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A Quick Look Back and a Charge Going Forward

Anne Marie Tharpe
Vanderbilt University School of Medicine
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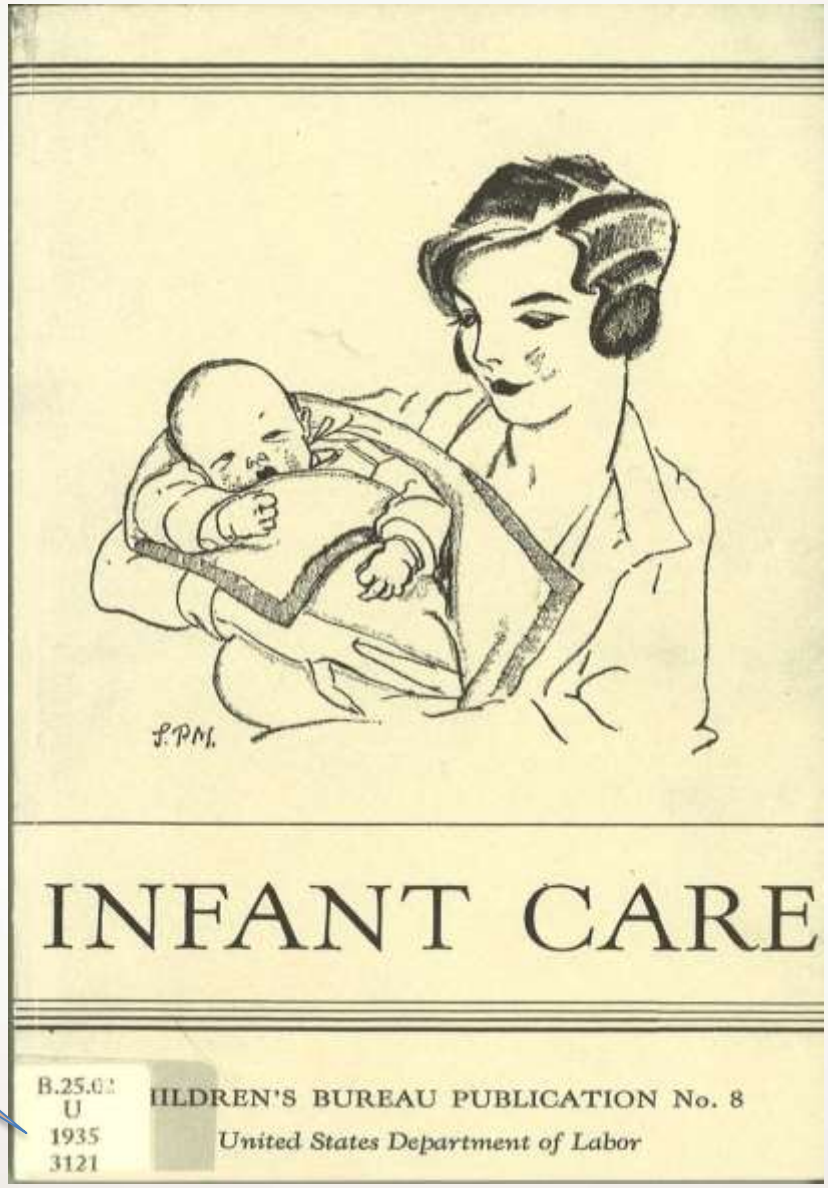
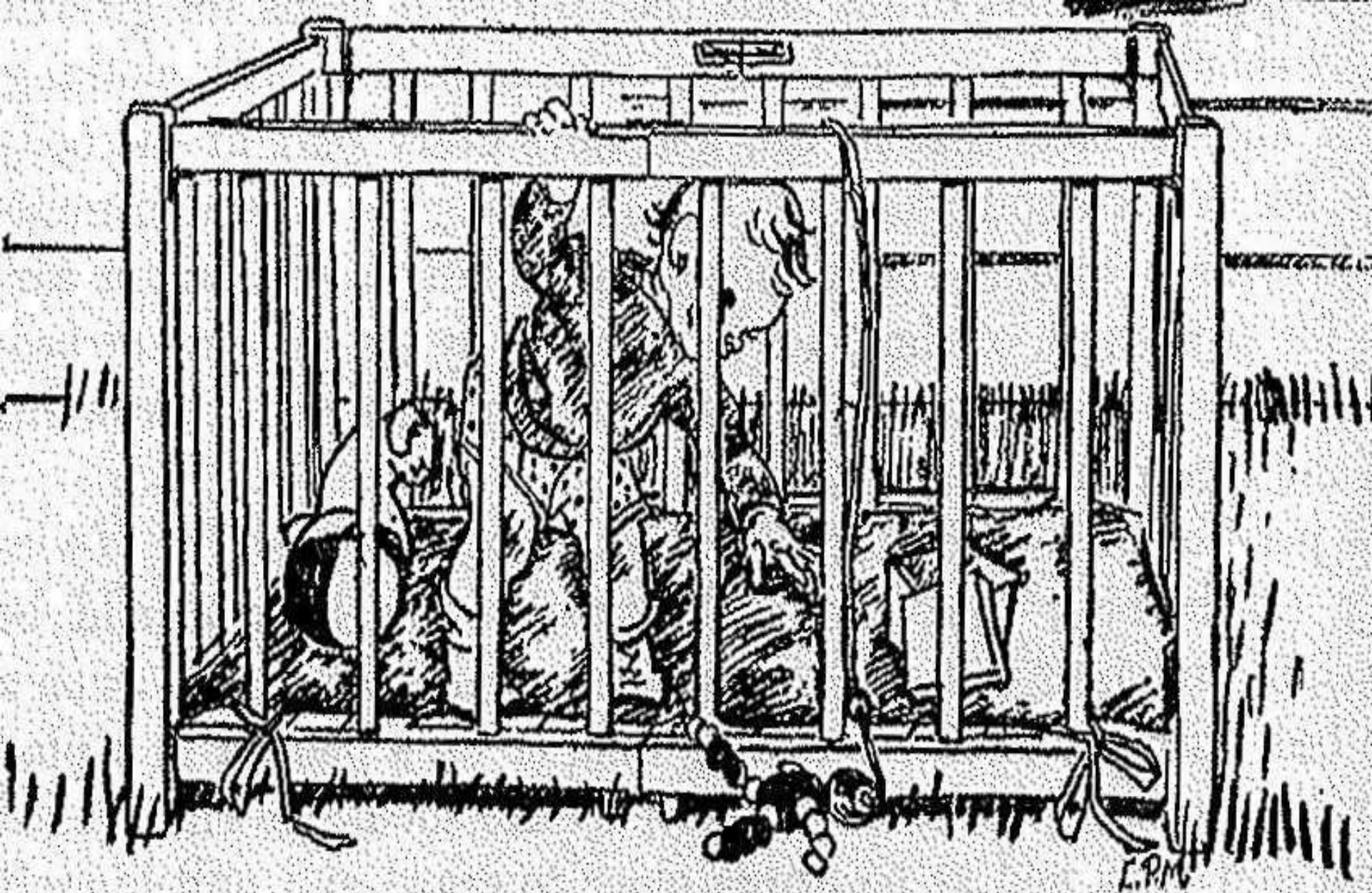
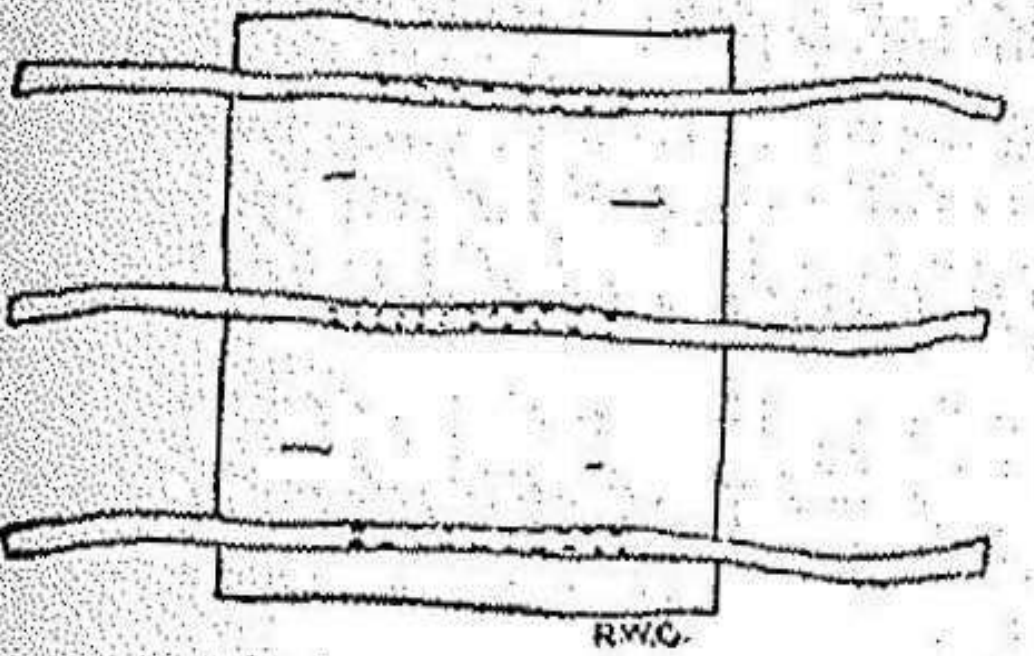
A Look Back…

