Cochlear Implantation: Research and Practice in Kentucky

Matthew L. Bush, M.D., Ph.D., MBA, FACS

UK College of Medicine Endowed Chair in Rural Health Policy

Professor and Department Chair

Department of Otolaryngology – Head and Neck Surgery

The Standard of Care of Pediatric Hearing: A Brain Development Emergency!

- Identify and intervene as early as possible to "maximize language & literacy development"
- Screening of newborns by **1 month of age**
- Diagnosis by **3 months of age**
- Hearing aids/speech therapy by **6 months**
- Cochlear implantation at **9 months** if no progress

The Burden of Hearing Loss in Kentucky and Challenges of Hearing Care

Permanent Pediatric Hearing Loss in KY

- 5 in 1000 children born with some degree of hearing loss
- 1 in 1000 children born with profound hearing loss
- Permanent childhood hearing loss in KY incidence of 1.1 cases out of 1000 live births (2022).

What is the Cost of Untreated Hearing Loss?

- Yearly total cost of special education for deaf or hard of hearing children → **$652 million** ($11k per child)
- Lifetime hearing impaired (>40dB) educational cost **$115,600 per child**
- Lifetime costs for people with hearing loss born in 2000 will be **$2.1 billion (Direct - medical costs 6%, education 30%, Indirect - lost wages, unemployment 63%)**

https://www.cdc.gov/hearing-loss-children/data/index.html

Pediatric Hearing Disparity: Delays in Diagnosis

(Bush et al, Journal of Pediatrics, 2014)

THE JOURNAL OF PEDIATRICS • www.jpeds.com ORIGINAL ARTICLES

Delays in Diagnosis of Congenital Hearing Loss in Rural Children

Matthew L. Bush, MD[1], Kristin Bianchi, BA[2], Cathy Lester, MSSW[3], Jennifer B. Shinn, PhD[1], Thomas J. Gal, MD, MPH[1], David W. Fardo, PhD[4], and Nancy Schoenberg, PhD[5]

- Poor Follow-up After Screening:
  - Rural Infants 2x Higher No-show Rate
- Delayed Diagnosis:
  - Rural Infants 2x Longer for Diagnosis

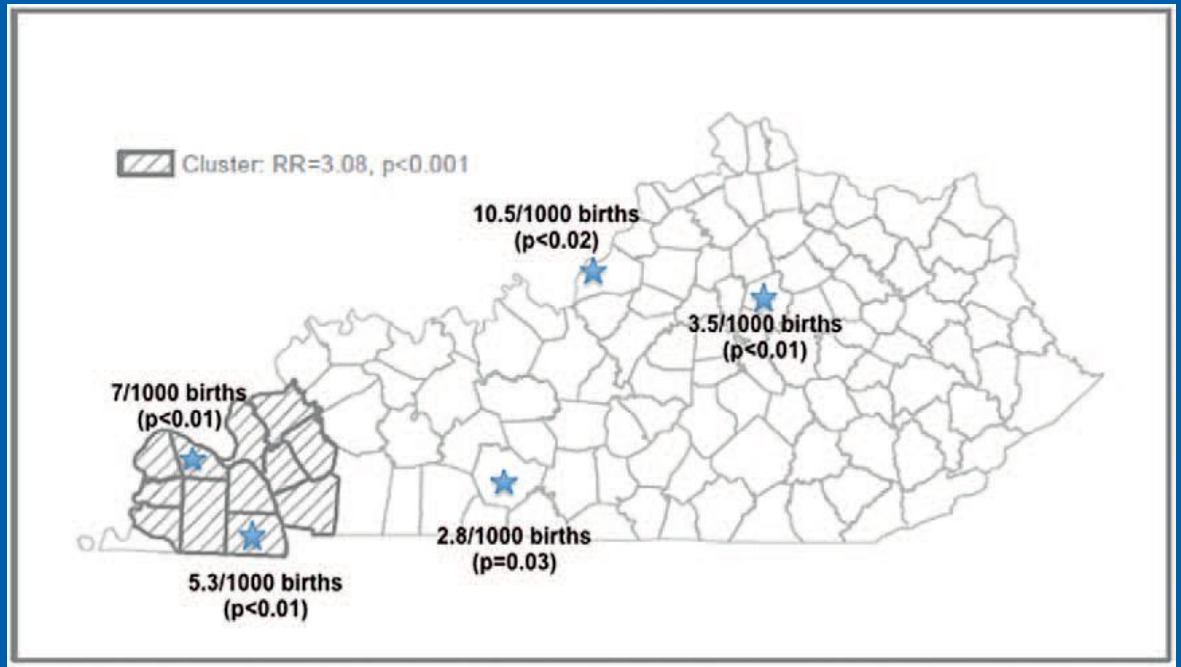
Pediatric Hearing Disparity: Disease Incidence

