Beyond Matching Targets: An Approach to Outcome Evaluation in Pediatric Hearing Aid Fitting

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Sound Foundations 2010, Chicago, USA
Acknowledgements

Funding Sources:

- Canadian Institutes of Health Research
  - Vanier Canada Graduate Scholarship to Marlene Bagatto 220811CGV-204713-174463
  - Frederick Banting and Charles Best Canada Graduate Scholarship to Sheila Moodie 200710CGD-188113-171346
- Ontario Research Fund, Early Researcher Award to Susan Scollie

Collaborators:

- Ontario Ministry of Children and Youth Services Infant Hearing Program
- Richard Seewald, Doreen Bartlett, Linda Miller, Anita Kothari
- Martyn Hyde
- April Malandrino, Christine Brown, Frances Richert, Debbie Clench
- Kelley Keene and Mary Powell
Acknowledgements

- **Network of Pediatric Audiologists of Canada (Sheila Moodie):**
  - Children’s Hospital of Eastern Ontario, Ottawa, ON
  - H.A. Leeper Speech & Hearing Clinic, University of Western Ontario, London, ON
  - Ear & Hearing Clinic, Kitchener, ON
  - Glenrose Rehabilitation Hospital, Edmonton, AB
  - Hospital for Sick Children, Toronto, ON
  - Hamilton Health Sciences, Audiology, Hamilton, ON
  - Vancouver Coastal Health, Vancouver Community Audiology Centre, Vancouver, BC
  - Montreal Children’s Hospital - McGill University Health Centre, Montreal, QC
  - Fraser Health Authority, Langley Public Health, Langley, BC
  - Nova Scotia Hearing & Speech Centres, Halifax/Truro, NS
  - Humber River Regional Hospital, Toronto, ON
  - Deer Lodge Hearing Centre, Winnipeg, MB
  - Central Speech and Hearing Clinic, Winnipeg, MB
AUDIOMETRIC ASSESSMENT

ELECTROACOUSTIC PRESCRIPTION

HEARING AID VERIFICATION

EVALUATION OF AUDITORY PERFORMANCE
OUTCOME EVALUATION
AUDIOMETRIC ASSESSMENT

ELECTROACOUSTIC PRESCRIPTION

HEARING AID VERIFICATION

EVALUATION OF AUDITORY PERFORMANCE
Considerations for Outcome Evaluation

- **Target Population:** Infants & young children who wear hearing aids
- **Purpose:** Measure the impact of the hearing aid fitting
- **Administration & Interpretation:** By Audiologist
- **Good Statistical Properties**
- **Clinically Feasible**
- **Clinically Meaningful**
UWO PedAMP Development

- Avoid tools that:
  - are too lengthy or complicated
  - rely on information or scoring by other professionals (e.g., standard language measures)
    - May be implemented in other parts of the Early Hearing Detection and Intervention (EHDI) program

- 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
Soliciting opinions and experiences from end-users is recommended when developing outcome evaluation tools and clinical practice guidelines

- (Graham et al, 2000; Andresen, 2000)

Network of Pediatric Audiologists of Canada
- Opinions were gathered regarding clinical relevance, quality, feasibility, utility, executability, acceptability, and comparative value of each tool
- Modifications made where possible
- Provided information about barriers and facilitators to implementation
Creating a Balance
(modified from Bhattacharyya, O. 2010)

CLINICAL UPTAKE

ACTIONABLE
Clear
Specific

EVIDENCE-BASED
Complex
Rigid
Purpose of the UWO PedAMP

- Intended to be used with children with permanent childhood hearing impairment (PCHI) 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
Contents of the UWO PedAMP

- Ontario Infant Hearing Program (OIHP) Amplification Benefit Questionnaire
- Hearing Aid Fitting Summary
- Aided Speech Intelligibility Index (SII) Normative Values
- LitlEARS Auditory Questionnaire (Tsiakpini et al, 2004)
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: UWO PedAMP v1.0 Training Manual
Hearing Aid Fitting Details
Reasons for Tracking Hearing Aid Fitting Details