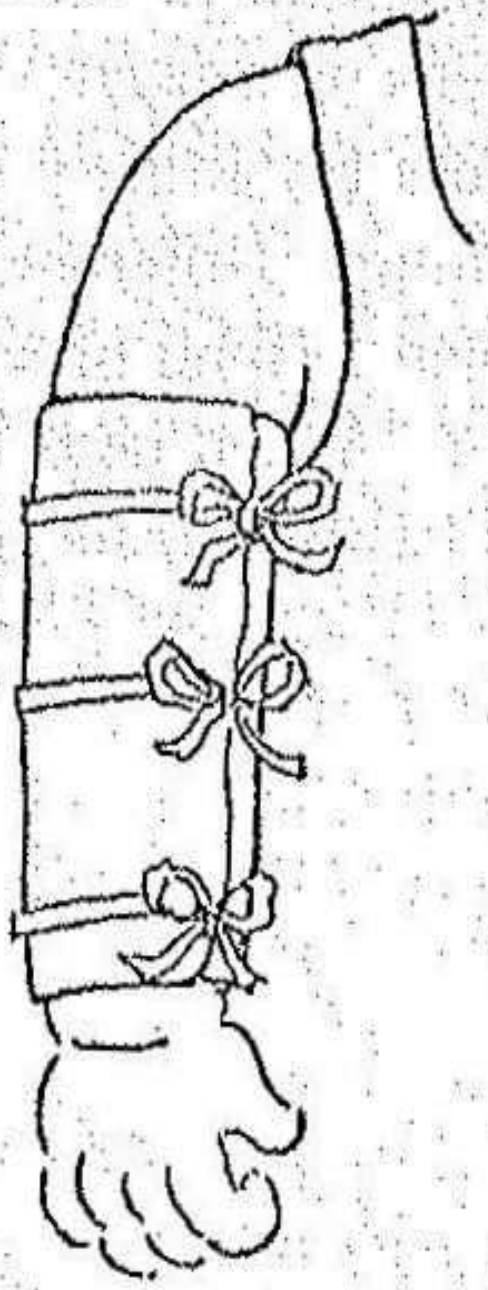
1935



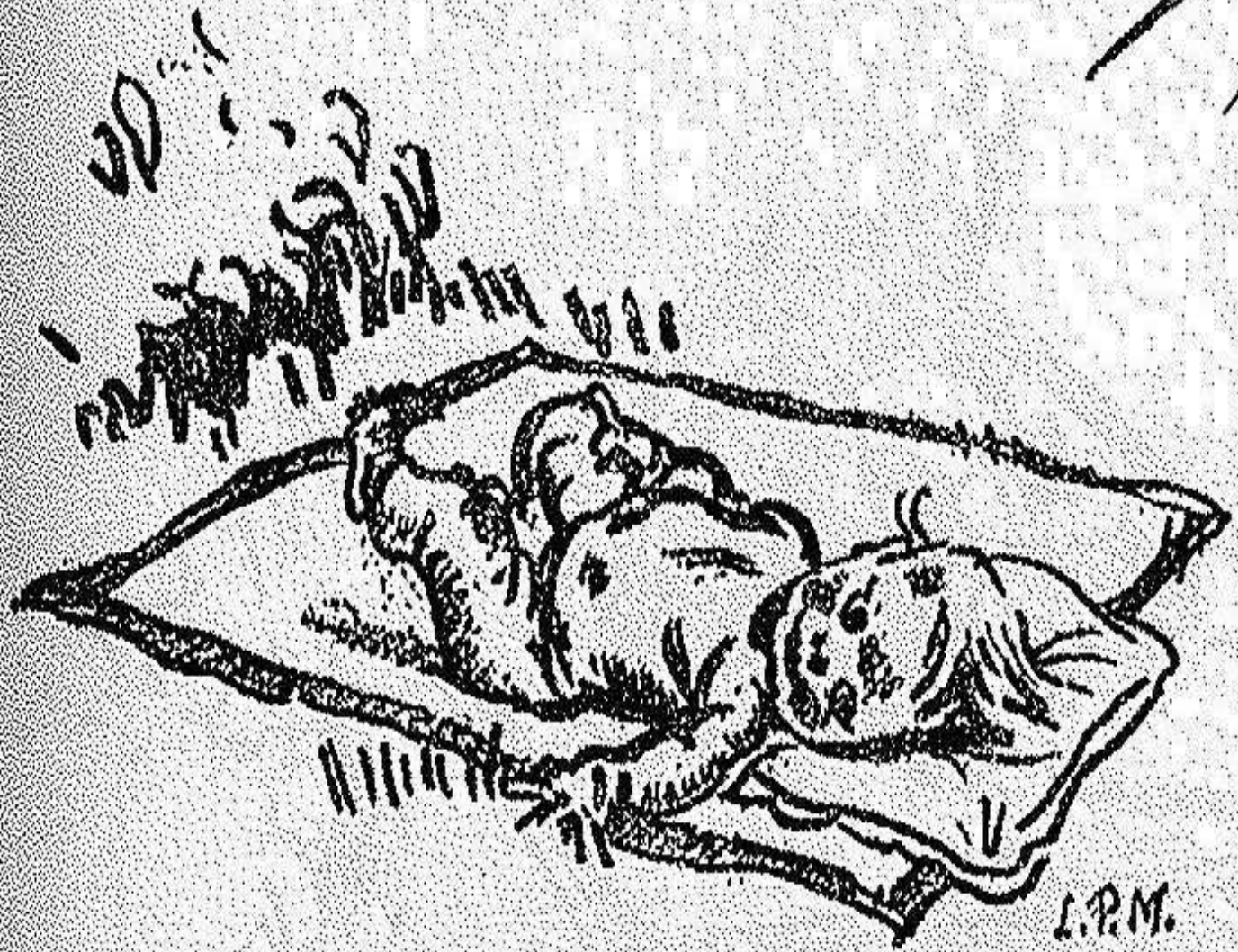


Baby can amuse himself with toys in a play pen





Stiff cuff to prevent thumb sucking



Give the baby a coat of summer tan

Ewing & Ewing, 1947

"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…"

