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Individualizing Pediatric Hearing Aid Fittings Part 1: Application of the RECD

Presenter: Marlene Bagatto, Au.D., Ph.D.

Moderator: Carolyn Smaka, AuD, Editor in Chief, AudiologyOnline

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Individualizing Pediatric Hearing Aid Fittings Part 1: Application of the RECD

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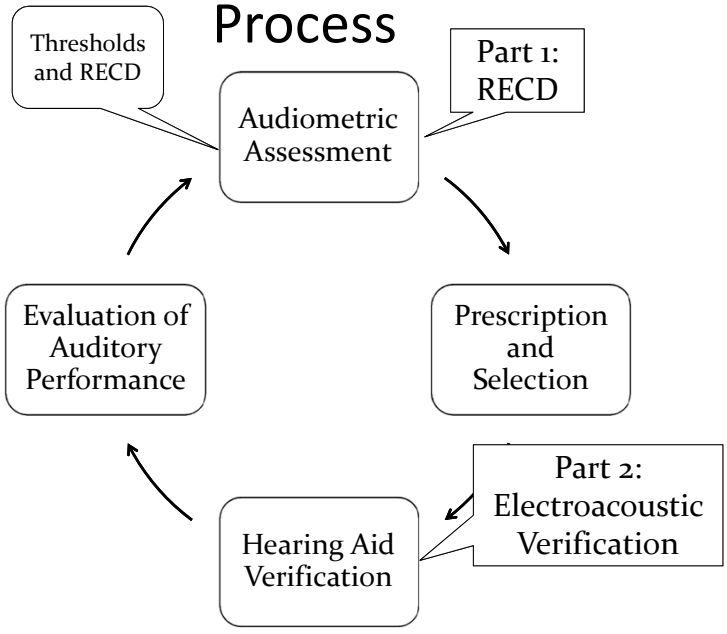
Child Amplification Laboratory, Western University

March 23, 2016
AudiologyOnline.com

Western
National Centre for Audiology

Pediatric Hearing Aid Fitting Process



Infants are not small adults

- Different listening needs
  - Pre-lingually hearing impaired
  - Critical period for language learning is birth to 2 years of age
- Significantly smaller ears
  - Ear canals grow and change
- Unable to provide verbal feedback about hearing aid fitting
  - Depend on caregiver for hearing aid use, monitoring and maintenance

Early Hearing Detection & Communication Development Programs

Goals:

- Identify infants with hearing loss and define the impairment by 3 months corrected age
- Initiate intervention by 6 months corrected age

Provision of Hearing Aids

- Suitable technology and evidence-based hearing aid fitting guidelines and protocols support accurate and safe hearing aid fittings for the pediatric population
  - American Academy of Audiology, 2013
  - Australian Protocol; King, 2010
  - British Columbia Early Hearing Program, 2006
  - Modernizing Children's Hearing Aid Services, 2005
  - Ontario Protocol; Bagatto, Scollie, Hyde & Seewald, 2010; **Updated in 2014: www.dslio.com**

Presentation Outline

- Brief overview of using ABR threshold estimates for hearing aid fitting
- What is the RECD and why is it important for pediatric hearing aid fitting?
- Clinical measurement of the RECD
- Technical updates to the RECD
- Application of the RECD in hearing aid fitting

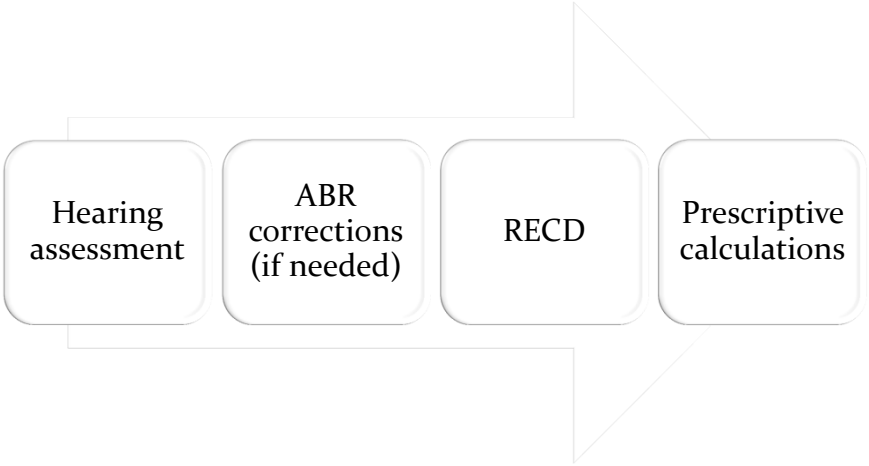
Learning Outcomes

1) Describe what the RECD is and why it is an important clinical procedure.

