Audiology in the NICU

EHDI Conference 2010
Chicago, IL

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Healthy People 2010: Objective 28.11

Increase the proportion of newborns who:

Are screened for hearing loss by age 1 month

Have audiologic evaluation by age 3 months

Are enrolled in the appropriate intervention services by age 6 months.

"The 1-3-6 EHDI Plan"

National EHDI Goals

- Developed in collaboration with state EHDI programs, federal and national agencies, CDC developed EHDI program objectives and performance indicators
- Goals
  - Program Objectives
    - Performance Indicators

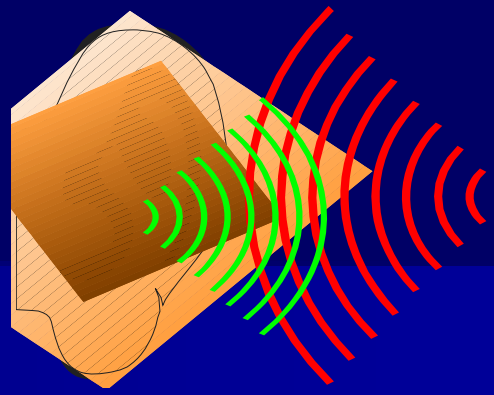
National EHDI Goals

- Goal 1:
  - All newborns will be screened for hearing loss before 1 month of age, preferably before hospital discharge.
- Goal 2:
  - All infants who screen positive will have a diagnostic audiologic evaluation before 3 months of age.

  (Fit with amplification when appropriate within 4 weeks of identification)
- Goal 3:
  - All infants identified with hearing loss will receive appropriate early intervention services before 6 months of age (medical, audiologic, and early intervention)

The 1-3-6 EHDI Plan

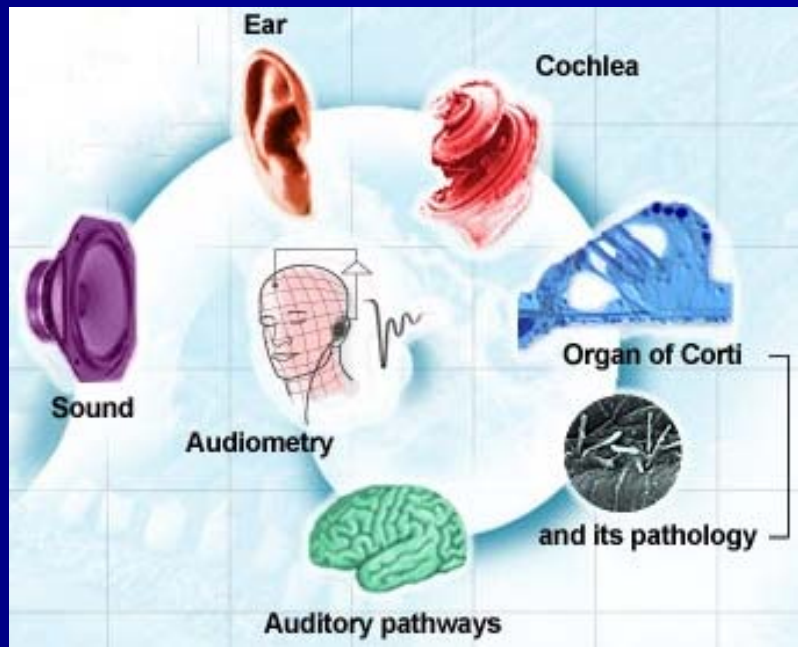
Prevalence of PCHL



- 1 / 1000 children born deaf (severe to profound bilateral SNHL)
- 2-4 / 1000 children with permanent childhood hearing loss 30 dB HL or greater
- 95% of children with substantial bilateral hearing loss are born to hearing parents
- Up to 60% of congenital hearing loss is genetic

Well Baby vs. Special Care Nursery (SCN) at Northside Hospital

- About 10-12% of all newborns will be special care babies (16,000-18,000 annual births)
- About 1 /100 from SCN will have PCHL



http://www.iurc.montp.inserm.fr/cric/audition/english/start2.htm

Definition of Targeted Hearing Loss

Expanded from congenital bilateral and unilateral sensory or permanent conductive HL to include

neural hearing loss (auditory neuropathy/dyssynchrony) in infants admitted to the NICU > 5 days.

