



Integrating diagnostic information to optimize management of hearing loss in infants

- Putting diagnostic audiology information together to plan habilitation

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Overview

1. Joint Committee on Infant Hearing (JCIH), 2007
 - Goals for infant diagnostic testing in the context of universal newborn hearing screening (UNHS)
 - Recommendations for audiologists
2. Tools available to audiologists in the diagnostic test battery
3. Prioritizing tests & techniques to maximize efficiency in diagnosing different types of hearing loss (case studies)
4. Key messages

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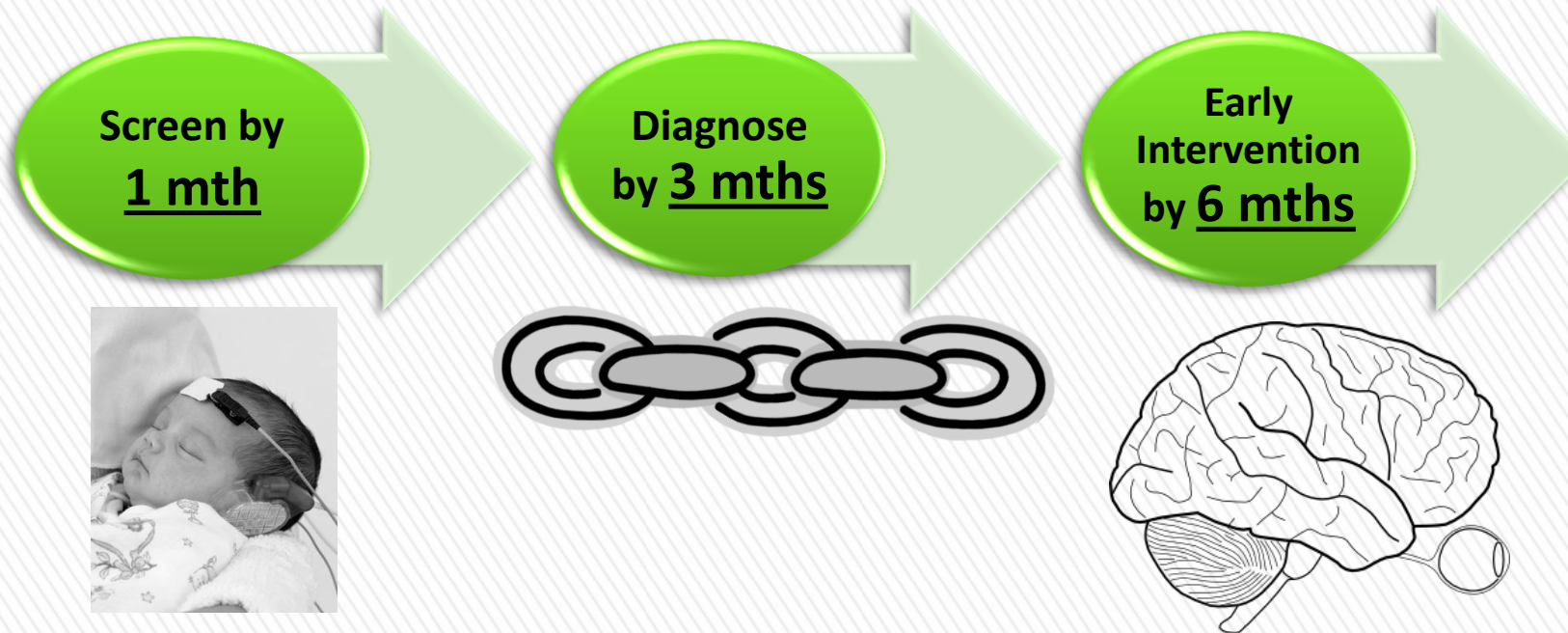


JCIH Goals for infant diagnostic testing in the context of universal newborn hearing screening



Joint Committee on Infant Hearing (JCIH), 2007 - UNHS timeframe goals

Universal Newborn Hearing Screening (UNHS)



Joint Committee on Infant Hearing (JCIH)

Year **2007** Position Statement:

Principles and Guidelines for Early Hearing Detection &
Intervention Programs

Pediatrics 2007;120;898-921



Joint Committee on Infant Hearing (JCIH) 2007

- Diagnostic Audiology

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- **Experience:** Comprehensive audiological evaluation of newborn and young infants who fail newborn hearing screening should be performed by audiologists experienced in pediatric hearing assessment
- **Degree, Type & Configuration:**to assess the integrity of the auditory system in each ear, to estimate hearing sensitivity across the speech frequency range, to determine the type of hearing loss, to establish a baseline for further monitoring, and to provide information needed to initiate amplification-device fitting.



Joint Committee on Infant Hearing (JCIH), 2007

- Diagnostic Audiology test battery

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The audiological assessment should include:

1. **History:** Child and family history (risk factors & parent observations)
2. **ABR – frequency specific:** A frequency-specific assessment of the ABR using air-conductedand bone-conducted tone bursts when indicated.
3. **ABR – ANSD check:** Click-evoked ABR testing using both condensation and rarefaction single-polarity stimulus, if there are risk indicators for neural hearing loss (auditory neuropathy/auditory dyssynchrony) such as hyperbilirubinemia or anoxia, to determine if a cochlear microphonic is present.any infant who demonstrates “no response” on ABR elicited by tone-burst stimuli must be evaluated by a click-evoked ABR
4. **OAEs:** Distortion product or transient evoked OAEs.
5. **Tympanometry:** using a 1000-Hz probe tone.
6. **Behavioral Observation:** Clinician observation of the infant’s auditory behavior as a cross-check in conjunction with electrophysiologic measures.



