MANUAL FOR TRAINING
VILLAGE HEALTH WORKERS
IN DPOAE SCREENING AND ASSISTING IN ABR
(The original manual was developed in Tamil)
This manual and CD was prepared as material for the training program to train village health workers in DPOAE screening and assisting in ABR

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WORKSHOP MATERIAL
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Introduction to hearing screening

a) Why should hearing be screened?

Hearing loss is one of the most common birth defects. The prevalence of hearing impairment in India is about 63 million.

Difficulty in identifying hearing impairment

Unlike physical and visual impairment, hearing impairment is ‘invisible’ as it is a condition that affects function and hence is not obvious. 90% of children with hearing impairment are born to parents without hearing loss hence parents or family members may not suspect hearing loss in their child.

Also, if hearing loss is “total” it is easier for parents and care givers to identify, as the child will not respond even to loud sounds. However the milder losses goes undetected until as responses are absent only for soft or moderate sounds. Thus, there may be no clear indication of presence of hearing loss.

Though hearing loss can be detected at birth and amplification can be fit even as early as 4-5 weeks. Children can develop hearing loss at any age. Many school going children develop temporary hearing loss due to ear infections, malnutrition can result in weakening of auditory nerve which may lead to poor speech understanding.

Consequences of hearing impairment

Hearing impairment, if not detected early and intervened, can have a significant impact on a child’s life. The age at which hearing loss is detected is critical for:

- Language development
- Socialization
- Psychosocial development
- Educational achievement
- Vocational achievement

Therefore, in order to curtail these effects one must put their effort on early detection of hearing loss.

| Early detection + Early intervention = Better chance for optimal development |

You as a community worker involved in hearing screening can help these children receive appropriate diagnosis and rehabilitation at the earliest.
Parts of the ear

The ear has three main parts: Outer, Middle and Inner ear.

- **Outer ear:** is the pinna and the ear canal portion up to ear drum
- **Middle ear:** is the space behind the ear drum, which houses three tiny bones
- **Inner ear:** has a small snail shape structure called “Cochlea”, it is fluid filled and has tiny hair like structures that codes sounds

![Diagram of ear parts](image)

When sound hits the ear drum, the ear drum vibrates and sets the three tiny bones to vibration which further pushes the inner ear fluid. This stimulates the tiny hair like structures and the nerve which carries the sound sends it to the brain and helps in perception.

Infection/damage to the external or middle ear is likely to result in temporary hearing loss, which can be reversed, however, damage of inner ear leads to permanent hearing loss which is irreversible.

**Causes of hearing impairment**

Some of the factors that are known to cause hearing loss are as follows:

- **Before Birth:**
  - Family history of childhood deafness
  - Marriage between close relations such as uncle-niece, first cousin.
  - Blood group complications or Rh incompatibility
  - Infectious diseases or illnesses during pregnancy (e.g. German measles or Rubella with fever, mumps)
  - Poor physical condition of the expectant mother.

These factors affect the inner ear.
b. During the Birth Process:

- Birth Asphyxia (lack of oxygen supply to the new born due to inability to breathe normally resulting in blueness of baby due to various reasons).
- Delayed or feeble birth cry.
- Birth weight less than 2500 grams.

These factors also affect the inner ear.

c. After Birth:

- Pre–maturity.
- Deformities of ear, nose, face & throat.
- Jaundice, high fever or convulsions immediately after birth.
- Infectious diseases (e.g. whooping cough, mumps, measles, meningitis, viral fever, T.B.)
- Intake of antibiotics for a long duration. (especially those known to be ototoxic)
- Injury to the head and/or ear – (by accidents)
- Middle ear infections or ear discharge

All of the above factors also affect inner ear except middle ear infection/ear discharge, which affects middle ear.

b) How is hearing screened?

Some of the informal methods of screening hearing are:

Parent report- Where, parent’s feedback about child’s hearing is used as an indicator of possible hearing loss. Example: repeated ear infections, report of no response to sound.

