

Deaf Services Advocates Training



Office of Deaf Services

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INTRODUCTION TO HEARING LOSS AND ASSISTIVE TECHNOLOGIES



Overview

- ▀ Defining Deaf and Hard of Hearing
- ▀ Prevalence, Types, and Causes of Hearing Loss
- ▀ Essential Audiology
- ▀ Assistive Technologies
 - ▶ Hearing Aids
 - ▶ Cochlear Implants
 - ▶ FM Systems

Defining Deaf and Hard of Hearing

Deaf

Audiological Definition

- ▶ Usually refers to a hearing loss in the severe to profound range, greater than 70 dB.
- ▶ Most commonly used by medical professionals.

Defining Deaf and Hard of Hearing

Deaf

Educational Definition (IDEA)

- ▶ A hearing impairment that is so severe that the child is impaired in processing linguistic information through hearing, with or without amplification, that adversely affects a child's educational performance.
- ▶ Used by schools to determine eligibility for special education.

Defining Deaf and Hard of Hearing

Deaf

Cultural Definition

- ▶ Sociolinguistic identity of those in the Deaf community based on shared language, values, behavior norms, and experiences.
- ▶ Commonly noted by capitalizing Deaf to indicate usage as a proper noun.
- ▶ Most commonly used by those who know ASL.

Defining Deaf and Hard of Hearing

Deaf

Functional Definition (DMH Definition)

- ▶ An inability, because of a hearing loss, to discriminate speech when spoken in normal conversational tone regardless of the use of amplification devices.
- ▶ Used in DMH regulations and contracts.
- ▶ Similar definition in 209.261, 302.174, and 476.750, RSMo.
- ▶ Variations often used in demographics research.

Defining Deaf and Hard of Hearing

Hard of Hearing

Audiological Definition

- ▶ Usually refers to a hearing loss in the mild, moderate, or moderately severe range, from 26 to 70 dB.
- ▶ Most commonly used by medical professionals.

Defining Deaf and Hard of Hearing

Hard of Hearing (“hearing impairment”)

▀ Educational Definition (IDEA)

- ▶ “Hearing impairment” is an impairment in hearing, whether permanent or fluctuating, that adversely affects a child's educational performance but that is not included under the definition of deafness.
- ▶ Used by schools to determine eligibility for special education.

Defining Deaf and Hard of Hearing

Hard of Hearing

Functional Definition

- ▶ A hearing loss that results in difficulty discriminating speech when spoken in normal conversational tone but still allows the person to rely primarily on speech and listening for communication regardless of the use of amplification devices.
- ▶ Variations may be used in demographics research.

Defining Deaf and Hard of Hearing

“The view of deafness as disability is tempered by the consideration that the vast majority of functional limitations of deafness would be overcome as effectively by hearing people learning sign language as by deaf people becoming hearing.”

A Note on Offensive Terms

❖ Deaf

❖ Hard of Hearing

Versus

❖ Deaf-Mute

❖ Deaf and Dumb

❖ Hearing Impaired



Prevalence in US Population: Sources of Data

“Deaf or Serious Difficulty Hearing”

American
Community Survey
(ACS, US Census Bureau, 2017)

-
- 3.6% of any age
 - 2.0% of age 18-64
 - 14.8% of age 65+
- (noninstitutionalized civilian population)

“Severe Hearing Difficulty”

Survey of Income and
Program Participation
(SIPP, US Census Bureau, 2012)

-
- 0.5% of age 15+
 - 39.2% are 15-64
 - 60.8% are 65+

“Deaf”

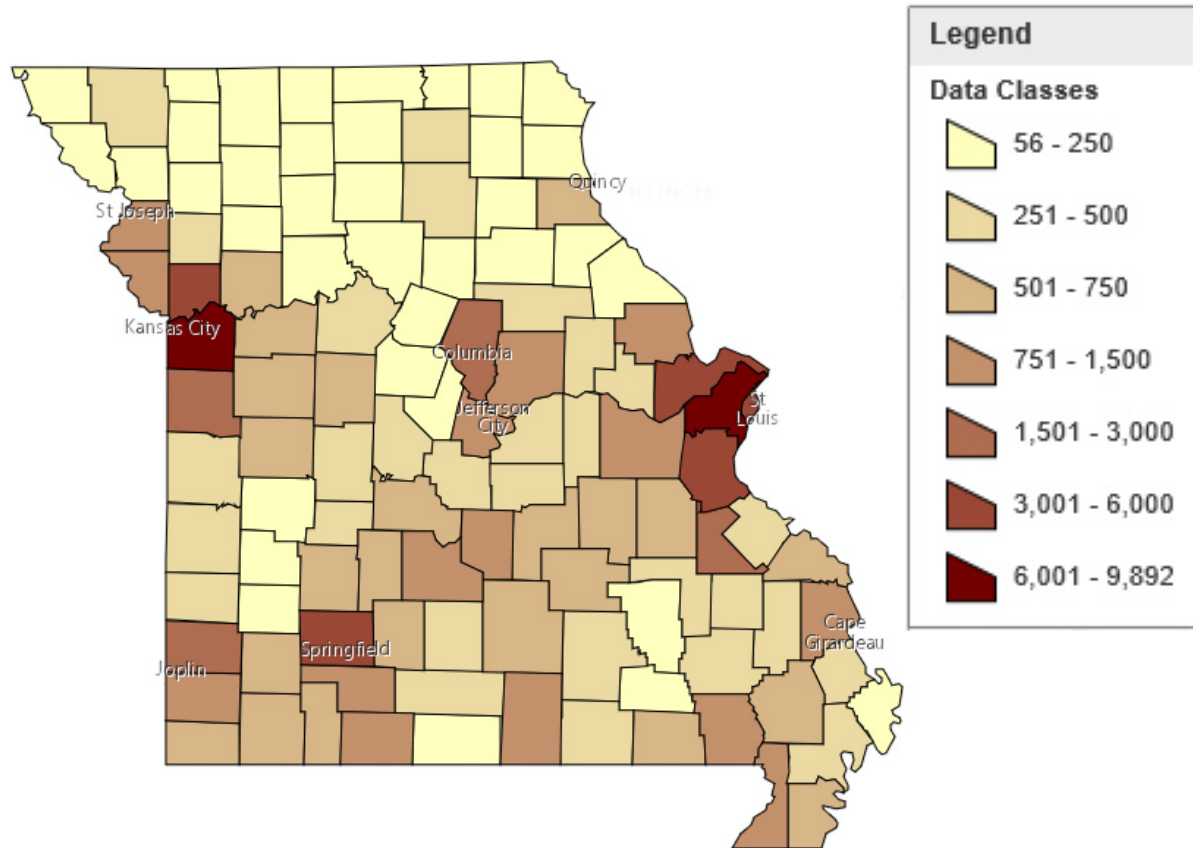
National Health
Interview Survey
(NHIS, National Center for
Health Statistics, 2015)