What are we trying to measure & manage?

To accurately determine:

- » Degree
- » Type
- » Configuration

Guide



Medical:

- Advice & treatment for conductive hearing loss
- Investigation of possible neurological conditions
- Investigate possible structural abnormalities (scans)

Amplification:

- Optimal amplification as early as possible
- Identify infants needing early referral for cochlear implant evaluations

Habilitation:

- Discuss whether the baby should learn language using auditory alone or may need visual communication





Tools available to us in the diagnostic test battery & what are we looking for?



What tools do we have in our audiological test battery?

Behavioural



1. Parent Observations



2. Behavioural Observation Audiometry (BOA)



3. Visual Reinforcement Observation Audiometry (VROA)

Objective

1. Tympanometry

2. Otoacoustic Emissions (OAEs)

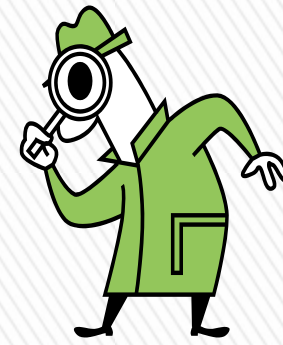
3. Auditory Brainstem Response (ABR)

4. Auditory Steady State Response (ASSR)

5. Cortical Auditory Evoked Potentials (CAEPs)



What are we looking for?



Normal
hearing

Mild sensorineural
hearing loss

Auditory
Neuropathy
Spectrum Disorder
(**ANSD**)

Normal	Mild
ANSD	CHL
SNHL	Mixed

Conductive
hearing loss

Sensorineural
hearing loss
(**moderate & greater**)

Mixed
hearing loss



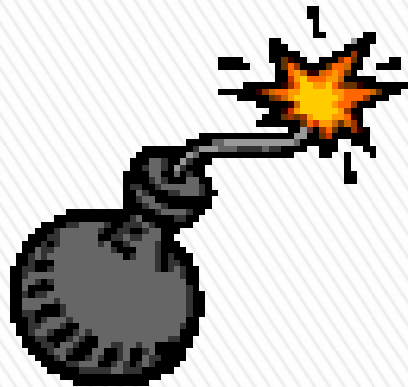


Maximizing test efficiency for diagnosis of different types of hearing loss (case studies)



What is the most important thing to test next?

Always assume this is the last piece of information you will get



There is more than one way you can approach this
Here are some suggestions



The first 10 minutes!

- Tympanometry & OAEs



Scenario 1

Tympanometry Normal ✓
OAEs Present ✓



Scenario 2

Tympanometry Normal ✓
OAEs Absent ✗



Scenario 3

Tympanometry Abnormal ✗
OAEs Absent ✗



ANSD could be 'hidden' under the middle-ear problems

Tympanometry & OAEs help to narrow down the "Type" of hearing loss & what intensity we should start with for ABR testing



Scenario 1

- Case 1A

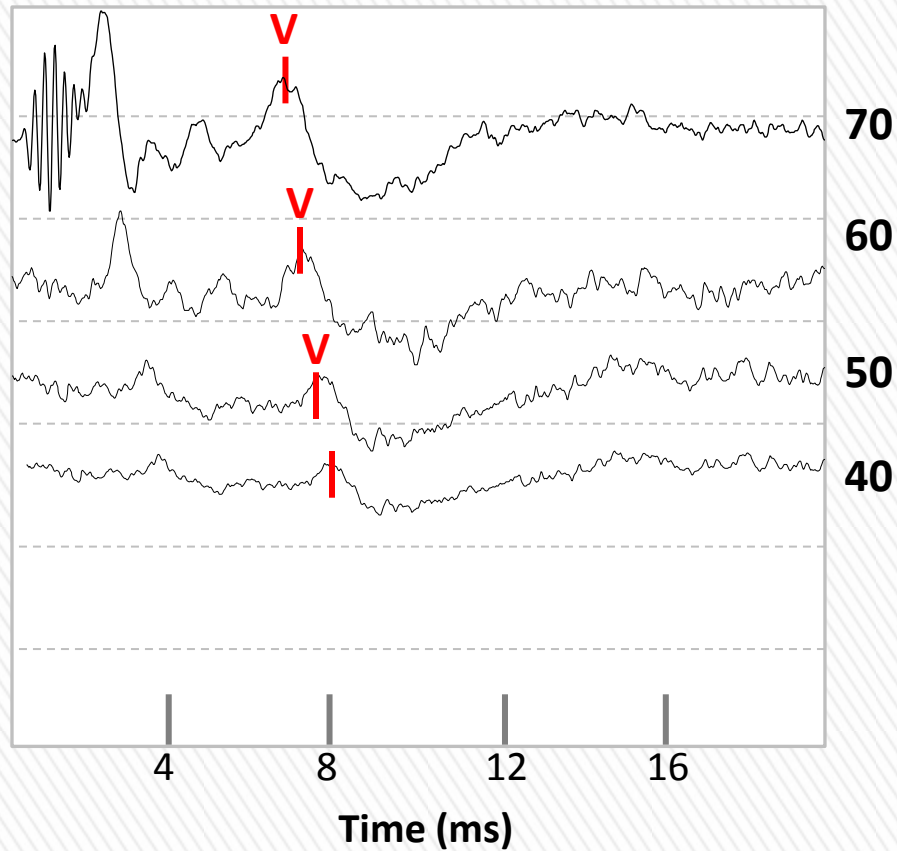
Tympanometry
Normal
OAEs Present



Normal	Mild
ANSD	CHL
SNHL	Mixed

What frequency & intensity will you start with for ABR?

