



Clinical Audiology

An Introduction

THIRD EDITION

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Kathryn E. Makowiec and Kaylee J. Smith

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Preface

THIS introductory textbook provides an overview of the broad field of audiology, a clinical profession devoted to the diagnosis and treatment of hearing and balance disorders. The aim of this book is to provide general familiarization with the many different assessment and treatment technologies and to demonstrate how these technologies are integrated into answering the many challenging clinical questions facing an audiologist.

It is the intention of this book to introduce audiology as a clinical profession, to introduce the clinical questions and challenges that an audiologist faces, and to provide an overview of the various technologies that the audiologist can bring to bear on these questions and challenges. It is hoped that this type of approach will be of benefit to all students who might take an introductory course. This book will provide an understanding of the nature of hearing impairment, the challenges in its assessment and treatment, and an appreciation of the existing and emerging technologies related to hearing. For those who will be pursuing the profession of audiology, this book will also provide a basis for more advanced classes in each of the various areas, with the added advantage of a clinical perspective on why and how such information fits into the overall scheme of their professional challenge.

Rather than writing another introductory textbook focused on rudimentary details, we have attempted in this book to provide a big picture of the field of audiology. Our assumptions were that (1) the basics of hearing and speech sciences are covered in other textbooks and in other classes; (2) teaching a basic skill in any one aspect of audiometry is not as useful as a broader perspective; (3) each of the topic areas in this book will be covered in significant depth in advanced classes; and (4) by introducing new students to the broad scope of the field, they will be better prepared to understand the relevance of what they learn later. For the nonaudiology major, this will promote an understanding of the clinical usefulness of audiology, without undue attention to the details of implementation.

In some of the clinical areas, we have included clinical notes that give descriptions of particular techniques that the student might consider using. Knowing that there are as many ways to establish a speech threshold as there are people teaching the technique, for example, we were reluctant to burden the beginning student with arguments about the merits of the various methods. Rather, we used the notes to express an opinion about clinical strategies that we have used successfully. We would expect that the contrary opinions of a professor would serve as an excellent teaching opportunity.

This book is intended primarily for beginning-level students in the fields of audiology and speech-language pathology. It is intended for the first major course in audiology, whether it be at the undergraduate or graduate level. Both intentions challenged the depth and scope of the content, and we can only hope that we reached an appropriate balance.

Over 20 years have passed since the first edition of this textbook. We are excited and inspired by the progress made in hearing health care over those years. When the book was first written, the profession of audiology was just beginning its transition to the doctoral level. Newborn hearing screening had not yet been fully implemented, and we did not yet have clear insight into the diagnosis of auditory neuropathy, third-window disorders, and similar conditions. All of that has changed. Advances on the treatment side have been even more stunning, from the dramatic changes in hearing aid technology and connectivity to the remarkable impact of early cochlear implantation. Although the questions an audiologist faces have not really changed much over the years, the ability to address those questions has changed substantially. We hope that the third edition conveys this progress effectively.

NEW TO THE THIRD EDITION

Additional content includes

- new case studies and enhanced perspectives on avoiding clinical errors;
- new chapters on implants and hearing assistive technologies;
- expanded content on many topics, including the latest advances in hearing aid and implant technologies; and
- new chapter on the assessment of the vestibular system and balance function.



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A number of friends in industry were called on to find us pictures of equipment and hearing instruments. They did, and we appreciate their efforts.

Angie Singh and Valerie Johns at Plural Publishing were responsible for the initial orchestration of this third edition. Their encouragement and patience were remarkable. Christina Gunning aptly saw it to its completion. We are grateful to all at Plural Publishing for their efforts and support.



1

THE PROFESSION OF AUDIOLOGY IN THE UNITED STATES

Chapter Outline

Learning Objectives

What Is an Audiologist?

What Is an Audiologist's Role?