(Bush et al, Ear & Hearing, 2015)

- **Rural Regions**: 3.08 times the risk of hearing loss (7/1000 live births)
- Limited Hearing Healthcare centers

Targeting Regional Pediatric Congenital Hearing Loss Using a Spatial Scan Statistic

Matthew L. Bush,[1] Warren Jay Christian,[2] Kristin Bianchi,[3] Cathy Lester,[4] and Nancy Schoenberg[5]



Pediatric Hearing Disparity: Delays in Treatment

(Bush et al, Laryngoscope, 2014)

The Laryngoscope

Assessment of Appalachian Region Pediatric Hearing Healthcare Disparities and Delays

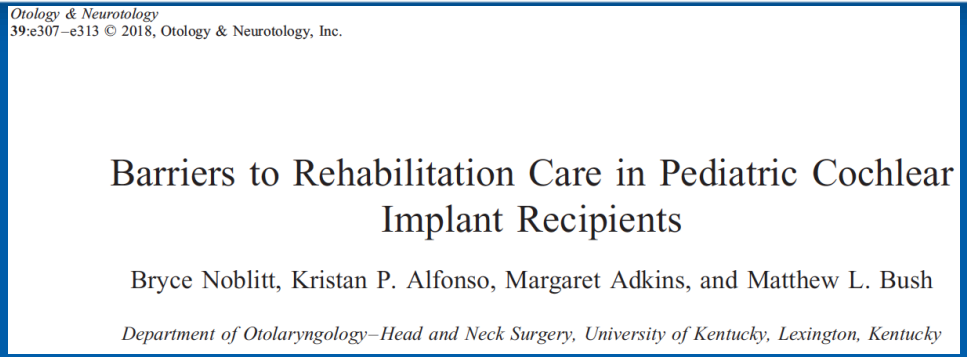
Matthew L. Bush, MD; Mariel Osetinsky, BA; Jennifer B. Shinn, PhD; Thomas J. Gal, MD, MPH; Xiuhua Ding, MS; David W. Fardo, PhD; Nancy Schoenberg, PhD

Rural children with hearing loss take:

- 2x longer obtain hearing aids
- 2x longer obtain a cochlear implant

Pediatric Hearing Disparity: Access to Support Care

(Noblitt, *Otology & Neurotology,* 2018)



Otology & Neurotology
39:e307–e313 © 2018, Otology & Neurotology, Inc.

Barriers to Rehabilitation Care in Pediatric Cochlear Implant Recipients

Bryce Noblitt, Kristan P. Alfonso, Margaret Adkins, and Matthew L. Bush

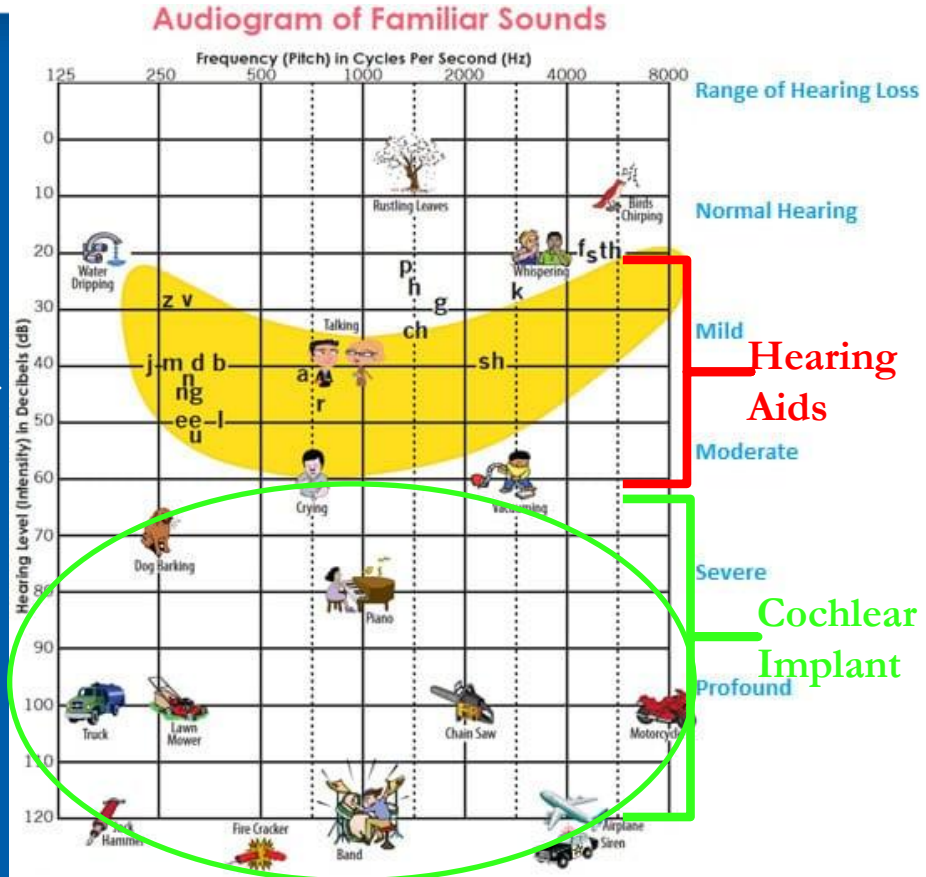
Department of Otolaryngology–Head and Neck Surgery, University of Kentucky, Lexington, Kentucky

