Older adults with hearing loss who receive care in the noisy environment of a critical care unit can be disadvantaged in their ability to understand speech, thus limiting their participation in decision making. Providing optimal outcomes for such patients can be understood through use of the American Association of Critical-Care Nurses Synergy Model. When older adults are admitted to a critical care unit, their spouses, children, and friends are in positions to participate in the patients’ care. The AACN Synergy Model patient characteristic of participation in care is useful in enhancing optimal outcomes for older patients. (Critical Care Nurse. 2012;32[6]:43-50)

Older adults account for approximately 60% of patients in intensive care units. Older adults with hearing loss who receive care in the noisy environment of a critical care unit can be disadvantaged in their ability to understand speech, thus limiting their participation in decision making. In this article, I present the incidence of hearing loss among older adults, the physiology of hearing, hearing loss in older adults, and strategies that can be used to enhance participation of patients with hearing loss in making decisions about their care.

Incidence
Hearing loss is the third most common chronic-condition disability in the United States.2 Approximately 36 million persons (17%) have some degree of hearing loss,3 and the prevalence of hearing loss is increasing among adults 45 to 69 years old4 because of environmental noises such as leaf blowers, lawn mowers, and motorcycles. This form of hearing loss due to nonoccupational noise is called socioacusis. A further increase in hearing impairment is expected; hearing loss is the No. 1 diagnosis for US soldiers returning from Afghanistan.4 In general, lifetime costs associated with severe to profound hearing loss are more than $1 million per person. Among adults more than 60 years old, 1 in 3 has a hearing loss,5 Half of the US population more than 80 years old have indications of bilateral hearing loss; the left ear is affected more than the right.4 This difference is thought to be caused by a "breakdown of the integration of binaural information, possibly caused by gradual demyelination of the callosal pathway necessary for interhemispheric transfer of information."6

Hearing loss varies by age, sex, race, and ethnicity. Figure 1 shows the percentage of hearing loss by sex and age. Men are more likely than women to have hearing loss. The mechanism for less hearing loss in women is thought to be related to levels of estrogen, vitamin B12, and red cell folates; the levels in women may have an otoprotective role in the cochlea.8-10 Men have consistently reported more hearing problems than have women regardless of race. Hispanic, blacks, and Asians report less hearing loss than do whites and Native Americans. The hypothesized explanation for this difference is the association with melanin. Melanocytes are distributed through the cochlea and have some antioxidant activities.8,11 The differences in hearing loss among races could be influenced by this cultural difference in the number of melanocytes.

Basic Anatomy and Physiology of Hearing
The auditory system consists of the outer, middle, and inner sections...
of the ear (Figure 2). The outer ear has the pinna (visible flap) that funnels sound waves through the external auditory meatus and then through the external auditory canal to the tympanic membrane (ear drum). The middle ear consists of the tympanic membrane and a chain of auditory ossicles called the malleus, incus, and stapes. The tympanic membrane separates the external ear from the middle ear. An oval window and a round window lie between the middle ear and the inner ear. Vibrations of the tympanic membrane send sound waves to the 3 small bones (malleus, incus, and stapes) in the middle ear. The stapes has a footplate, which inserts into the oval window and provides the interface between the middle ear and the inner ear. The inner ear consists of a bony labyrinth and a membranous labyrinth. The bony labyrinth consists of 3 semicircular canals (lateral, posterior, and superior). The membranous labyrinth consists of a series of ducts called the scala vestibuli, scala tympani, and scala media. Vibrations of the 3 small bones in the middle ear pass the sound waves to the small fluid-filled organ called the cochlea.

The cochlea and the vestibule are formed from bony and membranous labyrinths. The cochlea, a spiral-shaped series of 3 tubular canals or ducts, contains the organ of Corti. The organ contains the receptor cells responsible for auditory transduction. The receptor cells are of 2 types: inner hair cells and outer hair cells. The nerves that serve the organ of Corti are contained in the vestibulocochlear nerve (cranial nerve VIII). The eustachian tube is also part of the middle ear, and although it does not contribute directly to the transmission of sound through the ear, improper function of the tube can greatly affect hearing. The eustachian tube equalizes pressure against inner and outer surfaces for the tympanic membrane and prevents rupture of the membrane and the discomfort