Behavioral responses- Involves observing response of the baby to sound stimuli such as clap, name call, drum beat, bell etc.

High-risk register- Consists of a list of possible factors that cause hearing loss. This information is obtained from parent or hospital records. If one or more factors are present then it is considered as a risk for hearing loss.

The above three methods are informal / subjective and not reliable as screening method.

Instruments based tests, OAE and BERA screening, are more objective and hence reliable. The instrument is used to screen hearing and result of “Pass” or “Refer” will be displayed on the screen. “Pass” indicates, “No concern of hearing loss”, “Refer” indicates, “Concern of hearing loss” and hence further testing is required. Hence, these tests are more direct.

OAE is quick, simple and painless. OAE is the preferred method of screening hearing all over the world.
c) Principles of OAE screening:

- OAE primarily is for inner ear screening, however, OAE screens auditory pathway from outer ear to inner ear.
- A probe delivers a clicking sound to the ear, and records an echo emitted from inner ear/cochlea.
- Only if outer ear and middle ear are normal echo from inner ear can be recorded.
- If the baby has wax in the outer ear or middle ear infection/cold which fills the middle ear with fluid, the sound pathway gets blocked and baby will “Refer” the OAE screening. Hence, it is best to avoid screening if baby has ear infection/cold.
- If outer ear, middle ear is normal, and OAE result is “Refer” then it indicates damage to the inner ear and further testing must be done to confirm if hearing loss is present.

<table>
<thead>
<tr>
<th>Remember: OAE is</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Only the 1st step in process of hearing assessment</td>
</tr>
<tr>
<td>o Does not diagnose hearing loss</td>
</tr>
<tr>
<td>o Only identifies those at risk</td>
</tr>
<tr>
<td>o Sensitive enough that 96% of the babies with normal hearing will “Pass” screening</td>
</tr>
</tbody>
</table>

**Learning to conduct OAE screening:**

a) OAE instrument and accessories- Refer page 12

b) Preparing the screening environment

Screening is accomplished most effectively in a quiet environment. Although it is not necessary, you may want to be in a room where you can close the windows when there is excessive street noise or close the doors if there are children nearby who are crying, shouting or playing with noisy toys. Remember that the equipment is trying to pick up a very small echo generated by the inner ear.
If the child is sitting on a chair or held on a parent’s lap, you will need a table nearby to place the equipment on. If the child is sitting on the floor, you may choose to sit on the floor too and place the unit on the floor. It is important to make the screening as pleasant as possible.

Make sure you have quiet toys and distracters in hand that the child can play while being screened. Feeding is not a good idea as sucking / chewing can be a source of internal noise. So avoid these.

In summary, remember to:

- Screen in a quiet place
- Close windows (if applicable)
- Seat the baby on mother’s lap/ in a comfortable position
- Identify where you will place the equipment
- While screening older children (> 1 year) avoid noise makers to play with child or distract child
- Preferably screen when baby is asleep
- Avoid TV noise / Radio
- Avoid screening when baby is being fed
- Avoid screening when other children are talking or screaming, inform people around to stay quiet during testing

c) OAE screening process: Refer page 15

OAE screening and follow – up protocol

i. It is most important to identify children <1 year of age in each village.

ii. Plan your visit to their home. Inform ahead of time about screening hearing and time taken.

iii. Screen the baby’s hearing – If the result is “Pass”, inform parent that “there is no concern of hearing loss” and counsel them about hearing hygiene. If result is “Refer” inform, “there is a possibility that child has hearing loss, however this test is not confirmatory”. Explain that that the test should be repeated within 15 days.

iv. If the screening result is ‘Refer’ at re-screen, baby should be evaluated by Audiologist in the tele- van for babies tested in Thirukazhukunram or at SRU for babies tested at Maduranthagam

v. Inform the date of ABR test

vi. Remind parents, of babies who have to be re-screened, or tested with ABR, 2 days prior to date of appointment
Trouble shooting OAE instrument problems: Refer page 23

Assisting in ABR

ABR test helps in assessing the auditory pathway from the outer ear to the nerve. This test is used to confirm the presence of hearing loss and to estimate the severity of hearing loss. Your role in this test will ONLY be to prepare the baby for testing.

