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Twelfth Edition

INTRODUCTION TO AUDIOLOGY

FREDERICK N. MARTIN | JOHN GREER CLARK

Introduction to Audiology

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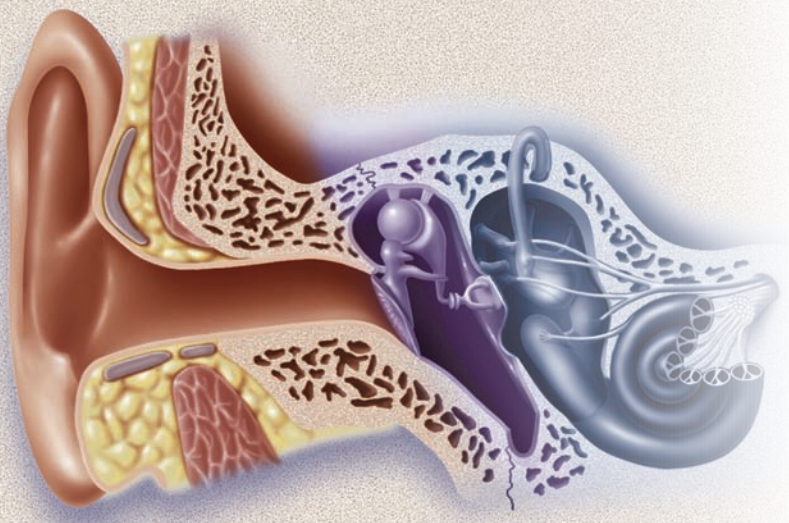

Introduction to Audiology

TWELFTH EDITION

Frederick N. Martin
The University of Texas at Austin

John Greer Clark
University of Cincinnati
Clark Audiology, LLC

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PEARSON

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To Cathy, my wife and best friend for almost six decades, for her support, encouragement, and love. To my son David, an anesthesiologist, who, with his generosity of spirit, does great good both within and outside the practice of medicine. To my daughter, Leslie Anne, a professional in human resources whose talents include a large measure of humanity, and who is a wonderful and sweet friend. To my daughter-in-law, April, an attorney and managed-care professional who leads a large network of hospitals. To my dear friend and colleague of nearly 60 years, Dr. Mark Ross, for his many contributions to audiology. To my many students and teaching assistants, especially Dr. John Greer Clark, who made mine a marvelous career. Finally, to my magnificent rescue dogs, Fearless-Bluedog and Gaia, who fill my life with joy, and to the memories of Decibelle and Compass Rose, whose presence on this earth blessed every day.

FNM

To my wife and partner, Suzanne, and our children and petite-fille, who make everything worthwhile; to Kitty, my first and favorite editor, good friend and mother; and to my students, who continue to challenge and teach me.

JGC

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Brief Contents

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About the Authors

Frederick N. Martin

Following a four-year enlistment in the U.S. Air Force, Frederick Martin returned to college to complete his bachelor's and master's degrees and embarked on a career as a clinical audiologist. After eight years of practice, he returned to graduate school and earned his Ph.D., then he joined the faculty at The University of Texas at Austin, where he taught and did research for 38 years. He is now the Lillie Hage Jamail Centennial Professor Emeritus in Communication Sciences and Disorders.

In addition to the twelve editions of *Introduction to Audiology,* six of which were co-authored by Dr. John Greer Clark, Martin has authored seven books, co-authored another seven, edited thirteen, and co-edited three. He has written 24 chapters for edited texts, 122 journal articles, 104 convention or conference papers, and 5 CD-ROMs. He served as a reviewer for the most prominent audiology journals and for years co-edited *Audiology: A Journal for Continuing Education*.

During his tenure at The University of Texas, Martin won the Teaching Excellence Award of the College of Communication, the Graduate Teaching Award, and the Advisor's Award from the Texas Alumni Association. The National Student Speech-Language-Hearing Association named him Professor of the Year in Communication Sciences and Disorders at The University of Texas for 2002–2003. He was the 1997 recipient of the Career Award in Hearing from the American Academy of Audiology, and in 2006, he was the first to receive the Lifetime Achievement Award from the Texas Academy of Audiology. In 2009, Martin was honored by the Arkansas Hearing Society with the Thomas A. LeBlanc Award. His book, *Introduction to Audiology,* was a finalist for the prestigious Hamilton Book Award of The University of Texas in 2006. He is a Fellow of the American Academy of Audiology and the American Speech-Language-Hearing Association and is an Honorary Lifetime Member of the American Speech-Language-Hearing Association and the Texas Speech-Language Hearing Association, and was the first and remains the only recipient of Honorary Lifetime Membership in the Austin Audiology Society.