**Figure 1** Permanent hearing loss, distribution by sex and age. Data from the 2002 National Health Interview Survey.

**Figure 2** Parts of the external, middle, and inner ear.
associated with marked differences in pressure.\textsuperscript{12,13} Hearing occurs when sound waves are transformed into electrical impulses that travel through the nervous system. Sound is characterized by pitch (tone) and intensity (loudness) and is transmitted through air by waves of compression and decompression. Pitch is determined by the frequency of sound waves: the faster the frequency, the higher is the pitch. Frequency is measured in Hertz. Intensity (loudness) depends on the amplitude of the sound and is measured in decibels, a relative measure on a log scale. Sounds greater than 100 dB can damage the auditory apparatus, and sounds greater than 120 dB can cause pain.\textsuperscript{12,14}

### Hearing Loss in Older Adults

Hearing loss in an older adult can be conductive, sensorineural, or mixed (Table 1). Conductive hearing loss occurs when the conduction of sound from the outer ear to the inner ear is impaired. A common cause of conductive hearing loss in older people is impacted cerumen (ear wax). People with conductive hearing loss have diminished hearing when they speak softly because they hear their voice through bone conduction as loud.\textsuperscript{15} Conductive hearing loss is an intensity (loudness) issue.

Sensorineural hearing loss is due to damage of the tiny hair cells in the cochlea or its central connections.\textsuperscript{15p146} Changes in the blood supply to the ear due to heart disease, high blood pressure, vascular conditions associated with diabetes mellitus, or other circulatory problems may also be a cause.

The most common cause of sensorineural hearing loss is related to aging. A gradual loss of hearing as a person grows older is known as presbycusis. Presbycusis is typically a bilateral high-frequency and high-pitch (tone) hearing loss associated with the inner ear or the auditory nerve.\textsuperscript{16} Its cause may be atrophy of the basal end of the organ of Corti, loss of auditory receptors, vascular changes, or stiffening of the basilar membranes.\textsuperscript{15p146} The loss associated with presbycusis is usually greater for high-pitched sounds. A man’s voice is easier to hear than is a woman’s voice. Hence, a woman’s voice in a critical care unit may result in diminished understanding of the words or be ignored by a patient because the patient does not hear the voice. High-pitched sounds such as s and th are difficult to understand, and speech may sound mumbled or slurred. Conversations are difficult to discern, especially when background noise is present, as in a busy critical care unit with frequent alarms. Although a hereditary component can be present (autosomal recessive or X-linked inheritance),

### Table 1 Comparison of types of hearing loss

<table>
<thead>
<tr>
<th>Type</th>
<th>Conductive hearing loss</th>
<th>Sensorineural hearing loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Kind of disorder</td>
<td>Intensity (loudness)</td>
<td>Pitch (tone)</td>
</tr>
<tr>
<td>Measure</td>
<td>Hertz</td>
<td>Decibel</td>
</tr>
<tr>
<td>Sounds</td>
<td>Deep sounds such as o, u</td>
<td>High-pitched sounds such as c, d, k, p, s, f, sh, t</td>
</tr>
<tr>
<td>Area</td>
<td>Inner ear, cranial nerve VIII, central processing centers</td>
<td>Middle ear, tympanic membrane, or inner ear</td>
</tr>
<tr>
<td>Possible causes</td>
<td>Fluid in the middle ear from colds</td>
<td>Illnesses</td>
</tr>
<tr>
<td></td>
<td>Ear infection (otitis media)</td>
<td>Ototoxic drugs</td>
</tr>
<tr>
<td></td>
<td>Allergies (serous otitis media)</td>
<td>Genetic or hereditary cause</td>
</tr>
<tr>
<td></td>
<td>Poor eustachian tube function</td>
<td>Aging</td>
</tr>
<tr>
<td></td>
<td>Perforated eardrum</td>
<td>Head trauma</td>
</tr>
<tr>
<td></td>
<td>Benign tumors</td>
<td>Malformation of the inner ear</td>
</tr>
<tr>
<td></td>
<td>Impacted earwax (cerumen)</td>
<td>Exposure to loud noise</td>
</tr>
<tr>
<td></td>
<td>Infection in the ear canal (external otitis)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Presence of a foreign body</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Absence or malformation of the outer ear, ear canal, or middle ear</td>
<td></td>
</tr>
<tr>
<td>Weber test</td>
<td>Sound localizes to normal ear</td>
<td>Sound localizes to affected ear</td>
</tr>
<tr>
<td>Rinne test</td>
<td>Bone conduction &gt; air conduction</td>
<td>Air conduction &gt; bone conduction</td>
</tr>
</tbody>
</table>
side effects of some medications or chemicals (aspirin, certain antibiotics such as aminoglycosides, mercury, gold, tobacco components, and alcohol) can contribute to the irreversible disorder of presbycusis. Exposure to these drugs and chemicals can cause ringing in the ears (tinnitus) and then sensorineural hearing loss. The underlying mechanism of ototoxic effects is unknown.12

