What is an audiologist?

Audiologists are the primary health-care professionals who evaluate, diagnose, treat, and manage hearing loss and balance disorders in adults and children. Most earn a clinical doctorate in audiology (AuD), however some possess a PhD, doctor of science degree, (ScD) or a Master’s degree. State licensed. Additional certifications exist (ABA Board Certified, CCC-A, PASC, CISC)
Patient A

• 80 year-old Female
• Long-term patient
• Accompanied by daughter who is speaking loudly to her
• Difficulty communicating in office
• Reported trying hearing aids 10 years ago
  • Limited benefit
  • Expensive

Untreated Hearing loss

• Physical, emotional and social consequences
  • Adherence to medical recommendations
  • More likely to report
    • Depression
    • Anxiety
    • Paranoia
    • Social isolation
Patient A in Office Screening?

- Whispered voice test
- Finger rubbing
  - Quick, simple, inexpensive
  - Limitations: subjective and not standardized
- Tuning Fork
- Hearing Handicap Inventory for Adults/Elderly (HHIA/E)
- Standardized sound production device
- Referral to audiology for confirmatory testing!

Amplified Headset

- Amplified headsets can be purchased through retail stores
- Pros:
  - Inexpensive- around $150
  - Ease of use for visually impaired and those with dexterity challenges
- Cons:
  - Cosmetics
  - Limited distance for the microphone to pick up- hard wired to patient
**Patient A’s hearing test**

<table>
<thead>
<tr>
<th>PITCH (Hz)</th>
<th>High</th>
<th>Soft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td>110</td>
<td>80</td>
</tr>
<tr>
<td>Left</td>
<td>105</td>
<td>75</td>
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</table>

**Range of Normal Hearing**

**Medical Clearance**

- Medical Clearance is required prior to a patient being fit with hearing aids.
- Medical Clearance may be obtained 3 ways
  - Evaluation by an ENT/Otologist
  - Evaluation by PCP, provided results do not warrant referral to an ENT
  - Patient Medical Waiver
### What to look for when giving medical clearance for amplification

- Asymmetric air conduction thresholds
- Air-Bone Gap
- Asymmetric speech discrimination
- Chronic middle ear disease

### Types of (Traditional) Hearing Aids

![Types of Hearing Aids](images)
Hearing Aids: Factors to consider

- Age of patient
- Dexterity
- Severity/configuration of hearing loss
- Cosmetics
- Battery life
- Anatomy of the patient’s ear
- Health of patient’s ear

Newer Features in Hearing Aids

*Available in some advanced level products*

- Wireless connectivity to Bluetooth devices
  - Direct streaming with Smartphones
- Automatic program changes
- Feedback control
- Adaptive microphones
- Rechargeable batteries
- Wireless accessories
When Hearing Aids Are Not Enough

- Cochlear implants and bone anchored implants are options for patients who cannot benefit from traditional amplification

Cochlear Implant Candidacy- Adults

- A cochlear implant consists of two parts: one is a surgically implanted device that sends electrical impulses directly to the auditory nerve and one is the external processor.

- Moderate to profound sensorineural hearing loss bilaterally, however, criteria has expanded more recently, which can include hearing within normal limits in the lower frequencies and unilateral hearing losses.

- Limited benefit from amplification defined by preoperative sentence recognition scores
Cochlear Implant Candidacy - Adults

- Do Not Consider for Implant
- Consider for Implant
- Definitely Consider for Implant

Cochlear Implant
Patient B

- 52 year-old female
- Routine physical
- Lawyer
- Hearing loss in her left ear since early 20s
- Increasing difficulty in social situations and at work
- Tinnitus, most noticeable at nighttime

Patient B’s audiogram

![Audiogram](image)
Asymmetric Hearing Loss

• Referral to ENT
  • Imaging?
  • Monitoring

• Treatment Options pending medical clearance
  • Traditional hearing aid
  • CROS technology
  • Bone-anchored devices
  • Cochlear Implant

Contralateral Routing of Signal (CROS)

• For use when one ear is not aidable
• Transmitter on the poorer hearing ear
• Receiver and hearing aid on the better hearing ear
• Wireless communication
Bone-Anchored Auditory Implants

