Presentation Overview

- Personal Background
- Research Review
- Time for discussion
Research Review

- Introduction / Background
- CI Literature Review
- Rationale and Research Questions
- Methods
- Description of the 18 Studies
- Analysis by Domain and Disability
- Discussion and Conclusions
Introduction

- Incidence: 2 to 3 per 1,000 children diagnosed with hearing loss (NIH, 2008)

- Before the 1990's - hearing aids (NIDCD, 2011)
  Currently CIs preferred intervention - (Chute & Nevins, 2006)

- 28,500 children in the U.S. have CIs (NIDCD, 2011)

- Candidacy criteria is expanding (Edwards, 2007)

- Definition of benefit is evolving (Paludneviciene & Leigh, 2011-Cochlear Implants: Evolving Perspectives)
Gallaudet Research Institute (2010)  
\[ n = 37,107 \]

- 5,562 - 15% one CI
- 943 - 17% second CI
- 4,733 - 86% use in school
- 454 - 8% non-users
- 40% with at least one disability
<table>
<thead>
<tr>
<th>Disability Category</th>
<th>Children 6-21 yrs</th>
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<tbody>
<tr>
<td>All disabilities</td>
<td>5,818,074</td>
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<tr>
<td>Specific learning disability</td>
<td>2,412,801</td>
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<tr>
<td>Speech/language impairment</td>
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<td>Other health impairment</td>
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<td>Mental retardation</td>
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<td>Emotional disturbance</td>
<td>387,368</td>
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<tr>
<td>Autism</td>
<td>369,774</td>
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<td>Multiple disabilities</td>
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<td>Developmental delay</td>
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<td>Hearing impairment</td>
<td>69,685</td>
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<td>Orthopedic impairment</td>
<td>55,704</td>
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<tr>
<td>Visual impairment</td>
<td>25,632</td>
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<tr>
<td>Traumatic brain injury</td>
<td>24,594</td>
</tr>
<tr>
<td>Deaf-blindness</td>
<td>1,281</td>
</tr>
</tbody>
</table>

1 Data Accountability Center (2010), IDEA Part B: Child Count
What are the gaps in the literature?

1. The following authors recommend more research about children with CI and additional needs:

   Belzner and Seal (2007)
   Berrettini et al. (2008)
   Bond et al. (2009)
   Edwards (2007)
   Holt and Kirk (2005)
   Spencer and Marschark (2010)
Gaps cont’d.

2. FDA clinical trials by the three CI manufacturers prior to approval of the devices excluded children with disabilities.

(J. Patrick, Chief Scientist Cochlear Ltd, personal communication, April 14, 2011; Holt & Kirk, 2005)

3. Lack of consensus about implanting this group of children. (Berrettini et al., 2008; Wiley, Jahnke, Meinzen-Derr, & Choo, 2005)

4. Research from “typically” developing deaf children may be generalized to this population.
Research Review
Questions

1. What domains are included in research about children with cochlear implants and diagnosed disabilities.

2. Based on the domains included in research about children with cochlear implants and diagnosed disabilities, what are the research findings?

