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Bridging the Gap: Adding Cortical Potentials to our Pediatric Care in partnership with the American Academy of Audiology

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Disclosures

- **Presenter Disclosure:** Financial: Tamar Gomes is an employee of Boston Children's Hospital and received an honorarium for this presentation. Non-financial: Tamar Gomes is the founder and active member of the International Pediatric CAEP Action Potential Working Group. She has no relevant non-financial disclosures.
- **Content Disclosure:** This learning event does not focus exclusively on any specific product or service.
- **Sponsor Disclosure:** This course is presented in partnership with The American Academy of Audiology.

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 - Amal Awdeh, AuD
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 - Jennifer Harris, AuD
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- Pediatric CAEP Action Potential Group
 - 30+ participants from around the globe
 - Clinical, Research, Industry, Universities, Hospitals



Where the world comes for answers

Limitations/Risks

- The applicability and accuracy of the course content may vary by the clinical, geographical, and cultural context; you should evaluate the course accordingly.
- As healthcare is rapidly evolving, new findings may change the validity of the information presented in this course. Providers should always consult the latest research and guidelines from professional associations.
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- It is the responsibility of course participants to critically evaluate the evidence from multiple sources to guide professional practice.

Learning Outcomes

Identify at least 3 patient populations that could benefit from cortical response testing.

Describe a basic setup for administering cortical testing for pediatric patients.

Identify and address common challenges in using CAEPs in clinical settings by utilizing practical insights, clinical tips, and collaboration with other pediatric clinicians.

Plan for this hour



Why CAEPs in pediatric care



Who may benefit



Basic setup & clinical tips



Challenges & Practical Solutions



Case Examples



Q & A

Cortical Auditory Evoked Potentials (CAEP)

- EEG response time locked to a stimulus
- Late latency response measured higher in the brain at the cortical level
- Approximately 80-300 ms
- P1-N1-P2 complex
- Present response indicates detection of the sound in the cortex

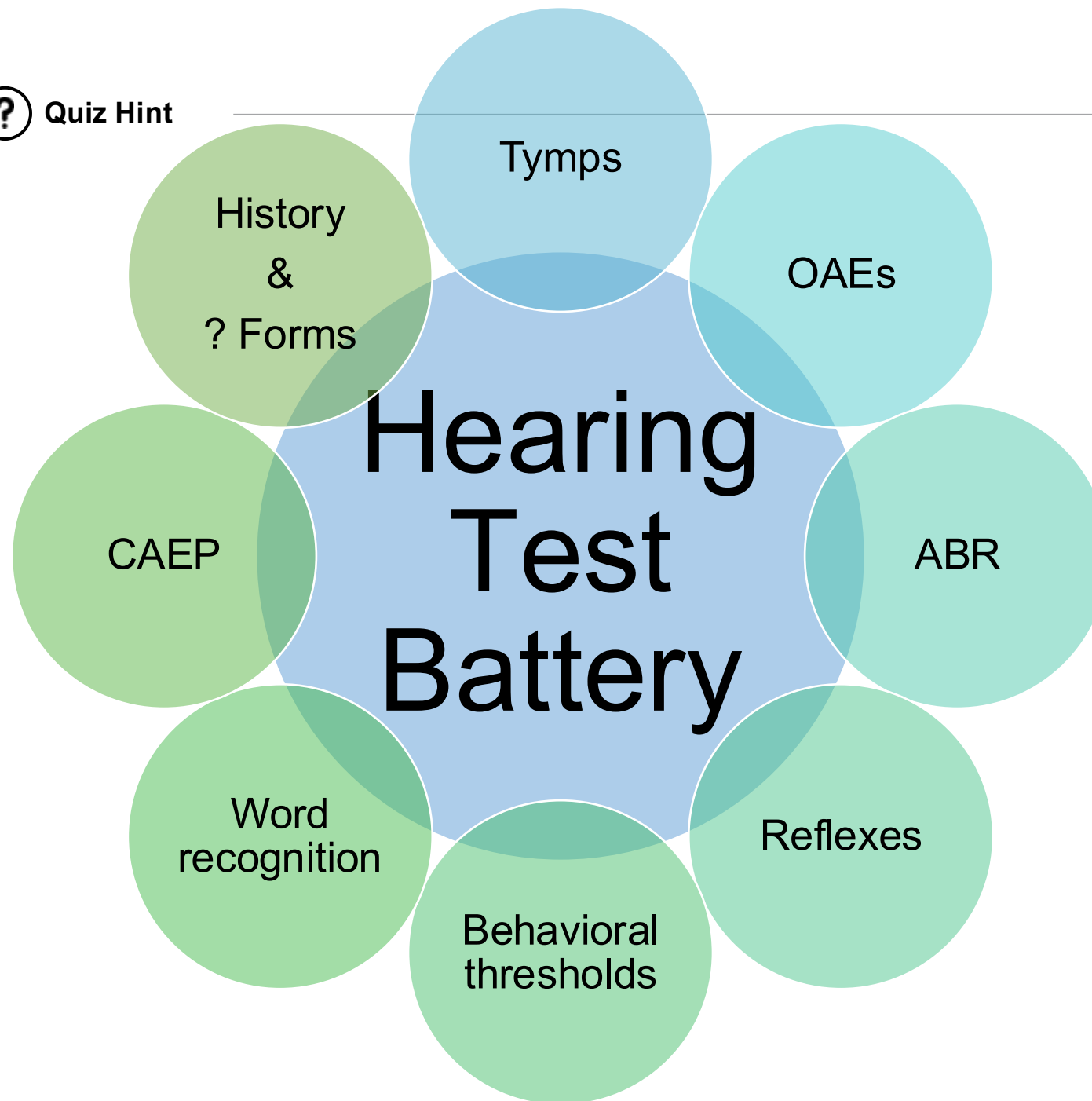
Who are WE?

