Selection, utilisation and maintenance of assistive technology

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OUTLINE OF PRESENTATION

- Part 1: Introduction
- Part 2: Hearing aids
- Part 3: Fm systems
- Part 4: Strategies for the teacher
- Part 5: Questions

Introduction

Past 3 ½ decades: tremendous gains achieved in speech & hearing sciences

These conceptual & technological advances have improved the lives of children with HL in ways that would have seemed inconceivable 4 decades ago…

NEW GENERATION of children with HL

- **Identified at/ shortly after birth (+- 2 months)**
- **Early amplification (3 months)**
- **Better hearing technology**
- **Early intervention (3 months)**
- **Increased family support/ education**

(Gabbard, 2004)

SOUTH AFRICA: What's happening?

	WESTERN CAPE (n=54) (Van der Spuy, 2005)	GAUTENG (n=20) (Venter & Viljoen, 2008)
Hearing screened at birth	24%	35%
Mean age of diagnosis	23 months	31 months
Mean age of initial HA fitting	28 months	39 months
Mean age of enrollment into EI program	31 months	43 months
Diagnosed before 12 months of age	37%	47%
Average time-interval between diagnosis and initial HA fitting	5 months	8 months
Average time-interval: diagnosis and initial enrollment into an intervention program	8 months	12 months

NEUROLOGICAL FOUNDATIONS

- We hear with the brain - the ears are just a way in. The problem with a hearing loss is that it keeps sound from reaching the brain.
- In order for auditory pathways to mature, acoustic stimulation must occur as early as possible.
- Full maturation of central auditory pathways is a precondition for the normal development of speech & language skills in children, whether or not they have a hearing loss.

NEUROPLASTICITY

The purpose of a cochlear implant/ hearing aids is to access, stimulate and grow auditory neural connections throughout the brain as the foundation for spoken language, reading & academics.

HEARING vs LISTENING

- **HEARING** = acoustic access to the brain (managing the environment and utilizing hearing technology)
- **LISTENING** = attending to acoustic events with intentionality

Sequencing is NB:

HEARING must be made available before LISTENING can be taught.

PRACTICE, PRACTICE, PRACTICE !!

NO skill is acquired without PRACTICE.

Children learn to walk by practicing walking.
They learn to listen by practicing listening.
They learn to talk by practicing talking.

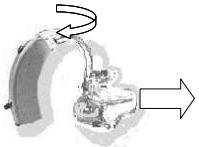
A great deal of practice is necessary for the acquisition of auditory skills.

Hearing aids

- Hearing aids are expensive.
- Hearing aids aren't like glasses.
  - You need to be an informed consumer.
  - You need to know how to use the aid.
- There are a lot of misconceptions about hearing aids.

All Hearing Aids Are Alike

- Sound goes in the Microphone.
- Sound gets amplified.
- Sound comes out the Speaker into your Ear



All Hearing Aids Are Different

- Style (Small is best?)
- Technology (Digital is only way to go?)
- Features (More is better?)
- Settings (your 'prescription')

Style

- Body
- Behind The Ear (BTE)
- In The Ear (ITE)

- In The Canal (ITC)
- Completely In the Canal (CIC)

Issues in amplification

- Appropriate test battery
- Necessary audiometric data
- Selection of amplification

- Ear moulds
- Verification of amplification
- Evaluation of auditory performance
- Counseling
- Follow-up recommendations
- Referral to early intervention
- Use of FM technology

Selection of Amplification

Ear moulds:

- initially soft moulds (silicone/vinyl) later on acrylic
- need proper impressions!
- replace moulds often (growth of ear canal)
- challenge of feedback

Selection of Amplification (cont)

Hearing Aids

- Practicality & flexibility NB
- Robust
- Air vs bone conduction
- Style (BTE)
- Size
- Pediatric-sized tone hooks
- FM compatible

Selection of Amplification (cont)

Hearing Aids

- Bilateral vs unilateral fittings
- Battery doors (tamper-resistant)
- Volume control

Selection of Amplification (cont)

BONE–CONDUCTION HA

BTE HA

Orientation & training

To promote consistent HA use, parents and/or caregivers & educators need information about proper care, appearance & benefits of HA's

- **Demonstration NB (how to put in/ take out/ take apart/operate HA's)**
- **Parents' skills & comfort will affect child's adjustment**
- **Practice & repetition NB (as with any new skill)**
- **Daily listening checks vital**
- **All orientation info should be provided in written form**
- **NB to keep on repeating/reviewing info with each session**

Orientation & training (cont)

Should include:

- Care & cleaning of HA's
- Suggested wearing schedule & retention
- Overnight storage
- Insertion/ removal
- Battery life/disposal/toxicity
- Insertion & removal of batteries
- Basic troubleshooting
- Assistive device coupling
- Moisture solutions
- Tools for maintenance & care
- Follow-up appointments to monitor use & effectiveness

HA maintenance suggestions

- Protect HA's against exposure to excessive heat from sources such as hair dryers, heaters etc.
- Avoid exposing HA's to excessive humidity of rain, saunas, steam baths, or when HA's have been placed in a pants pockets and sent to the laundry
- Place HA's in a container with silica jel at night to remove any moisture, particularly for persons who perspire heavily
- Prevent hair sprays and other sprays to be directed at the HA's

HA maintenance suggestions

- Clean ear molds and tubing periodically with mild soap and water or commercially available cleaning solutions
- Keep HA's away from dogs and small children when not wearing them
- Remove HA's from the ear and handle them over a soft surface, so that if dropped, potential damage is reduced

Limitations of amplification

- HA users often have unrealistic expectations of HA's
- Impossible to restore hearing to be "normal" again…
- A very positive, although straightforward approach may be required with a family member who is extremely skeptical about the benefits of amplification
- On the other hand, a guarded and realistic approach may be needed for someone who expect HA's to solve all their problems (especially when discrimination abilities are significantly reduced)
- Have to be realistic about type of technology, 1 vs 2 HA's etc…

Follow-up

MINIMALLY the audiologist should see the child:

- Every 3 months (during the first 2 years of amplification)
- Every 4-6 months after that time
- Semi-annual visits are appropriate for most children from 2-6 years of age
- Annual follow-up thereafter (unless hearing-loss progression risk factors are present

THE CHILD WITH A HEARING LOSS's CHALLENGES WITHIN THE EDUCATIONAL SETTING

ACOUSTICAL challenges

- **educational environment** (size of classroom, number of learners per class, noise levels, distance seated from speaker)

Why use other assistive listening devices?

- Why aren't hearing aids enough?
- What do hearing aids do?
  - soundS > sounds
- What do ALDs do?
  - sounds > sounds

Assistive Listening Devices (ALD's): Personal worn & sound field FM systems

HA's = the initial form of amplification for children, BUT HA's are not designed to deal with all listening needs

Their biggest limitation is their inability to make the details of spoken communication available under the following conditions:

- When there is competing noise
- When the listener cannot be physically close to the speaker
- When both these conditions exists together

Signal-to-Noise Ratio (S/N ratio)

- Also called Speech-to-Noise Ratio
- S/N ration = the relationship between a primary signal (such as the teacher's speech), and background noise
- NOISE= everything that conflicts with the auditory signal of choice (other talkers, heating/ cooling systems/ classroom noise/ playground sounds/ computer noise, wind)
- The quieter the room and the more favorable the S/N ration, the clearer the auditory signal will be for the brain
- The further the listener is from desired sound source & the noisier the environment, the poorer the S/N ratio and the more garbled the signal will be for the brain

Signal-to-Noise Ratio (S/N ratio)

Hearing-in-Noise presents the biggest of all challenges to hearing aid manufacturers!

Signal to Noise Ratio (SNR):

- **The relative difference in intensity level between the primary signal and the competing background noise.**

Examples:

- **SNR 0 = signal and noise are of same intensity**
- **SNR +10 = signal is 10 dBHL louder than noise**
- **SNR –10 = signal is 10 dBHL less than noise**

Signal-to-Noise Ratio (S/N ratio)

- Adults with normal hearing & intact listening skills require a consistent S/N ration of approximately **+6 dB**
  (the desired signal should be about twice as loud as background noise for the reception of intelligible speech)
- Children need a much more favorable S/N ratio because their neurological immaturity and lack of life and language experience reduce their ability to perform auditory/ cognitive closure

  They need the desired signal (including their own voice) to be about 10x louder than the competing sounds, thus S/N ration of about **+15 to +20 dB**

Signal-to-Noise Ratio (S/N ratio)

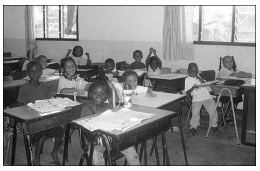
ALL CHILDREN NEED A

QUIETER ENVIRONMENT AND **LOUDER SIGNALS**

THAN ADULTS DO IN ORDER TO LEARN

Signal-to-Noise Ratio (S/N ratio)

- Typical classroom:
  S/N ration about +4dB or even 0 dB
  (due to noise, reverberation and variations in teacher position)
  Thus even less than ideal even for adults with normal hearing