2) Explain how to obtain a good RECD measurement.

3) Clarify how the RECD is used throughout the pediatric hearing aid fitting process.

Assessment for Amplification



Infant Hearing Assessment

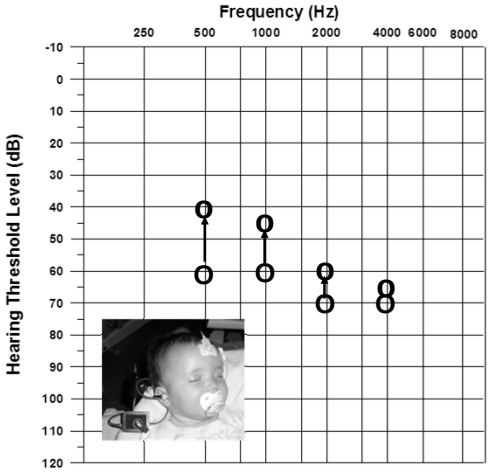
- Infants under 6 months of age cannot perform behavioural hearing test

Audiological Evaluation: 0-6 mo

- Estimates of hearing sensitivity are derived from FS-ABR measurements
- Hearing aid selection and fitting proceeds using ABR threshold estimates
  - Intervention is *not* postponed for collection of behavioural data

Best Practice: ABR Corrections

- Ensure a smooth transition from electrophysiologic hearing assessment to early hearing aid fitting: *standardized nHL to eHL corrections.*



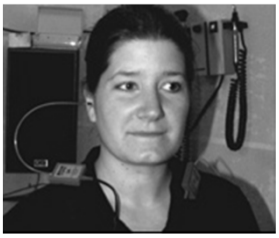
ABR vs. Behavioural Results

- ABR threshold estimates (in dB nHL) have been shown to be higher than behavioural thresholds (in dB HL)

e.g., 10 – 20 dB in children with SNHL

Stapells et al 1995
Stapells 2000
Picton et al 1979

Behavioural vs. Electrophysiological Assessment Procedures



- dB HL
- entire auditory system
- long duration pure tones
- standard calibration

- dB nHL
- measured from the brainstem
- brief tone bursts
- non-standard calibration

Relevant References

- Bagatto et al, 2005 - Clinical Protocols for Hearing Instrument Fitting in the Desired Sensation Level Method: http://tia.sagepub.com/content/9/4/199.abstract

- Bagatto 2008 – Baby Waves and Hearing Aids: Using ABR to Fit Hearing Aids to Infants: Hearing Journal, volume 61

Best Practice for Infant Assessment

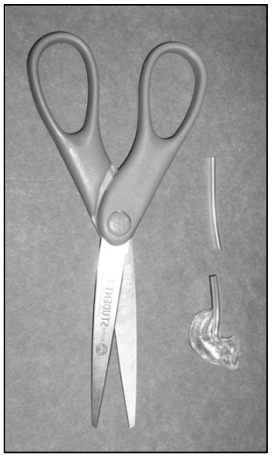
- Use insert earphones for infant hearing assessment whenever possible
- It is more accurate and compatible with the target population

Assessments for Hearing Aid Fitting

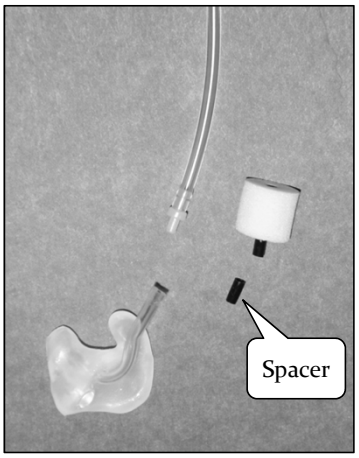
- Connect inserts to personal earmolds for follow-up audiograms
  - Better retention and acceptance
  - Sets you up for a more accurate hearing aid fitting
    - Earmold Audiogram
    - Earmold RECD