Opportunity and the Deaf Child, University of London Press

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

1960s: Apitron

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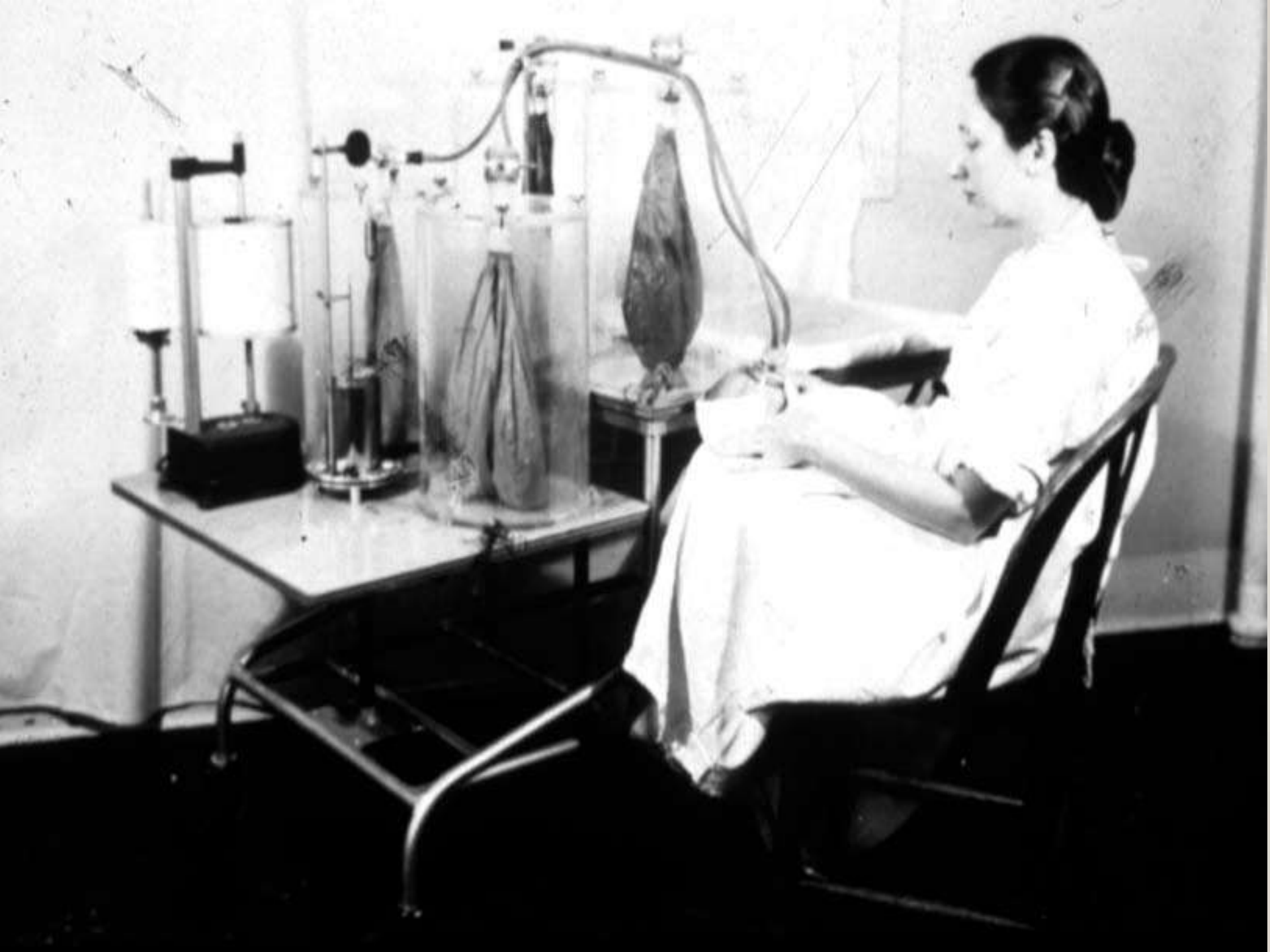
History of Neonatology

- 1961
  - Dr. Mildred T. Stahlman founds Division of Neonatology at Vanderbilt University Hospital, developing the first respirator for infants with damaged lungs.

- 1962
  - Dr. Mildred T. Stahlman founds nation's first Neonatal Intensive Care Unit at Vanderbilt University Hospital.



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"…loudspeaker placed at foot of baby's crib."

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 (Telesensory 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 [illegible] noise at a level of 92 dBA. Figure 2 illustrates the spectral characteristics [illegible] 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 harmfully loud because 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. [illegible] and the stimulus was calibrated to a level of 92 dBA and set just [illegible]

"…stimulus was a 2500-4500 Hz band noise at a level of 92 dBA"

"…records for 24 hours with 36 trials presented…"