-
- 0.29% of age 18+
 - Est. 26.3% lost hearing before 19*
 - Est. 73.7% lost hearing after 19*

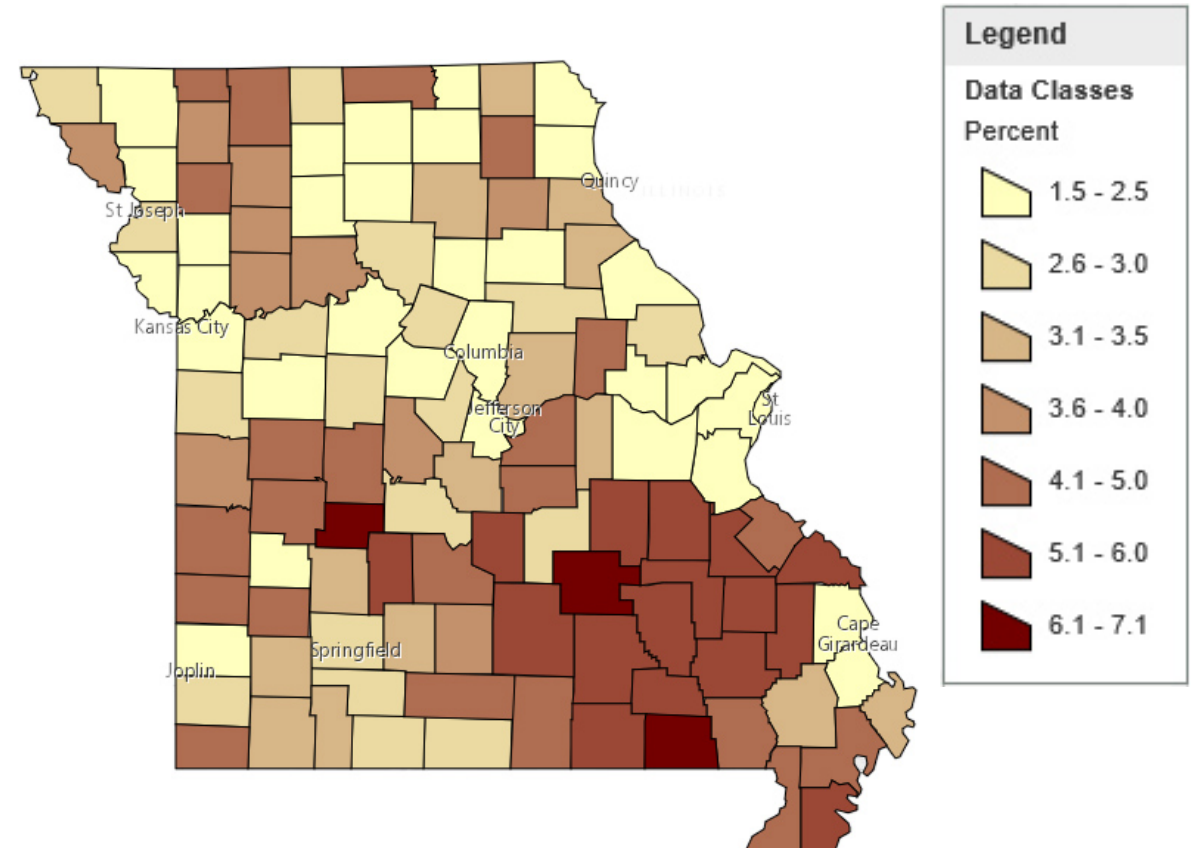
*Estimates based on 1991 NHIS. 2015 NHIS did not categorize age of onset.

“Deaf or Serious Difficulty Hearing” Age 18-64 By County (ACS)