The College of Communication of The University of Texas at Austin established the Frederick N. Martin Endowed Scholarship in 2011. Funds from this scholarship are awarded annually to an outstanding graduate student at The University who plans to pursue a career in audiology. The scholarship is designed to continue in perpetuity.

John Greer Clark

Dr. Clark received his bachelor of science from Purdue University and his master's degree from The University of Texas at Austin. Following postgraduate studies at Louisiana State University, he completed his doctoral degree at the University of Cincinnati.

A recipient of both the Prominent Alumni and Distinguished Alumnus Awards from the University of Cincinnati and the Honors of the Ohio Speech and Hearing Association, Dr. Clark was elected a Fellow of the American Speech-Language-Hearing Association in 1996. He is a Past President of the Academy of Rehabilitative Audiology, Past Chair of the American Board of Audiology, and a Fellow of the American Academy of Audiology. He served four years on the Board of Directors of the American Academy of Audiology and the Ohio Academy of Audiology, and, with his wife, was co-founder of the Midwest Audiology Conference, which subsequently evolved into separate conferences for the states of Indiana, Ohio, and Kentucky.

A presenter at local, national, and international association meetings and conventions, Dr. Clark has served as faculty for the Ida Institute, and as associate editor, editorial consultant, and reviewer for a number of professional journals. His more than 100 publications include three edited textbooks, a variety of co-authored texts, two single-authored books, 15 book chapters, and a range of journal articles on various aspects of communication disorders. His current research interests are within the areas of adult audiologic rehabilitation, audiologic counseling, and animal audiology.

Dr. Clark's professional career started with the Louisiana Department of Health and Human Resources, where he served as audiologist for the Handicapped Children's Program and coordinator for the Geriatric Pilot Project in Communicative Disorders. He was an Assistant Clinical Professor within the Department of Otolaryngology and Maxillofacial Surgery at the University of Cincinnati Medical Center before embarking on a successful private practice, which he left after 15 years to serve as the Director of Clinical Services of Helix Hearing Care of America. Currently, he is an Associate Professor in Communication Sciences and Disorders at the University of Cincinnati; a Faculty Fellow of the Ida Institute in Naerum, Denmark; a visiting professor at the University of Louisville; and president of Clark Audiology, LLC.

Preface

The founders of audiology could not have envisioned the many ways in which this profession would evolve to meet the needs of children and adults with hearing and balance disorders. Breakthroughs continue to come in all areas of audiological diagnosis and treatment, resulting in a profession that is more exciting and rewarding today than ever before.

Treatment is the goal of audiology, and treatment is impossible without diagnosis. Some people have developed the erroneous opinion that audiology is all about doing hearing tests. Surely, testing the hearing function is essential; however, it might appear that many tests could be performed by technical personnel who lack the education required to be total hearing healthcare managers. Historically, the profession has rejected this approach and has developed a model wherein one highly trained, self-supervised audiologist carries the patient and family from taking a personal history through diagnosis and into management. Toward this end, the development of a humanistic, relationship-centered, patient–professional approach to hearing care has evolved, one in which the audiologist guides patients and families to the highest success levels possible.

The profession has moved away from requiring a master's degree to requiring the Doctor of Audiology (AuD) as the entry-level degree for those wishing to enter the profession of audiology. This is due in part to recognition of the fact that additional education and training are necessary for those practicing audiology so that they can meet the demands of an expanding scope of practice and continuing technological growth.

New to This Edition

With each new edition of this book, we strive not only to update the material to keep content current with recent research, but also to make it more user-friendly for students. Although a great deal of advanced material has been added, the primary target of this book continues to be the new student in audiology. While providing an abundance of how-to information, every effort is made to reveal to the novice that audiology can be a rewarding and fascinating career. In this edition, a number of features have been added or enhanced, including:

- Expansion of the Evolving Case Studies to include more cases.
- A new list of frequently asked questions (FAQs) in each chapter. These lists are derived from students' actual queries in class and during instructor office hours.
- Updated references to reflect the most recent research.

In addition, for the first time, *Introduction to Audiology* is available in a whole new format as an eText. The advantages provided in this electronic version are numerous.

