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THE USE OF TELEHEALTH BY AUDIOLOGISTS: A SURVEY

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AUDIOLOGY DOCTORAL THESIS APPROVAL PAGE

This is to certify that the Audiology Doctoral Thesis prepared by Yael G. Schonfeld entitled: The Use of Telehealth by Audiologists: A Survey has been approved by the thesis committee as satisfactorily completing the Audiology Doctoral Thesis requirements for the degree Doctor of Audiology (Au.D.).

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ABSTRACT

The Use of Telehealth by Audiologists: A Survey

Yael Schonfeld

Telehealth in audiology is a means of providing hearing healthcare to patients, who have limited access to necessary services. These telehealth services can be provided to patients in remote areas of the world as well as underserved clinical populations within the United States. Telehealth allows audiologists to use various forms of technology such as videoconferencing or application sharing to bridge the gap between the location of the patient and the hearing healthcare provider (Swanepoel et al., 2010a). Telehealth is an emerging trend within the field of audiology and has been applied to hearing screening, various diagnostic procedures, and intervention services. The aim of this study was to qualitatively assess the audiologists knowledge and current practices related to telehealth.

A survey about telehealth was sent to 2000 audiologists across the country. The survey asked a series of questions for current users as well as non-users of telehealth. Results from this study indicated that people age 25-35 were more likely to use telehealth in their practice. The survey results also indicated that users of telehealth felt that it assisted them in providing healthcare to people in remote areas. Non-users of telehealth reported that the reliability of test results was their primary perceived barrier to providing telehealth. A variety of other results between the two groups were revealed. The majority of participants in this study expressed interest in receiving future education regarding telehealth. Implications of the results obtained from this survey are explored.

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CHAPTER 1

INTRODUCTION

The two main models of healthcare currently utilized by countries around the world are private and socialized. Both approaches have challenges when providing appropriate medical services to their citizens. One primary obstacle that both models face is the limited access to healthcare services and the delivery of quality healthcare to remote areas (Pawlson et al., 2004). Therefore, in order to address these challenges, an alternative to the current healthcare approaches is warranted. Telehealth is an innovative and feasible approach to healthcare. It allows the delivery of healthcare to underserved areas using technology. Telehealth can be applied in both need-based situations, such as providing healthcare in remote areas of Africa, and convenience-based situations, such as rural areas in the United States where healthcare providers are not readily accessible (Saunders, 2014).

There are three primary delivery modes for providing telehealth: synchronous (i.e., real-time) and asynchronous (i.e., store-and-forward) and a hybrid model which utilizes both synchronous and asynchronous methods of delivery (Swanepoel et al., 2010a). A synchronous service delivery method allows a healthcare provider to monitor a trained technician via videoconferencing while a patient is being seen. Conversely, an asynchronous approach enables a healthcare provider to review his or her patient's information or test results remotely at a later time (Saunders, 2014). The hybrid approach utilizes the benefits of the synchronous and asynchronous approaches, where the provider can monitor the appointment via videoconferencing (synchronous), and later review medical documentation remotely (asynchronous) (Krumm, 2007).

Telehealth services have been applied to various fields of medicine. Applications for the use of telehealth have been proven and applied on both a domestic and global level. In the context of audiology, the majority of the literature suggests that telehealth is a feasible way to provide audiological services to underserved patients. Telehealth allows audiologists to perform various diagnostic tests (e.g., automated auditory brainstem response [aABR], distortion product otoacoustic emissions [DPOAEs], and pure tone and bone conduction audiometry) and screening measures (e.g., newborn hearing screenings), as well as hearing aid fittings, cochlear implant mappings, and numerous other services at a distance using videoconferencing, teleconferencing, and application sharing. Furthermore, teleaudiology services have been proven to provide reliable and accurate test results when researchers compared findings from on-site and remote locations (Choi, Lee, Park, Oh, & Park, 2007; Ferrari & Bernardez-Braga, 2009; Givens & Elangovan, 2003; Krumm**,** Huffman**,** Dick, & Klich, 2008; Krumm**,** Ribera, & Klich, 2007; Lancaster, Krumm, Ribera, & Klich 2008; Ramos et al., 2009; Ribera, 2005; Swanepoel et al., 2010a; Swanepoel, Koekemoer, & Clark, 2010b; Towers, Pisa, Froelich, & Krumm, 2005).

While providing telehealth services, audiologists will presumably encounter numerous obstacles. Specifically, training a reliable technician/paraprofessional, finding an appropriate test environment, billing, and licensure will all pose challenges for the provider (Givens, 2004). It is imperative that audiologists who provide or intend to provide remote audiological services understand why teleaudiology is needed, how it is currently being utilized, and what challenges they may face with telehealth.

CHAPTER 2

LITERATURE REVIEW

Countries across the world utilize different types of healthcare systems that vary in their approach to providing care to their citizens and differ in the accessibility of these services to their citizens. According to Pawlson, Glover, Petrosyan and Anderson (2004), "a healthcare system can be defined as the method by which healthcare is financed, organized, and delivered to a population" (p.1116). A main objective in all healthcare models is to provide equal access to healthcare services for all citizens. There are two primary healthcare models employed worldwide, a socialized and a private healthcare model, which will be discussed below.

Primary Healthcare Models

Socialized healthcare. The socialized, or public, healthcare model, and the private healthcare model are the two most common types of healthcare models found worldwide. Mosby's Dictionary (2008) defines socialized healthcare as a system controlled by the government and supported by taxing the population (*Mosby's Dictionary,* 2008). In a socialized healthcare system, either: 1) the government asserts complete control over all aspects of healthcare, or 2) the government finances and/or guarantees that all citizens are enrolled in a healthcare plan (Pawlson et al., 2004). Examples of socialized healthcare systems with complete government control are found in Great Britain, the Scandinavian countries, and the former Soviet Union. In contrast, Germany, Belgium, France, and Canada each follow a system in which the government finances certain healthcare plans that ensures that all citizens are covered. The specific model of socialized medicine followed within Europe may vary from country to country;

however, it is widely known that a majority of the European countries have some degree of national health insurance that will cover hospital costs, maternity benefits, medications, and physicians' care ("Socialized Medicine," 2014).

Private healthcare. In contrast to the socialized healthcare system, in the private healthcare system the patient has more control over his or her healthcare plan, but is responsible for paying for medical services through monthly payments to the insurance company (premiums), co-payments for office visits, and/or deductibles (Pawlson et al., 2004; Reinhardt, 1993). Moreover, it is the providers' insurance companies, not the government, who negotiate polices (Pawlson et al., 2004). Therefore, the insurance industry plays a vital role in the financial outcome of the private healthcare system ("Socialized Medicine," 2014). The United States, Mexico, and South Korea are examples of countries that implement a private healthcare model. Since socialized healthcare and private healthcare models make up most of the world's healthcare systems, it might be expected that some countries utilize an approach that involves both models.

Many countries have adopted a "hybrid approach" to medicine, meaning they offer both a socialized and a private model of healthcare. For example, the United States offers government-run healthcare programs such as Medicare (≥ 65 years of age) and Medicaid (≤ 18 years of age and must meet certain financial requirements); however, over 50% of healthcare costs within the United States are covered via the private sector (Pawlson et al., 2004). As a result, the United States is classified as primarily utilizing a private healthcare model. Despite the clear benefits to both models, there are numerous challenges incurred by both healthcare models.

Challenges for each healthcare model. Some of the challenges socialized and private healthcare models face include the financing of the systems, methods of payment, and access to and delivery of healthcare (Pawlson et al., 2004). Socialized healthcare is financed through taxation. In many countries, socialized healthcare is paid for by global budgets, and doctors are paid via the government at a set rate for various procedures as determined by the government (Pawlson et al., 2004). As a result, this socialized payment system may have a negative effect on the effort and time physicians spend with their patients, as well as the quality of care they provide (Pawlson et al., 2004).

In contrast, in a private healthcare system the citizen is responsible for the payment of the insurance premium and all medical procedures and care as outlined in their insurance coverage. Some employers offer health insurance to their employees at a reduced cost as a part of their employment benefits. Typically, in this case at least a portion of the payment for healthcare services is covered through the insurance policy, while the patient is responsible for the remainder of the cost. For example, insurance may cover 80% of an individual's particular medical procedure, leaving the individual responsible for the remaining 20% of the total cost. In the private healthcare model, physicians have complete control over the way they practice, the procedures they provide, and the amount of time they spend with their patients (Pawlson et al., 2004). As a result, providers have the flexibility to control the amount of care and services they offer to their patients.

Access to healthcare is a major obstacle in both healthcare systems (Pawlson et al., 2004). Health expenditures and costs of medical care have increased substantially in many countries (Pawlson et al., 2004). According to the United States Bureau of Labor

Statistics (2009), the amount of household income spent on healthcare has slowly risen from 5.3% per year to about 5.9% per year since 1997. The United States' Center for Medicare and Medicaid Services stated that in 2013, healthcare costs have increased to $2.9 trillion dollars, or $9,255 per person ("National Health Expenditures 2013 Highlights," n.d.).

Since the socialized healthcare model is based upon the principle of providing equal medical care for the whole population, citizens are often limited in terms of the time spent with physicians and access to advanced technologies in order to contain the overall cost of healthcare. For example, there may only be a few advanced radiology centers in countries that have access to this technology, rather than numerous, local centers in order to limit spending on this service. Another possible outcome of this type of government control related to heath care is substantial wait lists for certain types of medical procedures (Pawlson et al., 2004). The individual's ranking on the wait list is usually determined by many factors, including his or her age and other associated health risks as defined by his or her physician.

On the contrary, with the minimal government control seen in private healthcare models, there can be considerable variability in terms of both the patients' access to care and the level of care they receive. For instance, some providers within the United States decide to limit their practice to patients with Medicare or with certain private insurance companies (Pawlson et al., 2004). This decision is often based upon reimbursement rates or ease of reimbursement from insurance companies. In other words, providers within a privatized healthcare system have greater ability to select the patients to whom they wish to provide medical services. Due to the challenges that exist within these two current

healthcare models, there is a need to supplement the current models with a new approach to healthcare.

Telehealth

Within both healthcare models, access and delivery of healthcare to remote and sparsely populated areas continues to be a challenge. Although the United States has the highest per capita spending on healthcare compared to other countries, some citizens, especially those in remote areas, find it difficult to access healthcare (Pawlson et al., 2004). For instance, it has been estimated that 30% of rural areas have a shortage of healthcare professionals (Weiner & White, 1995). Furthermore, Weiner and White (1995) noted that rural areas have half as many physicians (55.6 per 100,000 citizens) available compared to urban cities (96.2 per 100,000 citizens) within the United States. Similarly, Merwin, Snyder, and Katz (2006) noted that 36% of adults in rural areas reported their health status as "poor" or "fair," likely in part due to the lack of access to healthcare. On a global level, Swanepoel et al. (2010a) noted that within developing countries such as Africa, 80% of individuals with hearing loss have limited or no access to audiologic services. Healthcare disparities have remained a constant obstacle over the years.

Both types of healthcare systems strive to provide affordable healthcare to all citizens regardless of where they are located (Weiner & White, 1995). An issue that still remains is that some patients have trouble accessing their healthcare providers, and healthcare providers are unable to reach them (Wootton, Patil, Scott, & Ho, 2009). One innovative solution that was suggested to address this issue is telehealth, or telemedicine. Telehealth and telemedicine are synonymous terms that are often used interchangeably, for consistency the term "telehealth" will be used throughout this paper. Telehealth is an

approach to healthcare designed to provide equal access to medical care in rural and remote underserved areas of the world (World Health Organization [WHO], 2010). The WHO (2010) currently defines Telehealth as:

> The delivery of healthcare services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities. (p. 9)

Telehealth allows for "borderless" healthcare treatment in many countries (Poe, 2001). Bashshur, Reardon, and Shannon (2000) define telehealth as the "geographic separation between two or more actors engaged in health care and the use of telecommunication and related technology to enable, facilitate, and possibly enhance clinical care and the gathering, storage, and dissemination of health-related information" (p. 614). The telehealth model includes health-related activities such as continuing education courses, medical and scientific research, and public health activities (Poe, 2001). Poe (2001) notes that telehealth is not a medical practice, but rather, a means to help providers facilitate medical services to patients through the use of modern technologies. In countries such as Africa where medical care is not easily accessible for individuals living in remote villages, the need for telehealth is vital. Similarly, telehealth can be utilized for convenience within rural areas of the United States where there are no local medical facilities and it is not feasible for patients to reach providers (Saunders, 2014).

The origin of telehealth. Telehealth has historical roots dating back to the mid to late 19th century, however, the first published telehealth service was in the 20th century when electrocardiograph data was sent via telephone wires (WHO, 2010). The United States military and National Aeronautics and Space Administration (NASA) utilized telecommunication in the 1960s to help in medical emergencies by monitoring heart rate, oxygen levels, vital functions, and blood pressure (Bashshur et al., 2000). The private industry sector then adopted telecommunications, which grew substantially with the development and expansion of computers (Bashshur et al., 2000). In the 1950s and 1960s, telehealth was also used for transmission of radiographs, group therapy sessions via the television, and broadcasting surgeries via satellite (Bashshur et al., 2000). The recent growth in telehealth services has been, in part, due to the advancements of the Internet. The Internet allows individuals to remotely connect with others with ease and convenience. Telehealth services can be employed and delivered in several ways.

Delivery modes for telehealth services. Swanepoel et al. (2010a) stated that telehealth services can be delivered in three different modes. One manner of service delivery is a synchronous, real-time manner. The second method is an asynchronous, store-and-forward manner. The third method is a hybrid model, which encompasses both synchronous and asynchronous aspects of service delivery.

An example of a synchronous or real-time service delivery model is one utilizing videoconferencing. In this case, a trained technician performing a health related service is closely monitored via video feed by a licensed healthcare physician or provider. In the context of audiology, this can include video-otoscopy and videoconferencing pure tone audiometry while the audiologist is remotely monitoring the technician (Krumm, 2007).

An asynchronous or store-and-forward service delivery approach is when a patient's information is transmitted to a remote location to be reviewed by a healthcare provider at a later time (Saunders, 2014). For instance, a technician in one location can send case history information and various test results to be reviewed by a licensed healthcare provider in another location at a later time (Krumm, 2007). Within the field of audiology, an asynchronous approach can involve the audiologist pre-selecting and pre-programing hearing aids based on audiologic results and the trained technician can then facilitate the hearing aid fitting at the remote location (Swanepoel et al., 2010a).