- **Rural Residence**
  - Longer distance to audiologist/speech therapy
  - Delayed referral to Speech Therapy
  - Higher likelihood of broken equipment

The Treatment of Hearing Loss in Kentucky

Pediatric Hearing Loss Treatment in KY

- Mild - Moderate Loss → **Hearing aids and speech therapy**
- Moderately Severe to Profound → **Cochlear Implant and Speech Therapy**
- Must continue speech therapy through elementary school

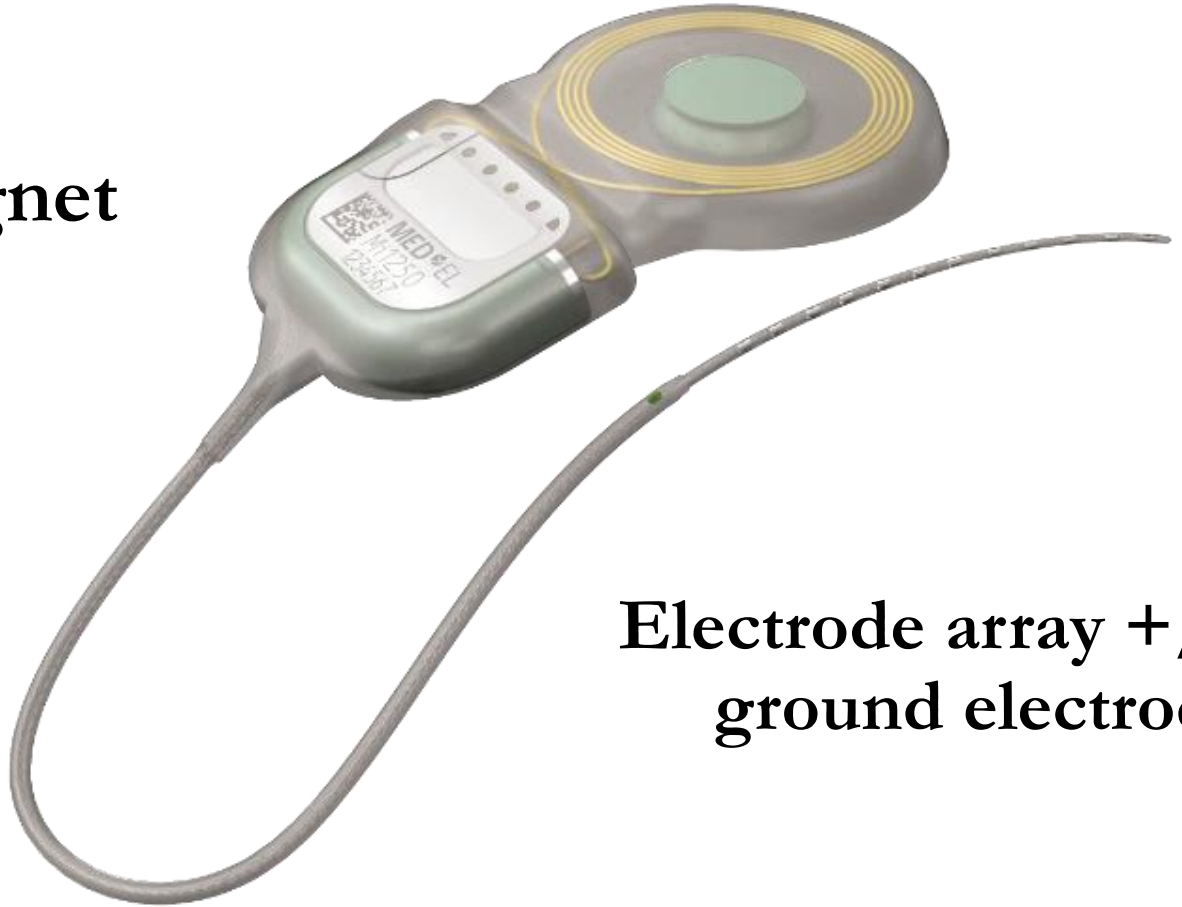


3 Cochlear Implant Companies

Transmitter & external magnet

Microphone & sound processor

Receiver-stimulator & internal magnet



Electrode array +/– ground electrode

Benefits of Implantation - Children

Otolaryngology–Head and Neck Surgery (2010) 142, 247-253

ORIGINAL RESEARCH–PEDIATRIC OTOLARYNGOLOGY

The children speak: An examination of the quality of life of pediatric cochlear implant users