Insert + Earmold

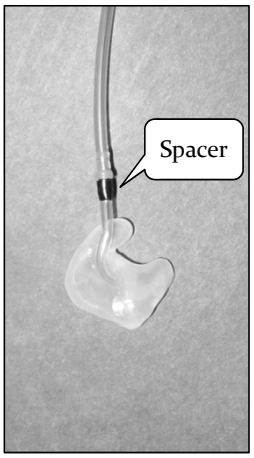
Trim Earmold Tubing



Trim Tube from Foam Tip



Connect Earmold to Insert Earphone

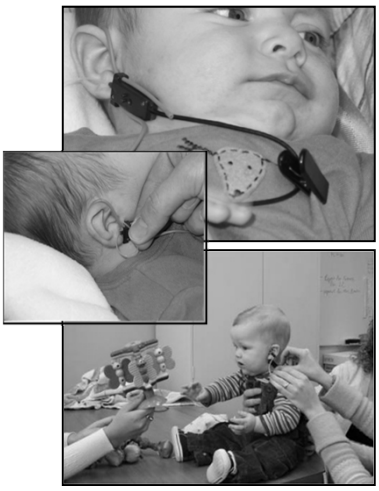


What is the RECD?

Why do we need it for good pediatric hearing aid fittings?

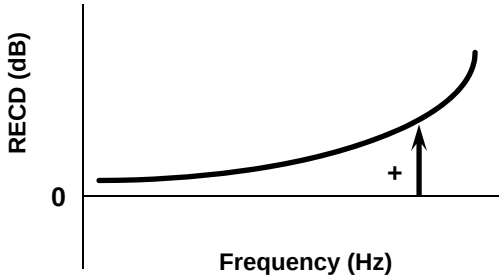
In a nutshell the RECD is….

- A set of values that describe the acoustic characteristics of an occluded ear canal.
- Difference between SPL in a coupler and SPL your patient's ear canal.

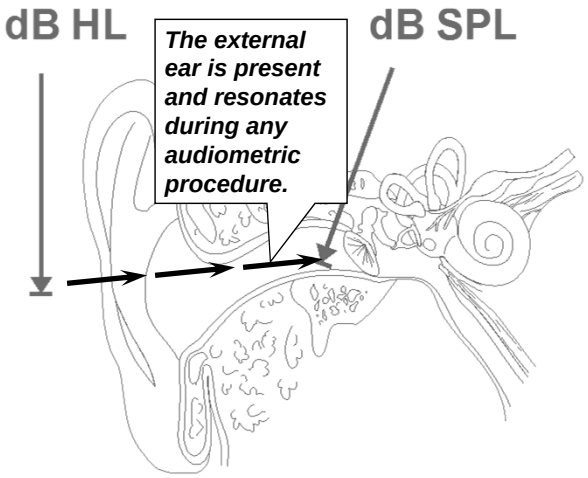


The RECD Defined

RECD (dB) = **Real-Ear Levels** - **Coupler Levels**



Why does it matter?



