Main difficulties in establishing a successful EDHI program
(lights and shadows in Hungary)

UNHS in Hungary
Automatic Evaluation of New-Born Baby Hearing Screening
Based on Three Criteria Scoring.

Pytel, J.

Pécs, Hungary
The UNHS was started in Hungary in 1997 in Pécs and in Baja

Thank to F. Grandori

<table>
<thead>
<tr>
<th>2005 - UNHS - HU</th>
<th>Cities / Hospitals</th>
<th>Live birth</th>
<th>Screened</th>
<th>Referred</th>
<th>Diagnosed HL</th>
<th>Screening method</th>
<th>Device</th>
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</table>
## The UNHS statistic in Hungary 2005

Statistic was made by dr. Zsolt Beke (Baja)

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Percent(%)</th>
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<tr>
<td>Total live birth</td>
<td>97500</td>
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<tr>
<td>Total screened</td>
<td>31294</td>
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</table>

### The Problem in Hungary

The neonatal hearing screening is obligatory

but

The method (objective) is not obligatory

The screening is not paid

Motivation is only the whole-hearted enthusiasm
The screening must be
Quick
Simple
Expert opinion on hand not necessary
The screening must have
High accuracy

In the cases of
higher volume of screening
(UNHS!)
automated method is needed
(A.Davis et al.)
Our automated program and database is an on-line (or off-line) help in screening for trained hearing screener or health visitor.

The database is suitable for follow up.
Our program is to help interpret the result.
Expert opinion on hand not necessary.
Double-checking not necessary.

In general
two criteria are used for scoring

Response to noise ratio in four frequency bands

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4 kHz</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>6</td>
<td>6</td>
<td>6 dB</td>
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</table>

Correlation in four frequency bands

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4 kHz</th>
</tr>
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<tbody>
<tr>
<td>50</td>
<td>70</td>
<td>70</td>
<td>70%</td>
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The three criteria for automatic evaluation

Criteria:

1. Amplitude (S/N dB)

<table>
<thead>
<tr>
<th>1 kHz</th>
<th>2 kHz</th>
<th>3 kHz</th>
<th>4 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

2. Repro (%)

<table>
<thead>
<tr>
<th>1 kHz</th>
<th>2 kHz</th>
<th>3 kHz</th>
<th>4 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
</tbody>
</table>

3. Duration (ms)

<table>
<thead>
<tr>
<th>1 kHz</th>
<th>2 kHz</th>
<th>3 kHz</th>
<th>4 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 8 ms</td>
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The three criteria for automatic evaluation include:

- **Amplitude (S/N dB)**: Measures the ratio of signal to noise.
- **Repro (%)**: Indicates the percentage of reproduction accuracy.
- **Duration (ms)**: Specifies the minimum duration required for automatic evaluation.

**Criteria:**

1. Amplitude (S/N dB)

2. Repro (%)

3. Duration (ms)

**The three criteria for automatic evaluation**

- **Signal to Noise Ratio per bands**
  - 1.6
  - 2.4
  - 3.2
  - 4 kHz
  - 20 dB
  - 20 dB
  - 20 dB

- **Repro per bands**
  - 99
  - 99
  - 99
  - 99%

- **Duration**: 16.56 ms
The third criterion of scoring the effective duration of emission

Effectiv duration = the red curve duration altogether

Duration = 8 ms

Critical value =>

Duration calculated by Moving Time Window Correlations Analysis

Duration of TEOAE - Moving Time Window Analysis

Correlation (window = 1ms):

Effective Duration of TEOAE = 13.8 ms
The third criterion for automatic evaluation: Duration

The third criterion for automatic evaluation: Duration

Signal to Noise Ratio per bands
1.6 2.4 3.2 4kHz
3 12 14 14db

Repro per bands
62 94 96 96%

Duration: 7.68 ms

Signal to Noise Ratio per bands
1.6 2.4 3.2 4kHz
3 9 11 1248

Repro per bands
64 87 92 94%

Duration: 7.88 ms
The third criterion for automatic evaluation: Duration

The three criteria for automatic evaluation

Amplitude

Signal to Noise Ratio per bands

Duration: 9.92 ms
The three criteria for automatic evaluation

Signal to Noise Ratio per bands
Repro per bands
Duration:

Signal to Noise Ratio per bands
Repro per bands
Duration:
Only the +++ is accepted

+++  ++++-  ---++  +---+  NOT ACCEPTED!

Special scoring variations

In 942 referred cases predictable usable hearing in speech frequencies

With two principle criteria 126 cases would have been passed as false negative
Hearing Screening in Pécs 01.01.1998 - 31.12.2004

- Bilateral HL > 80 dB: 36 0.38%
- BERA: 339 3.58%

1. step:
- Referred First: 2863 30.27%
- Appeared at Screening: 9457 95.1% (100%)
- Childbirth: 9934

2. step:
- Measured at Second Step: 2668 28.21% (93.18% of referred)

3. step:
- Referral Rate (%) and HL>80dB (%)

Referral Rate (%) and HL>80dB (%)

Trend of HL% * 100
Average of HL% * 100
Trend of referrals

referral HL>80dB

0.44 0.29 0.04 0.27 0.22 0.73 0.63 0.38
Maternity centre in Pécs is a centre for premature babies.
Screen program and database
Auditory neuropathy

TEOAE

Signal to Noise Ratio per bands
- 1.6 dB
- 2.4 dB
- 3.2 dB
- 4 dB

Repro per bands
- 94%
- 98%
- 99%
- 97%

Duration: 4.36 ns

Auditory neuropathy

BERA

Signal to Noise Ratio per bands
- 1.6 dB
- 2.4 dB
- 3.2 dB
- 4 dB

Repro per bands
- 94%
- 98%
- 99%
- 97%