- Surgically implanted
- Transmit sound via bone conduction bypassing the middle ear to a normally hearing cochlea (either ipsilaterally or contralaterally).
- Implications for single sided deafness and conductive/mixed hearing losses

Non-surgical Bone-conduction Devices
**Tinnitus**

*Ringing, buzzing, hissing, whistling, swooshing, clicking, thumping, and/or static noise*

- Defined as an auditory perception of sound not produced by an external source
- As many as 50 million adults—15% of the population experience tinnitus
  - More than 20 million struggle with chronic tinnitus
  - 2 million have extreme and debilitating cases of tinnitus
- May cause sufferers to report
  - Interference with sleep
  - Difficulty concentrating
  - Depression
  - Anxiety
  - Inability to tolerate moderate levels of noise (hyperacusis)

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**Causes of Tinnitus**

- The exact mechanism underlying tinnitus is unknown, however, some of the potential causes are
  - Disorders of the outer ear
  - Disorders of the middle ear
  - Disorder of the inner ear
  - Temporary effects from high dosages of medications such as anti-inflammatories, sedatives, and antidepressants
  - Systemic disorders
  - Trauma to the head/neck, cervical problems, and temporomandibular misalignment
  - Sinus pressure and barometric trauma
  - Traumatic Brain Injury
While there is no cure for most forms of tinnitus, there are a variety of management options available.

Audiologists specialize in hearing aids, tinnitus sound therapy, and can educate patient’s regarding their tinnitus.

Additional referrals may be needed: physical therapy, dentistry, cognitive behavioral therapy.

**Take Home:**
When to Refer to Audiology

- C/o Hearing loss
  - If hearing is significantly better in one ear compared to the other
  - If patient regularly asks to have things repeated
- Tinnitus- ringing/buzzing/sound in ears
- Hearing sensitivity
- Aural fullness
- History of ear infections
- Family history of hearing loss
- Occupational or recreational noise exposure
- Prescribed or exposed to ototoxic medications
- Vertigo, dizziness or imbalance
Tinnitus with and without hearing loss

Hearing aids and health insurance
Beyond Antibiotics and Hearing Aids

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Case Study

- 8 year old male presents with hearing loss of approximately 6 months duration
Patient with Hearing Loss

- Before we obtain a history and physical...
- What do we want to figure out?
  - Conductive vs Sensorineural
  - Progressive/Stable/Reversible
  - Etiology
  - Association with other symptoms
  - Association with other disease(s)
  - Treatment/Referral(surgery/HA)

Patient with Hearing Loss

- If otoscopy is normal, what can we rule out:
  - Otitis externa
  - Acquired atresia
  - Cerumen/Foreign body
  - TM perforation/retraction
  - Middle ear effusion/mass
- And our differential diagnosis would be:
  - Sensorineural hearing loss
  - Conductive hearing loss - Ossicular problem (Fixation, Erosion, Fracture, Dislocation)
    - Tympanosclerosis
    - Otosclerosis
    - Congenital fixation of malleus or stapes
    - Incus or stapes erosion from infection or cholesteatoma
    - Incus or stapes fracture
    - Incus or stapes dislocation
History

- Hx of childhood otitis media with tympanostomy tubes at age 2
- Passed school hearing screening exams
- Intermittent drainage and debris from right ear for 12 months
- Hearing subjectively decreased on right and normal on left
- No pain (otalgia), dizziness, or tinnitus
- No noise exposure or exposure to ototoxic medications
- No head trauma or penetrating ear trauma
- No family history of hearing loss

Physical Exam

- Auricle – Normal
- External Auditory Canal – Mildly inflamed
- Tympanic Membrane – See above
- Pneumatic Otoscopy – Immobile
- Tuning Fork Testing
  - Weber – Lateralizes to right ear
  - Rinne – Bone > Air
- Facial nerve function – Normal
- Left ear – All normal
Alternative Exams

Digression – The Otic “Drop”

- Many types and brand names
  - Presence/absence of antibiotic/antifungal
  - pH & viscosity
  - Single agents or combination products.
  - CiproDex, Ofloxacin, Neomycin/Polymyxin/HC
  - Acetic Acid +/- HC, Domeboro
  - Clotrimazole, Fluconazole
  - Ciloxin, Ofloxacin, Tobramycin, Sulfacetamide
    - Ophthalmic preparations
  - Quinolones most popular
- Cost
The Power of Ototopicals