4 kHz



Test session is over!

- Parents have to come back (increases stress)
- Your waiting time for appointments increases



Scenario 1

- Case 1A

Tympanometry

Normal

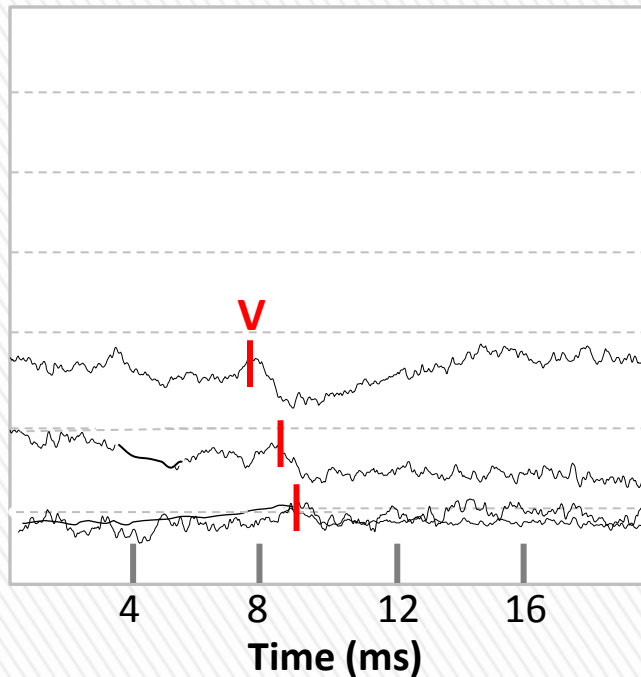
OAEs Present



Normal	Mild
ANSD	CHL
SNHL	Mixed

What frequency & intensity will you start with for ABR?

