Effectiveness of Ohio's Early Intervention on Language Outcomes

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Daniel Choo
Presentation Outline

- Overview of State of Ohio EHDI Program
- UNHS
- Regional Infant Hearing Program (RIHP)
- Results from language outcomes study
Infant Hearing Program at The Ohio Department of Health

- 4 Audiology Consultants & Supervisor
  - All birthing hospitals → UNHS
  - 10 RIHP’s → Intervention

- Stakeholders:
  - UNHS Advisory Council since 90’s
  - Partnerships with Audiologists
  - Medical Home Initiative
Pre-UNHS Ohio

- Infant Hearing Screening and Assessment Program (IHSAP)
- 1988-2004
- High Risk Questionnaire
- Hearing Assessment (screening)
- 1998 Study: IHSAP Missing 2/3 of kids!
Ohio’s Legislation

- House Bill 150, July 1, 2004
- Rules: Ohio Administrative Code, Chapter 3701-40
- [www.odh.state.oh.us](http://www.odh.state.oh.us) under Rules & Regulations, Final Rules: Chapter 3701-40
Review of Legislative Mandates

- All babies receive screening, unless objection
- Parents must be given the results and the ODH required brochure
- Follow up information on providers is necessary for any non-passing babies
- ODH Form (4632) completed and sent to ODH (14 days), other distribution
- PCP provided with results
Annually in Ohio:

- Approximately **150,000** births
- Approximately **6,000** non-pass UNHS
- Approximately **450** expected to be born with some degree of hearing loss
- **136,156** UNHS Reports submitted for 2005
Follow Up after UNHS

- Screening was the E-A-S-Y part.

- What Happens Next?
Intervention Component

Screening

Intervention
HMG & RIHP

Diagnosis
Components of the Infant Hearing Program

- Universal Newborn Hearing Screening (UNHS)

- 10 Regional Infant Hearing Programs (RIHPs)
  
  * Audiologists provide Technical assistance to hospitals and RIHP’s, monitor compliance, etc.*
Regional Infant Hearing Program
# = # of hospitals (incl. birthing, children’s hospitals, freestanding birthing centers)

County Name

# = Projected # Served

40% (not lost to follow-up) of 3/1000 born with hearing loss x 3 (to include all children birth to three served in a given year)

(#) = Projected # UNHS Referrals

4% of average # of births per county in a year

Based on 2000, 2001, 2002 births per county

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Regions I, II
The RIHP’s are funded by the Ohio Department of Health (ODH) Bureau of Early Intervention Services, through a federal grant from the US Department of Education, Individuals with Disabilities Education Act (IDEA).
The RIHP

- Provides services at no cost to the families
- Assures that all families enrolled in the program receive Part C core services
- Coordinates tracking and follow-along for newborns identified through Ohio’s newborn hearing screening program
What?

- The purpose:

1) To provide follow along and tracking of infants who do not pass their newborn hearing screening.

2) To provide family centered habilitative services for infants and toddlers age birth to three with hearing loss or deafness.
Components

- Home-based family support
- Unbiased parent education on communication choices
- Assistance with follow up audiological appointments, and connections to community resources

- Guidance in communication and language development
- Opportunities to interact with the deaf community
- Parent to parent support
- Planning for transition to preschool
Who?

- Staff of the Regional Infant Hearing Programs:
  1. Project Director
  2. Parent Advisors
  3. Data support staff
  4. Deaf Mentors - optional
  5. Consultative: Audiologist, SLP
Curriculum

- The Parent Advisors are SKI*HI trained.
  SKI*HI (Utah State University Logan, Utah.)

- SKI*HI: specialized curriculum offering nonbiased information on communication choices, ongoing home and family centered support for infants and children with deafness or hearing loss.
How?

- The family is contacted within two working days of receiving an electronic referral.
- The infant is part of Tracking and surveillance.
- Home visits begin once diagnosis of HL.
- The RIHP’s work in partnership with Help Me Grow (HMG) to provide necessary support and intervention.
- Transition to preschool at age 3.
Our Goal...

To ensure that all newborns have the opportunity to communicate from birth, the EHDI program is a part of a national effort to promote:

- The early detection of hearing loss.
- The tracking of infants/children who are deaf or hard of hearing.
- The initiation of effective intervention systems.
Objectives of Current Study

Ohio has fairly robust EI system; we wanted evaluate our system’s effectiveness regarding language outcomes

The objectives of the current study were:
1) To determine the impact of early intervention on language over time for children with permanent hearing loss;
2) To evaluate the association between language and:
   - Age of identification
   - Age of EI entry
   - Degree of hearing loss
Methods

- Children with permanent HL
- Enrolled in RIHP EI program 2004-07
- SKI*HI Language Development Scale
  - Every 6 months
  - Language quotient (LQ) was created by dividing the actual score (unit completed) with the unit that signifies the appropriate language skills for the child’s current age
  - Within “normal limits” considered at LQ > 80
Statistical Analysis

- Evaluated age of EI entry and age of identification regarding baseline language skills with ANOVA.

