

In the Clinic®

Hearing Loss

Hearing loss is highly prevalent and may significantly affect how we age. Although the population is aging, relatively few adults receive treatment for hearing loss. Internists are a critical partner to audiologists and otolaryngologists in caring for the adult population with hearing loss. This review provides a primer on diagnosing and managing hearing loss.

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Screening

Prevention

Diagnosis

Treatment

Ramifications of
Hearing Loss

Table 1. Hearing Loss and Rehabilitation

Severity	Hearing Loss	Patient Perspective	Communication Limitations	Intervention
Mild	26-40 dB HL	"My hearing is fine."	Speech with background noise	Communication strategies and amplification (e.g., hearing aids, assistive listening devices)
Moderate	41-60 dB HL	"People mumble."	Difficulty with normal speech	Communication strategies and amplification (e.g., hearing aids, assistive listening devices)
Severe	61-80 dB HL	"I have difficulty hearing."	Can understand only amplified speech	Communication strategies and hearing aids or cochlear implant
Profound	>80 dB HL	"I can't use the phone and rely on reading lips."	Difficulty understanding even amplified speech	Communication strategies and hearing aids or cochlear implant Sign language Lip reading

dB HL = decibels hearing level.

Hearing loss is common but is often unrecognized by patients and physicians and undertreated. The prevalence of clinically significant hearing loss roughly doubles with each decade of life (1, 2). Although approximately two thirds of Americans aged 70 years or older have hearing loss, only 15%–20% of U.S. older adults use hearing aids, and disparities exist by race/ethnicity and socioeconomic status (3–6).

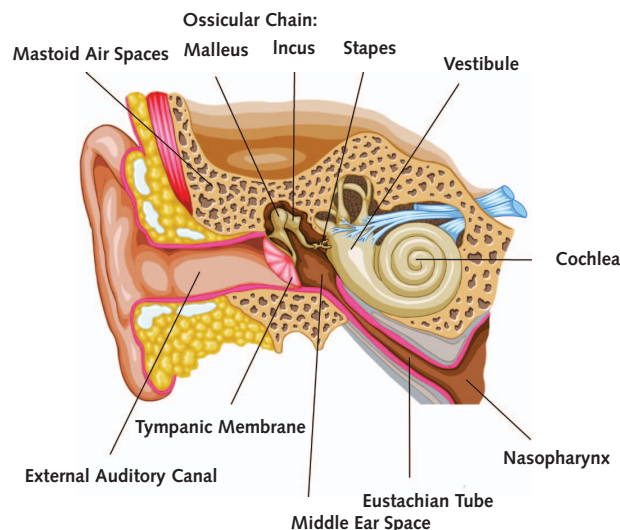
Severity of hearing loss as determined by audiometry is based on volume thresholds defined in decibels (dB HL): mild (26-40 dB

HL), moderate (41-60 dB HL), severe (61-80 dB HL), or profound (>80 dB HL) (**Table 1**). The term *deaf* is often used by persons with profound hearing loss, and those who identify as "Deaf" are generally members of the cultural and linguistic community of Deaf culture (7). However, variability exists and there are no standardized recommendations on preferred nomenclature beyond avoiding terms such as *hearing impaired* and deferring to personal preference (7).

Hearing loss is often classified by anatomical deficit as conductive, sensorineural, or mixed. Senso-

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Figure. Anatomy of the ear.



rineural loss is the most common type in adult primary care and can result from cochlear or retro-cochlear changes (**Figure**). The pace of sensorineural loss can indicate pathology: hours or days in sudden sensorineural loss, labyrinthitis, or Meniere disease (a disorder of the inner ear characterized by vertigo, tinnitus, aural fullness, and fluctuating hearing loss); weeks in drug-induced ototoxicity; or years in noise-induced loss. Age-related hearing loss is

multifactorial and typically affects high frequencies first but progresses across frequencies generally in persons older than 50 years. Conductive hearing loss is due to mechanical problems in the transmission of sound from the environment to the inner ear through the tympanic membrane and ossicles of the middle ear; common causes in adults are cerumen impaction, otosclerosis, cholesteatoma, and otitis media with effusion.

Who is at risk for hearing loss?

Hearing loss can occur in any age group. The reasons vary with age as well as resource setting (see the Box: Risk Factors for Hearing Loss). Middle-aged adults can develop hearing loss due to genetic mutations, noise exposure, and ototoxic medications. Older adults often develop multifactorial age-related hearing loss. Although uncommon, adults may also experience sudden hearing loss with infections (labyrinthitis),

episodic fluctuations in Meniere disease, or idiopathic sudden sensorineural hearing loss.

Hearing loss becomes more common with age, starting with subtle changes in hearing, such as difficulty understanding others in noisy environments and feeling like others are mumbling. Subclinical hearing loss, or hearing within limits traditionally defined as normal (<25 dB HL), has been independently associated with cognitive impairment and depressive symptoms, raising the possibility that the effect of hearing loss may begin earlier than previously believed (8, 9). As our understanding evolves, prevention and detection must be addressed at every age, though more intensive management may be focused on older adults.

When and how often should adults be screened for hearing loss?

Although most professional groups recommend screening of at-risk adults, little consensus exists on universal screening of adults or suggested interval screening in any group.