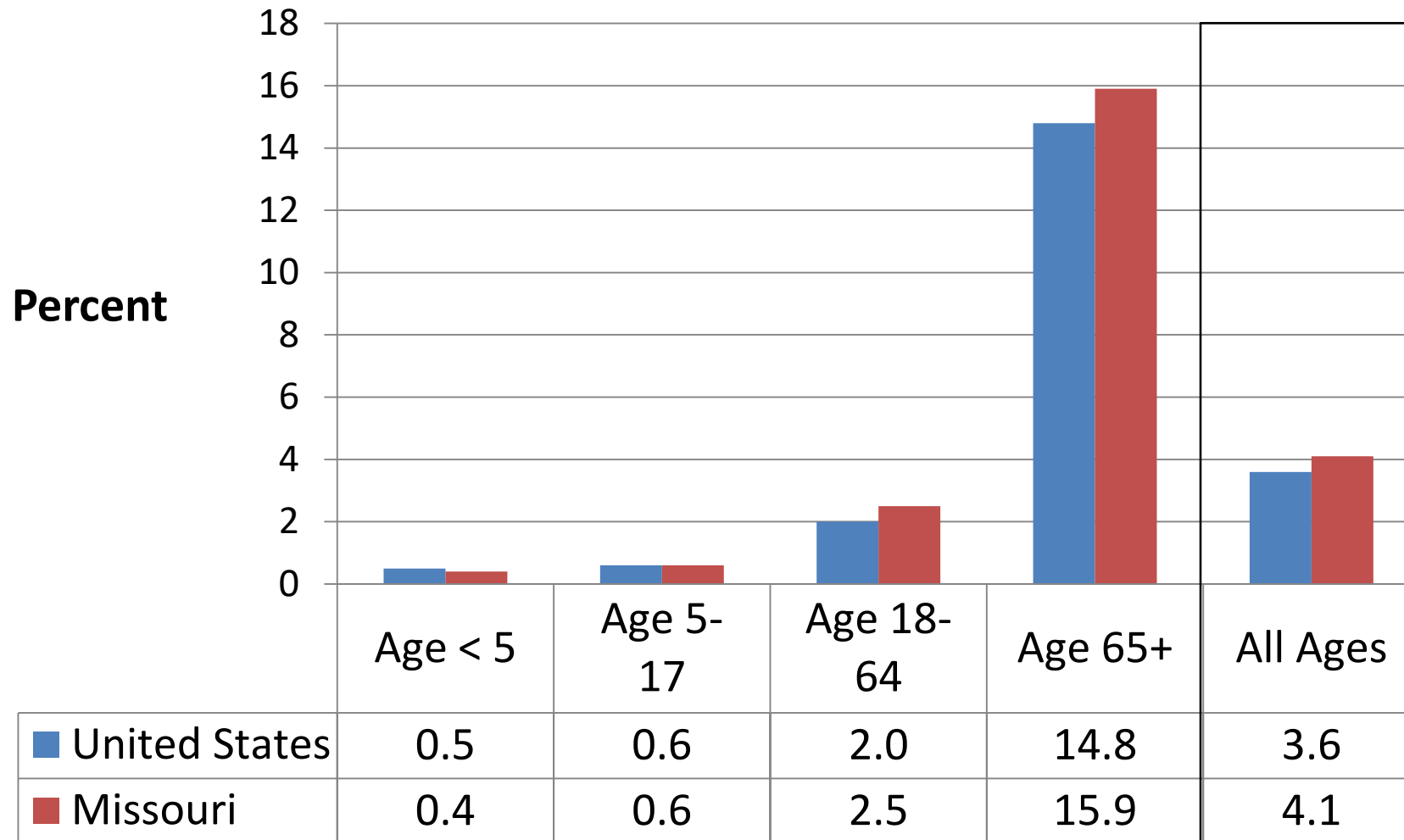
By Population Count



By Percent of Population



“Deaf or Serious Difficulty Hearing” Prevalence By Age (ACS)

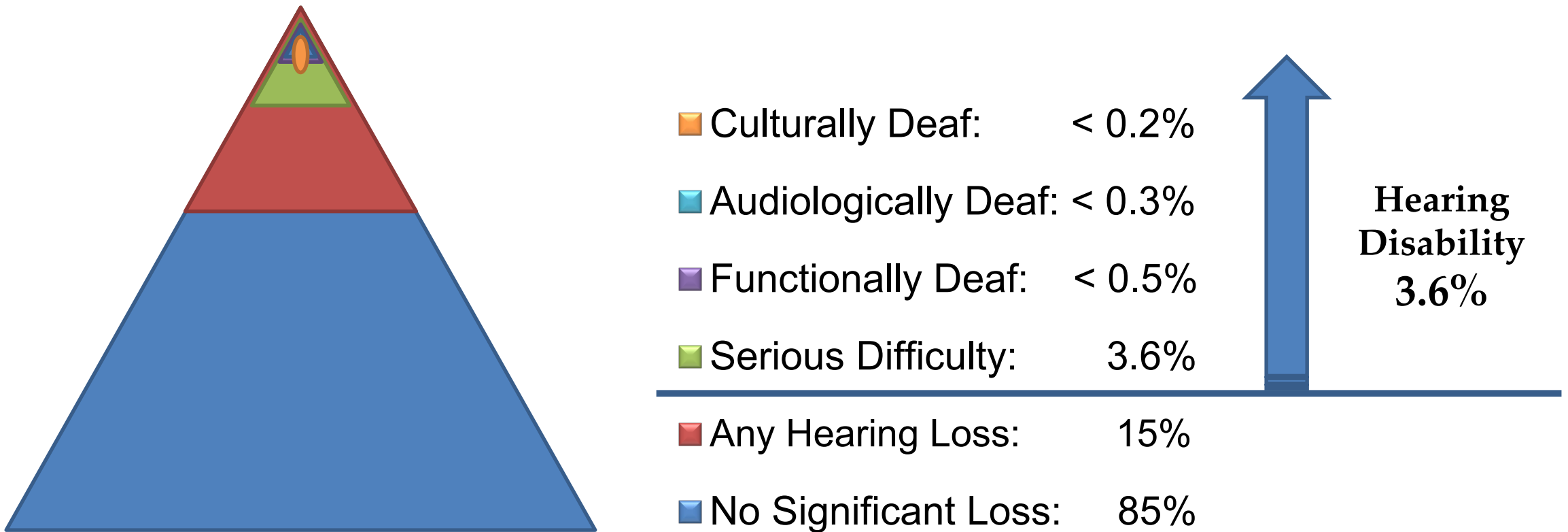


Estimated Prevalence of Hearing Loss in School-Age Children

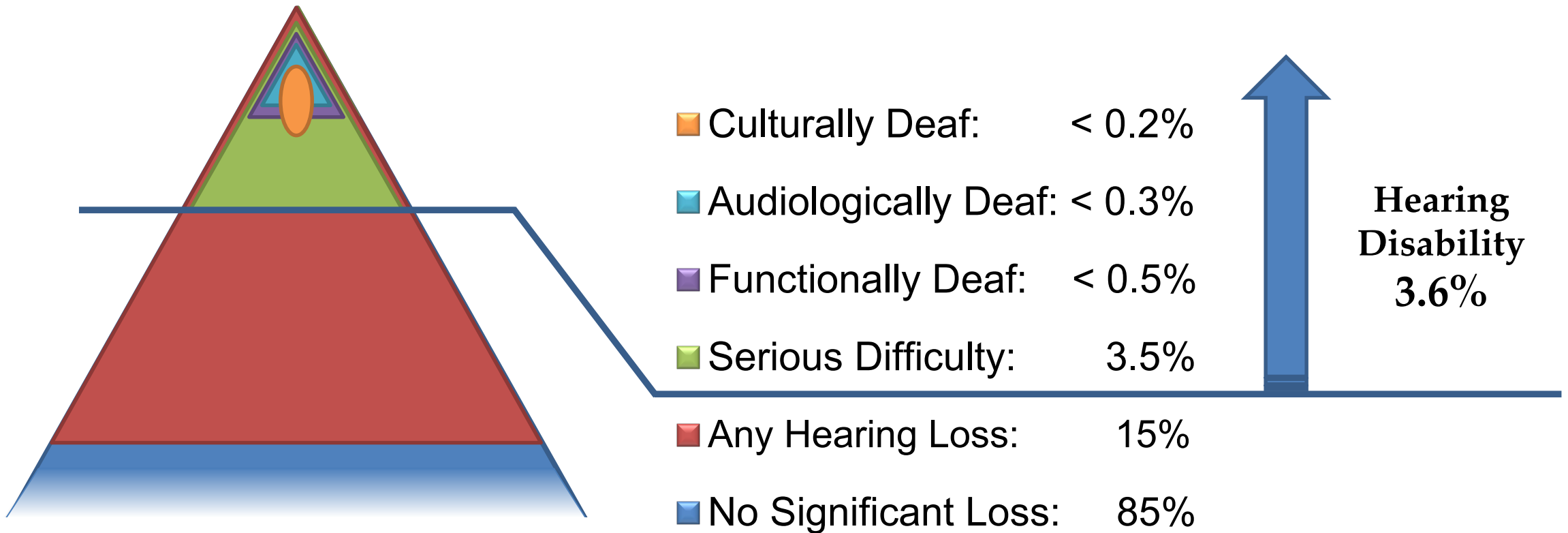
Child Count Data:

- ▶ 0.10% are identified as deaf or hearing impaired under IDEA (0.12% in Missouri).
 - ▶ Students with hearing loss make up approximately 1.12% of students receiving special education services.
- While estimates vary significantly, it is likely that many children who have a hearing loss and could benefit from support services are not receiving them.