- Identification of Hearing Loss
- Assessment and Diagnosis of Hearing Loss
- Treatment of Hearing Loss
- Assessment and Treatment of Balance Function
- Education
- Prevention
- Research
- Related Activities
- Scope of Practice

Where Do Audiologists Practice?

- Private Practice
- Physician's Practices
- Hospitals and Medical Centers
- Hearing and Speech Clinics
- Schools
- Universities

- Hearing Instrumentation Manufacturers
- Industrial Hearing Conservation

Relation to Other Professions

- Otolaryngology
- Other Medical Specialties
- Speech-Language Pathology
- Nonaudiologist Hearing Aid Dispensers
- Other Practitioners

The Evolution of Audiology

- The Professional Heritage of Audiology
- The Clinical Heritage of Audiology

Professional Requirements

- Becoming an Audiologist
- Academic and Clinical Requirements

Summary

Discussion Questions

Resources

Organizations

LEARNING OBJECTIVES

After reading this chapter, you should be able to:

- Define the profession of audiology.
- Describe the numerous roles and activities that are included in the scope of practice for audiologists.
- Describe the various environments in which audiologists typically practice.
- Explain how audiology relates to other professions and medical specialties.
- Describe how the field of audiology has changed and evolved since its inception.
- Identify and explain the qualifications audiologists possess that demonstrate competence to practice.
- Describe the components of audiologic academic and clinical education.

A **hearing disorder** is a disturbance of the function of hearing.

A **communication disorder** is an impairment resulting from a speech, language, or hearing disorder.

Electrophysiologic refers to measuring the electrical activity of the brain and body.

The portion of the ear from the tympanic membrane (or eardrum) to the oval window is called the **middle ear**.

The **inner ear** contains the sensory organs of hearing.

The portion of the hearing mechanism from the auditory nerve to the auditory cortex is called the **central auditory nervous system**.

AUDIOLOGY is the health care profession devoted to hearing. It is a clinical profession that has as its unique mission the evaluation of hearing ability and the treatment of impairment that results from **hearing disorders**. Most practitioners in the field of audiology practice their profession in health care settings or in private practice. Others practice in educational settings, rehabilitation settings, and industry. Regardless of setting, the mission of the audiologist is the prevention of hearing loss, diagnosis of hearing loss, and treatment of **communication disorders** that may result from hearing loss. Specifically, audiologists play a crucial role in early identification of hearing impairment in infants, assisting in the medical evaluation of auditory disorders, evaluation of hearing ability in people of all ages, and assessment of communication disorders that may result from hearing impairment. In addition, audiologists evaluate the need for hearing devices and assess, fit, and dispense hearing aids, implantable technology, and other assistive listening devices. Audiologists are also involved in post-fitting treatment and in educational programming and facilitation. Many audiologists also carry out testing designed to quantify balance function and treat balance dysfunction.

Relative to many health professions, audiology is a young profession. Its roots took hold following World War II, when clinics were developed to test the hearing of soldiers returning from the front lines who developed hearing loss as a result of exposure to excessively loud sounds. In those days, audiologic services consisted of measuring how much hearing impairment was present and providing instruction in lipreading and auditory rehabilitation. Hearing aid technology was in its early stages of development. If we fast-forward to today, the profession's capacity to meet the challenges of hearing loss have increased dramatically.

Today, using **electrophysiologic** techniques, audiologists screen the hearing of infants on their first day of life. They routinely assess **middle ear** function, **inner ear** function, and **central auditory nervous system** function with ever-evolving understanding. Questions about hearing aid amplification now go well beyond that of yes or no. Audiologists can measure, with great precision, the amount of amplification delivered to an eardrum. And they can alter that amplification and other hearing technologies in a number of ways to tailor them to the degree and nature of an individual's hearing loss and accommodate the personal preferences and desires of most patients.

