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Using Outcome Measures to Optimize Pediatric Hearing Aid Fittings

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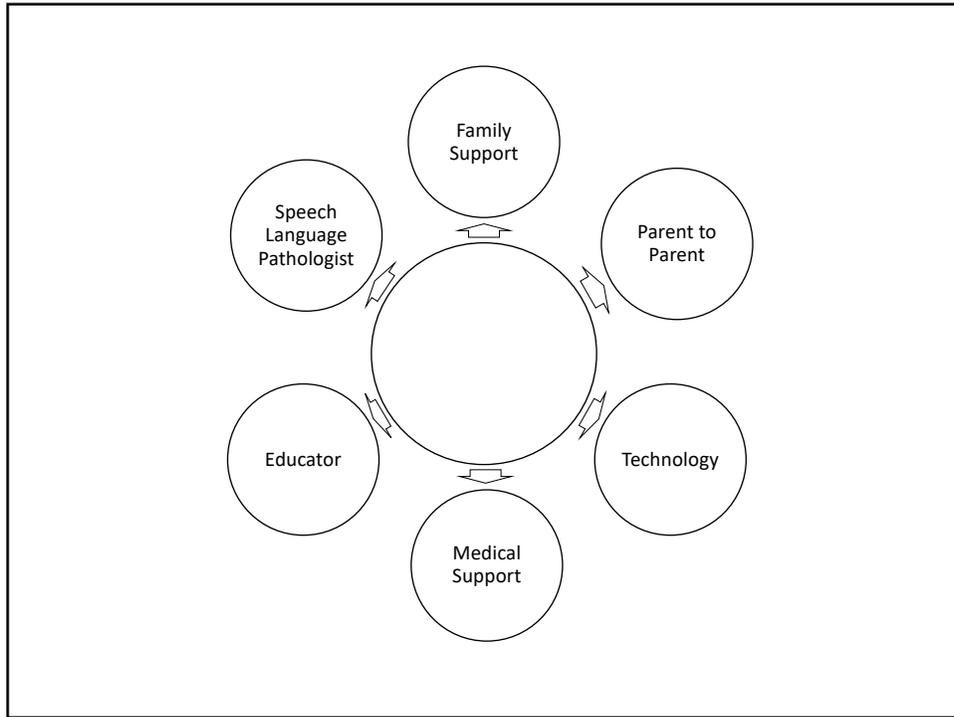
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Learning Outcomes

After this course, participants will be able to:

- Describe the rationale for using outcome measures;
- Explain tools included in a pediatric audiological monitoring protocol; and
- Apply outcome measures for infants and children who wear hearing aids.

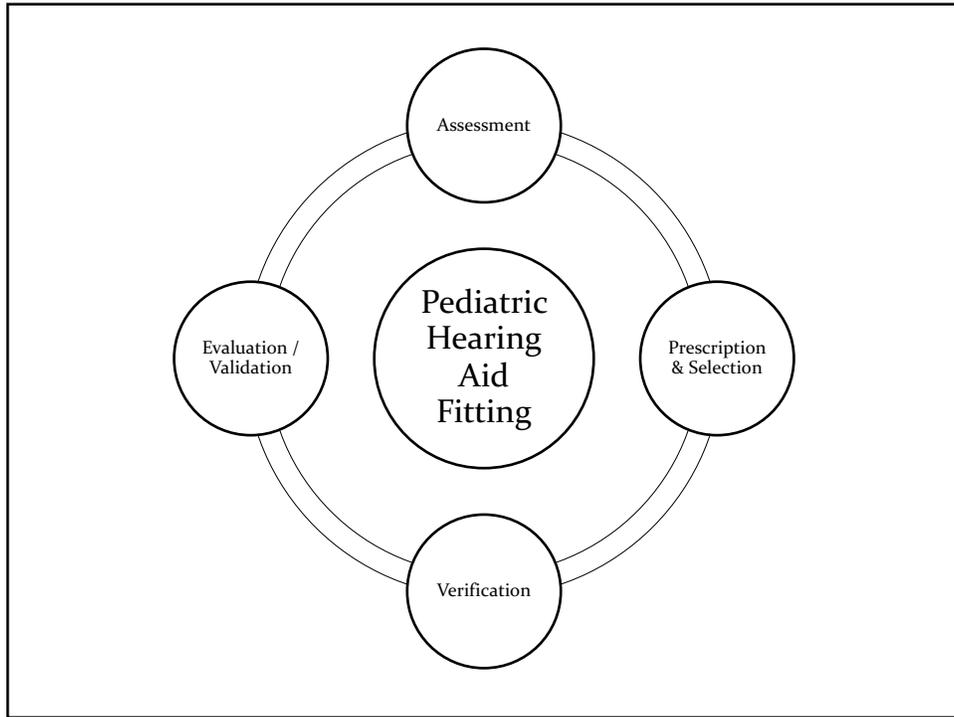
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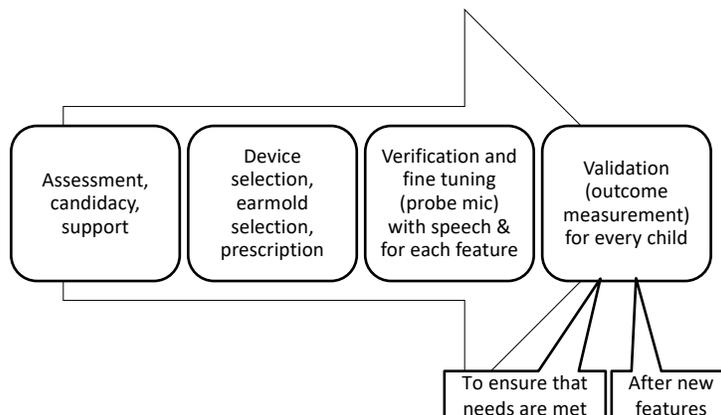
Hearing Aid Fitting

“The goals of prescription are to improve the ability to hear and thereby facilitate the development of sensory and perceptual skills, receptive and expressive language, speech production and literacy, academic performance, and social-emotional growth.”