4 kHz



40
30
20



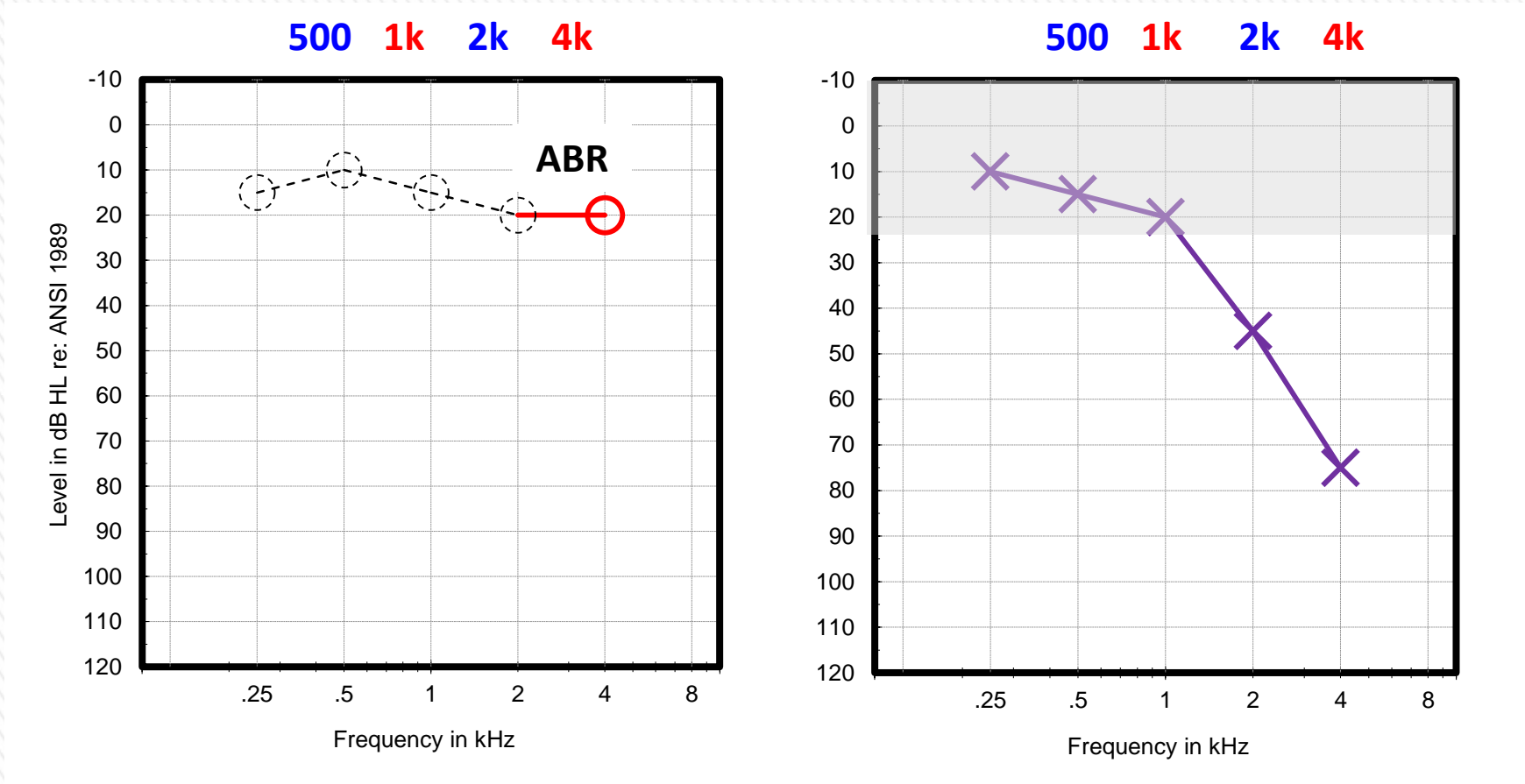
Test session is over

- But, you have been able to complete testing for one frequency



Toneburst ABR

- Minimum of 2 frequencies



Scenario 2

- Case 2

Tympanometry
Normal



OAEs Absent/
partially present

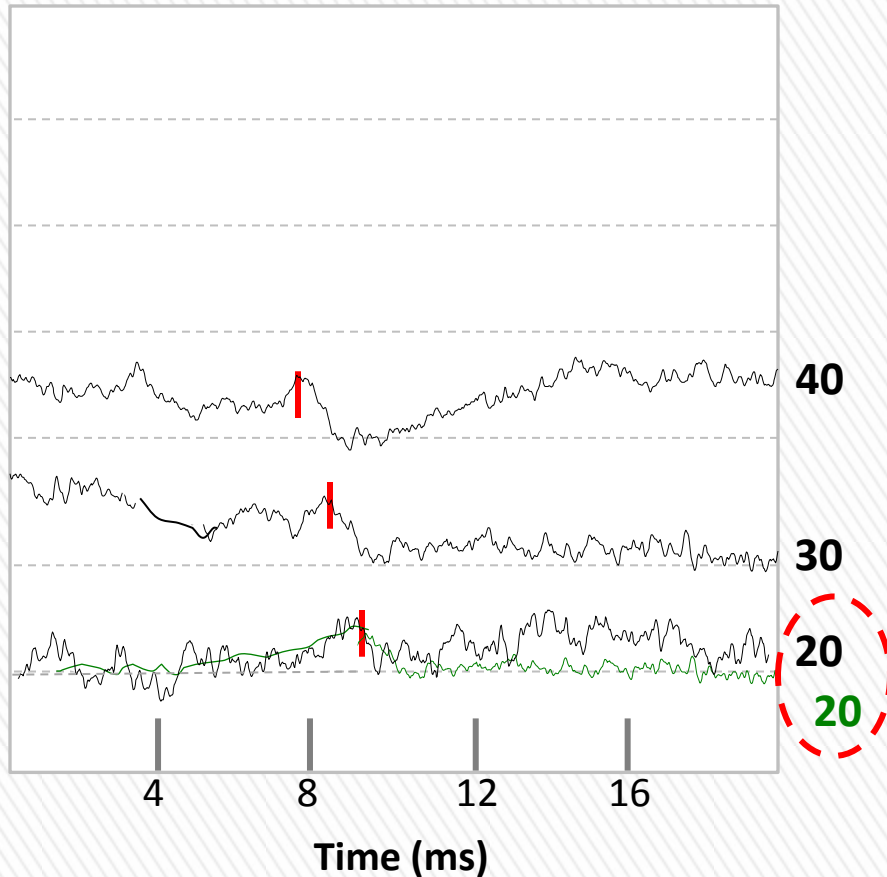


Normal	Mild
ANSD	CHL
SNHL	Mixed

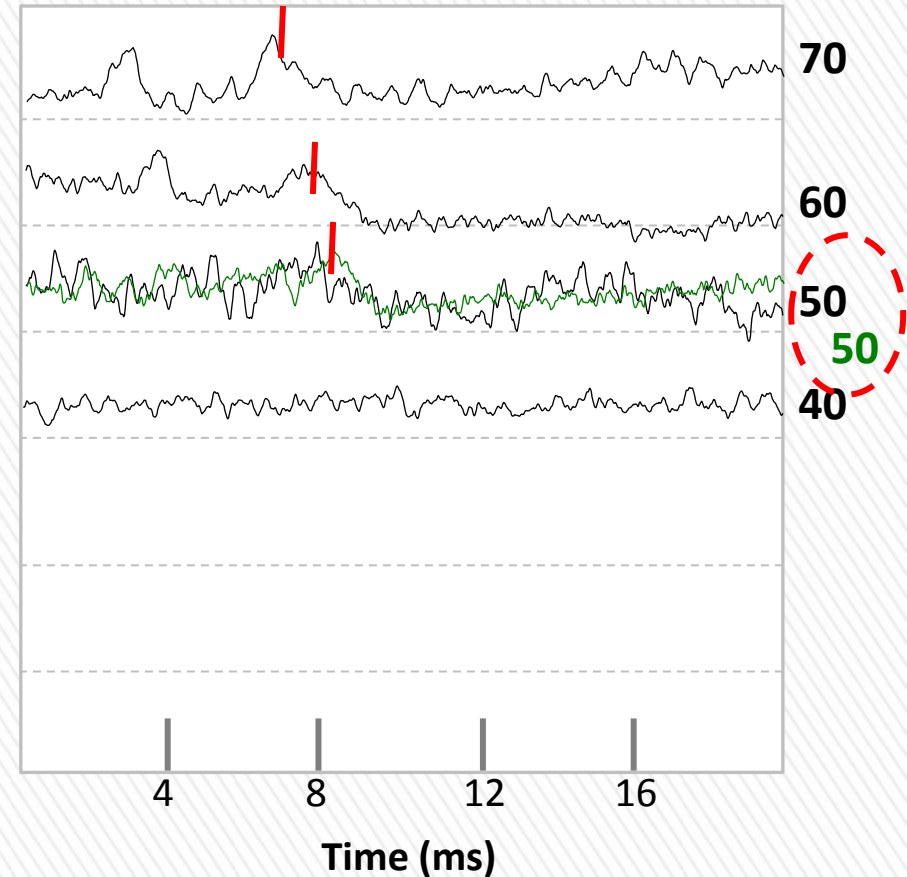


What intensity will you start with for 1 kHz ABR?