- Pediatric Hospital – inpatient/outpatient
 - 8 locations
 - 40+ Audiologists
 - 25,000+ visits annually
 - 2300+ ABRs annually
 - NICU screenings, diagnostics, habilitative (HA, CI, therapy, support groups)
 - Identification, monitoring & management for pediatric patients
-

Why we started exploring CAEPs

- Early diagnosis often comes from **ABR**
- Gap between ABR & behavioral
- Families and clinicians need more guidance in the interim
- CAEPs offer a potential way to narrow that gap
- Objective data for guidance & counseling

? Quiz Hint



**Boston
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Where the world comes for answers

Who could benefit from CAEP testing?

- Infants in the ABR – VRA gap
- Developmentally delayed/Medically Complex pts
- Inconsistent behavioral responses
- Auditory Neuropathy Spectrum Disorder (ANSD)
- Hearing aid users with unresolved access questions
- CI candidates or CI recipients
- Patients with central auditory processing disorders (CAPD)

Basic Set-up

ABR

- How: EEG 3-4 electrode montage
- What: Stimuli: Click & tonebursts
- Looking for: Waves I - V
- When: early response
(<20 ms)
- Where: Peripheral; inner ear & brainstem

CAEP

- How: EEG 3-4 electrode montage
- What: Stimuli: tones & **speech** bursts
- Looking for: P1-N1-P2 complex
- When: late response
(N1~100 ms; P2~150-300)
- Where: Later in the auditory cortex; cortical

Equipment Set up

- **Electrode montage like ABR**
 - 1 or 2 channels
 - High forehead (or vertex), mastoid & ground
- **Transducers**
 - Earphones or Soundfield
- **Stimuli**
 - Speech bursts / Tone bursts
(manufacturer files – just ask)
- **Presentation level**
 - 55 – 75 dB
- **Looking for**
 - Big positive hump followed by a negative dip around 150-300 ms
- **Amplifier / Filter / Stimulus Settings**
 - High Pass: 0.5 -1 Hz (as low as possible)
 - Low Pass: 30 Hz
 - Gain: 50k – 100k
 - Rep rate: 0.25 – 1.1/sec
 - Sweeps: 25-50 pending patient activity
 - Replicate
 - Jitter: 10% (varies interstimulus interval timing, reducing the neural refractory effect/neural fatigue)

Let's talk transducers

- Inserts
- Supra-aural headphones
- Soundfield
- Unaided
- Aided (in soundfield)
- Cochlear Implants too?