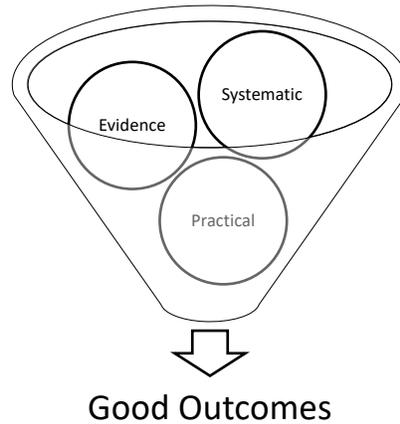
~Carney & Moeller, 1998



AAA Pediatric Amplification Guideline (2013)



Importance of Guidelines/Protocols



Joint Committee on Infant Hearing: Goal 6

“All children who are D/HH should have their progress monitored every 6 months from birth to 36 months of age through a protocol that includes the use of standardized, norm-referenced developmental evaluations...”

~ JCIH, 2013

In the clinic, outcome measures...

- can be used to measure the impact of the hearing aid(s) on the child's development;
- include caregivers in the management process;
 - good observers of their child's auditory behaviours
 - develop a shared language with professionals
 - active members of the team
- support collaboration with other professionals involved with the child.

In EHDI programs, outcome measures...

- provide systematic clinical data;
- can be used to assess the overall quality of the program;
- demonstrate to stakeholders the impact of the program for children with permanent hearing loss and their families.

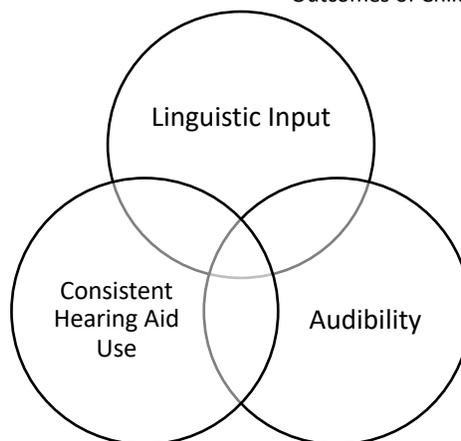


Examined the hearing, speech, language and psychosocial outcomes of children who are hard of hearing with respect to access to early intervention.

Boys Town National Research Hospital
University of Iowa
University of North Carolina

Factors Influencing Outcome

Outcomes of Children with Hearing Loss
ochlstudy.org



Moeller, Tomblin, McCreery, Walker, Arenas, Harrison, Spratford, Bentler, Holte, Roush, Oleson, Van Buren, Ambrose, Unflat-Berry

Best Practice: Outcome Evaluation

At regular intervals, use age-appropriate outcome measures to assess the impact of the hearing aid fitting: *demonstrates progress for the infant in the early stages of hearing aid use; monitor throughout intervention and when hearing aid changes.*



Considerations for Outcome Evaluation

Target Population:
Infants & young
children who wear
hearing aids

Good Statistical
Properties

Purpose: Measure
the impact of the
hearing aid fitting

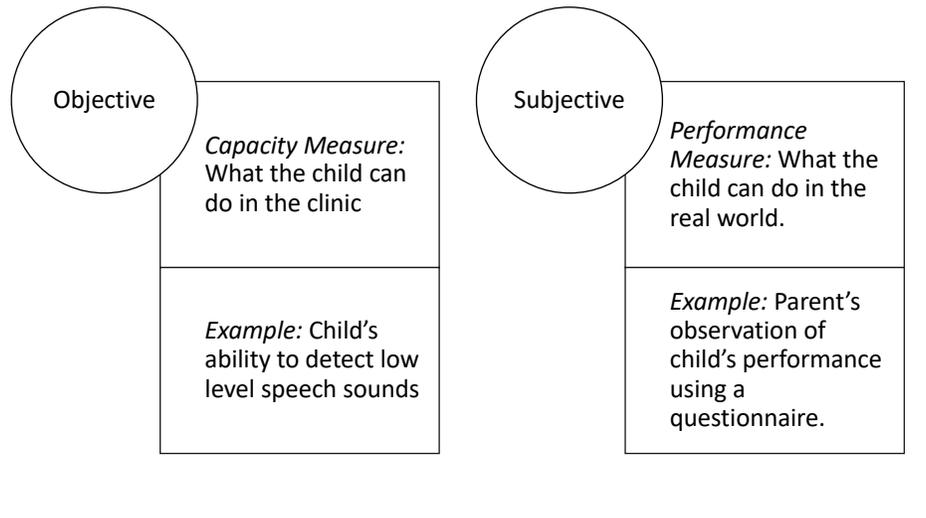


Clinically Feasible

Administration &
Interpretation: By
Audiologist

Clinically
Meaningful

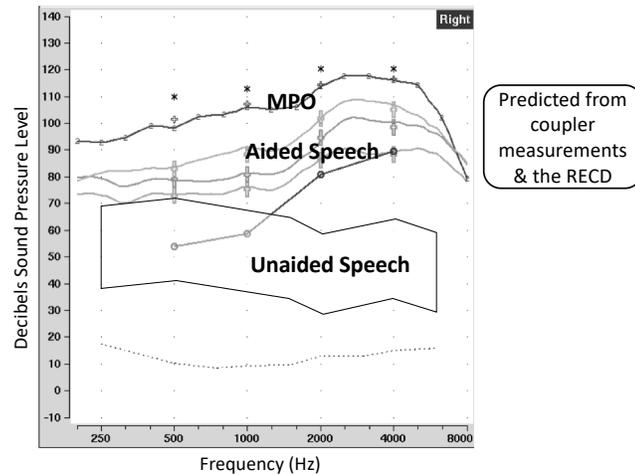
Types of Outcome Measures



Good auditory-related outcomes infer good audibility from hearing aids.