4 kHz



1 kHz

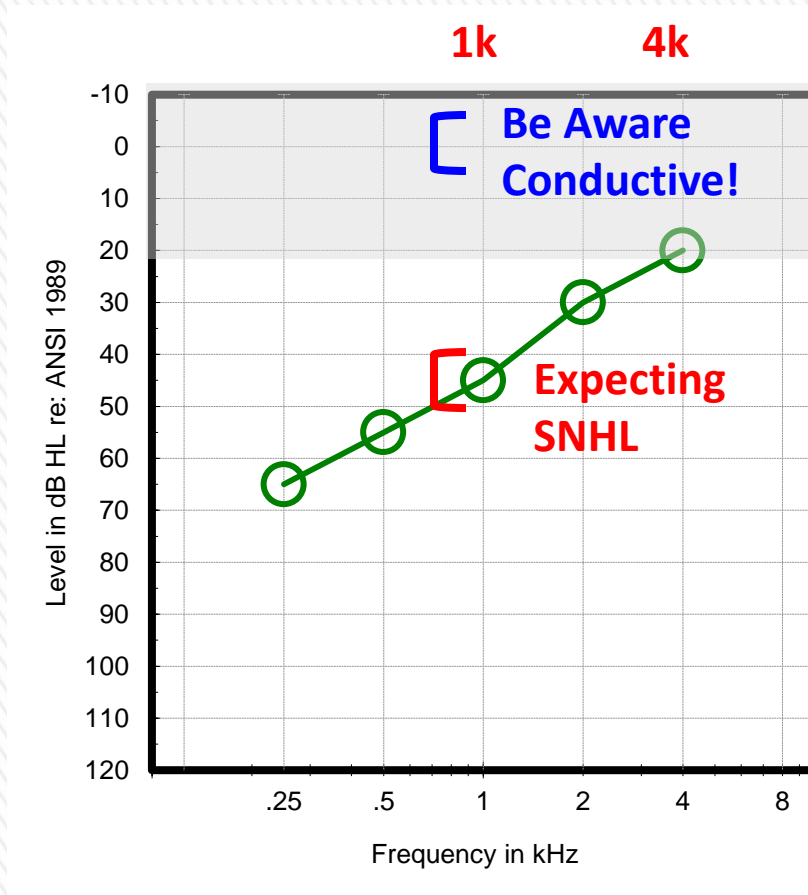


Toneburst ABR

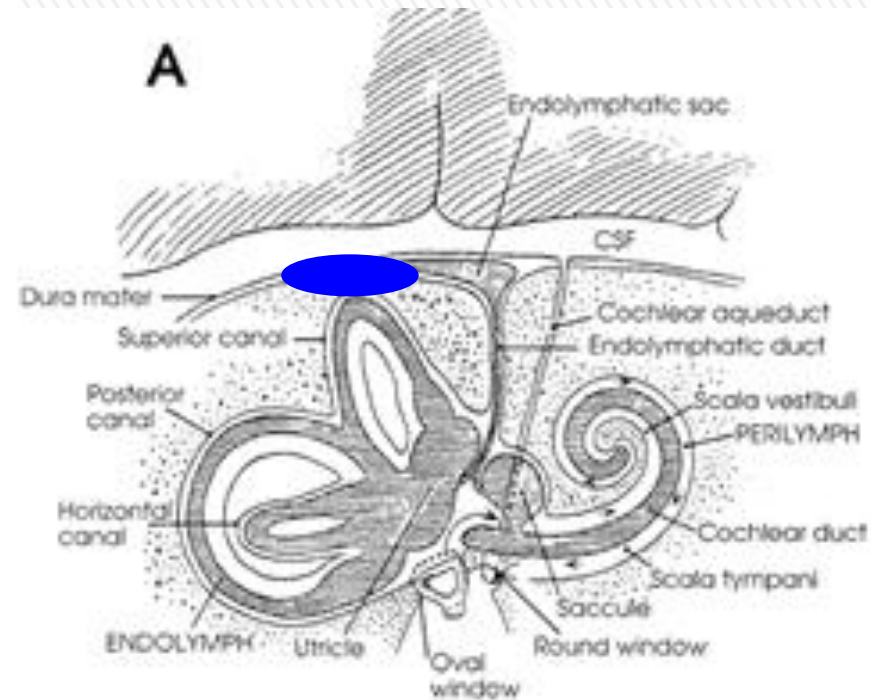
- Bone conduction ABR

Tympanometry Normal ✓
 OAEs Absent/
partially present ✗

Normal	Mild
ANSD	CHL
SNHL	Mixed



Superior Semicircular Canal (SSC) Dehiscence



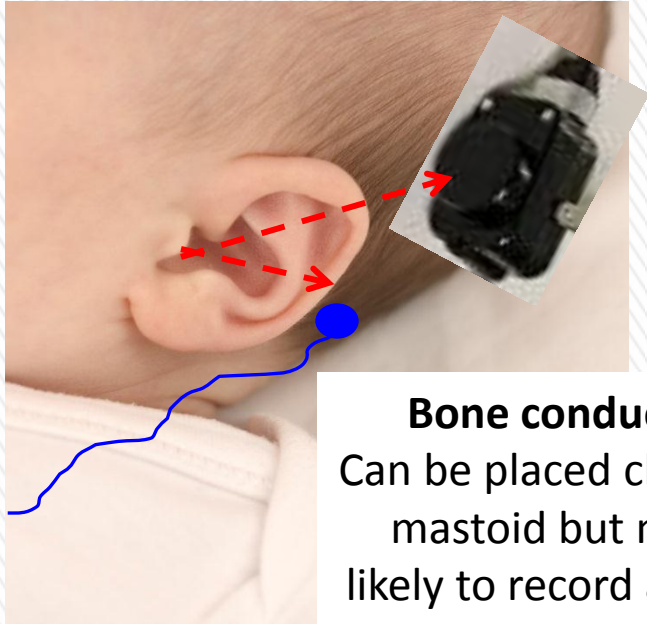
Should do Bone-conduction ABR even if you are expecting a SNHL



