

Hearing Assistive and Access Technology



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Foreword

Drs. Atcherson, Franklin, and Smith-Olinde have written a *must-read* book about assistive and emerging technologies that can vastly increase the ability of consumers with hearing loss to hear more clearly, communicate more effectively, and enhance their quality of life. Although written primarily for hearing health care professionals, consumers, family members, and those who interact with people with hearing loss can greatly benefit from understanding how technology, beyond and in conjunction with hearing aids and implantable devices, can provide greater access to more opportunities.

Today there are 48 million Americans, nearly 20% of the population, who have a hearing loss. It is the third largest public health issue, after heart disease and arthritis, and the third most common chronic disability affecting older adults. With millions of baby boomers reaching their golden years and more young people, including one-in-four teens, with a hearing loss, these assistive technologies can provide immediate life-changing communication tools that benefit consumers of all ages and backgrounds.

At the Hearing Loss Association of America, the nation's largest organiza-

tion for consumers with hearing loss, the overwhelming number of inquiries and issues surround the lack of knowledge and training about assistive and emerging technologies from hearing health care providers. We know from experience that consumers who use new and emerging technologies in conjunction with their hearing aids and implants can remove impediments to communication and hearing. To communicate, one must be able to understand and interpret sounds properly, to understand speech and be able to extract information, and to react appropriately to what is being said and what is happening—which is why assistive and emerging technologies are so important to consumers with hearing loss. These technologies do not work in isolation but work as part of an individual's communication system providing a more holistic approach to treatment.

The authors effectively highlight the power of harnessing new technology for better hearing, removing impediments, and training hearing health care professionals about the possibilities for consumers with hearing loss, not the limitations.

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PART I

Fundamental Considerations



1

Introduction

Why Did We Write This Book?

As audiologists in the field of communication sciences and disorders, we believe in the inherent right of all individuals to be able to communicate with others, and we believe that all individuals have a right to equal access to information, education, enjoyment, and entertainment. We recognize, however, that there may never be equal outcomes. For individuals with disabilities, including communication disorders, we agree with the National Joint Committee for the Communication Needs of Persons with Severe Disabilities (NJC) who advocate the right to affect, through communication, the conditions of their existence. The NJC created and published a *Communication Bill of Rights* for all people with disabilities regardless of the extent or severity (NJC, 1992). The

Communication Bill of Rights states that each person has the right to:

- request desired objects, actions, events, and people;
- refuse undesired objects, actions, or events;
- express personal preferences and feelings;
- be offered choices and alternatives;
- reject offered choices;
- request and receive another person's attention and interaction;
- ask for and receive information about changes in routine and environment;
- receive intervention to improve communication skills;
- receive a response to any communication, whether or

not the responder can fulfill the request;

- have access to AAC (augmentative and alternative communication) and other AT (assistive technology) services and devices at all times;
- have AAC and other AT devices that function properly at all times;
- be in environments that promote one's communication as a full partner with other people, including peers;
- be spoken to with respect and courtesy;
- be spoken to directly and not be spoken for or talked about in the third person while present; and
- have clear, meaningful, and culturally and linguistically appropriate communications.

This book was conceived as part of our beliefs in these rights. For individuals with hearing loss, there continues to be injustice in terms of access to auditory information, and there continues to be a lack of awareness about various hearing assistive and access technologies. Because of hearing loss, some technologies have been developed to take advantage of other sensory functions, such as the eyes and tactile responses through our skin and body. In this book, we define hearing *assistive* technology as any device that helps to overcome hearing loss whether it is to provide or enhance sound, or to provide sound-based information in an

alternative modality such as a visual or tactile cue. Hearing aids and implantable devices, however, are not considered directly under this definition but may well be used in conjunction with hearing assistive devices. We define hearing *access* technology as an approach to using devices to provide equal access and equal opportunity, but an approach that cannot guarantee equal outcomes. The term *access* is important here, since hearing aids, implantable devices, and various hearing assistive devices may help in some situations but not all.