Ideal Patient State

- Awake
- Attentive
- Reasonably calm/still
- Quiet

“Just Do It”

(Yes, but HOW?)



Let's Do it!

- **Literature support exists**
but real-world pediatric application is challenging

- **Common barriers:**

- **Provider/Clinic**

- Limited formal clinical training
 - Resource availability
 - Equipment
 - Time
 - Practice patients
 - Documentation/billing

- **Collection**

- Variable child state: fatigue/active
 - Developmental variability: ie tolerance of electrodes

- **Interpretation**

- Artifact & noise
 - Uncertainty
 - Lack of norms for under 5 yrs

What makes this hard?

- Translating literature into practice
- Selecting the right patients
- Managing logistics in a busy clinic
- Building confidence with waveforms
- Knowing how much to trust uncertain data

Learning Curve

Provider/Resource Tips

- Recommend starting with:
 - Normal hearing adults – coworkers, students, family members
 - Normal hearing children
 - Do not start with the most challenging patients
- Try during an “older” ABR session or a 1st VRA session
- Just add one stimulus to an existing appointment
- Start with inserts if you don’t have SF equipment
- Consult other colleagues
- It’s ok to not have the answers or be able to interpret
- Billing: CPT 92653 – AEP Neurodiagnostic – interpretation & report (***when appropriate***)

Prep for Success

Before testing

- Set expectations clearly
- Optimize timing and comfort
- Minimize movement and distraction
- Coach caregivers on their role
- Plan stimulus priority

During testing

- Choose stimuli strategically
 - Keep sessions focused
 - Replicate findings
 - Document child state during testing
 - Be flexible & child-led
 - Stop when data quality is no longer meaningful
-

Collection Tips

- CAEP & ABR combo session
- Fewer sweeps with more runs & sum together (ie 4x25 sweeps vs 1 run of 100 sweeps)
- Use a second tester – goal is quiet, active attention
 - Light up toys, books, barrel of monkeys, silent video, entertaining more heavily than VRA, but not overly active *in some cases CAEP *may* be recordable in a sleep state!
- If a patient won't tolerate DPOAEs, they're unlikely to tolerate EPs
 - Developmental delays vary:

IE Autism Spectrum vs Cerebral Palsy

Stimulus selection

- What stimulus to start with? – Depends on the goal
 - G** – Good lower freq starting place
 - T** – Good high frequency
 - M** – May be easier to see, lowest freq & can be impacted by fluid
 - S** – Highest frequency
 - *Different systems have different stimuli available
 - MAN-IRU
 - Speech bursts
 - Tone pips
-