The eText Advantage

Publication of *Introduction to Audiology* in an eText format allows for several advantages over a traditional print format. In addition to greater affordability, this format provides a search function that allows the reader to locate coverage of concepts efficiently. **Bold** key terms are clickable and take the reader directly to the glossary definition. Index entries are also hyperlinked and take the reader directly to the relevant page of the text. Navigation to particular sections of the book is also possible by clicking on desired sections within the expanded table of contents. Sections of text may be highlighted and reader notes can be typed onto the page for enhanced review at a later date.

All websites provided are now active eText links to aid interested readers in additional research on a topic. It should be noted that neither the authors nor Pearson Education endorse or approve, nor are they responsible for, the content of any third-party website linked to this text. The authors and Pearson Education make no representations as to the content or accuracy of any linked websites.

To further enhance assimilation of new information, links to 20 video clips are interspersed throughout the text and are available through the eText. These video clips demonstrate different aspects of audiological practice. They include illustration of otoscopic technique and basic hearing test procedures, as well as more advanced electroacoustic and electrophysiologic tests, earmold impression technique, hearing aid assessment measures, and more.

At the end of each chapter, readers can access interactive eText multiple-choice Check Your Understanding questions to assess comprehension of text concepts as well as a variety of Activities designed to facilitate learning. Immediate feedback is provided on the appropriateness of responses. We believe use of this material can increase confidence in preparation for examinations and other challenges. In their diagnostic form, these questions and activities can help identify points of knowledge and areas of weakness or knowledge gaps to direct students in their review of materials.

It is our hope that this new eText format will enrich the student's learning experience and further enhance the learning process. To learn more about the enhanced Pearson eText, go to www.pearsonhighered.com/etextbooks.

How to Use This Book

Throughout this book's history of nearly four decades, its editions have been used by individuals in classes ranging from introductory to advanced levels. Students who plan to enter the professions of audiology, speech-language pathology, and education of children with hearing impairment have used it. All of these individuals are charged with knowing all they can learn about hearing disorders and their ramifications. To know less is to do a disservice to those children and adults who rely on professionals for assistance.

The chapter arrangement in this book differs somewhat from most audiology texts in several ways. The usual approach is to present the anatomy and physiology of the ear first, and then to introduce auditory tests and remediation techniques. After an introduction to the profession of audiology, this book first presents a superficial look at how the ear works. With this conceptual beginning, details of auditory tests can be understood as they relate to the basic mechanisms of hearing. Thus, with a grasp of the test principles, the reader is better prepared to benefit from the many examples of theoretical test results that illustrate different disorders in the auditory system. Presentations of anatomy and physiology, designed for greater detail and application, follow the descriptions of auditory disorders.

The organization of this book has proved useful because it facilitates early comprehension of what is often perceived as difficult material. Readers who wish a more traditional approach may simply rearrange the sequence in which they read the chapters. Chapters 9 through 12, on the anatomy, physiology, disorders, and treatments of different parts of the auditory apparatus, can simply be read before Chapters 4 through 8 on auditory tests. At the completion of the book, the same information will have been covered.

The teacher of an introductory audiology course may feel that the depth of coverage of some subjects in this book is greater than desired. If this is the case, the primary and secondary headings allow for easy identification of sections that may be deleted. If greater detail is desired, the suggested reading lists at the end of each chapter can provide more depth. The book may be read in modules so that only specified materials are covered.

Each chapter in this book begins with an introduction to the subject matter and a statement of instructional objectives. Liberal use is made of headings, subheadings, illustrations, and figures. A summary at the end of each chapter repeats the important portions. Terms that may be new or unusual appear in **bold** print and are defined in the book's comprehensive glossary. Review tables summarize the high points within many chapters. Readers wishing to test their understanding of different materials may find the questions at the end of each chapter useful. For those who wish to test their ability to synthesize what they learn and solve some practical clinical problems, the Evolving Case Studies in selected chapters provide this opportunity. The indexes at the back of this book are intended to help readers to find desired materials rapidly.

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The authors would like to express their appreciation to Christina Robb for guiding us through the process of updating and converting *Introduction to Audiology* from print to digital format. The authors would also like to express their appreciation to the reviewers of this edition: Frank Brister, Stephen F. Austin State University; Nancy Datino, Mercy College; John Ribera, Utah State University; and Renee Shellum, Minnesota State University–Mankato. We also want to thank John Shannon at Jouve North America, who oversaw the many details involved getting from manuscript to finished product. Finally, we want to thank Steve Dragin who served as executive editor for well over a dozen of our books. We will miss his guidance and wish him great success in all future endeavors.