Another cause of sensorineural hearing loss is often occupational and is common in construction workers, farmers, musicians, airport workers, tree cutters, and people in the armed forces. This loss is due to loud noise (>40 dB).17 Table 2 lists loudness in decibels for common environmental situations.

**Diagnosis of Hearing Loss**

The criteria for a diagnosis of hearing loss are a loss greater than 20 dB at any single frequency. Table 3 indicates categories of hearing impairment: mild, moderate, severe, and profound. The categories are based on the level of decibels a person can detect during a hearing test.17

**Impact of Hearing Loss**

Hearing loss can lead to miscommunication, social withdrawal, confusion, depression, and reduction in functional status.17 Although treatable, hearing loss often goes undetected and untreated. Persons with moderate to severe hearing loss are more likely than persons without a loss to have impairments in activities of daily living and instrumental activities of daily living. Hearing loss is not a direct cause of a reduction in physical function, but persons with a hearing loss can have more difficulty with the daily tasks of living than do persons without a loss. Because communication is key to instrumental activities of daily living such as shopping for personal items, taking care of personal finances, preparing meals, and talking on the telephone, the finding that hearing loss is associated with reduced function in these areas is not surprising.18

Elderly persons with uncorrected hearing impairment are more likely than those who wear a hearing device to be depressed, withdrawn, and predisposed to falling.21,22 Hearing loss is a predictor of falls and postural balance problems. In one study,21 patients with poor hearing had a 3- to 4-fold higher risk for falls than did patients with better hearing. This association has not been explained. Hearing loss has also been associated with a reduction in the estimated glomerular filtration rate (<60 mL/min per 1.73 m²).24 Critical care nurses who recognize the link between hearing loss and a decrease in estimated glomerular filtration rate can use assessment skills to identify patients who have the link and can make an extra effort in designing strategies for the patients’ participation in decision making. Table 4 summarizes the impact of hearing loss.

**Strategies for the Hearing Impaired**

Many strategies are available to help people with hearing impairment (Table 5). Older adults with hearing loss can benefit from using

---

**Table 2** Decibels of the environment

<table>
<thead>
<tr>
<th>Environment</th>
<th>Decibels</th>
</tr>
</thead>
<tbody>
<tr>
<td>A quiet room at night</td>
<td>20</td>
</tr>
<tr>
<td>A quiet sitting room</td>
<td>40</td>
</tr>
<tr>
<td>Normal conversation, thunder</td>
<td>60</td>
</tr>
<tr>
<td>Medical equipment, nurses’ voices, busy restaurant</td>
<td>70</td>
</tr>
<tr>
<td>Level at which damage begins, for example, shouting, alarm clock</td>
<td>80</td>
</tr>
<tr>
<td>A pneumatic drill, rock concert</td>
<td>110</td>
</tr>
<tr>
<td>An airplane taking off 100 m away</td>
<td>130</td>
</tr>
<tr>
<td>Point of painfulness, for example, air-raid siren</td>
<td>140</td>
</tr>
</tbody>
</table>

*a Based on data from Action on hearing loss.18

---

**Table 3** Levels of hearing impairment/deafness

<table>
<thead>
<tr>
<th>Degree</th>
<th>Decibels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>25-39</td>
</tr>
<tr>
<td>Moderate</td>
<td>40-69</td>
</tr>
<tr>
<td>Severe</td>
<td>70-94</td>
</tr>
<tr>
<td>Profound</td>
<td>≥95</td>
</tr>
</tbody>
</table>

*a Based on data from Hearing impairment (deafness).19

---

**Table 4** Impact of hearing loss

<table>
<thead>
<tr>
<th>Miscommunication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social withdrawal</td>
</tr>
<tr>
<td>Confusion</td>
</tr>
<tr>
<td>Depression</td>
</tr>
<tr>
<td>Reduction in functional status</td>
</tr>
<tr>
<td>Conversations difficult to discern</td>
</tr>
<tr>
<td>Reduced function in instrumental activities of daily living</td>
</tr>
<tr>
<td>Reduction in estimated glomerular filtration rate</td>
</tr>
</tbody>
</table>