Lastly, the hybrid approach incorporates the benefits of utilizing both the synchronous and asynchronous methods to improve quality of care through telehealth practices. For instance, when a patient is being seen remotely, the professional can guide the technician via videoconferencing when needed (synchronous). When less complicated situations arise, such as reviewing a patient's case history, an asynchronous approach can be employed, in that the healthcare provider can review the information at a later time (Krumm, 2007). Specifically in the context of audiology, the trained technician can utilize automated audiometry and then allow the audiologist to counsel the patient regarding the findings via videoconferencing if needed (Swanepoel et al., 2010a). A huge advantage of telehealth is that these various modes of service delivery can be utilized and applied in different fields of medicine.

Applications of Telehealth

Telehealth has been applied on both a worldwide and a national level in numerous healthcare fields. The focus of the current study is the application of telehealth in the field of audiology, therefore, the remainder of this literature review will focus on this topic.

The American Academy of Audiology (AAA, 2008) endorses audiology telehealth services under the supervision and training of an audiologist. Within the audiology literature, services such as hearing screenings, diagnostic evaluations, hearing aid fittings, and cochlear implant mappings have been provided remotely, both worldwide and nationally (Choi, Lee, Park, Oh, & Park, 2007; Ferrari & Bernardez-Braga, 2009; Givens & Elangovan, 2003; Hughes et al., 2012; Krumm**,** Huffman**,** Dick, & Klich, 2008; Krumm**,** Ribera, & Klich, 2007; Lancaster, Krumm, Ribera, & Klich 2008; Ramos et al., 2009; Ribera, 2005; Swanepoel et al., 2010a; Swanepoel & Hall, 2010; Swanepoel, Koekemoer, & Clark, 2010b; Towers, Pisa, Froelich, & Krumm, 2005).

Worldwide telehealth audiology services. The need for telehealth services on a global level is evident (Ghia, Patil, Ved, & Jha, 2013). In the field of audiology, providing worldwide telehealth services remotely has been proven to provide accurate and reliable results during diagnostic evaluations (Choi et al., 2007; Swanepoel et al., 2010b). Swanepoel et al., (2010b) remotely conducted pure tone audiometry on 30 adults via interactive videoconferencing from Dallas, Texas to Pretoria, South Africa. Swanepoel et al. (2010b) reported that 98% of thresholds obtained via conventional audiometric thresholds differed by less than 5 dB HL when compared to thresholds obtained remotely. These investigators also reported that only 4% of their subjects had differences in thresholds obtained between the two locations of greater than 10 dB HL. Similarly, Choi et al. (2007) studied the differences in individuals' performance by conventional audiometric testing and remote testing in individuals in Seoul, South Korea. They, too, found little discrepancy between thresholds obtained at these two locations. Approximately 90% of their results demonstrated threshold differences less than 5 dB HL

between groups (Choi et al., 2007). Both Choi et al. (2007) and Swanepoel et al. (2010b) highlight the feasibility of establishing essential diagnostic audiological information via telehealth on a global level.

Telehealth audiology services have even been used to complete cochlear implant mappings and hearing aid validation remotely. Ramos et al. (2009) effectively programmed and fine-tuned cochlear implant settings 300 miles away from the local unit in Complejo Hospitalario Universitario Insular Materno Infantil de Gran Canaria, Spain. The researchers compared the standard procedure for cochlear implant mapping with the procedure for remotely programming the devices on five adult users. No significant difference was seen between the two methods, thus illustrating the feasibility of cochlear implant programming from a distance (Ramos et al., 2009).

Hearing aid verification is a useful tool that can help ensure the device's optimal performance. Ferrari and Bernardez-Braga (2009) compared real ear unaided responses (REUR), real ear aided responses (REAR), and real ear insertion gain (REIG) measurements obtained from 60 adult hearing aid users (ages 18-84 years) with unilateral or bilateral hearing loss. The participants remained in the same location for both the remote and in-person verification measures, which were obtained on the same day. An audiologist who was unfamiliar with REUR, REAR, and REIG was used to administer the measures at a remote location via videoconferencing and application sharing. A trained audiologist was instructing the audiologist at the remote location how to perform the verification measures while monitoring the results. No significant differences were seen between the remote and face-to-face verification measures; rather, the differences (0-2.2 dB HL) seen are likely due to the variability that is expected during verification

measures (Ferrari & Bernardez-Braga, 2009). This research demonstrated the feasibility of videoconferencing while conducting hearing aid validation measures (Ferrari & Bernardez-Braga, 2009). While the global use for teleaudiology services is clearly evident, AAA also recommends that telehealth services should be applied on a national level.

National telehealth audiology services. Teleaudiology applications have been employed on a national level in diagnostic evaluations, screening for hearing loss, and the verification and fitting of both cochlear implants and hearing aids (Swanepoel et al., 2010a). Prior to testing, audiologists and many other healthcare providers have been obtaining case history information via real time interactive videoconferencing and using online electronic forms in order to save valuable evaluation time (Swanepoel et al., 2010a).

In the audiology literature, several studies report numerous diagnostic measures that have been completed remotely in the United States and have shown no significant differences between the remote measurements versus the conventionally obtained results. These procedures have included: automated auditory brainstem response (aABR), distortion product otoacoustic emissions (DPOAEs), pure tone and bone conduction audiometry, Hearing in Noise Test (HINT), immittance testing, and otoscopy (Givens & Elangovan, 2003; Krumm et al., 2008; Krumm et al., 2007; Ribera, 2005; Towers et al., 2005). Givens and Elangovan (2003) assessed the validity of obtaining audiometric thresholds conventionally and remotely. Forty-five adult participants were utilized in a double blind study to assess the validity of both air conduction testing and bone conduction testing. The study noted that only 25 of the 45 participants underwent bone

conduction testing (Givens & Elangovan, 2003). Two audiologists performed the testing on the same model of audiometer for both the on-site and the remote testing conditions. All testing for both conditions was completed in a sound treated room (Givens & Elangovan, 2003). The researchers found a difference of less than 1.3 dB HL for air conduction thresholds and less than 1.2 dB HL for bone conduction thresholds obtained between methods (Givens & Elangovan, 2003). Similarly, at Minot State University (MSU), Krumm et al. (2007) studied 30 adults with normal hearing sensitivity (≤ 20 dB HL) and assessed both pure tone and DPOAE measurements remotely and in a conventional manner. A technician administered the testing at a secondary location, while an audiologist and a graduate student in audiology remained on site and performed the conventional face-to-face audiometric and DPOAE testing (Krumm et al., 2007). The tests were performed three times and each subject remained in a sound treated booth at MSU during all test conditions. The researchers found no differences when testing both pure tone audiometry and DPOAEs remotely compared to conventionally (Krumm et al., 2007). These studies, along with others, illustrate the feasibility of diagnostic telehealth services administered via automated equipment or videoconferencing on a national level (Givens & Elangovan, 2003; Krumm et al., 2008; Krumm et al., 2007; Ribera, 2005; Towers et al., 2005).

Another application of telehealth includes screening for hearing loss. This application can be beneficial for school-aged children in rural areas who may have limited access to specialists. Similar to the previous studies discussed above, Lancaster et al. (2008) compared conventional otoscopy, immittance, and pure tone audiometric test results obtained from 32 students in rural Utah with results of both synchronous and

asynchronous test results obtained on the same students. The research showed no significant differences between the results obtained for the synchronous and asynchronous test results. This finding was true for both otoscopy and immittance results. Pure tone audiometry results differed in only 5 of the 32 students; however, this finding was not statistically significant (Lancaster et al., 2008).

Moreover, the ability to map and verify cochlear implants remotely may provide great benefit to cochlear implant users. Hughes et al. (2012) studied a number of audiologic responses from 29 newly implanted adults and children. These audiologic measures were recorded from the same subjects both on-site as well as at a remote site in close proximity to their home. The major difference between locations was that remote locations did not utilize a sound treated room for testing. The specific measures assessed were: electrode impedance, threshold and comfort levels, electrically evoked compound action potential measurements, psychophysical threshold measurements, and the users' speech perception abilities. Hughes and colleagues (2012) reported that no significant differences were seen in essentially any of the test results between the remote site and on-site testing. The only exception was that the speech perception scores obtained remotely were significantly poorer than those obtained on-site. These researchers speculated that this finding was likely due to the inadequate testing environment at the remote site location (Hughes et al., 2012). As a result of this finding, this study in particular highlights some of the challenges that come into play during remote audiometric assessment.

It has been demonstrated on both a global and national level that teleaudiology, or the application of telehealth to audiology, is a feasible, beneficial and plausible option to

provide various diagnostic and screening measures to individuals in underserved areas. As previously mentioned, telehealth services can be performed in a real-time/synchronous manner or in an asynchronous manner. Swanepoel et al. (2010a) highlights which audiologic services are best utilized in either a synchronous or asynchronous manner; this information is summarized in Table 1 below. A side-by-side comparison of education/training, screening, diagnosis, and intervention options were looked at in order to determine whether one method of teleaudiology was more advantageous. Swanepoel et al. (2010a) suggests that automated testing and tasks such as obtaining a case history is most efficiently employed in an asynchronous manner, where as non-automated testing is most suitably administered using a synchronous approach. Furthermore, using a synchronous approach for intervention provides more feasible options for cochlear implant mapping and hearing aid fittings/verification when compared to the asynchronous approach.

It is evident within Table 1 that there is some overlap between both the synchronous and asynchronous approaches. For instance, either approach can be employed while taking a patient's case history or while performing diagnostic testing. However, the question of which approach to employ relies heavily on the skill set of the technician and access to technology in the test area. Proper training for the technician is essential and continues to be one of the various obstacles in place when providing teleaudiology services.

Table 1

Scope of Application Possibilities For Telehealth (Synchronous and Asynchronous) in Audiology

	Scope of Telehealth Applications	
	Synchronous*	Asynchronous**
Education/training		
Health care providers Paraprofessionals Parents	Real-time interactive videoconference presentations Telementoring and guidance during assessments or procedures Discussing difficult results/cases with experienced clinicians	Interactive online training modules Posting questions via email or online forums Requesting 2nd opinions from experienced clinicians
Screening		
Newborn hearing screening School-entry hearing screening Adult hearing screening (i.e. occupational health) Vestibular screening	Real-time screening directed via interactive videoconferencing and application sharing Quality control of screening via interactive videoconferencing	Automated OAE/ABR screening Automated audiometry screening Internet-based hearing tests may be valuable screening options
Diagnosis		
Case history Otoscopy Immittance Otoacoustic Emissions (OAE) Auditory Evoked Potentials (AEP) Audiometry (pure tone & speech) Vestibular assessment Intra-operative monitoring	Case history via interactive videoconferencing Video-otoscopy via interactive videoconferencing and application sharing directed by audiologist Immittance, OAE, AEPs via interactive videoconferencing and application sharing. Placement of probe/electrode etc., guided by audiologist and testing conducted via application sharing PC-based audiometers facilitate remote testing via interactive videoconferencing and application sharing	A case-history can be taken electronically (store-and-forward or electronic patient file) Video-otoscopy (store-and-forward or electronic patient file) Automated test sequences of immittance and OAE completed beforehand and emailed (store-and-forward or electronic patient file) Automated audiometry (store-and-forward or electronic patient file)
Intervention		
Counseling Ear canal management	Counseling and troubleshooting conducted via interactive	Hearing aids may be pre-selected and pre-programmed based on

Hearing aid selection, fitting & verification Cochlear implant mapping Intervention	videoconferencing Ear canal management guided remotely by audiologist via videoconferencing Hearing aids fitting guided and programmed via interactive videoconferencing and application sharing Verification of hearing aid via application sharing and interactive videoconferencing Cochlear implant activation and mapping via application sharing and interactive videoconferencing Follow-up sessions via interactive videoconferencing Home-based early intervention services via interactive videoconferencing	audiological results Counseling sessions via interactive videoconferencing may be preceded by questions and complaints emailed Internet-based audiological counseling programs Internet-based audiological treatment programs (i.e. tinnitus) Internet-based auditory training programs Home-based intervention for infants may be provided by recorded play sessions at home sent through to interventionist for evaluation

Note. Reprinted with permission from "Telehealth in audiology: The need and potential to reach underserved communities," by Swanepoel et al., 2010a, *International Journal of Audiology*, *49*(3), 195–202.
*Usually involves a paraprofessional or trained volunteer to facilitate the telemedicine setup at the remote location whilst the health care provider (audiologist) is present remotely via interactive videoconferencing.
** Usually involves a paraprofessional or trained volunteer to facilitate the telemedicine setup at the remote location whilst the health care provider (audiologist) is not present or available in real-time via interactive videoconferencing.

Challenges within a teleaudiology healthcare model. Audiologists who are contemplating employing teleaudiology services have likely encountered numerous challenges and considerations prior to making a final decision. These challenges may encompass several components, including: structural, organizational/infrastructural and socio-cultural barriers (Swanepoel, Olusanya, & Mars, 2010c). Givens (2004) highlights the importance of structure when providing successful teleaudiology services. For instance, structuring your practice with specific guidelines and protocols is necessary to ensure that everything runs smoothly from a distance. To help create structure within a teleaudiology practice, the professional can provide standardized protocols for the

paraprofessional to use during testing. Furthermore, Givens (2004) highlights the importance of a solid communication infrastructure network. Ideally an advanced Internet network system, which allows constant communication between the provider and patient, should be employed. Not all facilities will have access to such advancements in network communication and therefore, standard dial-up Internet or video telephone systems may be utilized (Givens, 2004). Internet connectivity and speed in general may be challenging in remote areas (Molini-Avejonas, Rondon-Melo, de La Higuera Amato & Samelli, 2015; Swanepoel et al., 2010c). If Internet is available, it is important to ensure the security of the connection, in order to maintain patient confidentiality and privacy for documentation in both the onsite and remote locations (Swanepoel et al., 2010c). Moreover, the Internet system software must be easily maintainable, easy to upgrade, and compatible with existing telehealth systems, such as billing and scheduling, in order to provide ease of accessibility between providers (Yao et al., 2010).

When instituting a telehealth audiology practice several considerations must be made. These considerations include: training a reliable technician/paraprofessional, the appropriate test environment, cost/reimbursement of services, and licensure (Givens, 2004). More specifically, the access and availability of paraprofessionals at the remote sites and equipment calibration and upkeep are vital when implementing teleaudiology (Givens, 2004). It is crucial for the paraprofessional to be well trained and comfortable with the equipment. This may require hands on training from the professional. Furthermore, an open line of communication between the professional and paraprofessional will help ensure optimal patient care.

