



# Examining Recommendations for Hearing Aid Use In Children with Unilateral Hearing Loss

Marlene Bagatto

Unilateral Hearing Loss in Children Conference  
October 23-25, 2017  
Philadelphia, PA, USA



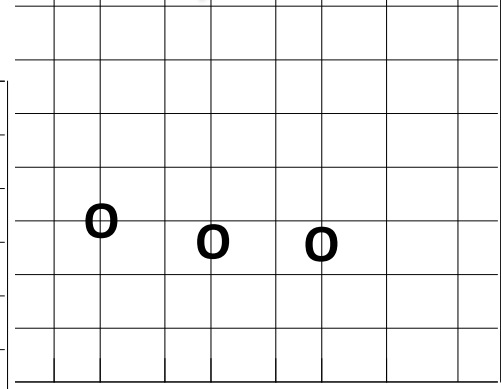
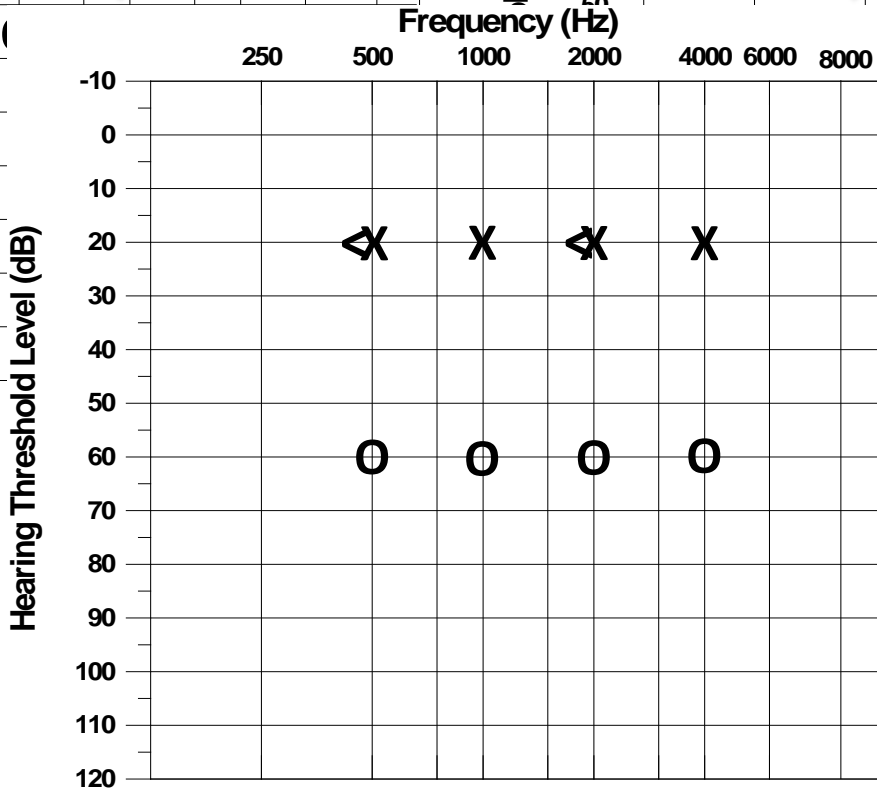
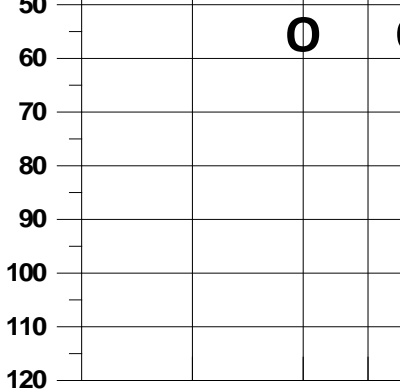
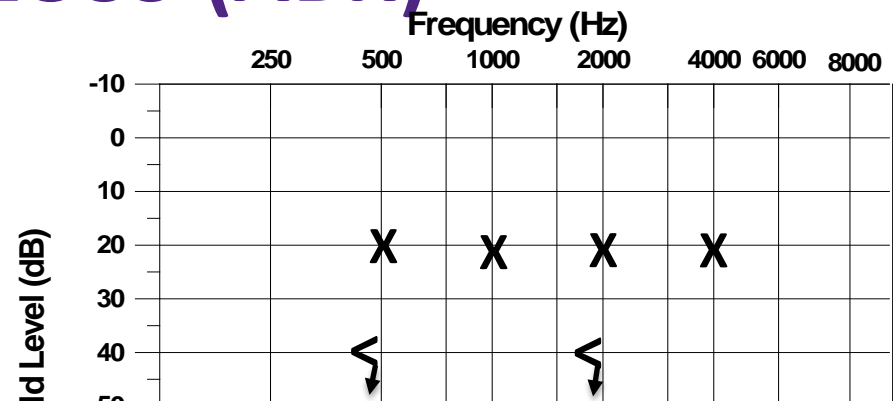
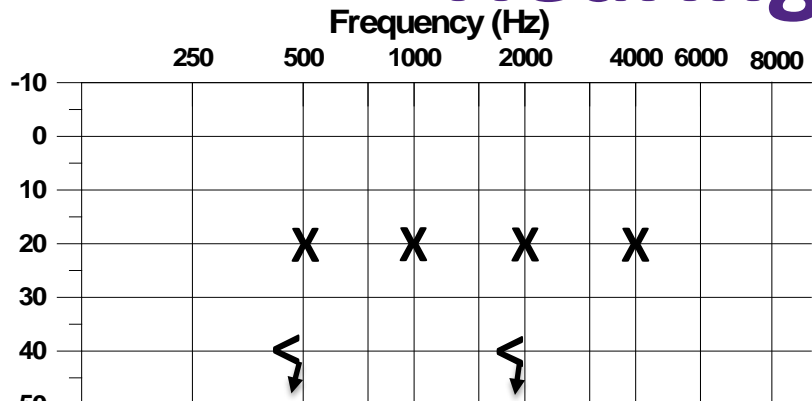
# Background

- Evidence exists demonstrating the benefits of hearing aids for bilateral sensorineural hearing loss
- Protocols are less well-established for other groups of children
  - Auditory neuropathy spectrum disorder
  - Minimal/mild bilateral
  - Unilateral

# Early Intervention

- Research suggests that in some cases, children with UHL/MBHL may have poorer outcomes than children with more severe bilateral hearing losses
  - Identified earlier and receive more services
- Consensus is to provide early intervention services
  - Goals to monitor audiometric thresholds and developmental progress
    - At risk of developing bilateral hearing loss

