

# Hear This!

## Lower-cost Automated ABR for Newborn Hearing Screening

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# Disclosures

- The presenters have no conflicts of interest related to this presentation

# Outline

- Background
- Screening tests and protocols
- Costs and Reimbursement
- Vanderbilt Newborn Nursery Data
- Conclusions

# Background

- Joint Committee on Infant Hearing Screening
- Universal Newborn Hearing Screening
  - State of TN: Claire’s Law, 2008<sup>1</sup>
  - Vanderbilt University Medical Center (VUMC)
    - Audiology: NICU
    - Neonatology: Newborn Nursery
- 2015: Audiology assumes responsibility for hearing screenings in the VUMC newborn nursery

# Background

- Vanderbilt Newborn Nursery:
  - 3500 births annually (level I and II nurseries)
    - State- required screenings/ reporting = 24-48 hrs
    - Average discharge age  $\approx$  59 hrs
- Vanderbilt Bill Wilkerson Center Goals:
  - All Infants screened prior to discharge
    - 2<sup>nd</sup> screen for refers (time permitting)
  - Meet JCIH benchmarks for refer rate ( $< 4\%$ )<sup>2</sup>
  - Create sustainable program

# Background

- Screening equipment and protocols
  - 2 main types of hearing screenings

## OAE



## AABR



# Screening Protocol Considerations

- 1) *Cost associated* with different screening protocols
  - Equipment, supplies, screen time, etc.
- 2) Potential effect of transducer type on *refer rate*
  - Influence of OE and ME status on refers

# Screening Protocols

Protocol	Advantages	Limitations	Equipment	Costs
<b>ABR</b> (rescreen with ABR)	<ul style="list-style-type: none"> <li>• Lowest refer rate [3-5]</li> <li>• Detects neural loss</li> </ul>	<ul style="list-style-type: none"> <li>• Longer test time than OAEs only [3-5]</li> </ul>	ABR	<ul style="list-style-type: none"> <li>• Higher cost for disposables, equipment and time [3,4]</li> <li>• Costs comparable when account for reduced refer and rescreening rate [3]</li> </ul>
<b>OAE</b> (rescreen with OAE)	<ul style="list-style-type: none"> <li>• Shorter test time [4,5]</li> </ul>	<ul style="list-style-type: none"> <li>• Highest refer rate [3-5]</li> <li>• Cannot detect neural loss</li> </ul>	OAEs	<ul style="list-style-type: none"> <li>• Lower cost for disposables, equipment and time [4,5]</li> <li>• Similar to ABR when account for rescreens</li> </ul>
<b>2 step:</b> OAE first followed by ABR for refers	<ul style="list-style-type: none"> <li>• Lower refer rate than OAEs only [3]</li> <li>• May detect neural loss</li> </ul>	<ul style="list-style-type: none"> <li>• Misses most neural loss</li> </ul>	ABR & OAEs	<ul style="list-style-type: none"> <li>• Depends upon initial refer rate</li> <li>• Higher equipment costs (2 versus 1) [5]</li> </ul>

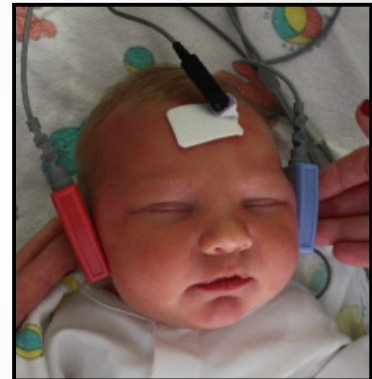


# Costs and Reimbursement

- Average screening costs
- Supply + labor
  - Note: rescreen was often only 1 ear
  - OAE / OAE
    - \$16.45
  - ABR / ABR
    - \$25.42
  - OAE / ABR
    - \$23.50

# Costs and Reimbursement

- Per patient, per screen supply costs
  - OAE
    - Disposable OAE probe: **\$1.15**
  - AABR
    - Disposable electrodes (**\$1.50**) + transducer
      - Supra-aural: \$9.42 - \$12.95
      - Insert(s): \$1.31 (\$2.62 for 2)
    - No disposables



# Costs and Reimbursement

- Although supply costs for ABR and OAE differ, reimbursement is similar
  - Average Medicaid reimbursement
    - AABR: \$56.59
    - OAE: \$45.05
  - Trends for decreasing reimbursement
    - Average decrease of 6% for AABR from 2000-2005

# Screening Protocols – *Refer Rate*

- Chang et al. (1993)<sup>7</sup>
  - 41 infants, 82 ears; (62 ears) 76% passed OAE
  - 15% of OAE screening failures were attributed to vernix

**Table 2.—Relationship Between External Canal Obstruction and OAE Result Before Cleaning\***

Preexamination OAE Result	n	Obstruction Before Cleaning, No. (%)		
		None	Partial	Total
Pass	62	43 (69)	18 (29)	1 (2)
Partial pass	10	2 (20)	6 (60)	2 (20)
Fail	10	2 (20)	3 (30)	5 (50)

\*OAE indicates otoacoustic emission.  $\chi^2=30.84$ ;  $P<.005$ .