Assistive Listening Devices (ALD's): Personal worn & sound field FM systems

Because a clear and complete speech signal is crucial, some means of improving the S/N ratio must be provided in all of a child's learning domains

ALD's =
describe a range of products designed to solve problems of NOISE, DISTANCE from speaker and room REVERBERATION or echo that can not be solved with a HA alone

ALD's enhance the S/N ration to improve the intelligibility of speech and expand the child's distance hearing and incidental learning

Assistive Listening Devices (ALD's): Personal worn & sound field FM systems

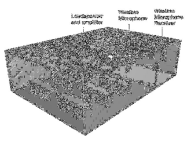
Conditions that might compromise a listening environment, and where ALD's may be helpful:

- **AMBIENT NOISE**: noise that is present in a room when it is unoccupied (may originate from open windows, air-condition systems, computers, etc.)
- **REVERBERATION**: echoes cause by sound rebounding/ reflecting off surfaces such as walls/ floors/ ceilings
- **BACKGROUND NOISE**: undesirable noise that masks the auditory signal of interest.

Assistive Listening Devices (ALD's): Personal worn & sound field FM systems

- Traditionally, personal-worn FM systems coupled to HA's have been used for school-aged children in school settings, but growing evidence suggests that infants and toddlers also can benefit from a personal FM system used at home

- Sound field amplification technology is an exciting educational tool that allows control of the acoustic environment in a classroom, thereby facilitation acoustic accessibility of teacher instruction for all children in the room



WIRELESS ALD SYSTEMS

- Wireless systems: does not use wire between the microphone & the unit that delivers the signal to the user's ear.
- Sound is transmitted by means of **radio waves** or **infrared** (invisible light) signals
- This system picks up the audio signal (either through microphone place d near the sound source or by means of a direct electrical plug-in)
- Sound is then converted into an electrical signal by a transmitter and delivered through the air to a receiver worn by the user [by means of radio waves or infrared]
- Signal is delivered to ear via earphones or thought the individual's HA/CI processor.

Wireless system: FM SYSTEM

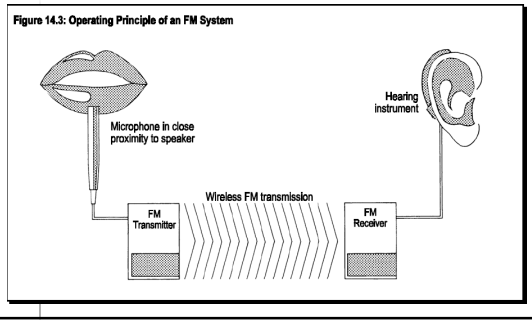
FM (Frequency Modulation) systems utilize radio waves to transmit sound from the source to the user.

Frequency Modulation = the process of creating a complex signal by means of sinusoidally varying a carrier wave frequency.

The **transmitter** couples with the sound source via direct input from a microphone

The **receiver** couples to the person via direct input into the person's hearing instruments (HA's or CI) or through speaker or a loop system

Wireless system: FM SYSTEM



Wireless system: FM SYSTEM

Personal FM trainer

An ALD in which the speaker wears a wireless microphone and the speech is frequency modulated on radio waves transmitted through the room to the listener who wears a receiver.

The receiver may connect to the person's HA by a direct auditory interface (DAI) and an audio boot connection OR person may wear an FM boot at the bottom of the HA.

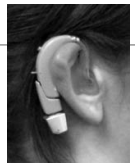
Some FM systems utilize a neckloop that transmits to the HA via the HA's telecoil

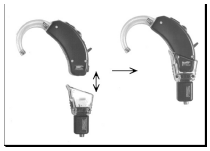
FM SYSTEM: Personal FM trainer

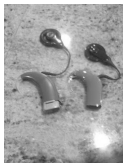
FM boot

Bootlike device that houses an FM receiver.

It attaches to the base of the BTE HA or speech processor of the CI







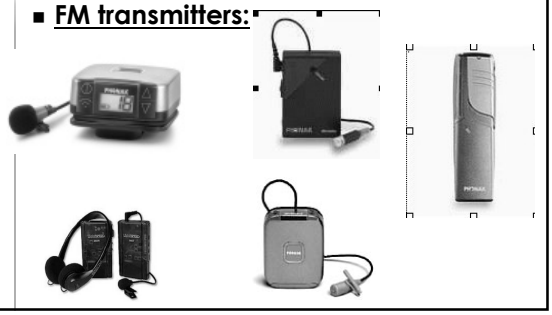
FM SYSTEM: Personal FM trainer

Neckloop

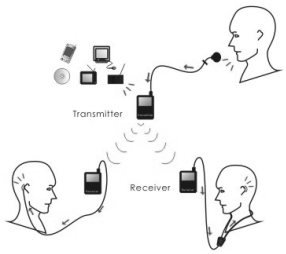
Transducer worn around the neck. Transmits signals via magnetic induction to the telecoil of the user's HA