- Evaluating the *quality* of the hearing aid fitting is an important part of outcome evaluation
- Determine whether an individual child's fitting is providing a typical degree of audibility
- Provides overall quality assurance of hearing aid fitting for EHDI programs as a whole

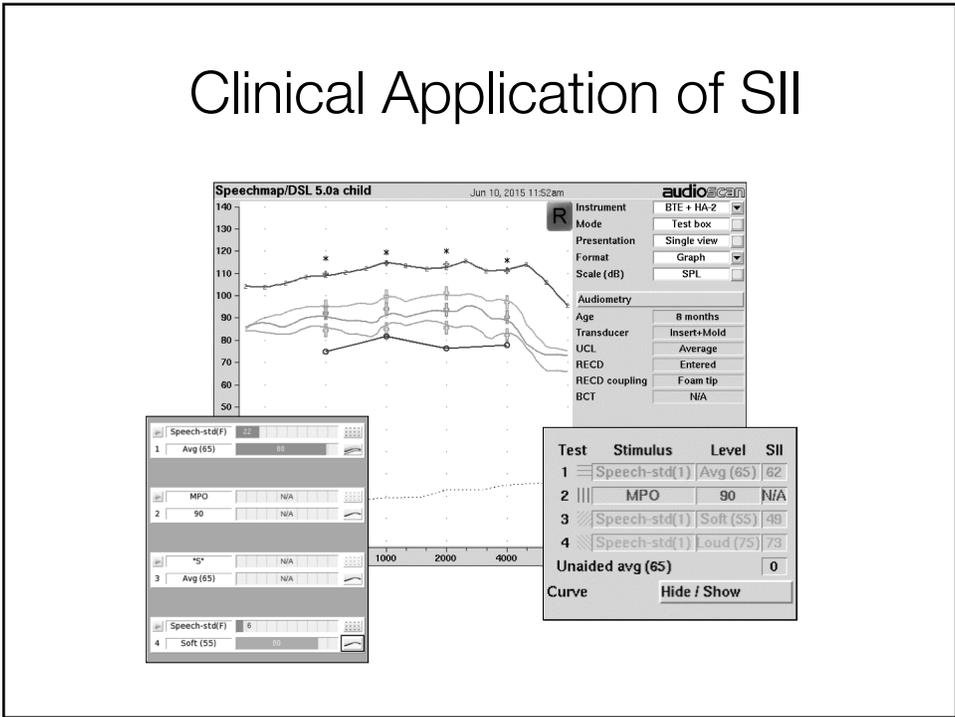
Electroacoustic Verification



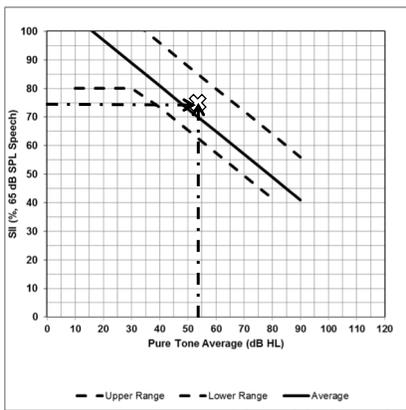
Other Analysis

- The Speech Intelligibility Index (SII)
 - An updated version of the Articulation Index (AI), standardized in 1997
- How to interpret:
 - 0 means no speech is audible
 - 1 means 100% is audible
 - *This doesn't mean that 100% will be heard correctly.*

Clinical Application of SII

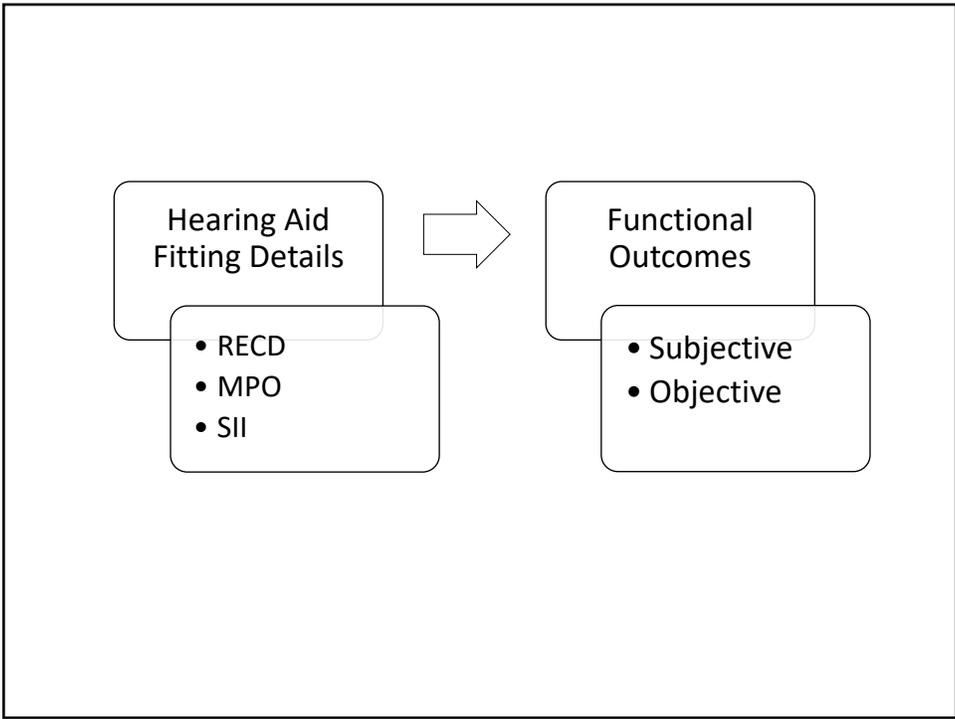
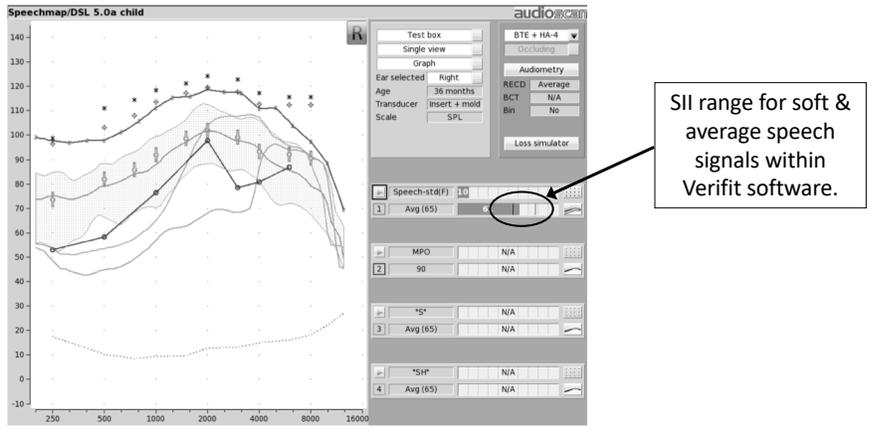


