Fitting and usage of hearing instruments in pediatrics

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- All of the centers who participate by sharing their fitting data
Agenda

1. Overview
2. Use of hearing instruments
3. Application of style and features
4. Provision of frequency lowering
5. Conclusion
Overview
» 6696 Pediatric HI fittings

» 44 US Unique Sites
  » 36 pediatric clinics
  » 8 schools

» Data streamed to a secure server between May-Nov 2013

» Anonymized

» HIPPA compliant

» Clinic consent
Cystic fibrosis: a case study of getting better

CF mortality rate >20%/yr.
Avg life expectancy <3

1957

1963

1966

1972

Life expectancy reaches 18 years

Life expectancy reaches 33 years with the best center reporting a mean of 47

2003

2013

Leroy Matthews in CLE claims his mortality rate is <2%/yr and median life expectancy =21

Life expectancy reaches 10 years

Today avg life expectancy is 40
First BTEs

ABR recommended for infant hearing assessment

1957

CI approved for children in US

1960s

DSL provides pediatric targets for HI fittings

1979

NIH recommends all infants screened for HL by 3 mo

1990

Bess reports avg age of ID >3 years

1993

NIH Recommends all infants screened for HL by 3 mo

2000

USPSTF reports that avg deaf student graduates with less than 4th gr academic/lang skills

2013

??
Our Big Hairy Audacious Goal

How do we perfect the management of pediatric hearing loss?

- Identify current state
- Identify positive deviants
- Develop guidelines
- Adapt clinical practice and counseling
6696 Pediatric fittings from 44 locations

- 2889: Age 0 - 4
- 2162: Age 5 - 8
- 1645: Age 9 - 18

Age of fittings
Type of hearing loss

- **SNHL**:
  - 0 - 4: 89%
  - 5 - 8: 83%
  - 9 - 18: 80%
  - Adults: 85%

- **Mixed or CHL**:
  - 0 - 4: 11%
  - 5 - 8: 17%
  - 9 - 18: 20%
  - Adults: 15%
Prescriptive method applied

Age groups

- PhonakDigital
- NaINIl1
- Dsl5Pediatric
- Dsl5Adult
Use of hearing instruments
Avg use time by age group with and without “non-users”

» Avg. use by children in routine use of devices = 6.1 hours

- Infant and toddler
- School aged
- Tween and teen
- Adult
- Senior

- Less than 30 min users
- Normal users
- Total
Non-users (less than 30 min/day)

% Not in routine use by age

- Infant and toddler: 0%
- School aged: 5%
- Tween and teen: 10%
- Adult: 15%
- Senior: 20%
Distribution of use time

» 33% of children wore HI for ≥ 8 hours/day
Application of styles and features
Device class by age

AGE GROUP

0-4

5-8

9-18

Economy

Business

First
Style selection by age group

![Bar chart showing style selection by age group.](chart.png)
# Junior mode defaults

<table>
<thead>
<tr>
<th>Program structure</th>
<th>0-3 years</th>
<th>4-8 years</th>
<th>9-18 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start-up</td>
<td>Roger/FM+M</td>
<td>Roger/FM+M</td>
<td>SoundFlow</td>
</tr>
<tr>
<td>Rx formula</td>
<td>DSL 5 Peds</td>
<td>DSL 5 Peds</td>
<td>DSL 5 Peds</td>
</tr>
<tr>
<td>Soundflow</td>
<td>Disabled</td>
<td>Disabled</td>
<td>Enabled</td>
</tr>
<tr>
<td>Push button</td>
<td>Disabled</td>
<td>Disabled</td>
<td>Enabled</td>
</tr>
<tr>
<td>Volume control</td>
<td>Disabled</td>
<td>Disabled</td>
<td>Enabled</td>
</tr>
</tbody>
</table>
Start up programs 0-18

- Sound Flow: 50%
- Calm situation fm: 35%
- Speech in quiet: 10%
- School fm mic: 4%
- Speech in noise: 0%
Accessible noise solutions

*Accessible FM/Roger program.*

*Up to 45% of children have accessible dir mic*
Active program toggle available

- 0-4: 53%
- 5-8: 65%
- 9-18: 81%
Automatic program start up or accessible by age group

- 0-4
- 5-8
- 9-18

Start-up
Accessible
Soundflow Programs

- **Calm situation**
- **Speech in noise**
  - Natural sound
  - Understanding speech in difficult environment
- **Comfort in noise**
- **Music**
  - Pleasant hearing in noise
  - Enjoying music, listening actively music
Manual Vs. Automatic

To optimize the HI for different hearing situations.....

«Additional programs»:
....switch manually between different programs.

«SoundFlow»:
...automatically «fades» between the programs.
Soundflow Structure
Output of the classifier

- Front Mic
- Sound Cleaning
- Gain

Time:
- 8:00
- 11:00
- 15:00

Calm situation
Speech in Noise
Noise
Music

Class proportion

Actuators:
- Sound Cleaning
- Gain
Portable audio recording equipment for children
Method for capturing real life usage and hearing performance

Flow of activities → of soundscape → of hearing object selection

School day (t)

8:00 11:15 13:30 16:00

Flow of hearing performance

100% of need

8:00 11:15 13:30 16:00

To investigate:
flow of optimal signal processing = ground truth

e.g.: static BF strength

8:00 11:15 13:30 16:00
Real life examples of classroom listening scenarios

Relevant programs:
1. «Calm situation»
2. «Speech in noise»

Hearing impaired child: Wearing recorder

Time stamp
Provision of frequency lowering
Use of frequency lowering by age group

<table>
<thead>
<tr>
<th>Ages</th>
<th>Deactivated</th>
<th>Partial</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>69%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-8</td>
<td>69%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-18</td>
<td>65%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-65</td>
<td>67%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>66-140</td>
<td>76%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Average audiograms for fittings with and without frequency lowering

![Graph showing audiograms with and without frequency lowering](image)

- FrLo off
- FrLo on
Workflow
Appointments

Days between initial fitting and 1st follow-up appt

- 60 (0-4)
- 80 (5-8)
- 90 (9-18)
Minutes per appointment

![Bar Chart]

Age group

- 0-4
- 5-8
- 9-18
- 19-65

1st
Follow up
RECD

- Measured RECD
- Avg RECD

<table>
<thead>
<tr>
<th>Range</th>
<th>Measured RECD</th>
<th>Avg RECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>90%</td>
<td>100%</td>
</tr>
<tr>
<td>5-8</td>
<td>90%</td>
<td>100%</td>
</tr>
<tr>
<td>9-18</td>
<td>90%</td>
<td>100%</td>
</tr>
</tbody>
</table>
In summary

• Majority of pediatric fittings in US apply validated prescriptive method, DSL

• Children are often given noise solutions such as manual directional microphones programs and automatic programs, but it is unclear 1. how often and how well individual children utilize these features them 2. How well the programs are able to make their listening intent more salient

• Usage data indicates that children are using devices regularly and point to groups that need more counseling and encouragement.

• Sound Recover is being disabled more frequently with children with milder and HF hearing loss, indicating there is more work to be done in this area

• We are developing a research stream to help us better understand the performance of our hearing instruments in school environments

• There is an opportunity to connect these use patterns to outcomes
Thank you