

FOUNDATIONS OF **Aural**  
**REHABILITATION**

*Children, Adults, and Their Family Members*

**FIFTH EDITION**

**NANCY TYE-MURRAY**



Foundations of

# AURAL REHABILITATION

Children, Adults, and Their Family Members



Fifth Edition

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# AURAL REHABILITATION

Children, Adults, and Their Family Members

Nancy Tye-Murray, PhD



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# CONTENTS

<i>Preface</i> .....	xi
----------------------	----

<b>CHAPTER 1</b> Introduction .....	3
-------------------------------------	---



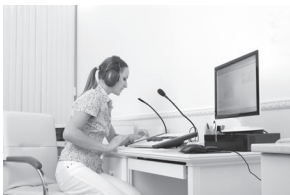
<i>The World Health Organization (WHO) and Hearing-Related Disability</i>
<i>Services Included in the Aural Rehabilitation Plan</i>
<i>Where Does Aural Rehabilitation Occur?</i>
<i>Who Provides Aural Rehabilitation?</i>
<i>Hearing Loss</i>
<i>Service Needs</i>
<i>Cost-Effectiveness and Costs</i>
<i>Evidence-Based Practice</i>
<i>Case Study: Applying the WHO's International Classification of Functioning, Disability and Health</i>
<i>Case Study: Evidence-Based Practice Decision Making</i>
<i>Final Remarks</i>
<i>Key Chapter Points</i>
<i>Terms and Concepts to Remember</i>
<i>Appendix 1-1</i>
<i>Appendix 1-2</i>
<i>Appendix 1-3</i>

---

## **PART I THE COMPONENTS OF AN AURAL REHABILITATION PLAN**

---

<b>CHAPTER 2</b> Assessing Hearing Acuity and Speech Recognition .....	35
--	----



<i>Review of the Audiological Examination and the Audiogram</i>
<i>Purpose of Speech Recognition Testing</i>
<i>Patient Variables</i>
<i>Stimuli Units</i>
<i>Test Procedures</i>
<i>Difficulties Associated with Speech Recognition Assessment</i>
<i>Multicultural Issues</i>
<i>Case Study: Reasons to Go with a Test-Battery Approach</i>
<i>Final Remarks</i>
<i>Key Chapter Points</i>

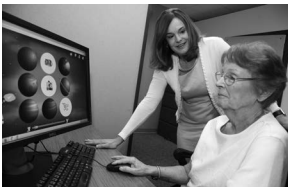
*Terms and Concepts to Remember*  
*Key Resources*

### CHAPTER 3 Listening Devices and Related Technology .....63



*Hearing Aids*  
*Cochlear Implants*  
*Hearing Assistive Technology Systems (HATS) and Assistive Listening Devices (ALDs)*  
*Computer-Based Technology*  
*Case Study: Audio Technology*  
*Case Study: Listen to the Music*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*

### CHAPTER 4 Auditory-Only Speech Perception and Auditory Training .....99



*Listening to Speech with a Hearing Loss*  
*Goals of Auditory Training*  
*Historical Notes*  
*Candidacy for Auditory Training*  
*Brain Plasticity and Auditory Training*  
*Theoretical Underpinnings for Auditory Training*  
*Auditory Training to Improve Speech Recognition*  
*Auditory Training to Improve Music Perception*  
*Benefits of Auditory Training*  
*Case Study: Learning to Hear Again*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*

### CHAPTER 5 Audiovisual Speech Perception and Speechreading Training .....119



*Speechreading for Communication*  
*Characteristics of a Good Lipreader*  
*What Happens When Someone Lipreads?*  
*The Difficulty of the Lipreading Task*  
*What Happens When Someone Speechreads?*  
*Importance of Residual Hearing*  
*Factors That Affect the Speechreading Process*  
*Assessing Vision-Only and Audiovisual Speech Recognition*  
*Traditional Methods of Speechreading Training*  
*Speechreading Training Today*  
*Benefits of Speechreading Training*  
*Oral Interpreters*  
*Case Study: An Exceptional Lipreader*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*



**CHAPTER 6** Communication Strategies and Conversational Styles . . . . . 153



*Conversation*  
*Facilitative Communication Strategies*  
*Repair Strategies*  
*Stages of Communication Breakdown*  
*Research Related to Repair Strategy Usage and Communication Breakdowns*  
*Conversational Styles and Behaviors*  
*Case Study: A Couple Conversing*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*

**CHAPTER 7** Assessment of Conversational Fluency and Communication Difficulties . . . . . 185



*Conversational Fluency*  
*General Considerations for Evaluating Conversational Fluency and Hearing-Related Disability*  
*Interviews*  
*Questionnaires*  
*Daily Logs*  
*Group Discussion*  
*Structured Communication Interactions*  
*Unstructured Communication Interactions*  
*The Significant Other*  
*Case Study: He Says, She Says*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*

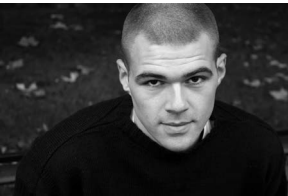
**CHAPTER 8** Communication Strategies Training . . . . . 203



*Self-Efficacy*  
*Issues to Consider When Developing a Training Program*  
*Getting Started*  
*Model for Training*  
*Program Evaluation*  
*Short-Term Training*  
*Communication Strategies Training for Frequent Communication Partners*  
*Benefits of Training*  
*Case Study: Patients with an Increased Sense of Self-Efficacy*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*  
*Key Resources*



CHAPTER 9 Counseling, Psychosocial Support, and Assertiveness Training . . . . .229



*Who Provides Counseling, Psychosocial Support, and Assertiveness Training?*  
*The Patient's Story and Narrative Therapy*  
*Counseling*  
*Psychosocial Support*  
*Assertiveness Training*  
*Related Research*  
*Case Study: Solving Challenging Situations*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*  
*Key Resources*

PART 2 AURAL REHABILITATION FOR ADULTS

CHAPTER 10 Adults . . . . .263



*Prevalence of Hearing Loss Among Adults*  
*Who Is This Person?*  
*Where Is the Patient in the Journey?*  
*A Patient-Centered Approach*  
*The Aural Rehabilitation Plan*  
*Case Study: One Size Doesn't Fit All*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*  
*Key Resources*  
*Appendix 10–1*

CHAPTER 11 Older Adults . . . . .307



*Overview of the Population*  
*An Aural Rehabilitation Blueprint*  
*Activity Limitations and Participation Restrictions*  
*Audiological Status and Otologic Health*  
*Life-Situation Factors*  
*Health Variables*  
*The Effects of Untreated Hearing Loss*  
*Aural Rehabilitation Intervention*  
*The Frequent Communication Partner's Journey*  
*Aural Rehabilitation in the Institutional Setting*  
*Case Study: Staying Active*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*  
*Key Resources*

## PART 3 AURAL REHABILITATION FOR CHILDREN

### CHAPTER 12 Detection and Confirmation of Hearing Loss in Children . . . . . 341



*Overview*  
*Detection of Hearing Loss*  
*Confirmation of Hearing Loss*  
*Health Care Follow-Up*  
*Parent Counseling*  
*Case Study: A Memorable Journey*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*  
*Key Resources*  
*Appendix 12–1*  
*Appendix 12–2*

### CHAPTER 13 Infants and Toddlers . . . . . 371



*Legislation Concerning Children Who Have Hearing Loss*  
*The Individualized Family Service Plan (IFSP)*  
*Communication Mode*  
*Listening Device*  
*Early-Intervention Programs*  
*Parental Support*  
*Auditory Training for Infants and Toddlers*  
*Case Study: A Mother's Karma*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*  
*Appendix 13–1*  
*Appendix 13–2*

### CHAPTER 14 School-Age Children . . . . . 413



*The Transition from Early Intervention Services to Elementary School*  
*The Beginnings of Education for Children Who Are Deaf and Hard of Hearing in the New World*  
*Creation of an Individual(ized) Education Plan (IEP)*  
*The Multidisciplinary Team*  
*School and Classroom Placement*  
*Amplification and Assistive Listening Devices*  
*Classroom Acoustics*  
*Other Services*  
*Children Who Have Mild or Moderate Hearing Loss or Unilateral Hearing Loss*  
*Case Study: IDEA(s) for All Children*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*

Key Resources  
Appendix 14–1

CHAPTER 15 Speech, Language, and Literacy . . . . .453



*Speech Characteristics*  
*Language Characteristics*  
*Literacy Characteristics*  
*Speech and Language Evaluation*  
*Literacy Evaluation*  
*Speech and Language Therapy*  
*Case Study: Writing Samples from 10- and 11-Year-Old Children*  
*Final Remarks*  
*Key Chapter Points*  
*Terms and Concepts to Remember*

*Glossary* . . . . .487  
*References* . . . . .507  
*Index* . . . . .541

# PREFACE

What exactly is aural rehabilitation? The answer to this question can conceivably include every aspect of audiology, education, and speech-language pathology for adults and children who have hearing loss and related services for their family members. Under the rubric of aural rehabilitation may fall any of the following topics: identification, quantification, and diagnosis of hearing loss and other hearing-related communication difficulties, assessment of visual-only and audiovisual speech recognition, selection and fitting of listening devices, speechreading and auditory training, patient and family counseling, psychosocial support, follow-up services, communication strategies training, tinnitus treatment, literacy promotion, speech and language therapy, classroom management, parent instruction, sign language instruction, noise protection, workplace accommodations, and school and nursing home in-services. The threads that run through the various services and that unify them into the discipline of aural rehabilitation include an emphasis on understanding and addressing the needs of patients who have hearing loss and their family members and an emphasis on ensuring that patients and their communication partners achieve maximum communication success in their everyday environments. Aural rehabilitation draws from a variety of disciplines. This text cites literature from the fields of cognitive psychology, counseling, medicine, occupational therapy, sociolinguistics, second language learning, and general education, as well as audiology, speech-language pathology, and deaf education.

This book presents an evidence-based approach to the discipline of aural rehabilitation, and reviews the scientific underpinnings that underlie much of what occurs in clinical practice. For some readers, *Foundations of Aural Rehabilitation: Children, Adults, and Their Family Members* may be their only textbook that is entirely devoted to aural rehabilitation, while for others, it may be their first followed by a more advanced class and corresponding textbook. The book can serve as an introduction to aural rehabilitation and as a reference that can be revisited by practicing professionals. It may also serve as a starting point for researchers and scientists. By design, the book is translational and is based on the premise that clinical practice informs scientific research and scientific research informs clinical practice.

The book includes a number of case studies, and general demographic, medical, and pop-cultural trends are considered in parallel with corresponding developments in aural rehabilitation. Sidebars, illustrations, and chapter inserts provide lively additions to the text and include quotations by patients, professionals, and family members, bulleted points, historical notes, and tangential asides.

## New Features

The fifth edition has been reorganized so that after Chapter 1, which is an introductory chapter, other chapters are now grouped into three parts. Part 1 concerns the components of an aural rehabilitation plan, Part 2 concerns adults and their family members, and Part 3 concerns

children and their parents or guardians. In previous editions, adults and children were considered separately, for each of the services comprised by aural rehabilitation, such as speechreading training and communication strategies training. The presentation has been streamlined, with greater focus on the “take-home message” of current research and its clinical implications. I hope that instructors will find this new organization easier to teach and students will find the materials easier to learn.

This edition includes several new features. For example, much has happened in the last five years in the field of auditory training and Chapter 4 presents a state-of-the-science review of the most current research as well as an overview of what it is like to listen with hearing loss. Chapter 5 concerns audiovisual speech perception, and since this is my area of research expertise, I took special pleasure in updating it, as nothing excites me more than sharing my enthusiasm with students. My goal in writing this chapter (and all the chapters) was to make audiovisual speech perception, as well as all aspects of aural rehabilitation, as interesting and compelling for my readers as it is for me. Chapter 15 presents emerging trends in speech and language therapy, including specific examples of therapy techniques. In this edition, I combined Chapters 2 and 11 from the fourth edition so as to consolidate the presentation about aural rehabilitation plans for adults and to minimize redundancies. Finally, this edition has more illustrations and figures than any of the previous editions—I truly believe that a picture is worth a thousand words.

The fifth edition addresses a global audience whenever possible, without sacrificing the importance of including information that might be uniquely relevant to students who intend to work in the United States. There are many reasons for this broad focus, including the increasing globalization and cross-pollination of speech and hearing services, the mobility of students, and the increased likelihood that they may practice and study in different countries, as well as the advent of telepractice, which means that students may someday provide services via telecommunications to patients living abroad.

### Target Audience

The book targets undergraduate students who are in their junior or senior year in a university or postsecondary program and graduate students who are in their first year of graduate training. It can serve as a primary resource for the disciplines of audiology, speech-language pathology, education of children who are deaf and have hearing loss, and speech and hearing science, and as a supplemental source for training programs in special education, medicine, nursing, occupational therapy, psychology, and vocational rehabilitation counseling.

I immensely enjoy hearing from my readers and can be contacted at [nmurray@wustl.edu](mailto:nmurray@wustl.edu).

Nancy Tye-Murray, Professor  
*Washington University in St. Louis School of Medicine*  
*St. Louis, MO*

*To the professors and instructors who teach aural rehabilitation: I salute you.*







Foundations of

# AURAL REHABILITATION

Children, Adults, and Their Family Members



# CHAPTER 1

## Introduction

### OUTLINE

**The World Health Organization (WHO) and Hearing-Related Disability**

**Services Included in the Aural Rehabilitation Plan**

**Where Does Aural Rehabilitation Occur?**

**Who Provides Aural Rehabilitation?**

**Hearing Loss**

**Service Needs**

**Cost-Effectiveness and Costs**

**Evidence-Based Practice**

**Case Study: Applying the WHO's International Classification of Functioning, Disability and Health**

**Case Study: Evidence-Based Practice Decision Making**

**Final Remarks**

**Key Chapter Points**

**Terms and Concepts to Remember**

**Appendix 1-1**

**Appendix 1-2**

**Appendix 1-3**

**H**earing loss has been called the “invisible condition,” yet its impact may be anything but invisible. People with hearing loss may miss out on casual conversations, on conversations that establish intimacy and friendship, and on conversations that convey important information or promote life goals. Everyday activities that people with normal hearing take for granted, such as talking on the telephone or with a store clerk, may be effortful and frustrating (Figure 1–1). For children, the difficulties may relate not only to hearing spoken messages, but also to interpreting and expressing messages because of their limited language skills. In addition, children may have restricted speech skills, world knowledge, and experience with social conventions, which will further constrain their conversations and other interactions.