But the main questions about the assessment and treatment of hearing loss remain the same:

- Does a hearing loss exist?
- What is the extent of the hearing loss?
- Is the dysfunction of the auditory system a symptom of an underlying medical disorder?
- Is the loss causing impairment in communication ability?
- Can the impairment be overcome to some extent with hearing aid amplification, implantable technology, or other hearing assistive technologies?
- What are the specific technology needs of the patient?
- How can success with this technology be verified?
- How much additional treatment is necessary?

These questions form the basis for the profession of audiology. They encompass the issues that represent the unique purview of the profession. Increasingly, audiologists are involved in the diagnosis and treatment of disorders relating to balance, particularly those involving the **vestibular** system. The clinical questions pertaining to those disorders are described in detail in Chapter 18.

WHAT IS AN AUDIOLOGIST?

An audiologist is a professional who, by virtue of academic degree, clinical education, and appropriate licensure or other credential, is uniquely qualified to provide a comprehensive array of professional services relating to the prevention of hearing loss and the audiologic identification, diagnosis, and treatment of patients with impairments in hearing and balance function.

According to the American Academy of Audiology (AAA) Scope of Practice, “An audiologist is a person who, by virtue of academic degree, clinical training, and license to practice and/or professional credential, is uniquely qualified to provide a comprehensive array of professional services related to the prevention of hearing loss and the audiologic identification, assessment, diagnosis, and treatment of persons with impairment of auditory and vestibular function, and to the prevention of impairments associated with them.”

According to the American Speech-Language-Hearing Association (ASHA) Scope of Practice, “Audiologists are professionals engaged in autonomous practice to promote healthy hearing, communication competency, and quality of life for persons of all ages through the prevention, identification, assessment, and rehabilitation of hearing, auditory function, balance, and other related systems.”

The **vestibular** system is a biological system that, in conjunction with vision and proprioception, functions to maintain balance and equilibrium.

The audiologist may play a number of different roles:

- clinician,
- teacher,
- research investigator,
- administrator, and
- consultant.

The audiologist provides clinical and academic training in all aspects of hearing impairment and its treatment to students of audiology and personnel in medicine, nursing, and other related professions.

WHAT IS AN AUDIOLOGIST'S ROLE?

The central focus of audiology is auditory impairment and its relationship to disordered communication. The audiologist identifies, assesses, diagnoses, and treats individuals with impairments of hearing function. The audiologist also evaluates and fits hearing aids and assists in the implementation of other forms of hearing loss treatment. The audiologist may also play a role in the diagnosis and treatment of individuals with impairments of vestibular function.

Identification of Hearing Loss

The audiologist develops and oversees hearing screening programs designed to detect hearing loss in patients. Although identification programs are used in patients of all ages, they are most commonly used to identify hearing loss in infants, children entering school, adults working in noisy environments, and aging patients. An audiologist may also screen for speech and language disorders to identify and refer patients with other communication disorders.

Assessment and Diagnosis of Hearing Loss

The audiologist serves as the primary expert in the assessment and audiologic diagnosis of auditory impairment. Assessment includes, but is not limited to, the administration and interpretation of **behavioral**, electroacoustic, and electrophysiologic measures of the function of the **peripheral** and central **auditory nervous systems**. Evaluation typically involves assessment of both the type of hearing loss and the extent or degree of hearing loss. The evaluation process reveals whether a hearing loss is of a type that can be medically treated with surgery or drugs or of a more permanent type that can be treated with personal amplification or other implantable technology. Once the nature of the loss is determined, the extent of the impairment is evaluated in terms of both **hearing sensitivity** and the ability to use hearing for the perception of speech. Results of this evaluation are then placed into the context of the patient's lifestyle and communication demands to determine the extent to which a loss of hearing has become an impairment and might impact communication function.

Behavioral measures pertain to the observation of the activity of a person in response to some stimuli.

Nerve endings in the inner ear and the VIIIth nerve constitute the **peripheral auditory nervous system**.

Hearing sensitivity is the ability of the ear to detect faint sound.