- Good auditory-related outcomes infer good audibility from hearing aids
  - Important part of outcome evaluation guideline

- Clinician can determine whether *individual child’s fitting* is providing a typical degree of audibility

- Provides overall reporting information for the *Early Hearing Detection and Intervention (EHDI) program as a whole*
  - Programs need measurable outcomes
Hearing Aid Fitting Details

- Real-Ear-to-Coupler Difference (RECD)
- Maximum Power Output (MPO)
- Speech Intelligibility Index (SII)
  - Soft = 55 dB SPL
  - Average = 65 dB SPL

• Proportion of speech above threshold
• Percentage value
• Not a speech recognition score
Aided SII Normative Data

This is the **typical fit to targets** zone.

This is the **under targets** zone.

Data courtesy of S.T. Moodie and Clinician Network
<table>
<thead>
<tr>
<th>Outcome Evaluation Tool</th>
<th>Initial Assessment</th>
<th>Prefitting</th>
<th>Initial Fitting</th>
<th>30 Day Recheck</th>
<th>3 month Recheck</th>
<th>6 month Recheck</th>
<th>Yearly Rechecks</th>
<th>Event Driven</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing Aid Fitting Details</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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<tr>
<td>IHP Hearing Aid Benefit</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>LittlEARS</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Establish Unaided Baseline: Administer at one of these appointments</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>If score ≥27, stop LittlEARS, use PEACH.</td>
<td>If score ≥27, stop LittlEARS, use PEACH.</td>
<td>If score ≥27, stop LittlEARS, use PEACH.</td>
<td>If score ≥27, stop LittlEARS, use PEACH.</td>
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<tr>
<td>PEACH</td>
<td>×</td>
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<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Hearing Aid Fitting Details

- RECD
- MPO
- SII

Functional Outcomes

- LittlEARS
- PEACH
The LittleEARS Auditory Questionnaire

http://www.earfoundation.org.uk/shop/items/98
Other languages direct from MED-EL. Tel: +44 (0) 1226 242 874
LittlEARS (Tsiakpini et al, 2004)

- **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
LittlEARS

- 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 15 languages (Coninx, et al, 2009)
Canadian Validation Study

- Data collected at H.A. Leeper Speech and Hearing Clinic, Humber River Regional Hospital, Rouge Valley Health System

- As a result, minor modifications to administration and score sheet
  - No changes to questionnaire items

- Network of Pediatric Audiologists of Canada examined questionnaire, administration guidelines and modified score sheet and provided feedback
  - 92% felt it was a suitable clinical tool
## Canadian Validation Study

<table>
<thead>
<tr>
<th>Subpopulation</th>
<th>Number of Participants</th>
<th>Mean Age (months)</th>
<th>Age Range (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Hearing</td>
<td>207</td>
<td>10.3</td>
<td>1.3-44.6</td>
</tr>
<tr>
<td>ANSD</td>
<td>21</td>
<td>14.1</td>
<td>3.9-45.1</td>
</tr>
<tr>
<td>Middle Ear Dysfunction</td>
<td>12</td>
<td>5.5</td>
<td>1.83 – 10.0</td>
</tr>
<tr>
<td>Unaided PCHI</td>
<td>55</td>
<td>15.3</td>
<td>1.9-66.4</td>
</tr>
<tr>
<td>Aided PCHI*</td>
<td>32</td>
<td>27.9</td>
<td>6.9-72.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>327</strong></td>
<td><strong>14.6</strong></td>
<td><strong>1.3 – 72.7</strong></td>
</tr>
</tbody>
</table>

* Clinicians followed OIHP hearing aid fitting protocol (Bagatto et al, 2010)
Analysis

1) Validation: Normal Hearing Children

Quadratic Regression Curves

**German Norm Curve: N = 218**

- Mean age = 8.11 months
- Age range = 2 to 23 months
- Standard Deviation = 4.93
- Mean score = 18
- Score range = 3 to 35
- Standard Deviation = 7.83

**Canadian Norm Curve: N = 130**

- Mean age = 8.11 months
- Age range = 2 to 23 months
- Standard Deviation = 4.93
- Mean score = 18
- Score range = 3 to 35
- Standard Deviation = 7.83
LittlEARS Score Sheet (Adapted from MED-EL)

Meeting Auditory Development Milestones

Not Meeting Auditory Development Milestones

Norms end at 24 months.