**FIGURE 1–1** Hearing loss affects everyday activities. Activities that persons with normal hearing take for granted may become effortful or frustrating for persons who have hearing loss.

**Aural rehabilitation** is intervention aimed at minimizing and alleviating the communication difficulties associated with hearing loss.

**Aural rehabilitation** is aimed at restoring or optimizing people’s participation in activities that have been limited as a result of hearing loss. It may be aimed at benefiting their communication partners as well. The goals of aural rehabilitation are to:

- Alleviate the difficulties related to hearing loss and
- Minimize its consequences.

**Conversational fluency** relates to how smoothly conversation unfolds.

Achieving these goals will enhance conversational fluency and reduce hearing-related disability. **Conversational fluency** refers to how smoothly conversation unfolds and how easily communication partners can exchange information, as well as to any restrictions in topic selection (e.g., Does hearing loss restrict them to talking about only simple topics, such as the weather?). **Hearing-related disability** is a loss of function caused by hearing loss or an inability to perform an activity and is a multidimensional phenomenon. Disability is not an attribute of the individual per se. It arises from a complex collection of conditions, some of which stem from the individual’s real-world environment.

A **hearing-related disability** is a loss of function imposed by hearing loss. The term denotes a multidimensional phenomenon, and may include pain, discomfort, physical dysfunction, emotional distress, and the inability to carry out typical activities.

## Those Whom We Serve

Children who receive aural rehabilitation services are often referred to as *students*, especially in the context of an educational setting. Terminology for adults who receive services is more variable and includes *patients*, *clients*, and *consumers*. Hernandez

(continues)

## Those Whom We Serve (continued)

and Amlani (2004) mailed out 1,428 surveys to a random sample of Fellows of the **American Academy of Audiology (AAA)**. Thirty-two percent of the surveys were returned. The results showed that an overwhelming majority (90%) preferred the term *patient*, which is the term that is used in this text.

The **American Academy of Audiology (AAA)** is a professional organization for audiologists that advances the profession of audiology through leadership activities, advocacy, educational programs, public awareness, and research support.

This chapter introduces the subsequent topics in this book. We will first consider a model of hearing-related disability and how it shapes the aural rehabilitation intervention plan. We will then review general issues and terms associated with aural rehabilitation and hearing loss as well as locales where aural rehabilitation might occur, who might provide it, and who might receive it, and then finally, review how you might go about selecting appropriate intervention services.

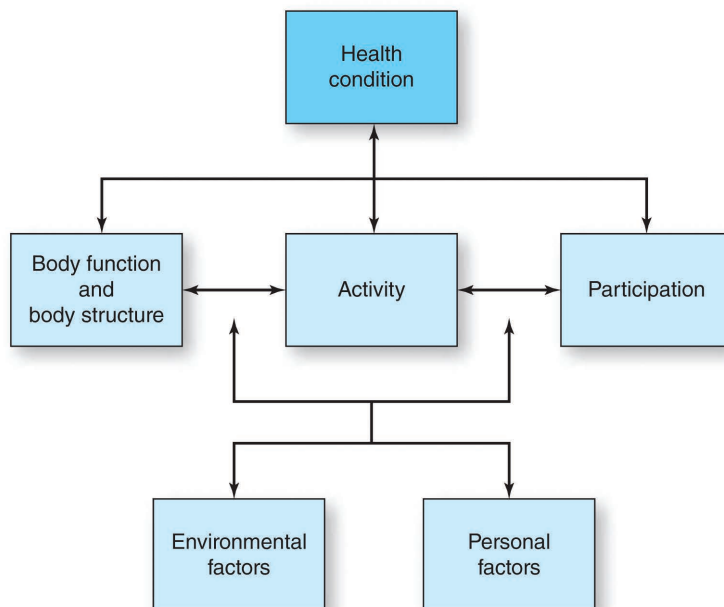
## ● THE WORLD HEALTH ORGANIZATION (WHO) AND HEARING-RELATED DISABILITY

The **World Health Organization (WHO)** developed the **International Classification of Functioning, Disability and Health (ICF)**, a classification system that provides a **biopsychosocial** framework for describing and considering a health condition (WHO, 2001). The ICF couches the consequences of a health-related condition within the context of a patient's environment and circumstances (Figure 1–2). It takes into account the nature and extent of a patient's functioning and how it may be limited in quality or quantity. The focus is not on a patient's hearing loss with the idea of “fixing” it, but rather, on how hearing difficulties affect the patient in everyday life and how hearing-related disability might be alleviated.

The **World Health Organization (WHO)** is an agency within the United Nations system that is responsible for providing leadership on global health issues, for setting health research agendas and health standards and norms, for dispensing evidence-based policy options, and for monitoring and assessing international health standards.

The **International Classification of Functioning, Disability and Health (ICF)** is an internationally recognized classification system for describing consequences of health conditions and for considering the dimensions of health and functioning, and can be applied to all rehabilitation sciences.

A **biopsychosocial** framework implies that biological, psychological (e.g., thoughts, emotions, behaviors), and social factors influence how a health condition may affect human functioning.



**FIGURE 1–2** The International Classification of Functioning, Disability and Health (ICF) that is utilized and promulgated by the World Health Organization (WHO). The ICF provides an international common language and conceptual framework for considering the effects of a health condition on functioning, disability, and health.



A **body structure**, as defined by WHO, is an anatomical part of the body, such as organs (e.g., the cochlea), limbs, and their components.

**Body functions** are physiological functions of body systems, including psychological functions.

An **activity** is the execution of a task or action by an individual; it is an endeavor that a patient wants or needs to do with hearing (e.g., alerting to sound; recognizing speech).

**Participation** is involvement in a life situation; it represents the societal perspective of functioning (e.g., participating in a dinner table conversation).

An **activity limitation** is a change at the level of the person brought about by an impairment at the levels of body structure (e.g., loss of hair cells in the cochlea) and function (e.g., loss of an ability to discriminate pitch); for example, a patient may no longer be able to engage easily in casual conversation.

A **participation restriction** is an effect of an activity limitation that results in a change in the broader scope of a patient's life; for example, a patient may avoid social gatherings.

**Environmental factors** are external to a patient, and are composed of the physical, social, and attitudinal environment in which the patient lives and conduct his or her life.

**Social factors** are the prevailing viewpoints of one's society.

**Personal factors** pertain to the patient, and encompass an individual's age, lifestyle, race, coping styles, attitudes, self-efficacy, lifestyle, habits, preferences, socioeconomic background, and other health conditions.

The central row of Figure 1–2 depicts reciprocal relationships between the **body structures** and **body functions** and activity and participation. An **activity** is, quite literally, the execution of a task or action by an individual. A **participation** is an involvement in a life situation. An **activity limitation** is a change at the level of the patient, such as an inability to recognize speech over the telephone, whereas a **participation restriction** is the effect of a change in participation on the broader scope of life, such as a patient's avoidance of social situations for fear of being left out. Activity limitations and participation restrictions are often intertwined. For example, a woman who cannot respond to questions in a crowded room has an activity limitation because she cannot recognize speech in the presence of background noise. She also has participation restrictions because she avoids noisy restaurants and parties as a result (Figure 1–3).



**FIGURE 1–3** Activity limitations and participation restrictions. A patient may experience difficulty in recognizing speech in the presence of background noise. This activity limitation may restrict the ability to participate in social gatherings.

The lower row of boxes in Figure 1–2 shows how the ICF takes into account two types of contextual factors, environmental factors and personal factors. **Environmental factors** include the physical, social, and attitudinal influences that a person regularly experiences. For example, **social factors** (also referred to as cultural factors) are the prevailing viewpoints of the people in a person's social milieu. If the prevailing view is that hearing loss is a negative state, as when it is a sign of aging in a youth-oriented society or of inadequacy to perform in the workforce, then the participation restrictions and other consequences may increase. **Personal factors** include gender, age, race, fitness, lifestyle, habits, social background, profession, family, coping styles, past and current experience, personality, values, preferences, knowledge, and any other health conditions. Personal factors also encompass a person's attitude toward the hearing loss. For example hearing loss might be a source of shame or it may seem inconsequential in comparison to other life events, such as diabetes or cancer.

Environmental and personal factors influence the magnitude of hearing-related disability. For example, a computer programmer and a car salesperson may have the same degree of hearing loss, yet their activity limitations and participation restrictions likely differ. The programmer may rarely experience conversational difficulties while working alone at a computer station. Conversely, the car salesperson must converse with customers throughout the workday, and may frequently misunderstand questions and hesitate to use the telephone.

The components of the model shown in Figure 1–2 are interlinked. For example, because a musician played the electric guitar (an *activity*) and performed in loud concert halls on a regular basis (a *participation*), he damaged hair cells in his inner ears (a change

in *body structure*) and incurred a bilateral hearing loss (a change in *body function*). Now he can no longer regulate his voice pitch (an *activity limitation*) and no longer sing harmony with his band (a *participation restriction*). He wears earplugs during concerts to prevent further hearing loss (a positive effect on *body structures* and *body function* from an *environmental factor*) and avoids all publicity interviews because he is a proud man and does not want to be humiliated because he cannot understand questions (a negative effect on *participation* by a *personal factor*).

The ICF may extend to a patient's families and communication partners. The behaviors and attitudes of **frequent communication partners** (the people the patient interacts with most often at home, in the workplace, in school, or during social activities) for the most part may fall under the rubric of *personal factors*, although in practice, they deserve more attention than the model shown in Figure 1–2 implies. Frequent communication partners can exert a significant effect on a patient's activities and participation. For example, a frequent communication partner who mumbles and who resents the patient's hearing loss may exacerbate the consequences of hearing loss, whereas one who speaks clearly and who empathizes may alleviate them.

The patient's hearing loss may impose an adverse effect on a frequent communication partner's **perceived quality of life**. The WHO labels the effects of hearing loss on the frequent communication partner as **third-party disability**. For example, answering interview questions about how their partner's hearing loss affects everyday life, one respondent wrote, "There's that thing of not wanting to go somewhere because there might be too many people around . . . [he] will find an excuse for not wanting to go out. So that affects me then because I might retract from something if somebody suggests we do something." Another wrote, "What I don't like is when I'm watching a television show and [he] would say "Can you turn that up?" And I'd just about bounce out of my chair. I think, you've got to be kidding me! . . . I'm not having a happy time" (Scarinci et al., 2009, pp. 2095–2096). In these two examples, one patient's hearing loss has limited his frequent communication partner's social life and another patient's hearing loss has caused auditory distress.

### The Perils of Loud Music

"I have unwittingly helped to invent and refine a type of music that makes its principal components deaf. Hearing loss is a terrible thing because it cannot be repaired."

—Peter Townshend, guitarist, vocalist, and songwriter for *The Who*, a rock band of the 1960s and 1970s

(Townshend, 2013)

### Frequent communication partners

are persons with whom another often converses, such as a family member.

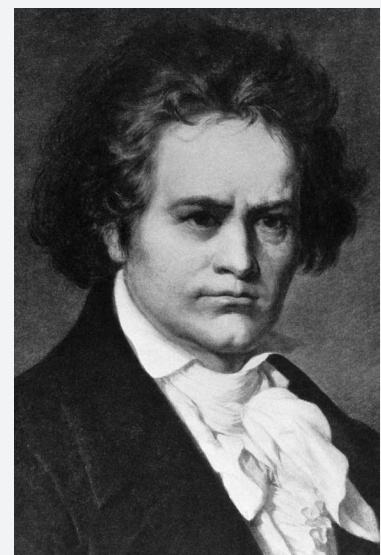
**Perceived quality of life** "reflects self-assessment of the current life experiences and includes such things as enjoyment, meaning, purpose, usefulness, value, freedom of choice, and independence. . . . It is influenced by function, activity, and participation, but is by no means completely determined by them" (Boothroyd, 2007, p. 64).

A **third-party disability** refers to changes in life functioning that accrue as a result of a family member's health condition.

## Participation Restrictions: A Very Famous Case Study

Ludwig van Beethoven (Figure 1–4) began to suffer hearing loss and chronic tinnitus at the age of 26 years, making it difficult for him to hear his music (activity limitation) and play the piano before an audience (participation restriction). At the age of 28 years, he sent this letter to his two brothers, Carl and Johann. Despite his enormous success as a composer, Beethoven still suffered the participation restrictions imposed by significant hearing loss:

Though born with a fiery, active temperament, even susceptible to the diversions of society, I was soon compelled to isolate myself, to live life alone. If at times I tried to forget all this, oh how harshly was I flung back by the doubly sad experience of my bad hearing. Yet it was impossible for me to say to people, "Speak louder, shout, for I am deaf." Ah, how could I possibly admit an infirmity in the one sense which ought to be more perfect in me than others, a sense which I once possessed in the highest perfection, a perfection such as few in my profession enjoy or ever have enjoyed. Oh I cannot do it; therefore, forgive me when you see me draw back when I would have gladly mingled with you. My misfortune is doubly



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(continues)

**FIGURE 1–4** Ludwig van Beethoven.



Participation Restrictions: A Very Famous Case Study (continued)

painful to me because I am bound to be misunderstood; for me there can be no relaxation with my fellow men, no refined conversations, no mutual exchange of ideas. I must live almost alone, like one who has been banished; I can mix with society only as much as true necessity demands. If I approach near to people a hot terror seizes upon me, and I fear being exposed to the danger that my condition might be noticed.

(Beethoven, 1802)

Communication partners of persons who have hearing loss may experience:

- Difficulties in communicating with their partners in background noise
  - Difficulties in coping with the high volume of the television set
  - Annoyance as to having to respond on behalf of their partners and having to repeat or clarify their utterances during conversations
  - Similar levels of frustration and irritation as their partner
  - Irritation during one-on-one conversations and group conversations
  - A similar degree of reduced social interactions
- (Scarinci et al., 2009, p. 2089)

**Tinnitus** is the perception of sound in the head without an external cause.

**Hearing protection** is means to prevent or minimize the deleterious effects of loud sound on the auditory system.

SERVICES INCLUDED IN THE AURAL REHABILITATION PLAN

Table 1–1 presents services often included in an aural rehabilitation plan. The plan typically includes diagnosis and quantification of the hearing loss and provision of appropriate listening devices. It may include communication strategies training, counseling related to hearing loss, assertiveness training, psychosocial support, auditory and speechreading training, and counseling and instruction for family members, colleagues, teachers, or caretakers. For adults, it may also include means and strategies to measure and manage **tinnitus** and a **hearing protection** component. For children, the plan may include interventions related to speech, language, and academic achievement.