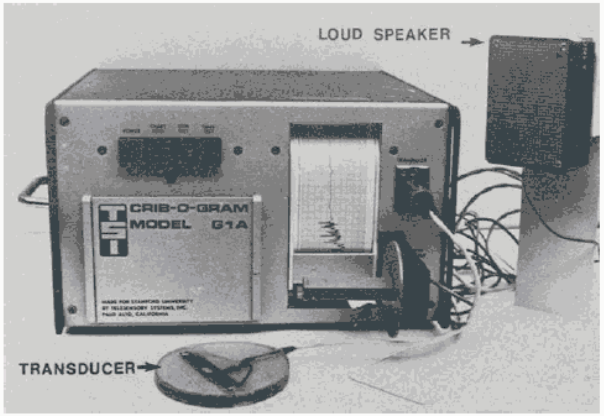
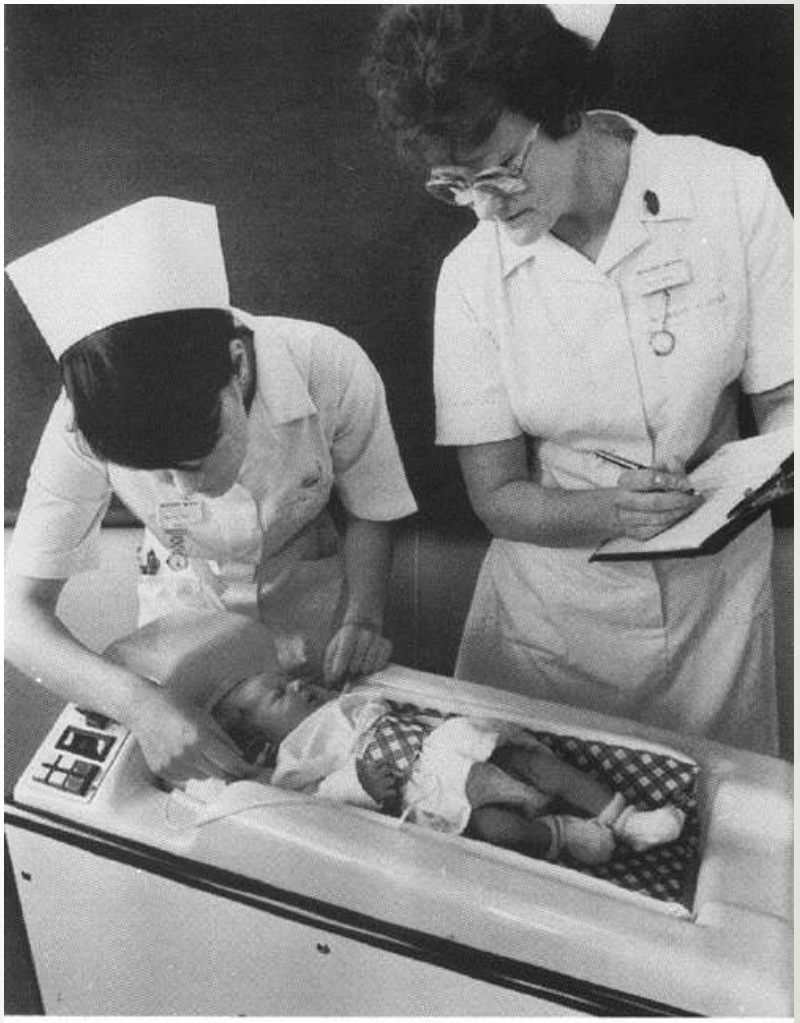


Figure 1. The Crib-O-Gram, which includes a central control unit with strip chart, a transducer, and a loudspeaker.

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.



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

Education of the Deaf in the United States: Report of the Advisory Committee on Education of the Deaf. Washington, DC: U.S. Government Printing Office.