A large meta-analysis in older adults suggests that screening with simple office tests, such as the whisper test or a self-assessment questionnaire, leads to successful therapeutic or compensatory treatment (10).

Screening

Risk Factors for Hearing Loss

Children

- Perinatal infections (e.g., cytomegalovirus, rubella)
- Family history of childhood hearing loss
- Stay in the neonatal intensive care unit >5 d
- Craniofacial abnormalities, including ear anomalies
- Syndrome associated with hearing loss (e.g., Usher, Waardenburg, Alport)
- Neurodegenerative disorder
- Meningitis
- Chemotherapy
- Head trauma

Adults

- Age
- Noise exposure
- Family history of hearing loss
- Exposure to ototoxic medications
- Smoking
- Diabetes

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The U.S. Preventive Services Task Force gave an “insufficient” rating to screening among asymptomatic adults aged 50 years or older (11). The Task Force acknowledged that screening is effective in identifying deficits and has no significant harms but could not find rigorous demonstration of important benefits to recommend screening. However, the recommendations do not apply to persons with perceived hearing loss or other symptoms that may be related to hearing loss. The 2020 recommendation is currently under review.

Medicare mandates screening as part of the annual wellness examination for adults older than 65 years. The American Speech-Language-Hearing Association recommends screening all adults once every decade until age 50 years and every 3 years thereafter. The World Health Organization's Guidelines on Integrated Care for Older People recommend screening and provision of amplification among older adults (12).

Relatively few randomized controlled trials have examined the long-term effects of hearing intervention among adults. Future studies addressing the outcomes of therapies for hearing loss in a general population or long-term use of therapies may clarify some of these screening issues. Although definitive recommendations have yet to be developed, appropriate practice is initial screening for any person with perceived hearing loss and persons with risk factors, followed by interval screening depending on individual continuing risk. However, given the prevalence of hearing loss among older adults, physicians should assume some degree of loss in their older patients and should ensure that patients have access to ef-

fective communication during encounters.

What are appropriate screening tests?

Screening can be done with self-assessment questionnaires, physical examination, mobile smartphone- and tablet-based applications, and portable audiometers. Self-assessment questionnaires are often used in practice but have limitations (see the Box: Self-Assessment Questions for Hearing Loss Screening) (13). Self-reported hearing difficulty varies by sociodemographic characteristics and degree of hearing loss and is often underestimated by persons with mild loss (14). Single-item screening questionnaires have positive and negative predictive values of 60%–80% compared with pure-tone audiometry (15–17).

Self-Assessment Questions for Hearing Loss Screening

Single question: Do you feel you have hearing loss? (yes/no) (positive likelihood ratio [LR] range, 2.4–4.2; negative LR range, 0.33–0.55)

Multiple questions: Hearing Handicap Inventory for the Elderly—Screening Version: 10-item questionnaire with options of “no,” “sometimes,” and “yes” (positive LR range, 2.4–7.9; negative LR range, 0.25–0.7)

Office-based screening tests include the finger rub or whisper test as well as mobile technology-based screening options, such as mobile apps (for example, uHear, Mimi) and smartphone- or tablet-based portable audiometers that can be adjusted to perform screening versus diagnostics (for example, hearTest, SHOEBOX) (see the Box: Physical Examination Screening Tests and Box: Office-Based Diagnostic Testing) (18–21).

Physical Examination Screening Tests

Finger rub: Examiner gently rubs fingers together 6 inches from patient's ear. Positive result is failure to identify rub in ≥ 2 of 6 attempts.

Whisper test: Examiner stands at arm's length (approximately 2 feet) behind patient. Patient occludes 1 ear. Examiner whispers 6 letter/number combinations. Positive result is failure to repeat ≥ 3 of the 6 combinations.

Handheld audiometer: Examiner holds device in patient's ear. Patient indicates awareness of each tone. Positive result is failure to identify either the 1000- or 2000-Hz frequency in both ears or the 1000- and 2000-Hz frequencies in 1 ear.

Mobile apps: Several validated apps are available for Apple iOS and Android platforms and use a standard set of earbuds. Depending on the app, they can include targeted screening or a more complete evaluation.

Smartphone- or tablet-based portable audiometers: Several systems exist that include active noise monitoring and can be programmed for screening only. They generally use supra-aural headphones.

Once hearing loss is identified, office-based testing using the Weber and Rinne tests can help identify it as conductive or sensorineural. Proper technique for these tests is demonstrated at <https://youtu.be/2js72BYjZAw>. If sound lateralizes to one side on the Weber test, the Rinne test is used to distinguish sensorineural from conductive hearing loss. Similar to mobile screening options, mobile apps can obtain air-conduction thresholds, as can smartphone- and tablet-based portable audiometers (19, 21, 22). Mobile audiometers include automated testing options that can be completed by trained technicians, including community health workers, and have been validated in a range of settings with diverse patient popu-

lations, including older adults with cognitive impairment.

To which specialists should a patient with hearing loss be referred?