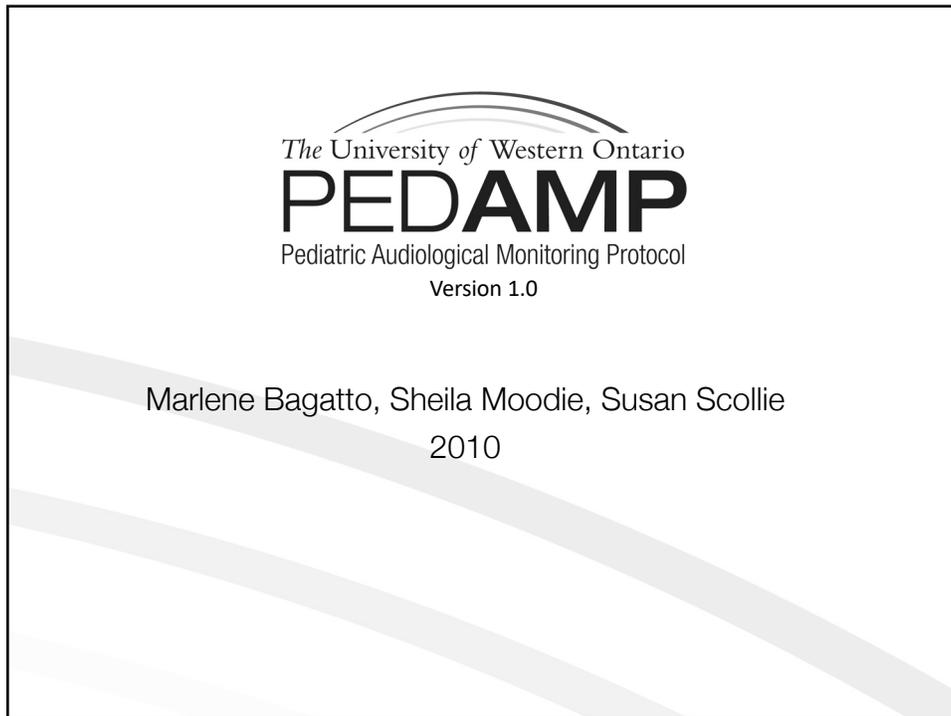
SII Norms for Pediatric Hearing Aid Fittings



Bagatto et al 2011; 2016; McCreery et al 2013;
 Stiles et al 2012;
 Bagatto et al, 2011; 2016;
 Moodie et al, 2017

SII Range for Soft & Average Speech within Verifit





Purpose of the UWO PedAMP

- Intended to be used with children with permanent childhood hearing loss from *birth to 6 years who may or may not wear hearing aids*
- Consists of several outcome evaluation tools that aim to measure *auditory-related outcomes* in infants and young children including the following dimensions:
 - Subjective assessment of early auditory development
 - Subjective ratings of auditory performance in daily life

UWO PedAMP developed with a Community of Practice

- Avoid tools that:
 - are too lengthy or complicated
 - rely on information or scoring by other professionals
(e.g., standard language measures)
- Include tools that:
 - have good statistical properties
 - have good clinical feasibility and utility
 - support family-centered practice
 - help you collaborate better with others
- Maximize efficiency and interpretation through:
 - Visual tools to permit rapid scoring
 - Data to support interpretation



Tools within the UWO PedAMP

Tool	Purpose	Description
Amplification Benefit Questionnaire	<ul style="list-style-type: none"> • Acceptance & use of hearing aids • Satisfaction with services 	11 items 5 point rating scale
Hearing Aid Fitting Details	<ul style="list-style-type: none"> • Quality of hearing aid fitting 	RECD, MPO, Speech Intelligibility Index (SII)
LittleEARS Auditory Questionnaire Tsiakpini et al, 2004	<ul style="list-style-type: none"> • Receptive & semantic auditory behaviour • Expressive vocal behaviour 	35 items Yes/no response
Parents' Evaluation of Aural/Oral Performance of Children (PEACH) Ching & Hill, 2005	<ul style="list-style-type: none"> • Communication in quiet & noise • Responsiveness to environment 	13 items 5 point rating scale

Appointment Type (Aided)								
	Initial Assessment	Prefitting	Initial Fitting	30 Day Recheck	3 month Recheck	6 month Recheck	Yearly Rechecks	Event Driven
Outcome Evaluation Tool	Hearing Aid Fitting Details	x	x	✓	x	✓	✓	✓
	IHP Hearing Aid Benefit	x	x	x	x	✓	✓	✓
	LittIEARS	✓ Establish Unaided Baseline: Administer at one of these appointments			✓ If score ≥27 & >24 mos, stop LittIEARS, use PEACH.	✓ If score ≥27 & > 24 mos, stop LittIEARS, use PEACH.	✓ If score ≥27 & > 24 mos, stop LittIEARS, use PEACH.	✓ If score ≥27 & > 24 mos, stop LittIEARS, use PEACH.
	PEACH	x	x	x	⇓	⇓	⇓	⇓

UWO PedAMP Manual: www.dslio.com

OIHP Amplification Benefit Questionnaire

- 11-item questionnaire jointly developed by the OIHP and Child Amplification Laboratory at UWO
- 5-point rating scale for parents addressing:
 - Acceptance and use of hearing aids
 - Auditory performance for different levels of sound
 - Effectiveness of service delivery
 - Overall satisfaction
 - Final question is open-ended asking about how hearing aid services could be improved

