Kansas
SoundBeginnings
Early Hearing Detection & Intervention

Elizabeth Abbey, MA., CCC-A
www.eabbey@kdheks.gov
785-368-7167
Kansas enacted legislation, effective July 1, 1999, to provide screening for the early detection of hearing loss in newborn infants.

“Every child born in the state of Kansas, within 5 days of birth, unless a different time period is medically indicated, shall be given a screening examination for detection of hearing loss”

SoundBeginnings provides tracking of infants from hospital screening to the infant’s primary care physician, to the audiologist, and to the agencies that provide early intervention.
Hearing Loss Compared to Other Conditions at Birth

Number of Disorders Per 10,000 Births
• 2-3 in 1,000 births will be diagnosed with some degree of hearing loss.

• Each year 12,000 Children are born with hearing loss in the United States.

• 90-95 % of babies with hearing loss are born to parents who have normal hearing.

• Some babies are born with normal hearing, but lose their hearing later.

• Any degree of hearing loss can be educationally handicapping for children.

• Mild to moderate hearing loss without amplification can miss up to 50% of classroom discussions.

• 37% of children with only minimal hearing loss not using hearing aids fail at least one grade
Goal 1: All newborns will be screened for hearing loss before one month of age, preferably before hospital discharge.

Goal 2: All infants who screen positive will have a diagnostic audiologic evaluation before three months of age.

Goal 3: All infants identified with a hearing loss will receive appropriate early intervention services before six months of age.
Percentage of Infants Screened before 1 month of age
Diagnostic Evaluations – Normal hearing before 3 months of age

- 2007: 72%
- 2008: 62%
- 2009: 67%
- 2010: 80%
Diagnostic Evaluations – Hearing Loss before 3 months of age

- 2007: 48%
- 2008: 63%
- 2009: 67%
- 2010: 68%
Average Age of Diagnosis

- 2007: 8 months
- 2008: 6.5 months
- 2009: 5 months
- 2010: 2.6 months
Early Intervention – Receiving Services before 6 months of age
Loss to Follow-Up

- 2007: 83%
- 2008: 72%
- 2009: 68%
- 2010: 67%
Loss to Follow-up

Any infant who did not receive or complete the recommended Birth Admissions screen, Diagnostic or Intervention process and Infants who are in process.

This Includes

- Parent declined services
- Infants who have moved out of jurisdiction
- Infants who are nonresidents
- Can not be contacted
- Parents who are unresponsive
- Unknown
Infants who did not pass their hearing screening and whose diagnostic or intervention status has not been reported to the state EHDI program

- Following screening
- Following diagnosis
- Following referral to early intervention
In 2009

• 68% of Kansas children who failed the initial hearing screen did not complete the hearing screening process.
Study Objectives

- To identify the parental reasons/concerns for LFU
- To identify the parental reasons/concerns for LTD
- Assess the factors for the non-completion of hearing screens for out of hospital births
Survey Results

Figure 1: LFU and LTD survey responses by number and percent

- LTD-Pass, 97.26%
- LTD-Fail, 1.0%
- LFU, 271, 74%

One child was diagnosed with hearing loss and never reported to SB
Where Did We Lose Them?

Figure 10: (Number) and percent of survey respondents whose children were LTD, n=98, to SoundBeginnings by place where hearing screening results were lost.

- Hospital, (48), 49%
- Infant Toddler, (4), 4%
- PCP\(^\ast\), (8), 8%
- Tested after Survey, (1), 1%
- Transferring Hospital, (5), 5%
- Audiology, (22), 23%
- ENT\(^\ast\), (7), 7%
- Birthing Facility, (3), 3%

Notes:
- PCP\(^\ast\) means Primary Care Physician
- ENT\(^\ast\) means otolaryngologists—head and neck surgeons
Parent Discussion

• “I was not told he had the screening or why he needed one.”

• “This letter was reminder that the screening wasn’t completed. Thanks. I will schedule one.”

• “I would have liked the score and pamphlet explained”

• “I am concerned that I wasn’t made aware of this until my child was 13 months old. I am also concerned that this isn’t automatically done at birth or 2 months check-up.”

• “My child was tested again, a month later and failed in left ear. I really didn’t know I was not allowed to go in with the nurse and my child, but I would love to have someone higher up test my child's hearing.”
Survey Quotes

Parental Views

• “It is against my religious beliefs.”