8 of 82 ears (10%)  
“total” vernix  
occlusion

1 of 8 (12%)  
Occluded “Passed”

- After cleaning vernix, increase PASS rate 76% → 91%

# Screening Protocols- *Refer Rate*

- Doyle et al. (2000) <sup>8</sup>
  - 200 babies (400 ears)- otoscopic exam, TM mobility (396), NHS
  - Occluding vernix found in 28% of ears (112)
  - Before vernix removal
    - 12% passed OAE
    - 78% passed ABR
  - Following vernix removal
    - 51% pass
    - 96% pass

62% of infants with reduced TM mobility that failed OAE passed ABR

**Table 1.** Pass/fail rates for EOAE and ABR in 90 healthy newborn ears with decreased tympanic membrane mobility on otoscopic examination

	Pass EOAE	Fail EOAE	Total
Pass ABR	29 (32.2%)	56 (62.2%)	85 (94.5%)
Fail ABR	1 (1.1%)	4 (4.4%)	5 (5.5%)
TOTAL	30 (33.4%)	60 (66.6%)	90 (100%)

# AIMS

- AIMS:
  - 1) Determine whether AABR refer rate differed for insert versus supra-aural earphones.
  - 2) Evaluate cost-effectiveness of 2-stage ABR protocol with insert earphones with respect to other options.

# Methods

- Retrospective analysis of clinical data (July – Aug 2015); quasi-experimental design\*
  - Population: 385 infants (770 ears) born in VUMC Newborn Nursery
  - Equipment: commercially-available AABR screener with coupling capability for supra-aural and insert earphones
  - Protocol: 2-step AABR screening
    - 1<sup>st</sup> screen: min 12 hrs (Vaginal), min 24 hrs (C-section)
    - Rescreen:  $\geq 8$  hours after 1<sup>st</sup> screen
- \* Unequal sampling across transducer type

# Methods

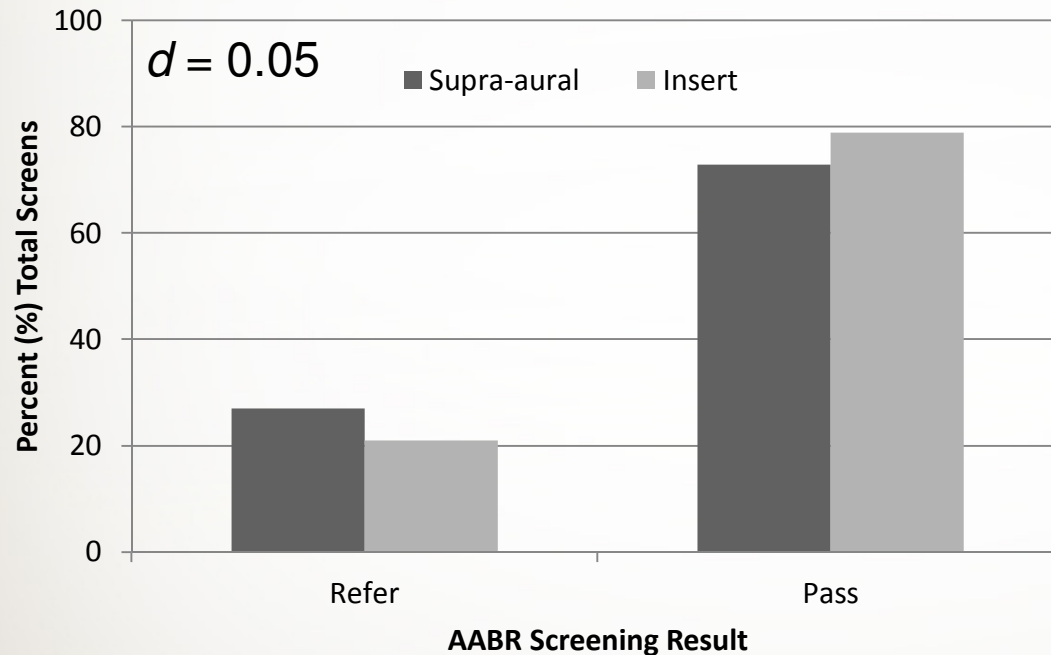
- 1151 screenings
  - 198 (17%) Supra-aural earphones
  - 953 (83%) Insert earphones





# Results

- No significant difference in refer rate found.
  - Supra-aurals = 27% refer, Inserts = 21% refer



\*Note: refer rate indicates per ear, per screen refers  
Ex. – Bilat refer on screen 1 and 2 = 4 refers

Insert earphones are a viable option for AABR.

# Results - Descriptives

- Cost: Insert earphones resulted in savings of \$8.11 per baby
  - Estimated annual savings = \$30,882
- Considerations: Supra-aural headphones may be preferable in some situations
  - Very small ear canals can't accommodate 3.5 mm tip

# Conclusions

- Refer rate for supra-aural versus insert earphones does not significantly differ.
- Insert earphones provide a lower-cost solution to AABR newborn hearing screening.

Questions?

# References

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# Program Goal Metrics

- Goal: Screen all newborns prior to discharge
  - 0 misses in newborn nursery since inception
- Goal: Reduce refer rate

VUMC Refer Rate by Month/Department