Toneburst ABR

- Bone conduction ABR

Bone conductor
Positioned Superior &
Posterior to the ear



Guiding Management

- Bone conduction thresholds elevated
- **SNHL** confirmed

- Bone conduction thresholds normal
- **CHL** confirmed

Hearing Aid
prescription for SNHL
according to degree &
configuration of loss



Hearing Aid
prescription for CHL
according to degree &
configuration of loss
&
High-resolution
imaging of the
temporal bones to
check for SSC
dehiscence



Scenario 2

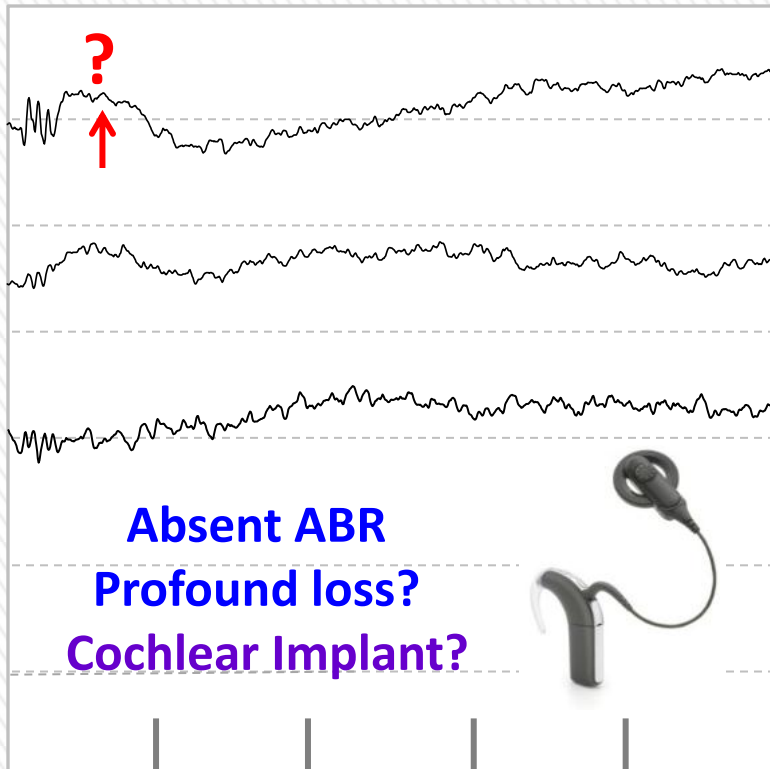
- Case 3

Tympanometry
Normal
OAEs Absent



Normal	Mild
ANSD	CHL
SNHL	Mixed

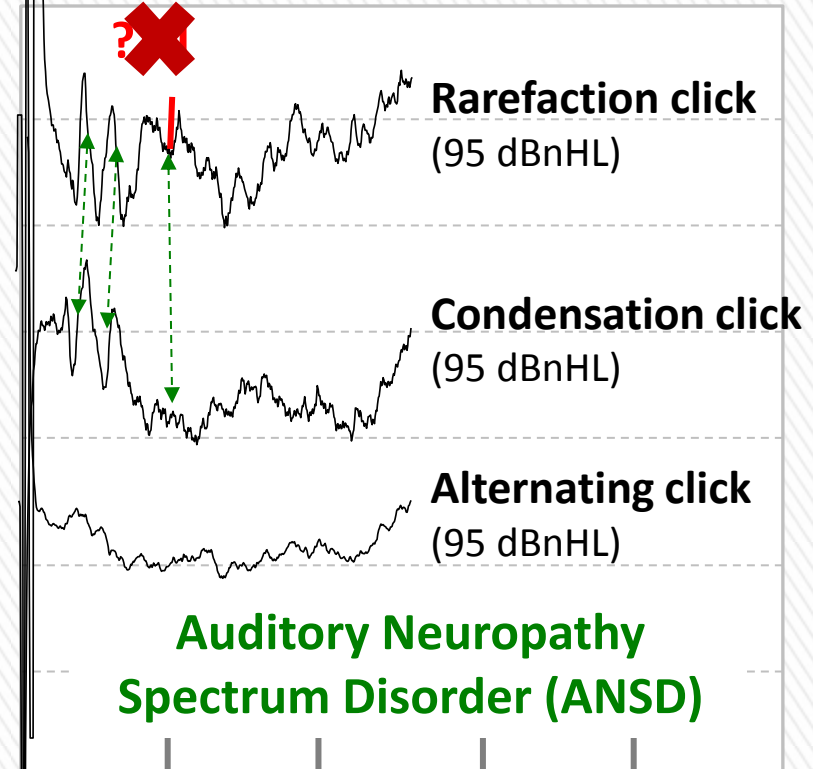
4 kHz



4 8 12 16

Time (ms)

'click' Cochlear Microphonic (CM)