• “It is a state funded program paid by me and taxpayer’s money. It is nothing but a state owned program that is ...”

• “I understood why hearing screening was NOT necessary for my child. I was able to screen for hearing problems myself and determined that my child did not have any sign of hearing loss or defect.”

• “Newborn startled to noise, turned his head, etc. It is clear his hearing is fine.”

• “She doesn’t seem to have any hearing difficulties”

• “All my child's well child screenings show he is healthy. He is beginning to talk, babble, etc and turns to sounds. Loves watching the traffic, notices sounds around him.”
Survey Quotes

**Hearing Process**

• “I asked my pediatrician about a screening. She asked if I had any reason to believe there was a problem—I haven’t heard any more about it.”

• “Told to go to Colby for a screen by a midwife, but didn’t find it a priority. No concerns.”

• “At the hospital they were using too large of a probe in the ear and were collapsing the ear canal. At the audiologists office she passed right away with a smaller probe.”

• “After doing some research I read that there might be fluid from the birth for up to 10 days after being born, so I honestly don’t know why I was sent directly to a specialist.”
Survey Quotes

Parent Feedback

“All hospitals should screen a baby's hearing BEFORE they leave the hospital. My son, 18 months of age, shall be wearing hearing aids. I wish I could have started him sooner with proper diagnosing.”

“When my child was tested at USD480 he didn't turn to the sound to his left ear. The audiologist had to repeat it 3 times. The sound was very soft. That was my only concern.”

“We were told to come back multiple times to hospital (each costing a lot) & decided to pay copay at specialist instead of more hospital bills. He was not concerned & we will have a follow up appt now that she is older.”
Why SoundBeginnings was concerned?

• More and more parents were refusing sedated ABRs

• 32% of infants identified with hearing loss are not receiving diagnostic evaluations before 3 months of age

• 60% of children identified with hearing loss were not enrolled in Infant-Toddler services before 6 months of age

• 69% of the infants who failed the initial screen or who were never screened at birth were not completing the hearing screening process.
My Experiences – Non Sedated ABR

- 2010 Early Hearing Detection and Intervention Annual Conference – Vivosonic Luncheon

- Hands On Demonstration
Who has Non-Sedated ABR in Kansas?

- Via Christi Health – Wichita (6 mo)
- Wesley Medical Center – Wichita (7 mo)
- University of Kansas – Kansas City (5 mo)
- Children’s Mercy Hospital – Kansas City (8 mo)
- SE Kansas Education Service Ctr. – Girard (3 mo)
What Results Do We Expect?

• Decrease Loss to Follow-Up rate

• Increase in Diagnostic Evaluations Completed before 3 months

• Increase in enrollment into Early Intervention before 6 months
Newborn Hearing Screening
Utilization of Non-Sedated ABR to Assist with Loss to Follow-Up

Mary L. Horsch, Au.D., CCC-A
Audiology Coordinator
Via Christi Health, Wichita, KS
Discussion:

• Loss to follow up
  • Stats
• Common issues associated with diagnostic ABR testing
• How the Vivosonic Integrity helps eliminate issues
Testing at our Facility
  • Background
  • Use of Integrity
  • Sedated Procedures

Case Studies

Conclusion
Our loss to follow-up rate is well below our State’s average. We are diligent in calling parents/physicians, sending letters to parents/physicians, etc.

But – this is not the only reason…
### 2010 Newborn Hearing Screening Data

Via Christi Hospital - Harry (VCH-H)

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Live Births</strong></td>
<td>2790</td>
<td></td>
</tr>
<tr>
<td><strong>Infants SCREENED Prior to Discharge - BIRTH ADMISSION</strong></td>
<td>2759</td>
<td>98.8%</td>
</tr>
<tr>
<td><strong>Infants NOT SCREENED Prior to Discharge - BIRTH ADMISSION</strong></td>
<td>31</td>
<td>1.1%</td>
</tr>
<tr>
<td><strong>REASONS Infants Hearing was Not Screened (list all)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infant Died after birth</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Parent Refused</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Transferred to another facility</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Missed</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Still in the NICU</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Infants who PASSED on the BIRTH ADMISSION Screen</strong></td>
<td>2653</td>
<td>96.2%</td>
</tr>
<tr>
<td><strong>Infants who REFERRED on the BIRTH ADMISSION Screen</strong></td>
<td>106</td>
<td>3.8%</td>
</tr>
<tr>
<td><strong>Infants who are REFERRED FOR OUTPATIENT Screening after the Birth Admission Screening</strong></td>
<td>106</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Infants who were NOT SCREENED and were SCHEDULED for OUTPATIENT Screening</strong></td>
<td>2</td>
<td>6.5%</td>
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***Note Outpatient Follow-up data reported below applies to facilities that provide outpatient screening.***