# Degree / Type of Unilateral Hearing Loss (ABR)



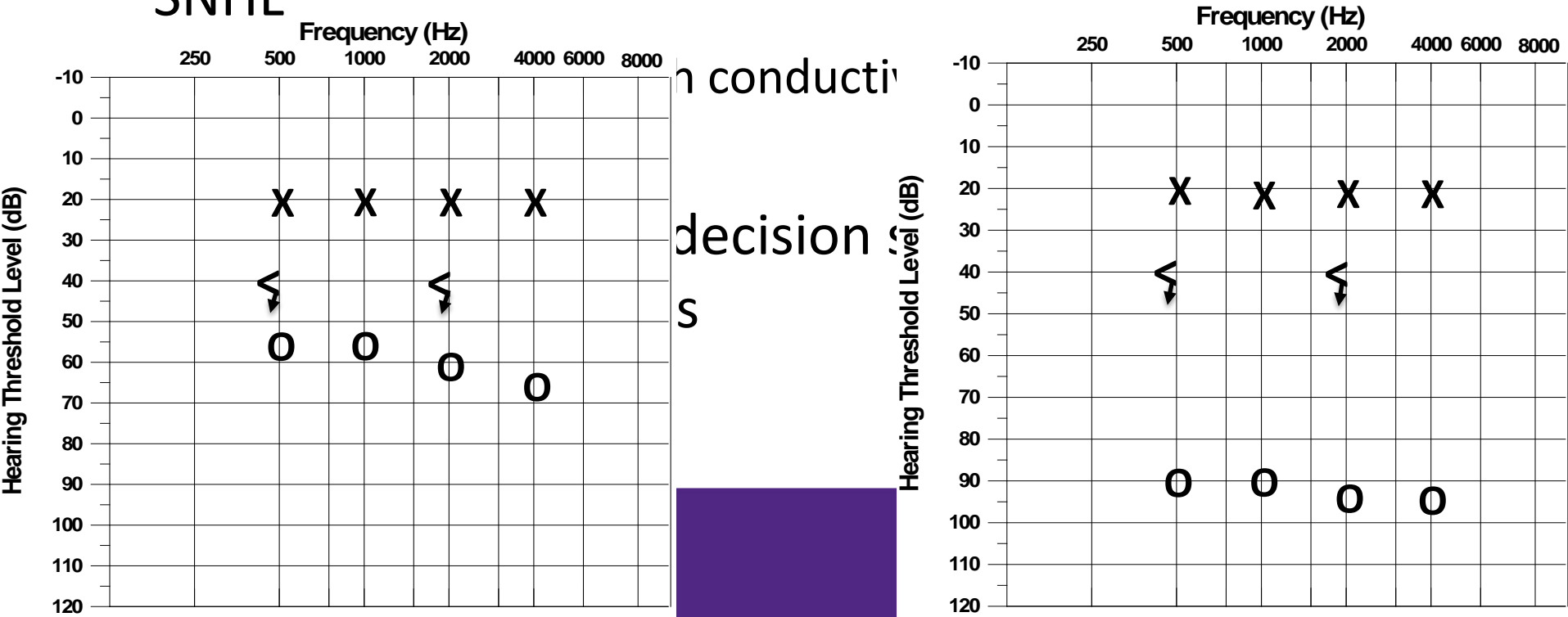


# Considerations for Management of UHL in Children

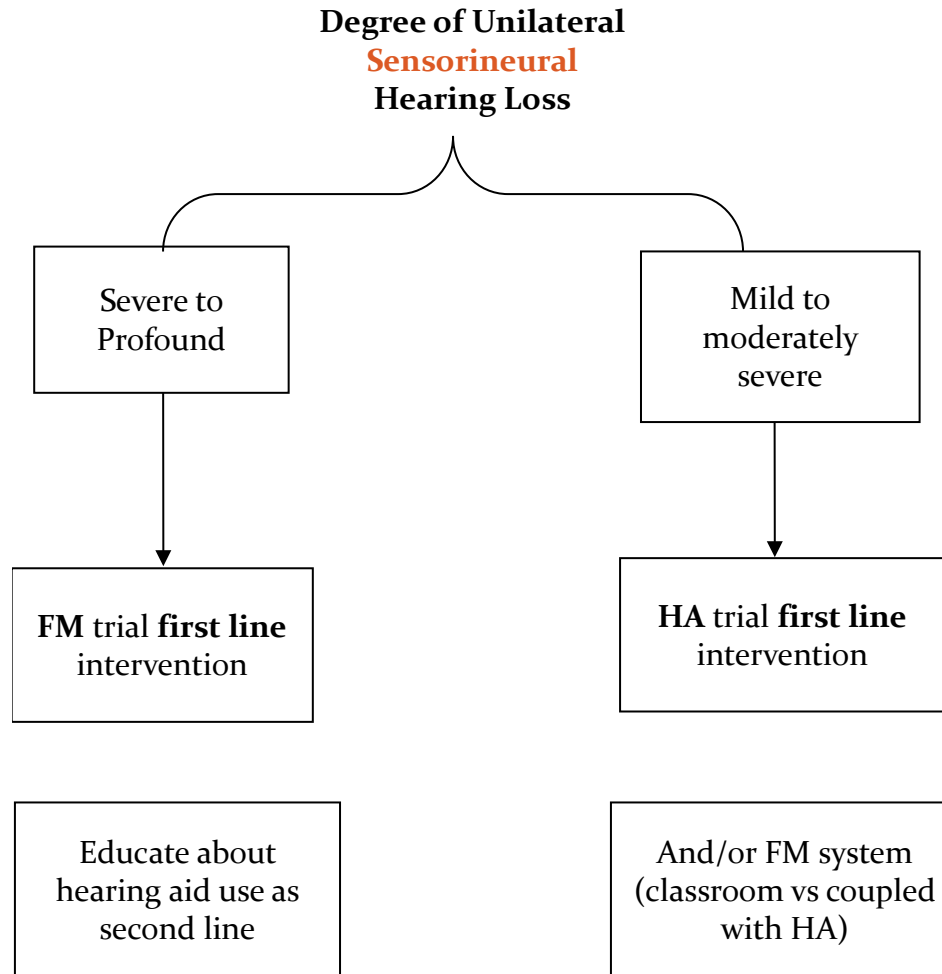
- Speech perception scores of children aged 7 through 12 years of age with UHL showed no significant aided benefit or detriment in the conditions assessed
- On the other hand, subjective assessment of aided benefit was noted at home and at school by the children as well as their parents
- Improved sound localization abilities if receive hearing aid before age 5 years
  - Aided 9 years or later had impaired localization abilities
- Critical period for optimizing bilateral auditory pathways

# Management of UHL in Children

- Cincinnati Children's Hospital review of evidence
- School-age children with any degree of unilateral SNHL



# Management of UHL in Children



# Management of UHL in Ontario EHDI

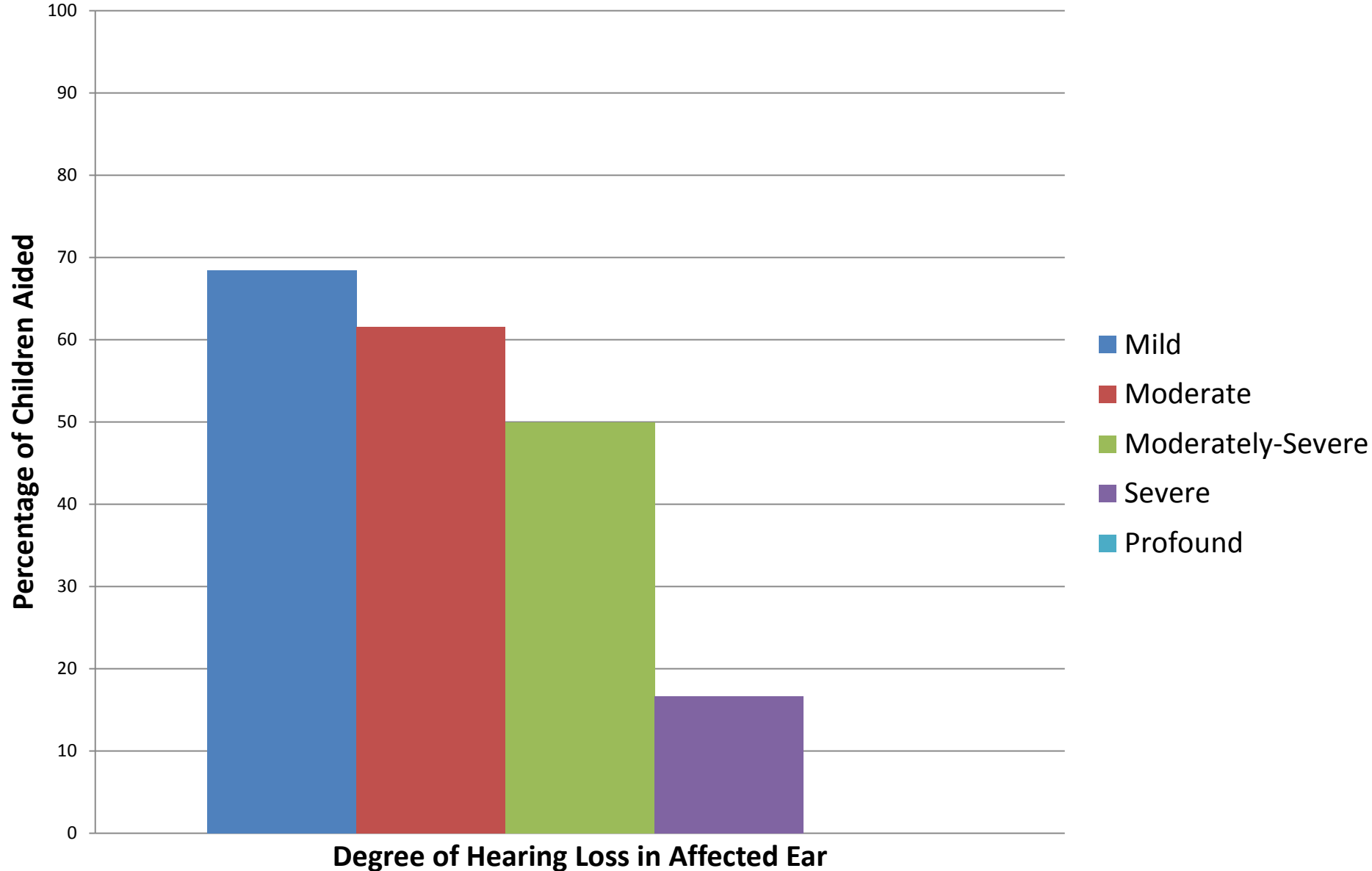
- Infants and young children identified with UHL comprise approximately 15% of children seen within the Ontario Infant Hearing Program (IHP)
- IHP Provision of Amplification Protocol (2007) and other guidelines (American Academy of Audiology, 2013) advises providing hearing aids to these children on a case-by-case basis
- Lack of clearer recommendations imposes a challenge for IHP Audiologists and the families of infants and young children with UHL with whom they work



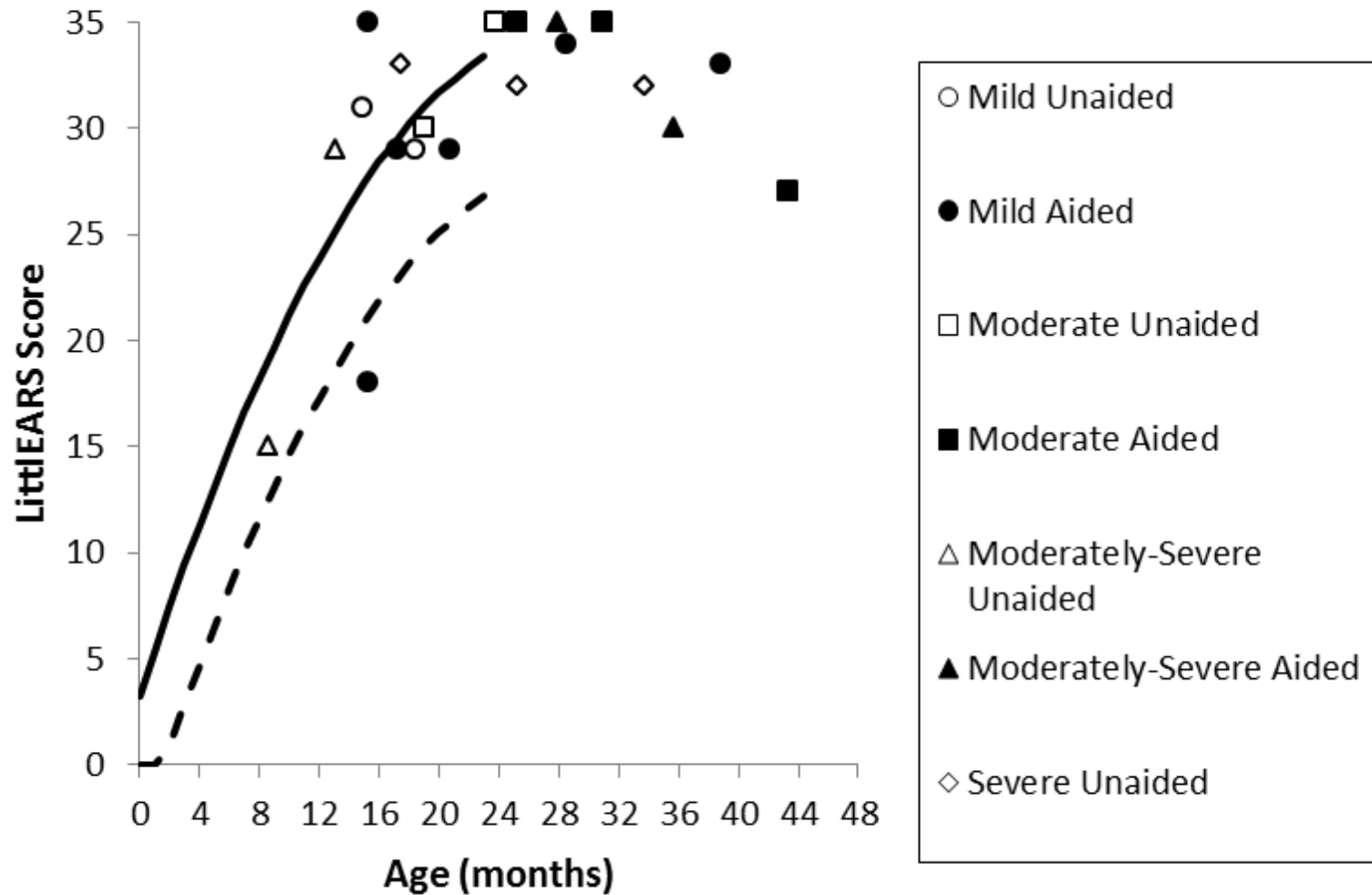
# Management of UHL in Ontario EHDI

- Protocol addendum (2014) endorses the Cincinnati statement (2009) to support the management recommendations for infants and children with USNHL
- FM use for children with mild to moderate USNHL
- Monitor hearing aid benefit (more on “aidable” later)
- Consider child/family preferences, development, environment, education, and medical factors when making technology recommendations