TABLE 1–1 Components of a Typical Aural Rehabilitation Program

COMPONENT	DESCRIPTION
Diagnosis	Assessment of hearing loss and speech-recognition skills
Provision of appropriate listening device	Provision of hearing aid(s) or participation on a team that results in cochlear implantation and follow-up services
Provision of appropriate hearing assistance technology systems (HATS), inclusive of assistive listening devices (ALDs)	Explanation and dispensing of devices that supplement or replace a hearing aid or that serve to lessen hearing-related communication difficulties and other devices that facilitate the reception and identification of non-speech auditory signals
Tinnitus management	Assessment of tinnitus disability and provision of means to gain relief or control over the sensation of tinnitus
Hearing protection	Assessment of sound levels and provision of hearing protection materials
Auditory training	Structured and unstructured listening instruction and practice
Communication strategies training	Teaching of strategies that enhance communication and minimize communication difficulties (facilitative strategies, repair strategies, environmental management)
Informational/educational counseling	Instruction about normal hearing, hearing loss, listening device technology, speech perception, available services
Personal adjustment counseling	Intervention to enhance the management and acceptance of hearing loss and communication difficulties
Psychosocial support	Addressing the psychological and social impact of hearing loss on the person with hearing loss, family, and friends (may include stress management and relaxation techniques)

(continues)

TABLE 1-1 (continued)

COMPONENT	DESCRIPTION
Frequent communication partner training	Communication training for the spouse, partner, family, friends, or coworkers
Speechreading training	Training speech recognition via both auditory and visual channels
Speech-language therapy	For children primarily, therapy that teaches children to produce the sounds and words of their language and that emphasizes developing strategies to monitor one's own speech production and therapy that develops their vocabulary, syntax, and pragmatics
In-service training	Specialized training for other professionals, such as teachers in the public school system or caretakers in senior citizen centers

### Other Terms Related to Aural Rehabilitation

Sometimes the terms *aural habilitation* or *audiologic rehabilitation* are used instead of *aural rehabilitation*. The term **aural habilitation** might be used when the person receiving the services is a child rather than an adult because in the strict sense, *rehabilitation* means to restore something that was lost. When providing auditory training or speech and language therapy to children who have hearing loss, the goal is not to restore lost function, but rather to develop (i.e., *habilitate*) skills that were not present beforehand.

The term **audiologic rehabilitation** implies an emphasis on the diagnosis of hearing loss and the provision of listening devices and a lesser emphasis on follow-up support services, such as communication strategies training. Moreover, it implies services provided exclusively by an audiologist as opposed to those provided by other professionals, such as a speech-language pathologist or a classroom teacher.

A survey of 1,625 audiologists in the United States indicated that they provided the following services:

86% provided counseling about communication strategies and realistic expectations

81% demonstrated and fit hearing assistive technology and hearing aids

60% measured patients' unaided and aided speech recognition abilities

45% provided services to babies ranging in age from birth to 6 months

41% validated their treatment outcomes by administering self-questionnaires

17% provided auditory training

12% programmed and fit cochlear implants

4% provided speechreading training

(ASHA Leader, May 2013, p. 22)

**Aural habilitation** is intervention for persons who have not developed listening, speech, and language skills.

**Audiologic rehabilitation** is a term often used synonymously with aural rehabilitation or aural habilitation; it may entail greater emphasis on the provision and follow-up of listening devices and less emphasis on communication strategies and auditory and speechreading training.

## ● WHERE DOES AURAL REHABILITATION OCCUR?

Aural rehabilitation may occur in a variety of locales. For example, it may be provided in any of the following settings:

- A university speech and hearing clinic
- An audiology private practice
- A hearing aid dealer's private practice
- A hospital speech and hearing clinic
- A community center or nursing home
- A school
- An otolaryngologist's office
- A speech-language pathologist's office
- Consumer organization meetings
- The home, sometimes with the aid of a computer and possibly Web-based communications
- Military veterans' organizations, such as a VA hospital or military or veterans center

A Rose By Any Other Name . . .

Other terms include:

Hearing rehabilitation

Hearing therapy

Listening therapy

Auditory management

Listening rehabilitation

(Hull, 2018)

## ● WHO PROVIDES AURAL REHABILITATION?

An **assistive listening device (ALD)** is an instrument designed to provide awareness or identification of environmental signals and speech and to improve signal-to-noise ratios.

The **American Speech-Language-Hearing Association (ASHA)** is a professional, scientific, and credentialing organization for audiologists, speech-language pathologists, and speech, language, and hearing scientists in the United States and internationally.

Aural rehabilitation might be provided by an audiologist, a speech-language pathologist, or a teacher for children who are deaf and hard of hearing. An audiologist usually takes the lead role in developing an adult's aural rehabilitation plan and coordinating the services provided by other professionals, whereas a speech-language pathologist often plays the lead role for a child, especially in a school environment. For example, the speech-language pathologist is most likely to provide speech and language therapy and often is the professional who provides auditory and speechreading training. Whereas the audiologist may fit and maintain a child's hearing aids and equip the classroom with appropriate **assistive listening devices (ALDs)** and hearing assistive technology, the speech-language pathologist may be the person who has extended one-on-one contact with a child and the one who knows the child well. For a very young child, a teacher for children who are deaf and hard of hearing often takes the lead, and may interact frequently with the child's parents.

The **American Speech-Language-Hearing Association (ASHA)** convened a working group on audiologic rehabilitation (ASHA, 2002). Its charge was to summarize the knowledge and skill sets that audiologists and speech-language pathologists should have if they are to provide aural rehabilitation. These outlines are presented in Appendix 1–1 (audiologists) and Appendix 1–2 (speech-language pathologists).

In addition to a general knowledge about basic communication processes, audiologists who provide aural rehabilitation are expected to understand the auditory system function and disorders, developmental status, cognition, sensory perception, audiologic assessment procedures, speech and language assessment procedures, evaluation and management of listening devices, effects of hearing impairment on functional communication, case management, interdisciplinary collaboration and public advocacy, and hearing conservation and acoustic environments.

In addition to general knowledge about the basic communication processes, speech-language pathologists are expected to have a broad knowledge of auditory system function and disorders, developmental status, cognition, sensory perception, audiologic assessment procedures, assessment of communication performance, listening devices, effects of hearing loss on psychosocial, educational, and vocational functioning, management, interdisciplinary collaboration and public advocacy, and acoustic environments.

## ● HEARING LOSS

Hearing loss may be categorized along four dimensions: degree, onset, causation, and time course (Figure 1–5). In terms of degree, hearing loss may be characterized as mild, moderate, moderate-to-severe, severe, or profound.

Degree of hearing impairment is often defined by the **pure-tone average (PTA)**, the average of the individual's pure-tone frequencies at 500, 1000, and 2000 Hz obtained with headphones. The following descriptors are often used to denote degree:

**Normal:** The PTA is 25 dB HL or better; for children, 15 dB HL or better.

**Mild:** The PTA is between 26 (or 15) and 40 dB HL.

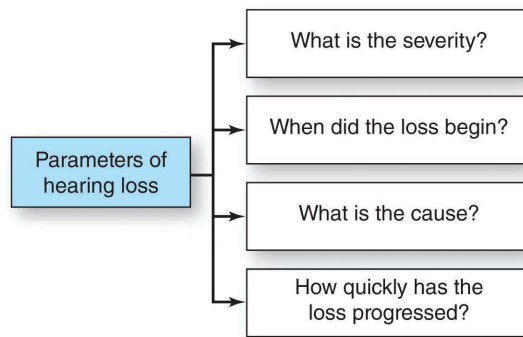
**Moderate:** The PTA is between 41 and 55 dB HL.

**Moderate-to-severe:** The PTA is between 56 and 70 dB HL.

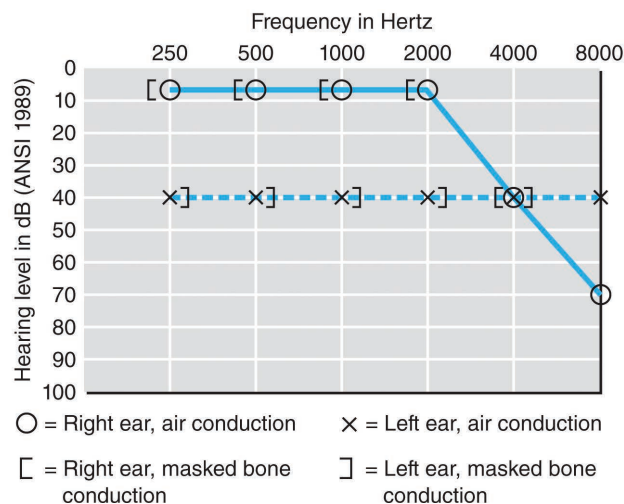
**Severe:** The PTA is between 71 and 90 dB HL.

**Profound:** The PTA is poorer than 90 dB HL.

The **pure-tone average (PTA)** is the average of the thresholds at 500, 1000, and 2000 Hz.



**FIGURE 1-5** Parameterization of hearing loss along four dimensions: degree, onset, causation, and time course.



**FIGURE 1-6** An audiogram that depicts an asymmetrical hearing loss. The left ear has a “flat” hearing loss; the right ear has a “high-frequency” hearing loss.

Closely related to the degree of hearing loss is its **configuration**. Configuration of hearing loss reflects the extent of hearing loss at each of the audiometric frequencies (**audiograms** indicate hearing sensitivity at the frequencies of 250, 500, 1000, 2000, 4000, and 8000 Hz) and provides an overall picture of hearing sensitivity. For example, a person who has normal hearing for the frequencies 250–2000 Hz and then reduced sensitivity for the frequencies 4000–8000 Hz may be described as having a “high-frequency hearing loss.” A person who has equal sensitivity across the audiometric frequencies has a “flat hearing loss” (Figure 1–6). Other descriptors associated with degree of hearing loss include the following:

- *Bilateral versus unilateral.* Bilateral hearing loss means both ears have reduced sensitivity, whereas unilateral means only one ear is affected.
- *Symmetrical versus asymmetrical.* Symmetrical hearing loss means the degree and configuration of hearing loss are the same in each ear, whereas asymmetrical means the two ears differ.
- *Fluctuating versus stable.* Sometimes a person’s hearing sensitivity may fluctuate (e.g., if a child has fluid in the ear), whereas at other times sensitivity remains stable.

**Configuration** refers to the extent of the hearing loss at each frequency and gives an overall description of the hearing loss.

An **audiogram** is a graphic representation of hearing thresholds as a function of stimulus frequency.

An **asymmetrical** hearing loss is one in which the degree and/or configuration of loss in one ear differs from that in the other ear.

**Hard of hearing** means having a hearing loss; usually not used to refer to a profound hearing loss.

**Deaf** usually means having minimal or no hearing.

**Prelingual** refers to a hearing loss acquired before the acquisition of spoken language.

A label of **congenital** implies the hearing loss was present at birth.

A label of **acquired** implies the hearing loss was incurred after birth.

**Perilingual** refers to a hearing loss acquired during the stage of acquiring spoken language.

**Postlingual** refers to a hearing loss incurred after the acquisition of spoken language.

A **conductive loss** results from an obstruction within the outer or middle ear.

**Microtia** is a congenitally small external ear.

A congenital closure of the external auditory canal is called **atresia**.

**Cerumen** is earwax.

**Otitis media** is an inflammation of the middle ear, often accompanied by the accumulation of fluid in the middle ear cavity.

**Sensorineural hearing loss** is a type of hearing loss that has a cochlear or retrocochlear origin.

A person who has a mild, moderate, or moderate-to-severe hearing loss (i.e., a hearing loss between 26 and 70 dB HL) is often called **hard of hearing**. Sometimes the term *hearing impaired* is used in lieu of the term *hard of hearing*. Many persons dislike it as it connotes that they may be exactly that, impaired, even though they may function effectively in their everyday lives. A person who has a profound hearing loss (and less often, severe) may sometimes be called **deaf**. People who belong to the Deaf community, often people who were born deaf or who grew up with deaf family members, may refer to themselves as *Deaf*. The capital “D” denotes their membership in the Deaf culture. Members of the Deaf culture share a similar sign language, culture, and often, educational experience.

In terms of onset, a hearing loss may be described as prelingual, perilingual, or postlingual. A person who has a **prelingual** hearing loss incurred the loss before acquiring language. Although there is no universally agreed cutoff time as to when the prelingual phase ends, generally, a child who incurs a hearing loss before the age of 2 years is said to have a prelingual loss. A **congenital** hearing loss is thought to be present at birth or associated with the birthing process. An **acquired** hearing loss is not present at birth but is incurred later, either as a child or as an adult. A child who lost his or her hearing after acquiring some spoken language but before acquisition was complete is said to have a **perilingual** hearing loss. Finally, a **postlingual** loss is one that occurred after the acquisition of speech and language. Again, there is no agreed-upon age at which the perilingual stage ends and the postlingual stage begins, but it is around the age of 5 years. The postlingual distinction may be further divided into four additional cohorts. These are:

- Prevocational (around the ages 5–17 years)
- Early working age (18–44 years)
- Later working age (45–64 years)
- Retirement age (65 years and older)