Estimated Prevalence of Hearing Loss by Type



Estimated Prevalence of Hearing Loss by Type





Hearing Disability Population Estimates

United States

- 11,500,000 hearing disability (3.5%)*
 - ▶ 460,000-690,000 with SMI (4.0-6.0%)
 - ▶ Unknown number of children w/ SED (?%)

Missouri

- 250,000 Hearing Disability (4.1%)*
 - ▶ 11,000-17,000 with SMI (4.5-6.8%)
 - ▶ Unknown number of children w/ SED (?%)

*Likely 2/3 to 3/4 lost hearing after age 65.

Deaf Population Estimates

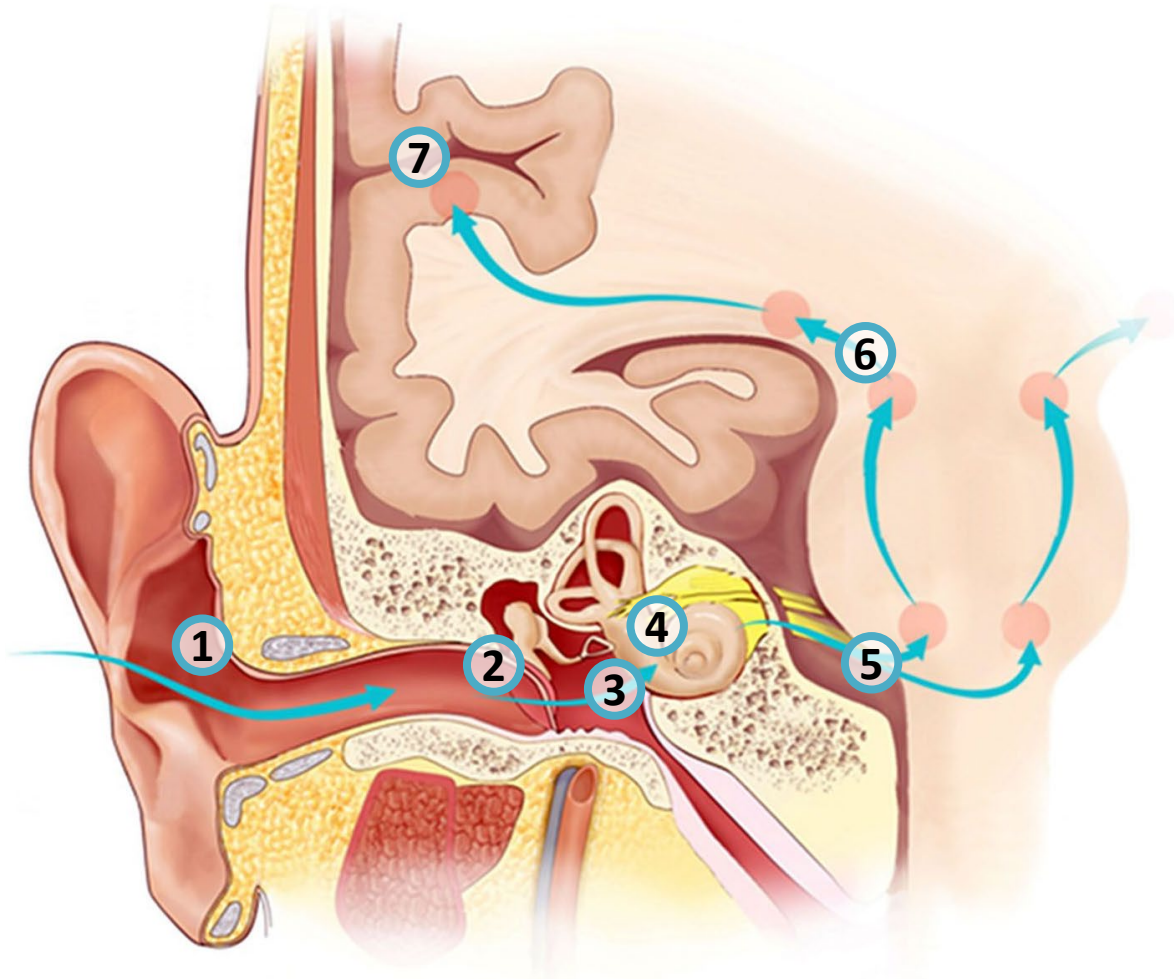
United States

- ▀ 1-1.6 million functionally deaf (< 0.5%).
 - ▶ Likely < 650,000 culturally Deaf/use ASL (< 0.2%).
 - 26,000-39,000 Deaf adults w/ SMI (4.0-6.0%).
 - Unknown number of children w/ SED (?%)

Missouri

- ▀ < 30,000 functionally deaf residents (< 0.5%).
 - ▶ Likely < 12,000 culturally Deaf/use ASL (< 0.2%).
 - 400-600 Deaf adults with SMI (4.5-6.8%).
 - Unknown number of children w/ SED (?%)

The Hearing Process



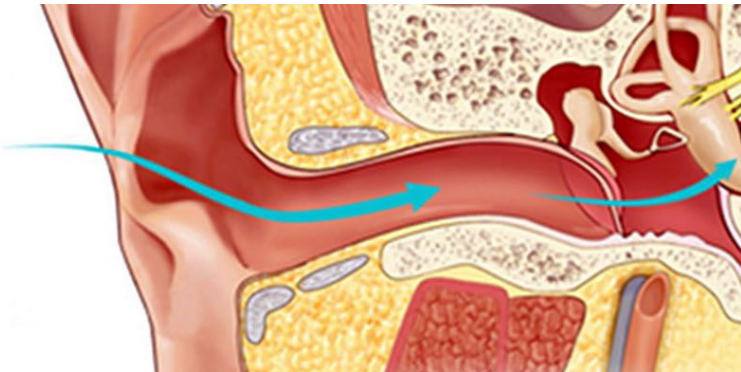
Waves → Vibrations → Electrical Signals

1. The **pinna** gathers sound waves and channels them into the **ear canal**.
2. Sound waves strike the **tympanic membrane**, converting waves to mechanical vibrations.
3. The **ossicles** (**malleus**, **incus**, and **stapes**) transmit vibrations to the cochlea.
4. The **cochlea** sorts sounds by frequency and converts them to electrical signals.
5. The **auditory nerve** transmits electrical signals to the brain **brainstem**.
6. Signals travel through the brain.
7. The **auditory cortex** recognizes and processes sounds and language patterns.