5 month old HA pt, before ABR

1.1/s **/t/ @ 75 dB SPL binaurally aided**

4-75R(A) ipsi
AC:CAEP_T-A
1.1/s

6-75R(A) ipsi
AC:CAEP_T-A
1.1/s

-200 -129 -58 13 84 155 226 297 368 439 510 ms

/g/ @ 75 dB SPL binaurally aided

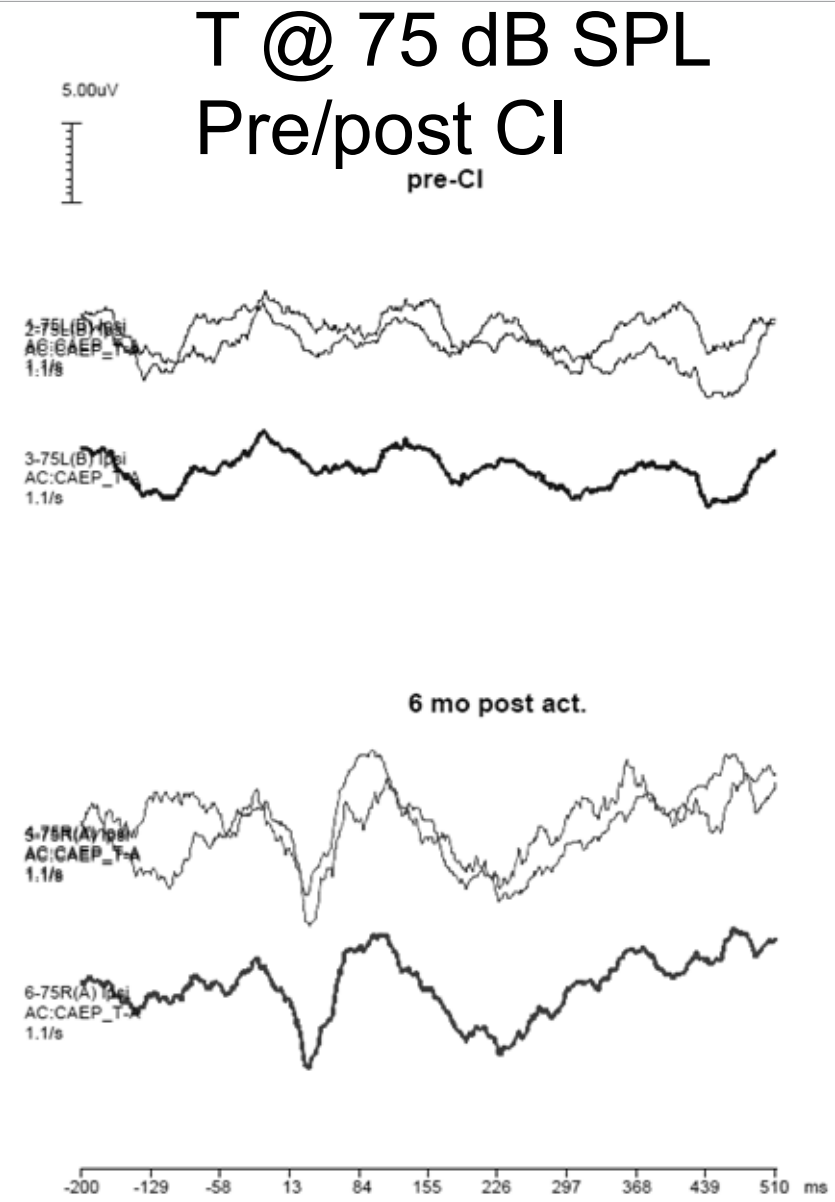
10-75R(A) ipsi
AC:CAEP_G-A
1.1/s

12-75R(A) ipsi
AC:CAEP_G-A
1.1/s

-200 -129 -58 13 84 155 226 297 368 439 510 ms

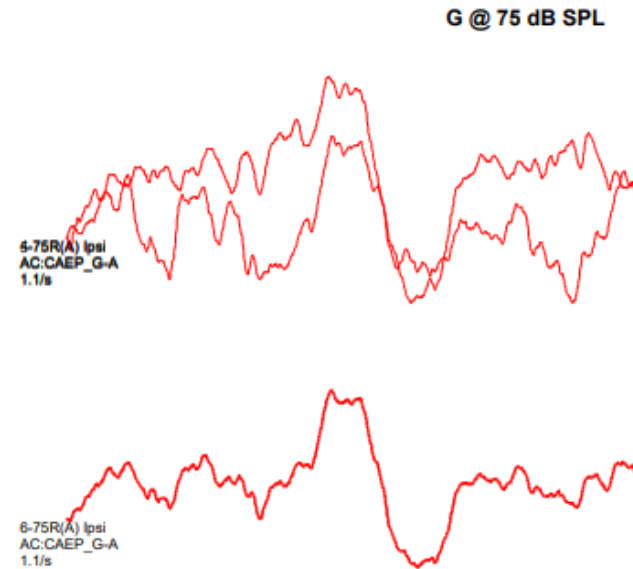
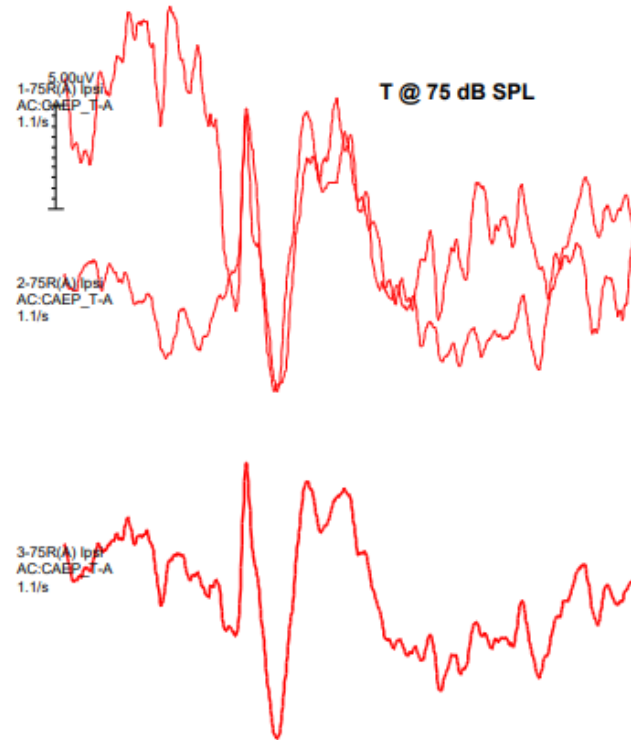
Interpretation Tips