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<tr>
<td><strong>Infants SEEN for OUTPATIENT Follow-up Screening (Via Christi Births Only; includes infants who referred and infants who were missed)</strong></td>
<td>98</td>
<td>90.7%</td>
</tr>
<tr>
<td><strong>Infants Who PASSED OUTPATIENT Follow-up Screening (Via Christi Births Only)</strong></td>
<td>82</td>
<td>83.7%</td>
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</table>
# 2010 Newborn Hearing Screening Data

**Via Christi Hospital - St. Teresa (VCH-ST)**

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<td>98.5%</td>
</tr>
<tr>
<td><strong>Infants NOT SCREENED Prior to Discharge - BIRTH ADMISSION</strong></td>
<td>1</td>
<td>1.5%</td>
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<td></td>
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<td>0</td>
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<td>0</td>
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<td>Transferred to another facility</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Missed</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Still in the NICU</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Infants who PASS on the BIRTH ADMISSION Screen</strong></td>
<td>58</td>
<td>90.6%</td>
</tr>
<tr>
<td><strong>Infants who REFER on the BIRTH ADMISSION Screen</strong></td>
<td>6</td>
<td>9.4%</td>
</tr>
<tr>
<td><strong>Infants who are REFERRED FOR OUTPATIENT Screening after the Birth Admission Screening</strong></td>
<td>6</td>
<td>100.0%</td>
</tr>
<tr>
<td><strong>Infants who were NOT SCREENED and were SCHEDULED for OUTPATIENT Screening</strong></td>
<td>0</td>
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<td>100.0%</td>
</tr>
<tr>
<td><strong>Infants Who PASSED OUTPATIENT Follow-up Screening (Via Christi Births Only)</strong></td>
<td>4</td>
<td>66.7%</td>
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I will be discussing how the Vivosonic Integrity has helped other facilities as well as ours in reducing our loss to follow-up.
Loss to Follow up

Why are infants lost to follow up?
The majority are due to the following:

• Do not return for appointment
• Return for appointment but unable to complete testing due to state of infant/time constraints.
We needed a piece of equipment that would work quickly and easily and allow for testing of any infant - awake or asleep.

What was the answer? First a look at those issues that we needed to overcome:
What are the most common issues associated with clinical ABR?
Noise and Interference

Artifact and interference can result in reduced accuracy of wave recognition and latency measurement.
Physiological Artifacts - From the Patient

- **Brain (EEG)**
- **Ocular muscles**
- **Skeletal muscles**
- **Heart (ECG/EKG)**
Interference

Extraneous *Interference – from outside the patient:*

- *Electric and magnetic field-induced interference*
- Electric field-induced noise
- Magnetic field-induced noise
- *Radio-frequency interference*
- *Conducted power-line noise: 50 or 60 Hz and their harmonics*
Utilization of the Vivosonic Integrity helps eliminate many of these problems.
Vivosonic Integrity

The Integrity allows:

• Signal pre-amplification in-situ, i.e. directly on the ground electrode.

• Analog band-pass filtering prior to pre-amplification.

• Bluetooth® wireless communication between the interface module and personal computer.

• Digital signal processing employing Kalman-weighted averaging.

• 24-Bit A/D resolution.

• Monitoring electrode impedance mismatch in real time.

www.audioelectronicsinc.com/images/Integrity_Technology
• Our department purchased the equipment in September 2010.
• Since that time, our employees are transporting the Vivosonic to each campus when an ABR is needed.
• Other ABR equipment is being utilized very little, if any, at this time
How has this equipment impacted how, when and where we test our patients?
Let’s take a look at the Via Christi Health Audiology Hospital system:
Via Christ Health Audiology

Testing at our Facility:
Via Christi Health Audiology

• Three full-time audiologists
• Four newborn hearing screening techs
• Two birthing hospitals
• Our newborn hearing screening process involves a two step screening process including OAEs and AABR
Via Christi Health Audiology

• We are the referral hospital for those infants who fail their newborn hearing screening in most of central and western Kansas.