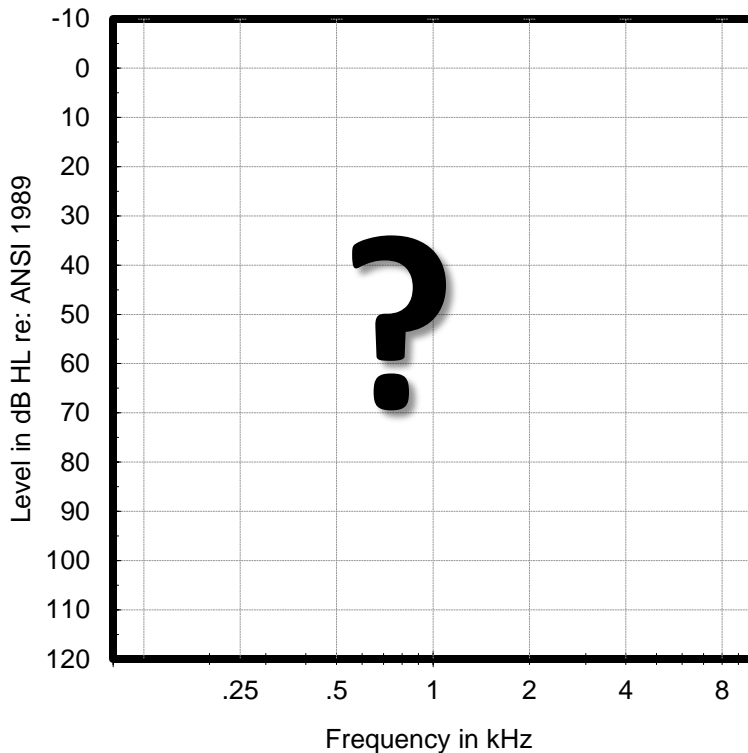
4 8 12 16

Absent ABR, profound loss?



Scenario 2

- Case 3, Auditory Neuropathy Spectrum Disorder (ANSD)



Parents Observed baby waking up when there was a noise in the next room



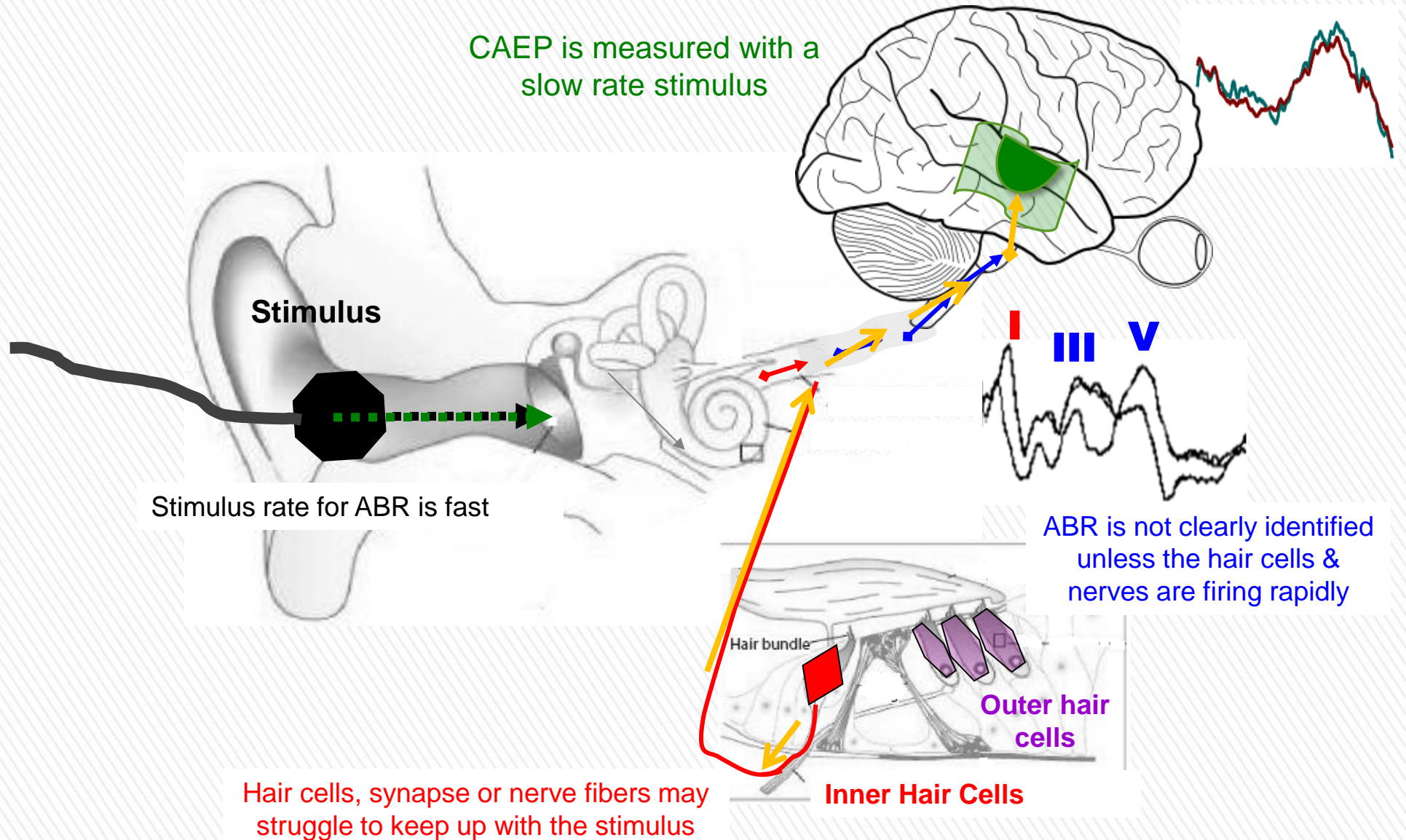
Behavioural Observation Audiometry (**BOA**) showed a 'startle' response with a loud rattle