Where to find: www.dslio.com

Administration of the OIHP Amplification Benefit Questionnaire

- Initially completed by the caregiver after the child has worn hearing aids for *3 months or more*
 - Gives respondent a chance to become comfortable with child's hearing aids and services offered

- Re-administered at follow-up visits

- Translated into several languages

Hearing Aid Fitting Details

- Real-Ear-to-Coupler Difference (RECD)
 - Measured
 - Predicted
 - Used other ear values
 - Used previously measured values

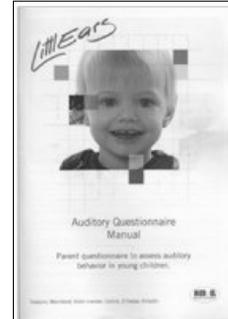
- Maximum Power Output (MPO)
 - Measured? Yes/No

- Speech Intelligibility Index (SII) values
 - Soft = 55 dB SPL
 - Average = 65 dB SPL

LittIEARS (Tsiakpini et al, 2004; Med-El)

- Goal: to assess auditory development during first 2 years of hearing
 - Receptive auditory behaviour
 - Semantic auditory behaviour
 - Expressive vocal behaviour

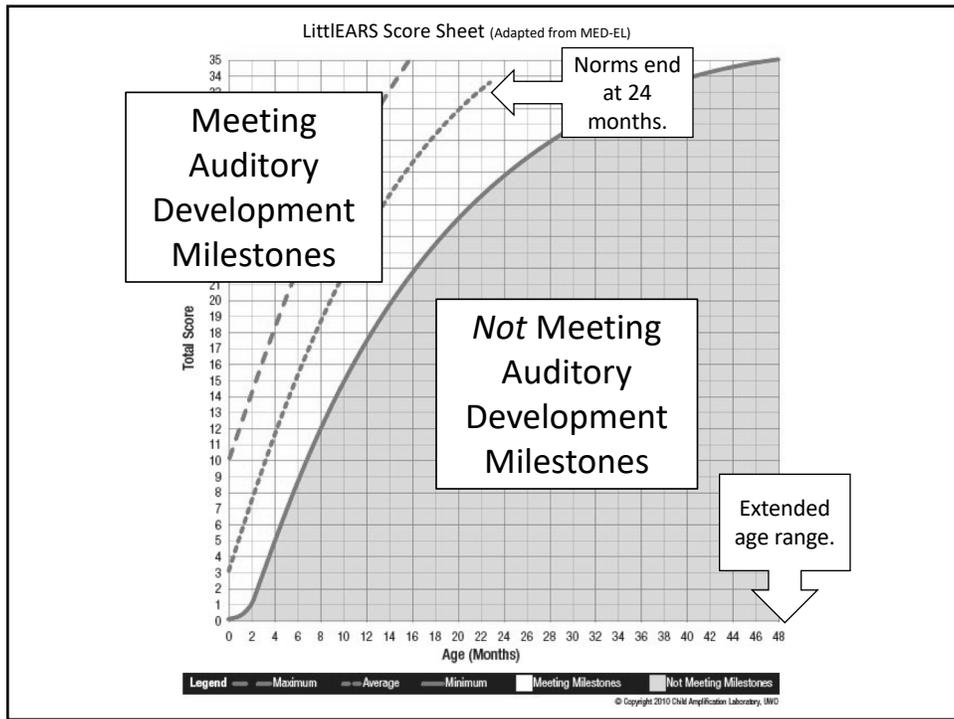
- Format: 35 yes/no questions listed in developmental order



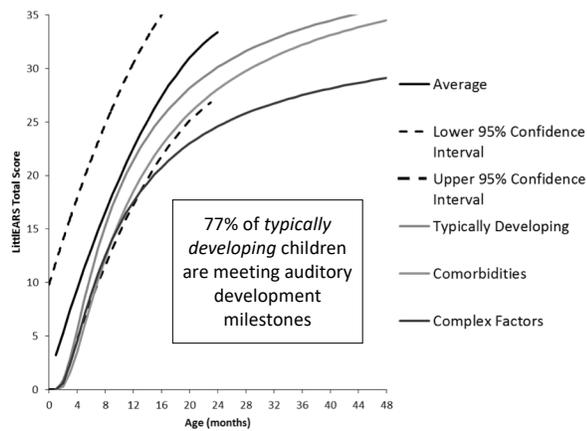
LittIEARS

- Scoring: All 'yes' answers are added and compared to average and minimum values

- Normative data collected with 218 German-speaking families (Weichbold et al, 2005)
 - Reliable
 - Good internal consistency
 - Good discriminative ability
 - Good correlation of overall score and age of child
 - Validated in several languages (Coninx, et al, 2009)



LittIEARS Results: Children who wear hearing aids



Bagatto et al, 2016

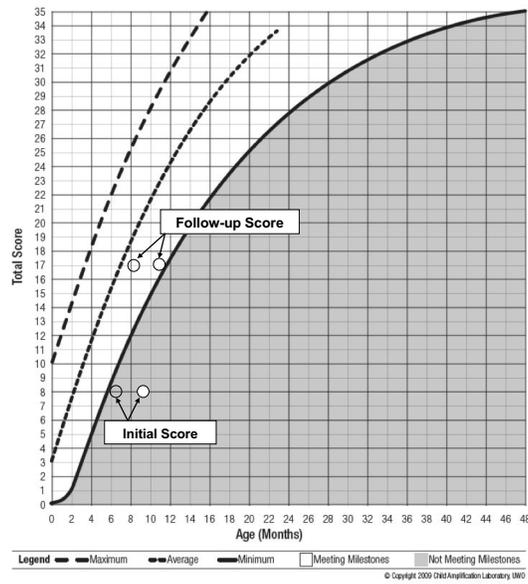
Case Study: Benny

- History:
 - Born 28 weeks gestational age
 - Spent 10 weeks in NICU
 - Refer in both ears on neonatal hearing screening

- Audiology Assessment:
 - 9 months (6 months adjusted)
 - 11 months (8 months adjusted)

- Results indicated ANSD positive in both ears

Child has ANSD



Summary: Benjamin

- LittleEARS scores = 8 and 17
- Initially, Benjamin was not meeting auditory development milestones for his chronological or adjusted ages. Two months later, his auditory development improved to where he was meeting auditory development milestones for both his chronological and adjusted ages according to the LittleEARS Auditory Questionnaire.