Types of Hearing Loss

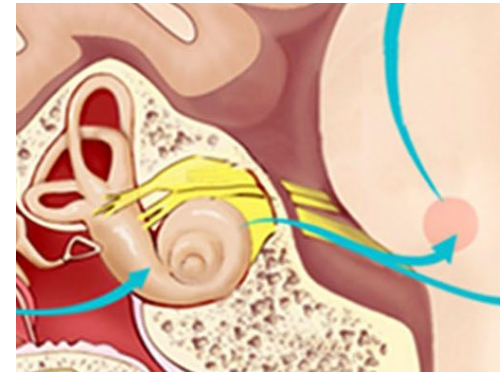
Conductive

- Occurs in the outer or middle ear.
- Caused by blockage or a structural defect.
- Distorts or blocks the physical transmission of sound.
- Can sometimes be corrected.



Sensorineural

- Occurs in the inner ear.
- Caused by damaged cochlea follicles or auditory nerve.
- Distorts or blocks neurological transmission of sound.
- Damage is usually permanent.



Etiology: Causes of Hearing Loss

Congenital: hearing loss present at birth

Loss is prelingual.

❖ Genetic reasons/heredity (most common reason):

- ▶ Autosomal recessive – both parents carry an abnormal recessive gene and pass it to the child. Parents usually do not have hearing loss themselves. (most common reason for genetic hearing loss)
- ▶ Autosomal dominant – either parent carries an abnormal dominant gene and passes it on to the child. Parent often also has a hearing loss.

❖ Nongenetic reasons:

- ▶ Maternal infections, premature birth, medications or toxins that cross the placenta, blood complications, maternal diabetes, anoxia, etc.

Etiology: Causes of Hearing Loss

Acquired: hearing loss after birth

Loss may be prelingual or postlingual. May be late-deafened.

▀ Genetic reasons/heredity:

- ▶ May have no loss at birth but later develop a sudden or progressive loss.

▀ Nongenetic reasons:

- ▶ Ear infections.
- ▶ Medications that are toxic to the ear (ototoxic).
- ▶ Meningitis, measles, chicken pox, flu, mumps.
- ▶ Head injury.
- ▶ Noise exposure.

Detecting Hearing Loss: Infant Hearing Screenings

- ❖ In the past, hearing loss was typically not discovered until 2.5 to 3 years.
- ❖ All states have an Early Hearing Detection and Intervention Program (EHDI).
- ❖ Almost all states, including Missouri, now require newborn screenings.
- ❖ A screening is typically done before a newborn is discharged from the hospital.

Detecting Hearing Loss: Screening Methods

❖ Otoacoustic Emission Screening (OAE):

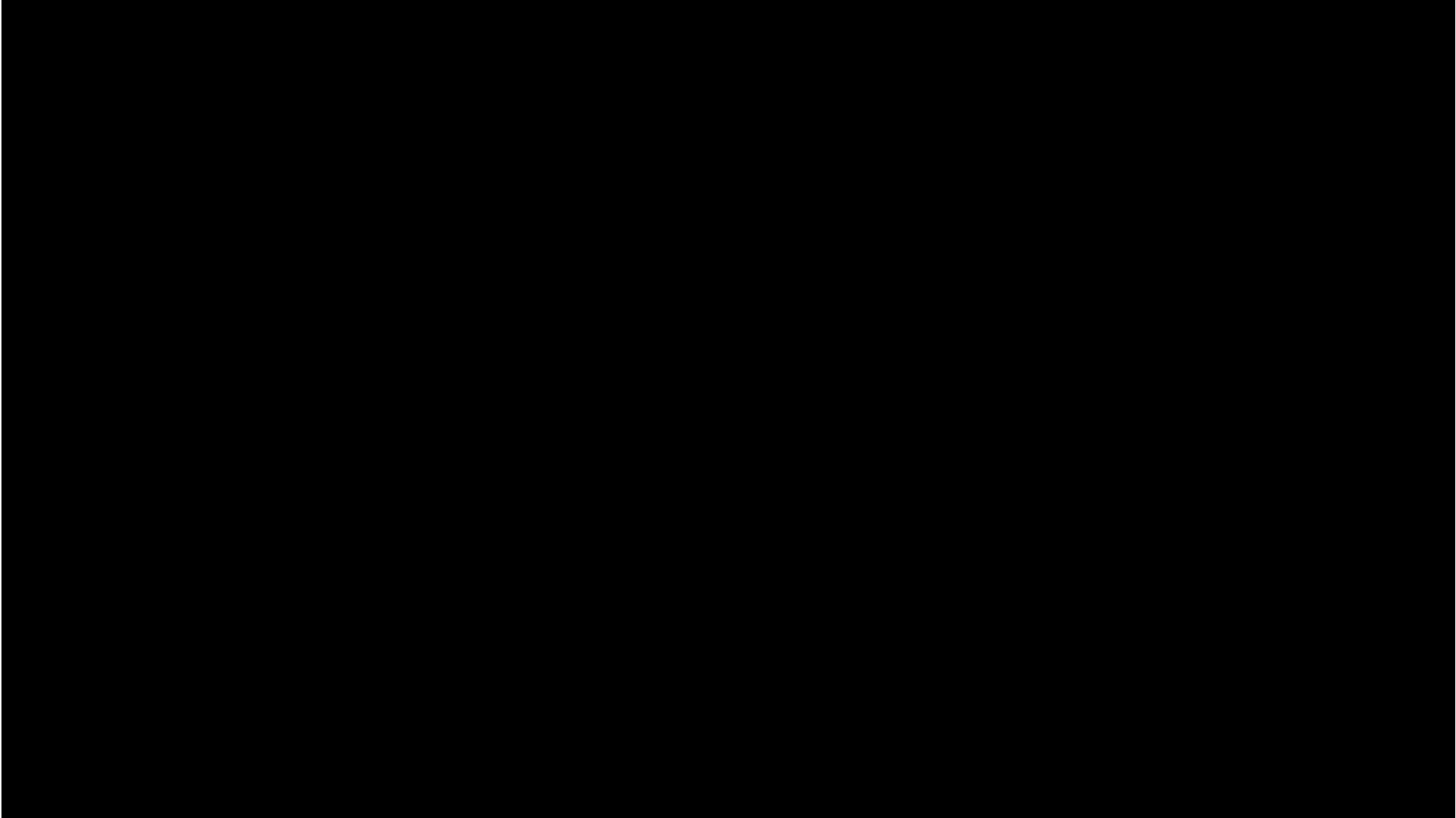
- ▶ A probe is inserted into the ear.
- ▶ A sound is played to vibrate the cochlea follicles.
- ▶ The follicles vibrate, emitting a sound that is detected by a microphone.
- ▶ Most common form of screening.

