Looking to the Past for a Glimpse Into our Future

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A Look Back...
Baby can amuse himself with toys in a play pen
Still cuff to prevent thumb sucking
Give the baby a coat of summer tan
“In the Education Act of 1944 both the rights and responsibilities of parents are clearly recognized. If, when a child becomes two years old, they suspect that he is handicapped by deafness or partial deafness, they may apply to their Local Education Authority, which must arrange for a medical examination...Diagnosis, we would urge, should be made by an otologist...”
Ewing & Ewing, 1958

“...To ensure that all children whose hearing is defective have the best possible chance of remedial treatment, the writers are convinced that all babies should be given screening tests of hearing, by the ninth to twelfth month.”

New Opportunities for Deaf Children, Charles C. Thomas: Springfield
Dr. Mildred Stahlman Designs 1st Respirator for Premature Infants at Vanderbilt University
1960s: Apitron

FIGURE 1-1. A specially designed battery-powered infant hearing screener used in the early 1960s known as the Apriton (from the auro-palpebral reflex, the involuntary body movement and eye blink resulting from sudden sound onset). The examiner presented a sudden onset narrow-band noise stimulus of 90 dB SPL followed by observation for the presence or absence of reflexive infant responses.
Figure 1 illustrates the single channel recording apparatus used in the ICN. The motion sensitive transducer is imbedded in a silicone elastomer pad. This transducer was placed under the mattress of each baby. The output from the transducer is fed to a central control unit (Telemesory Systems, Inc. Model G1-A) and is recorded on a strip chart. Typically the gain of the system was adjusted for each baby so that quiet respiration yielded tracings with approximate 2mm peak-to-peak amplitudes. Interstimulus intervals were typically set at 40 min via a timing circuit housed within the control unit. The final component of the system is a loudspeaker that was placed at the foot of each baby’s crib. Again the stimulus was a 2500–4500 Hz band noise at a level of 92 dBA. Figure 2 illustrates the spectral characteristics of the stimulus. The center frequency was 3500 Hz. The low frequency cut-off began at approximately 2500 Hz and dropped at a rate of 13 dB per octave. The high frequency cut-off began at 4500 Hz and sloped at a rate of 18 dB per octave. The stimulus intensity of 92 dBA was selected because preliminary investigations indicated that lower levels typically yielded fewer responses. This intensity was not considered harmful for each stimulus was of short duration and a small number of stimuli were presented. The stimulus spectrum was centered around 3500 Hz to stimulate hearing in the upper range of frequencies important for the reception of speech and to reduce the possibility of obtaining responses from children with marked hearing losses but with significant low frequency residual hearing.

In the intensive care nursery, the single channel instrument was set up for a given infant for a 24 hour period. The loudspeaker was placed under each mattress and the stimulus was calibrated to a level of 92 dBA and set for presentation for 10 minutes.

Simmons FB, Russ FW. Automated newborn hearing screening, the Crib-o-gram. Arch Otolaryngol 1974;1003:1-7
Auditory Response Cradle – 1980s

- Measured trunk and limb movements, startle responses of the head, and infant respiratory pattern with the combination of a pressure-sensitive mattress and transducers.
- Used a high-pass noise (2600 to 4500 Hz) of 85 dB SPL.
- The average time for response analysis was 2 to 10 minutes.
Arousal Test
1967 Recommendations from the National Conference on Education of the Deaf

- High-risk register to facilitate identification
- Public information campaign
- Testing of infants and children 5-12 months of age should be investigated

What Percentage of Hearing Impaired Children were High Risk as Infants?

Feinmesser et al. (1982) 49%
Pappas & Schaibly (1984) 54%
Elssmann et al. (1987) 48%
Watkin et al. (1991) 43%
Mauk et al. (1991) 50%
Mehl & Thomson (1998) 50%

From: K. White, Sound Foundations Conference 2010
Age in Months at Which Permanent Hearing Loss Was Diagnosed

- Coplan (1987) 35
- Elssman et al. (1987) 19
- Gustason (1987) 30
- Meadow-Orlans (1987) 30
- Stein et al. (1990) 25
- Mace et al. (1991) 31
- Johnson et al. (1997) 3
- Vohr et al. (1998) 3
- Harrison and Roush (2003) 4
- Massachusetts (2004) 2

January 30, 1987

• 8 year-old with severe hearing loss
• Parents suspected at 13 months
• Fit with hearing aids at approximately 2 years
• Cochlear implants not available
Alex: October 2008

- 6 year-old male with severe-to-profound hearing loss
- Failed newborn hearing screening but never went for follow up until age 2 years
- Fit with hearing aids at age 2 years
- Intervention at age 3 years
- Cochlear implant at age 4 years
Ellie: 2010

• Age 7 years
• Passed newborn screening
• Diagnosed, fitted with bilateral hearing aids, and enrolled in early intervention at 10 months
• Received first cochlear implant at age 14 months, second cochlear implant at age 4-5 years
What took us from There to here?

Newborn screening

Trained personnel

Technology

Timely, appropriate interventions

How does this happen?
Components of an effective program:

- Newborn hearing screening
- Early Intervention
- Family Support
- Monitoring
- Early Intervention
- Diagnosis
- Newborn hearing screening
- Family Support
- Medical Home
- Community support
- Personnel preparation
- Quality Assurance
- Program evaluation
- Data management
Is this level of care available for all infants?

If not, can we make it available?
Today, 96% of newborns in the United States receive hearing screening (NCHAM, 2009).

But only 46% of those who do not pass are reported as having received follow up.

Lehnhardt 2009

Screening Coverage (2008)
Vision for Pediatric Audiology Services:

“The services should...as far as possible be geographically convenient.”

(J. Bamford, 2010)
I. A Charge Forward: Tele-Audiology
Could all infants have access to the high quality ABR assessments described by Dr. Hyde?
Remote Assessment

electrodes
earphones
Can we eliminate the barriers of time and distance for families seeking optimal intervention services for their children with hearing loss?
Can we provide remote hearing aid support of the quality described by Drs. Roush and Wolfe?
Remote Intervention
Visions of the Future for Children with Hearing Loss

“Seek out opportunities for international collaboration focusing on early identification and follow up.”

(J. Gravel, 2007)
Angelina Martinez described the value that Dr. Seewald brought to her program in Brazil.
Could all audiologists receive assistance from experts like Dr. Seewald in providing the essential components of hearing instrument fittings?
Remote Consultation/Demonstration
II. A Charge Forward: New Considerations in Screening?

Screening for etiology?

• Screening for cytomegalovirus
• Screening expectant mothers for the mitochondrial gene MTRNR1
• Molecular genetic tests to detect cases of hearing loss not present at birth or associated with subclinical hearing loss
“Etiology is key for prognosis and therapy”...Dr. Cardero
III. A Charge Forward: Personalized Intervention

Are we ready to expand our personalized treatment of infants and children with hearing loss?
We currently individualize hearing technology fittings by the use of the RECD

But...
No longer have to treat all children with the same disorder the same way

– Cortical and psychoacoustic studies might be good predictors of functional outcomes for children with ANSD or cochlear implant candidacy (Gordon; Roush)
Such studies might allow us to determine the parameters of intervention needed for an individual child.

• Do all children need to receive therapy 3 days a week for one hour?
• Do all children need only auditory input or can we determine who needs added visual input?
Can **all** children get here?

- Newborn screening
- Trained personnel
- Technology
- Timely, appropriate interventions
"The best way to predict the future is to invent it."

-Theodore Hook