• We dispense hearing aids to over 95% of all infants and children with hearing loss in our region.
Our department currently staffs four different campuses, at which any patient may require an ABR.

Our department currently has conventional ABR equipment at each campus – three different manufacturers.
Our facility was made aware of the Vivosonic Integrity equipment through several different presentations around the United States.

We were able to demo the Integrity in early 2010.

An ABR was completed on an individual as we sat discussing the equipment.
In our NICU unit with use of ABR equipment other than the Vivosonic Integrity, electrical interference from feeding pumps, monitors, etc is #1 problem. Much more time is spent in trying to solve electrical interference issue than in actual test time.
The Integrity has had a tremendous impact on lowering the number of sedated ABRs required (over 50%).
• We have had to re-educate physicians regarding referrals for sedated ABR assessment.

• Sedation may no longer be needed in many cases as long as child can tolerate insert earphones.
Via Christi Health Audiology

- Sedated ABR procedures are costly, time consuming and require constant patient monitoring during procedure. Sedation can be high-risk for many patients that have airway issues or other medical conditions that contraindicate the use of sedating medication.
• If sedation is needed due to other issues such as intolerance of ear inserts, the Vivosonic is still a better option.
• There is much less, if any, interference from monitors and other OR equipment. Test time is easily cut in half.
Case Studies
Case 1

• Eleven-month-old male
• Diagnosed with meningitis, rhinovirus at 8 months of age. Hospitalized for several weeks.
• Patient passed hearing screening prior to hospital discharge as newborn.
Case 1

• Initial ABR during hospitalization indicated a bilateral profound hearing loss with no response obtained at output limits of equipment.

• At 9 months of age, ABR was repeated. Results obtained indicated a severe loss for the left ear and a moderate-to-severe loss for the right ear.
Case 1 – Right Ear Click 50dB
Case 1 — Right ear, 500Hz 40dB/1000Hz 45dB toneburst
CASE 1 — Right Ear 2000Hz 40dB toneburst
Case 1
Left Ear – Click ABR/500Hz 70dB toneburst
Case 1
Left Ear – 4000Hz 90dB toneburst
Case 1

- Estimated audiogram from the Vivosonic was accurate when compared to behavioral results.
- No need to sedate – not an option as infant was quite ill during hospital stay and parents did not want child sedated unless absolutely necessary.
Case 1
Case 2

- NICU infant – Diagnostic ABR required due to long-term mechanical ventilation, low birthweight, ototoxic medications, periventricular leukomalacia.
- Infant age on test date 37 weeks adjusted.
- Infant still in NICU bed with oxygen, full leads.
Case 2 – Right Ear Click ABR
Case 2 – Left Ear Click ABR
Case 2 – Note Correlation Coefficient
SS=Statistic Start  SE=Statistic End

ABR Test Results

Patient:
Patient ID: 
Date of Birth:
Gender: Male
Date of Test: 10/04/2010
Examiner: Susie Ternes, Au.D., CCC-A

ABR GRAPH

ABR (stimulus in dB nHL)

Latency (ms)

0 2 4 6 8 10 12 14 16 18 20 22

Time (ms)

I II III IV V I-III III-V I-V I-I III-V V-V

WAVEFORM DATA

Right Ear (R) Left Ear (L)

AMP (uV)


Corr. Coef. = Correlation Coefficient

KEY TEST CONDITIONS

Protocol

Stimulus Level Stimulus Type Stimulus Rate (sec) Trans. Type Polarity Rec. Side Mask Level (dB HL) Equivalent Sweep

1 80 R ABR air-conducted click 37.7 80 dB nHL click 37.7 ER-3A Rarefac. Ipsi. 2020
2 60 R ABR air-conducted click 37.7 60 dB nHL click 37.7 ER-3A Rarefac. Ipsi. 1739
3 40 R ABR air-conducted click 37.7 40 dB nHL click 37.7 ER-3A Rarefac. Ipsi. 1969
4 20 R ABR air-conducted click 37.7 20 dB nHL click 37.7 ER-3A Rarefac. Ipsi. 3588
5 80 L ABR air-conducted click 37.7 80 dB nHL click 37.7 ER-3A Rarefac. Ipsi. 2609
6 60 L ABR air-conducted click 37.7 60 dB nHL click 37.7 ER-3A Rarefac. Ipsi. 2318
7 40 L ABR air-conducted click 37.7 40 dB nHL click 37.7 ER-3A Rarefac. Ipsi. 1730
8 20 L ABR air-conducted click 37.7 20 dB nHL click 37.7 ER-3A Rarefac. Ipsi. 2890