The test environment and acoustics within the remote locations must control for excessive noise in order to obtain accurate results. As noted earlier, it is important to utilize a sound treated room during testing in order to ensure that the paraprofessional is obtaining accurate test results. Differences in test results can be seen when an inappropriate test environment is used (Hughes et al., 2012). As a result, it is further necessary to control for ambient noise. Swanepoel et al. (2010c) recommends utilizing both insert and circumaural earphones together during testing to control for ambient noise (e.g., circumaural earphones over insert earphones). Furthermore, Swanepoel et al. (2010c) recommends that active noise monitoring can be used to decrease the need for sound booths. These options provide a practical and cost-effective approach when sound treated booths are unavailable. Additionally, obtaining properly calibrated sound attenuated equipment in remote and sparsely populated locations may be challenging.

Performing teleaudiology services across state and national borders poses concerns and question regarding state licensure, jurisdictional responsibility and reimbursement rates (ASHA, 2002; Swanepoel et al., 2010a). Both national and word-wide organizations continue to develop standards, regulation, protocols, and policies that affect all aspect of tele-audiology (Swanepoel et al., 2010a). In 2005, the Academy of Doctors of Audiology, the American Academy of Audiology (AAA), and the Audiology Foundation of America formed a task force that developed a model license law, which enables the remote delivery of audiologic services within the United States (Freeman, 2010). Generally speaking, insurance coverage for audiologic procedures typically varies by insurance carrier, with the exception of Medicare and Medicaid within the United States. In terms of reimbursement, as of 2001 Medicare and Medicaid will cover

telehealth services within at least 27 states in the United States (Freeman, 2010). And, insurance in these 27 states will provide some degree of reimbursement for telehealth services, as well as some private insurance carriers (Freeman, 2010). A list of the current states which provide reimbursement and/or insurance coverage for telehealth services can be found at http://ctel.org/expertise/reimbursement/reimbursement-overview/. Financial reimbursement, along with the numerous challenges discussed above, continues to affect how teleaudiology services emerge.

Despite the numerous challenges that are associated with developing teleaudiology services, teleaudiology is a feasible option that provides access to rural and remote location both nationally and globally. Numerous studies have demonstrated that telehealth services can provide reliable and accurate test results (Givens & Elangovan, 2003; Krumm et al. 2008; Krumm et al., 2007; Ribera, 2005; Towers et al., 2005). Telehealth services can provide those individuals with limited access to healthcare the ability to be seen and treated by providers. In sparsely populated areas, teleaudiology enables those with hearing loss the access to care that is greatly needed. However, future research is needed to evaluate patient and clinician satisfaction with telehealth audiology services and the long-term outcomes of these services.

Statement of Purpose

The overall aim of this study was to obtain information about the current application of telehealth services in the field of audiology. Specifically, the goals were to determine:

a) whether or not audiologists are currently using telehealth;

b) if so, how telehealth is being applied in their practices;

c) what are potential concerns audiologists have regarding providing telehealth services;

d) if not, are audiologists interested in furthering their education regarding the applications and benefits of telehealth.

CHAPTER 3

METHODS AND MATERIALS

Participants

Two thousand participants were recruited using mailing addresses purchased from the American Academy of Audiology (AAA) database. The addresses requested were randomly selected by AAA and were domestic members who hold various positions and titles within the field of audiology. Specifically, clinical audiologists, audiology professors, educational audiologists, pediatric audiologists, and research audiologists were recruited to be participants in this study.

The study was submitted to the Towson University Institutional Review Board (IRB) prior to data collection and an exemption was obtained (Appendix A). All participants completed an informed consent document electronically prior to completing the survey. The informed consent document can be found in Appendix B. All participants were required to complete the survey in its entirety. If a survey was partially completed or the informed consent was not signed, the data from that survey was not utilized in the present study.

Survey Instrument Design

A hard copy of the survey was mailed to everyone on the AAA mailing address list. Each participant was given two weeks to complete the survey. A return by date of December 22, 2015 was listed on the cover sheet of the survey to encourage the participants to complete the survey in a timely manner. Survey responses were accepted until February 1, 2016.

The survey questions were divided into three main topics: demographics, clinical history and current clinical setting, and the use of telehealth to provide audiological

services. The survey can be seen in Appendix C. If the participant reported that he or she currently utilizes telehealth, follow-up questions from set "A" were asked; if the participant reported that he or she does not currently use telehealth, follow-up questions from set "B" were asked. Section 1 required the participant to provide demographic information such as age, gender, ethnicity, and geographic location. Section 2 asked the participants questions related to their current place of employment and educational background (e.g., which population they work with, current years of practice, and highest degree earned). Additionally, within Section 2, the participants were be asked to identify which ways they communicate with patients other than the conventional face-to-face approach (e.g., phone, email, letters, and videoconferencing such as Skype). Furthermore, in order to determine if questions from set "A" or set "B" were asked in Section 3, the participants needed to distinguish if they currently uses telehealth services in their current place of employment. Section 3 "A" aimed to investigate where the participant learned about telehealth, how and why the participant uses telehealth, and if the participant encounters any challenges while providing telehealth (e.g., patient privacy, reimbursement, licensure, salary, equipment failure, reliability of test results and lack of experience). Lastly, Section 3 "B" focused on the participants familiarity with telehealth, whether or not the participants have any concerns in terms of providing telehealth, and what would be their greatest motivation to provide telehealth services (e.g. saving patient's time, providing services to rural or areas with minimal audiologic services, convenience for the patients, cost effectiveness, and ease of communication with patients).

The survey consisted of open and closed-set questions. These formats included short answer, yes/no and multiple-choice questions. Several questions permitted multiple responses. Participants were also given the option to select “other” and type in responses wherever applicable.

Data Analysis

The responses obtained from the current survey was analyzed using both inferential and descriptive statistics. The descriptive statistics included calculating percentages and counts of responses for the various questions. Graphs were created utilizing Excel and the Statistical Package for the Social Sciences (SPSS) software. Specifically, crosstabs and chi square analysis was used to investigate relationships and trends throughout the survey.

CHAPTER 4

RESULTS

Of the 2000 surveys mailed to audiologists from the AAA database 439 completed surveys were returned. All respondents were audiologists who hold various positions within audiology. Of the 439 surveys, nine were removed from the present study, as pertinent sections of the surveys were not completed. Additionally, eight more respondents were removed because they did not return or complete the informed consent document. As a result, a total of 422 respondents were included in the data analysis for the present study.

The survey was divided into four main topics: 1) demographics, 2) clinical experience, 3) users of telehealth, and 4) non-users of telehealth. The results from each main topic will be discussed in detail.

Demographics

In this section, the first five survey questions dealt with the age, gender, ethnicity, and geographic location of the respondents. Each subcategory will be discussed separately.

Age. One hundred fifty-two (36%) respondents in this teleaudiology study were between the ages of 25-30 years. The second largest group of respondents in this study was 31-35 years of age. The respondents' ages in five-year intervals starting at 25 years and ending with a category of 56+ years and above can be seen in Table 2.

Table 2

Age of Respondents in Years

Age	*n*	*%*
25-30	152	36
31-35	83	20
36-40	32	8
41-45	33	8
46-50	29	7
51-55	31	7
56+	62	15
Total	422	

Note. *n* = 422.

Gender. The vast majority (85%) of respondents were female, specifically, 357 women participated. The breakdown of genders can be seen in Table 3, of note, one respondents did not answer this question.

Table 3

Gender of Participants

Group	*n*	*%*
Female	357	85
Male	64	15
Did not answer	1	0.2
Total	422	

Note. *n* = 422.

Ethnicity. The overwhelming majority (*n* = 395) of respondents identified themselves as white or Caucasian. White or Caucasian respondents account for 94% of the total respondents in this study. In contrast, Black or African American, Hispanic, Asian, Pacific Islander, and other make up the other 6% of the participant population. Ethnicity is broken down by number of respondents and in percentages in Table 4 below.

Table 4

Ethnicity of Participants

Group	*n*	*%*
White or Caucasian	395	93.6
Black or African American	4	0.9
Hispanic	7	1.7
Asian	5	1.2
Pacific Islander	1	0.2
Other	10	2.4
Total	422	

Note. $n = 422$.

Geographic Location. Participants' geographic locations were highly dispersed across the US, with the largest percentage (37%) of participants from the South (South Atlantic, East South Central, and West South Central). The Midwest region (East North Central and West North Central) represented the second largest percentage (24%) of participants, followed by the West (Mountain and Pacific) (20%) and Northeast (New England and Mid-Atlantic) (19%) regions, respectively. Specific geographic information by region is displayed in Table 5 below. The specific states included in each geographic division are found in Appendix C.

Table 5

Geographic Location of Participants

Region	*n*	*%*
New England	29	7
Mid-Atlantic	49	12
East North Central	77	18
West North Central	25	6
South Atlantic	106	25
East South Central	15	4
West South Central	35	8
Mountain	39	9
Pacific West	47	11
Total	422	

Note. $n = 422$.

Clinical Experience

Questions regarding the participants' clinical experience included: highest degree earned in audiology, current place of employment, patient population, years of clinical experience, modes of communication, and use of telehealth.

Highest degree earned in audiology. The majority (85%) of audiologists in the study had a Doctor of Audiology degree (Au.D.). There were also participants that held Masters degrees (9%) and Ph.D.'s (4%) within audiology. Various other degrees, such as Au.D./MD, Au.D./Ph.D., Ed.D., and Sc.D. were reported by less than 2% of the participants. Degree-specific information can be seen in Table 6 below.

Table 6

Participants' Highest Degree Earned

Degree	*n*	*%*
Au.D.	360	85
Masters	37	8.8
Ph.D.	17	4.0
Au.D., Ph.D.	4	0.9
Sc.D.	2	0.5
Au.D., MD	1	0.2
Ed.D	1	0.2
Total	422	

Note. $n = 422$.

Current place of employment. Approximately one third (30%) of the participants work in a private practice setting and approximately one fourth (23%) of the participants work in an ENT setting. A range of other places of employment were reported and summarized in Table 7. Of note, the participants that responded with "other" and specified their individual place of employment were grouped into broader categories (retail/corporate, medical setting/medical environment, government agencies [including

education], nonprofit, and did not specify/unemployed). For instance, industrial audiology was included in the retail/corporate grouping. A complete list of specific participant responses can be seen in Appendix E.

Table 7

Participants' Current Place of Employment

Group	*n*	%
Private practice	129	31
ENT practice	98	23
Hospital	63	15
Medical setting/medical environment	40	10
VA	26	6
University	21	5
Hearing aid or CI manufacturer representative	13	3
School	10	2
Retail/Corporate	9	2
Government agencies (including education)	5	1
Nonprofit	5	1
Did not specify/unemployed	3	0.7
Total	422	

Note. *n* = 422. CI = Cochlear Implant. VA = Veterans Administration.

Patient population. Participants were asked if they worked with the following populations: adults, pediatrics, and geriatrics. The most common population that audiologists reported working with was adults, with pediatrics being the second most common (Table 8). Three participants reported that they do not have direct contact with patients at this time.

Table 8

Participants' Primary Patient Populations

Population	*n*	*%*
Pediatric (0-18 years)		
Yes	254	60
No	165	40
Adults (19-65 years)		
Yes	361	86
No	58	14
Geriatrics (65+ years)		
Yes	64	15
No	355	85
No direct patient contact	3	1

Note. n = 422.

Years of clinical experience. Participants indicated how many years of clinical work experience they have. Almost half (48%) of the participants had 1-5 years of work experience in the field on audiology, the next largest group responding had 26 or more years' experience (19%). Table 9 displays clinical work experience in five-year intervals.

Table 9

Years of Clinical Experience

Years	*n*	*%*
1-5	202	48
6-10	49	12
11-15	35	8
16-20	25	6
21-25	31	7
26 +	80	19
Total	422	

Note. n = 422.

Modes of communication. Participants were asked to indicate how they communicate with patients when they are not utilizing a face-to-face approach.

Participants had the ability to select multiple answers for this question. 98% of participants communicate via phone, 83% communicate via email, and 67% noted that they also use letters to communicate with patients. A very small (7%) percentage of participants noted that they use videoconferencing. Other, less commonly reported means of communication included social networking, secure messaging, and video interfacing. One participant did not answer this question. Table 10 details the number of respondents as well as the percentages of participants utilizing the various modes of communication.

Table 10

Modes of Communication with Patients

Group	*n*	*%*
Phone		
Yes	414	98
No	7	2
Email		
Yes	351	83
No	70	17
Letters		
Yes	283	67
No	138	33
Videoconferencing		
Yes	28	7
No	393	93
Other		
Social networking	21	5
Secure messaging	11	3
Video interface	7	2
No direct patient contact	3	.7
Did not answer	1	.2

Note. $n = 421$. A conventional face-to-face communication approach was excluded from this question.

Responses to Survey Questions Related to Telehealth

Seven percent of the participants (n = 31) currently utilize telehealth in their clinical setting. Depending on the participant's response to this telehealth question (question 10), they were instructed to respond to a set of questions which investigated either (1) how they use telehealth in their current clinical practice (Section 3A of the survey); or (2) their knowledge of telehealth and how it could be incorporated into their practice in the future (Section 3B of the survey). The next section of the results will review the demographic data on the participants who are currently using telehealth in their practices and their responses to survey questions 11A – 24A. Refer to Appendix C for this section of the survey.

Table 11

Participants' Use of Telehealth

Group	*n*	*%*
Yes	31	7
No	391	93

Note. n = 422.

Users of Telehealth

Demographics. As displayed in Table 12, the majority (55%) of the 31 participants currently using telehealth are between the ages of 25-35 years old. The majority of these participants work in a VA (29%) or in a private practice setting (26%). Table 13 displays the current employment settings for the individuals in the present study who provide telehealth services.

Table 12

Age of Participants Utilizing Telehealth

Group	*n*	*%*
25-35 years	17	55
36-45 years	3	10
46-55 years	4	13
56+ years	7	23
Total	31	

Note. *n* = 31.

Table 13

Place of Employment for Participants Utilizing Telehealth

Group	*n*	*%*
VA	9	29
Private Practice	8	26
Hearing aid or CI manufacturer representative	3	10
Retail/Corporate	4	13
Hospital	2	6
University	2	6
Medical setting/medical environment	2	6
Nonprofit	1	3
Total	31	

Note. *n* = 31. CI = Cochlear Implant. VA = Veterans Administration.