---

**Table 5** Strategies for the Hearing Impaired

- Use assistive listening devices
- Use written materials
- Speak clearly and distinctly
- Provide a quiet environment
- Use lip reading
- Use sign language
a hearing aid, although the degree of benefit varies according to the type and amount of hearing loss. Only 20% of persons who could benefit from a hearing aid actually wear one, and only 28.9% of people hard of hearing who are 70 years or older use hearing aids. Hearing aids are best suited for a hearing loss related to damage of the hair cells in the inner ear (sensorineural). Hearing devices can be in the form of hearing aids or implants.

Hearing aids are available in 3 basic styles: in the ear canal, in the ear, and behind the ear (Figure 3). The electronics in a hearing aid are either analog or digital. Analog hearing aids are customized to the user by being specifically programmed. These aids are usually less expensive than are digital aids. Digital hearing aids convert the pitch of sound into digital codes that can be programmed for specific environments by an audiologist. However, digital aids can cost approximately $3000 for each ear, and the costs are usually not covered by health insurance. For financial assistance in obtaining or replacing a hearing aid, patients and their families should contact the National Institute on Deafness and Other Communication Disorders information clearinghouse. In the hospital, all patients’ hearing devices should be kept away from heat and moisture and should be turned off when not in use to extend the life of the battery. A dead battery requires replacement, and hearing aid batteries are not items typically stocked in a critical care unit.

The loss of hearing aids in a critical care unit should be prevented by placing the hearing aid in a denture cup when the aid is not in use. The denture cup should be labeled Hearing aid.

Another type of hearing device is implantable. Two types are available: middle ear implants and bone-anchored hearing aids. Both devices are attached to bone, and both strengthen sound vibrations. However, middle ear implants move the bone directly via the vibrations, whereas bone-anchored hearing aids transmit vibrations from the bone behind the ear through the skull. These devices are also used for sensorineural hearing loss.

Assistive listening devices can provide further improvement in hearing ability in certain situations. Built-in telephone amplifiers are 1 example. Frequency modulation (FM) systems are another example; they make sound clearer, with or without a hearing aid, by delivering sound waves as a radio does. Essentially, each of these devices decreases background noise, a change that ultimately enhances 1-on-1 conversations.

Radio and television listening systems are available that allow a person to increase the volume of the radio or television without being bothered by other noises or bothering others in the same room. Hearing aids can be used with these systems. Telephone devices can increase volume and work with some hearing aids that are equipped with a T switch. The T switch interacts with telephones that have an amplifying coil that is activated when the phone receiver is lifted. Simpler devices for telephones can be purchased that increase the sound through the receiver with a volume control. Cell phones have also been designed to work with hearing aids.

Amplifying devices for mobile telephones are called loopsets. A loopset is a small box worn around the neck that helps amplify sound. Loopsets allow people with a T-coil-equipped hearing aid to wear a loopset around the neck that transmits speech from the mobile phone to the hearing aid. Background noise is reduced, and the devices work well in noisy environments.

Cochlear implants have 3 main parts: a headpiece, a speech processor, and a receiver (Figure 4). The headpiece is worn just behind the ear, where a microphone picks up sound and sends the vibrations to the speech processor, a beeper-sized...
device that can fit in a pocket. The receiver obtains a signal from the speech processor, which is approximately the size of a quarter and is located under the skin behind the ear. Cochlear implants are reserved for people with a profound or severe hearing loss.14,25,27

Communication Techniques for Critical Care Nurses

Facing a person when speaking to him or her can facilitate projection of the sound waves in the direction of the person. Lighting in front of a nurse who is speaking allows patients with a hearing impairment to observe the nurse’s facial expressions, gestures, and lip and body movements. Nurses should turn off the television while talking to a patient. Nurses can facilitate communication with patients by speaking slightly louder and at a normal rate, using shorter and simpler statements, and restating. Unfortunately, critical care units are busy and often noisy environments (Table 2); closing the door to a patient’s room may help block out some of the background noise. Nurses should be aware that a patient’s extra effort in trying to hear lessens the patient’s recall, making instructions more time-consuming and necessitating printed material for patients and patients’ family members.28