3. Do outcomes of children with cochlear implants differ by disability category?
The 18 Studies
2000-2011

Location of studies

Number of Studies

US: 9
UK: 2
Australia: 2
Italy: 2
Germany: 1
Iran: 1
Croatia: 1
The 18 Studies

$n = 512$ participants

**Number of Studies**

**Sample Size**

- 1-10: 8
- 11-30: 5
- 49-69: 4
- 106: 1

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Participants

Age range: 2 years to 17 years

CI experience: at least 1 year

Education program: 7 of 18 reported
## Educational Placement

<table>
<thead>
<tr>
<th>Author</th>
<th>$n =$</th>
<th>Pre-CI</th>
<th>Post-CI</th>
<th>Change</th>
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<tr>
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<td>Pre-CI</td>
<td>Post-CI</td>
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<tr>
<td></td>
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</tr>
<tr>
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<tr>
<td>Dettman</td>
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<td>8</td>
<td>11</td>
<td>—</td>
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<tr>
<td>Winter</td>
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<td>1</td>
<td>7</td>
<td>—</td>
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<tr>
<td>El-Kashlan</td>
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<td>1</td>
<td>no change</td>
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<tr>
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<td>75</td>
<td>32</td>
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<td>Waltzman</td>
<td>29</td>
<td>12</td>
<td>17</td>
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<tr>
<td>Totals</td>
<td>178</td>
<td>31</td>
<td>70</td>
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<tr>
<td>%</td>
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<td>17</td>
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What Domains?
N=18 Studies

- Speech Perception: N=15
- Communication Mode: N=13
- Quality of Life: N=9
- Speech & Language: N=6
### Authors & Domains

**N=18 Studies**

<table>
<thead>
<tr>
<th>Authors</th>
<th>n</th>
<th>Speech Perception</th>
<th>Speech/Language</th>
<th>Quality of Life</th>
<th>Comm Mode</th>
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<tr>
<td>Donaldson (2004)</td>
<td>7</td>
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<tr>
<td>Filipo (2004)</td>
<td>18</td>
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</tbody>
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<td>Winter (2004)</td>
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Overall Results

Speech Perception

When speech perception skills were measurable

Children demonstrated improved awareness of environmental sounds, detection of speech sounds, and auditory discrimination to the word level in closed-set tasks.
Speech/Language

Donaldson (2004); Richter (2002); Vlahovic (2004); and Winter (2004) stated that speech production might not be a realistic goal for many children with CI and disabilities (across disability categories).

There was a trend for children’s receptive-expressive language scores to lag behind typically developing children with CI. Scores often remained in the “severely-disordered” range, although gains were reported by researchers (Bruce, 2011; Meinzen-Derr, 2010).
Quality of Life

Those parents who were asked said they would implant again and would support the decision to implant for families facing similar decisions:

Donaldson (2004) 67%, n= 7
Vlahovic (2004) 100%, n= 4
Wiley (2005) 99%, n= 16

Benefits included improved communication, sound awareness, a sense of safety and a sense of connectedness.
Missing data precluded an analysis of changes in communication mode from pre to post implant. No clear trend was evident from the available data.

12 of the 18 studies included children who sign. This group was a large proportion of the samples as seen in the slide showing Educational Placements.

Mode of communication was not associated with different outcomes in several studies. (Dettman, 2004; Holt & Kirk, 2005; Liu, 2008; Meinzen-Derr, 2010)
Communication Mode

Only 1 study included a sign language interpreter

No study included measures of ASL

A trend for children developing functional-auditory oral skills as the primary or exclusive communication mode post CI was not evident.
Results by Disability
N=18 Studies

- Cognitive Impairment: N=11
- Deafblindness: N=7
- Autism: N=7

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## Authors & Disabilities

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<tr>
<td>Donaldson (2004)</td>
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<tr>
<td>Filipo (2004)</td>
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<th>Cognitive Level</th>
<th>Deaf-Blindness</th>
<th>Autism</th>
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<tr>
<td>Richter (2002)</td>
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<tr>
<td>El-Kashlan (2001)</td>
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<td>Pyman (2000)</td>
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</tr>
<tr>
<td>Waltzman (2000)</td>
<td></td>
<td>✔</td>
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</tbody>
</table>
Cognitive Impairment $n=120$

Speech Perception

As cognitive impairment increased, speech perception scores decreased

Daneshi (2006): Gains in listening skills. Wilcoxin-matched pairs signed-ranked test, pre CI, 1 year post CI: mild mental retardation ($p<0.012$), moderate mental retardation ($p<0.043$).

Dettman (2004): 7 point CAP scale. The greater the degree of cognitive delay the lower the scale score ($H=11.13$, df=2, $p<0.01$). Kruskal-Wallis Test.