One important consideration is that some of these technologies are used on a personal level, whereas others are used on a public level. A second important consideration is that the financial and maintenance responsibility for these technologies will vary considerably. A final important consideration is that not all assistive and access approaches are electronics based and may involve human and animal facilitators. We would hope that effective hearing assistive and access technologies together can enrich the lives of many individuals with hearing loss. By increasing awareness and promoting advocacy, this outcome is achievable.

Certainly, it does not help matters that there is a large inventory of hearing assistive and access technologies constantly evolving while new technologies continue to be developed. In spite of the large inventory, there remain some compatibility and interoperability concerns for some technologies, and these issues can lead to confusion that increases anxiety, frustration, incompetence, noncom-

pliance, and wasted resources. Figure 1–1 offers a glimpse of how various wireless assistive technologies and their location on the electromagnetic spectrum (e.g., infrared [IR], near-field communication [NFC], frequency modulation [FM], digital enhanced cordless telecommunications [DECT], and Bluetooth) can feed into some of this confusion. We hope this book will reduce confusion and help educate and promote various hearing assis-

tive and access technologies. However, we want to caution here that this book is not a user's guide for these technologies. Rather, we introduce or remind the reader about the existence of these technologies and offer examples and scenarios that help the reader understand situations in which that particular technology might be useful.

We believe this book will be helpful for a variety of individuals: audiologists,

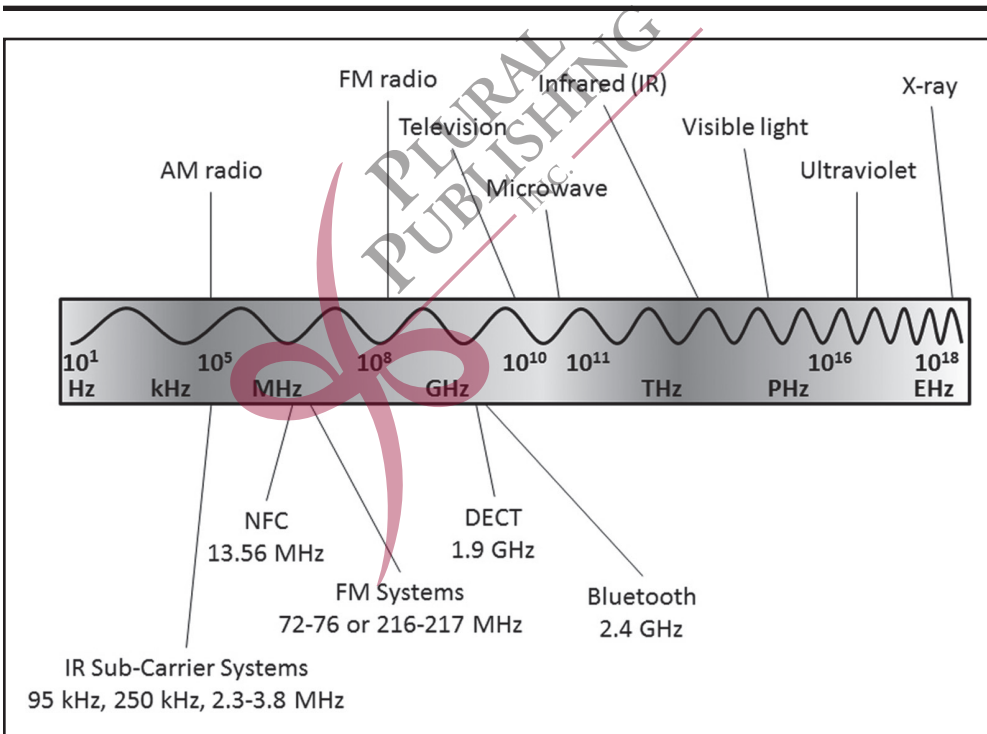


Figure 1–1. Various frequency bands on the electromagnetic spectrum. From left to right, the wavelengths progressively decrease, while frequencies increase. On the top of the figure are commonly recognized electromagnetic waves. On the bottom of the figure are transmission bands used by various communication devices and hearing assistive technologies. Abbreviations: *AM* = amplitude modulation; *FM* = frequency modulation; *IR* = infrared; *NFC* = near-field communication; *DECT* = digital enhanced cordless telecommunications; *Hz* = hertz (cycles/second); *k* = kilo; *M* = mega; *G* = giga; *T* = tera; *P* = peta; *E* = exa.