JCIH 2007

Hearing Screening Protocols

- Separate protocols are therefore recommended for NICU and well baby nurseries.

- NICU babies >5 days are to have AABR included as part of their screen so that neural HL will not be missed

JCIH 2007

Communication

- Information at all stages of the EHDI process is to be communicated to the family in a culturally sensitive and understandable format.
- Hearing screen information, audiology diagnostic and habilitation information should be transmitted to the medical home and the state EHDI coordinator.

JCIH 2007

JCIH 2007 Abbreviations

- JCIH
- EHDI
- ABR
- CMV
- ECMO
- AAP
- MCHB
- HRSA
- NIDCD
- CDC
- UNHS
- OAE
- IFSP
- OME
- FM
- DSHPSHWA
- GPRA
- OMB

Communication ?

- Auditory Brainstem Response
  - ABR
  - BAER
  - BSER
  - BSERA
  - EAP
  - BEAP
  - BERA
  - AABR
  - ABAER
  - SABR
- Otoacoustic Emissions
  - OAE
  - EOAE
  - SFOAE
  - TEOAE
  - DPOAE
  - COAE
  - TOAE

COMMUNICATION? Acronyms (cont.)

- Related to Behavioral Assessment
  - BOA
  - VRA
  - VROCA
  - TROCA
  - COR
  - CPA
  - DA
  - OPP
  - SRT
  - SDT
  - SAT
  - MTS
  - MRL
  - NBN
  - WT
  - SF
  - WRS
  - AC
  - BC

COMMUNICATION? Acronyms

- Professional Programs
  - EHDI -ASHA
  - UNHS -AAA
  - NHS -JCIH
  - HRSA -AAP
  - MCHB -CED
  - NIDCD -PINES
  - NIH -SLP
  - CDC -ASDC
  - NCBDDD -AGBell
  - AAO-HNS -AVI
- Intervention
  - HA
  - ALD
  - DSL
  - AGC
  - ALD
  - DSP
  - BTE
  - ITE
  - ASL
  - TC

NICU Acronyms

- AGA
- SGA
- LGA
- IUGR
- IV
- RDS
- PDA
- ABDs
- GA
- PO
- CPAP
- NC
- NBN
- WBN
- NICU
- NEC
- IVH
- ROP
- NG tube
- APGAR
- PROM
- LBW
- VLBW
- ELBW

Screening: NICU

- 10-15% of the newborn population
  - Level I: basic care, well-infant nurseries
  - Level II: specialty care by a neonatologist for infants at moderate risk of serious complications
  - Level III: a unit that provides both specialty and subspecialty care including the provision of life support (mechanical ventilation)

Real World NICU

Major indicators in NICU

- Gestational Age
  - Term = 40 weeks
- Birthweight
- APGAR

Recommended Age Terminology

- Gestational age (GA)
  - Time from the first day of the last menstrual period to the date of birth, expressed as complete weeks
- Chronological age
  - Time elapsed after birth
- Postmenstrual age
  - Time in number of weeks after the day of menstruation
- Corrected age
  - Calculated by subtracting the number of weeks born before 40 weeks gestation from the chronological age. (for children up to 3 years)

Birth Weight Terminology

- AGA — Average for gestational age
- LGA — Large for gestational age
- SGA — Small for gestational age
- IUGR — Intrauterine growth restricted

Birth Weight

- Extremely low birth weight (ELBW)
  - <1000 grams
    - 2.2 pounds
- Very low birth weight (VLBW)
  - <1500 grams
    - 3.3 pounds
- Low birth weight
  - <2500 grams
    - 5.5 pounds

Prevalence of Prematurity

- ~12.5% of births in the US are preterm

  Martin, J.A., et al. Births: Final Data for 2004. National Vital Statistics Reports, volume 55, number 1, September 29, 2006.