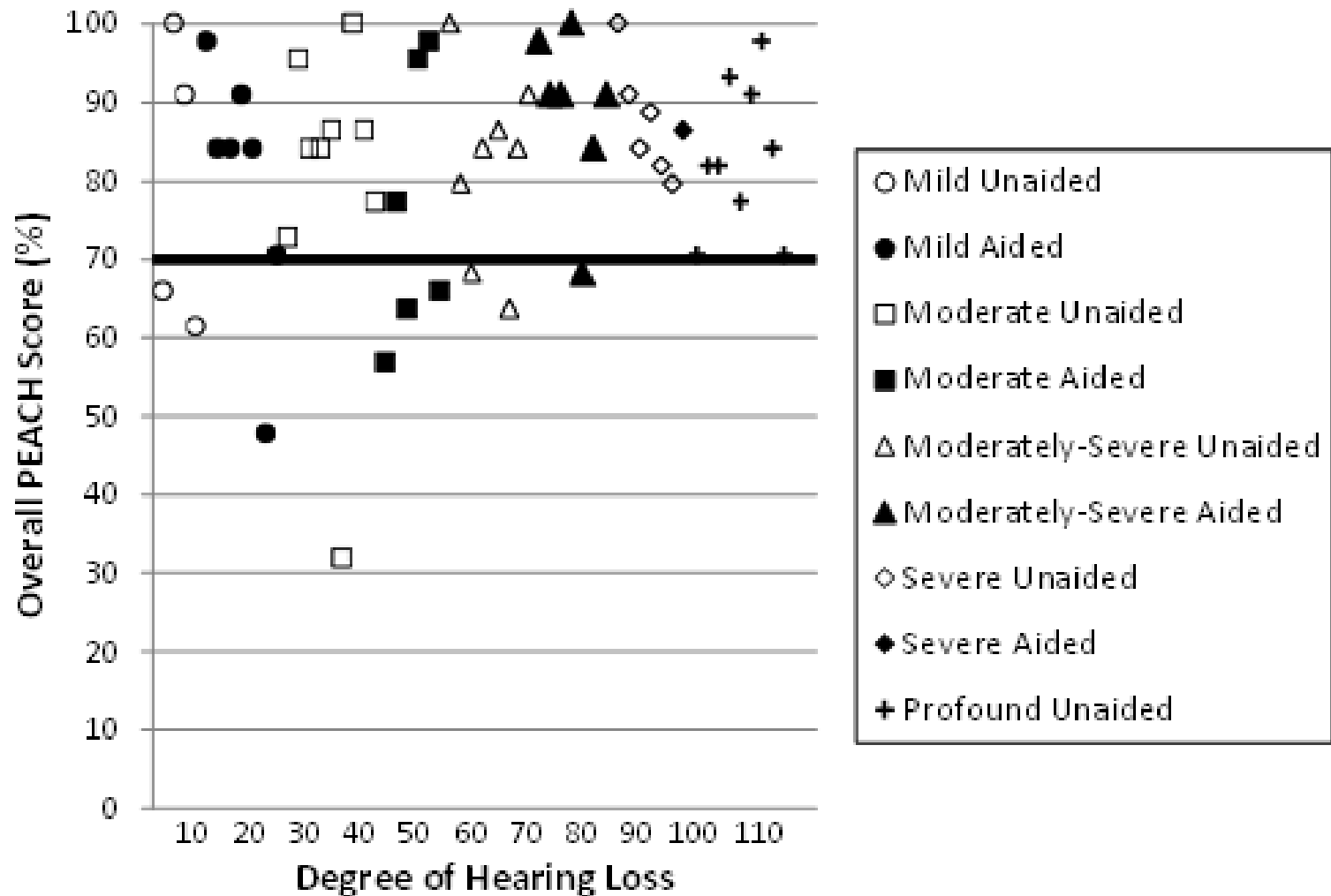
# Percentage of Ontario IHP Children with Unilateral Hearing Loss Provided with Hearing Aids (2011 Birth Cohort)



# LittleEARS Scores for IHP Children with Unilateral Hearing Loss



# Overall PEACH Scores for IHP Children with Unilateral Hearing Loss



# Outcome Measures

Subjective

Objective

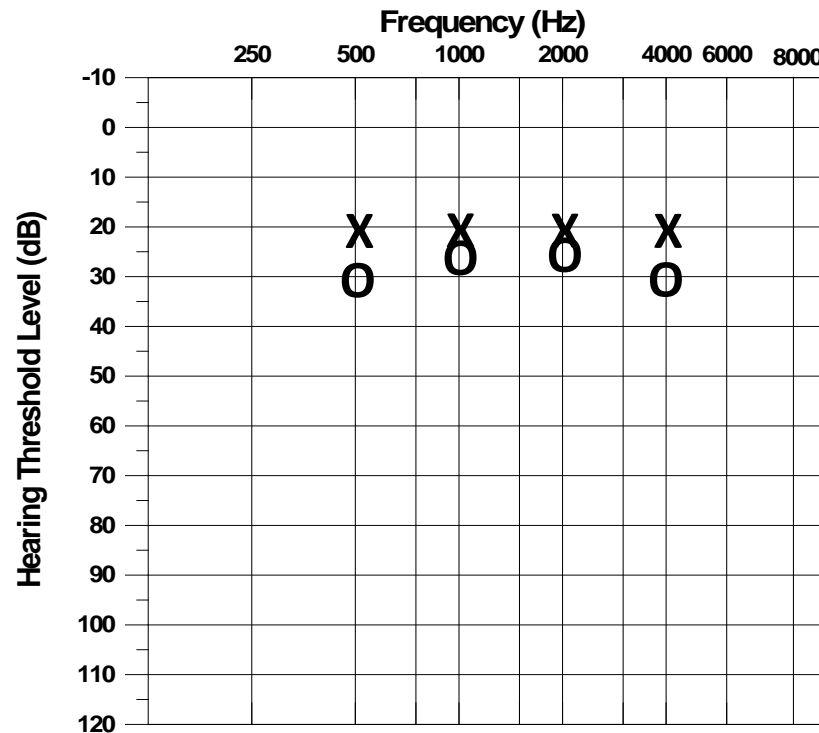
# Survey of Pediatric UHL Management Practices in North America

Dave Gordey  
Lisa Davidson  
Judith Lieu  
Marlene Bagatto

**I use the following outcome measures to evaluate the hearing aid fitting for infants and children with *mild to moderately-severe* UHL (N = 179)**

Answer Choices	Percentage of Respondents
Aided audiogram in soundfield (no masking)	17.88
Aided audiogram in soundfield (with masking noise or plugging the better ear, where appropriate)	59.78
Aided speech testing	60.34
Aided speech testing in noise (where appropriate)	64.25
Recorded/calibrated Ling 6 (HL) Test (Glista et al, 2014)	12.29
Live voice Ling 6	43.58
Parent/caregiver questionnaire (e.g., LittleARS, ELF)	69.83
I don't use outcome measures	3.35

# Air Conduction Hearing Aid for Mild USNHL in Children





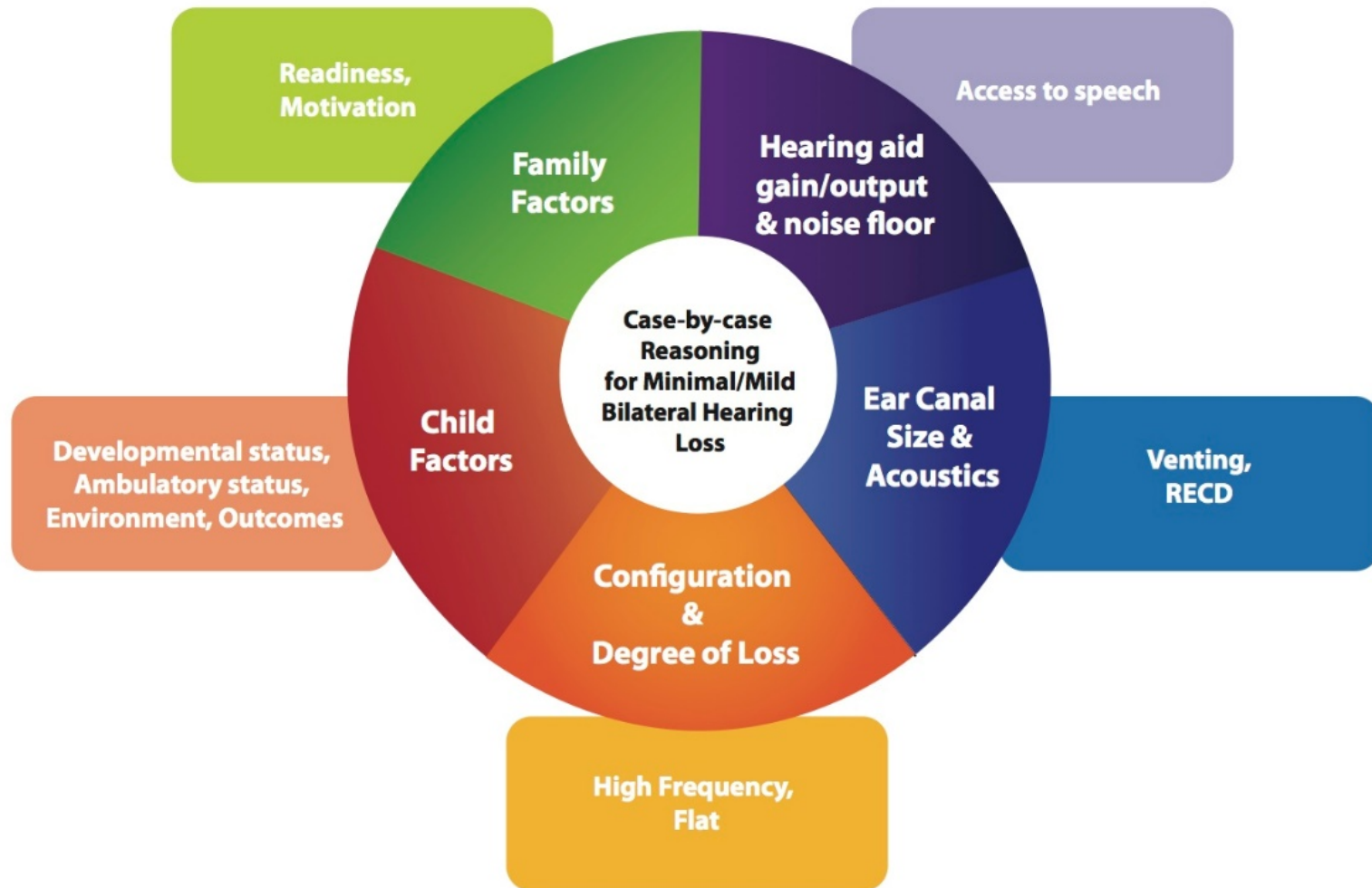


# Decision Support Guide for Hearing Aid Use in Infants & Children with Minimal/Mild Bilateral Hearing Loss

Marlene Bagatto & Anne Marie Tharpe

A Sound Foundation Through Early Amplification Conference Proceedings  
July 2014