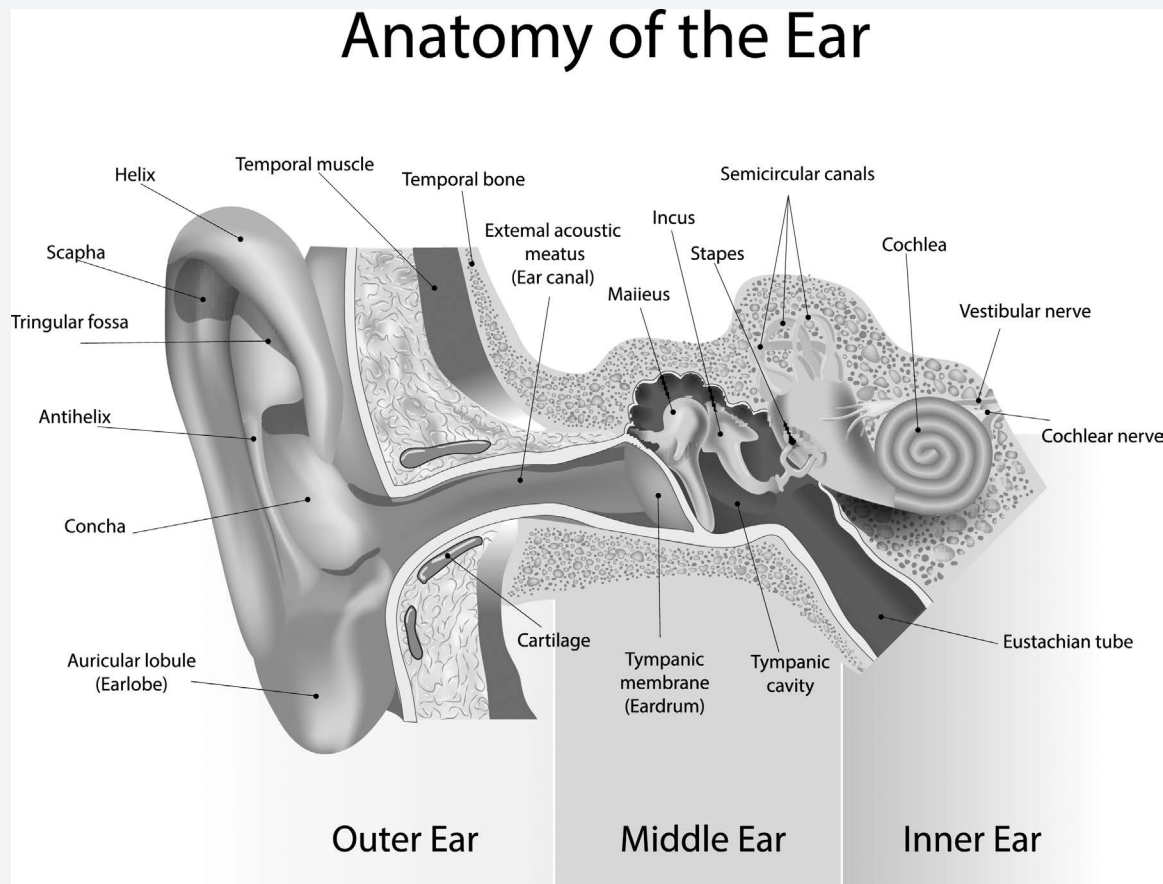
Depending on a patient’s membership in a cohort, his or her aural rehabilitation needs may vary. For example, someone who is prevocational may benefit from having a special amplification system available in the classroom, and the child’s family may benefit from communication strategies training. Another person of later working age may require personal adjustment counseling and even psychosocial support to accept his or her change in abilities. The consequences of *not* receiving aural rehabilitation will also vary because of cohort membership. For example, a toddler who incurs hearing loss and who does not receive an appropriate listening aid will likely experience significant spoken language delay. An older man who incurs hearing loss will maintain normal speech and language, but may withdraw and isolate from family and friends and experience depression.

The third dimension used to categorize hearing loss is causation. A hearing loss may be conductive, sensorineural, or a combination of both (a mix), and it may be of central origin. The source of impairment determines the type.

A **conductive loss** stems from an obstruction in either the outer or middle ear that prevents sound from reaching the sensorineural structures in the inner ear. An obstruction might be congenital, such as **microtia** or **atresia**, or it might be acquired, such as **cerumen** accumulation in the ear canal or **otitis media** in the middle ear. Many conductive hearing losses resolve with medical treatment or the passage of time. In instances when a loss in hearing sensitivity remains, effective amplification can minimize listening difficulties. Conductive losses result in speech being attenuated. If the speech can be amplified loud enough, the patient usually can recognize speech quite easily. Conductive losses typically are limited in degree as once the level of the sound rises above about 50 or 60 dB SPL, it is transmitted directly to the inner ear by bone conduction.



## A Quick Tour of the Human Ear



**FIGURE 1-7** The human ear.

The types of hearing loss are classified by where in the human auditory pathway the impairment occurs (Figure 1-7). The auditory system has the following three anatomical regions plus the auditory nerve and central mechanisms:

- Outer ear, which includes the outside of the ear and the ear canal up to the level of the tympanic membrane (eardrum)
- Middle ear, which includes the cavity behind the tympanic membrane that houses the three tiny bones or ossicles (malleus, incus, stapes) responsible for mechanically conducting sound waves to the inner ear
- Inner ear, the cavity next to the middle ear that houses the cochlea, the snail-like structure that houses the cells responsible for responding to sound and transmitting it to the auditory nerve, and the labyrinth, a structure that is integral to our sense of balance and includes the semicircular canals
- Auditory nerve and central mechanisms, the eighth cranial nerve, which is responsible for conveying sound from the inner ear to the brainstem, and the central mechanisms comprising the brainstem, midbrain, and auditory cortex

**Sensorineural hearing loss** stems from a disturbance in the inner ear, eighth nerve, brainstem, midbrain, or auditory cortex. Sensorineural losses are typically permanent. Prelingual sensorineural hearing losses might be caused by any number of factors, including genetic makeup, maternal infections, or postnatal infection such as **meningitis** or **encephalitis**. Postlingual sensorineural hearing losses might relate to noise exposure,

**Meningitis** is a common cause of childhood sensorineural hearing loss caused by bacterial or viral inflammation of the meninges. The meninges are the membranous linings of the brain and spinal cord.

**Encephalitis** is an inflammation of the brain.

**Ototoxic drugs** are harmful to the structures of the inner ear and the auditory nerve.

A hearing loss that has both a conductive and a sensorineural component is called a **mixed hearing loss**.

A **progressive hearing loss** is a hearing loss that increases over time.

A **sudden hearing loss** is a hearing loss that has an acute and rapid onset.

**Years lived with a disability (YLD)** is a term used by the WHO and refers to years of life lived with a disability, taking into account severity.

An **unserved** population refers to a group of patients in need of but not receiving services.

An **underserved** population is a group of patients receiving less than ideal services.

the ingestion of **ototoxic drugs**, or aging. People who have sensorineural hearing loss often experience decreased ability to recognize speech, even if they are using appropriate amplification, because they have reduced or ablated neural capacity for conveying sound to the brain.

Sometimes an individual can have both a conductive and a sensorineural hearing loss. For example, a child who has a congenital sensorineural hearing loss may have **mixed hearing loss** if he or she suffers a bout of otitis media.

A central hearing loss, which is a kind of sensorineural hearing loss, stems from a disorder in function in the central auditory structures. It may be characterized by seemingly normal hearing thresholds coupled with a difficulty in understanding speech, especially in noisy settings, and in localizing sounds.

Finally, a hearing loss may be categorized as progressive or sudden. A hearing loss that occurs over the course of several months or years is a **progressive hearing loss**. A loss that occurs abruptly, say as a result of head trauma, is a **sudden hearing loss**.

## ● SERVICE NEEDS

As of 2018, the number of people who suffer from disabling hearing loss worldwide is 466 million, of which 44 million are children (World Health Organization [WHO], 2018). This number will likely swell to almost a billion (i.e., 900 million people) by 2025 (Hear-it Organization, 2012). Globally, the WHO estimates that hearing loss is more prevalent than any other disabling condition (WHO, 2008). In the United States, about 48 million people have some degree of reduced hearing sensitivity (Center for Hearing and Communication, 2018). The high prevalence of hearing loss coincides with the WHO's report of **years lived with a disability (YLD)** statistics. Adult-onset hearing loss ranks third in years of life lived in a state of less than full health, outranked by only depressive disorders and unintentional injuries (WHO, 2006).

Many individuals who have hearing loss are unserved or underserved. **Unserved** means that they are not served as a result of policy, practice, or environmental barriers. **Underserved** means that they are inadequately served. In developing countries, 97% of people with hearing loss are unserved or underserved (Tucci, Merson, & Wilson, 2009). Developed and affluent countries also suffer from a shortage of services. For example, Margolis and Morgan (2008) estimate that by the year 2050, the United States will experience an annual shortfall of 15 million audiograms. The problem of being underserved is especially acute in rural settings, as only 13% of audiologists in private practice work in rural communities (ASHA, 2015).

Patients are unserved and underserved, in part, because there are too few speech and hearing professionals. For example, the average ratio of audiologists to the general population is 1 to 20,000 in developed countries and as high as 1 to every 6.25 million people in developing countries (Fagan & Jacobs, 2009). Other reasons include (Swanepoel et al., 2010, p. 197):

- Poor professional and public awareness
- Shortage of professional training programs
- A lack of outreach and immediate or extended support services
- Geographical barriers such as distance or remote terrains
- Natural barriers, such as severe weather
- A lack of government support and reimbursement policies for services



Increasingly, people with hearing loss and their families are exerting pressure on lawmakers and policy makers to ensure the availability of age-appropriate aural rehabilitation services (Figure 1–8).

### Infants and Toddlers

Advances in neonatology and critical-care medicine have led to better survival rates of high-risk babies. Infants who might have died in earlier times now survive, often with medical conditions that include hearing loss. Public policy in the United States provides for early identification of hearing loss and subsequent service provision, under the auspices of Public Law 105-17 (Individuals with Disabilities Education Act Amendments, 1997) (Chapter 12).

### School-Age Children and Teenagers

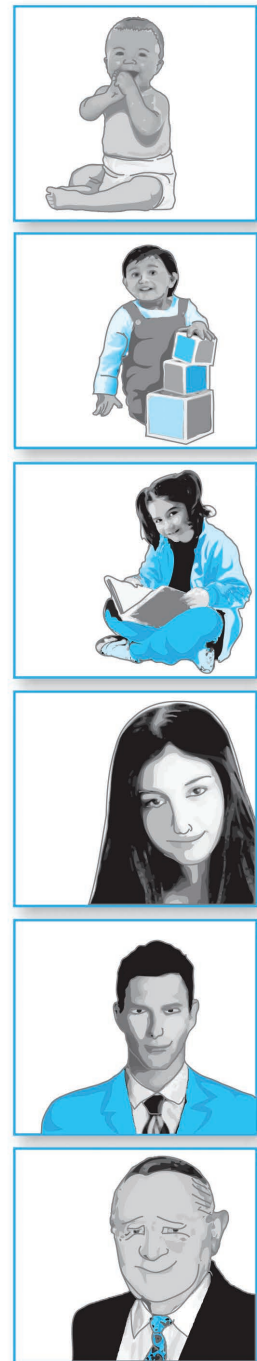
Once children enter school, they face the challenge of learning to read and master academic material. They encounter new independence away from the home. Friends and classmates become increasingly important, and often, learning how to communicate effectively with their peer group becomes a high priority. Services for children and teenagers may include educational planning, accommodation in the classroom, including the use of assistive technology, and support in transitioning from elementary school to secondary school to postsecondary school settings.

### Adults

Individuals in the center of the life cycle also may desire aural rehabilitation services. With appropriate support, adults with even significant hearing loss can function effectively in their workplace, community, and home environments. The passage of the Americans with Disabilities Act (ADA, 1990), which is landmark legislation that calls for equal access for all persons with disabilities (Chapter 10), requires that workplaces and public spaces accommodate people with hearing loss.

### Older Adults

With the aging of the “baby boom” population, age-related hearing loss affects an increasing percentage of the world’s population (Figure 1–9). Older adults often are unwilling to, nor should they be expected to, sit on the sidelines of life because they are unable to communicate with those around them. They have a demand for services that



**FIGURE 1–8** Demand for aural rehabilitation services across the life span.



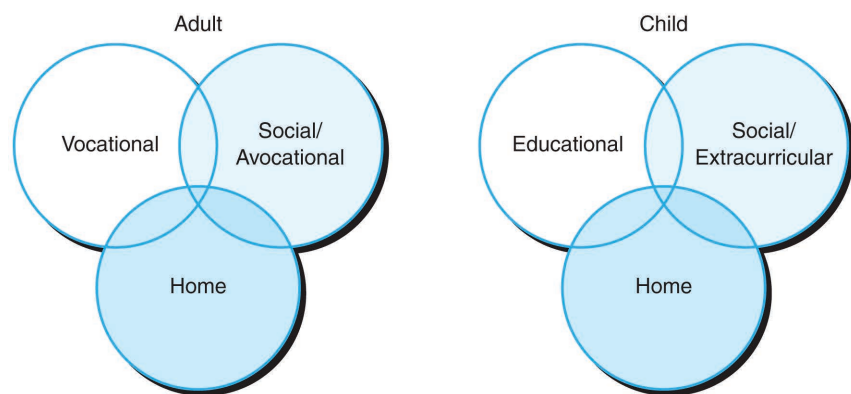
© Syda Productions | Shutterstock.com

**FIGURE 1–9** Aural rehabilitation and older persons.

will enhance their ability to communicate with their families and friends, to participate in community activities and volunteer work, and to stay in touch with their world via multimedia technology. Some desire to continue in their professional careers and postpone retirement. With increased awareness of preventative medicine routines and a growing sophistication in medical practice, an ever growing number of older persons live longer, and many have few health problems other than hearing loss that restrict their day-to-day functioning.

### Family and Frequent Communication Partners

A primary goal of any aural rehabilitation plan is to develop and enhance communication between the person with hearing loss and his or her family and communication partners. Implicitly, this goal suggests that the plan must target not only the individual, but also the people with whom the individual interacts during everyday activities. For an adult patient, the aural rehabilitation might include those people in the home, social/vocational settings, and the workplace. Figure 1–10 shows these communication realms as intersecting, because some communication partners may interact with the individual in both work and social environments. For a child, the plan might target the communication partners in the school system, social and extracurricular activities, and the home.



**FIGURE 1–10** The aural rehabilitation plan and the individual's communication realms.

Communication partners of persons with hearing loss can learn effective communication techniques. For example, a husband may learn how to speak slowly and clearly so that his partner might better speechread him. A mother might develop techniques for stimulating conversation between herself and her daughter. In addition, communication partners sometimes need additional support from a speech and hearing professional. Parents may need personal adjustment counseling as they reconcile themselves to their baby's hearing loss. A woman may need to adjust to the changed hearing status of her partner who may have just received a cochlear implant.

## ● COST-EFFECTIVENESS AND COSTS

**Cost-effectiveness** is the relationship between the money spent and the benefits accrued.

**Cost-effectiveness** relates to the relevance of aural rehabilitation, whereas the costs of providing services relate to the reality of providing services in an environment where health care expenses are spiraling, and services are being cut for economic reasons.

Aural rehabilitation can promote an individuals' quality of life and increase their conversational fluency in the home, workplace, and community. In the case of children,

appropriate aural rehabilitation can promote success in school as well. For example, children who receive cochlear implants and then receive follow-up aural rehabilitation, particularly auditory speech stimulation, are more likely to develop language, speech, and literacy skills than those who do not receive follow-up support (e.g., Geers, Nicholas, & Seedy, 2003). Research shows that when counseling and follow-up programs are provided, adult patients are less likely to return their hearing aids to the audiologist than when they are not provided (Northern & Beyer, 1999) and that the benefits of an aural rehabilitation program justify the expense (Abrams, Chisolm, & McArdle, 2002).