All patients with hearing loss who are willing should be referred to an audiologist for a hearing test and/or an otolaryngologist for further evaluation. However, for many older adults with symmetric mild to moderate hearing loss that occurred gradually, a growing range of over-the-counter (OTC) amplification options exist and may not require further medical evaluation (23, 24). Counseling in the primary care setting can support a patient's willingness to seek hearing care (25).

Office-Based Diagnostic Testing

Weber test: Strike a tuning fork and place it on the middle of the forehead. A normal test produces sound on both sides (no lateralization). In unilateral conductive loss, the sound will be louder in the affected ear. In sensorineural hearing loss, the sound will lateralize to the better-hearing ear.

Rinne test: Strike a tuning fork and place it on the mastoid bone behind the ear. When the patient indicates no further sound, move the still-vibrating fork to the ear. In a normal test, the patient will still hear air-conducted sound (air conduction should be better than bone conduction). With conductive loss, the patient will not hear the air-conducted sound.

Mobile apps: Several validated apps are available for Apple iOS and Android platforms and use a standard set of earbuds. Depending on the app, they can include a complete audiogram or only screen air-conduction thresholds.

Smartphone- or tablet-based portable audiometers: Several systems exist that include active noise monitoring and can be used to obtain air-conduction pure-tone audiometry as well as speech stimuli. They generally use supra-aural headphones.

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A hearing test can confirm the diagnosis, determine severity, and direct therapy. It can also assess the ability to hear tones and understand words. Tones between 250 and 8000 Hz are presented at varying intensities. Speech discrimination is tested with word presentation at a standard sound intensity and in the setting of noise. Good speech discrimination scores, particularly when tested in noise, can predict a good response to amplification. However, with the expected debut of OTC hearing aids in 2021, specialist referral may not be required to obtain hearing aids.

Urgent referral to an otolaryngologist is warranted for sudden sensorineural hearing loss or hearing loss associated with trauma. Sudden hearing loss may present with aural fullness, which may be initially misdiagnosed as otitis media with effusion or obstructive Eustachian tube dysfunction. Other reasons for referral to an otolaryngologist include severe or recurrent infections; associated vertigo (as in Meniere disease); conductive hearing loss; fluctuating hearing loss; and failure of hearing aids to be useful, particularly given expanding definitions of persons eligible for alternative approaches, such as cochlear implantation.

Screening... Hearing loss can occur at any point in the lifespan. Risk factors in adults include age, noise exposure, family history, smoking, diabetes, and exposure to ototoxic medications. Screening is appropriate for at-risk persons or those with signs or symptoms of hearing loss. Screening tools include self-assessment questionnaires, physical examination tests, and mobile-based technologies. All patients with hearing loss should be offered a referral to an audiologist and/or an otolaryngologist. Worrisome symptoms accompanying hearing loss should prompt referral to an otolaryngologist.

CLINICAL BOTTOM LINE

Prevention

Can hearing loss be prevented?

The best way to prevent hearing loss is to limit exposure to excessive noise in both work and leisure activities. Nearly 40 million Americans between the ages of 20 and 69 years (or a quarter of the adult population) have audiometric evidence of noise-induced hearing loss (26). Whether due to very loud sounds over a span of minutes or moderately loud noises (like a lawnmower) over a span of hours, noise-induced hearing loss is completely pre-

ventable with routine use of hearing protection (27). App-based sound level meters are available for free, including from the National Institute for Occupational Safety and Health, and several devices and apps can track daily noise exposure. Other preventive measures include avoiding or closely monitoring ototoxic medications and chemical exposure, carefully following patients with recurrent ear infections, and instituting measures to avoid head trauma.

What symptoms should make patients and clinicians consider hearing loss?

For persons of any age, any functional or cognitive decline may trigger a hearing screen. Most adults, particularly older adults, present with mild hearing loss that occurs gradually. For age-related hearing loss, the changes in the cochlea (inner ear) that occur with age translate to de-graded electrical signals sent to the brain for processing, which often leaves persons feeling like they can hear but cannot understand others. Those with mild or greater hearing loss may struggle to follow conversations in noisy settings or complain that others mumble. Generally, patients with mild hearing loss do well one-on-one in a quiet setting, like an examination room, and neither they nor their physician may notice difficulty in communicating.

Although hearing loss is common and is often accepted as part of normal aging by older adults, no degree of loss is considered normal. Depression or anxiety, withdrawal from relationships and hobbies, and poor word discrimination can be signs of hearing loss. If health care providers notice that they are repeating themselves, they should evaluate the patient for hearing loss. Similarly, family reports of hearing difficulty (such as turning up the television volume) indicate possible hearing loss. Persons who report tinnitus have increased risk for hearing loss and should be carefully screened.

Do any conditions complicate diagnosis of hearing loss, and can hearing loss mask other conditions?

Many persons may not recognize changes in their hearing,

whereas others may accept them as normal and untreatable or may be embarrassed or frustrated by their perceived deficits or by having to ask to have information repeated. Hearing loss, as opposed to neuropsychiatric causes, may be why some patients seem to have cognitive impairment or are inattentive during an examination. Hearing loss can affect routine cognitive assessments and should be identified and addressed via provision of amplification or testing that does not rely on auditory input (28, 29).

What physical examination findings suggest hearing loss?