- Presence vs Absence
- Waveform should replicate with consistency
- Responses stand out of the noise
- Latency & morphology change with development
- Use Pre/Post comparisons
- Focus on within patient comparisons
- Use full clinical context
- Sum the good waves, then interpret
- “Response not present at this time”



Active 7 month old

Awake
tummy
time
playing

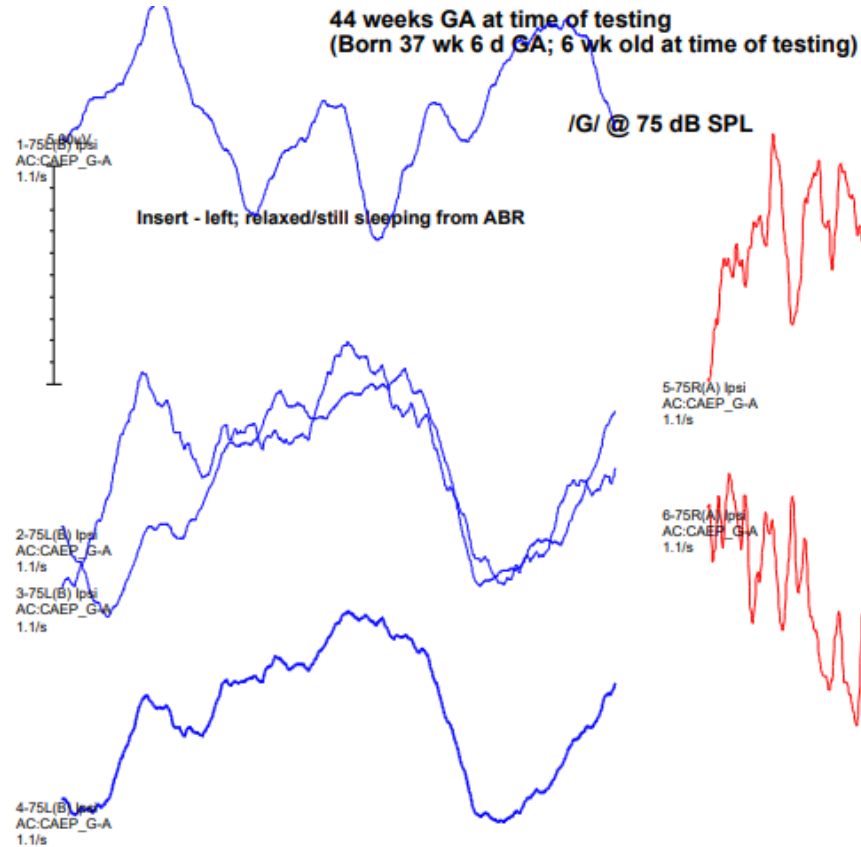


Awake
sitting up
engaged