Steps in preparing the child for ABR test

1. Seat the baby on the mother’s lap or on the bed. This is to ensure that the child is comfortable

2. Take some cleaning gel on cotton. Rub and clean the child’s skin on upper and lower forehead and behind the two ears (on the bony part). Apply enough pressure while rubbing. The skin may appear red, in that case, rub another site and then return back to the same site for rubbing. This step is very important for getting accurate test results

3. Next step is to fix the electrode wires on the child’s skin. Remove the plastic cover on the white colored electrode disc. Place the sticky portion on the skin area that was cleaned. Ensure that there is no hair caught between the skin and electrode disc. The disc should be well adhered on the skin.

4. Place the insert earphones with the ear tip in the child’s ear canal (of the ear to be tested). The insert will deliver clicking sounds to the ear. Ensure the tip is inserted well in the canal to avoid and sound leakage.

Once the above steps are completed, the child is ready to be tested by Audiologist

Refer CD for video demonstration on preparing the child for ABR testing.

Things to remember for ABR testing:

- Inform parents ahead.
  - Date and approximate duration (1 hour) of test
  - The child should be asleep for the test so it helps to bring the child when he/she is sleepy.
  - Mother/caregiver should accompany child for test
Instruct parents to avoid…

- Applying oil on the baby’s face or hair
- Applying kajal
- Bringing the child for testing (tele-van/SRU) if child has severe cold/ fever

In the tele-van…

- Indicate to the Audiologist when the child is ready for testing
- Inform the audiologist when child moves/ wakes

This will help the Audiologist test the baby and provide quick and accurate results

**Role and responsibilities of VHW:**

You have the following role to play in the project:

1. Identify children from 0-5 years of age in the village with a special attention to new born/babies <1 year of age in the villages
2. Talk to parents in community about hearing screening
3. Provide information to parents/caregivers regarding the test to be conducted
4. Obtain parent consent
5. Complete screening effectively
6. Complete administrative duties associated with screening protocol
   - Document the results in data sheet
   - Inform parents about results. It is important to use appropriate words while conveying test results
     For example: Since screening is not a confirmatory test it is best to say “your child ‘referred’ from screening and therefore will need follow-up screening. Do not use the word “did not pass” or “failed” screening while explaining test result. While you should convey the importance of screening you should not cause stress unnecessarily.
   - Provide educational material on hearing health
   - Coordinate follow-up screening, diagnostic testing in tele-van/ SRU hospital
- Prepare monthly activity plan
- Prepare monthly report of work done

**Future direction:**

If a child is identified with hearing loss:

- Drugs and surgery are useful in treating middle and outer ear problems.
- In case where the hearing impairment is irreversible, hearing aid fitting is recommended.
- The rehabilitation process includes training to make the best use of residual hearing, speech–language stimulation and therapy and the services of special educators.
- Early identification and intervention & family support are important factors which determine the success of a rehabilitation program.

Your support will help people in this community get hearing care and appropriate follow-up in a timely manner.
INSTRUCTION MANUAL
OAE INSTRUMENT AND ACCESSORIES

Equipment box
Holds the OAE instrument, the charger, the probe and the power cord.
Carry the instrument safely in this box to prevent any damage to the equipment.

OAE instrument
Used to screen hearing.
Do not expose instrument to heat or cold.

Probe
Delivers the sound stimuli to the ear and measures otoacoustic emissions.
Use and maintain the probe carefully.
*Refer page 26, 27 for probe handling guide and steps for cleaning*
Connecting Cord
Connects the probe wire to the OAE instrument

Charger
Used to charge OAE instrument. Connected at one end to OAE and other to power cord.