A primary obstacle to providing aural rehabilitation relates to the short-term costs of providing services. Aural rehabilitation can be expensive for two reasons: (1) listening device technology is often costly and (2) providing services such as communication strategies training is labor intensive. Often such costs are not covered by insurance companies and must be borne by the individual.

In the United States, coverage policies can be classified as private (e.g., health maintenance organizations [HMOs]), state (e.g., Blue Cross and Blue Shield), federal (e.g., **Medicare**), or a combination of state and federal (e.g., **Medicaid**). Policies vary in the costs they cover. For example, private insurance plans are governed by the terms of the individual policy. Sometimes when insurance plans provide coverage for services following receipt of a listening device, they do so only when a speech-language pathologist rather than an audiologist provides the services. Medicaid permits flexibility to the states in implementing their programs, but typically, hearing aids are covered if they are deemed medically necessary for a patient and the patient qualifies for Medicaid. Some states offer low-cost loans, with hearing aids being one of the common devices purchased with the loan funds (Hager, 2007).

**Medicare** is a program under the United States Social Security Administration that reimburses hospitals and physicians for medical care they provide to qualified people who are 65 years or older.

**Medicaid** is a program in the United States authorized by Title XIX of the Social Security Act that is jointly funded by the federal government and state governments, which reimburses hospitals and physicians for providing health care to qualified people who cannot otherwise afford services.

## ● EVIDENCE-BASED PRACTICE

In the following chapters, we will consider the services that may be included in an aural rehabilitation plan and how they might be customized for both adult and pediatric populations. To the extent possible, the focus will be on services that are based on an **evidence-based practice (EBP)** approach.

Many aural rehabilitation services that are routinely provided to patients, and the techniques for providing them, have been well researched and shown to work. Some, however, are supported more by tradition and expert opinion than by scientific evidence. Historically, there has been a paucity of well-controlled experiments for such reasons as the following:

- The heterogeneity of patient populations, which makes generalization of research results problematic and sometimes makes definitions of success patient specific; some therapies work for some patients but not for others.
- The role played by the skill of the clinician in determining outcome; as one clinician-researcher asked, “When we get good outcomes, is it the therapies or the therapists?” (Ratner, 2006, p. 206).
- The lack of agreement among researchers and clinicians about **outcome measures**; for example, a patient with significant bilateral hearing loss may never regain normal function in all situations and decisions will have to be made about how to gauge success.
- The tendency for journals not to publish non-significant results; journals publish what works as opposed to what does not work.
- Ethical concerns about data collection; for example, a researcher might not be able to justify assigning patients who might benefit from an intervention to a

**Evidence-based practice (EBP)** is clinical decision making that is based on a review of the scientific evidence of benefits and costs of alternative forms of diagnosis or treatment, on clinical experience, and on patient values.

An **outcome measure** indicates the amount or type of benefit experienced by either an individual or a group of individuals to a treatment or series of treatments, and/or indicates a response.

### Using a Grand Rounds Format to Promote EBP

A grand rounds format is an educational methodology that has long been used to instruct physicians, residents, and medical students. This format can be adapted for the purpose of teaching faculty and students about EBP in aural rehabilitation. Here are tips for creating a grand rounds program:

Schedule the grand rounds on a weekly basis, to last for one hour, typically early in the day before classes and clinics begin.

Invite students and faculty alike to attend.

Have a student present a case study at the onset of the grand rounds, along with a review of literature that is relevant to the case.

Invite a faculty member to lead a question-and-comment session after the student presentation.

Occasionally invite a visiting professor or a local audiologist to serve as a guest speaker.

Enhance the diversity of cases that are presented via periodic teleconferences with other universities and clinics.

(Hall, 2018, p. 86)

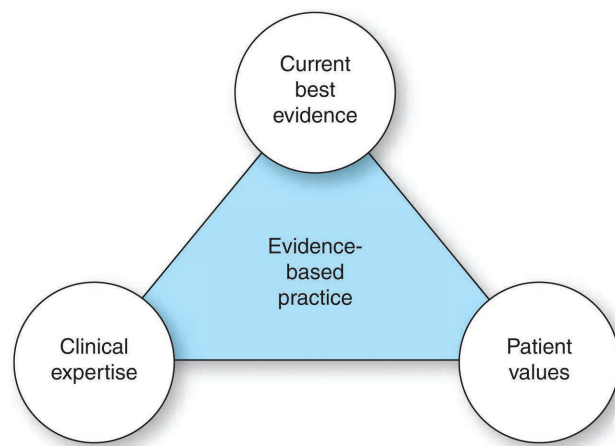
A **control group** is composed of research participants who closely resemble members of the experimental group but who do not receive the experimental treatment and thereby serve as a standard against which to detect and measure changes in the experimental group due to the treatment.

An **experimental group** is composed of research participants who receive the treatment under study.

In a **randomized controlled trial**, investigators randomly assign eligible people into treatment and control groups and then compare outcomes. The chance assignment reduces the likelihood that differences stem from pre-existing differences between the two groups.

**control group** for the sake of comparing their outcome to that of those assigned to an **experimental group**.

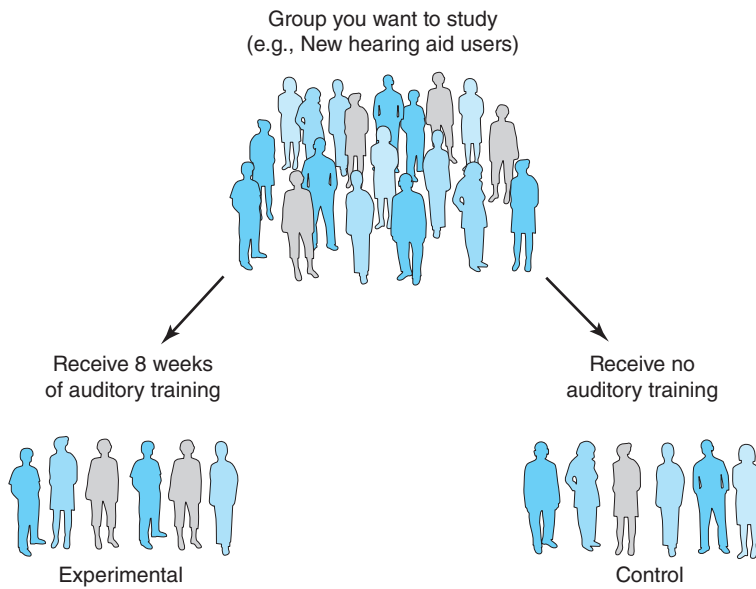
Nonetheless, in this age of managed care and accountability, increasingly the services included in an aural rehabilitation plan must be supported by empirical evidence. ASHA encourages that whenever possible, services be based on an EBP approach (ASHA, 2004a). EBP entails integrating the best research evidence with clinical expertise and patient values. In such an approach, you will judiciously integrate scientific evidence into your clinical decision making, along with your own clinical expertise and knowledge about the particular preferences, environment, needs, culture, and values of your patient (ASHA, 2004a) (Figure 1–11). Even though it is tempting to rely primarily on past clinical experience and the opinions of colleagues to guide clinical decision making, as many professionals do (Zipoli & Kennedy, 2012), services should not be provided just because “that is what we have always done” and “this is the way we have always done it.” Rather, selection of services should also be driven by relevant and valid data obtained from clinically oriented studies.



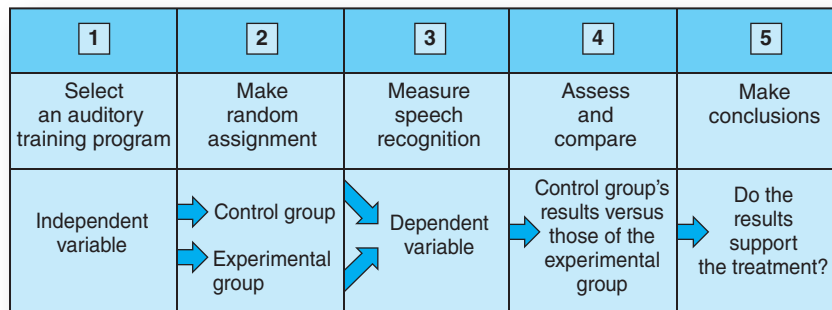
**FIGURE 1–11** An evidence-based practice approach, which takes into account quality research evidence, clinical experience, and patient values and needs.

The most compelling evidence for selecting services, sometimes referred to as “Level 1” evidence, results from a meta-analysis of more than one randomized controlled trial. A **randomized controlled trial** entails comparing participants who have been **randomly assigned** to receive a test treatment to participants who receive no such treatment or a different test treatment (Figure 1–12). For example, if you were a clinical researcher, you might opt to compare the efficacy of a particular eight-week-long computer-based auditory training program and determine whether it improves the ability of new hearing aid recipients to recognize speech in the presence of background noise. You might include two groups in your experimental design, one group that receives training and one group that receives no training (the control group). In this example, the eight weeks of computer-based auditory training is the independent variable of the experiment and measures of participants’ ability to recognize speech in the presence of noise are the dependent variables. An **independent variable** is the **variable** that is manipulated (e.g., provision of auditory training). The variable that is measured (e.g., speech recognition ability) is the **dependent variable** (Figure 1–13).

Because it is unlikely that a single study will provide a definitive answer to a single scientific question, a **meta-analysis** of the existing studies, where results from several studies



**FIGURE 1-12** Random assignment. Each participant in the available population of new hearing aid users has an equal chance of being assigned to a level of the independent variable, which in this example, is either eight weeks of auditory training or 0 weeks of auditory training. The *available population* is called a “convenience sample” because it is a subgroup of a larger population and implies that these are participants who are available and willing to participate in the particular experiment.



**FIGURE 1-13** A randomized controlled experimental design for assessing the benefits of auditory training. The independent variable is eight weeks of auditory training. The dependent variable is participants' ability to recognize speech.

**Random assignment** is a method of placing research participants into the conditions or treatments of an experiment in such a way that every participant has an equal chance of being assigned to any of the conditions or to any level of the independent variable.

The **independent variable** in an experiment is the variable that is manipulated by the experimenter in order to assess its consequences or impact on the dependent variable.

A **variable** is something that can vary and that research can measure.

The **dependent variable** in an experiment is the variable that is affected by the treatment or manipulation of the independent variable and can be measured.

A **meta-analysis** is a study of studies that combines the results of a set of studies on the same topic to reach a general conclusion.

## Meta-Analysis: The Gold Standard

Researchers who perform a meta-analysis summarize the results of many studies that have addressed the same topic. For example, in a now classic study, Sweetow and Palmer (2005) surveyed the literature to address the question, *Is there evidence of improvement in communication skills through individual auditory training in an adult hearing-impaired population?* The researchers identified a possible 213 articles in the literature that provide results pertinent to this question. Rather than simply counting up the number of positive and negative findings to derive an answer, they instead identified those studies that had adequate sample sizes, sufficient detail, and good methodological rigor and culled the number of studies to consider down to 6. They then looked at the size of each effect (i.e., whether a large gain in skills occurred, a small gain, or no gain) and concluded that in general, auditory training leads to enhanced skills.



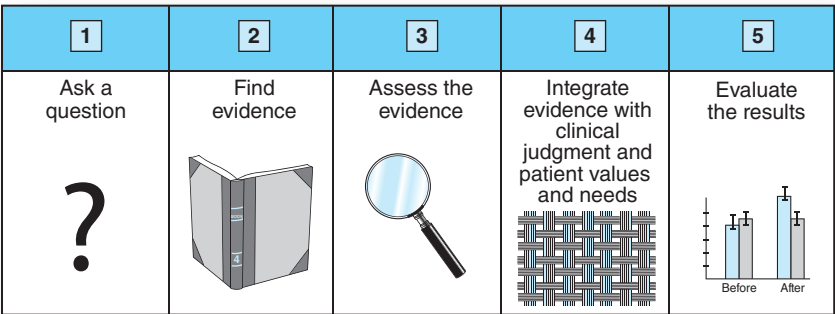
are synthesized, provides the optimum basis for choosing treatment. Especially in an active field of research, where numerous studies may produce inconsistent results (e.g., whether or not auditory training yields meaningful improvement in speech recognition skill), a meta-analysis will provide guidance to the clinician about whether a particular intervention will be effective for a particular patient.

This kind of evidence is not always available, so other levels of evidence might have to suffice. Table 1–2 presents the levels of evidence in order of quality and credibility, from most optimal to least optimal, that can support EBP services.

**TABLE 1–2** Levels of Evidence to Support EBP Treatment Interventions, Ranked in Order of Highest/Most Credible (Ia) to Lowest/Least Credible (IV) (Adapted from ASHA, 2004a, p. 2)

LEVEL	DESCRIPTION
Ia	<i>Systematic meta-analysis of more than one randomized controlled trial.</i> A meta-analysis is a synthesis of the major findings of a group of studies.
Ib	<i>Well-designed randomized controlled trials.</i> In a randomized controlled trial, participants are assigned randomly to either a treatment or a control group. One reason that a researcher may opt not to conduct a randomized trial pertains to the ethical issue of withholding treatment.
IIa	<i>Well-designed controlled trials without randomization.</i> These are less reliable than randomized trials because the participant groups might differ in unanticipated or unrecognized ways.
IIb	<i>Well-designed quasi-experimental studies, e.g., cohort studies.</i> A cohort study is one in which a group of patients exposed to a particular treatment is followed over time and is compared with an unexposed group. It is not as reliable as a randomized controlled trial because the two groups may differ in ways that are not readily apparent.
III	<i>Well-designed nonexperimental studies, e.g., correlational and case studies.</i> A correlation study determines the relationships (correlations) between variables but does not permit causal interpretations. A case study is an uncontrolled study of a single individual or a series of individuals for the purpose of observing the outcome of an intervention. Neither one includes a control group.
IV	<i>Expert committee report, consensus conference, and expert opinion.</i> A committee report might define required procedures and practices, based on scientific data and/or expert opinion. Consensus is an agreement among experts about an issue, whereas an expert opinion reflects the scholarly knowledge and clinical experience of recognized leaders in the field.