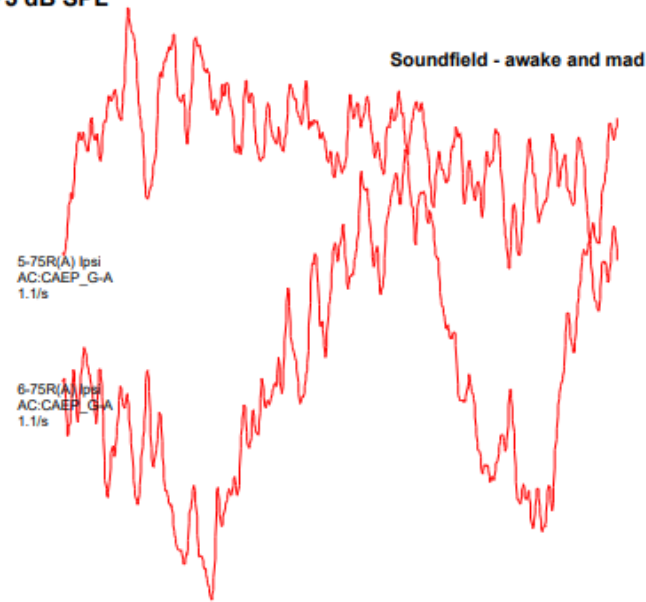
-200 -129 -58 13 84 155 226 297 368 439 510 ms -200 -129 -58 13 84 155 226 297 368 439 510 ms

44 wk GA (born 37 wk;6 wk old)

Asleep
&
Relaxed



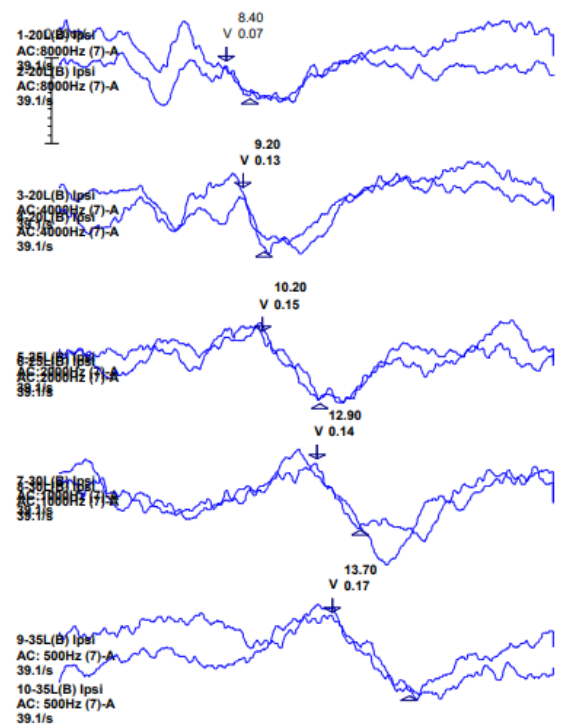
Awake
&
Mad



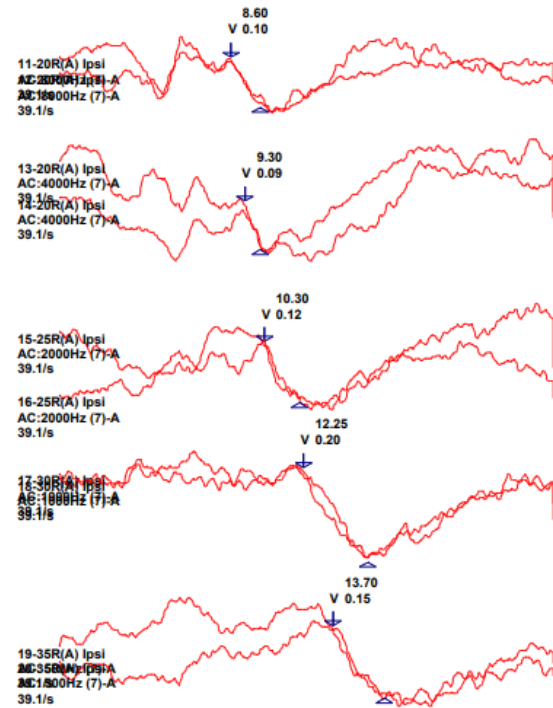
-200 -129 -58 13 84 155 226 297 368 439 510 ms -200 -129 -58 13 84 155 226 297 368 439 510 ms 4 ms

43 weeks GA - sleeping (born at 37 wk, 6 wks old)