❖ Auditory Brainstem Response (ABR) Screening:

- ▶ Electrodes placed on forehead and back of head.
- ▶ A sound is played through earphones.
- ▶ Electrodes record neurological response to sound.



Detecting Hearing Loss: Screening Methods



[youtube.com/embed/QvrBogzziXA](https://www.youtube.com/embed/QvrBogzziXA)

Diagnosing Hearing Loss: Testing Methods

▀ Pure Tone Audiometry

- ▶ Audiologist plays tones at specific pitches and volumes.
- ▶ Determines thresholds for detecting the presence of sound.

▀ Speech Audiometry

- ▶ Audiologist plays or produces speech sounds or words at specific volumes.
- ▶ Determines thresholds for detection, reception, and perception of speech.

▀ Play Audiometry

- ▶ Play activities reinforce responses to sound to allow testing in younger children. May be used with pure tones or speech.

Measuring Hearing Loss: Units and Degrees

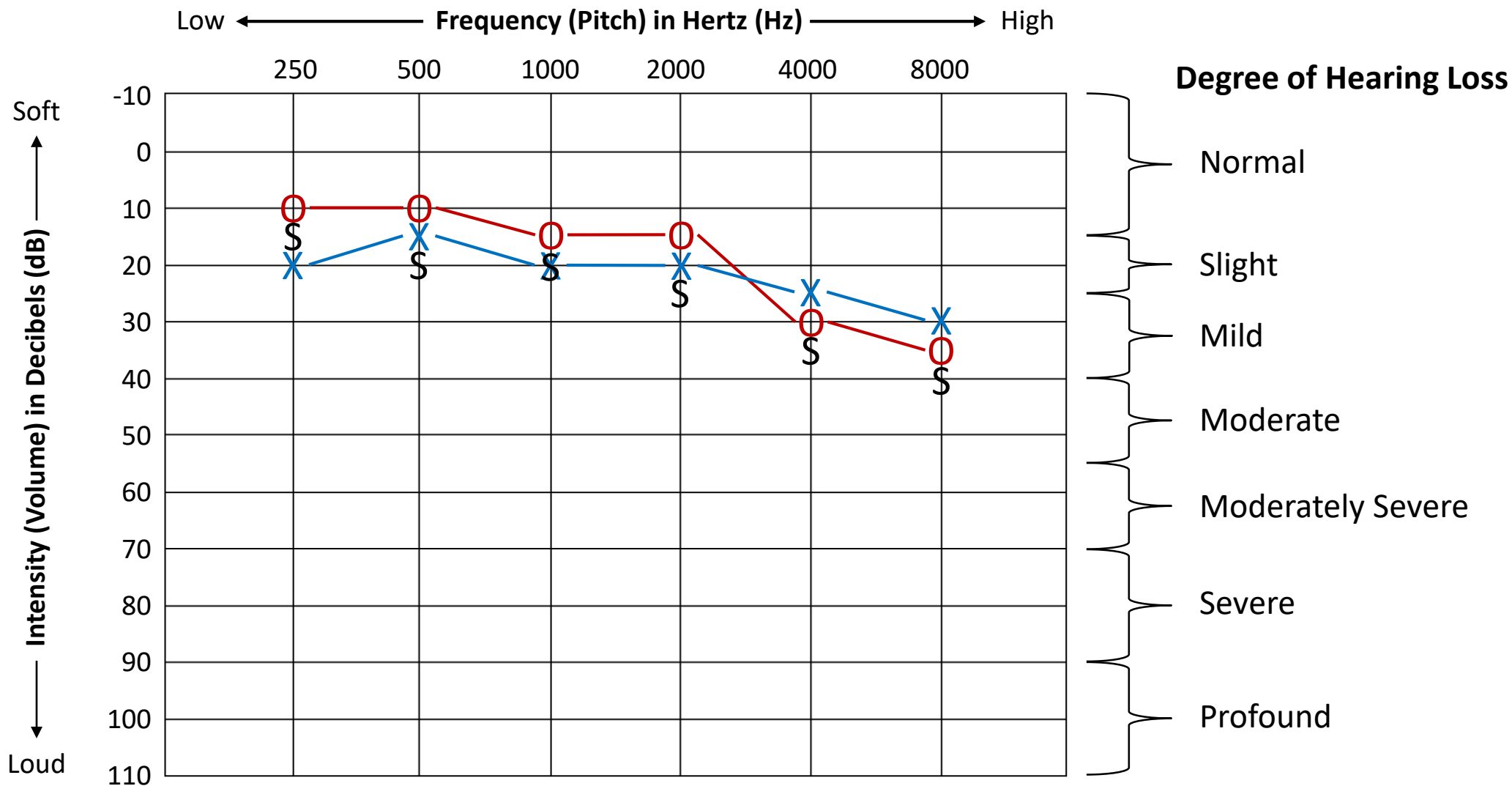
Units of measurement:

- ▶ Decibels (dB) – sound intensity/pressure or volume.
Logarithmic ratio – volume doubles every +3 dB.
- ▶ Hertz (Hz) – sound frequency or pitch. Cycles per second.