speech-language pathologists, special educators, school-based administrators, vocational rehabilitationists, consumerists, parents, and any individual experiencing hearing loss. This book was written in large part with first-year audiology graduate students in mind. In doing so, we aim to reach the most people possible to try to make a difference in the lives of individuals with hearing loss, their families, coworkers, and social spheres in a variety of settings. Although there is much information in this book, it is neither all-encompassing nor comprehensive. That was never the goal. Rather, it is intended as a starting place. Before we describe how to get the most out of this book, a review of some hearing loss statistics is helpful to get “the lay of the land,” appreciate the magnitude of the issue, and the importance of this book.

Some Relevant Statistics

Hearing loss is a common disorder with a variety of congenital (present at birth) and acquired causes. In this brief section, we describe some relevant statistics pertaining to hearing loss. These statistics are helpful and necessary to understand the importance of early detection and intervention, accurate and timely diagnosis, personal and societal burden, treatment, and hearing loss prevention. Hearing loss that is not resolved, limits one or more daily activities, and/or restricts participation, is a serious issue, particularly when it negatively impacts communication and overall quality of life.

According to the World Health Organization (2012), an estimated 360 million individuals around the world (5.3% of the world population) have some form of debilitating hearing loss. Hearing loss is commonly cited as one of the top 10 disabilities in the United States (Kirschman & Grandgenett, 1997; U.S. Census Bureau, 2005), and the Better Hearing Institute (BHI) estimated that untreated hearing loss has economic impact in excess of \$100 billion (Kochkin, 2005). This equates to a loss of up to \$30,000 per person with hearing loss in lost salary and wages annually. With few exceptions, hearing loss can lead to lost productivity as well. For the U.S. population ages 12 years and up, Lin, Niparko, and Ferrucci (2011) reported an estimated 30 million Americans (12.7% of the U.S. population) with bilateral hearing loss, with an estimated increase to 48.1 million Americans (20.3% of the population) when unilateral hearing loss is included. These figures are expected to grow because of the aging population (Lin et al., 2011), the increase in childhood noise exposure (Niskar et al., 2001) and noise exposure, smoking, and various cardiovascular risks of young adults (Agrawal, Platz, & Niparko, 2008; Le Prell, Hensley, Campbell, Hall, & Guire, 2011). Approximately 15% of Americans (26 million) between the ages of 20 and 69 have noise-induced hearing loss due to a variety of noise types. For children, it is estimated that two to three out of every 1,000 U.S. babies born will have some form of hearing loss (Vohr, O’Shea, & Wright, 2003), and between ages 6 and 17 years an estimated 14.9% of U.S. children will have hearing loss that

exceeds 16 dB HL pure tone average (Niskar et al., 1998).

Common approaches for remediating hearing loss include surgical correction (full or partial correction), hearing aids, implantable devices, and alternative communication modalities (e.g., sign language). There have been numerous technological advances over the years, particularly for hearing aids and implantable devices. The use of hearing aids for remediation of hearing loss is the most common, but the adoption rates for hearing aids have long been reported by the industry to be about 20%, with adoption rates as high as 25% (Kochkin, 2009). This means that, at most, only one in four individuals with hearing loss is actually using hearing aids. The prevalence of hearing aid use increases from about 3% to 4% in young adults to about 14% to 30% in older adults (Chien & Lin, 2012; Kochkin, 2009). The U.S. Food and Drug Administration (FDA) has reported, as of December 2012, that there are an estimated 324,200 individuals worldwide with cochlear implants, with about 96,000 of those in the United States, roughly 58,000 adults and 38,000 children. Potential cochlear implant users generally must have a severe to profound hearing loss to qualify for the surgery. What these figures indicate is that there are quite a number of individuals with hearing loss who (1) are not seeking treatment, (2) are unhappy with the performance of hearing aids, or (3) have hearing loss so severe that other strategies have been adopted. The prevalence of hearing loss will only continue to grow, and the need for hearing aids, implantable devices, and other hearing

assistive and access technologies will be required to counteract the effects of hearing loss.