- Since 1981, the number of preterm babies born has increased by 36%

  March of Dimes
  http://www.marchofdimes.com/peristats/

Preemies

- at increased risk for:
  - newborn health complications
  - Chronic disabilities
    - Developmental delay
    - Cerebral palsy
    - lung and gastrointestinal problems
    - vision and hearing loss
    - death

March of Dimes
http://www.marchofdimes.com/peristats/

Prematurity

Extremely preterm	≤27 +6 weeks GA
Very premature	28 to 31+6 weeks GA
Premature	32 to 36+6 weeks GA
Full Term	37 to 42 weeks GA

Distribution of prematurity

- 71.2 % 34 - 36 weeks
- 13 % 32 - 33 weeks
- 10 % 28 - 31 weeks
- 6 % < 28 weeks

March of Dimes
http://www.marchofdimes.com/peristats/

Survival Rate

- About 80 % of GA>26 weeks survive to one year
- about 90 % at 27 weeks
- about 25 % develop serious lasting disabilities
- up to half may have milder problems, such as learning and behavioral problems

March of Dimes
http://www.marchofdimes.com/peristats/

Common Problems in the NICU

- Related to breathing:
  - Respiratory Distress Syndrome
  - Apnea (breathing stops)
  - Bronchopulmonary dysplasia (lungs not formed appropriately – chronic lung problems)

Respiratory Assistance

- ECMO
- Oscillator
- Mechanical ventilation
- CPAP (Continuous positive airway pressure)
- High Flow Nasal Cannula
- Nasal Cannula

Common Problems in the NICU

- Intraventricular Hemorrhage (IVH)
  - (bleeding in the brain)
- Patent Ductus Arteriosus (PDA) (heart)
- Necrotizing enterocolitis (NEC) (intestines)
- Retinopathy of prematurity (ROP) (Vision)
- Anemia (blood)
- Hyperbilirubinemia (blood)
- Infections

Northside Hospital - Atlanta

- Acute Care Facility
- 16,000-18,000 babies annually
- 125 bed level III NICU (~1900 annually)
- Staffing
  - 4 full time audiology technicians
  - 1 full time audiologist
  - 1 full time position OPEN
    - Visit www.northside.com – 'careers' to apply

Northside Hospital Hearing Screening Protocol

- Well Baby Nursery
  - TEOAE
    - Wait 20 hours for vaginal delivery
    - Rescreen refers prior to discharge if time permits (1 OAE, 1 AABR)
  - NICU
    - TEOAE for all babies
    - AABR when in NICU >5 days

NICU Addition to JCIH

- Diagnostic Evaluations prior to hospital discharge for babies:
  - ≤ 27 weeks gestational age
  - ≤1000 grams birth weight
  - biliruben ≥ 20 or exchange transfusion
  - syndrome with associated hearing loss
  - Cooling, ECMO, PPHN
  - Audiologist/neonatologist discretion

When to screen

- When baby is medically stable
  - Out of isolette
  - Breathing room air
  - GA 34 weeks or greater
  - Acuity level 4 or less (scale of 1-7)

Implications for Audiology

- All NICU babies on monitors
  - Oxygen saturation
  - Cardiac function
  - Respiratory rates
  - Temperature
- Many need additional assistance
  - Respiratory
  - Nutritional

Challenges to Screenings in the NICU

- Electrical Noise (AABR)
  - Monitors, leads to babies
- Baby Noise (OAE and AABR)
  - Stridor, grunting, congestion
  - Breathing, sucking
  - Myogenic artifact
- Environmental Noise (OAE)
  - Monitors, people, phones

Screening Challenges cont.

- Finding each baby's nurse
- Co-bedded newborns
- "Lining up" to provide baby all that's needed before discharge
- Space
  - For instrumentation
  - For electrodes
  - For electrical outlets

Co-Bedding

Deciding to co-bed multiples is one of the few decisions families get To make for their infants in the NICU

Screening Challenges

- Documentation – Paper and pen
  - Hospital
    - Medical Record:Nurse's chart &Doctor's chart
    - Dept. Tracking system
  - Parents
    - Admit packet – state brochure
    - Results letters
  - State
    - All babies who do not pass – Children 1st
    - All confirmed hearing loss

Electronic Documentation

- Wireless laptops
- Direct charting into the medical record
  - NBN – Dec 15, 2009
  - SCN – Mar 8, 2010
  - Diagnostics – Apr 1, 2010
- Parent letters generated automatically
- Children 1st forms generated automatically
- Pediatrician letters automatically generated