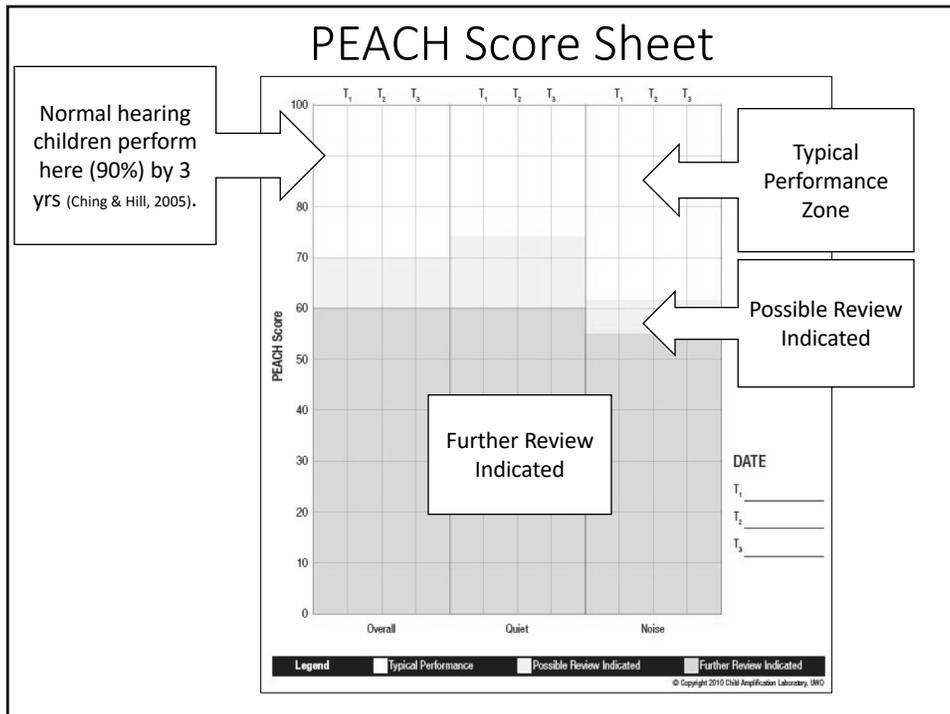
PEACH (Ching & Hill, 2005; NAL)



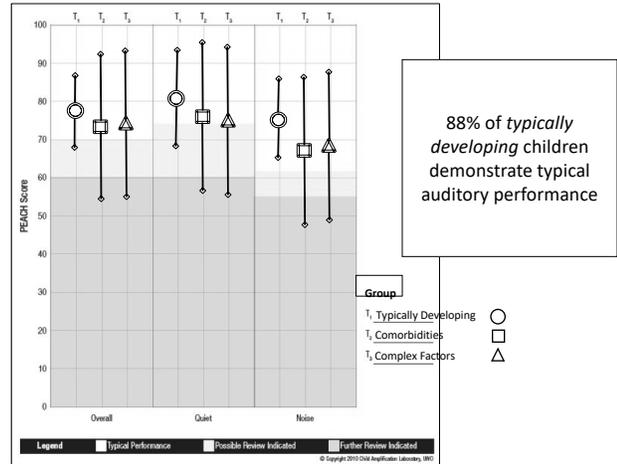
- Goal: to evaluate effectiveness of device for infants and children with hearing impairment
- Format: 13 item questionnaire assesses
 - hearing aid use
 - loudness discomfort
 - communication in quiet and noise
 - phone use
 - responsiveness to environmental sounds

PEACH Rating Scale

- 5-point rating scale
- Includes most of the scenarios from the Diary
- Parents think about their child's behaviour over the past week in relation to each question
 - Can be done in one appointment
 - No follow-up interview by clinician necessary
- Percentage scoring