# MINIMAL/MILD BILATERAL HEARING LOSS

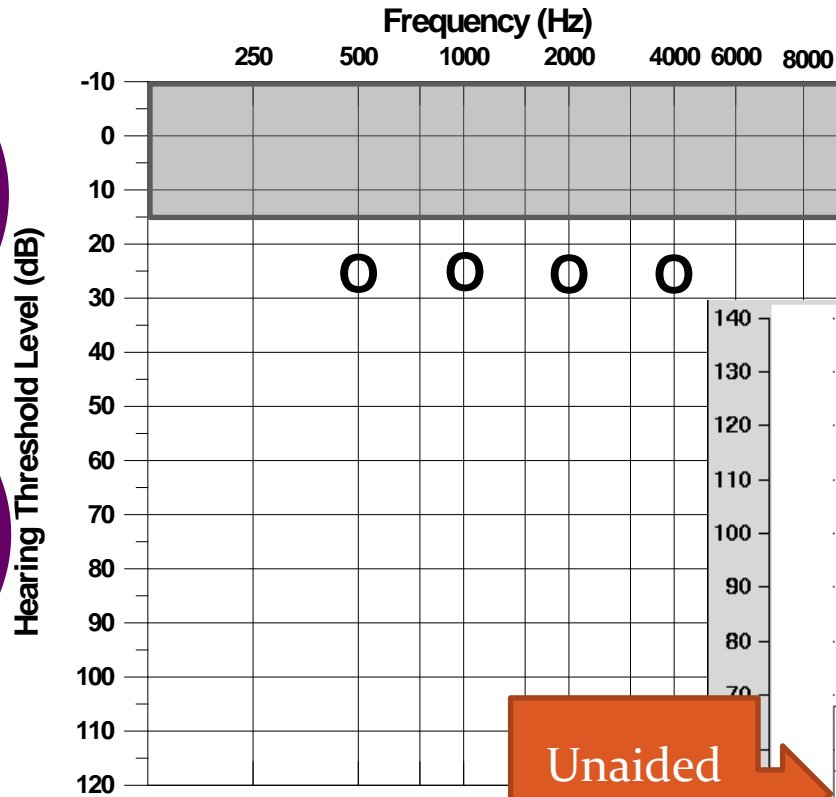


# Flat 25 dB HL

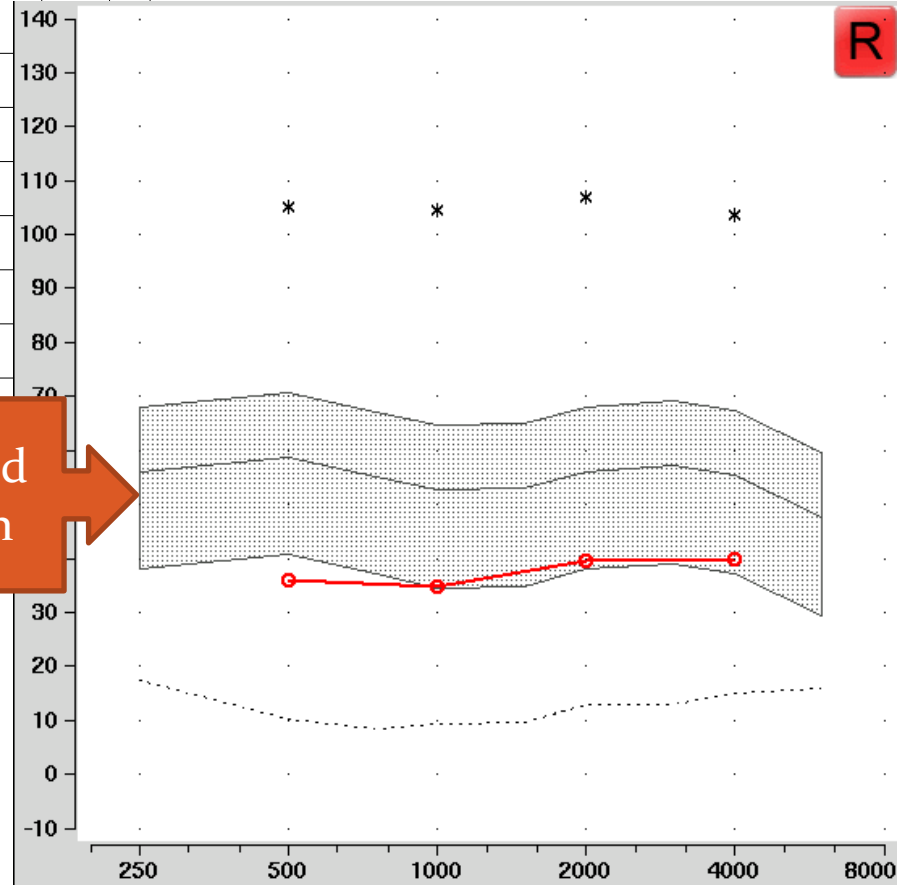
Configuration  
& Degree of  
Loss

Ear Canal  
Size &  
Acoustics

Hearing aid  
gain/output  
& noise floor



Unaided  
Speech

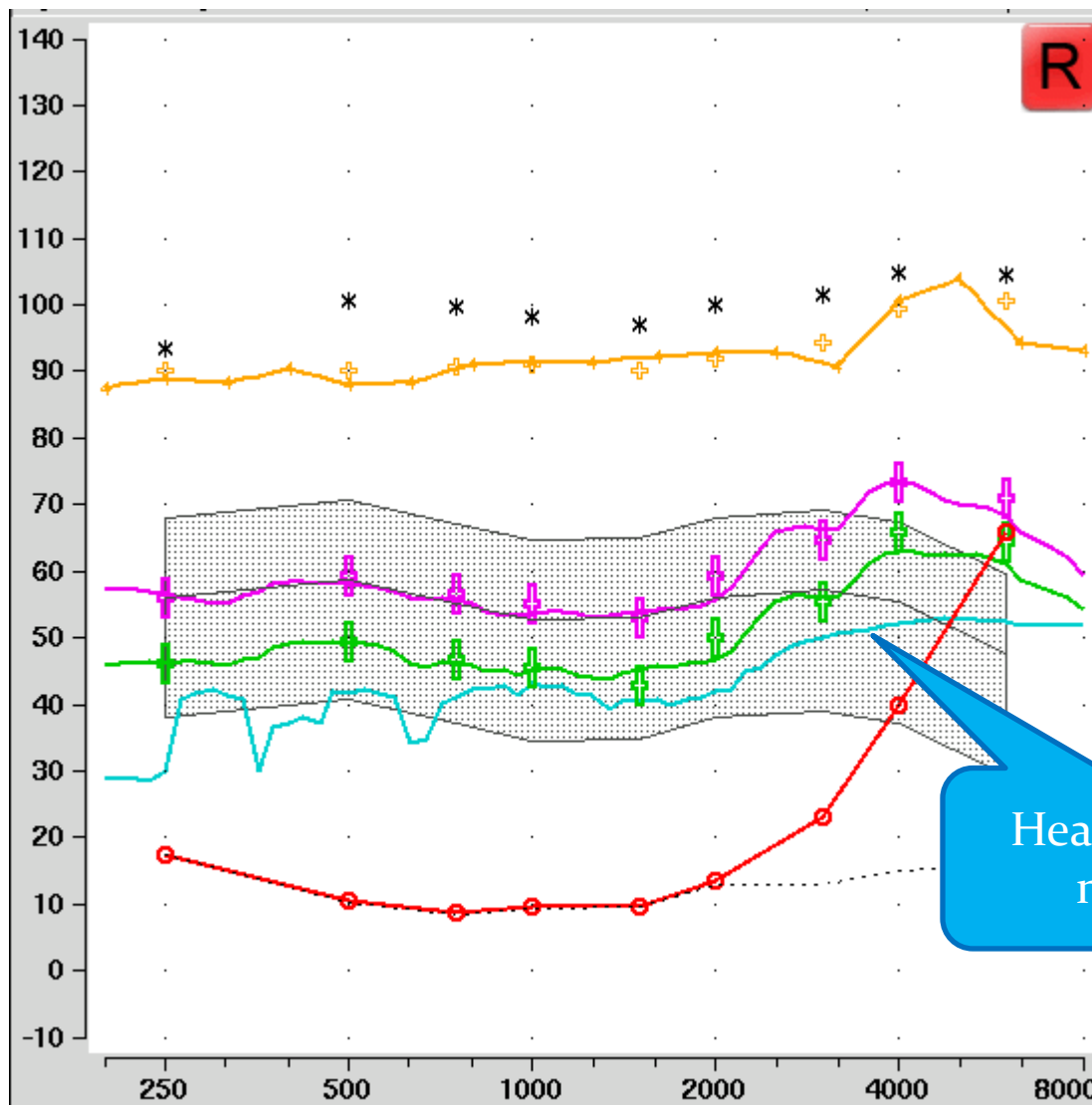


# High Frequency Hearing Loss

Configuration  
& Degree of  
Loss

Ear Canal  
Size &  
Acoustics

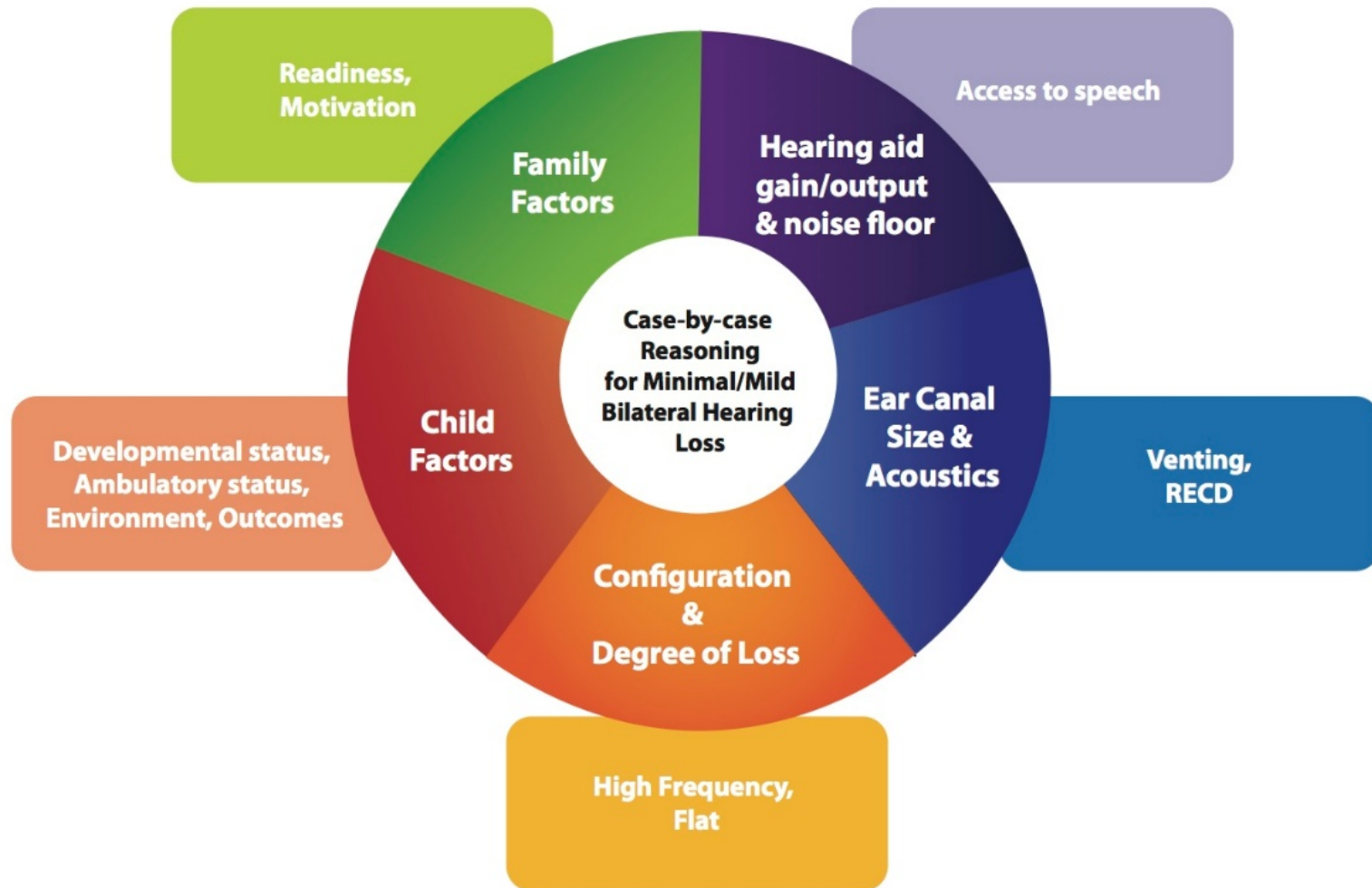
Hearing aid  
gain/output  
& noise floor