Accommodations for the Hearing Impaired

The Americans With Disabilities Act of 1990 and the Rehabilitation Act of 1973 prohibit discrimination against disabled people such as people with a hearing loss. These laws require public entities such as hospitals to ensure that persons with hearing impairments have access to the same goods, services, and privileges as persons without such impairments. Title IV of the Americans With Disabilities Act requires all telephone companies to provide telecommunications relay services. This service can be accessed by dialing 711. A communications assistant is available to facilitate communication for persons who are deaf or hard of hearing. Communications assistants maintain confidentiality and can provide typed responses for persons with hearing impairment to read (voice carry-over). Telecommunications relay services are helpful to many intensive care patients who are able to communicate.19,27

The Americans With Disabilities Act also requires health care providers to furnish appropriate auxiliary aids (eg, sign language interpreters) and services for persons with hearing impairments when necessary to enable effective communication. Appropriate auxiliary aids and services include qualified interpreters, note takers, computer-aided transcription services, written materials, telephone handset amplifiers, assistive listening devices, assistive listening systems, telephones compatible with hearing aids, closed-caption decoders, open and closed captioning,29 telecommunications devices for deaf persons, videotext displays, and other effective methods of making aurally delivered materials available to persons with hearing impairments.30 Friends or family members of a person who has a hearing impairment should not be considered qualified interpreters. A qualified interpreter is defined as a person who is able to interpret effectively, accurately, and impartially both receptively and expressively, using any necessary specialized vocabulary.31 The interpreter does not have to be certified, and auxiliary aids can be selectively chosen by the hospital to have on site.

Participation in Decision Making

The American Association of Critical-Care Nurses Synergy Model identifies the patient characteristic of participation in decision making as 1 of the 8 characteristics inherent for acute and critically ill patients.32,33 In this model, participation in decision making is defined as the extent to which a patient and his or her family members participate in decision making.33 Critical care nurses should encourage patients to participate in
decision making to promote the patients’ autonomy. Participation in decision making can be challenging for older patients with hearing loss. Therefore, critical care nurses should understand hearing loss and strategies to use to facilitate communication with these patients.

Optimal outcomes could be hampered when patients are unable to hear instructions. Improved outcomes have been associated with patients’ participation in decision making.34,37 The level of decision making can be variable among patients. This variability has been associated with the degree of participation (major or minor),34,38 sex, education, living conditions, occupational status,39 health literacy,40 and the impact of the “sick role.”41

Critical care nurses should assess each patient to determine the level and role of decision making the patient prefers. Various assessment tools can be used, such as the Control Preference Scale,42 the Autonomy Preference Index,43 and the Health Opinion Survey.44

Stiggelbout et al41 have suggested a simple and quick way to assess a patient for the physician’s preferences regarding information and participation in medical decisions. Two questions can be asked: (1) Would you always want to be fully informed about your treatment up to the physician or make the decisions yourself or make the decisions equally with the physician. Critical care nurses should keep in mind that most patients want to share in major decisions but prefer to be less involved in minor decisions.38

Hindrances for a patient’s participation can range from the nature of the patient’s disease, level of acuity, autonomy afforded to the patient by providers, attitude of the patient in the sick role, caregiver control, and sensory deficits.41 Sensory problems such as hearing and vision loss are often considered a part of growing old and are overlooked by health care providers.

Summary
Evidence indicates that the US health care system inadequately acknowledges and fulfills the needs of patients who are hearing impaired. Modifications, accommodations, and training should remedy these shortcomings.46 Hearing problems can make it hard to understand explanations and follow instructions. Registered nurses do not successfully involve patients in clinical decision making during nursing care according to the nurses’ own perceptions. Involvement in decisions among patients with a preference for a moderate level of participation in decision making is often overlooked by nurses and requires a direct assessment of the individual patient’s preference.39

Unfortunately, clinicians often do not optimize patients’ participation in decisions associated with a serious illness.18 Better outcomes have been documented when patients participate in decisions about the patients’ care.47

These findings correlate with the patient characteristic of participation in decision making from the American Association of Critical-Care Nurses Synergy Model.48

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To learn more about caring for older critical care patients, read “Postoperative Delirium After Colorectal Surgery in Older Patients” by Mangnall et al in the American Journal of Critical Care, 2011;20:45-55. Available at www.ajconline.org.


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Hearing Loss in Older Critical Care Patients: Participation in Decision Making
Sonya R. Hardin

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