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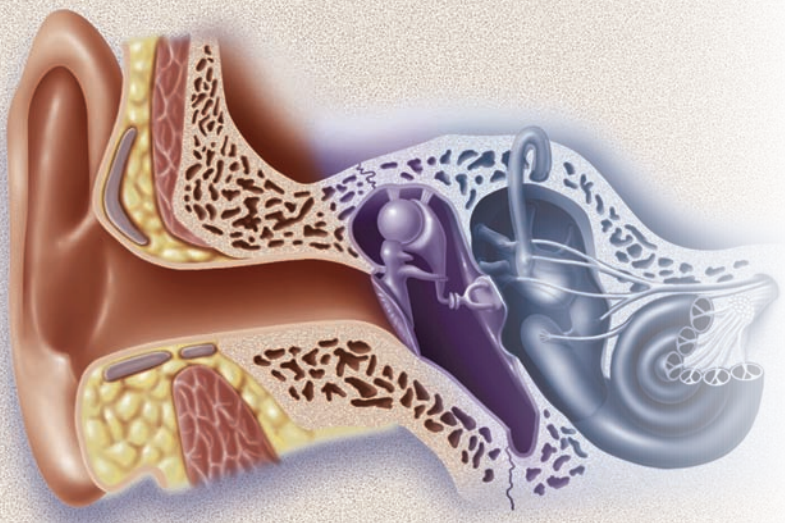
Contents

Introduction to Audiology

PART I

ELEMENTS OF AUDIOLOGY

The first part of this book requires no foreknowledge of audiology. Chapter 1 presents an overview of the profession of audiology, its history, and directions for the future. Chapter 2 is an elementary look at the anatomy of the auditory system to the extent that basic types of hearing loss and simple hearing tests can be understood. Oversimplifications are clarified in later chapters. Tuning-fork tests are described here for three purposes: first, because they are practiced today by many physicians; second, because they are an important part of the history of the art and science of audiology; and third, because they illustrate some fundamental concepts that are essential to understanding contemporary hearing tests. Chapter 3 discusses the physics of sound and introduces the units of measurement that are important in performing modern audiologic assessments. Readers who have had a course in hearing science may find little new information in Chapter 3 and may wish to use it merely as a review. For those readers for whom this material is new, its comprehension is essential for understanding what follows in this text.



CHAPTER 1

The Profession of Audiology

LEARNING OBJECTIVES

The purpose of this opening chapter is to introduce the profession of audiology, from its origins through its course of development to its present position in the hearing-healthcare delivery system. At the completion of this chapter, the reader should be able to

- Describe the evolution of audiology as a profession.
- Discuss the impact of hearing impairment on individuals and society.
- List specialty areas within audiology and the employment settings within which audiologists may find themselves.
- Describe the reasons that speech-language pathologists may interact closely with audiologists as they provide services within their chosen professions.

THE PROFESSION OF AUDIOLOGY has grown remarkably since its inception only a little more than 70 years ago. What began as a concentrated effort to assist hearing-injured veterans of World War II in their attempts to reenter civilian life has evolved into a profession serving all population groups and all ages through increasingly sophisticated diagnostic and rehabilitative instrumentation. The current student of audiology can look forward to a future within a dynamic profession, meeting the hearing needs of an expanding patient base.

The Evolution of Audiology

Prior to World War II, hearing-care services were provided by physicians and commercial hearing aid dealers. Because the use of hearing protection was not common until the latter part of the war, many service personnel suffered the effects of high-level noise exposure from modern weaponry. The influx of these service personnel reentering civilian life created the impetus for the professions of **otology** (the medical specialty concerned with diseases of the ear) and speech pathology (now referred to as **speech-language pathology**) to work together to form military-based **aural rehabilitation** centers.

These centers met with such success that, following the war, many of the professionals involved in the programs' development believed that their services should be made available within the civilian sector. It was primarily through the efforts of the otologists that the first rehabilitative programs for those with hearing loss were established in communities around the country, but it was mainly those from speech-language pathology, those who had developed the audiometric techniques and rehabilitative procedures of the military clinics, who staffed the emerging community centers (Henoch, 1979).