When engaging in EBP, many clinicians follow a five-step approach (adapted from Affiliate Representatives, 2003, p. 5, Figure 1–14):



**FIGURE 1–14** The five-step approach for engaging in EBP.

1. *Ask a straightforward question.* For example, in developing an aural rehabilitation plan for a business executive who is experiencing communication difficulties, you might pose the question: Does group communication strategies training, as compared with individual training, result in better adjustment to hearing loss? Your purpose is to determine whether you should recommend group communication strategies training for this patient, individualized training, or neither.
2. *Find the best evidence to answer the question.* You might consult a journal or textbook, conduct a database search with an electronic bibliographic database, search the internet, or engage in a citation search, where you determine if an article has been included in a review article bibliography (see Appendix 1–3 at the end of this chapter). You might also contact professional organizations such as ASHA or the AAA or government agencies such as the **National Institutes of Health (NIH)**'s agency, the **National Institute on Deafness and Other Communication Disorders (NIDCD)**, for information.
3. *Critically assess the evidence and decide if the results pertain to your patient.* You might consult with Table 1–2 and determine the level of evidence available for EBP and consider effect size, or the magnitude of benefit provided by a particular intervention, and consider whether this effect is of **clinical significance**. For example, a treatment might be shown to have a significant effect on a test group of patients, but the effect might be inconsequential to everyday communication or might not justify the time and effort entailed in providing the service.
4. *Integrate the evidence with your clinical judgment and the patient values and needs.* In considering the applicability and feasibility of an aural rehabilitation plan, you will talk to the patient and/or to the patient's family about possible options and weigh the potential benefits and disadvantages of each; for instance: Can the patient afford individualized communication strategies training and is there time in your workday to provide it?
5. *Evaluate the performance after having implemented your plan.* For this, you will choose measures to monitor progress and adjust your decisions if the desired outcomes are not being achieved.

The **National Institutes of Health (NIH)** is the medical research agency of the United States and has the mission of acquiring knowledge to help prevent, detect, and treat disease and disability.

The **National Institute on Deafness and Other Communication Disorders (NIDCD)** supports research activity concerning the normal and disordered processes of hearing, speech, language, balance, taste, and smell and about problems experienced by people with communication impairments.

**Clinical significance** relates to whether an experimental result has practical meaning to either the patient or the clinician.

A **case study** involves an in-depth examination of a patient, either because the patient is considered to be unusual or because the patient might be representative of a larger group, although that possibility can only be considered speculative.

## What Exactly Is a Case Study?

A **case study** provides an in-depth description of an individual, sometimes because that individual is unusual and sometimes because that individual might possibly be representative of a population, although whether that is so can only be speculative. For example, a set of identical twins were once studied because one had incurred a profound hearing loss shortly after birth. The researchers were interested in studying the effects of hearing loss on language development, and in this situation, the two children were otherwise very comparable in terms of genetic makeup and home environment (variables that could affect language development), so the situation presented an ideal window of opportunity. In another example, a patient who received a cochlear implant was studied because she improved her speech recognition by listening to books-on-tape according to a predetermined schedule.

Although case studies provide information about an individual and might provide direction for future research, the results cannot be generalized. In the first example, it is not possible to conclude that other children will experience the same degree of language delay that was experienced by the twin because of significant hearing loss. Children vary in their language experiences, educational opportunities, sociability, and all manner of other variables, so the outcomes noted for one child cannot possibly be extrapolated to a population. In the second example, it is not possible to conclude that listening to books-on-tape will improve the speech recognition of new cochlear implant recipients. Patients may respond differently to this treatment, perhaps as a function of their entry level speech recognition abilities, their brand of cochlear implant, or their vocabulary and level of education.



Many professionals who provide aural rehabilitation bemoan the time that they have available to read the literature and cite limited time as a reason for not engaging in EBP. For example, in a survey of 1,000 audiologists and speech-language pathologists, 60 percent of audiologists and 75% of speech language pathologists indicated that they had insufficient time to engage in EBP. Sixty-two percent of the school-based respondents indicated that the cost of continuing education was a barrier to learning about and implementing evidence-based interventions (Schooling & Solomon, 2017).

The good news is that, increasingly, professional journals are providing web-based access to research abstracts, full-text articles, and tutorials. Professional organizations such as ASHA and AAA are packaging best practice evidence into user friendly formats such as position papers, clinical practice guidelines, and evidence maps. For example, ASHA's National Center for Evidence-Based Practice in Communication Disorders (N-CEP) launched a series of evidence maps, each of which is organized around the three lynchpins of EBP: scientific evidence, clinical expertise, and patient values and perspectives (<https://www.asha.org/Evidence-Maps/>). For a particular topic (e.g., hearing loss—children, hearing loss—adults), the N-CEP searches and then reviews the scientific literature and provides summaries of key findings and recommendations. The maps are organized by clinical topic and can be searched by typing in clinical questions or situations (Schooling & Solomon, 2018).

Selecting the components to include in an aural rehabilitation plan is not always a straightforward or easy proposition, and many variables will factor into the decision making process. These variables will include the needs and desires of the patient, the availability of services within an aural rehabilitation practice and the surrounding community, and the cost-effectiveness of providing a particular intervention or treatment. An EBP approach is a means to ensure that the services that are included in the plan will likely result in the desired and predicted outcomes.

## CASE STUDY

### Applying the WHO's International Classification of Functioning, Disability and Health

Hickson and Scarinci (2007, pp. 288–289) introduce their readers to Hugh, a 72-year-old man who rarely uses his hearing aids at home, despite pleas from his wife, Lorna, that doing so would enhance their conversational fluency significantly (and thereby reduce activity limitations, see Figure 1–1). Hugh believes that his hearing *isn't all that bad* and that *I hear well enough at home* (psychosocial factor). Thus, Lorna experiences a third-party disability, and in the home environment, experiences a greater communication activity limitation than does Hugh. Hugh rarely attends social gatherings because of his inability to recognize speech in noisy situations, resulting in participation restrictions for both himself and his wife. Lorna misses socializing with the couple's friends, but does not want to attend functions alone and leave Hugh to fend for himself on a Friday night. The couple discussed these ongoing communication activity limitations and participation restrictions with their audiologist, who recommended that they participate in a communication strategies training class. Hugh and Lorna took the class, where they met other couples who were experiencing similar communication activity limitations and participation restrictions. The couple appreciated their classmates' empathy and support, and with input from the audiologist who led the class, developed the following list of communication strategies to reduce both of their communication activity limitations and participation restrictions:

- Lorna will use repair strategies and clear speech to promote conversational fluency.
- Lorna will make sure that Hugh can see her face so he can read her lips as well as hear her voice.
- Lorna will gain Hugh's attention before beginning to speak, so he is aware that she is speaking.
- Hugh will wear his hearing aids more often in the home and when going out to social situations, which should lead to fewer participation restrictions for both Hugh and Lorna.

The happy ending is that Hugh now wears his hearing aid more often and their Friday nights are much more fun.

## CASE STUDY

### Evidence-Based Practice Decision Making

Cox (2005) describes a 75-year-old woman who lives alone on a fixed income. The woman has a bilateral, moderate, sensorineural hearing loss. She does not socialize often, but does visit her children for lunch every Sunday. She has difficulty in understanding their conversations around the dining table. Her daughter has accompanied her to today's audiology appointment. She is interested in purchasing one of the fancy "digital" hearing aids for her mother. Here are the steps that the audiologist pursues in practicing EBP:

**Step 1:** Generates the question. "Will an older woman with moderate bilateral presbycusis obtain better speech understanding in noise with digital processing hearing aids than with . . . analog devices . . . ?" (p. 422). Note that the key elements in this question are *the person* (i.e., an older woman with some social contacts), *the problem* (difficulty understanding conversation in social situations), *the proposed treatment* (digital hearing aids), a *comparison treatment* (analog hearing aids), and an *outcome measure* (how well the woman will recognize speech using a hearing aid in the presence of background noise).

**Step 2:** Finds the best available evidence. The audiologist conducts an Internet search of an online database. She enters into the search field the items: "hearing aid AND digital AND (analog OR analogue)" (p. 423). The database that she uses, PubMed (see Appendix 1–3), allows her to limit her search from 1995 to the present. The search yields 13 English-language articles. A quick reading of the articles' abstracts eliminates 5 as irrelevant to the question posed in Step 1.

**Step 3:** Evaluates the evidence. Beginning with the most recent article and working backward in time, the audiologist selects a subset of the remaining eight articles for a careful review. She assesses the strengths and weaknesses of the evidence.

**Step 4:** Makes a recommendation. The audiologist considers the similarities and differences between her patient and the participants included in the research studies that she has just read (their ages, health, gender, education, and so forth) to determine the extent to which the evidence applies to her patient. She synthesizes this information with her own clinical judgment and what she knows about her patient, and decides on an appropriate course of action. She shares her recommendation with the patient and her daughter. A hearing aid is ordered for the patient.

**Step 5:** Follows up. After the patient is fitted with her new hearing aid, the audiologist schedules a follow-up clinic visit in case the recommendation is not successful and needs to be modified.

## ● FINAL REMARKS

A number of professional journals deal with aural rehabilitation. These journals are listed in Appendix 1–3 at the end of this chapter. They can provide additional and timely information about the topics covered in this text. They are also a source for EBP.

## ● KEY CHAPTER POINTS

- The WHO uses the ICF for considering a health-related disability.
- Hearing loss may limit communication activity and impose participation restrictions on everyday activities.
- The impact of hearing loss on a patient may be mediated by environmental and personal factors—for example, a patient's use of listening aids, his or her physical environment, lifestyle and frequent communication partners, and individual characteristics such as personality.



- Aural rehabilitation for adults may include diagnosis and quantification of hearing loss, provision of appropriate listening devices, training in communication strategies, counseling related to hearing loss, vocational counseling, noise protection, and counseling and instruction for family members. It may or may not include auditory and speechreading training.
  - Aural rehabilitation for children may include diagnostics, provision of appropriate amplification, auditory and speechreading training, communication-strategies training, family training, and intervention related to speech, language, and educational development.
  - Aural rehabilitation may occur in a variety of locales, including schools, hospitals, university speech and hearing clinics, and audiology private practices.
  - Aural rehabilitation may be provided by an audiologist, speech-language pathologist, or educator.
  - Hearing loss may be categorized by degree, onset, causation, and time course.
  - The aural rehabilitation plan includes the communication realms of the person who has hearing loss.
  - Aural rehabilitation is relevant for at least two general reasons: demographics and cost-effectiveness.
  - EBP approaches reflect best research evidence, clinical expertise, and patient values.
  - Randomized controlled trials typically compare groups of individuals who have been randomly assigned to a treatment or to a control condition.
  - When engaging in EBP, clinicians ask a question, find evidence to answer it, assess the evidence, integrate the evidence with their judgment and patient values, and then evaluate performance.
- 

## ● TERMS AND CONCEPTS TO REMEMBER

*Conversational fluency*

*Hearing-related disability*

*World Health Organization (WHO)*

*International Classification of Functioning, Disability and Health (ICF)*

*Activity limitations*

*Participation restrictions*

*Environmental factors*

*Personal factors*

*Third-party disability*

*Frequent communication partner*

*Perceived quality of life*

*Unserved and underserved*

*Evidence-based practice (EBP)*

*Randomized controlled study*

*Levels of evidence*

*Evidence-based practice five-step approach*

*Clinical significance*

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## Appendix 1–1

### Basic Areas of Knowledge and Skills

Audiologists who provide aural rehabilitation services demonstrate **basic knowledge** in the areas that are the underpinnings of communication sciences and disorders. These include the following:

- I. General Knowledge
  - A. General psychology; human growth and development; psychosocial behavior; cultural and linguistic diversity; biological, physical, and social sciences; mathematics; and qualitative and quantitative research methodologies
- II. Basic Communication Processes
  - A. Anatomic and physiologic bases for the normal development and use of speech, language, and hearing (including anatomy, neurology, and physiology of speech, language, and hearing mechanisms)
  - B. Physical bases and process of the production and perception of speech and hearing (including acoustics or physics of sound, phonology, physiologic and acoustic phonetics, sensory perceptual processes, and psychoacoustics)
  - C. Linguistic and psycholinguistic variables related to the normal development and use of speech, language, and hearing (including linguistics [historical, descriptive, sociolinguistic, sign language, second-language usage], psychology of language, psycholinguistics, language and speech acquisition, verbal learning and verbal behavior, and gestural communication)
  - D. Dynamics of interpersonal skills, communication effectiveness, and group theory

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**Basic knowledge** is demonstrated by the recall of specifics, universals, methods, and processes, or the recall of a pattern, structure, or setting (Bloom, Hastings, & Madaus, 1971, p. 271).

### Special Areas of Knowledge and Skills

Audiologists who provide aural rehabilitation have **special knowledge** in the following areas and demonstrate the itemized requisite skills in those areas:

- III. Auditory System Function and Disorders
  - A. Identify, describe, and differentiate among disorders of auditory function (including disorders of the outer, middle, and inner ear; the vestibular system; the auditory nerve and the associated neural and central auditory system pathways and processes)
- IV. Developmental Status, Cognition, and Sensory Perception
  - A. Provide for the administration of assessment measures in the client's preferred mode of communication
  - B. Verify adequate visual acuity for communication purposes
  - C. Identify the need and provide for assessment of cognitive skills, sensory perceptual and motor skills, developmental delays, academic achievement, and literacy
  - D. Determine the need for referral to other medical and nonmedical specialists for appropriate professional services
  - E. Provide for ongoing assessments of developmental progress
- V. Audiologic Assessment Procedures
  - A. Conduct interview and obtain case history

**Special knowledge** permits application, analysis, synthesis, and evaluation; an individual not only possesses knowledge but can apply and elaborate upon that knowledge (Bloom et al., 1971).