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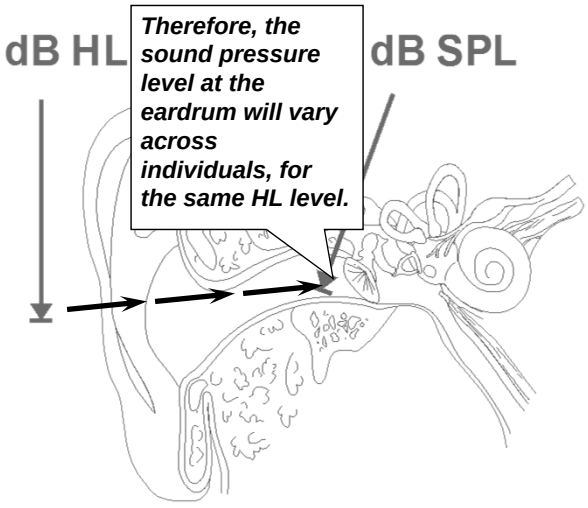
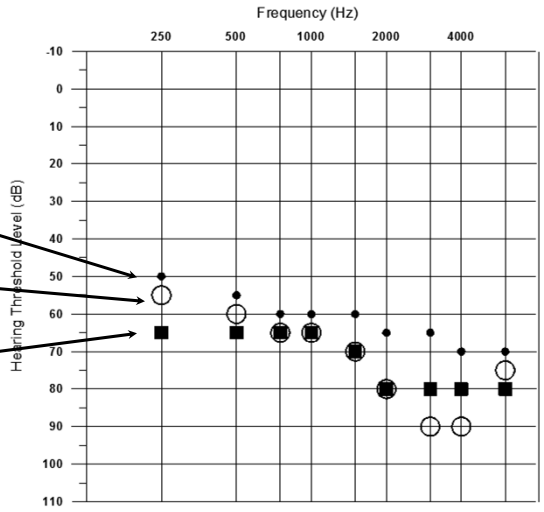


Different Transducer, Different HL Thresholds

Insert phones

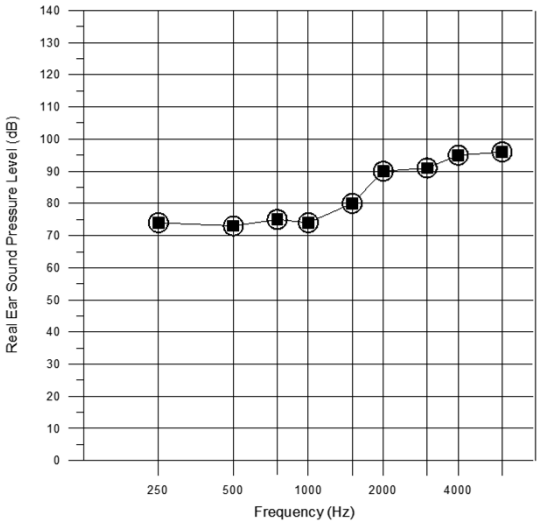
Sound Field

TDH



In real-ear SPL (dB): SPLogram

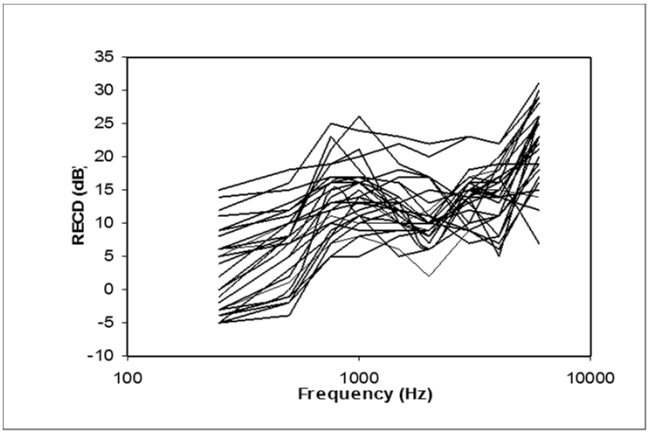
This is the scale used for hearing aid measurements: Real-ear SPL (dB)



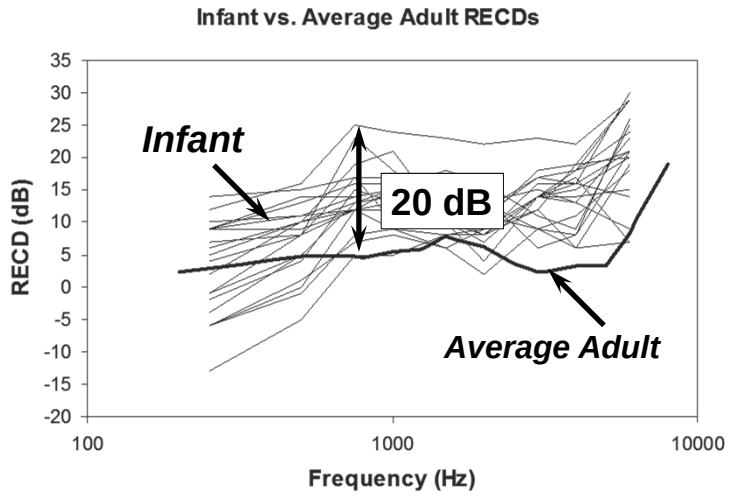
Variable Ear Canal Acoustics

- Large variability in ear canal SPL across infants and young children
  - Kruger 1987, Feigin et al 1989, Bagatto et al 2002
- Must account for this variability in both audiologic assessment and in hearing instrument fitting