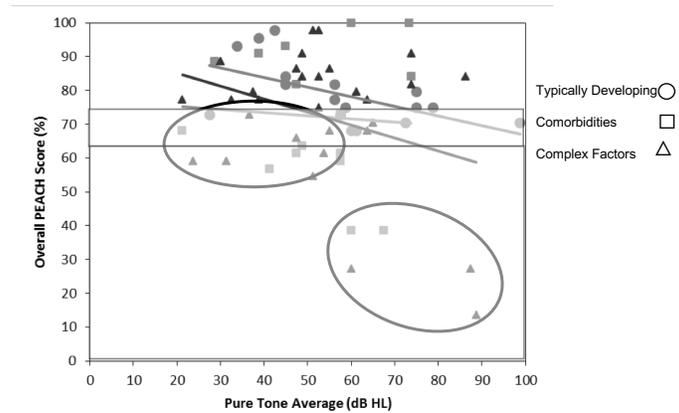


PEACH Results: Children who wear hearing aids



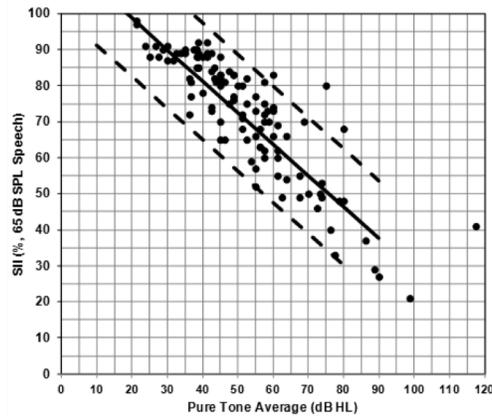
Bagatto et al, 2016

PEACH Results: Children who wear hearing aids



Bagatto et al, 2016

SII Data from Current Study

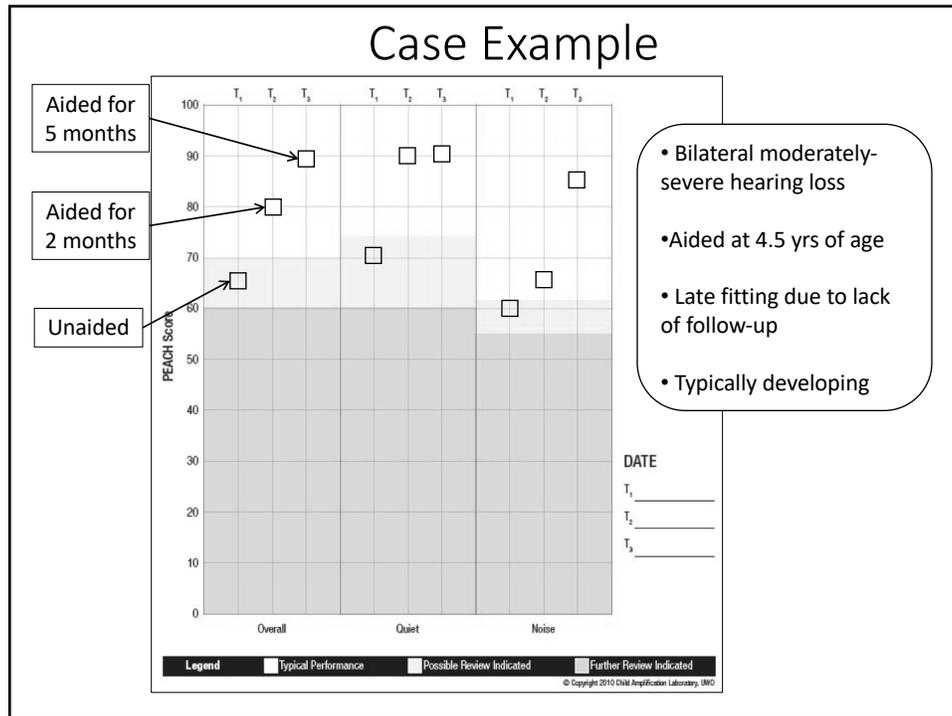


UWO PedAMP



- A guideline consisting of several outcome evaluation tools that aim to measure *auditory-related outcomes* in infants and young children
 - Visual tools to permit rapid scoring
 - Data to support interpretation

- The UWO PedAMP will evolve through clinical implementation
 - Community of practice is important to support uptake



Advantages of Subjective Outcome Measures

- Families become good observers of their child's auditory behaviours in the real world
- Families develop a shared language with the clinician
- Can be conducted with children who have complex needs
- No special equipment required
- Available in several languages
 - Use interpreter if needed

Objective Outcome Measures

- Ling 6 (HL) Detection Task
 - Recorded and calibrated signals
 - Scollie et al, 2012

- UWO Plurals
 - Recorded and calibrated signals
 - Glista et al, 2012



The Ling 6 Sounds

- /m/, /u/, /a/, /i/, /j/, and /s/
 - These span the speech frequencies

- Originally proposed for live voice use by therapists: (see Ling, 1989 for more detail)
 - Probe whether child can detect all sounds
 - Probe whether child can discriminate the sounds
 - Do these prior to every therapy session
 - Protects against running a therapy session during a period of hearing aid malfunction, etc.

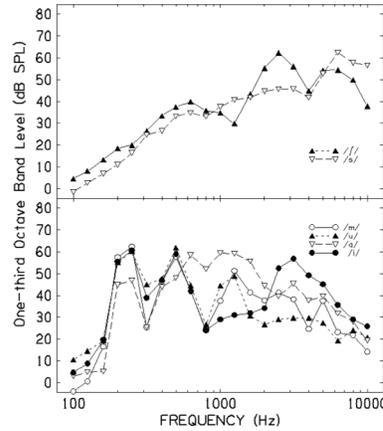
A specific tool: Ling 6 (HL)

Scollie et al, 2012



- Pre-recorded female utterances of each sound
- Norms for detection in dB HL in sound field
- Scoring corrections, a score sheet, and a CD

- Normally hearing listeners:
 - Detect the sounds between - 10 and 10 dB HL
 - Have average test-retest reliability of 1 – 2 dB and a range of test re-test of one to two step sizes



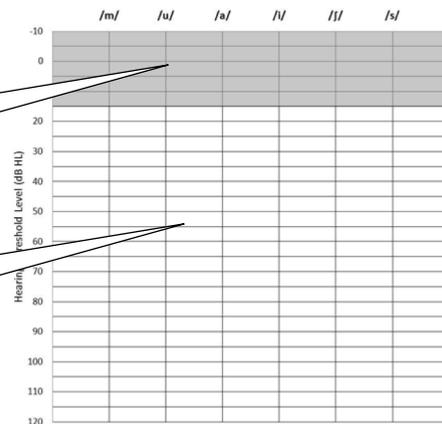
Score Sheet

Ling-6(HL) Scoring Sheet

Name: _____ D.O.B: _____
 Date: _____ Respondent: _____
 Notes on testing conditions: _____

Test method: Standard CPA VRA
 Reliability: Good Fair Poor
 Test type: Aided Unaided CI Bone conducted BAHA
 Masking (unaided ear): n/a Yes No

Plot the corrected threshold values in dB HL below.



Normal range

Plot (un)aided thresholds as you would on an audiogram.

Grey region shows the normal hearing range.
 Values assume binaural sound field testing at zero degrees azimuth.

