Learning Outcomes

- To learn about current technology available for children with hearing loss
- To learn how children and families can access hearing services in Oregon

Types of hearing loss

- Conductive
- Sensory (cochlear)
- Neural
- Mixed

Conductive Hearing Loss

- Due to abnormality or dysfunction in the outer and/or middle ear
  - Ear canal atresia
  - Ossicular abnormality
  - Untreatable middle ear disease

Sensory Hearing Loss

- Usually due to abnormal structure and/or function of the cochlear hair cells, or damage to the hair cells
Management of Children with Hearing Loss

• Hearing loss manifests itself as a communication disorder.
• The reason for the disorder is that the signal does not get to the brain.
• Technology allows for the signal to reach the brain.
• Focus on brain development with early intervention and language stimulation.

Communication Development

• Children with hearing loss can develop verbal speech and language similar to hearing peers if:
  1. The loss is identified early
  2. The child has appropriate technology and uses it consistently
  3. The child has appropriate intervention
  4. Family is committed to intervention and language stimulation

Hearing aids

• Best intervention for children with mild to severe hearing loss

Behind the ear (BTE) hearing aids are appropriate for children

Why BTE’s?

• Children’s ears grow quickly. BTE’s use an plastic earpiece (earmold) to fit the hearing aid to the child’s ears. When the child outgrows the earmold, replacing it is fairly inexpensive.
• Safety – the earmold that sits inside the ear is made from soft material. The electronics are outside of the ear.
• Children can use “loaner” hearing aids fit to their earmolds if their hearing aid needs repair or if it is lost.
• Require fewer repairs

Components of hearing aids

• Hearing aid microphone picks up sound
• Amplifier shapes and increases the loudness of sound
• Amplified sound is delivered through tubing into a custom earpiece (earmold).
• The earmold is attached to the hearing aid and it delivers the sound into the ear canal.
Goal of amplification

- Make all speech sounds audible and comfortably loud
- Limit output of hearing aids so amplified sound never exceeds discomfort level
- Amplification adjusts depending on signal
  - More amplification for soft speech
  - Adjust frequency response for noise

Hearing aid technology

- Analog
- Digitally programmable analog
- Digital, programmable
  - Multiple microphones
  - Directional microphones
  - Multiple programs
  - Digital feedback control

Characteristics of hearing aids

- Gain – overall level of amplification/power.
- Frequency response – the amount of amplification the hearing aid provides at different frequencies.
- Saturation sound pressure level – the maximum amount of sound the hearing aid can produce regardless of the incoming signal.
- Compatibility with other hearing technology (FM systems).

How are hearing aids fit in infants and children?

- Probe Microphone Testing - a tiny, soft microphone is placed in the ear canal next to the earmold. The amplification provided by the hearing instrument is then measured while the hearing aid is in place in the ear. The measured response is evaluated and adjustments are made on the computer as needed – for soft speech, average speech and loud speech.

How long do hearing aids last?

- Earmolds need to be replaced every 2-3 months in infants, every 6 months in older children.
- Hearing aids usually need replacement after 3-5 years.
- Batteries need to be replaced every 2 weeks (on average).

*Functional gain* - Behavioral test methods can be used to determine the softest level at which a child responds to speech and sound while wearing a hearing instrument.
- Older children may be asked to repeat words and sentences in quiet and in noise.
- Monitor speech sound development, auditory comprehension, language development.
Cochlear implants

- For children with severe to profound sensorineural hearing loss 12 months or older.
- When hearing aids do not provide enough power to support verbal speech and language development.
- When parents desire that their child to communicate with verbal language.
- Bilateral CI’s are becoming more common.

Cochlear implant components

- A microphone, which picks up sound from the environment.
- A speech processor, which selects and arranges sounds picked up by the microphone.
- A transmitter and receiver/stimulator, which receive signals from the speech processor and convert them into electric impulses.
- An electrode array, which is a group of electrodes that collects the impulses from the stimulator and sends them to different regions of the auditory nerve.

How the implant works

Cochlear implants

- Hearing aids amplify sounds so that they can be heard with impaired ears. Cochlear implants bypass damaged portions of the ear and directly stimulate the auditory nerve. Sound is converted from an acoustic signal to an electrical signal. Signals generated by the implant are sent by way of the auditory nerve to the brain, which recognizes the signals as sound. Hearing through a cochlear implant is different from normal hearing and takes time to learn or relearn.

Bone anchored hearing device (Baha)

- For children with bilateral conductive hearing loss who are unable to wear or benefit from BTE hearing aids.
- Children with unilateral deafness

Conductive hearing loss
How does the Baha work?

- Processor is placed on the skull bone
- Sound vibrations are passed to the inner ear structures through the bone

Options

- Children 5-6 years and older can have titanium fixture surgically placed in the skull bone. Within the month following surgery the fixture becomes integrated with the skull bone. The processor attaches directly to the fixture.

Bone conduction hearing aid

- Older technology for children with conductive hearing loss who are unable to wear BTE hearing aids
- Very few manufacturers
- Metal headband is not child-friendly

FM systems

- Used with hearing aids or cochlear implant
- Teacher/parent wears wireless microphone
- Microphone transmits signal to the hearing aid/FM
- Can also be used with other technology – computer, DVD, IPOD
- Usually provided through the child’s school

Why is FM needed?

- Even with amplification it is difficult to hear over noise and distance
- As teacher moves around the room and noise levels fluctuate, the speech signal is not consistently heard
- FM makes it so that the teacher always sounds like he/she is right next to the student the teachers voice is always louder than the classroom noise
### How can children access hearing technology

- Regional deaf and hard of hearing programs
  - State department of education
  - Audiologic services
  - Sign language
  - Auditory/oral therapy
  - Fitting and monitoring of hearing aids
  - Home or preschool program for infants and young children
  - Support for IFSP/IEP

### Benefits of regional hearing services

- Home-based services for infants and toddlers
- Hearing technology often available to families at cost
- Coordination of services between teacher of the hearing impaired, audiologist, speech-language pathologist, teacher
- Professional services provided at no charge

### How can a child qualify for regional services

- Hearing loss >25 dB HL (500-4000 Hz) or >35 dB HL high frequency loss (3000-6000 Hz)
- Medical statement signed by a physician documenting if the hearing loss is conductive or sensorineural and is not medically treatable.
- Children 5 years and older:
  - Disability has adverse effect on educational performance
  - Child needs special education services due to disability

### Private audiology clinics

- If children do not qualify for regional services (lack of “academic need”, attending private school)
- If the regional program does not fit hearing aids or does not bill medicaid
- Few private clinics that accept medicaid
- Private early intervention services/programs are also available

### Costs for hearing technology

- **Hearing aids** – $1000-3000 per aid depending on features and technology
- **Earmolds** – $50.00 each
- **Cochlear implant** – $60,000 per implant (device, surgery, programming, rehabilitation)
- **Baha** – $4000 device, approximately $20,000 for surgery
- **FM systems** – $1000-3000

### What does medicaid pay for?

- Up to $670.00 (cost) per hearing aid every three years
- Earmolds used with hearing aids
- 48 batteries per year (binaural amplification)
- Small fitting fee
- Cochlear implant, surgery and mapping
- Medicaid does not currently cover Baha, but will pay for a bone conduction hearing aid
Care of hearing technology

- Hearing aids, implants, Baha should not get wet!
- Devices should be removed for bathing, swimming, and sleeping.
- Earmolds should be cleaned at least once a week.