The relationship between risk indicators for permanent hearing loss and diagnostic audiology assessment results

Among infants referred on a newborn hearing screen in 2016-2017

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Background

• **Universal Newborn Hearing Screening (UNHS)**
  ➔ well established rationale for the earlier identification of infant hearing loss

• **Routine collection of risk indicator information**
  ➔ historical usage
  ➔ targeted surveillance for postnatal hearing loss

• **Improving efficiency of the hearing screening pathway**
  ➔ cost-effectiveness of UNHS
  ➔ prioritising audiological waiting lists and aiding resource allocation
The use of risk indicators in newborn hearing screening

• As a primary method for hearing screening
• Targeted surveillance for postnatal hearing loss
• Joint Committee on Infant Hearing (JCIH) criteria
• Concerns with using risk indicator information
• Current gaps in research
Research aims

Aim 1
• To examine associations between the risk indicator profile of infants referred through newborn hearing screening and their audiological diagnostic outcomes

Aim 2
• To establish whether service providers could utilise this information, along with the automatic results from newborn hearing screening, to improve efficiency across the screening pathway

Are referred infants with a specific reported risk indicator more likely to have a diagnosis of the target condition hearing loss?
Victorian Infant Hearing Screening Program (VIHSP)

• Screening process and VIHSP protocol

• Risk indicator collection

• Infant Audiological follow-up in Victoria
Study population


1,158 - ineligible (including moved, lost contact, declined, deceased)

156,927 - passed VIHSP screening

1,360 - referred infants (ABDR2 unclear response or direct refer)

158,194 - completed VIHSP screening

93 - direct refer

4 - Audiology not commenced

1,356 - Audiology assessment undertaken

31 - hearing status not determined or Audiology not completed

602 - any hearing loss

723 - normal hearing

146 - VIHSP target condition

456 - other hearing loss

149 - other SNHL (unilateral/mild)

34 - auditory neuropathy

11 - mixed hearing loss

177 - conductive hearing loss

22 - atresia

63 - unknown hearing loss type

= 1,325 infants
Study population demographics and hearing profile

• **1,325 referred infants** born in 2016/2017, who underwent complete follow-up audiological assessment

• **Proportionally more males** *(739 cases or 55.8% of the study population)* than females

• **No significant difference** *(p > 0.05)* in proportions of infants with the target condition hearing loss between males/females, and pre-term/full-term infants

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal hearing</td>
<td>54.6%</td>
</tr>
<tr>
<td>Target condition</td>
<td>11%</td>
</tr>
<tr>
<td>Other SNHL (mild or unilateral)</td>
<td>11.2%</td>
</tr>
<tr>
<td>Conductive hearing loss</td>
<td>13.4%</td>
</tr>
<tr>
<td>Other hearing loss</td>
<td>9.8%</td>
</tr>
</tbody>
</table>

*Note: 'Other hearing loss' refers to mixed hearing loss, Auditory Neuropathy, atresia, and type unknown*
Risk indicator profile of referred infants

• **20.7% (274 infants)** of referred infants had any risk indicator recorded

• **14.4% (191) of referred infants had one risk indicator recorded, while 6.3% (83) had multiple risk indicators recorded**

<table>
<thead>
<tr>
<th>Risk indicator</th>
<th>Infants with reported indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ototoxic medications</td>
<td>8.2% (109 infants)</td>
</tr>
<tr>
<td>Congenital abnormality of head/neck</td>
<td>6.5% (86)</td>
</tr>
<tr>
<td>Family history</td>
<td>4.7% (62)</td>
</tr>
<tr>
<td>Ventilation &gt; 5 days</td>
<td>4.1% (54)</td>
</tr>
<tr>
<td>Syndrome related to hearing loss</td>
<td>3.6% (47)</td>
</tr>
<tr>
<td>Meningitis or encephalitis</td>
<td>&lt;1% (9)</td>
</tr>
<tr>
<td>Maternal infections during pregnancy</td>
<td>&lt;1% (8)</td>
</tr>
<tr>
<td>Severe jaundice at exchange transfusion levels</td>
<td>&lt;1% (6)</td>
</tr>
</tbody>
</table>
Diagnostic audiology outcome – any risk indicator

- Almost three-quarters (73.7%) of referred infants with any risk indicator recorded had a type of hearing loss diagnosed.
- 61.9% of referred infants with no risk indicator recorded had a diagnosis of normal hearing.