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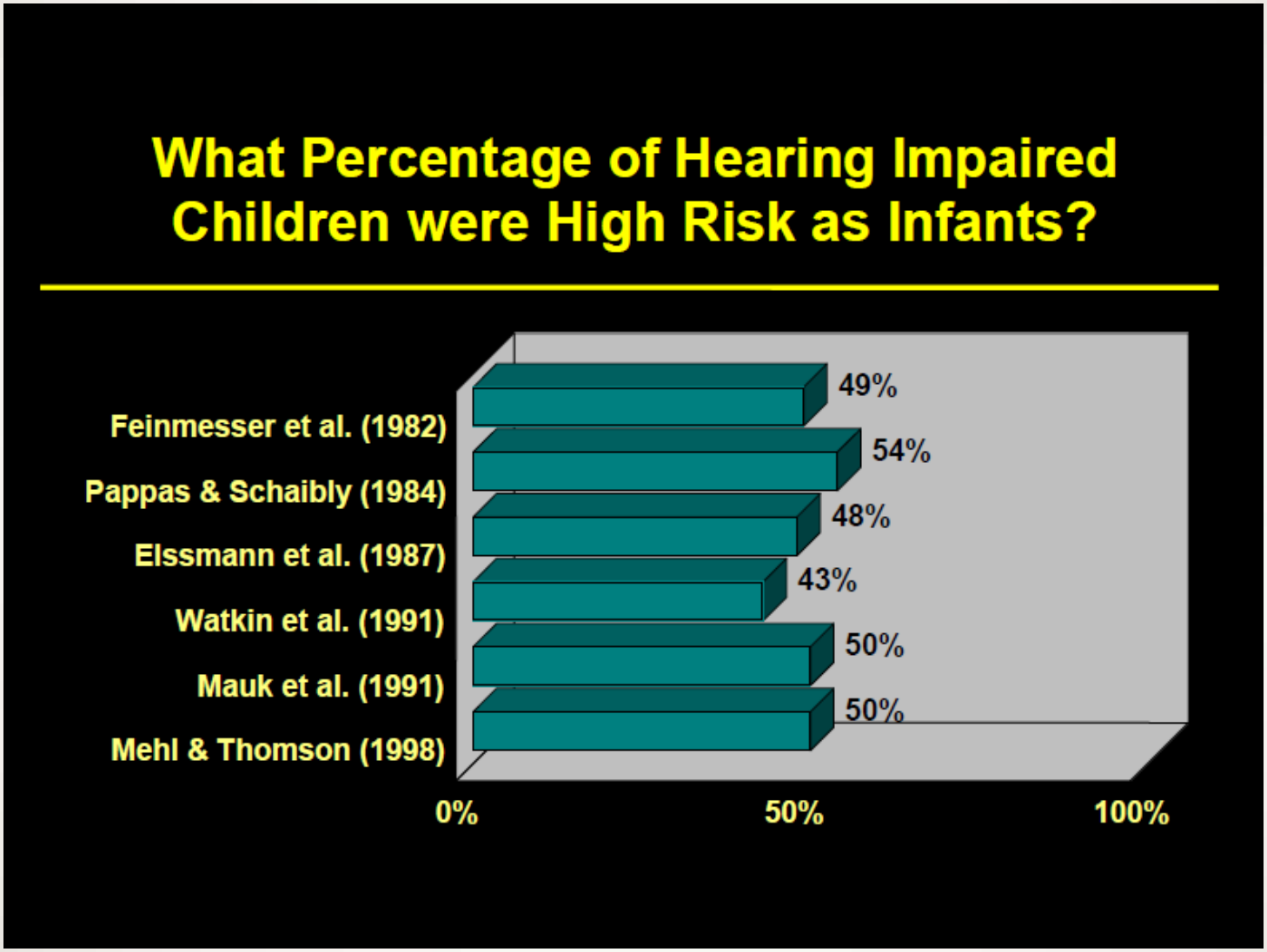
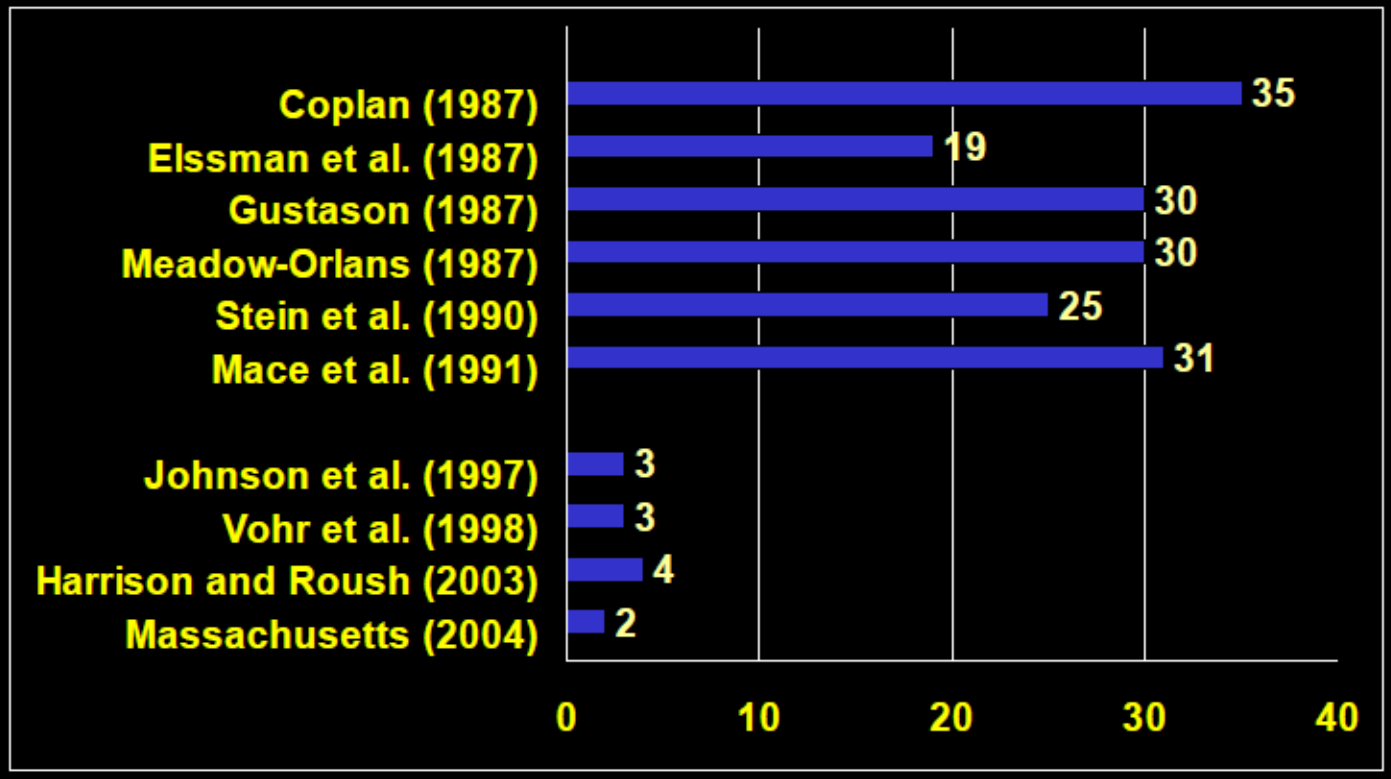


From: K. White, Sound Foundations Conference 2010

Age in Months at Which Permanent Hearing Loss Was Diagnosed



White KR, Forsman I, Eichwald J, Munoz K (2010). The evolution of early hearing detection and intervention programs in the United States. *Semin Perinatol.* 34(2):170-9.

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

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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

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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

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What took us from

There to here?