Survey responses to questions 11A-24A, are found in Appendix D. These questions included specifics about telehealth services they provide; incentives to providing telehealth; the challenges they face while providing these services; their perspective on the growth of teleaudiology in the future; and their interest in furthering their education regarding teleaudiology. The responses to these questions will be discussed below.

Where participants first learned about telehealth services. Multiple responses were permitted for question 11A. The top three responses were: employer (61%),

seminar/conference (39%) and graduate studies (26%). The responses and percentages for question 11A are summarized in Figure 1.

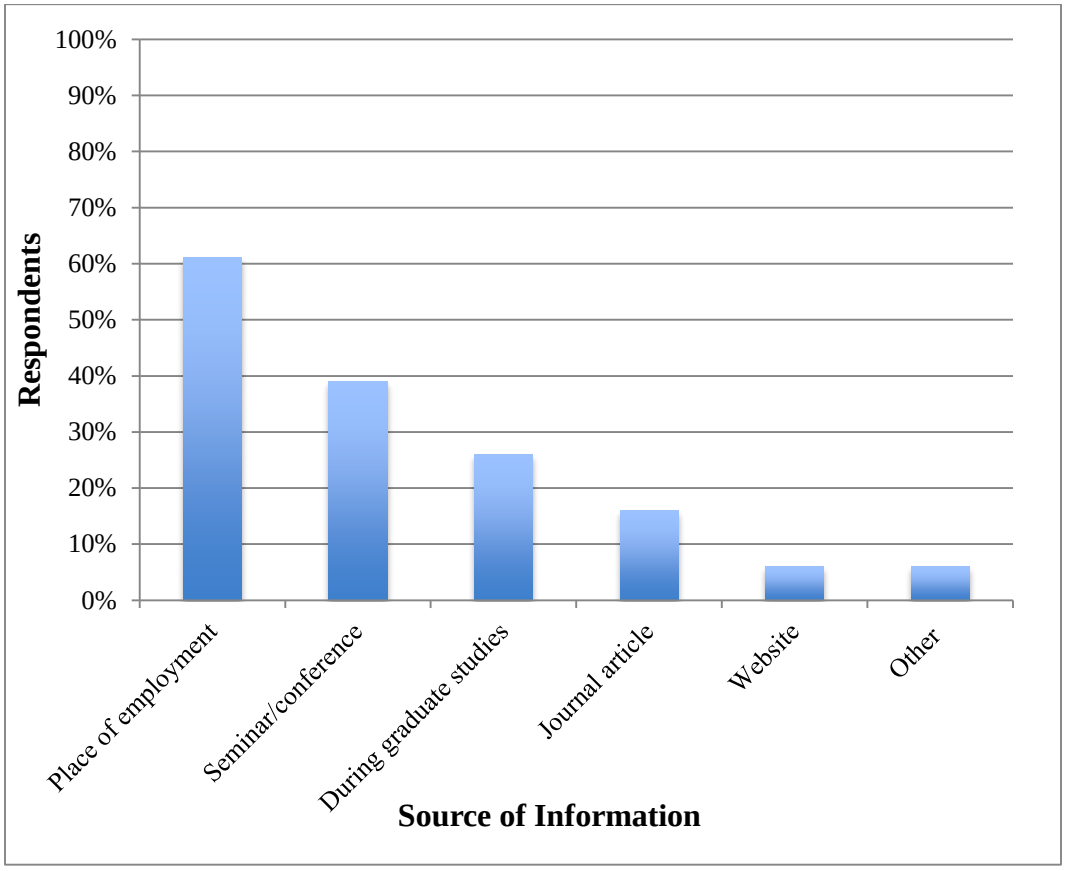

Figure 1. Where users of telehealth first learned about teleaudiology. Multiple selections were allowed by each participant. *Note.* These are participants' responses to question 11A. *n* = 31. Other = manufacturer/health professional.

The next six questions (12A, 13A, 14A, 15A, 16A, and 17A) addressed if participants have clinical protocols in place for telehealth; if so what services do they provide; what percentage of their clinical practice does telehealth encompass; their future projections for their practice regarding telehealth; how is telehealth services provided, and do they provide national or international telehealth services.

Telehealth protocols, types of services, and service delivery. The majority (65 - 68%) of participants reported that they provide both intervention services and education/training via telehealth. Moreover, 48% of participants noted that they provide

hearing aid/cochlear implant programming, adjustments, and checks utilizing teleaudiology (question 12A; Figure 2). Seventy-four percent of the 31 participants confirmed that telehealth protocols were in place in their current practices (question 13A).

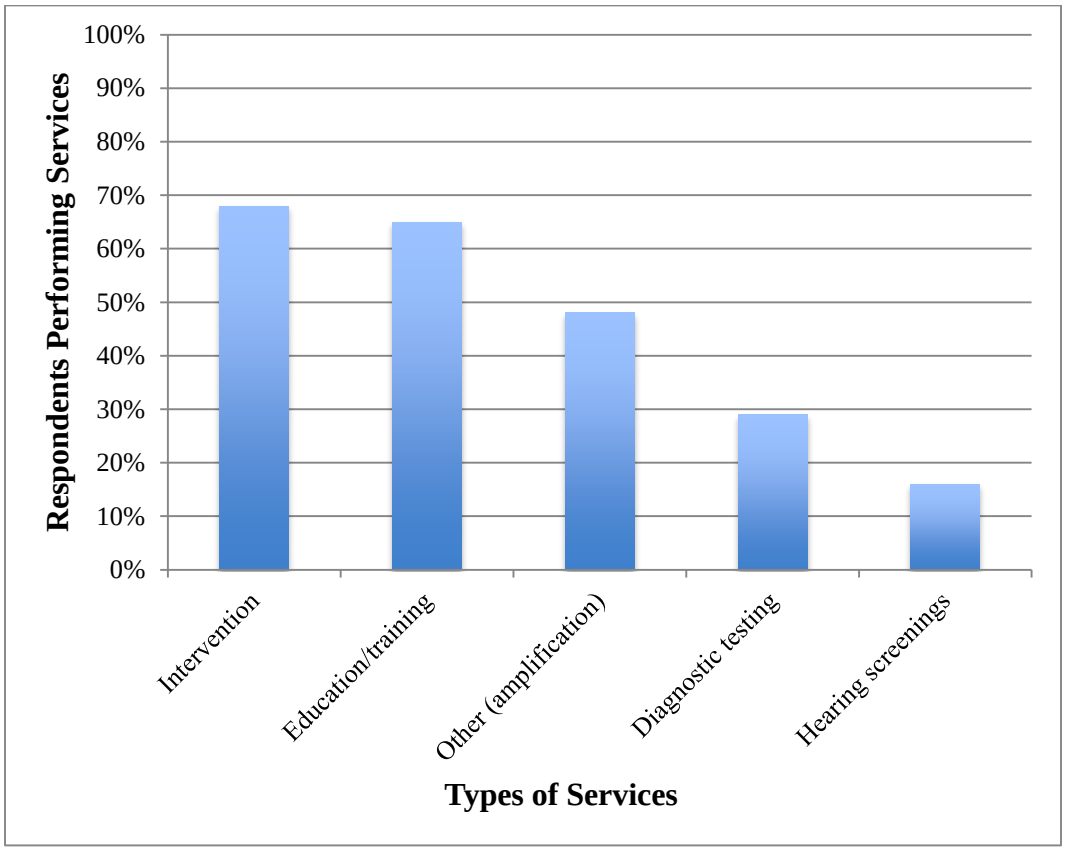

Figure 2. Types of telehealth services provided by respondents. Multiple selections were allowed by each participant. *Note.* These are participants' responses to question 12A. *n* = 31.

Of the 31 participants who currently utilize telehealth, the majority (77%) noted that ≤ 25% of their clinical practice involved telehealth practices (question 16A). Twenty-three participants (74%) reported that they did not want the majority (>50%) to encompass telehealth services. Moreover, participants did not project that their practice would move to a trend of providing the majority of their services via telehealth (question 17A).

Another aspect of telehealth that is important when evaluating clinical practice is how it is conducted. The 31 participants were asked to identify how they provided telehealth services (i.e., in a real-time manner, store-and-forward manner, or both). The vast majority (77%) of participants utilize a real-time approach to providing services. Only 10% reported engaging in a store-and forward method. In a related question, the majority (74%) of participants provide teleaudiology on a national level, while only 10% engaged in providing international telehealth services (see questions 14A and 15A in Appendix D).

Incentives for providing telehealth. The incentives for providing audiologic telehealth services varied among the 31 participants (question 18A in Appendix D). Seventy one percent of the participants noted that their primary incentive was to provide services to those with minimal access to healthcare. This was followed by improving the quality of life for their patients (68%) and reducing cost of audiology services (45%). The two lowest incentives included growing their current audiologic practices and conducting research on telehealth.

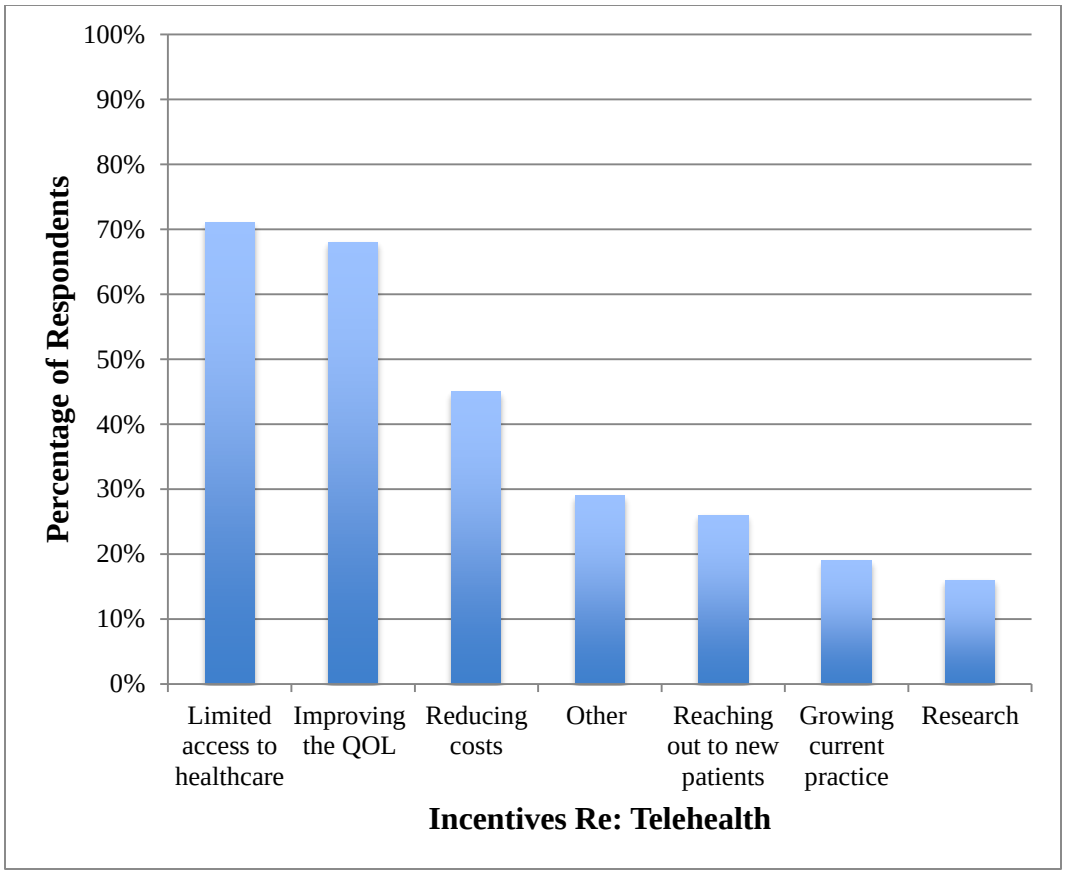

Figure 3. The participants' primary incentives to providing teleaudiology. Multiple selections were allowed by each participant. *Note*. These are participants' responses to question 18A. QOL = Quality of life. Other = improving ease of access to service. *n* = 31.

Challenges of providing telehealth. The majority (52%) of the 31 participants providing telehealth services noted that equipment failure remains a large obstacle to providing telehealth. Twenty three to twenty six percent of respondents reported reimbursement, licensure, and lack of experience providing telehealth as challenges. Interestingly, only a small percentage (10-13%) of participants reported that reliability of the test results or patient privacy were of concern. Lastly, salary was not a concern for any of the participants (question 19A, Figure 4).

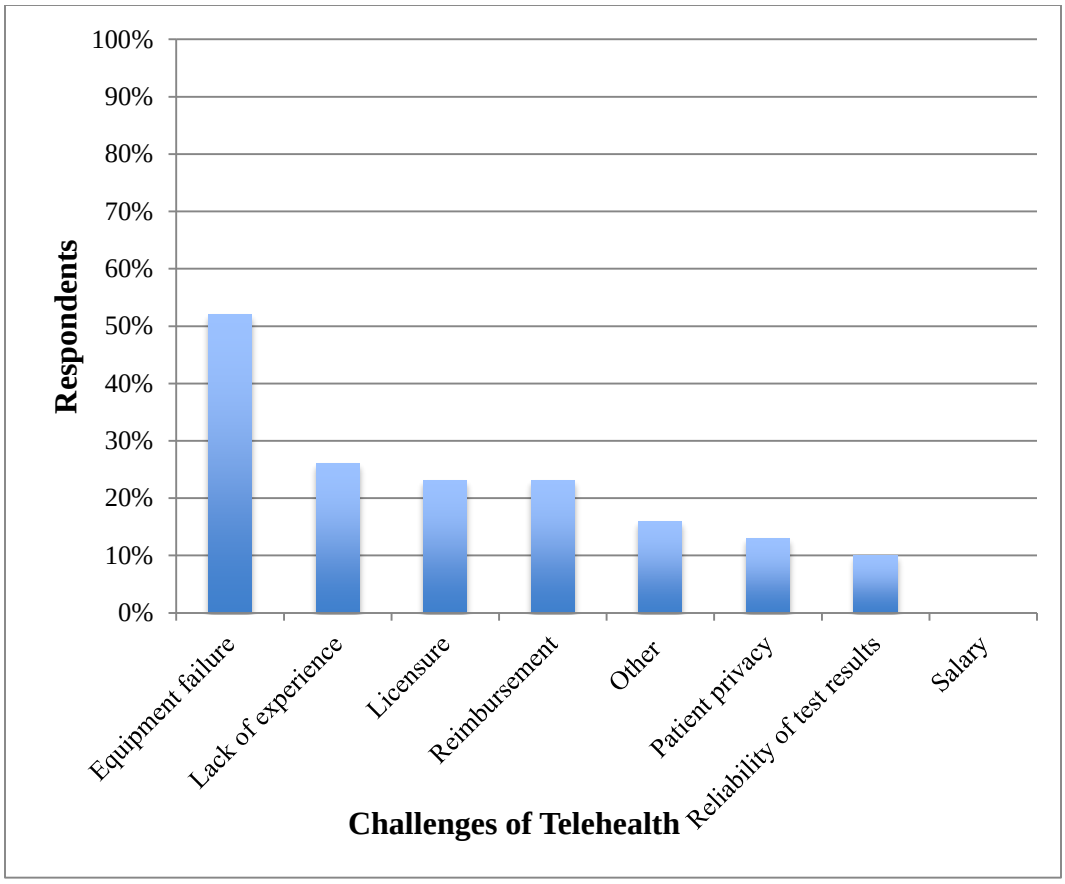

Figure 4. The challenges participants' face while providing telehealth services. Multiple selections were allowed by each participant. *Note*. These are participants' responses to question 19A. *n* = 31.