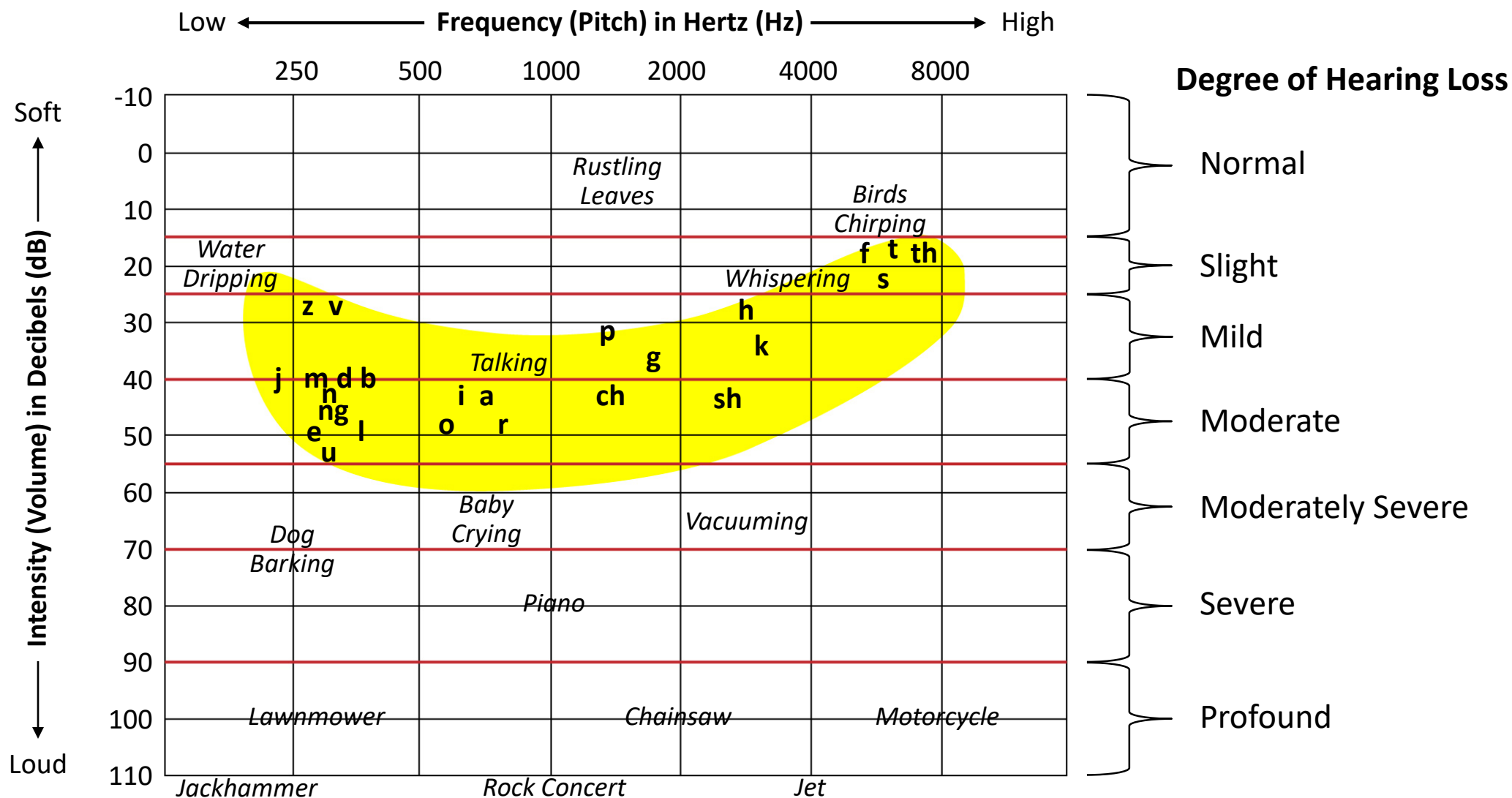
Degrees of Hearing Loss:

- ▶ Normal – <15 dB
- ▶ Slight/Minimal – 16 to 25 dB
- ▶ Mild – 26 to 40 dB
- ▶ Moderate – 41 to 55 dB
- ▶ Moderately severe – 56 to 70 dB
- ▶ Severe – 71 to 90 dB
- ▶ Profound 91+ dB

The Audiogram: Graphing Thresholds

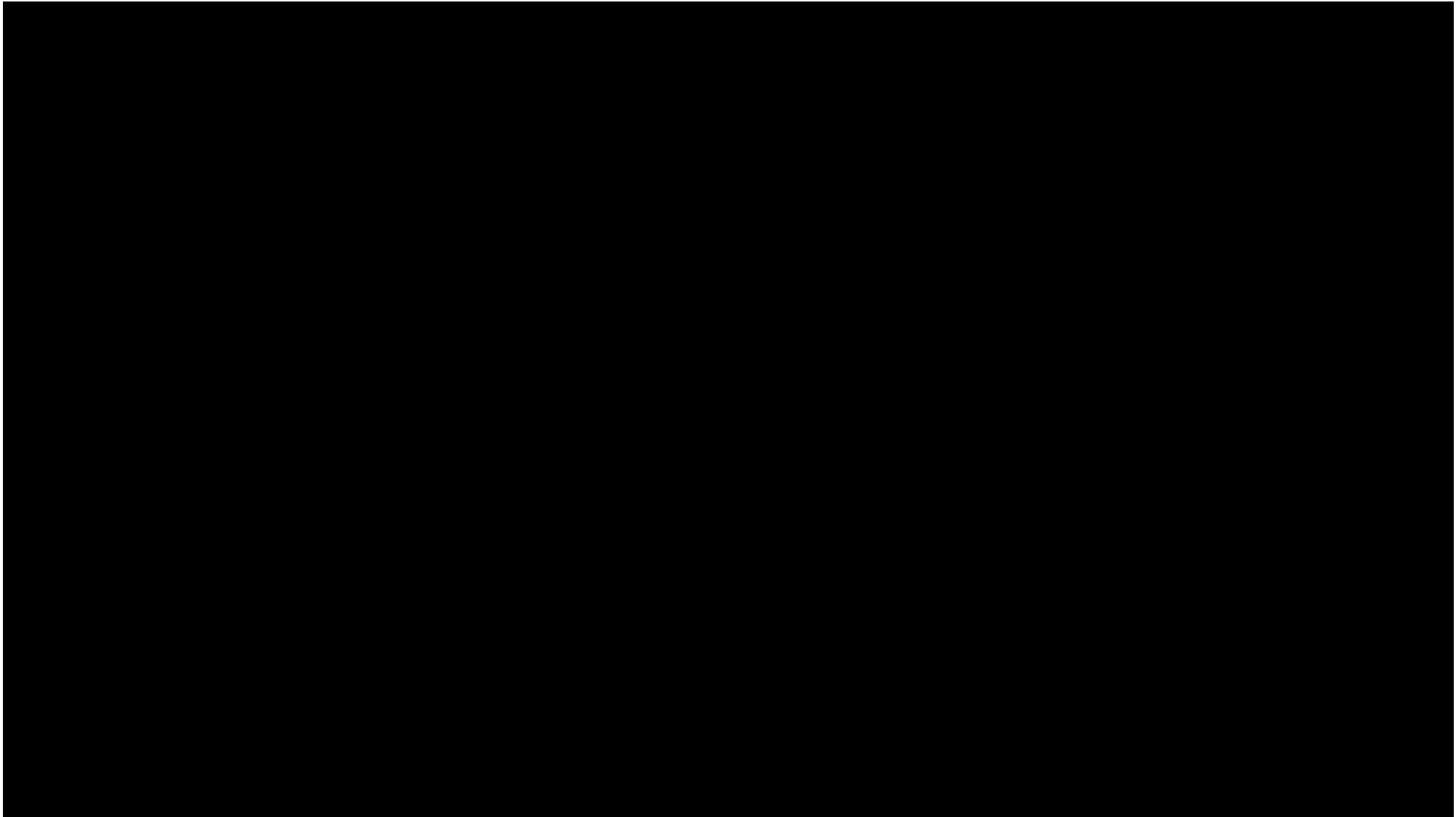


The Speech Banana: Access to Speech Sounds





Hearing Loss Simulation



[youtube.com/embed/ar1Dq-M2ok4](https://www.youtube.com/embed/ar1Dq-M2ok4)