Sample Findings



Infant vs Average Adult RECDs



The RECD is used in <u>two</u> places:

HL Threshold **+ RECD** + RETSPL
= Real Ear SPL Threshold

HL to SPL transform

SPLogram

Coupler SPL or gain **+ RECD** + MLE
= predicted Real Ear SPL or gain

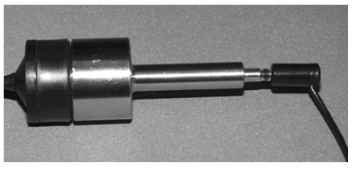
Coupler Verification

For BTEs, this needs to account for earmold!

Clinical Measurement of the RECD

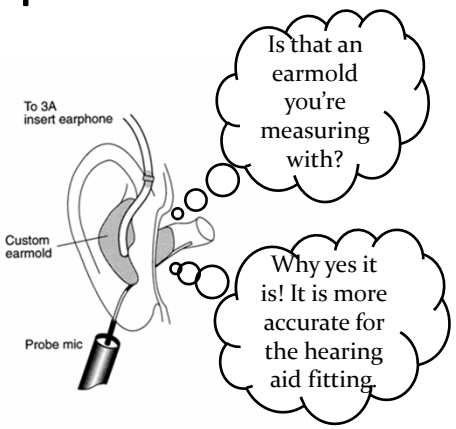
How to Measure The RECD

- Measure *coupler SPL* across frequencies
- Place probe tube in ear, then insert tip or *earmold*
- Measure *real ear SPL* for same signal
- *RECD = real ear SPL - coupler SPL*



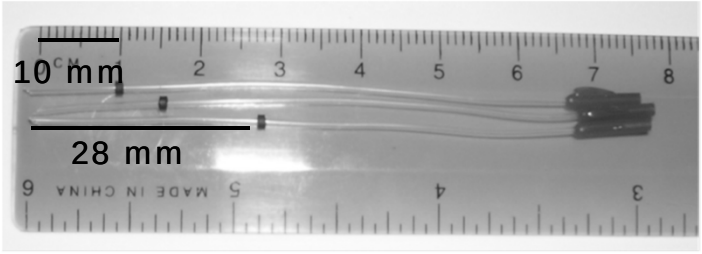
Probe-tube placement

- Place the tip of the probe tube within 3-5 mm of the eardrum



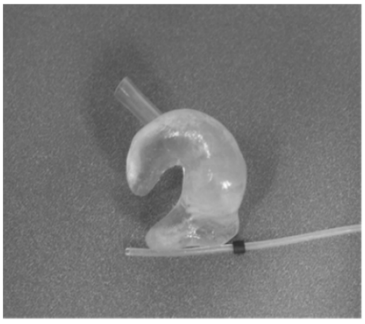
Constant Insertion Depth

- 30mm for adult males, 28mm for females
- 10-25mm for infants/children
- Hints:
  - Tape a ruler to your desk
  - Use a highlighter to mark a few depths along it



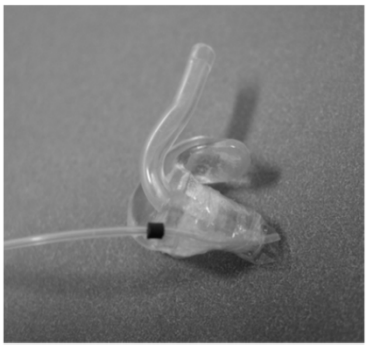
Customized Insertion Depth

- Identify the ridge of the *earmold* corresponding to the location of the intertragal notch
- Lay the tube along the bottom of the *earmold*