Predictions and recommendations regarding telehealth. An overwhelming amount (97%) of the audiologists providing telehealth recommended that other providers should provide telehealth to patients. Furthermore, all 31 participants that currently using teleaudiology predict that telehealth services will grow in popularity within the field of audiology in the next 10 years (questions 20A and 21A)**.**

Further education and future studies. In three related questions in the survey (questions 22A, 23A and 24A), 90% percent of the 31 participants reported that they would be interested in furthering their education regarding the use of telehealth in the field of audiology. These participants were specifically interested in learning more about teleaudiology via a variety of different methods including: online courses (77%);

literature on the topic (68%); conferences (65%); and/or websites (58%). Participants were also asked if they would be interested in participating in future research and 90% responded “yes”.

Non-users of Telehealth

Three hundred and ninety one participants indicated that they did not perform telehealth. Questions 11A and 11B of the non-telehealth providers portion of the survey focused on the participants’ familiarity with telehealth; would they be comfortable providing telehealth; what would be the greatest draw to providing telehealth; the challenges/concerns they may face while providing these services, their perspective on the growth of teleaudiology in the future, and their interest in furthering their education regarding teleaudiology. Results from each section will be discussed at length. Question-specific details can be seen in Appendix D.

Familiarity with teleaudiology and where the participants first learned about teleaudiology. Ninety-nine percent (n = 389) of the participants responded to the question about their familiarity with teleaudiology services (question 11B). The majority (64%, n = 250) of participants that responded indicated that they were familiar with these services. Similar to the group of participants using telehealth, these participants were asked where they first learned about telehealth (question 12B). Two of the most common ways the participants learned about telehealth services were during graduate studies (33%) or while attending a seminar/conference (29%) (Figure 5).

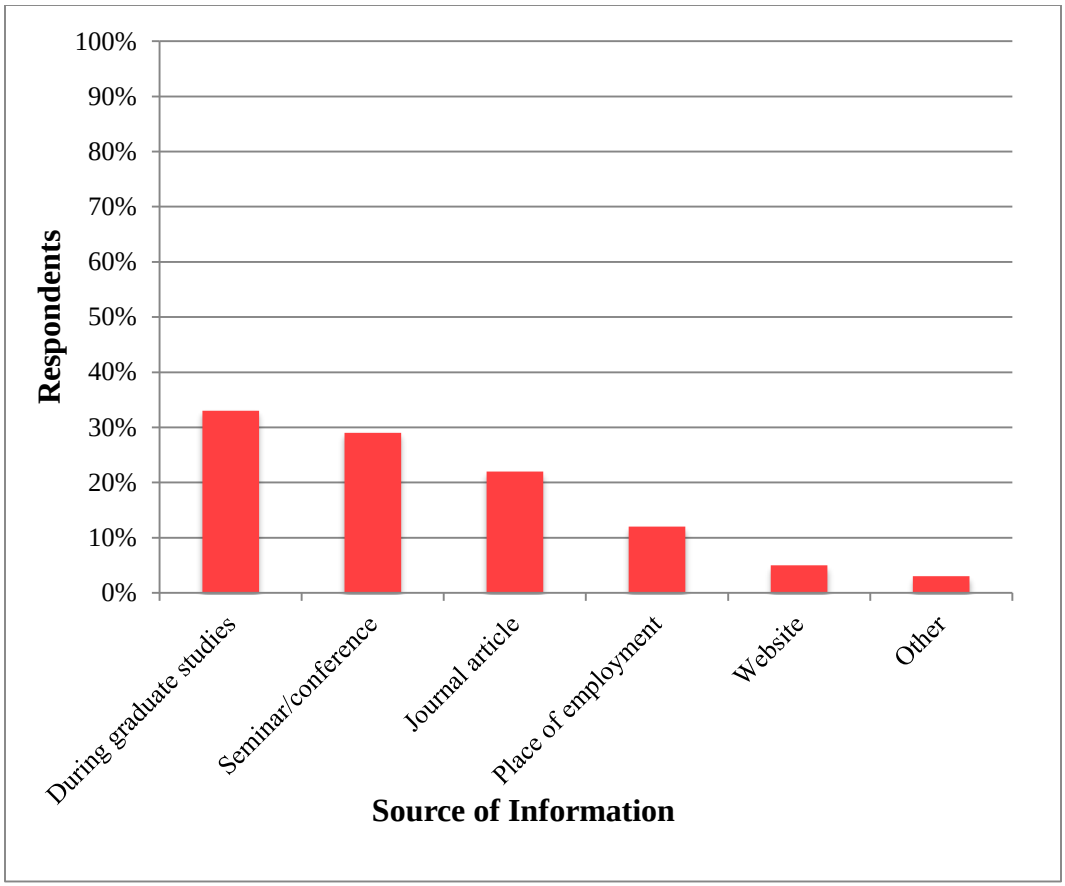

Figure 5. Where non-users of telehealth first learned about teleaudiology. Multiple selections were allowed by each participant. *Note.* These are participants' responses to question 12B. *n* = 250. Other = professional organization (2%), place of employment or word of mouth (1%), and media (0.5%).

Comfort level and concern regarding telehealth. Participants were asked to indicate if they would or would not be comfortable providing telehealth services (question 13B). Interestingly, the responses were equal, with 49% reporting they were comfortable and 49% reporting they were not comfortable providing remote services. Nine participants (2%) did not answer question 13B.

Participants were then asked to identify which concerns they had if they were to provide telehealth (question 14B). Participants noted their greatest concerns were with reliability of test results (75%), equipment failure (62%), and/or reimbursement of these

services (60%). Lack of experience providing telehealth (48%) and patient privacy (34%) were also notable concerns.

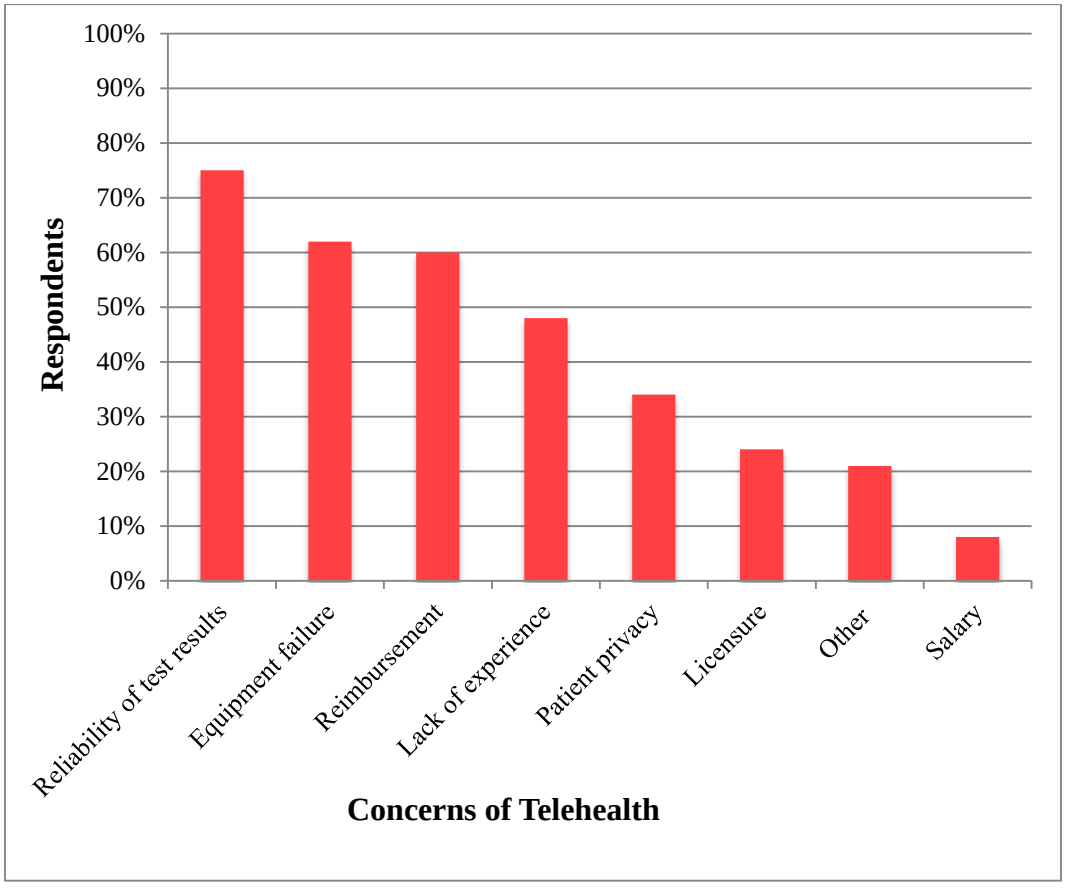

Figure 6. The concerns participants' may face if they were providing telehealth services. Multiple selections were allowed by each participant. *Note.* These are the participants' responses to question 14B. *n* = 391. Other = cost and logistics (6%), personal interaction (4%), technician (3%), service delivery (quality) (3%), patient satisfaction (3%), time constraints (1%), and technology (1%).

Greatest draw to performing telehealth and predictions for the future of telehealth. The audiologists responding to the survey that do not currently provide telehealth were asked to indicate what were the greatest incentives for to provide audiology telehealth services in their practice (question 15B). Their responses indicated that providing services to rural areas with minimal audiologic services (80%) and

convenience of telehealth for the patients (73%) were the greatest draws for performing telehealth. Figure 7 highlights all of the responses from question 15B.

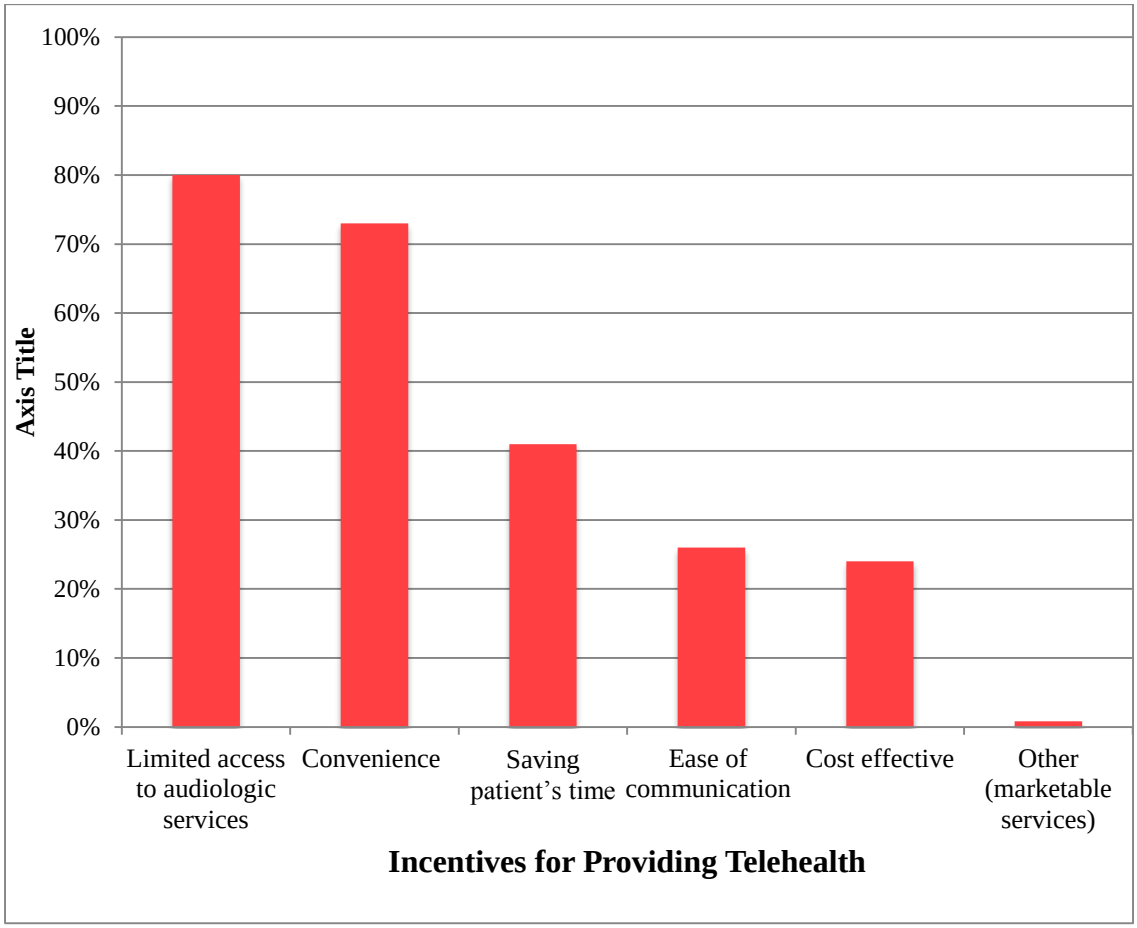

Figure 7. The participants' primary incentives if they were to provide teleaudiology. Multiple selections were allowed by each participant. *Note.* These are participants' responses to question 15B. *n* = 390.

Participants were asked to predict whether or not they thought telehealth would grow in popularity in the next decade (question 16B). Of the 386 participants not using teleaudiology (five participants did not answer question 16B), the vast majority (81%) predicted that telehealth services within the field of audiology will grow in popularity in the next 10 years.