Physical examination screening tests, such as the finger rub and whisper tests, were summarized earlier. Abnormal localization on the Weber and Rinne tests may help guide diagnosis. Abnormalities of the tympanic membrane, such as scarring, may suggest a history of middle ear disease, and a visible perforation may suggest conductive hearing loss.

What diagnostic tests should be done when hearing loss is suspected?

Patients with suspected hearing loss should be offered a hearing test, which is useful diagnostically and therapeutically. Patient preferences about pursuing therapy can be better clarified after information is obtained from a hearing test about therapeutic options. In patients with cerumen impaction, testing should be deferred until after cerumen removal.

Routine laboratory evaluation has no role unless the history and physical examination suggest a systemic illness (30). If the hearing loss pattern and audiologic evaluation are consistent with age-related hearing loss—specifically symmetric loss of gradual onset,

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generally with more loss at higher frequencies—there is no need to order imaging studies. Imaging studies may be useful to characterize conductive hearing loss and, in certain scenarios, sensorineural hearing loss (including asymmetric hearing loss) for diagnostic and/or treatment management, including surgical

planning. Typically, patients with these types of hearing loss should be referred to an otolaryngologist, and potentially to an otologist or neurotologist who specializes in ear and hearing care. Generally, it is appropriate to defer to the consultant surgeon for ordering of imaging studies.

Diagnosis... For persons of any age, functional or cognitive decline may indicate hearing loss and should trigger screening. More commonly, hearing loss presents gradually, and patients may not recognize the change. Patients with suspected hearing loss should be offered a hearing test and evaluation by a specialist. There is no role for routine laboratory evaluation. Imaging studies may be useful in certain scenarios. Patients with concerning symptoms or certain types of hearing loss should be referred to an otolaryngologist.

CLINICAL BOTTOM LINE

Treatment

Are there medical treatments for hearing loss?

Various options are available for patients with suspected hearing loss. Initial evaluation should include a focused otologic history with information on the chronicity and onset of hearing loss, along with otoscopy. Improvement in the perception of sound and in communication for patients with hearing loss can be achieved using a range of approaches, including drug therapy for specific types of hearing loss (**Table 2**).

Cerumen impaction

Cerumen accumulation may be responsible for hearing loss of up to 40 dB or may contribute to other causes of hearing loss (31). If cerumen is obstructing the canal, it can be softened and removed by using cerumenolytics, irrigation, or manual removal (**Table 3**) (8).

Cerumenolytics. Water- or oil-based preparations can be used to manage wax impaction, either as single therapy or combined

with irrigation or manual extraction. A Cochrane review concluded that no specific agent was superior to any others or to water or saline instillation (32). Patients without risk factors, such as tympanic membrane perforation or active infections of the ear canal, can be instructed to use cerumenolytic drops (such as Debrox, Cerumenex, Murine, acetic acid, or hydrogen peroxide) once or twice daily for 3-5 days (31). In up to 40% of patients, the drops alone may be effective (33).

Irrigation. Although no randomized controlled trials comparing irrigation with other methods of cerumen removal have been performed, there is consensus that irrigation with low-pressure water is effective (31). Irrigation should not be done in patients with a history of ear surgery or ear tubes, ear canal abnormalities, known tympanic membrane perforation, or active infection or dermatitis of the ear canal (31). The jet of water should be directed at the canal wall, not

Table 2. Drug Treatment for Selected Types of Hearing Loss

Disorder	Agent	Examples	Mechanism of Action	Dosage	Benefits	Adverse Effects	Notes
Cerumen impaction	Cerumenolytics	Water-based: Acetic acid, hydrogen peroxide, Cerumenex Oil-based: Mineral oil Not water- or oil-based: Debrox	Decreases impaction by lubrication and softening of earwax (oil-based) and/or fragmentation of skin cells within cerumen (water-based)	3-5 drops in affected ear 1-2 times a day for 3-5 d	Cheap and effective	Minimal	May ease cerumen removal; may prevent future impaction
Idiopathic sudden sensorineural hearing loss	Oral steroids	Prednisone	Anti-inflammatory	60 mg/d for 7-14 d, then tapered over similar period	Relatively safe and effective	Increased blood glucose level and leukocyte count	Useful first-line agent Begin within 14 d of symptom onset
Idiopathic sudden sensorineural hearing loss	Intratympanic steroids	Dexamethasone	Anti-inflammatory	Varies by institution	Relatively safe and effective Fewer adverse effects than oral steroids	Risk for tympanic membrane perforation May require multiple doses	Equivalent first-line agent to high-dose oral steroids May also be used as salvage therapy within 2-6 wk of symptom onset

down the canal toward the tympanic membrane. Complications include ear canal trauma and otitis externa. Aural irrigation with water in patients who have a history of diabetes or are otherwise immunocompromised should be done with caution—the clinician should not use water; should counsel the patient on worrisome symptoms, such as otorrhea or otalgia; or should use an acidifying agent, such as vinegar or acetic acid, after irrigation (31). Approximately 1 in 1000 irrigations is associated with complications severe enough to warrant referral to a specialist (31).