FM SYSTEM: Personal FM trainer

- **FM transmitters:**



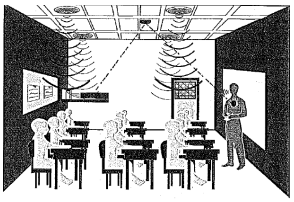
FM SYSTEM: Personal FM trainer



FM SYSTEM: Personal FM trainer

Sound-field FM system

An ALD, similar to a FM trainer, in which sound from a microphone is transmitted to loudspeakers that are positioned throughout the room (thus beneficial to the entire audience)



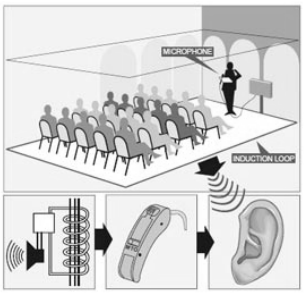
Wireless system: Induction Loop System

An Induction Loop System =
a system that works by running a wire around the circumference of a room or table that conducts electrical energy from an amplifier and thus creates a **magnetic field**, which induces the **telecoil** in a hearing aid to provide amplified sound to the user.

The listener must sit either inside of the loop or wire or beside it.

Some religious settings, classrooms and theatres have permanent loop systems in place.

Wireless system: Induction Loop System



Talker & listener physical positioning

- 1 strategy for improving S/N ration = move closer to the infant's or child's ear so that the talker's voice will take priority over all background sounds
- Yelling from across the room promotes only **AUDIBILITY** (hearing the presence of speech), **NOT INTELLIGIBILITY** (hearing differences among speech sounds)
- An average loudness of speech very close to the ear facilitates intelligibility of the speech signal for the listener

FM Advantages

- Very portable
- Very easy to set up and use
- Offers great flexibility of movement
- Used indoors or outdoors
- Appropriate for mild to profound losses
- Receiver can be covered or put in pocket
- No fluctuation in strength of signal

FM Advantages

MAIN BENEFITS OF A FM SYSTEM:

- With FM system the speaker (teacher) is free to move around the classroom whilst staying audible to the child with the FM system
- Portable: goes with child wherever he/ she is

FM is useful when there is a distant speaker, room with poor acoustics (echoing of sound), background noise

AMPLIFICATION: tactile communication devices

Tactile Communication Devices=
analyze sound into frequency bands and converts the frequency bands into signals that are felt on the skin as vibrations from electrical impulses.

Could provide some cues of the speech spectrum

Who are candidates?

- **Some children around the world with profound deafness don't have access to cochlear implants & their families have spoken language as a desired outcome**
- **Deaf-blind children**

Tactile aids can be worn on the sternum, abdomen, neck, knee, fingers.

Insufficient funding?

Acoustic absorption can be added to the ceiling (as here) or to the ceiling and walls

Insufficient funding?

- Carpets and curtains

STRATEGIES FOR THE CLASSROOM TEACHER

- Encourage the child to respond to his name through listening
- Call the child to get his attention before talking to him
- Engage in rich verbal communication with the child by using a natural voice
- Allow pause time and allow time for the child to process auditory information

STRATEGIES FOR THE CLASSROOM TEACHER

- Point to or call out a child's name when (s)he is contributing to class discussions, so that the child with a HA can turn towards the child that is talking
- When another child in the class makes a comment, paraphrase or repeat
- Communicate to other team members (speech language therapist) the content or themes covered in the classroom so they can be integrated in individual sessions with the child

STRATEGIES FOR THE CLASSROOM TEACHER

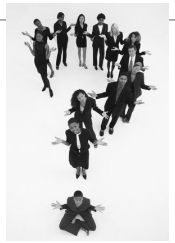
- Collaboration & frequent contact with speech-language therapist / audiologist is crucial
- Use the FM system as specified by the audiologist/ speech language therapist
- Make the room as quiet as possible closing doors and windows and reducing distracting noises from within the classroom. Noise should be minimized as much as possible

Brighter future for children with hearing loss in SA?

- A welcoming and supportive learning environment (classroom)
- A trained teacher with a positive attitude
- Sufficient and appropriate support services - audiologist

"A school should not be a preparation for life. A school should be life." (Elbert Hubbard)

Thank you!!



Questions ??