Audiology developed rapidly as a profession distinct from medicine in the United States. While audiology continues to evolve outside the United States, most professionals practicing audiology in other countries are physicians, usually otologists. Audiometric technicians in many of these countries attain competency in the administration of hearing tests; however, it is the physician who dictates the tests to be performed and solely the physician who decides on the management of each patient. Some countries have developed strong academic audiology programs and independent audiologists, like those in the United States, but, with the exception of geographically isolated areas, most audiologists around the globe look to American audiologists for the model of autonomous practice that they wish to emulate.

The derivation of the word *audiology* is itself unclear. No doubt purists are disturbed that a Latin root, *audire* (to hear), was fused with a Greek suffix, *logos* (the study of), to form the word *audiology*. It is often reported that *audiology* was coined as a new word in 1945 simultaneously, yet independently, by Captain Raymond Carhart[1] and Dr. Norton Canfield, both active in the establishment of military aural rehabilitation programs. However, a course established in 1939 by the Auricular Foundation Institute of Audiology entitled "Audiological Problems in Education" and a 1935 instructional film developed under the direction of Mayer Shier titled simply *Audiology* clearly predate these claims (Skafte, 1990). Regardless of the origin of the word, an audiologist today is defined as an individual 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 audiologic identification, assessment, diagnosis, and treatment of persons with impairment of auditory and vestibular function, and to the prevention of impairments associated with them" (American Academy of Audiology, 2004).

Academic Preparation in Audiology

In the United States, educational preparation for audiologists evolved as technology expanded, leading to an increasing variety of diagnostic procedures and an expanded professional scope of practice (American Academy of Audiology, 2004; American Speech-Language-Hearing Association, 2004b). Audiology practices have grown to encompass the identification of hearing loss, the differential diagnosis of hearing impairment, and the nonmedical treatment of hearing impairment and balance disorders. What began as a profession with a bachelor's level preparation quickly transformed into a profession with a required minimum of a master's degree to attain a state license, now held forth as the mandatory prerequisite for clinical

practice in most states. More than a quarter of a century ago, Raymond Carhart, one of audiology's founders, recognized the limitations imposed by defining the profession at the master's degree level (Carhart, 1975). Yet it was another 13 years before a conference, sponsored by the Academy of Dispensing Audiologists, set goals for the profession's transformation to a doctoral level (Academy of Dispensing Audiologists, 1988).

In recent years academic programs have transitioned to the professional doctorate for student preparation in audiology, designated as the doctor of audiology (Au.D.). At most universities, the Au.D. comprises four years of professional preparation beyond the bachelor's degree, with heavy emphasis on didactic instruction in the early years gradually giving way to increasing amounts of clinical practice as students progress through their programs. The final (fourth) year consists of a full-time clinical placement usually in a paid position.

Although the required course of study to become an audiologist remains somewhat heterogeneous, course work generally includes hearing and speech science, anatomy and physiology, fundamentals of communication and its disorders, counseling techniques, electronics, computer science, and a range of course work in diagnostic and rehabilitative services for those with hearing and balance disorders. Through this extensive background, university programs continue to produce clinicians capable of making independent decisions for the betterment of those they serve.

Licensing and Certification

The practice of audiology is regulated in the United States through license or registration in every state of the union and the District of Columbia. Such regulation ensures that audiology practitioners have met a minimum level of educational preparation and, in many states, that a minimum of continuing study is maintained to help ensure competencies remain current. A license to practice audiology or professional registration as an audiologist is a legal requirement to practice the profession of audiology. Licensure and registration are important forms of consumer protection, and loss or revocation of this documentation prohibits an individual from practicing audiology. To obtain an audiology license, one must complete a prescribed course of study, acquire approximately 2,000 hours of clinical practicum, and attain a passing score on a national examination in audiology.

In contrast to state licensure and registration, certification is not a legal requirement for the practice of audiology. Audiologists who choose to hold membership in the American Speech-Language-Hearing Association (ASHA) are required by ASHA to hold the Certificate of Clinical Competence in Audiology, attesting that a designated level of preparation as an audiologist has been met and that documented levels of continuing education are maintained throughout one's career. Many audiologists select certification from the American Board of Audiology as a fully voluntary commitment to the principles of lifelong continuing education. ABA certification is an attestation that one holds him- or herself to a higher standard than may be set forth by professional associations or in the legal documents of licensure or registration.