- Investigated the relationship between age of entry (<6 mo vs. ≥ 6 mo) and mean baseline language skills after adjusting for age of identification and severity.

- Repeated measures regression models to investigate language development over time for each level of HL severity.
Subjects

- 605 infants and toddlers receiving EI services between Jan 2004-July 2007
- Subjects excluded from analyses due to:
  - Complex medical conditions (35%, n=210)
  - Missing data related to:
    - Hearing loss severity (n=15), Age of entry (n=5), Not yet complete data entry (n=87)
- 288 subjects included in analyses
  - 235 (82%) bilateral hearing loss
  - 53 (18%) unilateral hearing loss
Age of Identification over Time
For Children in EI

P<.0001 for decreasing ages over time
<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>Bilateral N=235 (82%)</th>
<th>Unilateral N=53</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ID in months</td>
<td>4.0 (0-33.8)</td>
<td>2.7 (0-22.5)</td>
</tr>
<tr>
<td><em>Post UNHS implementation</em></td>
<td>2.8 (.16-25.4)</td>
<td>2.7 (0.4-15.5)</td>
</tr>
<tr>
<td>Age Entry in months</td>
<td>7.1 (0-34)</td>
<td>4.6 (1.3-23.4)</td>
</tr>
<tr>
<td><em>Post UNHS implementation</em></td>
<td>5 (0-25.5)</td>
<td>4.5 (1.4-22.1)</td>
</tr>
<tr>
<td>Severity of Bilateral HL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe to Profound</td>
<td>38%</td>
<td>---</td>
</tr>
<tr>
<td>Mod to Moderately Severe</td>
<td>36.5%</td>
<td>---</td>
</tr>
<tr>
<td>Mild</td>
<td>25.5%</td>
<td>---</td>
</tr>
<tr>
<td>Amplified</td>
<td>89%</td>
<td>23%</td>
</tr>
<tr>
<td>Cochlear Implant</td>
<td>16%</td>
<td>---</td>
</tr>
<tr>
<td>Age at amplification</td>
<td>7.0 (1.2-36)</td>
<td>14.1 (2.8-31.9)</td>
</tr>
<tr>
<td>Primary Comm</td>
<td>Oral 58%</td>
<td>85%</td>
</tr>
<tr>
<td></td>
<td>ASL/bilingual-bicultural 1%</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>TC 37%</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Other/undecided 4%</td>
<td>---</td>
</tr>
</tbody>
</table>
Language Skills at Baseline by Age

Receptive Language Quotient

Age of Identification

< 3  3- <6  6-<12  12 +

Age at EI Entry

<6  6-<12  12+

*P<0.05 multiple comparisons
## Mean (SD) Baseline Language Skills

<table>
<thead>
<tr>
<th>Language*</th>
<th>&lt; 6 mos N=122</th>
<th>≥6 mos N=146</th>
<th>Effect for age at entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressive</td>
<td>100.3 (36)</td>
<td>72.3 (35)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Receptive</td>
<td>96.2 (32)</td>
<td>78.9 (32)</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

### By Severity, Expressive language quotients**

<table>
<thead>
<tr>
<th>Severity</th>
<th>&lt; 6 mos N=122</th>
<th>≥6 mos N=146</th>
<th>Effect for age at entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>94.0 (29)</td>
<td>70.3 (28)</td>
<td>0.006</td>
</tr>
<tr>
<td>Moderate</td>
<td>102.7 (39)</td>
<td>74.7 (38)</td>
<td>0.006</td>
</tr>
<tr>
<td>Severe</td>
<td>114.5 (34)</td>
<td>64.9 (32)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Profound</td>
<td>93.6 (32)</td>
<td>65.9 (33)</td>
<td>0.02</td>
</tr>
<tr>
<td>Unilateral</td>
<td>105 (25)</td>
<td>84.6 (56)</td>
<td>0.07</td>
</tr>
</tbody>
</table>

*Controlling for age of identification and severity; region not significant
**Controlling for age of identification
Children within Normal Expressive Language Limits

P<.0001

P<.0001
Children within Normal Expressive Language Limits

<table>
<thead>
<tr>
<th>Category</th>
<th>Baseline</th>
<th>1 Year</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilateral</td>
<td>70%</td>
<td>85%</td>
<td>0.03</td>
</tr>
<tr>
<td>Mild</td>
<td>55%</td>
<td>65%</td>
<td>0.08</td>
</tr>
<tr>
<td>Moderate</td>
<td>60%</td>
<td>70%</td>
<td></td>
</tr>
<tr>
<td>Sev-Prof</td>
<td>50%</td>
<td>60%</td>
<td></td>
</tr>
</tbody>
</table>
Statistical Models

- Thus far, only looked at baseline language skills

- Evaluate the change in language skills (language development) over time spent in EI
  - Controlled for potential confounders that may influence outcome

- Created multiple regression models for each level of hearing loss

- Investigated the possible interaction between age of entry and duration in EI
# Mild and Moderate HL