- Newborn screening
- Trained personnel
- Improved Technology
- Timely, appropriate interventions

How does this happen?

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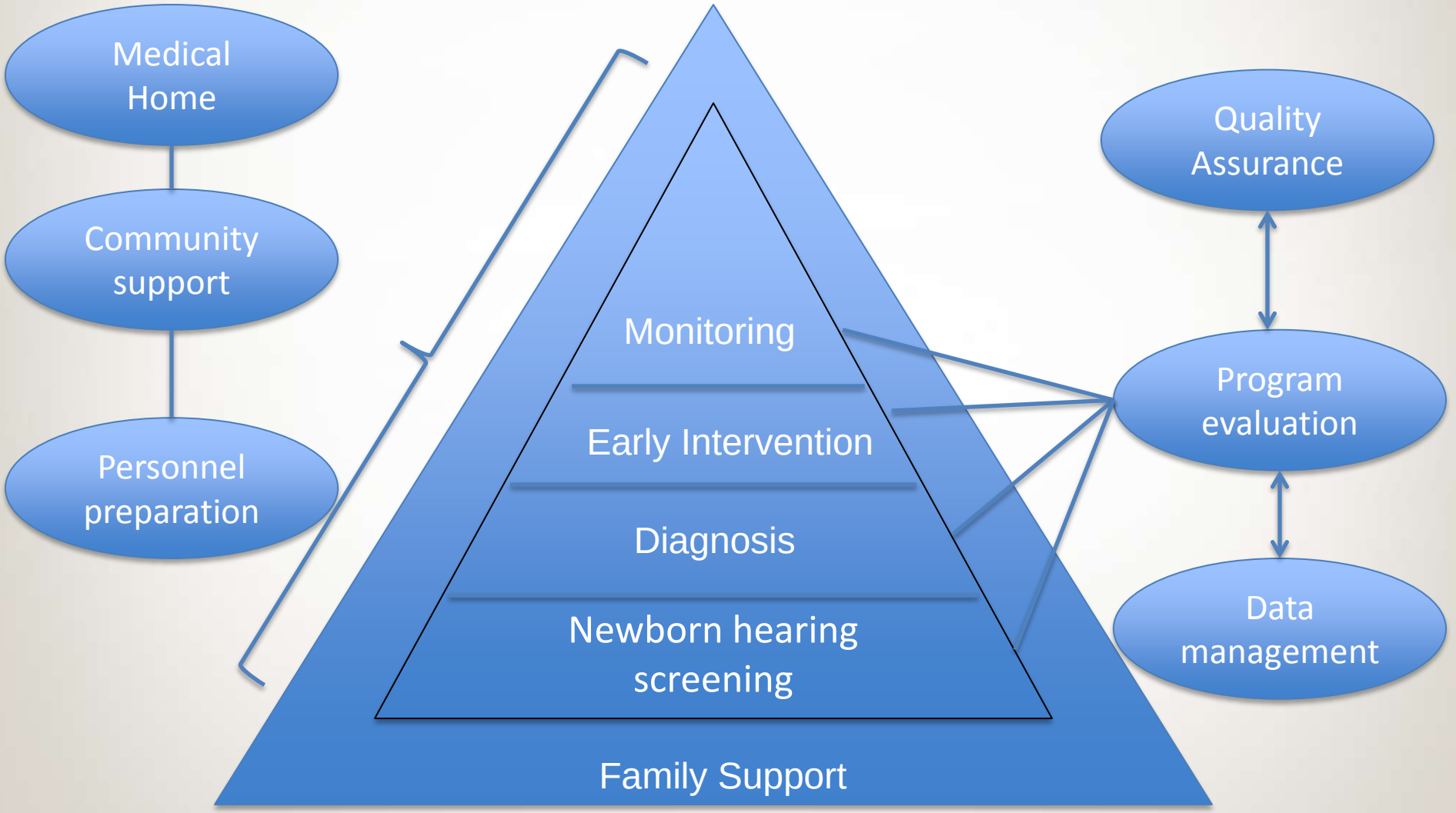
Components of an effective program:



Is this level of care available for all infants?

If not, can we make it available?

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Today, 96% of newborns in the United States receive hearing screening (CDC, 2010)

But only 54% of those who do not pass are reported as having received follow up.

Centers for Disease Control and Prevention (2010). Retrieved from www.cdc.gov/ncbddd/hearingloss/documents/nhs_follow_up_2010.pdf.