- B. Perform otoscopic examinations and ensure that the external auditory canal is free of obstruction, including cerumen
  - C. Conduct and interpret behavioral, physiologic, or electro-physiologic evaluations of the peripheral and central auditory systems
  - D. Conduct and interpret assessments for auditory processing disorders
  - E. Administer and interpret standardized self-report measures of communication difficulties and of psychosocial and behavioral adjustment to auditory dysfunction
  - F. Identify the need for referral to medical and nonmedical specialists for appropriate professional services
- VI. Speech and Language Assessment Procedures**
- A. Identify the need for and perform screenings for effects of hearing impairment on speech and language
  - B. Describe the effects of hearing impairment on the development of semantic, syntactic, pragmatic, and phonologic aspects of communication, in terms of both comprehension and production
  - C. Provide for appropriate measures of speech and voice production
  - D. Provide for appropriate measures of language comprehension and production skills and/or alternate communication skills (e.g., signing)
  - E. Administer and interpret appropriate measures of communication skills in auditory, visual, auditory-visual, and tactile modalities
- VII. Evaluation and Management of Devices and Technologies for Individuals with Hearing Impairment (i.e., hearing aids, cochlear implants, middle ear implants, implantable hearing aids, tinnitus maskers, hearing assistive technologies, and other sensory prosthetic devices)**
- A. Perform and interpret measures of electroacoustic characteristics of devices and technologies
  - B. Describe, perform, and interpret behavioral/psychophysical measures of performance with these devices and technologies
  - C. Conduct appropriate fittings with and adjustments of these devices and technologies
  - D. Monitor fitting of and adjustment to these devices and technologies to ensure comfort, safety, and device performance
  - E. Perform routine visual, listening, and electroacoustic checks of clients' hearing devices and sensory aids to troubleshoot common causes of malfunction
  - F. Evaluate and describe the effects of use of devices and technologies on communication and psychosocial functioning
  - G. Plan and implement a program of orientation to these devices and technologies to ensure realistic expectations; to improve acceptance of, adjustment to, and benefit from these systems; and to enhance communication performance
  - H. Conduct routine assessments of adjustment to and effective use of amplification devices to ensure optimal communication function
  - I. Monitor outcomes to ensure professional accountability
- VIII. Effects of Hearing Impairment on Functional Communication**
- A. Identify the individual's situational expressive and receptive communication needs

- B. Evaluate the individual's expressive and receptive communication performance
- C. Identify environmental factors that affect the individual's situational communication needs and performance
- D. Identify the effects of interpersonal relations on communication function
- IX. Effects of Hearing Impairment on Psychosocial, Educational, and Occupational Functioning
  - A. Describe and evaluate the impact of hearing impairment on psychosocial development and psychosocial functioning
  - B. Describe systems and methods of educational programming (e.g., mainstream, residential) and facilitate selection of appropriate educational options
  - C. Describe and evaluate the effects of hearing impairment on occupational status and performance (e.g., communication, localization, safety)
  - D. Identify the effects of hearing problems on marital dyads, family dynamics, and other interpersonal communication functioning
  - E. Identify the need and provide the psychosocial, educational, family, and occupational/vocational counseling in relation to hearing impairment and subsequent communication difficulties
  - F. Provide assessment of family members' perception of and reactions to communication difficulties
- X. AR Case Management
  - A. Use effective interpersonal communication in interviewing and interacting with individuals with hearing impairment and their families
  - B. Describe client-centered, behavioral, cognitive, and integrative theories and methods of counseling and their relevance in AR
  - C. Provide appropriate individual and group adjustment counseling related to hearing loss for individuals with hearing impairment and their families
  - D. Provide auditory, visual, and auditory-visual communication training (e.g., speechreading, auditory training, listening skills) to enhance receptive communication
  - E. Provide training in effective communication strategies to individuals with hearing impairment, family members, and other relevant individuals
  - F. Provide for appropriate expressive communication training
  - G. Provide appropriate technological and counseling intervention to facilitate adjustment to tinnitus
  - H. Provide appropriate intervention for management of vestibular disorders
  - I. Develop and implement an intervention plan based on the individual's situational/environmental communication needs and performance and related adjustment difficulties
  - J. Develop and implement a system for measuring and monitoring outcomes and the appropriateness and efficacy of intervention
- XI. Interdisciplinary Collaboration and Public Advocacy
  - A. Collaborate effectively as part of multidisciplinary teams and communicate relevant information to allied professionals and other appropriate individuals
  - B. Plan and implement in-service and public-information programs for allied professionals and other interested individuals



- C. Plan and implement parent-education programs concerning the management of hearing impairment and subsequent communication difficulties
  - D. Advocate implementation of public law in educational, occupational, and public settings
  - E. Make appropriate referrals to consumer-based organizations
- XII. Hearing Conservation/Acoustic Environments**
- A. Plan and implement programs for prevention of hearing impairment to promote identification and evaluation of individuals exposed to hazardous noise and periodic monitoring of communication performance and auditory abilities (e.g., speech recognition in noise, localization)
  - B. Identify need for and provide appropriate hearing protection devices and noise abatement procedures
  - C. Monitor the effects of environmental influences, amplification, and sources of trauma on residual auditory function
  - D. Measure and evaluate the environmental acoustic conditions and relate them to effects on communication performance and hearing protection

## Appendix 1–2

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  - A. Anatomic and physiologic bases for the normal development and use of speech, language, and hearing (including anatomy, neurology, and physiology of speech, language, and hearing mechanisms)
  - B. Physical bases and process of the production and perception of speech and hearing (including acoustics or physics of sound, phonology, physiologic and acoustic phonetics, sensory perceptual processes, and psychoacoustics)
  - C. Linguistic and psycholinguistic variables related to the normal development and use of speech, language, and hearing (including linguistics [historical, descriptive, sociolinguistic, sign language, second-language usage], psychology of language, psycholinguistics, language and speech acquisition, verbal learning and verbal behavior, and gestural communication)
  - D. Dynamics of interpersonal skills, communication effectiveness, and group theory

### Special Areas of Knowledge and Skills

Speech-language pathologists who provide aural rehabilitation have special knowledge in the following areas and demonstrate the itemized requisite skills in those areas:



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  - A. Identify, describe, and differentiate among disorders of auditory function (including disorders of the outer, middle, and inner ear; the vestibular system; the auditory nerve and the associated neural and central auditory system pathways and processes)
- IV. Developmental Status, Cognition, and Sensory Perception
  - A. Provide for the administration of assessment measures in the client's preferred mode of communication
  - B. Verify adequate visual acuity for communication purposes
  - C. Identify the need and provide for assessment of cognitive skills, sensory perceptual and motor skills, developmental delays, academic achievement, and literacy
  - D. Determine the need for referral to other medical and nonmedical specialists for appropriate professional services
  - E. Provide for ongoing assessments of developmental progress
- V. Audiologic Assessment Procedures
  - A. Conduct audiologic screening as appropriate for initial identification and/or referral purposes
  - B. Describe type and degree of hearing loss from audiometric test results (including pure-tone thresholds, immittance testing, and speech audiometry)
  - C. Refer to and consult with an audiologist for administration and interpretation of differential diagnostic procedures (including behavioral, physiological, and electrophysiological measures)
- VI. Assessment of Communication Performance
  - A. Provide for assessment measures in the client's preferred mode of communication
  - B. Identify and perform screening examinations for speech, language, hearing, auditory processing disorders, and reading and academic achievement problems
  - C. Identify and perform diagnostic evaluations for the comprehension and production of speech and language in oral, signed, written, or augmented form
  - D. Provide diagnostic evaluations of speech perception in auditory, visual, auditory-visual, or tactile modalities
  - E. Identify the effects of hearing loss on speech perception, communication performance, listening skills, speechreading, communication strategies, and personal adjustment
  - F. Provide for clients' self-assessment of communication difficulties and adjustment of hearing loss
  - G. Monitor developmental progress in relation to communication competence
- VII. Devices and Technologies for Individuals with Hearing Loss (i.e., hearing aids, cochlear implants, middle ear implants, implantable hearing aids, hearing assistive technologies, and other sensory prosthetic devices)
  - A. Describe candidacy criteria for amplification or sensory-prosthetic devices (e.g., hearing aids, cochlear implants)
  - B. Monitor clients' prescribed use of personal and group amplification systems

- C. Describe options and applications of sensory aids (e.g., assistive listening devices) and telephone/telecommunication devices
  - D. Identify the need and refer to an audiologist for evaluation and fitting of personal and group amplification systems and sensory aids
  - E. Implement a protocol, in consultation with an audiologist, to promote adjustment to amplification
  - F. Perform routine visual inspection and listening checks of clients' hearing devices and sensory aids to troubleshoot common causes of malfunctioning (e.g., dead or corroded batteries, obstruction or damage to visible parts of the system)
  - G. Refer on a regularly scheduled basis clients' personal and group amplification systems, other sensory aids, and assistive listening devices for comprehensive evaluations to ensure that instruments conform to audiologists' prescribed settings and manufacturers' specifications
  - H. Describe the effects of amplification on communication function
  - I. Describe and monitor the effects of environmental factors on communication function
- VIII. Effects of Hearing Loss on Psychosocial, Educational, and Vocational Functioning**
- A. Describe the effects of hearing loss on psychosocial development
  - B. Describe the effects of hearing loss on learning and literacy
  - C. Describe systems and methods of educational programming (e.g., mainstream, residential) and facilitate selection of appropriate educational options
  - D. Identify the need for and availability of psychological, social, educational, and vocational counseling
  - E. Identify and appropriately plan for addressing affective issues confronting the person with hearing loss
  - F. Identify appropriate consumer organizations and parent support groups
- IX. Intervention and Case Management**
- A. Develop and implement a rehabilitative intervention plan based on communication skills and needs of the individual and family or caregivers of the individual
  - B. Provide for communication and counseling intervention in the client's preferred mode of communication
  - C. Develop expressive and receptive competencies in the client's preferred mode of communication
  - D. Provide speech, language, and auditory intervention (including but not limited to voice quality and control, resonance, phonologic and phonetic processes, oral motor skills, articulation, pronunciation, prosody, syntax/morphology, semantics, pragmatics)
  - E. Facilitate appropriate multimodal forms of communication (e.g., auditory, visual, tactile, speechreading, spoken language, Cued Speech, simultaneous communication, total communication, communication technologies) for the client and family
  - F. Conduct interviews and interact effectively with individuals and their families
  - G. Develop and implement a system to measure and monitor outcomes and the efficacy of intervention

- X. Interdisciplinary Collaboration and Public Advocacy
  - A. Collaborate effectively as part of multidisciplinary teams and communicate relevant information to allied professionals and other appropriate individuals
  - B. Plan and implement in-service and public-information programs for allied professionals and other interested individuals
  - C. Plan and implement parent-education programs concerning the management of hearing impairment and subsequent communication difficulties
  - D. Plan and implement interdisciplinary service programs with allied professionals
  - E. Advocate implementation of public law in educational, occupational, and public settings
  - F. Refer to consumer-based organizations
- XI. Acoustic Environments
  - A. Provide for appropriate environmental acoustic conditions for effective communication
  - B. Describe the effects of environmental influences, amplification systems, and sources of trauma on residual auditory function
  - C. Provide for periodic hearing screening for individuals exposed to hazardous noise

## Appendix 1–3

### Professional Journals That Might Be Consulted for Evidence-Based Practice

*Advance for Audiologists*

*Advance for Speech-Language Pathologists and Audiologists*

*American Annals of the Deaf*

*American Journal of Audiology: A Journal of Clinical Practice*

*American Journal of Speech-Language Pathology: A Journal of Clinical Practice*

*ASHA (American Speech-Language Hearing Association)*

*Asian Pacific Journal of Speech, Language, and Hearing*

*Audiology and Neurotology*

*Deafness and Education*

*Ear and Hearing*

*Educational Audiology Review*

*Hearing Journal*

*Hearing Review*

*International Journal of Audiology* (formerly *Audiology*, *British Journal of Audiology*, and *Scandinavian Audiology*)

*International Tinnitus Journal*

*Journal of the Academy of Rehabilitative Audiology*

*Journal of the American Academy of Audiology*

*Journal of Child Language*

*Journal of Communication Disorders*

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*Journal of Deaf Studies and Deaf Education*

*Journal of Educational Audiology*

*Journal of Speech, Language, and Hearing Research*

*Language and Speech*

*Language, Speech, and Hearing Services in the School*

*Noise and Health*

*Noise Regulation Report*

*Perspectives on Aural Rehabilitation and Its Instrumentation*

*Seminars in Hearing*

*Seminars in Speech and Language*

*Speech Communication*

*Tinnitus Today*

*Topics in Language Disorders*

*Trends in Amplification*

*Volta Review*

*Volta Voices*

### **Electronic Databases That Might Be Consulted for Evidence-Based Practice**

*Medline*, at <http://www.nlm.nih.gov/>, spotlights medical and health-related research (see also PubMed, [www.pubmed.gov](http://www.pubmed.gov)).

*PsychINFO*, at <http://www.apa.org/pubs/databases/psycinfo/index.aspx>, spotlights the psychological literature.

*Educational Resource Information Center (ERIC)*, at <http://www.eric.ed.gov/>, spotlights educational research.

*ASHA National Center for EBP in Communication Disorders*, at <https://www.asha.org/Evidence-Maps/>

*ComDisDome*, at <http://search.proquest.com/login?accountid=15159>, lists dissertations and monographs that are peer-reviewed.

*CINAHL*, at <http://www.ebscohost.com/academic/cinahl-plus-with-full-text/>, lists trade journals.

# **PART 1**

## **The Components of an Aural Rehabilitation Plan**





# CHAPTER 2

## Assessing Hearing Acuity and Speech Recognition

### OUTLINE

Review of the Audiological Examination and the Audiogram

Purpose of Speech Recognition Testing

Patient Variables

Stimuli Units

Test Procedures

Difficulties Associated with Speech Recognition Assessment

Multicultural Issues

Case Study: Reasons to Go with a Test-Battery Approach

Final Remarks

Key Chapter Points

Terms and Concepts to Remember

Key Resources

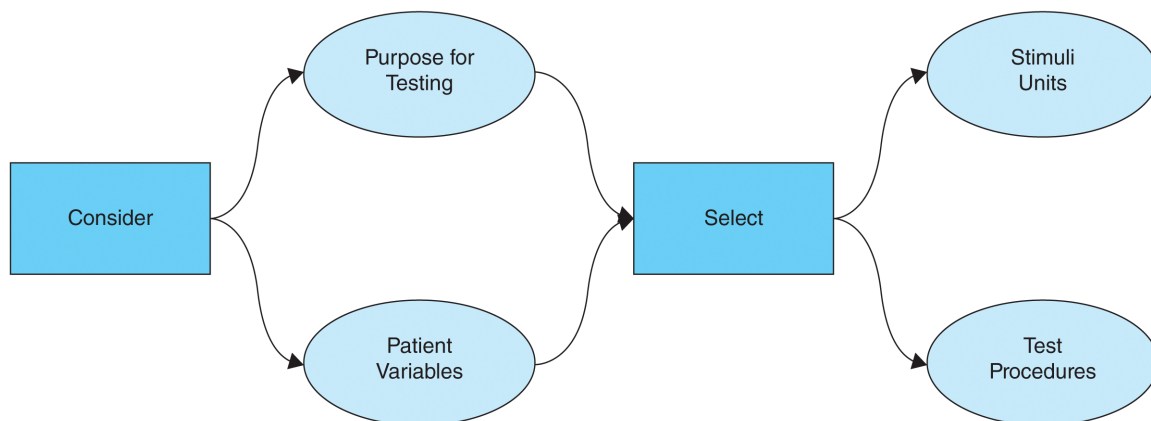
**Speech recognition** is the ability to perceive a spoken message and make decisions about its lexical composition using auditory and sometimes visual information.