Sample Case

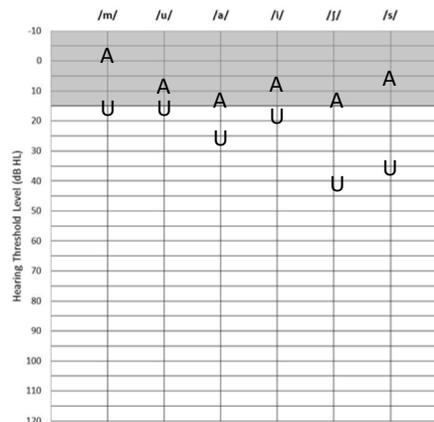
- Age 3 yrs 6 mos
 - Moderate SNHL bilaterally
- Fitting: DSL v5.0
- Standard audiometry, good reliability on Ling6

Ling-6(HL) Scoring Sheet

Name: _____ D.O.B: _____
 Date: _____ Respondent: _____
 Notes on testing conditions: _____

Test method: Standard CPA VRA
 Reliability: Good Fair Poor
 Test type: Aided Unaided CI Bone conducted BAHA
 Masking (unaided ear)? n/a Yes No

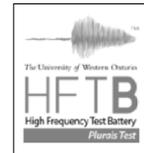
Plot the corrected threshold values in dB HL below.



Grey region shows the normal hearing range.
 Values assume binaural sound field testing at zero degrees azimuth.

The UWO Plurals Test

Glista et al, 2012

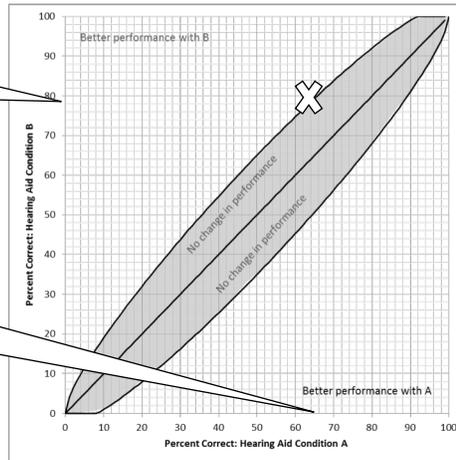


- Developed to be similar to a research task used in evaluating hearing aid bandwidth at Boys Town (Stelmachowicz, Pittman, Hoover, & Lewis, 2002)
- Nouns in singular & plural form at a high SNR
 - The task is to hear the word-final fricative
 - Sensitive to high frequency audibility
- UWO version uses 15 nouns: ant, balloon, book, butterfly, crab, crayon, cup, dog, fly, flower, frog, pig, skunk, sock and shoe
 - Pre-recorded, calibrated, available on a CD with scoring and interpretation guidelines

Scoring & Critical Differences

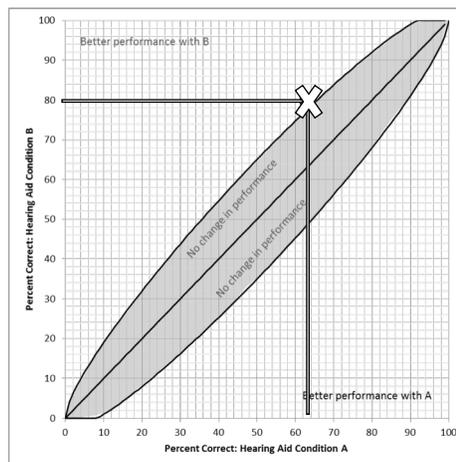
Aided test #2, after re-adjusting: 79% correct

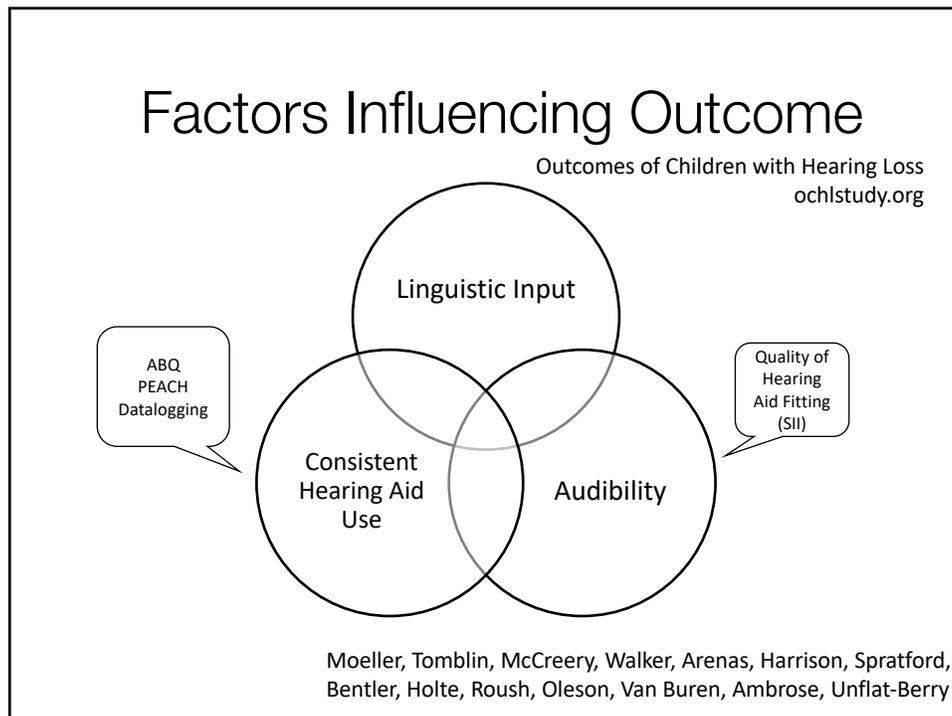
Aided test #1: 64% correct



Scoring & Critical Differences

- The plotted score falls outside the shaded region and is therefore significantly better
- The re-adjustments improved the score significantly
- Note that this test does not assess correct speech sound identification





Importance of Outcome Evaluation

- Patients
 - Track and monitor
 - Involve parents – result: good observers
 - Shared language
- Audiologists
 - Way to measure impact of hearing aid fitting
 - Improve efficiency and effectiveness of service delivery
 - Improve communication with families and professionals
- EHDI
 - Measure how program is doing
 - Helps describe patterns that affect children within the program

What gets measured gets managed.

~ P. Drucker (?)

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