ABR

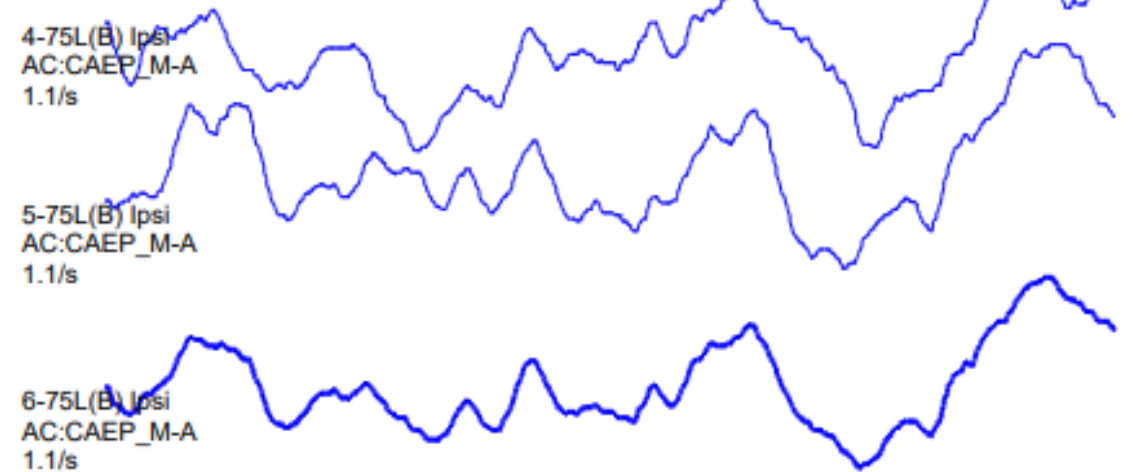


0 3 6 9 12 15 18 21 24 ms



0 3 6 9 12 15 18 21 24 ms

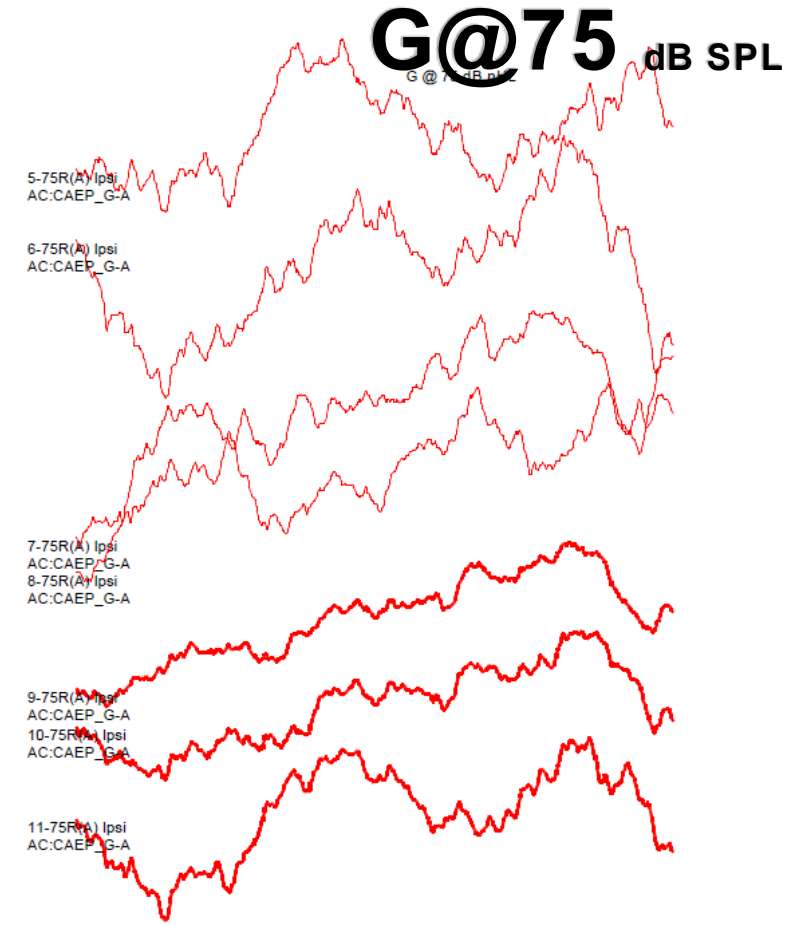
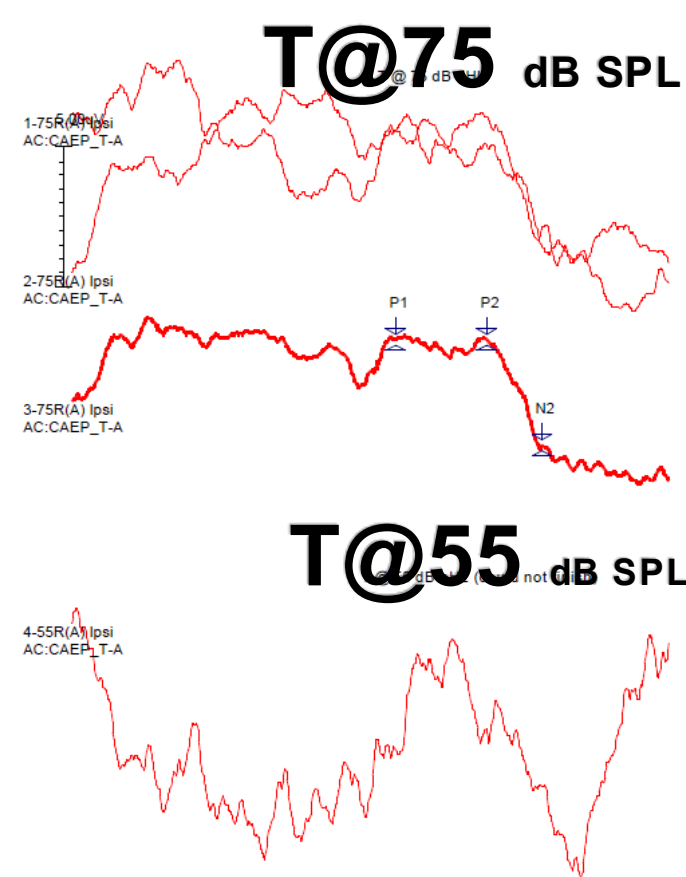
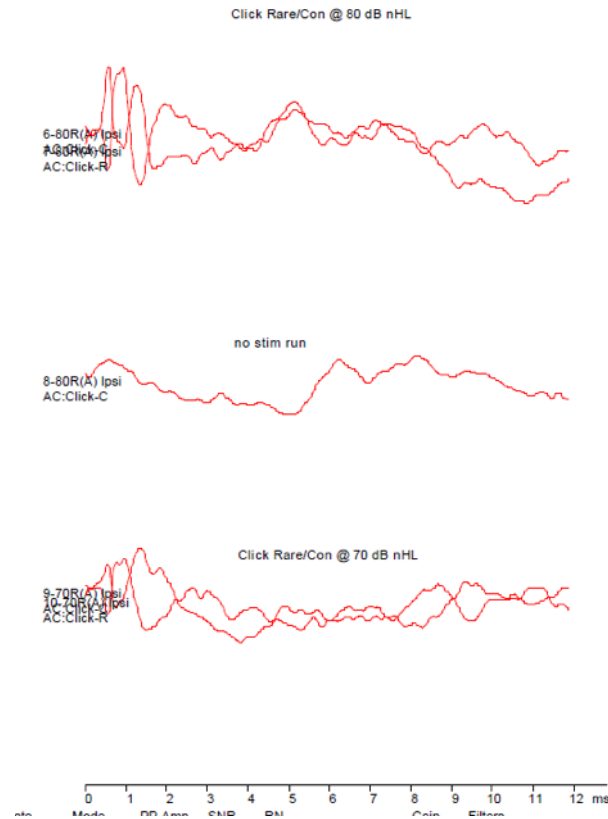
M @ 75 dB



-200 -129 -58 13 84 155 226 297 368 439 510 ms

7 months old – bilateral ANSD

ABR



-200 -129 -58 13 84 155 226 297 368 439 510 ms

Key Take Aways

- CAEPs are not a replacement for existing pediatric audiology tools.

They are an additional objective measure that can strengthen decision-making, counseling, and auditory care in children with limited or complex behavioral information.

- If you can do an ABR, then you can attempt CAEPs!

Just do it!



QUESTIONS?

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