Treatment of Hearing Loss

Academic preparation and clinical experience qualify the audiologist to provide a full range of auditory treatment services to patients of all ages. Treatment services include those relating to hearing aids, **cochlear** and other **implants**, hearing assistive technologies, audiologic rehabilitation, cerumen removal, and tinnitus management.

The audiologist is the primary individual responsible for the evaluation and fitting of all types of amplification devices, including hearing aids and hearing assistive technologies. The audiologist determines whether the patient is a suitable candidate for amplification devices, evaluates the benefit that the patient may expect to derive, and recommends an appropriate system to the patient. In conjunction with these recommendations, the audiologist will take ear impressions, fit the hearing-aid devices, provide counseling regarding their use, dispense the devices, and monitor progress with the hearing aids.

The audiologist is also the primary individual responsible for the audiologic evaluation of candidates for cochlear implants. Cochlear implants provide direct electrical stimulation to the inner ear of hearing, or the **cochlea**, and to the **neural system** of hearing. They are used for individuals who do not obtain sufficient benefit from hearing aid amplification, usually those with **severe-to-profound hearing loss**. Prior to implant surgery, the audiologist carries out audiologic testing to determine patient candidacy and provides counseling to the candidate and family members about appropriateness of implantation and viability of other amplification options. After implant surgery, the audiologist is responsible for programming implant devices, providing **auditory training** and other treatment services, troubleshooting and maintaining implant hardware, and counseling implant users, their families, and other professionals such as teachers.

The audiologist also provides treatment services and education to individuals with hearing impairment, family members, and the public. The audiologist provides information pertaining to hearing and hearing loss, the use of **prosthetic devices**, and strategies for improving speech recognition by exploiting auditory, visual, and tactile avenues for information processing. The audiologist also counsels patients regarding the effects of auditory disorder on communicative and psychosocial status in the personal, social, and vocational arenas.

Assessment and Treatment of Balance Function

Assessment of balance function encompasses several aspects of the biological system, including the vestibular system. In some cases, audiologists may evaluate and treat the entire balance system. More typically, audiologists focus on evaluation of the vestibular system. Assessment of the vestibular system includes administration and interpretation of behavioral and electrophysiologic tests of function of the system. Audiologists may also be involved in the treatment of patients with vestibular disorders as participants in multidisciplinary balance teams that recommend

A **cochlear implant** is a device that is implanted in the inner ear to provide hearing for individuals with severe-to-profound hearing loss.

The portion of the inner ear that consists of a fluid-filled shell-like structure is called the **cochlea**.

A **neural system** is a system containing nerve cells, in this case the VIIIth cranial nerve or auditory nerve.

A hearing loss of 70 dB HL or greater is called a **severe-to-profound hearing loss**.

Auditory training is a rehabilitation method designed to train people to use their remaining hearing.

A device that assists or replaces a missing or dysfunctional system is called a **prosthetic device**.

and carry out treatment and rehabilitation of patients with vestibular function impairments.

Education

Audiologists may provide clinical and academic education in audiology. Audiologists teach audiology students, physicians, medical students, medical residents, fellows, and other students about the auditory and vestibular systems and their disorders. They may also be involved in educating the public, the business community, and related industries about hearing and balance, hearing loss and disability, prevention of hearing loss, and treatment strategies, particularly those pertaining to hearing aids and other assistive devices. In the field often referred to as forensic audiology, audiologists may also serve as expert witnesses in court cases, which usually involve issues pertaining to the nature and extent of hearing loss caused by some compensable action.

Audiologists involved in educational settings administer screening and evaluation programs in schools to identify hearing impairment and ensure that all students receive appropriate follow-up and **referral** services. The audiologist also trains and supervises nonaudiologists who perform hearing screening in educational settings. The audiologist serves as the resource for school personnel in matters pertaining to classroom acoustics, assistive listening systems, and communicative strategies. The audiologist maintains both classroom assistive systems and personal hearing devices. The audiologist serves on the team that makes decisions concerning an individual child's educational setting and special requirements. The audiologist also participates actively in the management of all children with hearing disorders of all varieties in the educational setting.

