: Naida Q70ci and Naida Q90ci
Cochlear: Nucleus 7
MedEl: Sonnet, Rondo2

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Rechargeable Hearing Aid Batteries

Silver-zinc (AgZn)

Life Span: ~ 1year

Can use Zinc Air? Usually

Brand: Z-Power

- ReSound Linx 3D-61 (312 battery)
- Oticon OPN
- Starkey Muse Micro 312 R
- Widex Unique
- Unitron Moxi All and Stride R

Direct wireless connectivity

- Made for iOS
  - Hearing Aids
    - GN ReSound Linx2, 3D Quattro
    - Oticon OPN
    - Signia NX
    - Starkey Halo, Halo 2
    - Widex Beyond, Evoke
  - CI
    - Nucleus 7
  - OI
    - Baha 5
- Made for All
  - Phonak B –Direct, Marvel (in release)

• Improved Remote Microphones

- 3rd party partnerships
  - Signia, Oticon
- Multi-Function Mics
  - MultiMic 2
  - Roger Pen
- Adaptive table mic
  - Roger Select

Cochlear Implant MRI compatibility

- MRI Strength measured in Teslas
- Typical MRIs today are 1.5T or 3.0 T
- Magnet intact
  - Head Wrap
  - No wrap
- Magnet Removal

MRI compatibility – Intact Magnet

- Head Splint Kit
  - Supports Magnet
  - Splint plus compression bandage
- Rotating Magnet
  - Magnet moves in opposition of MRI magnetic field

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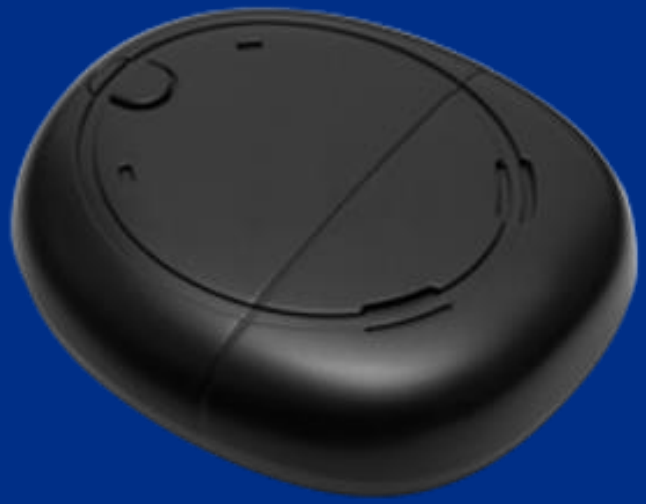
MRI compatibility – Magnet Removal

- Magnet is removed prior to MRI
- Non-magnetic spacer inserted
- Implant remains in place
- Ater MRI, a new, sterile magnet is installed
- Incision id closed
- Patient may use processor immediately after magnet replacement
- Detailed coverage of this topic coming in a future issue of *Hearing Life* magazine.

One-piece Cochlear Implant Processors

- Cochlear CP950
- Med-El Rondo and Rondo 2



PSAPs and Over the Counter Hearing Aids

- Personal Sound Amplification Products
  - NOT hearing aids
  - Indicated for enhancing recreational sounds, not correcting hearing loss
  - Range in price from 10s to 100s of dollars

- Over The Counter Hearing Aids
  - New FDA class of hearing aids (2017)
  - Indications
    - Over 18 years old
    - Mild to Moderate hearing loss
    - Distribution regulations still being developed