Holt & Kirk (2005): Children with mild cognitive delays improve but had reduced scores relative to typical peers with CI. ANOVA
Cognitive Impairment
Speech and Language

Holt & Kirk (2005): Children with mild cognitive impairment showed improvement on speech-language tests over time but significantly lower scores compared to typically developing children with CI. ANOVA.

Meinzen-Derr (2010): NVCQ accounted for 67% of the variance in language outcomes. Multiple linear regression ($p=.0003$). LQ - no significant change.
Deafblindness, n=19
Speech Perception

Bruce, 2011, n=1: improvement to 99% in sentences
Liu, 2008, n=9: significant gains from CAP Level 0 to Levels 3-6
Daneshi, 2006, n=3, no significant gains p<0.102
Wiley, 2005, n=1, QOL improved, oral pre and post CI
Filipo, 2004, n=2, 50 to 70%, 30 to 70% on listening measures
El-Kashlan, 2001, n=2, n=1 reported CID 88% sentences
Waltzman, 2000, n=1, 80%-100% on listening measures
Deafblindness, \( n=19 \)

**Speech/Language Quality of Life**

Speech/Language: Only Bruce (2011) reported on speech-language outcomes. No test data was given. Results were reported as positive although scores were 4 years below age level.

Quality of Life: Daneshi, (2006); Wiley (2005); and Filipo (2004) reported improved QOL.
Autism, n=20

Speech Perception
Speech/Language
Quality of Life

Berrettini (2008), n=2, minimal gains. Improved QOL.

Daneshi (2006), n=4, least gain pre to post $p=0.068$

Donaldson (2004), n=7, gains sound awareness, attending, music, eye contact. Improved QOL.
Autism, n=20

Speech Perception
Speech/Language
Quality of Life

Filipo (2004), n=1, satisfactory gains. Improved QOL.

Johnson (2008), n=2, improved language

Winter (2004), n=2, minimal gains, unable to stay in oral

Waltzman (2000), n=2, minimal gains
Conclusions

1. Outcomes according to domains

**Speech Perception:** Improvement included environmental sound awareness, detection of speech, and detection or comprehension of words in closed set tasks.

**Speech-Language:** Gains were reported but most children’s oral language scores remained in the severely-disordered range. Speech was not viewed as a realistic goal for many children, particularly with diagnosis of autism. ASL language skills were not assessed even though 12 of the 18 studies included children who sign.

N=15  
N=9
Conclusions

I. Outcomes according to domains

**Quality of Life:** Six studies document improved quality of life across disability categories. Most families would implant again.

N=6

**Communication Mode:** A change from a visual system to an oral system was not evident. A large number of children continue to sign.

N=13
Conclusions

2. Differences by disability category

Children diagnosed with deafblindness demonstrated the greatest gains.

Children with a diagnosis of autism showed the least improvement.

As level of cognitive impairment increased, speech perception scores decreased.
Conclusion

Continuum of 3 Outcome Trajectories for All Children with Cochlear Implants

1. Only sign or augmentative system. No change in QOL
2. Primarily sign. Some speech & listening. Improved QOL
3. Proficient speech & listening. Improved QOL

No benefit from cochlear implant............................................Benefit from cochlear implant

Children with CI with some disabilities
Implications
Research and Practice

1. Quality of Life measures should be included in future research on this topic.

2. Sign language interpretation should be provided when conducting research with children who sign.

3. Additional research focusing on outcomes based on disability category is needed given this low incidence population.
4. Research investigating the threshold of cognitive skill necessary to process and interpret spoken language may be beneficial.

5. Parents and professionals should be advised that research shows many families continue to use sign language with this population.

6. The presence of disabilities may have significant implications for expectations of benefit given research findings. Research should be shared with parents presenting the full-range of expected outcomes.
References

The 18 Studies


References


*Additional references available upon request