* Using the Kalman Weighted algorithm, 2000 "equivalent sweeps" is comparable to 2000 "accepted sweeps" used in conventional averaging.
Case 2

- Total test time from set up to completion was 15 minutes.
- Infant was alert and sucking on pacifier for the duration of the test.
Case 3

- NICU infant born at 32 weeks gestational age.
- Tested at 39 weeks adjusted age.
- No significant health issues other than prematurity and small for gestational age.
- Extremely small ear canals
ABR Click Stimulus Right Ear
ABR Click Stimulus Left Ear
Case 3

• Note latency normative data for Wave V.
• Great tool to have if unsure where waveforms should present for those premature infants younger than 40 weeks’ corrected age.
Case 4

- Infant born at 25 weeks gestational age
- Spent 3 ½ months in the NICU
- Intestinal surgery for blockage
- Received multiple blood transfusions / high bilirubin levels
- Failed ABR while in the NICU (at a different facility) – parents were told testing indicated bilateral profound hearing loss
Case 4

- Parents are seeing some responses at home to louder sounds
- Current age 4 ½ months (adj. 1 month)
- Currently receiving PT, OT services
- Current issues include chronic lung disease – on oxygen at all times.
Case 4

Stim (Pa/ms) | Response Waveform (mPa/ms)
-------------|---------------------------
0.6          | 0.6
0.3          | 0.3
0.0          | 0.0
-0.3         | -0.3
-0.6         | -0.6
0 1 2 3 4    | 0 1 2 3 4

Stim (Pa/ms) | Response Waveform (mPa/ms)
-------------|---------------------------
0.6          | 0.6
0.3          | 0.3
0.0          | 0.0
-0.3         | -0.3
-0.6         | -0.6
0 1 2 3 4    | 0 1 2 3 4

OAE response

Left
1/26/2011
9:13:02 AM
72.0 secs
TE-QS
O4IL1Q30

Resp=9.6dB Noise=3.9dB Stim=84.0dB
NumLo=220 NumHi=109 Correl=81% Stab=99%

Right
1/26/2011
9:16:24 AM
39.0 secs
TE-QS
O4IL1Q31

Resp=10.5dB Noise=11.6dB Stim=83.7dB
NumLo=100 NumHi=92 Correl=42% Stab=100%
Case 4 – Right TEOAE Spectrum Detail
Case 4 – Left TEOAE Spectrum Detail
Right Ear Click Stimulus – Rarefaction/Condensation
Left Ear Click Stimulus – Rarefaction/Condensating
Case 4

Diagnosis: Auditory Neuropathy

- Referral to neuro-otologist
- Hearing Aid Trial (common practice to determine benefit)
- Repeat ABR every 2-3 months
- May be cochlear implant candidate
Conclusion
In Conclusion

• The Integrity provides accurate ABR latencies for diagnostics and easily identifiable waveforms to determine thresholds for hearing aid fittings for pediatrics.

• This equipment can be used on all ages and especially for those who have medical conditions that contraindicate sedation.
In Conclusion

• In three months, our facility has utilized the equipment on 47 patients. In all but 2 instances we were able to get a complete diagnostic assessment including click and toneburst stimuli with little difficulty.

• Two patients would not tolerate insert phones and/or were too fussy to complete testing
In Conclusion

Of the 45 completed, 19 identified with permanent hearing loss.

- One completed in the OR (having another procedure at the same time)
- Six completed in the NICU
- Other 39 were completed either on the floor as an inpatient or in our clinic as an outpatient with no sedation needed.
In the past three months, our clinic has utilized our other ABR equipment a total of three times for assessment of hearing loss.
In Conclusion

Our Audiology department was somewhat skeptical that an accurate ABR could be completed on a child that was awake. We have been pleasantly surprised at how well it works and now we prefer the use of the Integrity over our other systems.
In Conclusion

Our staff would highly recommend the Integrity for ABR assessment.
Case 5 – Right Ear Click Stimulus Adult