Cortical Auditory Evoked Potential (**CAEP**) testing arranged

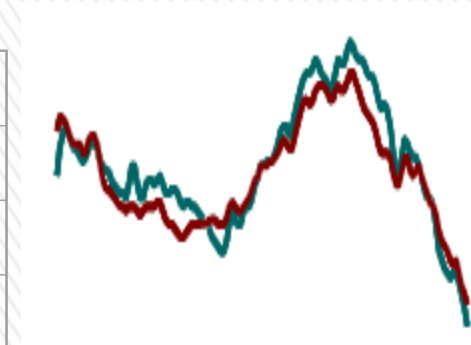
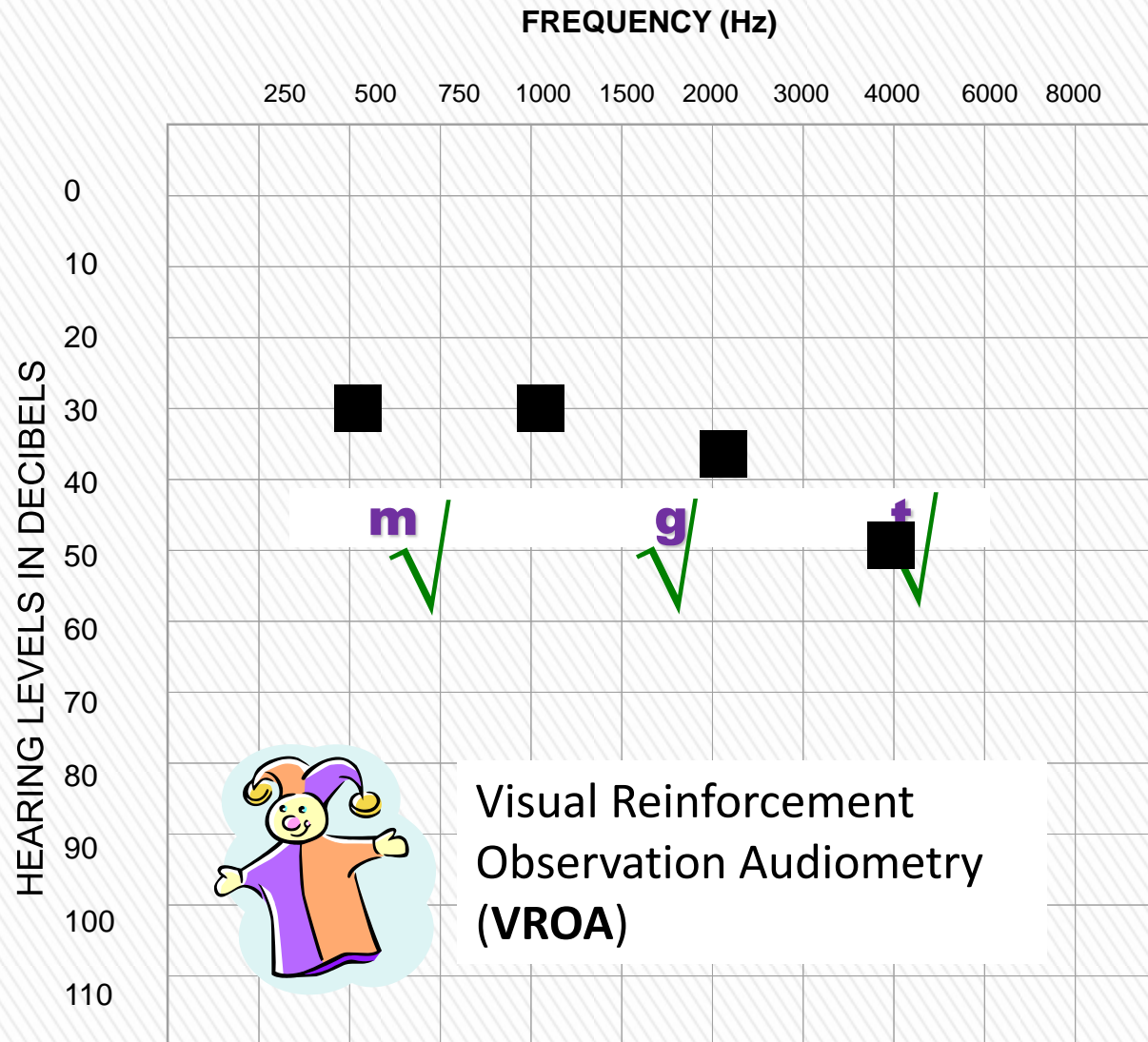


CAEPs & ANSD: Just because there isn't synchrony to rapid stimuli at brainstem level doesn't mean sound isn't getting through at all



Scenario 2

- Case 3, Auditory Neuropathy Spectrum Disorder (ANSD)



CAEPs present at
65 dB SPL
(conversational levels)

Later **behavioral**
testing showed
a **mild to moderate**
hearing loss





Key messages for the diagnosis & management of infants with hearing loss



Summary: Key messages



1. Infant diagnostic audiologists play a very important role in **linking** newborn hearing screening to timely & effective early intervention



Screening – Diagnosis - Intervention

1 mth

3 mths

6 mths

2. Audiologists should **choose the order of each test carefully** to get the maximum amount of information at each appointment



3. A **full battery** of tests needs to be used to determine the **degree**, **type** and **configuration** of the hearing loss. This includes ABR (air & bone conduction), OAEs, Tympanometry, behavioral observation, and CAEPs (if possible)



Thank-you for listening

谢谢你听