Assistive Technologies

Hearing Aids

- Programmed to amplify natural sounds to match hearing threshold.
- Increase stimulation to damaged portions of the ear.
- Less effective for higher frequencies.
- Effectiveness decreases as hearing loss increases.



Cochlear Implants

- Convert natural sounds to electrical impulses.
- Bypass damaged portions of the ear to stimulate the auditory nerve.
- Less effective for lower frequencies.
- Effectiveness may vary considerably.

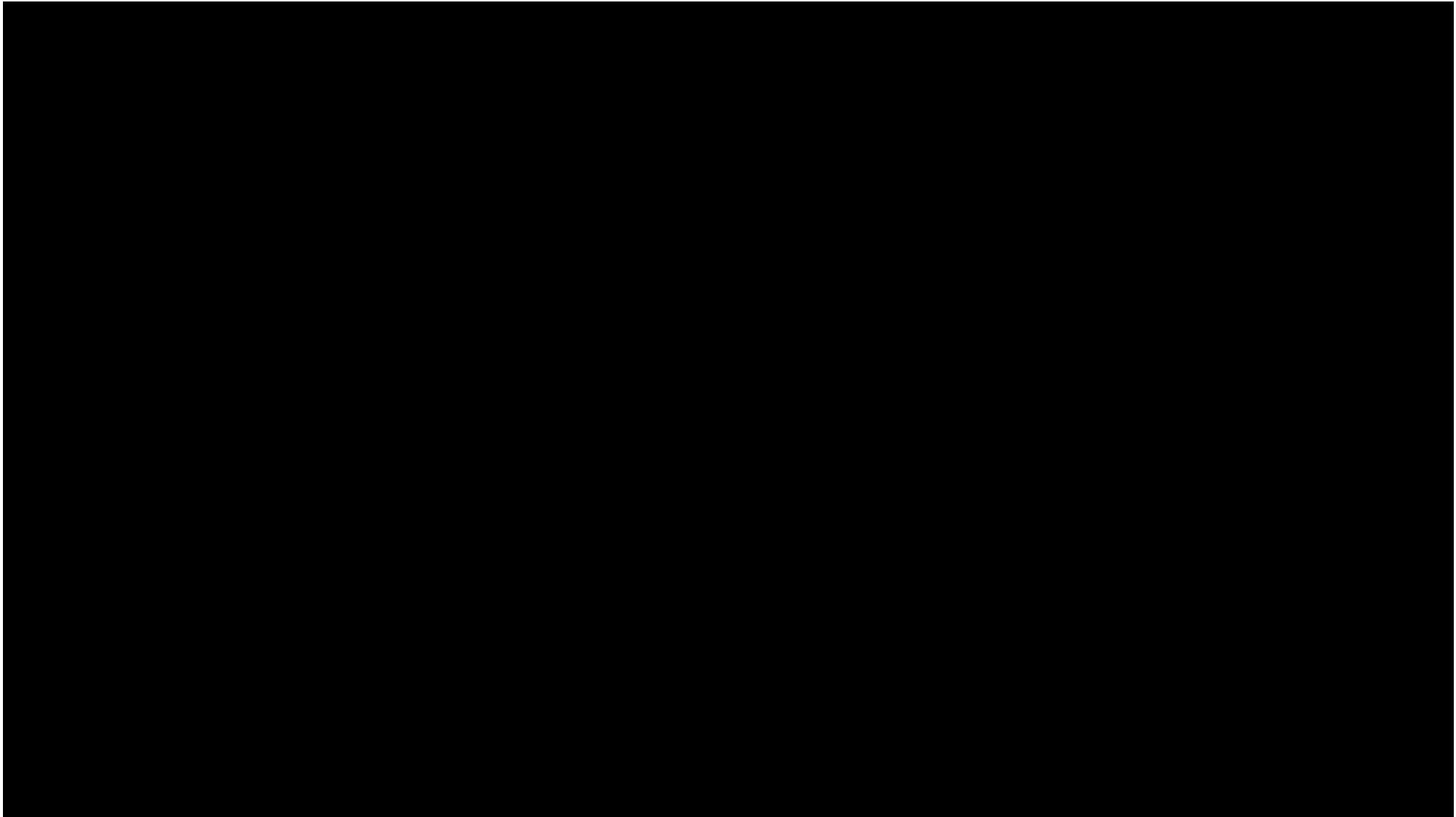


Neither option restores normal hearing.

Limitations of Cochlear Implants

- ❖ Not a miracle technology that restores normal hearing.
- ❖ Delicate surgery and medical risks.
- ❖ Requires initial mapping and periodic programming adjustments.
- ❖ Prelingually deaf implant recipients must receive intensive listening habilitation.
- ❖ Results vary widely. Most successful in late-deafened implant recipients.

Cochlear Implant Simulation



youtube.com/embed/SpKKYBkJ9H

Assistive Technologies

FM Systems



- ❖ Limit loss of sound quality caused by distance and background noise.
- ❖ Sound is detected by a microphone or input directly from a recorded source.
- ❖ Transmitter sends the signal wirelessly to a receiver.
- ❖ Receiver delivers the sound to a hearing aid, cochlear implant processor, or external speaker.

Optimum listening distance of a hearing aid or cochlear implant is within 3 ft.



Hearing Aid & FM System Simulation

[youtube.com/embed/JNzxOJKCUg](https://www.youtube.com/embed/JNzxOJKCUg)

Hearing Aid & FM System Simulation

[youtube.com/embed/1I371zLLgQU](https://www.youtube.com/embed/1I371zLLgQU)



Resources in the DSA Manual

dmh.mo.gov/deafservices/dsamannual



Questions?