Prevention

The audiologist designs, implements, and coordinates industrial and military hearing conservation programs in an effort to prevent hearing loss that may occur from exposure to excessively loud noises. These programs include identification and amelioration of hazardous noise conditions, identification of hearing loss, employee education, the fitting of personal hearing protection, and training and supervision of nonaudiologists performing hearing screening in the industrial setting.

Research

The audiologist may be actively involved in the design, implementation, and measurement of the effectiveness of clinical research activity relating to hearing loss assessment and treatment.

Related Activities

Some audiologists, by virtue of employment setting, education, experience, and personal choice, may engage in other health care activities related to the profession. For example, some audiologists practice in hospital operating rooms, where **multimodality sensory evoked potentials** are used to monitor the function of sensory systems during surgery. In such settings, an audiologist administers and

Referral means to direct someone for additional services.

Multimodality sensory evoked potentials is a collective term used to describe the measurement of electrical activity of the ears, eyes, and other systems of the body.

interprets electrophysiologic measures of the integrity of sensory and motor neural function, typically during neurosurgery.

Scope of Practice

It is incumbent on all professions to define their boundaries. They must delineate the professional activities that lie within their education and training and, by exclusion, the activities outside their territory. Audiology scope of practice and standards of practice, from the American Academy of Audiology, are included in Appendix A.

It is important to understand scope of practice issues. Audiology is an autonomous profession. As long as audiologists are practicing within their boundaries, they are acting as experts in their field. Decisions about diagnostic approaches and about hearing aids and other treatment strategies are theirs to make. A patient with a hearing loss can choose to enter the health care door through the audiologist, without referral from a physician or other health care provider. This is a very important responsibility to have and to uphold. Audiologists should be very familiar with their scope of practice along with their code of ethics.

Defining the scope of practice for any profession remains a fairly dynamic process. For example, many years ago in the 1970s, official scope of practice guidelines for the profession of audiology did not delineate the **dispensing of hearing aids** as being within the scope of the profession. Because the dispensing of hearing aids was such a natural extension of the central theme of the profession, audiologists began expanding their practices into this area. Soon, it became a common part of professional practice, and today dispensing hearing aids is considered an integral part of an audiologist's responsibilities.

Professional practices have also expanded in other ways. One example of an expanded activity is in the area of ear canal inspection and **cerumen** management. In order to evaluate hearing, make **ear impressions**, and fit hearing protection devices and hearing aids, the ear canals of patients need to be relatively free of debris and excessive cerumen. **Otosopic** examination and external ear canal management for cerumen removal are a routine part of most audiologists' practices.

Another example is in the assessment of vestibular function. The most common type of testing is called **videonystagmography/electronystagmography**, or VNG/ENG. Today, VNG/ENG testing is commonplace in audiology offices and is considered an integral part of the scope of practice.

A further example of expanding roles is in the area of auditory electrophysiology. Since the late 1970s, audiologists have used what are termed *electrophysiologic procedures* to estimate hearing ability in infants and other patients who could not cooperate with behavioral testing strategies. The main electrophysiologic procedure is termed the **auditory brainstem response** (ABR). This technique measures electrical activity of the brain in response to sound and provides an objective assessment of hearing ability. Audiologists have embraced this technology as an

Approximately 85% of all audiologists today in the United States **dispense hearing aids**.

Cerumen is earwax, the waxy secretion in the external ear canal. When it accumulates, it can become impacted and block the external ear canal.

An **ear impression** is a cast made of the ear and ear canal for creating a customized earplug or hearing aid.

Otosopic pertains to an otoscope. An **otoscope** is an instrument used to visually examine the ear canal and eardrum.

Videonystagmography/electronystagmography measures eye movements to assess vestibular (balance) function.

An **auditory brainstem response** is an electrophysiologic response to sound that represent the neural function of auditory brainstem pathways.