The use of support personnel within a variety of practice settings is growing. The responsibilities of these "audiologist assistants" have been delineated by the American Academy of Audiology (1997). Licensing laws in nearly half of the states define permitted patient care assignments for audiology assistants. Assistants can be quite valuable in increasing practice efficiency and meeting the needs of a growing population with hearing loss. It is audiologists' responsibility to ensure that their assistants have the proper preparation and training to perform assigned duties adequately.

Prevalence and Impact of Hearing Loss

Although the profession of audiology was formed under the aegis of the military, its growth was rapid within the civilian sector because of the general prevalence of hearing loss and the devastating impact that hearing loss has on the lives of those affected. The reported prevalence of hearing loss varies somewhat depending on the method of estimation (actual evaluation of a population segment or individual response to a survey questionnaire), the criteria used to define hearing loss, and the age of the population sampled. However, following the world health organization's definition for hearing loss, prevalence in the United States may be as high as 30 million Americans with hearing loss in both ears or as many as 48 million with hearing loss in at least one ear (see Table 1.1).

The **prevalence** of hearing loss increases with age, and it has been estimated that the number of persons with hearing loss in the United States over the age of 65 years will reach nearly 13 million by 2015. The number of children with permanent hearing loss is far lower than the number of adults. However, the prevalence of hearing loss in children is almost staggering if we consider those children whose speech and language development and academic performances may be affected by mild transient ear infections so common among children. While not all children have problems secondary to ear pathologies, 75 percent of children in the United States will have at least one ear infection before 3 years of age (National Institute on Deafness and Other Communication Disorders, 2010a).

For children with recurrent or persistent problems with ear infections, the developmental impact may be significant. Studies have shown that children prone to ear pathologies may lag behind their peers in articulatory and phonological development, the ability to receive and express thoughts through spoken language, the use of grammar and syntax, the acquisition of vocabulary, the development of auditory memory and auditory perception skills, and social maturation (Clark & Jaindl, 1996). There is indication, however, that children with early history of ear infections, while initially delayed in speech and language, may catch up with their peers by the second year of elementary school (Roberts, Burchinal, & Zeisel, 2002; Zumach, Gerrits, Chenault, & Anteunis, 2010). Even so, a study reporting no significant differences in speech understanding in noise between groups of third- and fourth-grade students with and without histories of early ear infections did, however, find a much greater range in abilities for those with a positive history of ear infections (Keogh et al., 2005). This study demonstrated that some of these children experience considerable difficulty in speech understanding.

TABLE 1.1 Prevalence of Hearing Loss and Related Disorders

50 million people have tinnitus (ear or head noises).
30 million are exposed to hazardous noise levels or ototoxic chemicals at work.
48 million people are hard of hearing in one or both ears.
10 million people have some degree of permanent, noise-induced hearing loss.
2 million people are classified as deaf.
6 of every 1,000 children may be born with hearing impairment.
1 in 6 baby boomers (ages 41 to 59) have a hearing problem.
1 in 14 Generation Xers (ages 29 to 40), or 7.4%, already have hearing loss.
15% of school-age children may fail a school hearing screening mostly due to a transient ear infection.
90% of children in the United States will have had at least one ear infection before the age of 6 years.

Sources: Johns Hopkins Medical Center (www.ata.org); Tinnitus Association (www.ata.org); Centers for Disease Control and Prevention (www.cdc.gov); National Institute for Occupational Safety and Health (www.cdc.gov/niosh/topics/noise); Better Hearing Institute (www.betterhearing.org).

The fact that many children with positive histories of ear infection develop no speech, language, or educational delays suggests that factors additional to fluctuating hearing abilities may also be involved in the learning process (Davis, 1986; Williams & Jacobs, 2009), but this in no way reduces the need for intervention. The impact of more severe and permanent hearing loss has an even greater effect on a child's developing speech and language and educational performance (Diefendorf, 1996) and also on the psychosocial dynamics within the family and among peer groups (Altman, 1996; Clark & English, 2014).

Often, the adult patient's reaction to the diagnosis of permanent hearing loss is to feel nearly as devastated as that of the caregivers of young children with newly diagnosed hearing impairment (Martin, Krall, & O'Neal, 1989). Yet the effects of hearing loss cannot be addressed until the reason for the hearing loss is diagnosed. Left untreated, hearing loss among adults can seriously erode relationships both within and outside the family unit. Research has demonstrated that, among older adults, hearing loss is related to overall poor health, decreased physical activity, and depression. Indeed, Bess, Lichtenstein, Logan, Burger, and Nelson (1989) demonstrated that progressive hearing loss among older adults is associated with progressive physical and psychosocial dysfunction.