Manual extraction. Removal of cerumen under otoscopic observation is often the quickest method, does not expose the ear

to moisture, and should be performed by an otolaryngologist (31). Harms include trauma to the external canal or exacerbation of impaction by propelling cerumen farther down the canal to the tympanic membrane. Patients who use anticoagulants or have a history of radiation to the head and neck, narrowed canals, or other abnormalities are at increased risk for external canal trauma with manual extraction and might benefit from vacuum extraction or extraction under binocular microscopy, which is typically available in otolaryngology offices (31).

Prevention. All patients should be counseled that cerumen is normal and healthy and to avoid inserting

Table 3. Cerumen Removal Options

Consideration	Cerumenolytic	Irrigation	Manual Extraction
Advantages	Easy application Effective Noninvasive Done at home Minimal or no risk	Effective Immediate resolution	Effective Immediate resolution
Disadvantages	Multiple applications over 3-5 d	Typically clinic-based procedure	Clinic-based procedure
Complications	Allergic reactions Skin irritation Transient hearing loss	Otitis externa External canal trauma Tympanic membrane perforation Vertigo Hearing loss	Canal trauma Hearing loss Tinnitus Worsened impaction Tympanic membrane perforation
When to avoid	Potential for pain, infection, or ototoxicity if tympanic membrane not intact	Tympanic membrane not intact History of ear surgery Susceptibility to ear infections Active ear infection	Anticoagulation History of head and neck radiation Ear canal abnormalities
Important considerations	No specific agent has been found to be better than any others	For diabetic patients, avoid water or use an acidifying agent after irrigation	Curette, forceps, and suction are possible options Must perform under direct visualization

cotton-tipped swabs or other instruments into the ear canal (31). Patients with a history of abundant or impacted cerumen may use cerumenolytics or self-irrigation weekly. Patients with hearing aids should regularly clean them to avoid wax buildup.

Sudden hearing loss

Sudden hearing loss is relatively rare but is an otologic emergency. Physicians should obtain a targeted otologic history, examine the ear, and perform tuning fork testing to aid in differentiating conductive from sensorineural hearing loss. Sudden hearing loss occurs within a 72-hour window and can be unilateral or bilateral (30). Patients can be misdiagnosed with cerumen impaction or an effusion given symptoms of hearing loss or aural fullness. Patients with suspected loss should be referred for audiometric confirmation within 14 days of symptom onset, and ideally within 7 days (30). A 2019 practice guideline from the American Academy of Otolaryngology-Head and Neck Surgery Foundation recommended steroids as initial treatment for sudden hearing loss in adults within 2 weeks of symptom onset, based on grade C evidence (30). First-line treatment for idiopathic sudden sensorineural hearing loss is oral or intratympanic corticosteroids within 14 days of symptom onset. Prednisone or equivalent should be prescribed at 1 mg/kg of body weight per day at a maximum dose of 60 mg/d for 7-14 days, followed by tapering over a similar period (30). Patients with sudden hearing loss should be comanaged with an otolaryngologist; intratympanic steroids may be used as an alternative to oral high-dose steroids or salvage therapy if oral steroids fail within 2-6 weeks after symptom onset (30).

What surgical therapies are available?

For patients with conductive hearing loss due to mechanical problems, such as perforation of

the tympanic membrane, ossicular pathology, or a cholesteatoma, surgical treatment should be considered. Risks include facial nerve injury, dizziness, cerebrospinal fluid leak, infection, and a change in taste due to chorda tympani damage.

Cochlear implantation is increasingly considered in adults with sensorineural hearing loss given advances in technology and growing understanding of the benefits in a wider range of patients. Cochlear implantation technology and surgical techniques have advanced significantly since its approval for commercial use in 1985. Current techniques allow for a greater degree of hearing preservation, and patients with a range of hearing who no longer benefit from hearing aids may benefit from cochlear implantation. The U.S. Food and Drug Administration indications for cochlear implantation expanded in 2019 to include persons with single-sided deafness (profound loss in one ear but normal to moderate loss in the other) (34).

Cochlear implants send sound signals directly to the auditory nerve, bypassing cochlear hair cells. A receiver/stimulator unit and an intracochlear electrode are surgically implanted, typically in an outpatient procedure with limited blood loss and less than 2 hours under anesthesia (34). A basic orientation to the procedure can be viewed at www.nejm.org/doi/10.1056/NEJMra1904407. Given the relatively low perioperative anesthetic risks, cochlear implantation is routinely performed on patients ranging in age from infants to nonagenarians (34-36). Once the device is activated, a speech processor is worn behind the ear. Cochlear implants do not replicate normal hearing; with training, many patients can learn

to recognize words, phrases, and environmental sounds, providing access to sounds and speech that was not possible with hearing aids. Outcomes in older adults are similar to those in younger candidates but vary on an individual basis. Most insurance programs, including Medicare, cover cochlear implants for persons who meet criteria.

What types of hearing aids are available?

Most approaches to hearing loss involve amplification, including for age-related hearing loss, the most common type (Table 4). Individual variation in patient preference, manual dexterity, cognitive capacity, and cost ultimately determines the best approach. Regardless of the use of amplification, education and counseling through aural rehabilitation are key components of optimizing communication for persons with hearing loss.