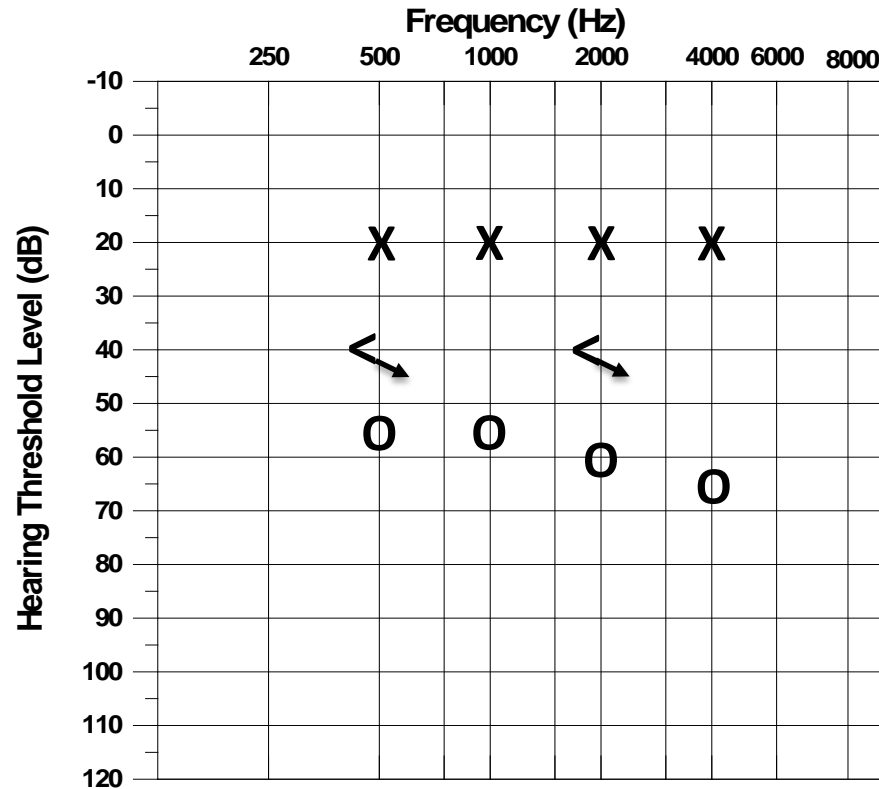
SII Unaided  
= 89%  
SII Aided  
= 94%

Hearing aid  
noise

# MINIMAL/MILD BILATERAL HEARING LOSS



# Air Conduction Hearing Aid for USNHL in Children

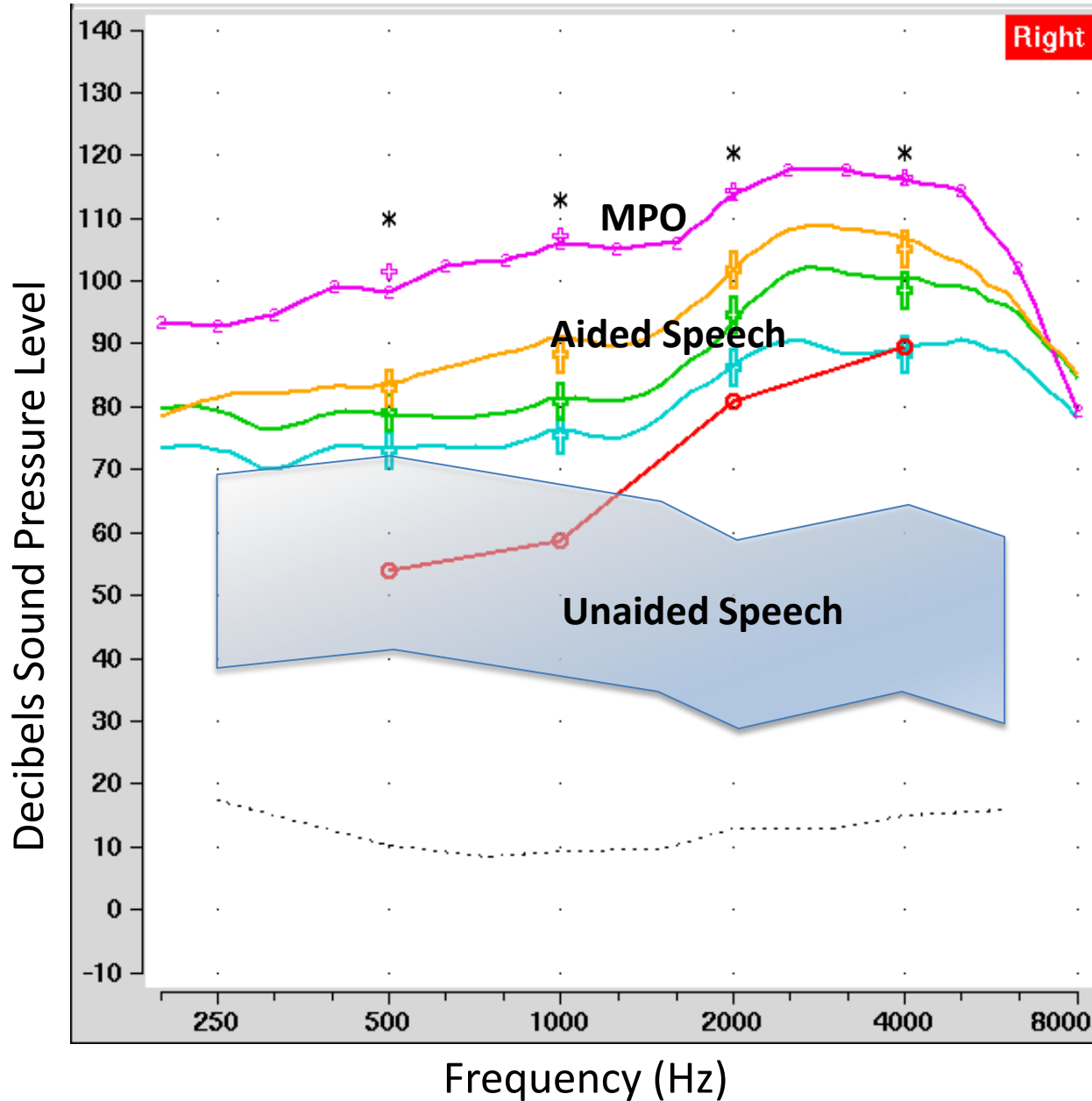




# Air Conduction Hearing Aid for *Mod to Mod-Severe USNHL*

- Most available devices can provide appropriate match to prescriptive targets within  $\pm 5$  dB on average, across frequency
- Potential speech perception performance is good with appropriately fitted device if follow current fitting protocols
- Currently no adjustment to DSL prescriptive target for a UHL fitting

# Electroacoustic Verification - SPLogram

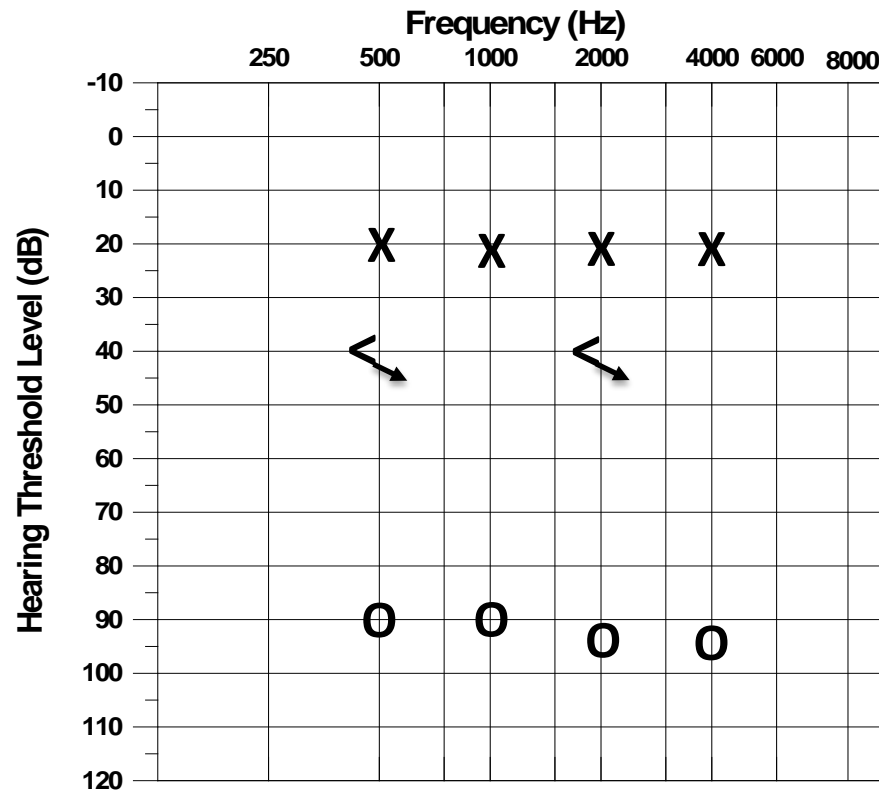


Right

Predicted from coupler measurements & the RECD



# Air Conduction Hearing Aid for USNHL in Children





# Air Conduction Hearing Aid for *Severe to Profound UHL*

- Few available devices can provide appropriate match to prescriptive targets within  $\pm 5$  dB on average, across frequency
  - Impacted by ear canal characteristics
  - Reduced dynamic range
- Tolerance for amplified sound
- Potentially poor speech perception performance
  - Difficult to measure in infants



# Is the affected ear “aidable”?

- Assumption that measureable hearing is usable hearing
- In infants and young children, difficult to assess dead regions or speech perception abilities
- Can a fitting be achieved without feedback?
- What about crossover?