- Pseudomonas organism with an MIC of 8 mcg/mL for ciprofloxacin is considered resistant
- A 0.3% antibiotic solution contains 3000 mcg/mL of antibiotic.
  - Middle ear concentrations after oral
    - Amoxicillin at 90 mg/kg (6-10 mcg/mL)
    - Cefuroxime at 500mg dose (2-4 mcg/mL)
    - Cefpodoxime at 200mg dose (1-2 mcg/mL)
    - Clarithromycin at 500mg dose (2-5 mcg/mL)
    - Ciprofloxacin at 500mg dose (3-7 mcg/mL)

https://emedicine.medscape.com/article/873963-overview

Back to our 8 yr old with hearing loss and otorrhea

- What do we know based on history and physical exam?
  - History suggests?
  - Exam suggests?
  - Tuning fork?
- Differential diagnosis:
  - “Attic” cholesteatoma
  - Chronic atticoantral suppurative otitis media
  - Left conductive hearing loss
Cholesteatoma – Don’t be fooled!

Audiogram
CT Scan

Management

- Treatment Options:
  - Cholesteatoma is a surgical disease
  - Tympanomastoidectomy
  - Ossicular reconstruction – often staged
Take Home Messages

• Look not only at the tympanic membrane, but through it
• Examine the pars flaccida ("attic")
• Don’t forget tuning fork exam
• Drainage that recurs or persists should be referred
• Otic drops are safe in all situations, but know which one to use

Case Presentation

• 38 year old male, otherwise healthy, awakens with marked decrease in left ear hearing
• + high frequency tinnitus
• No dizziness or imbalance
• No otalgia or otorrhea
• Denies trauma, URI, fever
Course of Management

- Seen at Urgent Care
- Assessment: left otitis media
- Treatment: Amoxicillin 875mg BID x 10 days
- Follow up with PCP 3 weeks later with no improvement
- Exam: normal TM, no middle ear effusion
- Referred for audiometric testing

Audiogram – 1 month post-onset
Sudden Sensorineural Hearing Loss

- 30dB loss at 3 contiguous frequencies over a period of < 3 days
- 5-20/100,000 per year
  - Columbus Metropolitan Statistical Area (10 counties)
  - population of 2.4 million
  - 120-480 cases/year
- 85-90% are idiopathic at time of presentation
- 50% have associated vertigo
- 32-65% will have some spontaneous recovery
  - Usually within 2 weeks of onset
- Shape of audiogram correlates with chance of recovery

Etiology

- Herpes Simplex I
- Lyme Disease
- Cytomegalovirus
- HIV
- Meningococcal Meningitis
- Cryptococcal Meningitis
- Syphilis
- Toxoplasmosis
- Rubella
- Mumps
- Autoimmune Inner Ear Disease (AIED)
- Cogan’s Syndrome
- Polyarteritis Nodosa
- Lupus
- Relapsing polychondritis
- Ulcerative Colitis
- Wegener’s Granulomatosis
- Red Blood Cell Deformability
- Vertebrobasilar Insufficiency
- Sickle Cell
- Focal Pontine Ischemia
- Vascular Disease Associated with Mitochondriopathy
- Migraine
- Small Vessel Disease
- Blood Dyscrasias
- Cardiopulmonary Bypass
- Acoustic Neuroma
- Leukemia
- Myeloma
- Multiple Sclerosis
- Meningeal Carcinomatosis
- Ototoxicity
- Perilymph Fistula
- Meniere’s
- Inner Ear Decompression Sickness
- Otologic Surgery
- Inner Ear Concussion
- Temporal Bone Fracture
- Large Vestibular Aqueduct
- CSF Leak (LP)
### Prognostic Factors for Hearing Recovery

**Good Prognosis**
- Age <60
- minimal hearing loss
- low frequency hearing loss
- no vestibular symptoms
- early onset recovery

**Poor Prognosis**
- Age >60
- total deafness
- high frequency hearing loss
- objective vestibular symptoms
- vascular risk factors