Further education and future studies. In two related survey questions (questions 17B and 18B), the participants were asked if they would be interested in furthering their education about telehealth audiology services and, if so, in what ways. Seventy-five percent (n = 292) of the participants indicated that they would be interested in furthering their education about teleaudiology. Of those 292 participants, the majority (59%) noted that they would be interested in utilizing online courses to learn more about teleaudiology. Participants were also interested in learning about telehealth at a conference (48%), from literature on the topic (42%), and via websites (36%). Furthermore, participants were asked if they would be interested in participating in future research and 65% responded that they would be interested (question 19B).

The next section will compare where users and non-users of telehealth first learned about telehealth and the challenges/concerns they face with telehealth.

A Comparison Between Users and Non-users of Telehealth

Figure 8 below displays where both groups (users and non-user of telehealth) first learned about telehealth. Minimal differences were noted for all sources of information with the exception of place of employment. A chi-squared analysis (X^2) revealed a statistically significant [X^2 (1) = 29.91, N = 281, p = .000] finding between the responses of the users and non-users of telehealth for place of employment. This data suggests that a significantly higher percentage (61%) of current users of telehealth were exposed to and/or learned about this type of delivery of audiology services at their place of employment versus only 12% of non-users.

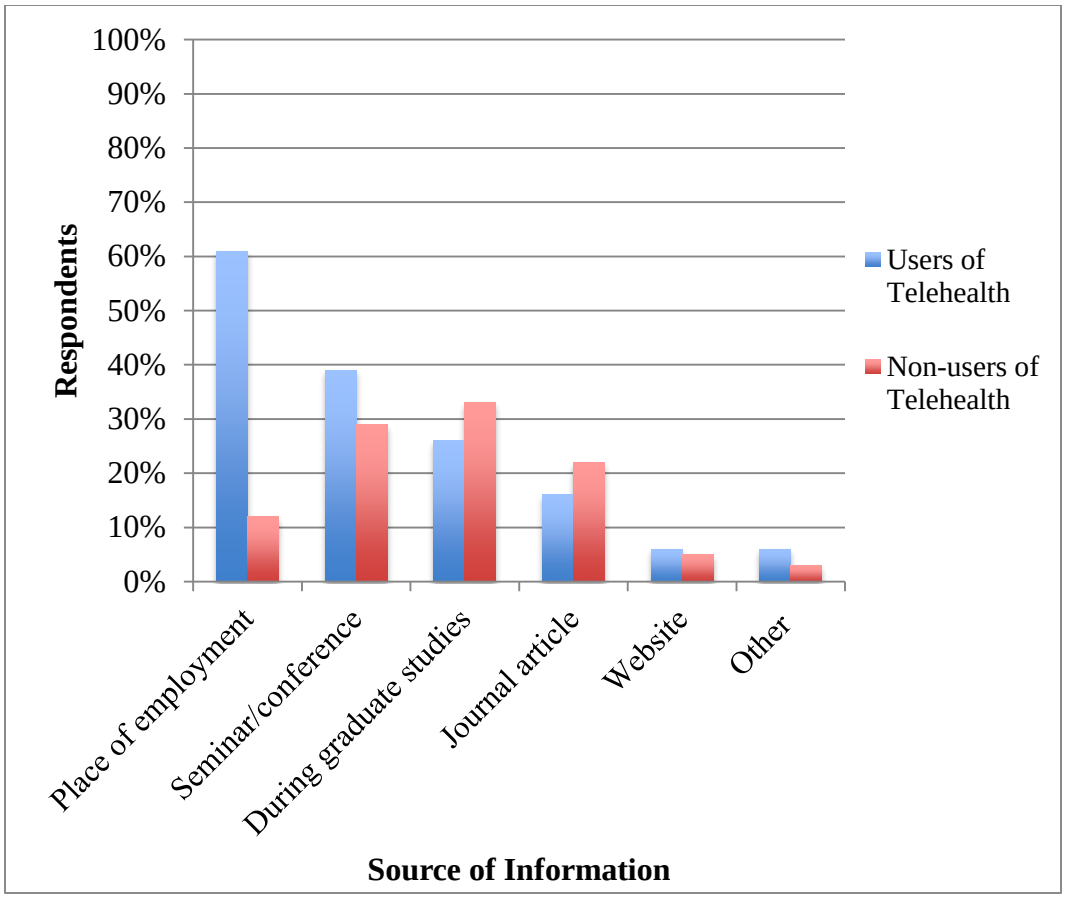

Figure 8. Where users and non-users of telehealth first learned about teleaudiology. Multiple selections were allowed for each participant. *Note.* These are participants' responses to question 11A and 12B. n = 281. Other = professional organization (2%), place of employment or word of mouth (1%), and media (0.5%).

Figure 9 displays the responses between participants using and not using telehealth and the challenges/concerns of telehealth. The largest discrepancy between groups is noted for the reliability of test results. A chi-squared analysis (X^2) revealed a statistically significant [X^2 (1) = 57.69, N = 422, p = .000] finding between the responses to reliability of test results for users and non-users of telehealth. This finding suggests that non-users of telehealth are more concerned with reliability of test results when preforming telehealth compared to users of telehealth. The second notable difference seen between groups was reimbursement of telehealth services. A chi-squared analysis (X^2)

also revealed a statistically significant [X^2 (1) = 16.53, N = 422, p = .000] finding between groups in regards to reimbursement of services. This data suggests that participants providing telehealth are less concerned with reimbursement compared to non-users of telehealth.

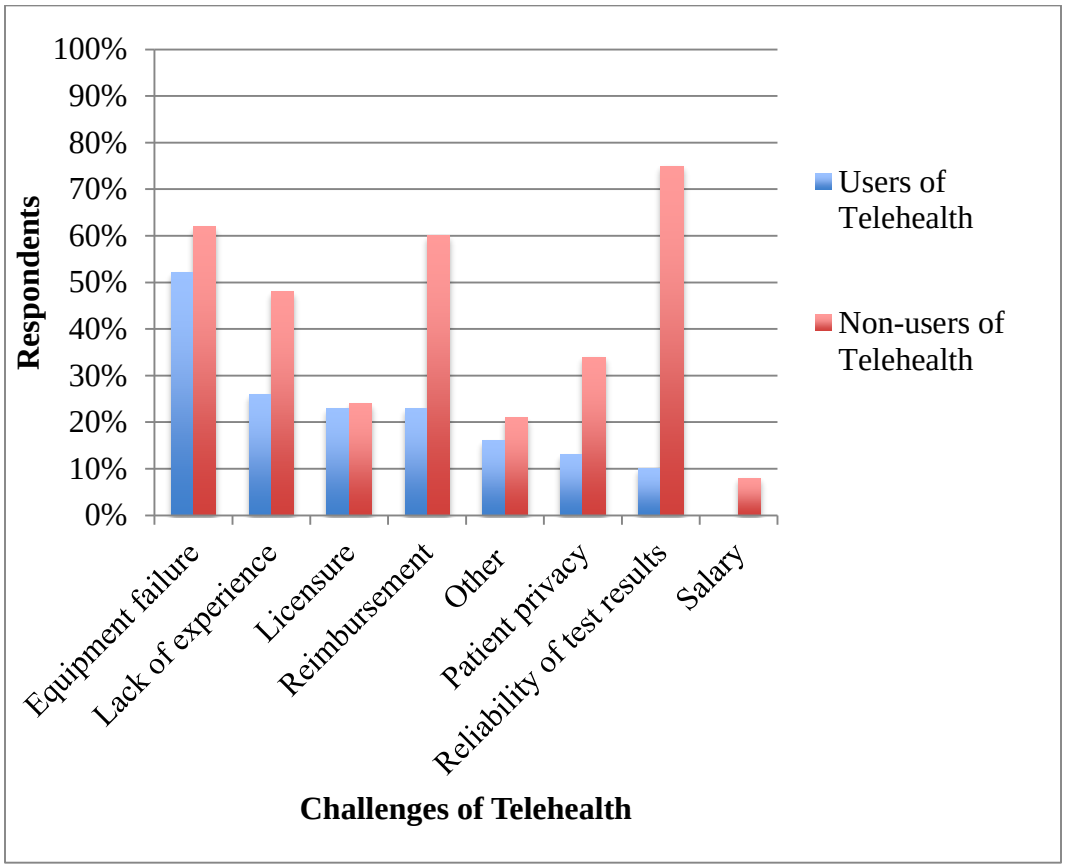

Figure 9. A comparison of the challenges/concerns while providing teleaudiology between users and non-users of telehealth. Multiple selections were allowed for each participant. *Note.* These are the participants' responses to questions 19A and 14B. *n* = 422.

CHAPTER 5

DISCUSSION

As previously stated, the survey employed in the current study looked at several key areas related to telehealth in audiology. These key areas were: demographics, clinical experience, and users and non-users of telehealth. In this discussion section, the findings in each of these key areas will be reviewed and compared to available literature.

Demographics

A total of 2000 surveys were distributed for this study and 422 were completed, yielding a response rate of 21%. The majority (56%) of respondents in this study were between 25-35 years old and were predominately white females. These findings are not surprising, as younger generations are more career-driven, tech savvy, and generally more interested in telehealth (Modahl, 2015). The demographics of this study's population are also similar to the composition of ASHA's audiology membership, which is 84% female and 92% Caucasian (ASHA, 2016).

Clinical Experience

The majority (85%) of audiologists in the present study had a Doctor of Audiology degree, which is now the required degree to practice clinically (AAA, n.d). Approximately 50% of the participants reported that they had 1-5 years of clinical experience while another 20% had been in the field for greater than 25 years.

The four most common clinical work settings in the present study included: private practices (31%), ENT practices (23%), hospitals (15%), and medical settings/environments (10%). ASHA (2014) reported that the majority (74%) of audiologists work in a health care settings such as hospital and nonresidential health

facility. Additionally, 30% of audiologists work in a private practice setting (ASHA, 2014). These facts are in line with the results of the present study.

Responses to Survey Questions Related to Telehealth

Of the 422 participants, only 7% indicated that they currently use telehealth in their practices. This finding is in agreement with the results of an ASHA survey, which reported that as of 2013 only 7% of their registered audiologists used telehealth to in their practices (ASHA, 2016).

Users of Telehealth

Demographics. As expected, the largest percentage (29%) of participants currently using telehealth services work in a VA setting. This finding is in agreement with ASHA's telehealth survey, which reported that a majority (45%) of audiologists providing telehealth worked in a VA system (ASHA, 2016).

Types of services, telehealth protocols, and service delivery. In the present study the majority of participants reported using telehealth for counseling and education/training (65-68%). In contrast, hearing screenings and diagnostic testing accounted for a smaller percentage of responses (16-29% respectively). These present findings are similar to an ASHA survey conducted in 2002 which reported that the two areas audiologist utilized telehealth services in were counseling (83%) or follow-up (68%) services. Hearing screenings (15%), diagnostic assessments (11%), and treatment (14%) accounted for a smaller percentage of services provided via telehealth (ASHA, 2002).

In the present study audiologist that utilized telehealth in their practice responded that ≤ 25% of their clinical practice consists of providing telehealth services. The real-

time/synchronous approach to providing telehealth accounted for the majority (77%) of responses, followed by the hybrid (synchronous and asynchronous approach) approach (13%), and the store-and forward/asynchronous approach (10%). When Molini-Avejonas et al. (2015) reviewed 103 articles related to the use of telehealth in audiology and speech pathology they reported that the majority (54%) of the studies utilized a synchronous approach, followed by a hybrid approach (26%); and lastly an asynchronous method (18%). These findings are in agreement with the practices reported in the present study.

One interesting and somewhat unexpected finding was that the majority (74%) of participants in the present study did not project or want the bulk of their practice to be strictly providing telehealth services. This finding differed from results seen in the ASHA (2002) survey, which reported that 53% of telehealth users showed interest in expanding telehealth services within their practice. Additionally, when Ghia et al. (2013) surveyed 223 physicians and specialists to assess the benefits of using telehealth services in rural India they reported that 48% of the physicians strongly agree that telehealth services should be utilized in all hospital settings, if possible. The response for this question (17A) however may be related the need for more national vs international applications of telehealth.

Incentives and predictions regarding telehealth. In the present study, users of telehealth indicated that the top three greatest incentives for providing telehealth were: the ability to provide services to those with minimal access to healthcare (71%), improving the quality of life for patients (68%), and reducing cost of audiology services (45%). Molini-Avejonas et al. (2015) reported that the majority (81%) of studies identified that access to healthcare for patients as the main benefit to providing telehealth.

When Eikelboom and Atlas (2005) surveyed 116 patients they found that reduced cost was one of the highest perceived advantages for using telehealth. The responses in the present study are not surprising as the overall goal of telehealth is to improve access to healthcare and increase a patient's quality of life (Swanepoel & Hall, 2010; Swanepoel et al., 2010a).

All participants reported that telehealth would grow in popularity in the next ten years and the majority of (97%) participants would recommend that other providers utilize telehealth services. Based on the results of their survey, Singh and colleagues noted that participants are generally viewing the growth of telehealth in a positive manner and would encourage other to try utilizing these services (Singh et al., 2014).

Non-users of Telehealth

Familiarity and comfort level regarding telehealth. The majority (64%) of participants indicated that they were familiar with telehealth services and approximately half of the participants would be comfortable while the remaining half were not comfortable providing these services. In general, clinical experience typically improves the audiologist comfort level with providing services therefore, it is expected that audiologist would likely gain comfort with providing these services if they were built into their practices in the future.

Greatest draw to performing telehealth and predictions for the future of telehealth. The two most common reasons that audiologists reported that they would want to provide telehealth were: to be able to provide audiology services to rural areas with minimal access to hearing healthcare providers (80%) and convenience of telehealth for the patients (73%). Less common responses included ease of communication with

patients (26%) and cost effectiveness (24%). These present finding are in good agreement with Molini-Avejonas et al. (2015) who indicated that the majority (81%) of patients felt that telehealth would increase their access to services. Eikelboom and Atlas (2005) also reported that reduced appointment wait time, less time required to be taken from work, and reduced travel time for the patients were perceived advantages for using telehealth.

A Comparison Between Users and Non-users of Telehealth

Where participants first learned about telehealth services. Both groups reported that they first learned about telehealth at their place of employment. However, approximately two-thirds of the current users of telehealth received this information/exposure from their work setting. In contrast, approximately ten percent of the non-users reported that they learned about telehealth at work. This finding suggests that perhaps the motivation for the current users of telehealth was related at least in part to the expectation of their employer wanting to incorporate teleaudiology in their current practice. Also telehealth is a relatively new approach to healthcare and as such telehealth is not regularly discussing in the work environment (Swanepoel & Hall, 2010; Swanepoel et al., 2010a).