Diagnostic Protocol

- ABR
  - AC Clicks
  - 500 Hz and 4000 Hz
- OAE
- Tympanometry (1000 Hz)

- If hearing loss is indicated:
  - BC clicks, additional tone bursts

Challenges to Diagnostics

- When baby is ‘quiet’
- On a ‘good day’
- Out of isolette
- Acuity a 4 or below (7 point scale)
- Breathing room air (preferably)
- When 3 months chronologically regardless of GA (coordinated w/ neonatology)

Diagnostic Challenges

- Noise
  - Electric
  - Baby / myogenic
  - Acoustic
- Baby state
  - Reflux, helping out, touch defensive

Communication

- Information at all stages of the EHDI process is to be communicated to the family in a culturally sensitive and understandable format.
- Hearing screen information, audiology diagnostic and habilitation information should be transmitted to the medical home and the state EHDI coordinator.

Communication with Parents

- GA law – educate parents about newborn hearing screening
- Report results to follow up pediatrician (medical home post-discharge)

Communication Challenges

- Parents often not present during screening / diagnostics
- Results communicated to nurse, nurse practitioner, NPP, and/or neonatologist
- Direct contact to parents of all infants if they do not pass or if Dx results are not normal

NSH Program Stats

1-1-07 to 12-31-07

- Total Infants 18,016
  - Transferred 125
  - Deceased 100

- Eligible to Screen 17,791
  - Infants Screened 17,661 (99.3%)
  - Infants Not Screened 130 (0.7%)
    - Inconclusive 2
    - Refused 1
    - Missed 127

NSH Program Stats

1-1-07 to 12-31-2007

- Total Screened 17,661
  - Passed 17,064 (96.6%)
  - Referred 597 (3.4%)

Missed 127

Needing OP follow up: 724
Returned for follow up: 535 (74%)

NSH Program Stats

1-1-07 to 12-31-2007

- Recommended for Evaluation 218
  - Normal Hearing 131 (60.2%)
  - Not Evaluated 1 (0.3%)
  - Eval in Process 15 (6.9%)
  - Confirmed Hearing Loss 71 (32.6%)
    - Sensorineural 25 (35.2%)
    - Mixed 1 (1.4%)
    - Permanent Cond. 4 (5.6%)
    - Transient Cond. 41 (57.7%)

NSH Program Stats

1-1-07 to 12-31-2007

- *3.99 Infants per 1000 with hearing loss of any type
- *1.69 infants per 1000 with permanent childhood hearing loss

*follow up not yet completed for 2007

Confirmed Hearing Loss

- Conductive - Transient
  - Not our primary target, but we don't ignore
  - Allow several weeks to clear w/o intervention
  - Repeat screening, refer for medical follow-up
  - Persistent conductive losses are referred for ENT consult
  - Increased emphasis on monitoring communication development
- Conductive - Permanent
  - Considered a target to ID through program
  - Referral for ENT consult
  - Consideration for amplification

Confirmed Hearing Loss

- Sensorineural
  - ENT consult
  - *Genetics referral
  - Early Intervention program w/ experience with hearing loss
  - Amplification (HA, CI, ALD, etc.)
  - Speech/Language evaluation
  - *Vision evaluation
  - GA State DOH, Babies Can't Wait, Children's First; GA PINES, etc.
  - Ongoing audiologic testing

Confirmed Hearing Loss

- Auditory Neuropathy
  - ENT consult
  - *Genetics referral
  - Early Intervention program w/ experience with hearing loss
  - Amplification (HA, CI, ALD, etc.)
  - Speech/Language evaluation
  - *Vision evaluation
  - GA State DOH, Babies Can't Wait, Children's First; GA PINES, etc.
  - Ongoing audiologic testing

Incidence of Hearing Loss and Permanent Childhood Hearing Loss

	Total NSH Population	NBN	SCN
Infants per 1000 with HL	3.99	1.49	29.3
Infants per 1000 with PCHL	1.69	0.87	9.98