Betty Loy, AuD, CCC-A, Andrea D. Warner-Czyz, PhD, CCC-A, Liyue Tong, MS, Emily A. Tobey, PhD, CCC-SLP, and **Peter S. Roland, MD,** Dallas, TX

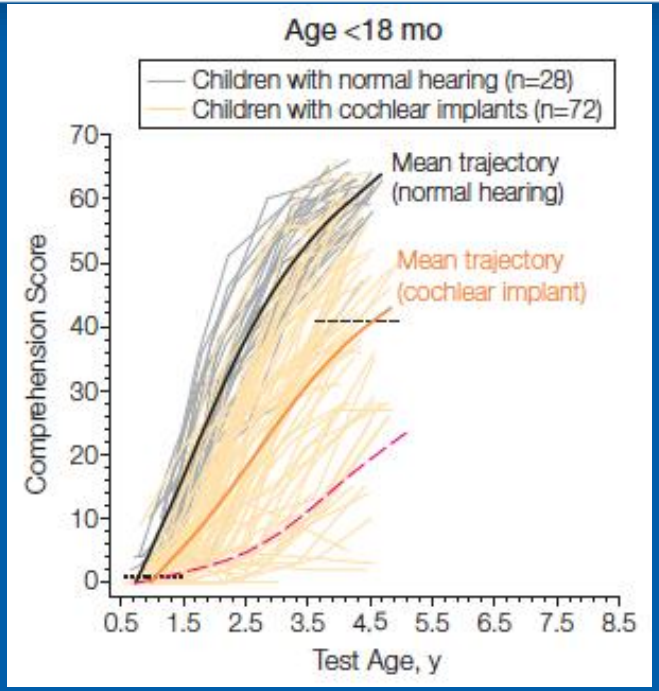
Benefits of Implantation - Children

Spoken Language Development in Children Following Cochlear Implantation

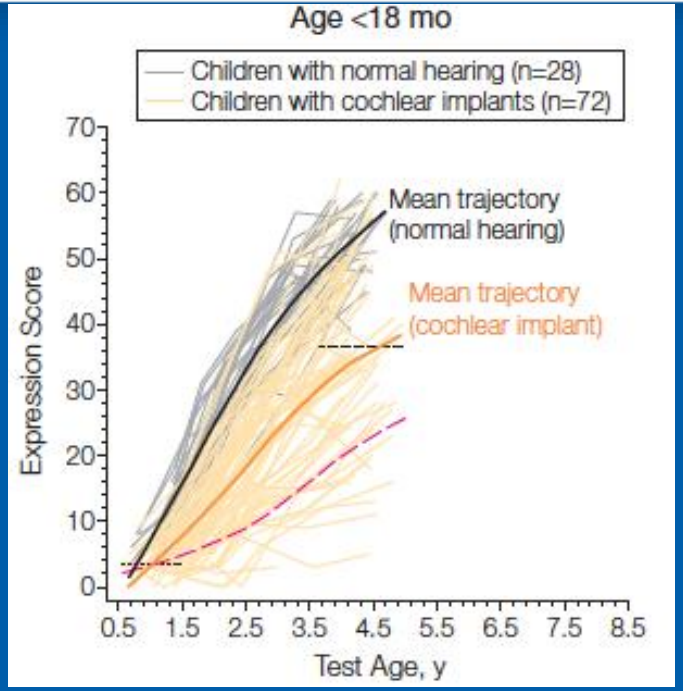
John K. Niparko, MD
Emily A. Tobey, PhD
Donna J. Thal, PhD
Laurie S. Eisenberg, PhD
Nae-Yuh Wang, PhD
Alexandra L. Quittner, PhD
Nancy E. Fink, MPH
for the CDaCI Investigative Team

JAMA. 2010;303(15):1498-1506 www.jama.com

Benefits of Implantation - Children



Improvement of language comprehension = Listening



Improvement of language expression = Talking

The Cost-Effectiveness of Cochlear Implants

- **Highly cost-effective** surgical intervention regardless of age.
- Lifetime net expected savings (children w/ CI) = **$53,198.**
- Early CI = ↑ quality of life and net societal savings
- Early CI = ↑ employment opportunities, ↓ psychosocial/ educational support
- Infants implanted under 12 months versus over 12 months = **$24,000 society savings**

Colletti L, et al. Laryngoscope. 2011.
O'Neill C, et al. Laryngoscope. 2000.
Cheng AK, et al. JAMA. 2000.
Semenov YR, et al. 2013.
Dettman SJ, et al. 2007.

Thank You!