Power cord
Connected to charger at one end and to power supply at the other end.
Ear Tips
Attached to the probe before placing probe in ear canal. Ear tips are available in various sizes.

Ear Tips Box
Used to store ear tips. Each size has a separate compartment.
OAE SCREENING PROCESS

1. Switch on the instrument by pressing the button on the left corner of the OAE instrument.

2. Once the instrument switches on, the right ear indicated as [R] will be highlighted. Begin the test by pressing the TEST option, as indicated in this picture.

3. Visually examine the outer ear to see if it is well formed. Check if ear canal portion is clean and free of discharge or any debris. Select the appropriate tip after examining the ear canal. Commonly used ear tips sizes for infants are 3.5mm (yellow), 4mm (pink) and 5mm (blue) ear tips. Use clean ear tips.
4. Attach the selected ear tip on the probe.

5. To test the right ear, place the ear tip in the right ear canal by gently pulling the pinna downward and backward. Probe should be well fitted in the ear canal. Avoid holding the probe.

6. If the tip size is inappropriate or if the probe is not placed correctly, a message will be displayed as ‘The probe is not completely sealed. Please adjust probe. TEST again or STOP’.

If this message appears, adjust the ear tip or change the ear tip to the appropriate size and press the RETRY option.
7. If a message “NOISY” is displayed, it indicates that the environment is noisy (e.g. baby sucking, moving, fan sound etc).

Ensure the environment is quiet and baby is still and press the RETRY option.

8. If the above two problems are overcome, test begins from 4000Hz. When the test begins, the horizontal black bar progresses indicating that the testing is in progress.

9. Once the test is completed at 4000Hz, result will be displayed as PASS or REFER on the screen. The instrument then screens at 3000Hz and 2000Hz in a similar manner.
10. Once all the frequencies are tested in the right ear, press the **DOWN** button in the screen to test left ear. The Left ear indicated as **[L]** gets highlighted.

11. Press the **TEST** option. Follow the same procedure as performed for the right ear.

12. Once testing for both ears is completed, the results for both the ears will be displayed as shown. Document the result of each frequency and the overall result for both ears in the data sheet.

**PLEASE ENSURE THAT THE RESULT IS NOTED BEFORE YOU SWITCH OFF THE OAE INSTRUMENT.**

Do not forget to remove the ear tip and clean with cotton and spirit.
13. Switch off the instrument by pressing the button. The following message will be displayed ‘Are you sure you want to shut down?’ Press the option. The instrument will shut down.

Three keys to successful screening are:

a) Good probe fit.

b) Minimizing external noise.

c) Minimizing internal noise (feeding, chewing etc)

Refer CD for video demonstration on OAE screening process
CHARGING OAE INSTRUMENT

Switch on the power button. Watch for red/green light. If the light is red, then the instrument is not charged, or the battery is low and needs to be recharged.

1. Connect the pin (a) of the charger to the socket (b) of the OAE instrument.

2. Connect one end of the power cord (c) to the charger.

3. Connect the plug (d) of the power cord to the power socket. Switch on the power supply. Charging will begin.
Full charge is indicated by a filled battery symbol on the right corner of the OAE instrument.

Charging time should not exceed 2 hours.

Each time you charge the battery will last for 24 hours.
EQUIPMENT MAINTENANCE
## TROUBLESHOOTING

Following table will help you attend to some of the errors/ problems related to the OAE instrument

<table>
<thead>
<tr>
<th>DISPLAY MESSAGE</th>
<th>WHAT TO DO?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you sure you want to shutdown?</td>
<td>If you need to shutdown, press YES, if not, press NO.</td>
</tr>
<tr>
<td>Are you sure you want to delete all of the records in the database?</td>
<td>If you want to delete, press YES, if not, press NO.</td>
</tr>
<tr>
<td>Are you sure you want to delete this record?</td>
<td>If you want to delete, press YES, if not, press NO.</td>
</tr>
<tr>
<td>Are you sure you want to delete this configuration?</td>
<td>If you want to delete, press YES, if not, press NO.</td>
</tr>
</tbody>
</table>

### 1. Confirmation of certain user commands

- **Notification of Internal Processing.**
  - The records are deleted

### 2. Notification of Internal Processing.

### 3. Conditions that require intervention

- The probe is not completely sealed. Please adjust probe. TEST again or STOP?
  - Adjust the probe or change the ear tip to the appropriate size and press TEST. If you want to stop the test, press STOP.