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#### Audiogram Patterns: Prognosis

<table>
<thead>
<tr>
<th>Good Prognosis Audiogram</th>
<th>Poor Prognosis Audiogram</th>
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<tr>
<td><img src="image1" alt="Good Prognosis Audiogram" /></td>
<td><img src="image2" alt="Poor Prognosis Audiogram" /></td>
</tr>
<tr>
<td><img src="image3" alt="Good Prognosis Audiogram" /></td>
<td><img src="image4" alt="Poor Prognosis Audiogram" /></td>
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Initial Evaluation

- History
  - Onset, Severity, Laterality
- Exam
  - Otoscopy, Pneumatic Otoscopy
  - “Hearing” Tests
    - Whisper, Hum, Tuning Fork


Tuning Fork Testing
(remember left ear HL in this case)

Weber

Louder here suggests sensorineural hearing loss on left

Rinne

Louder here suggests conductive hearing loss on left

Normal is louder by air conduction
Management Algorithm

Role of Systemic Steroids

- **Wilson et al., 1980**
  - 78% recovery in moderate/severe hearing loss
  - 38% recovery with placebo

- **Rx:** Prednisone
  - 1mg/kg (max 60mg/day)
  - 7-10 days with taper

Transtympanic Steroid Injection

- Studies that show equal efficacy to systemic steroids
- Role of “rescue” therapy also documented
- No consensus on dosing
  - Dexamethasone
  - Hydrocortisone
  - Methylprednisolone


Difference in PTA Improvement Compared to Placebo

- IT plus systemic steroids 25.85 dB
- IV + PO steroids 22.06 dB
- IT steroids 18.24 dB

The Importance of Prompt Evaluation

- Presentation to a physician less than a week after onset of SSNHL also correlates with improved odds of hearing recovery, with chances of complete hearing recovery decreasing after that time.
  - If diagnosis & treatment are correct
- Rates of hearing recovery following evaluation/audiogram within:
  - Few days of onset 87%
  - Within 1 week 87%
  - 2 weeks 52%
  - > 3 months <10%


Clinical Practice Guideline: Sudden Hearing Loss

- Distinguish CHL from SNHL
- Head CT and routine labs not recommended
- MRI indicated

Clinical Practice Guideline: Sudden Hearing Loss

- Counseling on risks, benefits, and limitations of treatment
- Steroids (Oral +/- intratympanic)
- No antivirals, thrombolytics, or vasoactive medications
- F/u audiogram within 6 months
- Counseling on treatment options if recovery is incomplete

STMT 7. PATIENT EDUCATION: Clinicians should educate patients with ISSNHL about the natural history of the condition, the benefits and risks of medical interventions, and the limitations of existing evidence regarding efficacy.

STMT 8. INITIAL CORTICOSTEROIDS: Clinicians may offer corticosteroids as initial therapy to patients with ISSNHL.

STMT 9. HYPERBARIC OXYGEN THERAPY: Clinicians may offer hyperbaric oxygen therapy within three months of diagnosis of ISSNHL.

STMT 10. OTHER PHARMACOLOGIC THERAPY: Clinicians should not routinely prescribe antivirals, thrombolytics, vasoconstrictors, vasoactive substances, or antioxidants to patients with ISSNHL.

STMT 11. SALVAGE THERAPY: Clinicians should offer IT steroid perfusion when patients have incomplete recovery from ISSNHL after failure of initial management.

STMT 12. OUTCOMES ASSESSMENT: Clinicians should obtain follow-up audiometric evaluation within six months of diagnosis for patients with ISSNHL.

STMT 13. REHABILITATION: Clinicians should counsel patients with incomplete recovery of hearing about the possible benefits of amplification and hearing assistive technology (HAT) and other supportive measures.


Take Home Messages

- One of the few otologic emergencies
  - Own a tuning fork, and use it!
  - Don’t talk yourself into a diagnosis of otitis media
  - A prompt audiogram can make a difference
- Steroids are the primary mode of therapy
  - Benefits of oral therapy probably outweigh risks even in the setting of delayed referral
- Unilateral hearing loss can result in significant disability
  - Counseling regarding hearing aids (medical and surgical) and ALDs should be provided