NSH Program Stats

1-1-07 to 12-31-07

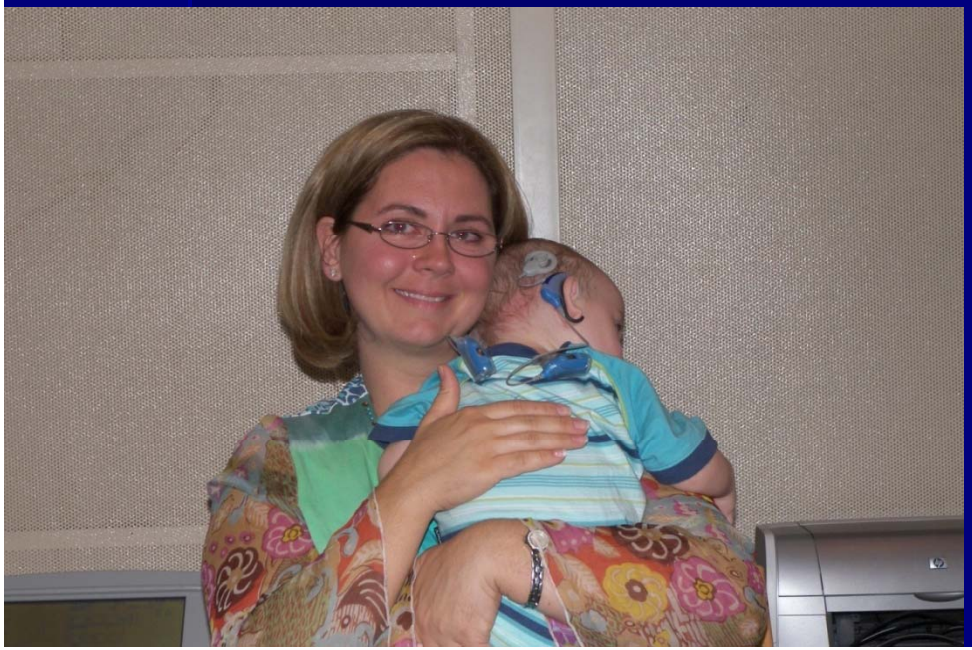
- Outpatient Screening
  - Referred babies
    - 74% returning to NSH for OP rescreen to date
- Not screened as IP
    - 79% returned to NSH for OP rescreen

Case Studies

- Comparison of 2 babies

Newborn Nursery Special Care Nursery

Full Term 25 wk GA



Comparison: WBN vs. SCN

Zachary

- Born at 39 weeks GA
- Birth weight 4860 gms (10 lbs. 11 oz.)
- APGARs 9 and 9
- C-section
- Mild jaundice
- Discharged at day 4 of life

Zoe

- Born triplet C at 25 wk GA
- Birth weight 726 grams (1 lb 7 oz.)
- APGARs 5 and 8
- C-section
- Multiple complications and risk factors for hearing loss
- Discharged at 1 year, 3 months

Comparison WBN vs. SCN

Zachary

- IP Screening on day 3
- IP Rescreen on day 4
- OP Screening on day 11
- Diagnostic Evaluation on day 22 (week 3)

Zoe

- Day 3 – intubated, bilious pneumonia, phototherapy
- Day 4 – intubated, photoTx
- Day 11 – intubated, phototherapy, small PDA, minimal grade 1 IVH
- Day 22 – intubated, paralytics, diuretics, antibiotics, cardiac meds
- Day 51 – weaned to CPAP

Comparison: WBN vs. SCN

Zack

- ENT week 5

Zoe

- No IP screen – Dx eval
- Concerns raised by OT/PT Developmental Team
- Still on NC, acuity 5
- Dx Eval on week 22 Chronological age (5 months), week 7 Corrected Age
- ENT as IP 23 weeks
- Parents to ENT 24 weeks

Comparison: WBN vs. SCN

Zack

- GA PINES week 4
- ENT 'visualized fluid' week 5
- Tubes week 7
- Repeat ABR – severe to profound SNHL
- Hearing aids week 12
- CI workup 8 months
- CI bilateral 10 months

Zoe

- GA PINES week 37 (still an IP)
- Repeat ABR –sedated 41 weeks
- Hearing Aids – week 45
- Discharge from hospital 63 weeks 1 day

GA PINES = Georgia Parent Infant Network for Educational Services

Implications for 1-3-6 EHDI Goals

Well Babies

- Should be able to meet outlined goals

SCN

- Many preterm and/or medically fragile babies are ‘not ready’ for audiologic services until after their chronological age has passed the EHDI goals