- The test environment is too noisy. TEST again or
  - Reduce the environmental noise (e.g.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baby sucking, moving (etc)</td>
<td>Press TEST. If you want to stop the test, press STOP.</td>
</tr>
<tr>
<td>One or both of the test frequencies cannot be calibrated. Please check probe tip, probe module, probe placement or ear canal.</td>
<td>Test again or STOP? Check the probe tip, probe module, probe placement or ear canal. Then press TEST. If you want to stop the test press STOP.</td>
</tr>
<tr>
<td>The battery is too low to begin testing. Please charge the battery before continuing.</td>
<td>Charge the battery and continue the test.</td>
</tr>
<tr>
<td>The GSI AUDIO screener battery is critically low. Please discontinue operation and apply the battery charger immediately.</td>
<td>Stop the test and charge the battery.</td>
</tr>
<tr>
<td>The GSI AUDIO screener battery is too low to continue operation. Shutting Down….</td>
<td>Charge the battery immediately for at least 2 hours.</td>
</tr>
<tr>
<td>4. Conditions that do not require intervention.</td>
<td>There are no records in the database</td>
</tr>
<tr>
<td></td>
<td>The test was stopped by the</td>
</tr>
</tbody>
</table>

**Contact Us**
<table>
<thead>
<tr>
<th>operator</th>
<th>Contact Us</th>
</tr>
</thead>
<tbody>
<tr>
<td>You may not delete the default configuration.</td>
<td></td>
</tr>
<tr>
<td>The data cannot be saved because the storage capacity for this device has been exceeded.</td>
<td></td>
</tr>
<tr>
<td>Blank patient IDs are not allowed.</td>
<td></td>
</tr>
<tr>
<td>The specified ID is already in use.</td>
<td></td>
</tr>
<tr>
<td><strong>Internal error conditions.</strong></td>
<td></td>
</tr>
<tr>
<td>5. A start up error has occurred. There is not enough memory to initialize this devise</td>
<td></td>
</tr>
<tr>
<td>The patient data may be corrupted.</td>
<td></td>
</tr>
</tbody>
</table>
PROBE HANDLING GUIDE

1. The probe is ONLY to be used for hearing screening purposes.
2. Store probe in its proper packaging when not in use.
3. Handle the probe wire with care. Do not excessively twist, bend or stretch the probe wire.
4. DO NOT insert ANY object(s) into the probe head. This can cause permanent damage to the probe. Only use the cleaning floss to clean the probe tip.
5. Do not clean the probe tip when it is attached to the probe wire.
6. Do not use water or any kind of liquid to clean the probe.
7. For instructions on cleaning the probe, please refer page 27.
8. NEVER use the probe without an ear tip in place.
9. Do not drop or cause undue impact to the probe.
CLEANING THE PROBE

1. Remove the probe by squeezing and applying pressure while turning counter clockwise.

2. Lift off the probe tip.

3. Insert the stiff end of the cleaning floss brush into the hole of the probe tip.

4. Pull each cleaning floss completely through the probe tube, cleaning all three tubes.

5. Before reattaching the probe tip, verify that the gasket is positioned over the three holes in the probe.

6. Reattach by realigning the three tabs on the probe tip with the notches in the probe body.

7. Squeeze, apply inward pressure, and turn the probe tip clockwise until the white lines match. The probe tip must fit tightly and not feel loose or wobbly.
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