Recent national efforts to increase the affordability and accessibility of hearing technology resulted in bipartisan legislation signed into law in August 2017 that created the designation of OTC hearing aids, which are expected to debut in 2021 (37) and will target self-reported mild to moderate hearing loss. Appropriate regulations from the U.S. Food and Drug Administration will aid in ensuring quality and

safety of available devices. OTC hearing aids will provide patients the ability to obtain care through a wider number of outlets beyond audiologists and otolaryngologists and are expected to enhance hearing health care options.

Assistive listening devices

An assistive listening device is currently the least expensive and simplest approach. These handheld devices involve an external microphone and headphones that transmit sound to one or both ears. The microphone may be worn in a pocket or around the neck or placed on a table. Volume and microphone placement can be adjusted. Cost is generally \$100–\$200. These devices can be rechargeable or use commonly available batteries, have few or no buttons, and are an excellent option for patients who have limitations in manual dexterity or cognitive impairment or require greater amplification (24).

Hearing aids

Hearing aids are the most widely recommended devices for persons with hearing loss. They vary in design, capabilities, and cost. With future OTC options, not all patients will need to be evaluated by an audiologist or otolaryngologist before purchasing hearing aids. Interventions that focus on self-management may improve outcomes for persons

Table 4. Hearing Aid Styles

Style	Description	Hearing Loss Indication	Visibility	Ease of Use	Notes
Behind the ear	Receiver worn behind the ear	All ranges	Highly visible	Easy	Powerful; sturdy
In the ear	Earpiece sits inside pinna	All ranges	Slightly less visible	Easy	-
In the canal	Most of device in external canal	Mild to moderate	Hard to see	Moderately difficult	More difficult to adjust and use
Completely in the canal	Entire device in external canal	Mild to moderate	Nearly invisible	Difficult	Will not fit some canals; high manual dexterity needed; easily lost

who use hearing aids (38). Medicare and many private insurance companies do not cover the full out-of-pocket cost, which averages \$4700 for bilateral hearing aids (39). However, Medicaid may offer help with coverage in many states, Medicare Advantage plans may provide some coverage, and many older veterans may also be entitled to hearing aids. The Hearing Loss Association of America provides many patient-oriented references, including OTC options (www.hearingloss.org/hearing-help/technology/hearing-aids).

The following device features must be considered:

Location and form factor. The device can sit behind the ear, in the bowl of the pinna, or in the ear canal. The size and cosmetic appearance change as models move into the ear. Larger external units are easier to place and have larger volume controls and battery chambers. Smaller units generally have less amplification capacity but may be more cosmetically acceptable. Among OTC devices, many form factors exist and offer patients the ability to wear devices that do not appear to be hearing aids.

Sound quality and enhancements. Hearing aids and OTC devices can be programmed for different frequencies and loudness. Settings to reduce amplification of background noise and improve signal-to-noise ratio are available in a range of devices, as well as algorithms that optimize listening comfort. Some devices can be used with remote microphones, which improve the signal-to-noise ratio and speech understanding, particularly when face masks are worn.

Connectivity. Many hearing aids and OTC devices have Bluetooth capabilities, which allow adjust-

ments via a smartphone and can enhance telephone use and audio streaming.

Telecoil inclusion. A special amplification device can be added that is useful for telephones and connecting with amplification systems at larger venues.

Charging options. An increasing number of hearing aids and OTC products offer a rechargeable option. Patients with limited manual dexterity, vision impairment, or limited financial resources may benefit from a rechargeable option to avoid the recurring cost and management of small hearing aid batteries.

User interface. Hearing aids and OTC devices may require users to adjust volume and listening settings through buttons on the device and/or a mobile app on a smartphone. Patients should be aware of required technology and proficiency when considering options.

Unilateral or bilateral devices. In most patients, bilateral amplification produces the best outcomes. One aid provides gain in decibels perceived; the second helps with speech discrimination and localizing the source of the sound. Cost may be prohibitive for some patients.

What communication strategies and environmental adaptations are useful for persons with hearing loss?

In health care settings, in addition to offering sign language interpreters for patients who request them, quiet areas facilitate communication. When addressing patients, it is important to ensure that they have access to their eyeglasses (if needed) and that lighting is adequate to illuminate the providers' faces. Assistive listening devices should be universally available in health care settings (see the Box: Tips

for Improving Communication With Patients With Hearing Loss). For telemedicine encounters, clinicians should use headsets to improve the signal-to-noise ratio, prioritize video-based encounters when possible to allow for visual cues, and use captioning via automatic speech recognition where available (40).

For the homes of patients with more severe hearing loss, amplified telephones with vibrating or flashing ringer alerts may be pur-

Tips for Improving Communication With Patients With Hearing Loss

- For older adults, assume some degree of hearing loss.
- Ask the patient how they prefer to communicate.
- Reduce background noise.
- Have the patient's attention.
- Face the patient; do not obscure your mouth with your hands.
- Speak toward the better ear when applicable.
- Speak slowly and distinctly in sentences or phrases. Do not shout.
- Monitor for signs the patient is not following the conversation.
- Rephrase rather than repeat.
- Incorporate teach-back techniques throughout the encounter.
- Write down key points of conversation.

chased. Text telephones with large fonts and closed captioning are also available. Flashing and vibrating devices for alarm clocks, smoke alarms, and doorbells can improve safety and convenience.