Challenges/concern of telehealth. When providing telehealth services numerous challenges have been discussed in the literature (Givens, 2004; Hughes et al., 2012; Swanepoel et al., 2010a; Swanepoel et al., 2010c). These challenges include: patient privacy, reimbursement, licensure, salary, equipment failure, reliability of test results, and lack of experience. There were statistically significant differences between how these two group perceived the challenges associated with providing teleaudiology. The two challenges that presented the largest differences between the two groups were

reimbursement and reliability of services. Specifically, 60% of the non-users of telehealth reported a concern regarding being reimbursed for teleaudiology while only 23% of the current users reported this as a concern. Similarly, about 75% of the non-users of telehealth reported reliability of the test results as a substantial concern while only a 10% of the current users noted this as a concern. The literature has demonstrated that test results are reliable and feasible when conducted via telehealth (Choi et al., 2007; Givens & Elangovan, 2003; Krumm et al., 2008; Krumm et al., 2007; Ribera, 2005; Towers et al., 2005; Swanepoel et al., 2010b). This finding suggests that the reliability of telehealth services is not widely understood and further education is needed in this specific area of teleaudiology (Swanepoel & Hall, 2010).

Further education and future studies. The majority of users (90%) and non-users (65%) of telehealth indicated that they were interested in furthering their education regarding the use of telehealth in the field of audiology. Furthermore, user and non-users of telehealth reported that they prefer to learn more about telehealth via online courses. As previously stated, telehealth is not commonly used by participants in the present study and by ASHA certified audiologists (ASHA, 2016). However, participants' interest in furthering their education suggests that additional resources and educational training can be beneficial to the growth of telehealth within the field of audiology (ASHA, 2002).

CHAPTER 6

CONCLUSION

Access to healthcare on a national and international level still remains a major obstacle for patients. Telehealth can bridge the gap between patient and provider by facilitating services via videoconferencing and application sharing methods (Swanepoel et al., 2010a). Swanepoel and Hall (2010) highlight the clinical feasibility and reliability of teleaudiology; however, as evidenced by the results of the present study, only a small percentage of audiologists are currently using telehealth in their clinical practice. The numerous challenges and concerns audiologists have may be hindering the growth of teleaudiology. Therefore, while telehealth has the potential to be an effective and efficient alternative to the traditional approach to healthcare, more widespread education is needed on this topic.

Future directions

It would be beneficial to conduct a future qualitative study, which would be directed toward the individuals who are currently employing telehealth services. A survey could be developed for two primary purposes: 1) to investigate the specific diagnostic, intervention, and screening services that these audiologists are currently providing via telehealth; 2) to explore the challenges and successes they have encountered in each area. This information is intended to assist audiology facility to provide audiology students with a prouder understanding of this emerging field within audiology. Secondly, this information may provide better resources on this topic for practicing audiologist.

APPENDIX A

TOWSON UNIVERSITY

EXEMPTION NUMBER: 16-X011

To: P. Korczak & J. Smart

From: Institutional Review Board for the Protection of Human Subjects, Debi Gartland,Chair

Date: Monday, July 27, 2015

RE: Application for Approval of Research Involving the Use of Human Participants

Office of Sponsored Programs
& Research

Towson University
8000 York Road
Towson, MD 21252-0001

t. 410 704-2236
f. 410 704-4494
www.towson.edu/ospr

Thank you for submitting an application for approval of the research titled,

The Use of Telehealth by Audiologists: A Survey

to the Institutional Review Board for the Protection of Human Participants (IRB) at Towson University.

Your research is exempt from general Human Participants requirements according to 45 CFR 46.101(b)(2). No further review of this project is required from year to year provided it does not deviate from the submitted research design.

If you substantially change your research project or your survey instrument, please notify the Board immediately.

We wish you every success in your research project.

CC: Y. Schonfeld; T. Ashby
File

APPENDIX B

**Department of Audiology, Speech-Language Pathology,
and Deaf Studies**

INFORMED CONSENT

Project Title: The Use of Telehealth by Audiologists: A Survey

Principal Investigators:
Jennifer L. Smart, Ph.D., CCC-A
Peggy Korczak, Ph.D., CCC-A

Co-investigators:
Yael Schonfeld, B.A.
Tricia Ashby, Au.D., CCC-A

Dept. of ASLD
8000 York Road
Towson, MD 21252

Purpose of the Study:
The purpose of this study is to determine: whether or not audiologists are currently using telehealth; how, if at all, telehealth is being applied; what concerns audiologists have regarding telehealth; and if audiologists are interested in furthering their education regarding the applications and benefits of telehealth.

Procedures:
If you choose to participate, you will proceed to a short survey. Please complete all sections of the survey to the best of your abilities, and provide additional information where applicable.

Risks/Discomfort:
There are no known personal risks or potential discomfort for those participating in this study.

Benefits:
There is minimal data regarding if or how audiologists are utilizing telehealth services within the field of audiology. Data collected during this research study will help provide further insight into the various applications of telehealth and the challenges that audiologists may encounter while providing telehealth services.

Participation:
Participation in this study is voluntary. Participants can abstain from answering any survey question if they choose. Participants can withdraw from the study at any time.

Compensation:
There is no compensation or payment for participating in this study.

Confidentiality:
All information obtained in the present study will remain strictly confidential. If the findings of the study become published, no personal names and/or identifying information of participants will be disclosed.

If you agree to participate in this study, please indicate that you have read and understood the aforementioned information by checking the box below. By writing your initials on the provided line you are giving your consent to participate in the research study.

☐ I have read and understood the information on this form.

_____
Participant's Initials

_____
Date

If you have any questions regarding this study please contact one of the Principal Investigators or the Institutional Review Board Chairperson. Their contact information is listed below.

Dr. Jennifer L. Smart
Principal Investigator
Phone: (410) 704-3105
Email: JSmart@towson.edu

Dr. Peggy Korczak
Principal Investigator
Phone: (410) 704-5903
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Dr. Deborah Gartland
Institutional Review Board Chairperson
Office of University Research Services
Phone: (410) 704-2236

THIS PROJECT HAS BEEN REVIEWED BY THE INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN PARTICIPANTS AT TOWSON UNIVERSITY (PHONE: 410-704-2236)

APPENDIX C

The Use of Telehealth by Audiologists: A Survey

Instructions: Please answer all of the questions to the best of your ability. Provide additional comments to your responses when needed.

Section 1: Demographics

1. Age (years)

- ○ 25-30
- ○ 31-35
- ○ 36-40
- ○ 41-45
- ○ 46-50
- ○ 51-55
- ○ 56+

2. Sex

- ○ Female
- ○ Male

3. Ethnicity

- ○ White or Caucasian
- ○ Black or African American
- ○ American Indian or Alaskan Native
- ○ Hispanic
- ○ Asian
- ○ Pacific Islander
- ○ Other; please specify_____

4. Geographic location

- ○ **New England** (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont)
- ○ **Mid-Atlantic** (New Jersey, New York, and Pennsylvania)
- ○ **East North Central** (Illinois, Indiana, Michigan, Ohio, and Wisconsin)
- ○ **West North Central** (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota)
- ○ **South Atlantic** (Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, Washington D.C., and West Virginia)
- ○ **East South Central** (Alabama, Kentucky, Mississippi, and Tennessee)
- ○ **West South Central** (Arkansas, Louisiana, Oklahoma, and Texas)

- **Mountain** (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming)
- **Pacific West** (Alaska, California, Hawaii, Oregon, and Washington)

Section 2: Clinical History

5. Highest degree earned in the field of audiology

- Masters
- Au.D.
- Ph.D.
- Other; please specify_____

6. Current clinical work setting

- Private Practice
- Hospital
- School
- University
- ENT practice
- Veterans Administration (VA)
- Hearing aid or cochlear implant manufacturer representative
- Other; please specify_____

7. Patient population you primarily work with? Check all that apply.

____Pediatric (0-18 years)

____Adults (19-65 years)

____Geriatric (65+ years)

Other; please specify_____

8. Current years of practice

- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26+

9. What are the ways you communicate with patients when you are not utilizing a conventional face-to-face approach? Check all that apply.

- ○ Phone
- ○ Email
- ○ Letters
- ○ Videoconferencing (e.g., Skype)
- ○ Other; please specify_____

10. Do you currently use telehealth (as defined on page 1) to provide audiological services?

- ○ Yes (please proceed to the yellow pages)
- ○ No (please proceed to the pink pages)

Section 3A: Telehealth

11. Where did you first learn about telehealth? Check all that apply.

____Seminar/conference

____During your graduate studies

____Place of employment

____Journal article

____Website

Other; please specify_____

12. What telehealth service(s) do you provide? Check all that apply.

____Education/training

____Hearing Screenings

____Diagnostic testing (e.g., otoacoustic emissions (OAE), audiometry, etc.)

____Intervention (e.g., counseling)

____Other; please specify_____

13. Does your practice currently have telehealth protocols in place?

- ○ Yes
- ○ No

14. Do you provide the services listed in question 12 in a real-time manner (e.g. interactive videoconference or teleconferencing) or a store-and-forward manner (e.g. testing or screening is performed by technician and results are sent to you at a later time to review and provide feedback)?

- ○ Real-time
- ○ Store-and-forward
- ○ Both

15. Do you provide national or international telehealth services?

- ○ National
- ○ International
- ○ Both

16. What percentage of your practice currently involves telehealth?

- ○ ≤ 25%
- ○ 25%-50%
- ○ 50%-75%
- ○ ≥ 75%

17. In the future would you project or do you want the majority (>50%) of your practice to partake in telehealth services?

- ○ Yes
- ○ No

18. What is your practice's primary incentive for providing telehealth services? Check all that apply.

____Reaching out to new patients

____Improving the quality of life for your patients

____Growing your current practice

____Research

____Providing services to those with minimal access to healthcare

____Reducing costs

Other; please specify_____

19. Do you encounter any of the following challenges while providing telehealth services? Check all that apply.

____Patient privacy

____Reimbursement

____Licensure

____Salary

____Equipment failure

____Reliability of test results

____Lack of experience

____Other; please specify_____

20. Would you recommend that other providers consider offering telehealth services?

- ○ Yes
- ○ No

21. Do you predict that telehealth services within the field of audiology will grow in popularity in the next 10 years?

- ○ Yes
- ○ No

22. Would you be interested in furthering your education about telehealth services in audiology?

- ○ Yes (if yes then move to question 23 on the next page)
- ○ No (skip question 23)

23. In what ways would you like to further your education regarding telehealth? Check all that apply.

____Literature on the topic

____Online courses

____Conference

____Website

____Other; please specify_____

24. Would you be interested in participating in future studies in the area of telehealth?

- ○ Yes
- ○ No

Section 3B: Telehealth

11. Are you familiar with the services that can be provided via telehealth in the field of audiology?

- ○ Yes
- ○ No (skip question 12)

12. Where did you first learn about telehealth? Check all that apply.

____Seminar/conference

____During your graduate studies

____Place of employment

____Journal article

____Website

____Other; please specify_____

13. Would you be comfortable providing telehealth services (e.g., providing automated audiometry or providing services via interactive videoconferencing) within your current practice?

- ○ Yes
- ○ No

14. What are your concerns if you were to provide telehealth services? Check all that apply.

____Patient privacy

____Reimbursement

____Licensure

____Salary

____Equipment failure

____Reliability of test results

____Lack of experience

____Other; please specify_____

15. If you were to offer telehealth, which of the following is the greatest draw to performing telehealth services? Check all that apply.

____Saving patient's time

____Providing services to rural or areas with minimal audiologic services

____Convenience for the patients

____Cost effective

____Ease of communication with patients

____Other; please specify_____

16. Do you predict that telehealth services within the field of audiology will grow in popularity in the next 10 year?

- ○ Yes
- ○ No

17. Would you be interested in furthering your education about telehealth services in audiology?

- ○ Yes (if yes then move to question 18)
- ○ No (skip question 18)

18. In what ways would you like to further your education regarding telehealth? Check all that apply.

____Literature on the topic

____Online courses

____Conference

____Website

____Other; please specify_____

19. Would you be interested in participating in future studies in the area of telehealth?

- ○ Yes
- ○ No

Thank you for your participation in this survey

APPENDIX D

Question 11A: Where did you first learn about telehealth?			
Category	Response	Number (n)	Percentage (%)
Place of Employment	**Yes**	**19**	**61%**
	No	12	39%
Seminar/conference	**Yes**	**12**	**39%**
	No	19	61%
During your Graduate Studies	**Yes**	**8**	**26%**
	No	23	74%
Journal Article	**Yes**	**5**	**16%**
	No	26	84%
Website	**Yes**	**2**	**6%**
	No	29	94%
Other	**Manufacturer/health professional**	**2**	**6%**
	No	29	94%

Question 12A: What telehealth service(s) do you provide?			
Category	Response	Number (n)	Percentage (%)
Intervention	**Yes**	**21**	**68%**
	No	10	32%
Education/training	**Yes**	**20**	**65%**
	No	11	35%
Other	**Amplification**	**15**	**48%**
	No	16	52%
Diagnostic testing	**Yes**	**9**	**29%**
	No	22	71%
Hearing Screenings	**Yes**	**5**	**16%**
	No	26	84%

Question 13A: Does your practice currently have telehealth protocols in place?		
Category	Number (n)	Percentage (%)
Yes	23	74%
No	8	26%

Question 14A: Do you provide the telehealth services in a real-time manner or a store-and-forward manner?		
Category	Number (n)	Percentage (%)
Real-time	24	77%
Store-and-forward	4	10%
Both	4	13%

Question 15A: Do you provide national or international telehealth services?		
Category	Number (n)	Percentage (%)
National	23	74%
International	3	10%
Both	4	13%
Did not answer	1	3%

Question 16A: What percentage of your practice currently involves telehealth**?**		
Category	Number (n)	Percentage (%)
≤25%	24	77%
25%-50%	5	16%
50-75%	1	3%
≥75%	1	3%

Question 17A: In the future would you project or do you want the majority (>50%) of your practice to partake in telehealth services?		
Category	Number (n)	Percentage (%)
Yes	8	26%
No	23	74%