What's in This Book?

How do we get access to auditory signals? We offer the information in this book to help you answer that question. We include information on the latest access technologies (e.g., NFC and Bluetooth LE), new uses of older technologies (e.g., induction neck loops with wireless streamers), as well as long-proven technologies (e.g., FM and IR systems) to assist the reader in making the best choices in particular situations for access to the auditory signal. We should be cognizant that not all individuals with hearing loss will benefit from only auditory signal enhancements, and instead, various visual technologies may also be helpful.

This book is laid out in four sections. Foundational information is presented in Section One, including this chapter. Chapter 2 contains information on the federal laws governing access for deaf and hard-of-hearing consumers. Coverage includes one of the first U.S. laws in this arena, the Rehabilitation Act of 1973, through the Twenty-First Century Communications and Video Accessibility Act of 2010. Chapter 3 provides a tutorial on the acoustics of sound as well as the acoustics of various listening environments. Chapter 3 explains the obstacles of reverberation, distance, and background noise and how and why assistive devices are useful for those with hearing

loss with each of those barriers to communication. Chapter 4 is an overview of personal amplification such as hearing aids and implantable devices. Features of hearing aids that aid listening in difficult acoustic environments are included (e.g., directional microphones and digital noise reduction). Explanations of how newer technologies, such as wireless communication, have been harnessed for use with personal amplification will help the reader understand the role of personal amplification, both its usefulness and limitations. Rounding out the first section is Chapter 5 on assessing the needs of an individual in terms of assistive technologies for communication. The World Health Organization's health classification model is introduced, along with ideas for implementing that model in audiology, which helps identify an individual's activity limitations and participation restrictions that need to be addressed.

Section Two consists of a group of chapters dedicated to various hearing assistive technologies (HATs). Chapter 6 addresses frequency-modulated (FM) devices and the many uses for them. Chapter 7 contains an explanation of how induction technology works. Also included in this chapter are uses for induction loops, telecoil use in hearing aids, cochlear implants, and bone-anchored implants, and an explanation of how assistive devices can employ telecoils to interface with personal amplification. Chapter 8 explains how an infrared (IR) signal is used to convey sound across a space, as well as various devices available for home and public space use. Chapter 9

introduces the reader to various wireless technologies, some quite familiar such as Wi-Fi and Bluetooth, and others less familiar to many in 2014, such as near-field communication (NFC).

Section Three is dedicated to access through telephones, to television programs and movies, and to alerting and signaling devices for various situations. Chapter 10 covers access to and through various forms of telephones and other telecommunications. Text-based technologies and software and equipment that offer access to the spoken word through speech-to-text and text-to-text translation are presented in Chapter 11. In this chapter, read about access avenues such as closed captioning and an app that provides live speech-to-text translation. Closed captioning can be used both offline, to caption recorded programming, and in real time, for access to live events. Chapter 12 has material about alerting/signaling technologies that can be important for both safety and environmental information. "Mobile phone tips" are included for many of the device types discussed in this chapter, given that mobile phones have become ubiquitous and essential for so many people.

Finally, Section Four contains three informative chapters that did not quite fit in the previous three sections. The reader will find Chapter 13 useful because of the seven case studies, which, together, display a variety of people, settings, and needs for different types of hearing assistive and access technologies. This chapter will help readers "put it all together" as they read about several pieces of equip-

ment used in each case, as well as the specific information about each client which requires unique solutions to prevent or address issues for that person. Chapter 14 will help the reader understand the specialized needs of health care professionals with hearing loss. As an example, listening to heartbeats both on physical examination and when taking blood pressure is a critical skill for many health care professions. Moreover, audiologists with hearing loss working in a hearing-based field will often face challenges related to both speech audiometry and to the care of patients' hearing aids. Hearing loss could compromise these skills, but included in this chapter are assistive technologies and strategies for compensating. To round out and finalize the book, Chapter 15 is a grab bag of relatively new or novel technologies as well as up-and-coming technologies.

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