**Speech recognition testing** is performed in order to determine how well an individual can recognize speech units.

**A** key element in promoting conversational fluency and reducing hearing-related disability is to optimize a patient's ability to recognize speech. The reason that conversational fluency is often degraded is that persons with hearing loss cannot recognize the spoken messages of their communication partners. **Speech recognition**, also called speech perception, refers to how well people use auditory and/or visual information to understand spoken messages. **Speech recognition testing** involves assessing how well someone can recognize speech units such as phonemes, words, and sentences. The first phase of most aural rehabilitation plans is to assess a patient's hearing acuity and assess how well the person can recognize speech. Depending upon a patient's hearing status and communication needs, he or she may then go on to receive a listening device such as a hearing aid or a cochlear implant and may engage in communication strategies training, auditory training, or speechreading training, or any combination of the three. To the extent that speech recognition performance can be optimized, there will be a concomitant enhancement of conversational fluency and a reduction of hearing-related disability.

The audiogram provides a general description of the magnitude of a patient's hearing loss. However, the audiogram does not adequately portray the communication difficulties an individual may experience or an individual's aural rehabilitation needs. Speech recognition measurement is an important element in assessing how hearing loss affects someone's life and communication interactions.

In this chapter, we will focus on four considerations underlying the assessment of speech recognition: purpose, patient variables, stimuli units, and test procedures (Figure 2–1). Before considering these topics, we will first review the audiogram and other components of the audiological examination. A later chapter, Chapter 12, will present a more in-depth consideration of testing infants and young children.



**FIGURE 2-1** Four variables to consider when assessing speech recognition.

## ● REVIEW OF THE AUDIOLOGICAL EXAMINATION AND THE AUDIOGRAM

A typical audiological assessment includes an audiogram, a determination of speech recognition threshold, and an assessment of speech recognition. Sometimes the examination might entail a determination of most comfortable loudness and uncomfortable loudness levels for speech as well. It is not unusual that a patient receives an audiogram after failing a hearing screening.

## Hearing Screening

Many people experienced their first **hearing screening** in a school setting as children (Figure 2–2), and many adults who work in noisy settings, such as a baggage handler at an airport, routinely receive hearing screenings. The screening may be conducted by an audiologist or another health care professional such as a nurse. It typically occurs in the quietest room available. The purpose of a hearing screening test is to separate individuals into two groups: those who are likely and those who are unlikely to have a hearing loss. A hearing screening entails presenting a limited range of **pure tones** (usually 500–4000 Hz) at only one intensity level (usually 20 decibels hearing level [dB HL]). If an individual fails a hearing screening and is deemed a member of the group that is likely to have a hearing loss, that individual is referred for more in-depth audiological testing.

A **hearing screening** presents a rapid and truncated audiological assessment to a large group of individuals with the goal of identifying those who require additional diagnostic procedures.

A **pure tone** has only one frequency of vibration.



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**FIGURE 2–2** Hearing screenings. Most people undergo their first hearing screening in a school setting as children. Adults who work in a noisy environment, such as a factory or on an airport tarmac, often undergo a hearing screening on an annual basis.

Simple questions that might be asked during a screening procedure:

- Can you hear on the telephone?
- Do people tell you that you set the TV volume too high?
- Do you often ask people to repeat?
- Do you have problems listening in a noisy room?
- Do people seem to mumble?
- Are women and children especially difficult to hear?

## Pure-Tone Audiometry

The audiogram provides a quantitative assessment of an individual's ability to detect sounds. An audiologist typically performs the test, with the use of an **audiometer** (Figure 2–3). The audiometer presents tones and the individual indicates when he or she hears them. The goal is to determine the softest sound level at which the tones can be detected, or the threshold of audibility. A **threshold** is the level of sound so faint that it can be detected only 50% of the time. Hearing threshold levels are typically assessed across a range of **octave** frequencies from 250 to 8000 Hz.

An **audiometer** is an instrument for measuring hearing sensitivity for a range of frequencies.

The level at which sound can be detected only 50% of the time is called a **threshold**.

An **octave** is the interval between two frequencies having a 2 to 1 ratio.

**Impetus for Inventing the Audiometer**

"I can't bear to hear that even my friends should think that I stumbled upon an invention and that there is no more good in me."

—Alexander Graham Bell, whose first invention was the telephone, writing about why he continued to develop and promote new inventions, including the audiometer



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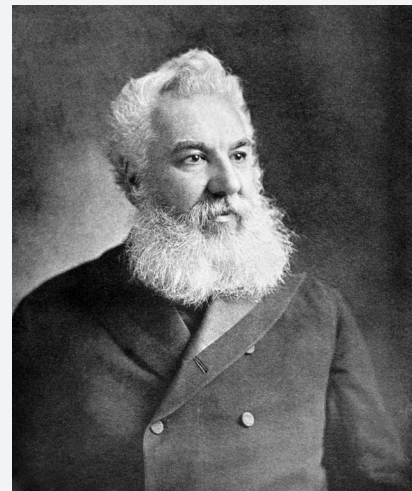


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**FIGURE 2-3** An audiometer and air conduction testing. An audiologist presents tones with an audiometer (upper panel) to a patient who is wearing headphones (lower panel). The patient indicates that he has heard a tone by depressing a response switch.

**Mr. Bell's Other Invention**

Alexander Graham Bell (Figure 2-4), who was married to a woman with significant hearing loss, invented the first audiometer in 1879. It consisted of a pair of induction coils and a telephone receiver. Calibrated frequencies of calibrated intensity could be generated to measure the hearing abilities of individuals. Bell's audiometer revealed "unsuspected vestiges of hearing in many previously classed as totally deaf. Once recognized, even a slight hearing capacity was useful in developing articulation and speechreading. The device also detected hearing impairment in many public school children whose handicap had been taken for stupidity or inattention. In exhibiting his audiometer to the National Academy of Sciences in 1885, Bell reported that of seven hundred pupils whom he and an assistant had tested with it, more than ten percent had some hearing impairment" (Bruce, 1973, p. 394).



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**FIGURE 2-4** Alexander Graham Bell. The first transmission of voice sounds occurred on June 3, 1875. Alexander Graham Bell spoke to his assistant, Thomas Watson, via a diaphragm made of stretched animal membrane.

The tones may be presented by **air conduction**, either through **insert earphones**, supra-aural earphones, or sound field, or by **bone conduction**, through a bone conduction oscillator placed against the skull, either on each mastoid process or the forehead. Air conduction test results indicate hearing losses that might be either conductive (involving the outer or middle ear) or sensorineural (involving the inner ear, eighth nerve) in nature. Bone conduction test results reflect only the sensorineural component. By comparing the air and bone conduction results, the audiologist can determine whether there is hearing loss stemming from a problem in either the outer or the middle ear. The difference between the two sets of thresholds is termed the **air-bone gap**.

Audiological thresholds are plotted on an audiogram, where the y-axis indicates **sound level** (loudness) and the x-axis indicates **frequency** (pitch). As shown in Figure 2–5, an X on the audiogram represents the left-ear and an O represents the right-ear thresholds when the test signals are presented via air conduction. A less-than sign (<) indicates an unmasked bone conduction threshold for the right ear and a left bracket ([) indicates a masked bone conduction threshold. A greater-than sign (>) indicates an unmasked bone conduction threshold for the left ear and a right bracket (]) indicates a masked bone conduction threshold. The capital letter *A* denotes an aided threshold or how the patient hears when wearing a hearing aid. An *R* subscript below the *A* is used to refer to testing with the right hearing aid worn and an *L* subscript is used to refer to testing with the left hearing aid worn. The capital letter *C* denotes a threshold when the patient is wearing a cochlear implant. In this figure, the patient's audiogram indicates that the threshold for 250 Hz is 10 dB HL in the right ear and 55 dB HL in the left ear. As noted in Chapter 1, the pure-tone average (PTA) is often used to denote degree of hearing loss. Table 2–1 indicates the relationship between degree of hearing loss and speech recognition, as a function of the descriptors *mild*, *mild-to-moderate*, *moderate*, *severe*, and *profound*.

Another class of descriptors often assigned to a patient's audiogram is the configuration of the hearing loss. Four common configurations of hearing loss appear in Figures 2–6, 2–7, 2–8, and 2–9, which illustrate a flat configuration of hearing loss, a high-frequency

**Air conduction** refers to when sound travels through the air into the external auditory canal and stimulation progresses through the middle ear, inner ear, and to the brain.

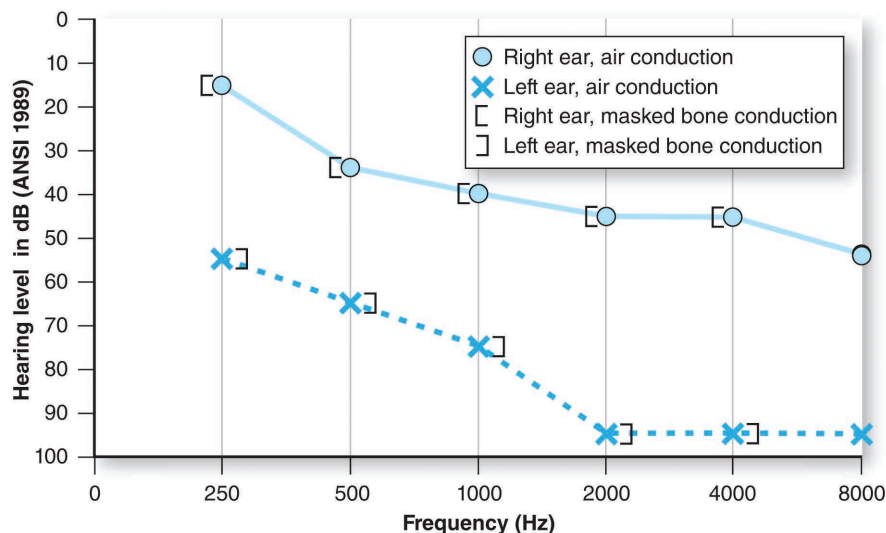
An **insert earphone** is an earphone whose receiver is attached to a tube that leads to an expandable cuff. It can be inserted into the external auditory canal.

**Bone conduction** refers to the transmission of sound through the bones in the body, particularly the skull.

An **air-bone gap** is the difference between air and bone conduction thresholds; a difference may indicate a conductive component in the hearing loss.

**Sound level** is the intensity of sound expressed in decibels.

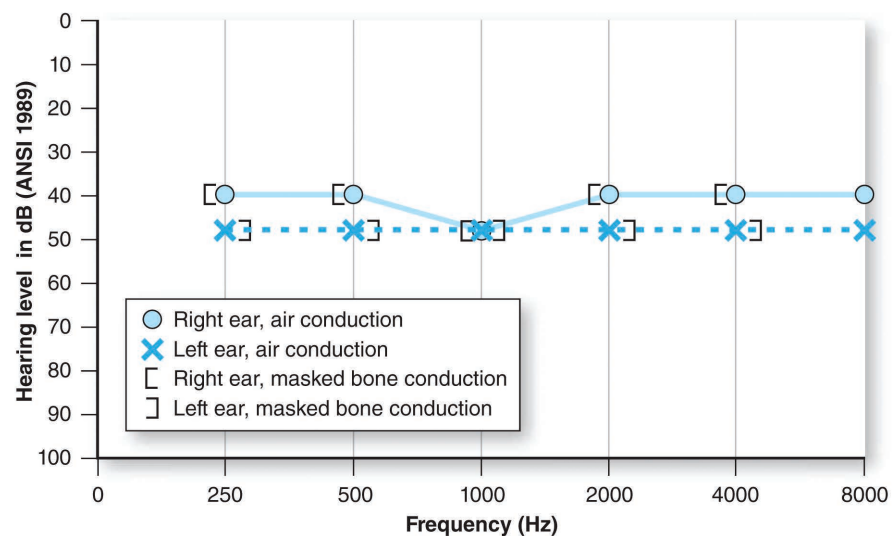
**Frequency** is the number of regularly repeated events in a given unit of time; usually measured in cycles per second and expressed in Hertz (Hz).



**FIGURE 2-5** An audiogram for someone who has a PTA of 40 dB HL in the right ear (a mild hearing loss) and 73 dB HL in the left ear (a severe hearing loss).

**TABLE 2-1** How Degree of Hearing Loss Affects Speech Recognition (Flexer, 1999)

HEARING LOSS	EFFECT ON WORD RECOGNITION
Mild (PTA = 26–40 dB HL)	In quiet situations, speech recognition will be fairly unaffected. In the presence of noise, speech recognition may decrease to 50% words correct if the PTA is 40 dB HL. Consonants are most likely to be missed, especially if the hearing loss involves primarily the high frequencies.
Mild-to-Moderate (PTA = 41–55 dB HL)	The patient will understand much of the speech signal if it is presented in a quiet environment face-to-face, and if the topic of conversation is known and the vocabulary is constrained. If a hearing aid is not used, the individual may miss up to 50–75% of a spoken message if the PTA is 40 dB HL and 80–100% if the PTA is 50 dB HL.
Moderate (PTA = 56–70 dB HL)	If the patient does not use a hearing aid, he or she may miss most or all of the message, even if talking face-to-face. He or she will have great difficulty conversing in group situations.
Severe (PTA = 71–90 dB HL)	The patient may not even hear voices, unless speech is loud. Without amplification, the individual probably will not recognize any speech in an audition-only condition. With amplification, he or she may recognize some speech and detect environmental sounds.
Profound (PTA = 90 dB HL or greater)	The patient may perceive sound as vibrations. An individual will rely on vision as the primary sense for speech recognition. He or she may not be able to detect the presence of even loud sound without amplification.

**FIGURE 2-6** An audiogram for someone who has a flat configuration of hearing loss.

configuration, a low-frequency configuration, and a saucer-shaped configuration of hearing loss, respectively. These configurations may be defined as follows:

- *Flat*: Thresholds are within a 20-dB range of each other across the span of frequencies tested.
- *High-frequency*: Thresholds are within normal range for the low and mid-frequencies, but decline for the higher frequencies. A high-frequency loss may be described as *precipitous* if the loss at each of the higher frequencies is at least 20 dB greater with each ascending frequency. It may be described as *sloping* if thresholds for the higher frequencies are 20 dB or poorer than for the lower frequencies.
- *Low-frequency*: Thresholds are lowered for the low frequencies but are within normal range for the mid-frequencies and higher frequencies.
- *Saucer-shaped*: The loss is confined to the mid-frequencies.