Extended age range.
Results

1) Validation: Normal Hearing Children

![Graph showing Total Score vs Age (months)]

**German Norms:**
- Average
- Upper 95% confidence interval
- Lower 95% confidence interval

**Sensitive to Medical Issues**

**Canadian Raw Data:**
- Typically Developing
- Premature (chronological age)
- Medical Issues
Results

2) Children with Hearing Aids

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>Upper 95% confidence interval</th>
<th>Lower 95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td></td>
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<tr>
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<td>34</td>
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<tr>
<td>35</td>
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</tr>
</tbody>
</table>

This is the same child

German Norms:

- Average
- Upper 95% confidence interval
- Lower 95% confidence interval

Canadian Raw Data:

- Typically Developing
- Premature (chronological age)
- Medical Issues
- Inconsistent HA Use; Profound
- Complex Factors
Summary: LittlEARS

- Short questionnaire that parents and clinicians find feasible to complete
- Norms developed from normal hearing children work well
- Sensitive to medical issues
  - Require more data to characterize different patient profiles
- Useful for monitoring the progression of auditory behaviours in infants and young children
  - Normal hearing
  - PCHI but unaided
  - PCHI and aided

LittlEARS Score ≥ 27 ➔ PEACH
The Parent’s Evaluation of Aural/Oral Performance in Children (PEACH)

Diary:

Rating Scale:
PEACH (Ching & Hill, 2005)

- 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 Diary

- **Administration**: systematic parental observation for 1 week followed by a structured interview with audiologist

- Good internal consistency and test-retest reliability

- Normative data collected with 90 parents of normal hearing children and 90 parents of hearing impaired children (Ching et al, 2007)

- Ching et al, 2008 demonstrated the tool is responsive to evaluating the impact of changes in hearing aid frequency response in severe to profound fittings
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 Scoring

- No score sheet provided with PEACH, therefore, needed to develop one from existing literature and preliminary data

- Ching et al, 2005, 2008, NAL/DSL Study
  - Normal hearing children achieve 90% around age 3 years
  - Hearing impaired children achieve a range
    - Ching et al, 2005 = 62%
    - Ching et al, 2008 = 66%
    - NAL/DSL Study = 80%
      - Ching, Scollie, Dillon, Seewald, et al., 2010
Normal hearing children perform here (90%) by 3 yrs (Ching & Hill, 2005).
Preliminary Data: Aided PCHI

- 23 Subjects
- Typically developing
- Mean Age = 46.91 months
- Age Range = 20.63 – 78.40

Graph shows PEACH scores for Overall, Quiet, and Noise conditions.
Case Example

- Bilateral moderately-severe hearing loss
- Aided at 4.5 yrs of age
- Late fitting due to lack of follow-up
- Typically developing

Aided for 5 months

Aided for 2 months

Unaided

DATE

T₁
T₂
T₃

Legend: □ Typical Performance
        □ Possible Review Indicated
        ■ Further Review Indicated

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Summary: PEACH

- Assesses functional auditory performance in quiet and noisy situations
  - Can compare to hearing impaired children who wear hearing aids using score sheet

- Can identify whether child is or is not performing typical auditory behaviours

- For example:
  - If noise score is poor, can discuss noise options
UWO PedAMP within an EHDI Program

- Implemented with children who may or may not wear hearing aids

- Consists of:
  - OIHP Amplification Benefit Questionnaire (aided only)
  - Hearing Aid Fitting Summary (aided only)
  - LittlEARS Auditory Questionnaire OR
  - PEACH Rating Scale
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
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
  - Preliminary data to support interpretation

- The UWO PedAMP will evolve through clinical implementation
  - Community of practice is important for success
Thank you...

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