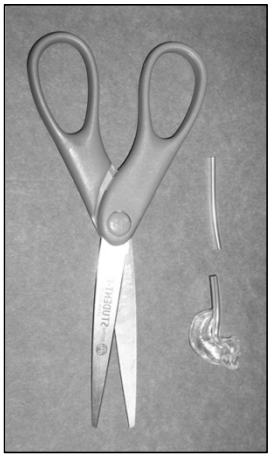
Customized Insertion Depth

- If you have some clear wrap or soft surgical tape, connect the probe tube to the *earmold* and insert it simultaneously
- To the active toddler, this may seem like you are only inserting the *earmold*

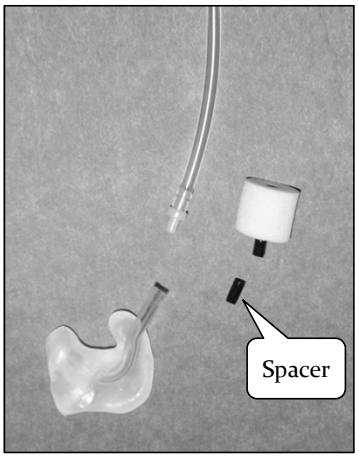


Do Audiometry & RECD with Earmolds!

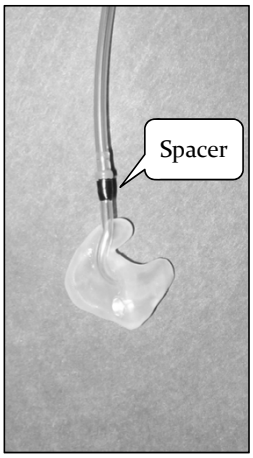
Trim Earmold Tubing



Trim Tube from Foam Tip



Connect Earmold to Insert Earphone

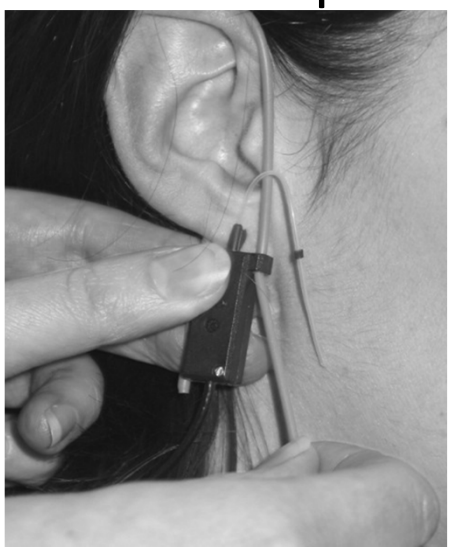


Otoscopy First!

- Pediatric audiologists must be ambidextrous
  - Comes in handy for all procedures
- Hold the head of the otoscope and brace your pinky finger on the child's cheek
- Use other hand to pull pinna up and back

Tips for Real-Ear Setup

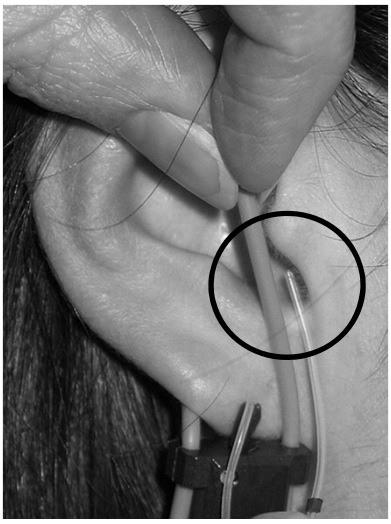
Secure probe module on pinna by tightening elastic



Tips for Real-Ear Setup

Fasten clip across patient's shirt to hold probe module in place.

Probe Tube Insertion



Probe Tube Insertion

1) Guide tube until mark meets intertragal notch

2) Use otoscopy to check the depth of probe tube

Tip or *Earmold* Insertion

3) Insert foam tip or *earmold*

4) Ensure a good seal (use lubricant; let foam expand)

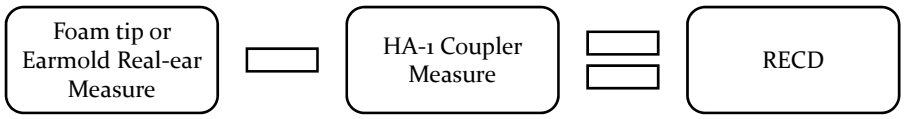
Technical RECD Updates & How the RECD is Applied in Hearing Aid Fitting

Measure Ear Canal Acoustics to Individualize Hearing Aid Fitting

- *Real-ear measurements* allow us to do this
  - Protects against errors in the fitting
- Real-ear measurement takes two forms:
  - *Real-ear verification*: Place the probe tube, verify hearing aid output in the ear.
  - *Coupler verification*: Same thing, but in a coupler with predictions to the real-ear. Common practice for pediatrics. (Join us for Part 2 to learn more!)