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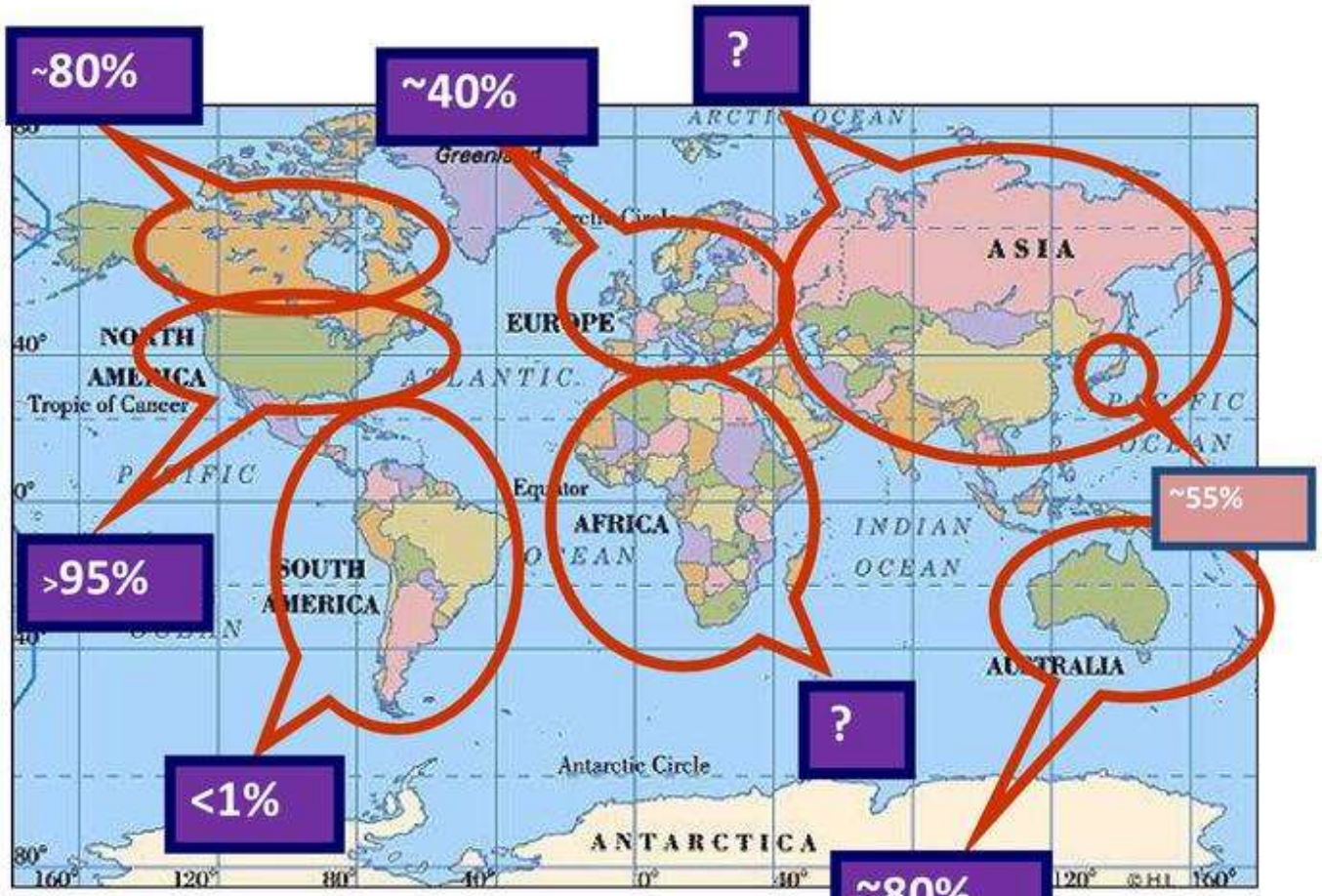
Lehnhardt 2009



Screening Coverage (2008)

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

(J. Gravel, 2007)

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"The services should…as far as possible be geographically convenient."

(J. Bamford, 2010)

I. A Charge Forward: Tele-Audiology

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Our Challenge…

Success of telepractice has more to do with <u>OUR</u> attitudes than those of our patients

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Could all infants have access to high quality diagnostic and intervention services?

- 42% of states in the U.S. report some telepractice efforts
- 79% are in planning or pilot stages; only 4% are fully implemented

2010 NCHAM EHDI survey

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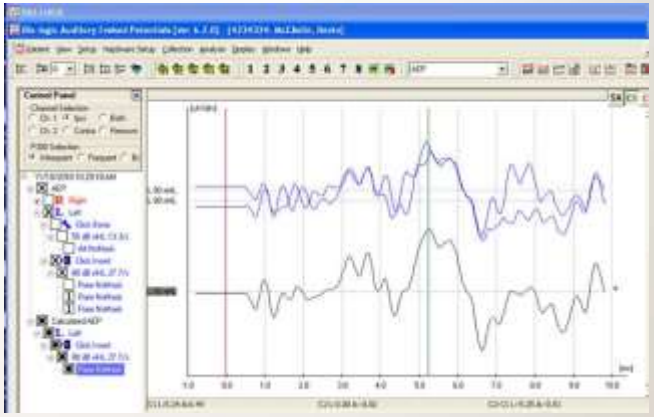
Remote Assessment

electrodes

earphones



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Remote Intervention

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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

III. A Charge Forward: Working Toward Prevention – Not just Treatment – of Hearing Loss?

- Childhood cancer survival rates are ~80% in developed countries
- Platinum chemotherapy drugs result in ototoxicity in 60% of pediatric patients
- We will have a role in determining alternative approaches
  - Protective agents (chemoprotectants)
  - Alternative dosages

IV. 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 what else can we do?

Develop clinical tests of temporal processing to aid in predicting which children with ANSD are hearing aid versus cochlear implant candidates?

Can we improve the individualized care we provide to our patients based on individual child and family factors?

If so, maybe we can get more than 33% of children to wear their hearing aids

>8 hours a day!

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Can **all** children get here?

Newborn screening

Trained personnel

Improved Technology

Timely, appropriate interventions

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The early years…

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What's in our future?

"The best way to predict the future is to invent it."

-Theodore Hook