# Safety / Risk is a Concern for Profound Fittings

- Counsel against the use of hearing aids in high sound levels
- Use lower gains for high noise environments
- Monitor audiograms for changes
- Recommendations not necessarily for children with USNHL

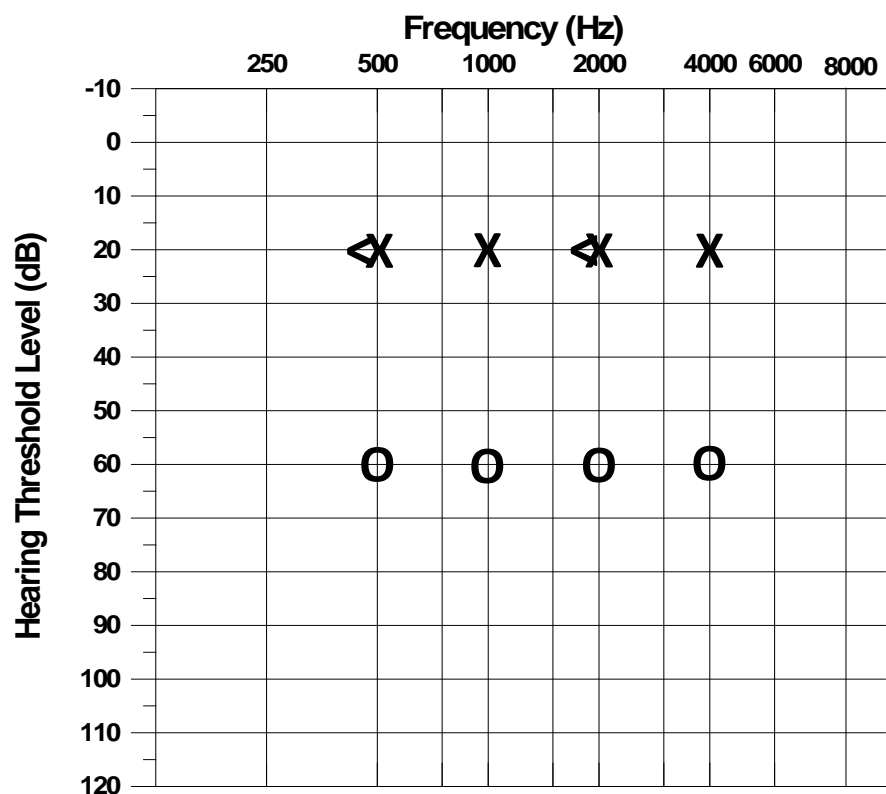


# Considerations: Sev/Pro UNSHL

- What should we base our management recommendations on:
  - Audiogram?
  - Speech perception abilities?
  - Potential for intervention with other technologies?
- Intervention with a child should not be pursued if there is lack of benefit
  - Hearing aid trial
  - Meaningful monitoring (outcome measures)

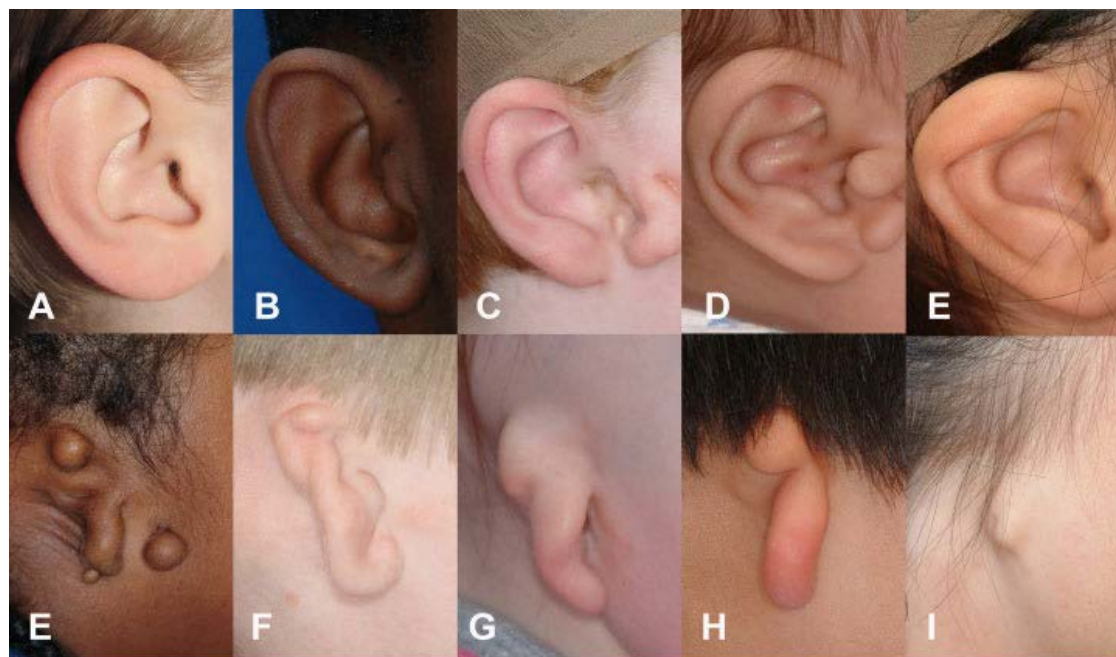


# Bone Conduction Hearing Aid for UCHL in Children

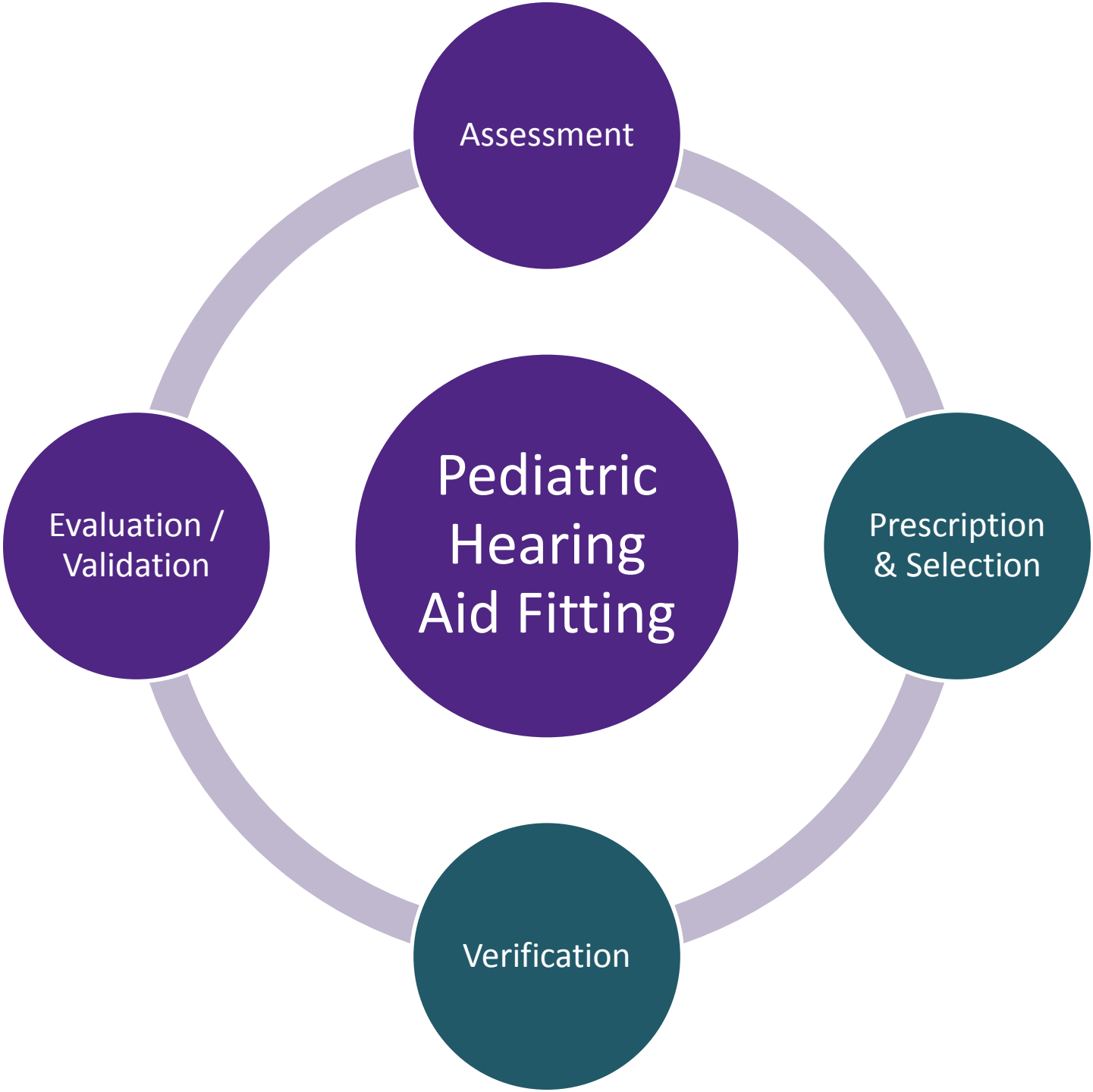




# Bone Conduction Device Fitting Practices in Children (in prep)



Dave Gordey & Marlene Bagatto

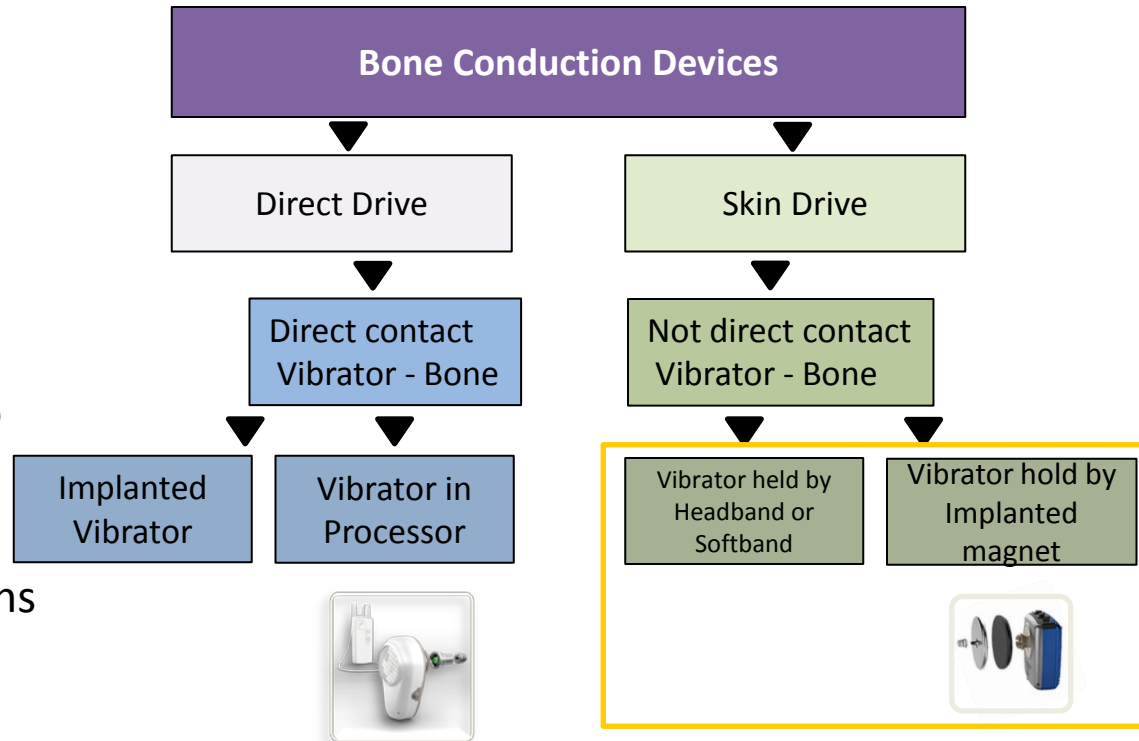




# Options for Delivering Bone Conducted Sound

## Direct Drive vs Skin Drive systems

- There are two types of bone conduction devices:
  - **Direct Drive** devices send vibrations via direct route to bone
  - **Skin Drive** devices send vibrations through the skin to bone
- Softband and magnet solutions provide similar performance<sup>1</sup>