ANSI Standard for REM (S3.46)

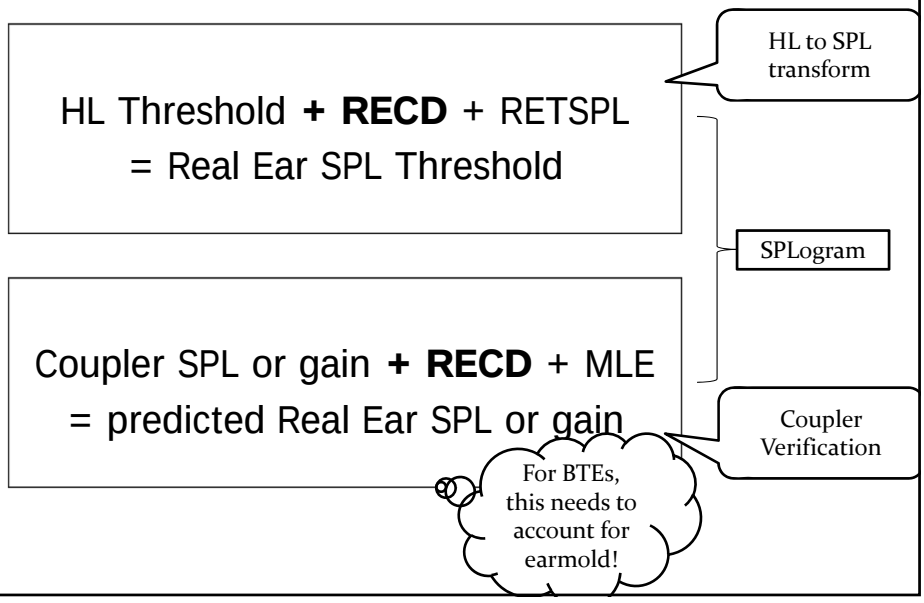
- 1997: standardized REM terminology, such as "REAR"
- 2013: first in North America to standardize RECD



But why do we need to standardize the RECD?

Let's Review……

The RECD is used in <u>two</u> places:



If you do real-ear verification, you may still be using the first one behind the scenes:

HL Threshold **+ RECD** + RETSPL
= Real Ear SPL Threshold

HL to SPL transform

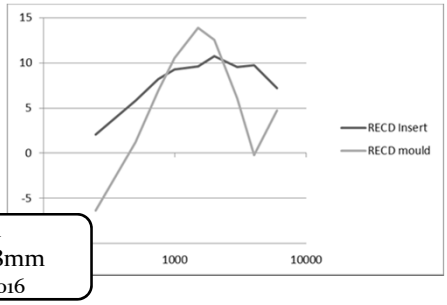
Direct verification of the REAR does not use the RECD at all.

SPLogram

RECDs Measured with Foam Tips vs Earmolds are Not the Same

- Foam tip tubing is 25mm long
  - Earmold tubing is usually longer
  - High frequency roll-off results

Let's call this:
"Coupling Type"



36 children
Avg tubing = 38mm
Moodie et al, 2016

Coupling Type: Foam tip vs Earmold

- What if you need one type and only have the other type?
  - Example: foam tip audiogram, but only earmold RECD
  - Age trends for both types are known (Bagatto et al 2002; 2005).
- DSL5 will generate a predicted RECD for either type
  - These might be used instead of measured RECD if the **Coupling Type** is not matched between *RECD type* and *RECD usage*

ANSI 2013 Standard Uses HA1

- Conceptually, this accounts for the acoustic properties of the ear cavity and not designed to measure anything about earmolds
  - *Means that verification would use the HA1 coupler + putty, unless there is another solution*

- Conversion between HA1 and HA2 are applied
  - Simple, well-understood, and are easily transformed by software

In the Clinic…..