In addition to the personal effects of hearing loss on the individual, the financial burden of hearing loss placed upon the individual, and society at large, is remarkable. The National Institute on Deafness and other Communication Disorders (2010b) reports that the total annual costs for the treatment of childhood ear infections may be as high as $5 billion in the United States. When one adds to this figure the costs of educational programs and (re)habilitation services for those with permanent hearing loss and the lost income when hearing impairment truncates one's earning potential, the costs become staggering. Northern and Downs (1991) estimate that for a child of 1 year of age with severe hearing impairment and an average life expectancy of 71 years, the economic burden of deafness can exceed $1 million.

A survey conducted by the Better Hearing Institute of over 44,000 American families reported that those who are failing to treat their hearing problems are collectively losing at least $100 billion in annual income (National American Precis Syndicated, 2007). While many people think of hearing loss as affecting mainly older individuals, most people with hearing loss are in the prime of their lives, including one out of six baby boomers ages 41 to 59 years. While the Better Hearing Institute study reported that the use of hearing aids can reduce the effects of lost income by nearly 50 percent, only one in four with hearing problems seeks treatment.

A Blending of Art and Science

Audiology is a scientific discipline based upon an ever-growing body of research on the fundamentals of hearing, the physiologic and psychosocial impacts of lost hearing, and the technological aspects of both hearing diagnostics and pediatric and adult hearing-loss treatments. Over the years, some have cautioned that audiology should avoid becoming mired in the technological aspects of service delivery. Indeed, as Hawkins (1990) points out, the importance of the many technological advances seen in audiology may be of only minor importance to the final success with patients when compared to the counseling and rehabilitative aspects of audiological care.

The blending of the science of audiology with the art of patient treatment makes audiology a highly rewarding profession. The humanistic side of professional endeavors in audiology is what brings audiologists close to the patients and families they serve and makes the outcomes of

provided services rewarding for both the practitioner and the recipient of care. All patients bring to audiology clinics their own life stories, personal achievements, and recognized (and unrecognized) limitations. Audiologists must learn to listen supportively, thus allowing patients to tell their own stories, so that both diagnostics and rehabilitation may be tailored to individual needs effectively (Clark & English, 2014).

Clinical COMMENTARY

Speech-language pathologists often find that they work in close concert with audiologists. This may be true with children, whose hearing loss can have a direct impact on speech and language development, as well as with older adults, who have a higher incidence of age-related communication disorders. The frequent coexistence of hearing disorders and speech and language problems has led the American Speech-Language-Hearing Association to include hearing-screening procedures, therapeutic aspects of audiological rehabilitation, and basic checks of hearing aid performance within the speech-language pathologist's scope of practice (ASHA, 2001, 2004a).

Audiology Specialties

Most audiology training programs prepare audiologists as generalists, with exposure and preparation in a wide variety of areas. Following graduation, however, many audiologists discover their chosen practice setting leads to a concentration of their time and efforts within one or more specialty areas of audiology. In addition, many practice settings and specialty areas provide audiologists with opportunities to participate in research activities to broaden clinical understanding and application of diagnostic and treatment procedures. When those seeking audiological care are young or have concomitant speech or language difficulties, a close working relationship of audiologists with professionals in speech-language pathology or in the education of those with hearing loss often develops.

The varied nature of the practice of audiology can make an audiology career stimulating and rewarding. Indeed, the fact that audiologists view their careers as both interesting and challenging has been found to result in a high level of job satisfaction within the profession (Martin, Champlin, & Streetman, 1997). In 2013, audiology was ranked as the fourth most desirable profession in the United Sates out of 200 rated occupations, based on five criteria including hiring outlook, income potential, work environment, stress levels, and physical demand (CareerCast, 2013). The appeal of audiology as a career choice is hightened by the variety of specialty areas and employment settings available to audiologists.

Medical Audiology

The largest number of audiologists are currently employed within a medical environment, including community and regional hospitals, physicians' offices, and health maintenance organizations. Audiologists within military-based programs, Department of Veterans Affairs medical centers, and departments of public health often work primarily within the specialty of medical audiology. Many of the audiology services provided within this specialty focus on the provision of diagnostic assessments to help establish the underlying cause of hearing or balance disorders (see Figure 1.1). The full range of diagnostic procedures detailed in this