1) Briggs (2015) Clinical Performance of a New Magnetic Bone Conduction Hearing Implant System: Results from a Prospective, Multicenter, Clinical Investigation. Otol Neurotol. 2015 Jan 28. [Epub ahead of print]

# Surgical Eligibility

- Children must have sufficient skull thickness and bone quality before implantation of a magnet, abutment or active bone stimulator can be considered
  - At least 2.5 mm thick (Davids et al, 2007; Papsin et al, 1997; Tjellstrom et al, 2001)
  - Currently the smallest implant available is 3 mm thick
- Currently, the placement of a bone anchored implant is recommended around age 5 years
  - Hakansson et al, 1990; Wade et al, 2002
  - Surgical criteria varies from country to country

# Non-Surgical Option

## *Headband or Softband*

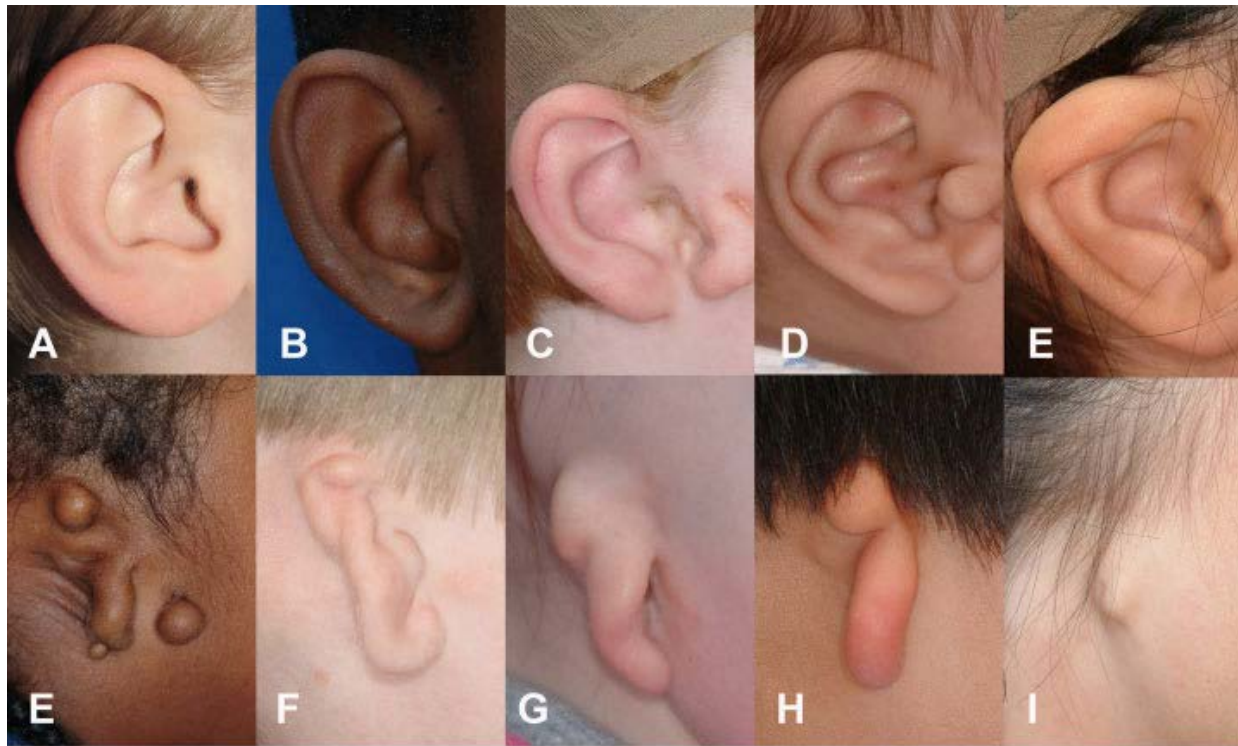
- Delivers sound via vibrations across the skin to the skull. Device is snapped onto a soft headband for use; *no surgery is required.*
- Recommended for children with conductive or mixed hearing losses who do not have properly formed outer ear or ear canal to accommodate a BTE hearing aid.



# Infants with unilateral & bilateral aural atresia....

- Will be identified at birth through EHDI programs
- Are candidates for bone conduction hearing devices on a soft headband
  - Many programs recommend trial with this before pursuing surgical option
- Are not eligible for surgical device for several years