- When measuring the coupler portion of the RECD, the HA2 coupler can be used
- **Clinical** advantages:
  - Fewer infection control issues because we avoid the need to putty earmolds onto the HA1
  - Faster, more reliable connection to the coupler because a putty connection doesn't need to be constructed
- **Standardization** advantages:
  - The standard HA1 RECD can be constructed & reported by software even though you didn't measure it that way
- Let's call this: "**Coupler Type**"

Putting Together "Coupling Type" & "Coupler Type"

		Coupler Type	
		HA1	HA2
Coupling type	Foam tip	**Standard,** requires puttying of foam tip to coupler.	Nonstandard, no putty required.
	Earmold	**Standard**, requires puttying of earmold to coupler.	Nonstandard, no putty required.

- We can and do measure for both coupling types.
- We prefer to measure on the HA2 – easier & cleaner.
- We need **software systems that label the RECD subtype**, so that the RECD can be corrected and used as needed.

New software functions for the RECD are appearing

Goal: to comply with the new standard, but also to support a wide range of clinical practice.

Note: Specific to Audioscan systems

Relevant Links

- Audiology Online: http://www.audiologyonline.com/audiology-ceus/course/recd-recording-with-audioscan-26622
- AAA Online: https://www.eaudiology.org/products/a-new-standard-for-the-recd-new-standard-new-tools-better-accuracy-in-real-ear-measures-for-adults-or-children-1-ceus
- Canadian Audiologist: http://canadianaudiologist.ca/issue/volume-2-issue-6-2015/column/science-matters/

Pediatric Fitting Protocol

(historical, and relies on "matching" for accuracy)

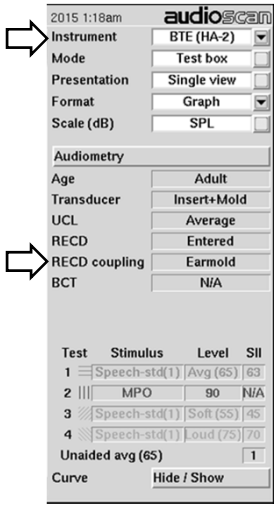
- Audiometry with insert phones + earmolds, measure RECD with earmolds, verify BTE in the HA2 coupler
  - Good for babies & young children, likely little or no venting

But what about this "mis-matching" protocol?

- Audiometry with insert phones + foam tip, measure RECD with earmolds, verify BTE in the HA2 coupler

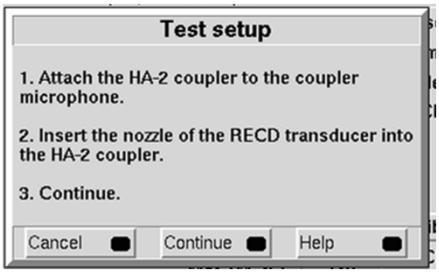
New software systems allow you to label the RECD type. This supports new corrections that handle mismatches.

- A few small changes:
  - You will label what type of coupler-based fitting you are going to use:
    - HA2 or HA1? **COUPLER TYPE**
  - You will label what type of RECD you are measuring:
    - With an earmold or a tip? **COUPLING TYPE**
- If necessary, the software will convert between foam tip & earmold RECDs using a *new correction procedure*.
- Preliminary data suggest this may be more accurate than using age-predicted averages (Moodie et al, 2016; JAAA).



Measuring the coupler portion of the RECD still uses the HA2 coupler

- Note: terminology change to "RECD Transducer Calibration" or "Xducer" for short.
- Values will be converted to HA1 later. This produces the "standard RECD" even if you didn't measure it that way.



Take Home Messages

- A *measured* RECD is necessary for an accurate description of your patient's ear canal which individualizes the hearing aid fitting
- RECDs are used to convert HL to SPL AND to allow for coupler-based verification
- Measuring audiometry AND the RECD with the earmold is best practice
- ANSI standard (2013) references RECD to HA-1 coupler, but corrections are imbedded in some systems so you don't have to change your clinical procedure


THANK
YOU!