<table>
<thead>
<tr>
<th>Predictor</th>
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<th></th>
<th>&gt; 6 mos</th>
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<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>$p$</td>
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<tr>
<td><strong>Expressive</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Duration in EI (mo)</td>
<td>0.001</td>
<td>0.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Receptive</strong></td>
<td></td>
<td></td>
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<tr>
<td>Duration in EI (mo)</td>
<td>0.003</td>
<td>0.16</td>
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*Controlling for Age of ID (NS); Region of Ohio not significant in the models*
## Mild and Moderate HL

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<td></td>
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<td></td>
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<tr>
<td>Duration in EI (mo)</td>
<td>0.001</td>
<td>0.68</td>
<td>0.011</td>
<td>&lt;.0001</td>
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<tr>
<td><strong>Receptive</strong></td>
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<td></td>
<td></td>
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Controlling for Age of ID (NS); Region of Ohio not significant in the models
Mild and Moderate HL

Duration in Early Intervention

Expressive Language Quotient

0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4
Mild and Moderate HL

Expressive Language Quotient vs. Duration in Early Intervention

< 6mo
Mild and Moderate HL

Duration in Early Intervention

Expressive Language Quotient
## Unilateral Hearing Loss

<table>
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<td>Duration in EI (mo)</td>
<td>-0.003</td>
<td>0.32</td>
<td>0.01</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>Receptive</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration in EI (mo)</td>
<td>0.002</td>
<td>0.68</td>
<td>0.0091</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Region of Ohio not significant in the models; controlled for amplification, age ID
Unilateral Hearing Loss

Receptive Language Quotient vs. Duration of EI

- < 6 months
- ≥ 6 months

Data points and trend lines indicate a relationship between duration of EI and receptive language quotient.
<table>
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<tr>
<td>Duration in EI (mos)</td>
<td></td>
<td></td>
<td>0.008</td>
<td>0.10</td>
</tr>
<tr>
<td>Age at ID</td>
<td>-0.033</td>
<td>0.008</td>
<td>-0.006</td>
<td>0.03</td>
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<td><strong>Receptive</strong></td>
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<td></td>
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<td>-0.02</td>
<td>0.19</td>
<td>-0.004</td>
<td>0.19</td>
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Region of Ohio not significant in the models; controlled for amplification
Severe to Profound

Duration in Early Intervention

Expressive Language Quotient

< 6 months
≥ 6 months
Severe to Profound

Duration in Early Intervention

Expressive Language Quotient

< 6 months

≥ 6 months
Strengths and Challenges

- Infants included with any degree of HL
  - Includes unilateral HL

- Systematic data collection on all infants as part of Ohio’s EI system

- Able to evaluate age of early enrollment and improvement in language skills over time across all degrees of hearing loss
Strengths and Challenges

- Statewide data: unable to account for certain factors that may influence outcomes (e.g., developmental disabilities)

- Missing data may bias our results

- Used a language quotient as opposed to standardized score
  - A good approximation of actual skill development
In Summary

- Majority of infants who enter EI < 6 months have normal language skills at entry.

- Infants/toddlers who enter the program “late” ( >6 months of age) make significant progress, “catching up” to their early entry peers.
In Summary

- Language development over time is not necessarily a linear relationship (i.e. constant increase in skills)

- Normal language development in all infants/toddlers varies over time

- Infants who enter EI very early (<3 months) do not have many language skills
  - Difficult to determine delay at that age; delay may show up later however.
  - Children may start out with high language skills early and appear to lose them as the language testing gets harder
  - Particularly evident among those with severe to profound HL
In Summary

- Infants diagnosed with permanent HL, enrolled in Ohio’s EI program, all make significant progress, or maintain age-appropriate skills while in EI.

- Results from this study emphasize the importance of EI services for children with HL, regardless of severity of HL or age of entry.

- Early Intervention is simply important!
### Mild and Moderate HL

<table>
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<tr>
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<td>0.68</td>
<td>0.011</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Age at ID</td>
<td>-0.03</td>
<td>0.33</td>
<td>0.001</td>
<td>0.75</td>
</tr>
<tr>
<td><strong>Receptive</strong></td>
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<tr>
<td>Duration in EI (mos)</td>
<td>0.003</td>
<td>0.16</td>
<td>0.007</td>
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</tr>
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<td>Age at ID</td>
<td>-0.03</td>
<td>0.17</td>
<td>-0.0005</td>
<td>0.78</td>
</tr>
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Region of Ohio not significant in the models
## Unilateral Hearing Loss

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<td>0.06</td>
</tr>
<tr>
<td>Age at ID</td>
<td>-0.2</td>
<td>0.24</td>
<td>-0.005</td>
<td>0.51</td>
</tr>
<tr>
<td>Receptive</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Duration in EI (mos)</td>
<td>0.002</td>
<td>0.68</td>
<td>0.0091</td>
<td>0.02</td>
</tr>
<tr>
<td>Age at ID</td>
<td>-0.05</td>
<td>0.05</td>
<td>-0.001</td>
<td>0.87</td>
</tr>
</tbody>
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Region of Ohio not significant in the models; controlled for amplification
## Severe to Profound HL

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