<table>
<thead>
<tr>
<th></th>
<th>Normal hearing</th>
<th>Target condition</th>
<th>Other SNHL</th>
<th>Conductive hearing loss</th>
<th>Other hearing loss</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No risk indicator</strong></td>
<td>61.9%</td>
<td>8.5%</td>
<td>11.6%</td>
<td>10.1%</td>
<td>7.9%</td>
</tr>
<tr>
<td><strong>Any risk indicator</strong></td>
<td>26.3%</td>
<td>20.8%</td>
<td>9.9%</td>
<td>25.9%</td>
<td>17.2%</td>
</tr>
<tr>
<td><strong>All referred infants</strong></td>
<td><strong>54.6%</strong></td>
<td><strong>11%</strong></td>
<td><strong>11.2%</strong></td>
<td><strong>13.4%</strong></td>
<td><strong>9.8%</strong></td>
</tr>
</tbody>
</table>

Note: ‘Other hearing loss’ refers to mixed hearing loss, Auditory Neuropathy, atresia, and type unknown
Target condition hearing loss and risk indicators

- **Maternal infections** had the highest yield of the target condition hearing loss (62.5% of referred infants with maternal infections recorded)

- **Family history, severe jaundice, ventilation, and ototoxic medications** were other risk indicators with relatively high yields of the target condition

<table>
<thead>
<tr>
<th>Risk indicator</th>
<th>Number of infants with recorded cases</th>
<th>Yield of target condition hearing loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal infections</td>
<td>8</td>
<td>62.5%</td>
</tr>
<tr>
<td>Family history</td>
<td>62</td>
<td>40.3%</td>
</tr>
<tr>
<td>Severe jaundice</td>
<td>6</td>
<td>33.3%</td>
</tr>
<tr>
<td>Ventilation</td>
<td>54</td>
<td>20.4%</td>
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<td>18.3%</td>
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<td><strong>1,325</strong></td>
<td><strong>11%</strong></td>
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Risk indicators and diagnostic audiological outcome
Further statistical analyses

• Chi-squared analyses ($x^2$)
  → Significant associations between the diagnosis of the target condition and family history, ototoxic medications, ventilation, and maternal infections

• Logistic regression analysis

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<thead>
<tr>
<th>Risk indicator</th>
<th>Yield of target condition hearing loss</th>
<th>Adjusted odds ratio</th>
<th>Standard error / 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family history</td>
<td>40.3%</td>
<td>6.4</td>
<td>1.8 (3.7 – 11)</td>
</tr>
<tr>
<td>Maternal infections</td>
<td>62.5%</td>
<td>11.6</td>
<td>8.8 (2.6 – 51.5)</td>
</tr>
<tr>
<td>Ototoxic medications</td>
<td>18.3%</td>
<td>1.8</td>
<td>0.5 (1 – 3.1)</td>
</tr>
</tbody>
</table>
UNHS-referred infants with specific recorded risk indicators – **maternal infections, family history, and ototoxic medications** – were more likely to be diagnosed with the **target condition hearing loss**

Infants with the recorded indicators of **maternal infections, congenital abnormality of the head/neck, and family history**, were much less likely to have a diagnosis of **normal hearing**

Infants with **any risk indicator** recorded had considerably higher proportions of the **target condition hearing loss**, and **any type of hearing loss**, than infants with no indicators recorded
Discussion

• Comparisons with existing research
  → Beswick, R., Driscoll, C., Kei, J., Khan, A., & Glennon, S. (2013)

  • Scope of existing research
  • Methodological differences
    • Comparing results
Strengths and limitations

• **Strengths**
  → Data from a population-derived source
  → Established UNHS system
  → Audiological assessment and minimal loss to follow-up

• **Limitations**
  → Timeframe of data collection period and audiological follow-up information
  → Data items included in analysis
  → Collection and reporting of risk indicator information
Conclusion and future directions

Aim 1
- Referred infants with specific recorded risk indicators were more likely to be diagnosed with the target condition hearing loss, as well as other types of hearing loss.

Aim 2
- This information has the potential to be utilised within UNHS systems to aid resource allocation and prioritise audiological waiting lists, improving the efficiency of the screening pathway.

Future directions
- Expansion of population sample
- Incorporation of other information from hearing screening
Thank you. Questions?

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