An Approach to Evaluating the Impact of Hearing Aid Intervention

Marlene Bagatto
The University of Western Ontario, London, Canada

European Pediatric Amplification Conference
Istanbul, Turkey
November 15, 2011
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
EVALUATION OF AUDITORY PERFORMANCE

ELECTROACOUSTIC PRESCRIPTION

HEARING AID VERIFICATION

EVALUATION OF AUDITORY PERFORMANCE
OUTCOME EVALUATION
EVALUATION OF AUDITORY PERFORMANCE

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

Good Statistical Properties

Clinically Feasible

Administration & Interpretation: By Audiologist

Clinically Meaningful
Community of Practice (Sheila Moodie)

• 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)
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
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

- LittlEARS Auditory Questionnaire (Tsiakpini et al, 2004)

## Appointment Type (Aided)

<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><strong>Hearing Aid Fitting Details</strong></td>
<td>✗</td>
<td>×</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>IHP Hearing Aid Benefit</strong></td>
<td>✗</td>
<td>×</td>
<td>×</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>LittLEARS</strong></td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Establish Unaided Baseline: Administer at one of these appointments</td>
<td>✓</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>PEACH</strong></td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
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
Hearing Aid Fitting Details

Clinical Process Outcomes
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.

**Average Speech Input (65 dB SPL)**

Data courtesy of S.T. Moodie and Clinician Network
Clinical Process Outcomes
- RECD
- MPO
- SII

Functional Outcomes
- LittlEARS
- PEACH
The LittlEARS 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)
External Validation of the LittlEARS® Auditory Questionnaire with English-Speaking Families of Canadian Children with Normal Hearing

Bagatto, Brown, Moodie & Scollie, 2011

*International Journal of Pediatric Otorhinolaryngology*

Volume 75(6): 815-7
Longitudinal Intervention Study

Total Sample = 352
Mean age = 21.7 months
Range = 1.3 – 107.1 months

Normal Hearing = 223
Hearing Loss = 129

Aided* = 68
Unaided = 61

* Clinicians followed OIHP hearing aid fitting protocol (Bagatto et al, 2010)
Analysis
1) Validation: Normal Hearing Children

Canadian Raw Data:
- Typically Developing, ≤ 24 months of age

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

Bagatto et al, 2011
*Int J Ped Otorhinolaryn*
Results

1) Validation: Normal Hearing Children

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

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

Sensitive to Medical Issues
LittlEARS Score Sheet (Adapted from MED-EL)

Meeting Auditory Development Milestones

Not Meeting Auditory Development Milestones

Norms end at 24 months

Extended age range

Legend: Maximum, Average, Minimum, Meeting Milestones, Not Meeting Milestones

© Copyright 2010 Child Amplification Laboratory, UW
The University of Western Ontario
Pediatric Audiological Monitoring Protocol (UWO PedAMP)

Bagatto, Moodie, Malandrino, Richert, Clench & Scollie

In Press
Trends in Amplification
Children with Hearing Aids

Aided* = 68
PTA = 48.41 dB HL
Range = 16.67 to 110 dB HL

Typically Developing = 23 (33.82%)
Comorbidities = 22 (32.35%)
Complex Factors = 23 (33.82%)

* Clinicians followed OIHP hearing aid fitting protocol
(Bagatto et al, 2010)
Administration of LittleEARS

43 caregivers; 58 times

Mean age = 27.3 months
Range = 6.9 – 72.7 months

- Typically Developing = 12 (27.9%)
- Comorbidities = 17 (39.5%)
- Complex Factors = 14 (32.6%)
All Profiles: Aided PCHI

German-derived norms

Typically Developing
Mild/Mod Comorbidities
Complex Factors

Bagatto et al, In press, *Trends in Amplification*
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 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

  - 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).
Administration of PEACH

48 caregivers; 75 times
Mean age = 27.3 months
Range = 6.9 – 72.7 months

Typically Developing = 16 (33.3%)
Comorbidities = 14 (29.2%)
Complex Factors = 18 (37.5%)
Preliminary Data: Aided PCHI

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

Typically-developing children tend to achieve higher overall PEACH scores as they age. The graph shows the relation between age (in months) and overall PEACH score (%). Two equations are presented: 

1. $y = e^{4.51 - (4.66/x)}$
2. $y = 0.03x + 81.67$

The data points on the graph represent the observed scores, and the lines represent the predicted scores based on the equations. Bagatto et al., In press, Trends in Amplification
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...

bagatto@nca.uwo.ca
References