In public spaces, infrared, hearing loop, and wireless FM devices are often available. Theaters and concert halls frequently provide these devices on request. Hearing loop systems are more commonly installed in large halls, museums, restaurants, and places of worship. These devices transmit sound to persons with telecoils in their hearing aids or to FM receivers. Information for patients can be found at www.hearingloss.org/hearing-help/technology/hat/hearing-loop-technology.

What medications should be avoided in persons with hearing loss?

Medications that damage the hair cells in the ears can cause permanent hearing loss because these cells do not regenerate in mammals (41). Although many medications can be implicated (see the Box: Known Ototoxic and Potentially Ototoxic Medications), aminoglycosides are among the highest-risk medications, and salicylate use may be a

reversible cause of hearing loss. Combining a loop diuretic with an aminoglycoside can increase toxicity. If long-term use is anticipated, a pretreatment hearing test may be useful, at least for medicolegal purposes.

Known Ototoxic and Potentially Ototoxic Medications

Known to Be Ototoxic

- Aminoglycosides (amikacin, neomycin, kanamycin, streptomycin)
- Erythromycin (high intravenous doses only)
- Vancomycin (synergistic with gentamicin)
- Nonsteroidal anti-inflammatory drugs, salicylates
- Loop diuretics (ethacrynic acid, furosemide)
- Quinine
- Cisplatin

Potentially Ototoxic

- Propylene glycol
- Povidone-iodine
- Industrial solvents
- Bleomycin
- Carbon monoxide
- Lead
- Alcohol
- Caffeine
- Methylmercury
- Potassium bromate
- Chloramphenicol
- Nitrogen mustard
- Arsenic
- Nicotine

Treatment... Persons with hearing loss have various treatment options. Initial evaluation should include a targeted otologic history and otoscopy, including cerumen removal as indicated. Sudden hearing loss is an otologic emergency that can be misdiagnosed. Oral or intratympanic steroids are the first-line treatment, and care should be provided in collaboration with an otolaryngologist. Cochlear implantation may be considered for patients with sensorineural hearing loss who no longer benefit from hearing aids or have profound unilateral loss. Devices to improve sound perception and communication include assistive listening devices and hearing aids, including OTC options. Communication strategies and environmental adaptations are critical in health care settings to ensure effective communication. Ototoxic medications can permanently damage hearing and should be avoided if possible.

CLINICAL BOTTOM LINE

Ramifications of Hearing Loss

What are the consequences of hearing loss?

Access to effective communication is increasingly recognized as fundamental to healthy aging (39, 42, 43). Many large epidemiologic studies have documented a range of negative outcomes associated with hearing loss in the context of healthy aging. Age-related hearing loss has been independently associated with worse quality of life, depression, social isolation, functional decline, falls, increased hospitalization and health care use, and accelerated cognitive decline and incident dementia (44–50).

A recent study found that compared with persons with normal hearing, those with mild, moderate, and severe hearing loss had a 2-, 3-, and 5-fold increased risk, respectively, for incident dementia (50).

Proposed mechanisms for this decline include social isolation, increased cognitive load, and altered cortical processing (51). Given increases in life expectancy, the prevalence of hearing loss, and emerging evidence of the degree of association, age-related hearing loss is the largest potentially modifiable risk factor for dementia at a population level (43).

How should clinicians counsel patients about the benefits of hearing care?

Outcome studies reporting changes with hearing care, such as hearing aids or cochlear

implants, are limited, particularly those with long-term follow-up.

A randomized controlled trial done in veterans in the late 1980s showed improvement in communication function, quality of life, depression, and cognition at 4 months after treatment, and improvements in communication, depression, and social and emotional function were maintained at 12 months (52, 53).

A 2017 Cochrane review found benefits of hearing aids in adults with mild to moderate hearing loss, including improved quality of life, communication function, and social and emotional function (54).

With regard to the potential role of hearing care as a form of primary prevention of dementia, the ACHIEVE trial (ClinicalTrials.gov: NCT03243422) is an ongoing multicenter randomized controlled trial investigating the efficacy of hearing treatment on cognitive decline (55).

Use of hearing technology, such as hearing aids, is a low-risk nonpharmacologic intervention that improves communication, engagement, and overall well-being. Patients should be counseled that hearing is an important part of aging but that the evidence is evolving on whether hearing care may affect important outcomes, such as cognitive decline (56).

What role do internists have in addressing hearing loss as a public health priority?

Hearing loss is highly prevalent, and one can assume that an older patient has at least some degree of it. Rates of hearing aid use are low and have remained stagnant for decades.

Recent national and international efforts have called for recognition of hearing loss as a public health priority, and the National Academies of Sciences, Engineering, and Medicine's 2016 report provides recommendations on how to increase the affordability and accessibility of hearing care (39, 57).

Multidisciplinary efforts beyond audiology and otolaryngology are required to meet the hearing care needs of an aging population. Integration of public health approaches into hearing care can extend access through home- and community-delivered care models and incorporation of task sharing, such as through partnership with community health workers, facilitated by the availability of high-quality, low-cost OTC hearing aids (39). Internists will have a critical role in identifying and prioritizing hearing health, particularly as an increasing number of affordable and accessible options emerge.