# *How do I fit/verify bone conduction hearing devices (BCD) to infants/children?*





# Improving Clinical Practice: Current Research

Clinician  
Survey

Retrospective  
File Review

Draft Protocol

Prescriptive  
Targets

Equipment

Clinical  
Application

Hodgetts & Scollie,  
2017, IJA

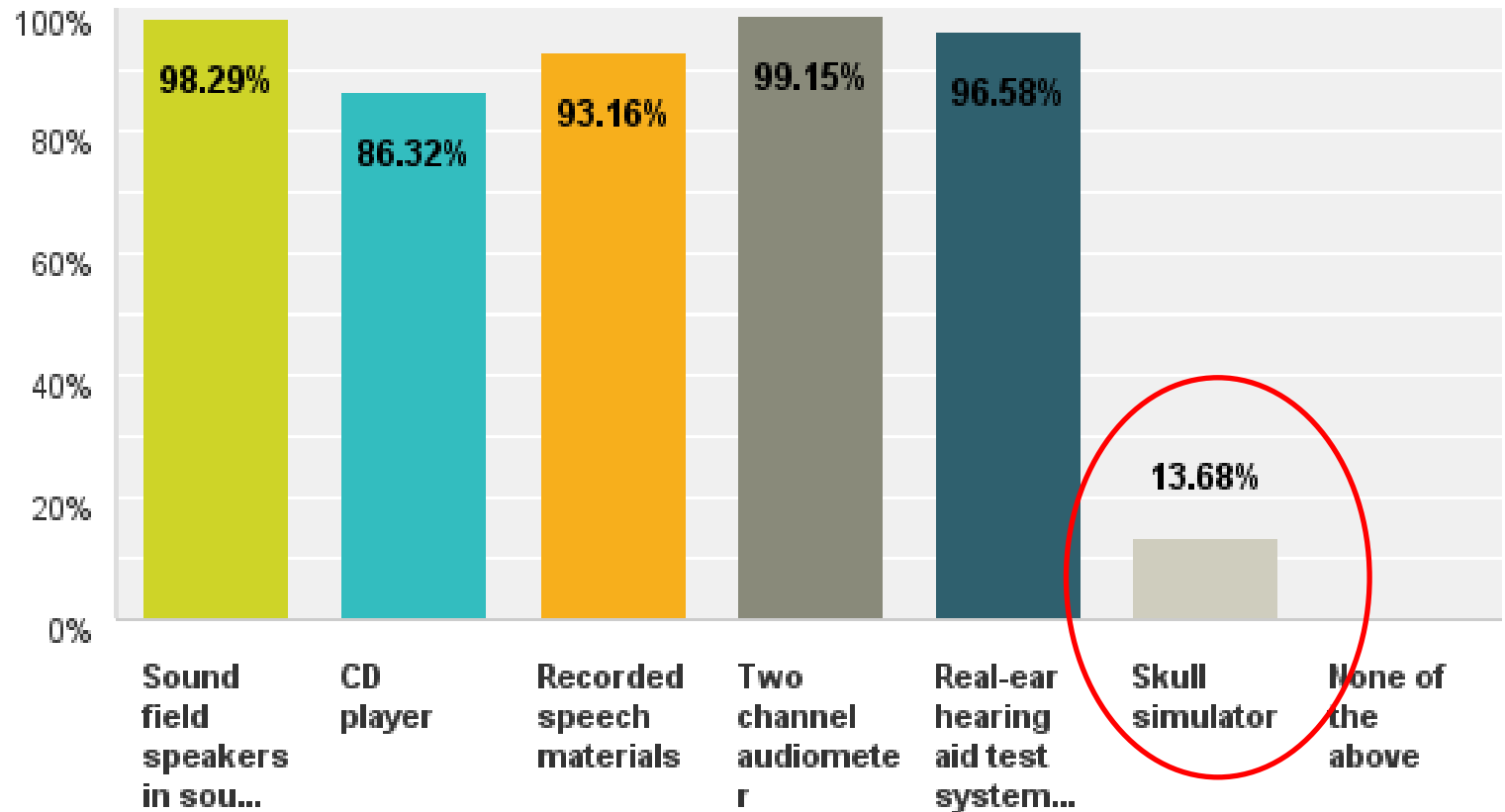
Skull simulator

Clinical populations  
& devices



## Q6 My workplace is set-up with the following equipment: (check all that apply)

Answered: 117 Skipped: 28

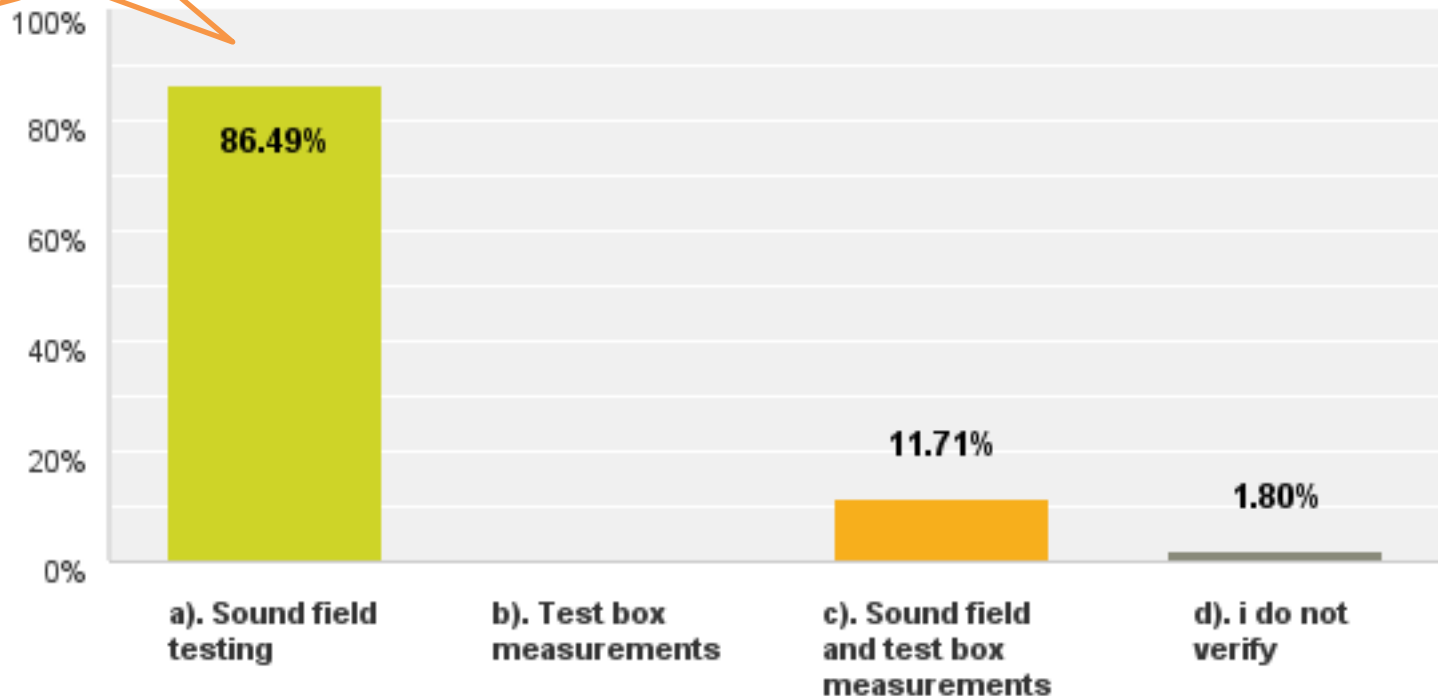


# Clinical Verification of Devices

Validation tool in AC HA Fittings

Q13 I verify my bone conduction devices for children using: (select one)

Answered: 111 Skipped: 34





# Current Work:

## Retrospective File Review

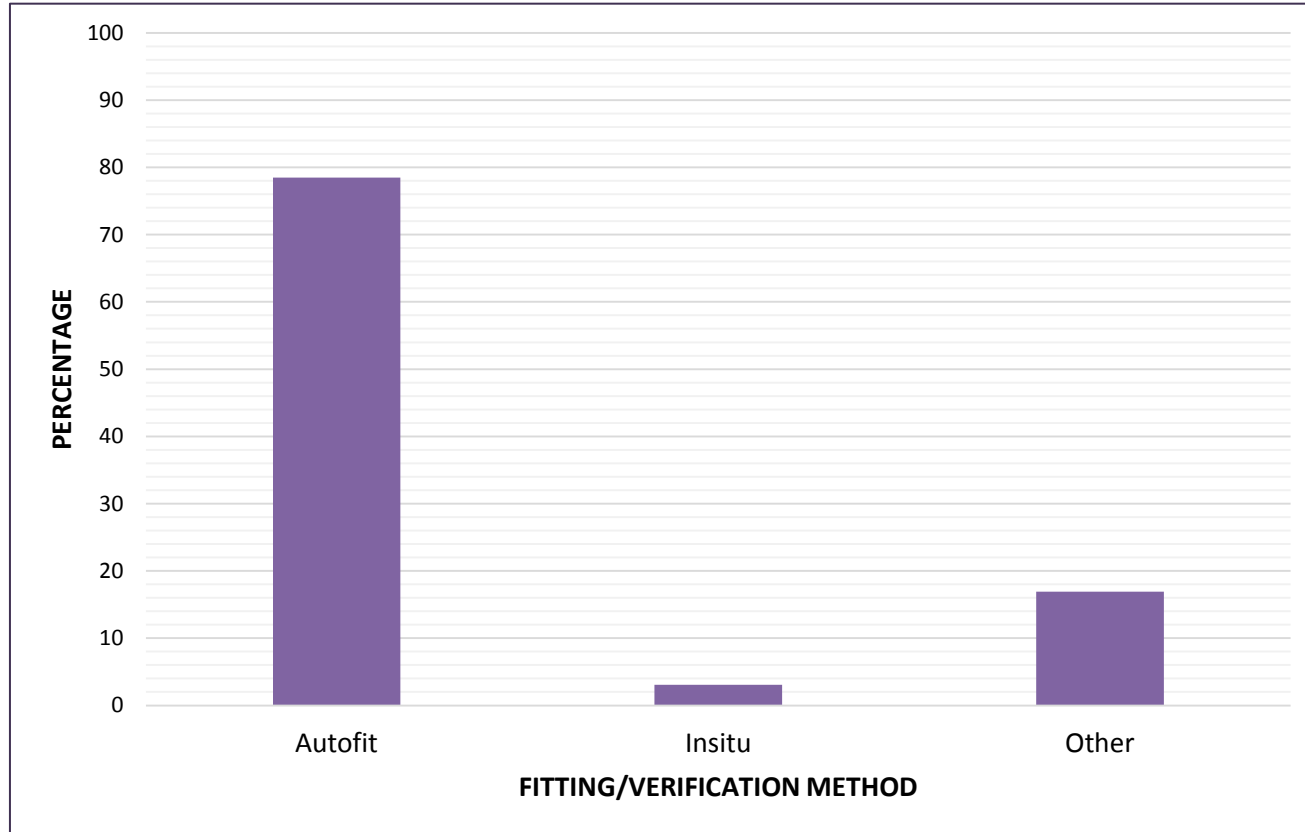
**Purpose:** To gain further knowledge about the clinical fitting and management of infants and young children who wear BC devices

**Collaborators:** *The Pediatric Bone Conduction Working Group*

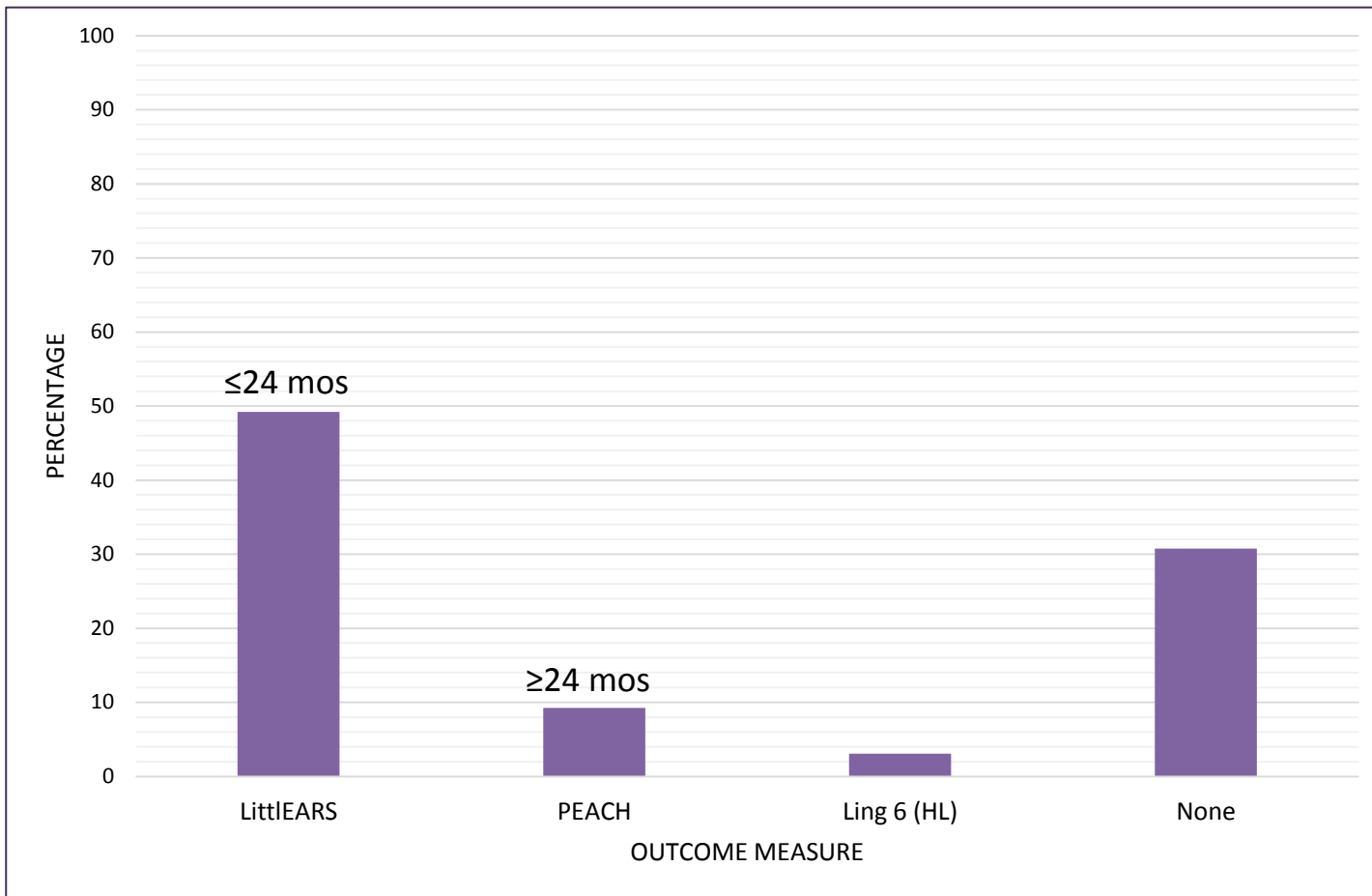
- Boys Town National Research Hospital
  - Michelle Vogel, Ashley Kaufman
- Children's Hospital of Philadelphia
  - Joy Peterson, Laurie Mauro
- Cincinnati Children's Hospital
  - Annemarie Wollet, Michael Scott
- Institute for Reconstructive Sciences in Medicine, Alberta, Canada
  - Meredith Haluschak
- Saskatoon Health Region, Canada
  - Charlotte Douglas, Lynne Brewster
- University of Miami Children's Hearing Program
  - Kari Morgenstein
- Western University
  - Christine Brown, Marlene Bagatto

# Results:

## Fitting/Verification Method



# Results: Outcome Measures



# Conclusions

- BCD on softbands are fitted to infants and young children
  - Unilateral atresia/microtia
- Due to the lack of necessary elements for verifying BCD, clinicians are applying their own strategies
  - Variability across clinics and clinicians
- Some consistency in outcome measurement tools used for validation
  - LittleEARS, PEACH, Ling 6 (HL)

# Important Updates

- DSL targets for Oticon Ponto BCD unilateral percutaneous fittings for adults (Hodgetts & Scollie, 2017)
- Skull simulators for clinical hearing aid test systems



Interacoustics Affinity



Audioscan Verifit

# Counseling Families: UHL

- Reduced audibility
- Localization of sounds
- Listening in noise
- Speech and language development
- Social-emotional development
- Learning and/or cognitive development
- “Training” for alternative technologies



# Supporting Clinical Recommendations for Children with USNHL

- Degree of loss in affected side
- Child factors
  - Speech and language status (functional assessments)
  - Cognitive ability or academic progress
  - Motivation
  - Potential acceptance
- Family factors
  - Understanding of management options
  - Understanding of child's hearing difficulty
  - Readiness and motivation

[bagatto@nca.uwo.ca](mailto:bagatto@nca.uwo.ca)