Ramifications of Hearing Loss... Hearing loss has been associated with negative outcomes across multiple domains of aging, including accelerated cognitive decline. Hearing is essential to effective communication and the delivery of person-centered care. Hearing care improves communication, quality of life, and social and emotional function.

CLINICAL BOTTOM LINE

In the Clinic Tool Kit

Hearing Loss

Patient Information

<https://medlineplus.gov/hearingdisordersanddeafness.html>

<https://medlineplus.gov/languages/hearingdisordersanddeafness.html>

Patient information and handouts on hearing disorders and deafness in English and other languages from the National Institutes of Health's MedlinePlus.

www.nidcd.nih.gov/health/hearing-loss-older-adults

www.nidcd.nih.gov/es/espanol/perdida-de-audicion-en-los-adultos-mayores

Information on hearing loss in older adults in English and Spanish from the National Institute on Deafness and Other Communication Disorders.

www.healthinaging.org/a-z-topic/hearing-loss

Information on hearing loss from the Health in Aging Foundation of the American Geriatrics Society.

www.asha.org/aud/pei

Patient education handouts on hearing loss in English and Spanish from the American Speech-Language-Hearing Association.

Information for Health Professionals

<https://journals.sagepub.com/doi/full/10.1177/0194599819859885>

Clinical practice guideline on sudden hearing loss, updated in 2019, from the American Academy of Otolaryngology-Head and Neck Surgery.

<https://apps.who.int/iris/handle/10665/258981>

Screening recommendations on integrated care for older adults from the World Health Organization.

www.nice.org.uk/guidance/ng98

Guidance on the assessment and management of hearing loss in adults from the National Institute for Health and Care Excellence.

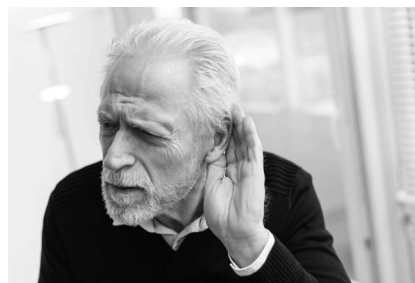
In the Clinic

WHAT YOU SHOULD KNOW ABOUT HEARING LOSS

In the Clinic
Annals of Internal Medicine

What Is Hearing Loss?

Hearing loss happens when there are changes within the ears or problems with the nerves that carry sound to the brain. It can happen at any age but is most common among older adults. Although hearing loss is common, it is not considered normal. It is important to detect and treat it early. Undiagnosed hearing loss may lead to depression, anxiety, and declines in mental function.



What Causes It?

Risk factors in adults include:

- Age
- Exposure to loud noises
- Family history of hearing loss
- Smoking
- Diabetes
- Taking certain medicines

Although rare, certain infections or injuries can cause sudden hearing loss and a feeling of fullness in your ear. If this happens, you should see a doctor right away.

What Are Some Symptoms?

Signs of hearing loss can include:

- Difficulty understanding others in loud environments
- Feeling like others are mumbling
- Trouble differentiating between words and sounds
- Frequently turning up the television volume

Hearing loss can happen gradually. A family member may notice it before you do if, for example, they see you withdrawing from relationships and hobbies.

How Can I Prevent It?

- Limit exposure to loud noises, both at work and in your free time.
- Use hearing protection if you will be around loud noises.
- Avoid or closely monitor your use of certain medicines and exposure to chemicals.
- Take precautions to avoid head injury.

How Is It Diagnosed?

- Your doctor will do a physical examination. This will include looking in your ears for infection, wax buildup, or other blockages.
- Your doctor will take a medical history and ask when you first noticed your hearing loss. They will also ask about any medicines you take.

- Your doctor can do simple tests in the office to detect hearing loss. These include whispering close to your ear or rubbing their fingers together by your ear and asking you about what you heard. They might also use a handheld device called an audiometer or a mobile or tablet-based app.
- Once your doctor determines you have hearing loss, they will refer you to an audiologist, who can perform additional tests to see how much hearing you have lost and identify ways to help you hear better.

How Is It Treated?

- If your doctor notices wax buildup (which is normal but can cause hearing loss), they will remove it.
- Sudden hearing loss may be treated with steroids, either by mouth or by an injection in the ear.
- Hearing aids, which make outside noises louder, are most commonly used to manage hearing loss. Many different kinds are available. Over-the-counter hearing aids are expected to be available in 2021.
- Handheld devices, called assistive listening devices, are simple and inexpensive ways to help you hear better.
- Cochlear implants are sometimes recommended. They are small devices that are implanted surgically and send sound directly to the nerves in your ear.

Questions for My Doctor

- What can I do to prevent hearing loss?
- Should I be screened for hearing loss?
- Should I see a specialist?
- What type of hearing aids will work for me? Will insurance cover them?
- How can my family best communicate with me?

For More Information



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American Geriatrics Society's Health in Aging Foundation
www.healthinaging.org/a-z-topic/hearing-loss

Hearing Loss Association of America
www.hearingloss.org/hearing-help/technology/hearing-aids

MedlinePlus
<https://medlineplus.gov/hearingdisordersanddeafness.html>