Question 18A: What is your practice's primary incentive for providing telehealth services?			
Category	Response	Number (n)	Percentage (%)
Providing services to those with minimal access to healthcare	**Yes**	**22**	**71%**
	No	9	29%
Improving the quality of life for your patients	**Yes**	**21**	**68%**
	No	10	32%
Reducing costs	**Yes**	**14**	**45%**
	No	17	55%
Other	**Improving ease of access to service**	**9**	**29%**
	No	22	71%
Reaching out to new patients	**Yes**	**8**	**26%**
	No	23	74%
Growing your current practice	**Yes**	**6**	**19%**
	No	25	81%
Research	**Yes**	**5**	**16%**
	No	26	84%

Question 19A: Do you encounter any of the following challenges while providing telehealth services?			
Category	Response	Number (n)	Percentage (%)
Equipment failure	**Yes**	**16**	**52%**
	No	15	48%
Lack of experience	**Yes**	**8**	**26%**
	No	23	74%
Reimbursement	**Yes**	**7**	**23%**
	No	24	77%
Licensure	**Yes**	**7**	**23%**
	No	24	77%
Other	**Support of patient's needs**	**5**	**16%**
	No	26	84%
Patient privacy	**Yes**	**4**	**13%**
	No	27	87%
Reliability of test results	**Yes**	**3**	**10%**
	No	28	90%
Salary	**Yes**	**0**	**0%**
	No	31	100%

Question 20A: Would you recommend that other providers consider offering telehealth services?		
Category	Number (n)	Percentage (%)
Yes	30	97%
No	1	3%

Question 21A: Do you predict that telehealth services within the field of audiology will grow in popularity in the next 10 years?		
Category	Number (n)	Percentage (%)
Yes	31	100%
No	0	0%

Question 22A: Would you be interested in furthering your education about telehealth services in audiology?		
Category	Number (n)	Percentage (%)
Yes	28	90%
No	3	10%

Question 23A: In what ways would you like to further your education regarding telehealth?			
Category	Response	Number (n)	Percentage (%)
Online course	**Yes**	**24**	**77%**
	No	4	13%
	N/A (answered no to question 22A)	3	10%
Literature on the Topic	**Yes**	**21**	**68%**
	No	7	23%
	N/A (answered no to question 22A)	3	10%
Conference	**Yes**	**20**	**65%**
	No	8	26%
	N/A (answered no to question 22A)	3	10%
Website	**Yes**	**18**	**58%**
	No	10	32%
	N/A (answered no to question 22A)	3	10%
Other	**Licensure**	**3**	**10%**
	No response	25	81%
	N/A (answered no to question 22A)	3	10%

Question 24A: Would you be interested in participating in future studies in the area of telehealth?		
Category	Number (n)	Percentage (%)
Yes	28	90%
No	2	6%
Did not answer	1	3%

Question 11B: Are you familiar with the services that can be provided via telehealth in the field of audiology?		
Category	Number (n)	Percentage (%)
Yes	250	64%
No	139	36%
Did not answer	2	0.5%

Question 12B: Where did you first learn about telehealth?			
Category	Response	Number (n)	Percentage (%)
During your Graduate Studies	**Yes**	**127**	**33%**
	No	123	32%
	DNA	2	0.5%
	N/A (answered no to question 11B)	139	36%
Seminar/conference	**Yes**	**114**	**29%**
	No	136	35%
	DNA	2	0.5%
	N/A (answered no to question 11B)	139	36%
Journal Article	**Yes**	**86**	**22%**
	No	164	42%
	DNA	2	0.5%
	N/A (answered no to question 11B)	139	36%
Place of Employment	**Yes**	**48**	**12%**
	No	202	52%
	DNA	2	0.5%
	N/A (answered no to question 11B)	139	36%
Website	**Yes**	**21**	**5%**
	No	229	59%
	DNA	2	0.5%
	N/A (answered no to question 11B)	139	36%
Other	**Professional organization**	**6**	**2%**
	Place of employment or word of mouth	**5**	**1%**
	Media	**2**	**0.5%**
	No	237	61%
	DNA	2	0.5%
	N/A (answered no to question 11B)	139	36%

Note. DNA = Did not answer.

Question 13B: Would you be comfortable providing telehealth services within your current practice?		
Category	Number (n)	Percentage (%)
Yes	190	49%
No	192	49%
Did not answer	9	2%

Question 14B: What are your concerns if you were to provide telehealth services?			
Category	Response	Number (n)	Percentage (%)
Reliability of test results	**Yes**	**292**	**75%**
	No	99	25%
Equipment failure	**Yes**	**243**	**62%**
	No	148	38%
Reimbursement	**Yes**	**235**	**60%**
	No	156	40%
Lack of experience	**Yes**	**188**	**48%**
	No	203	52%
Patient privacy	**Yes**	**131**	**34%**
	No	260	66%
Licensure	**Yes**	**92**	**24%**
	No	299	76%
Other	**Technician**	**12**	**3%**
	Service delivery (quality)	**13**	**3%**
	Time constraints	**4**	**1%**
	Personal Interaction	**14**	**4%**
	Patient satisfaction	**11**	**3%**
	Technology	**5**	**1%**
	Cost and logistics	**24**	**6%**
	No response	308	79%
Salary	**Yes**	**30**	**8%**
	No	361	92%

Question 15B: Greatest Draw to Performing Telehealth Services			
Category	Response	Number (n)	Percentage (%)
Providing services to rural or areas with minimal audiologic services	**Yes**	**311**	**80%**
	No	79	20%
	DNA	1	0.3%
Convenience for the patients	**Yes**	**284**	**73%**
	No	106	27%
	DNA	1	0.3%
Saving patient's time	**Yes**	**161**	**41%**
	No	229	59%
	DNA	1	0.3%
Ease of communication with patients	**Yes**	**100**	**26%**
	No	290	74%
	DNA	1	0.3%
Cost effective	**Yes**	**94**	**24%**
	No	296	76%
	DNA	1	0.3%
Other	**Marketable Services**	**3**	**0.8%**
	Did not specify	1	0.3%
	No response	387	99%

Note. DNA = Did not answer.

Question 16B: Do you predict that telehealth services within the field of audiology will grow in popularity in the next 10 year?		
Category	Number (n)	Percentage (%)
Yes	318	81%
No	68	17%
Did not answer	5	1%

Question 17B: Would you be interested in furthering your education about telehealth services in audiology?		
Category	Number (n)	Percentage (%)
Yes	292	75%
No	98	25%
Did not answer	1	0.3%

Question 18B: In what ways would you like to further your education regarding telehealth?			
Category	Response	Number (n)	Percentage (%)
Online courses	**Yes**	**232**	**59%**
	No	60	15%
	N/A (answered no to question 17B)	98	25%
	DNA	1	0.3%
Conference	**Yes**	**188**	**48%**
	No	104	27%
	N/A (answered no to question 17B)	98	25%
	DNA	1	0.3%
Literature on the Topic	**Yes**	**163**	**42%**
	No	129	33%
	N/A (answered no to question 17B)	98	25%
	DNA	1	0.3%
Website	**Yes**	**139**	**36%**
	No	153	39%
	N/A (answered no to question 17B)	98	25%
	DNA	1	0.3%
Other	**Training and funding**	**10**	**3%**
	Did not specify	1	0.3%
	No response	282	72%
	N/A (answered no to question 11B)	98	25%

Note. DNA = Did not answer.

Question 19B: Would you be interested in participating in future studies in the area of telehealth?		
Category	Number (n)	Percentage (%)
Yes	255	65%
No	127	32%
Did not answer	9	2%

APPENDIX E

Q6. Current clinical work setting: Other.	
Retail/Corporate (n=9)	Retail Retail clinic (Sam's Club) Retail hearing aids sales franchise Retail-HearUSA Corporation/National company Costco Corporation-multiple hearing aid dispensing Equipment manufacturer Industrial Au.D.
Medical setting/medical environment (n=40)	ENT, university (n=3) Hospital, ENT (n=5) Hospital, university (n=2) Medical practice owned by hospital Multi-specialty clinic (n=5) Multi-specialty clinic, ENT Native Primary Care Center Nursing facility Ophthalmology Outpatient clinic Physician group Private practice in hospital (neurology) Private practice, ENT (n=6) Private practice, hospital (n=3) Private practice, university, ENT Primary care clinic Skilled nursing facilities Specialty clinic University hospital (n=3) Kaiser
Government agencies (including education) (n=5)	Vocational rehab-state government State government – Newborn Hearing Screening Program School, consultant for state EHDI US Navy Indian Health Service
Nonprofit (n=5)	Community clinic (non-profit) Non-profit clinic (n=4)
Did not specify/unemployed (n=3)	Other: did not specify Unemployed (Entering the ENT setting) Unemployed (Last job was ENT setting)

Q7. Patient population you primarily work with: Other	
No direct contact with patients (n=3)	No direct contact (n=3)

Q9. What are the ways you communicate with patients when you are not utilizing a conventional face-to-face approach? Other	
Social networking (n=21)	Facebook and twitter (n=2) Health program app Texting (n=17) Texting, website, and Facebook
Secure messaging (n=11)	Secure messaging through VA website for veterans (n=4) Secure messaging through online system (n=4) Patient portal (n=3)
Video interface (n=7)	Meeting interface Sign phone service Video relay service Telehealth (n=3) Video interpretation service
No direct contact with patients (n=3)	No longer sees patients Fax Postcards

Q11A. Where did you first learn about telehealth? Other	
Manufacturer/health professional (n=2)	Manufacturer Other health professional

Q12A. What telehealth service(s) do you provide? Other	
Amplification (hearing aids and cochlear implants) (n=15)	Programming Hearing aid fittings (n=8) Hearing aid checks/adjustments (n=2) Hearing aid checks/adjustments/fittings (n=2) Cochlear implant programming Cochlear implant mapping at schools

Q18A. What is your practice's primary incentive for providing telehealth services? Other	
Improving ease of access to service (n=9)	Demo and providing simple solutions, many patients live more than an hour away Providing services to patients with limited ability to drive Reduce patient wait time at remote site Provide service when staff is limited (n=2) Coverage for multiple offices, overflow, absence Supporting the patient via the professional Reducing travel time Reducing travel, improving quality of hearing conservation program

Q19A. Do you encounter any of the following challenges while providing telehealth services? Other	
Support of patient's needs (n=5)	Staff to support operation at remote site Lack of support Coaching patients through the process (e.g. Facebook) Training/scope of the technician who assists at remote site Technician's limited skill set, visual limitations

Q23A. In what ways would you like to further your education regarding telehealth? Other	
Licensure (n=3)	What is the manufacturers place in telehealth State licensure vs. national licensure AAA forum

Q12B. Where did you first learn about telehealth? Other	
Professional organization (e.g. national or state level) (n=6)	UTHDCSA Teleaudiology program Participation on NY SLP/Au.D. licensure board NDEHDI Partners IDA telehealth task force Best committee through AAA Discussion on state board of Au.D.
Place of employment or word of mouth (n=5)	Colleagues discussed (n=3) From a student Experience as clinical director using telehealth as SLP
Media (n=2)	Other media re: telehealth in all areas of healthcare News

Q14B. What are your concerns if you were to provide telehealth services? Other	
Technician (quality and competency) (n=12)	Training of off site technician, especially with diagnostic testing Under qualified technician onsite Education and use of assistant with patients Training of technician assistant Training of technician and administrative coworkers in remote locations Technician offsite being responsible for cleaning, communication, checking hearing, etc. Staffing issues (technicians) Need for additional staff on remote site Appropriate help from paraprofessional with patient Competency of technician if one is involved Experience of paraprofessional, setup and follow up (n=2)
Service delivery (quality) (n=13)	Effectiveness Service would not be appropriately provided Quality of service delivery Quality of communication Quality of care Profession going away/loosing personal touch Professional respect, concerns regarding scope of practice found outside professionals Fraud/incompetence Appropriate patient care Lack of support from corporations that own physical practices Lack of training (n=2) Difficult for the profession of audiology
Time constraints (n=4)	Too busy with current patients, can not practice in person with patient Time constraints and reimbursement The amount of time it would take out of schedule Reliability of site and patients showing up to appointment
Personal Interaction (n=14)	Lack of sensitive counseling regarding pediatrics Lack of interaction/impersonal (n=5) Difficult building relationships with patients Counseling is not really face to face Face to face exam, can not do some treatments Explaining results to patient's family No hands on time with patients, confusing for non tech-savvy patients Non English speakers Patients compliance Poorer interpersonal relationship with patient
Patient satisfaction (n=11)	Rapport with patients, keeping personal touch Patient's satisfaction

	Patient rapport (n=2) Patient's experience would be poorer Confusion for patient Comfort of patient (n=2) Building relationship with patient may be a challenge Patients "buy-in"/ Transition to new practice techniques
Technology (n=5)	Patients with poor understanding of technology Patients ability/inability to participate Patients ability to use technology well Patient's understanding the task/ level of "tech-savvy-ness" Patient understanding the task
Cost and logistics (n=24)	Need to change plans quickly with pediatrics Patients need full diagnostic exams Observing patients in person especially CI and pediatric patients Physical issue Re: cerumen, blockage, growth, perforation, etc. can not be determined via telehealth Medical evaluation of ears/intervention Setup and verify equipment Telehealth more useful in rural setting Startup costs, lack of IT (computer) support Equipment setup by remote site Ease of use, documentation Correct use of equipment on patients Client ability Can not remove wax, change parts and pieces of hearing aids, etc. Troubleshooting issues Difficult to do telehealth with pediatrics, difficult with education budget as new equipment is needed Difficult to do telehealth with pediatrics (n=2) Logistics, setup Setup cost Secure systems are needed Scheduling between sites, training offsite quite room Practical, time, space, equipment, setting up protocol, etc., Staffing needs, finding remote locations to best serve area Setup, funding for remote site / technician, limited ability to do amplification through telehealth

Q15B. If you were to offer telehealth, which of the following is the greatest draw to performing telehealth services? Other	
Marketable Services (n=3)	Coolness Factor Potential for new patients Competitive advantage
Did not specify (n=1)	Did not answer

Q18B. In what ways would you like to further your education regarding telehealth? Other	
Training and funding (n=10)	Hands on demonstration (n=2) Hands on training (n=4) Manufacturer training Simulation/opportunity to practice Talking to other in the field that preforms telehealth Finding support for additional equipment
Did not specify (n=1)	Did not answer

References

Adams, L. N. & Grigsby, R. K. (1995). The Georgia state telemedicine program: Initiation, design, and plans. *Telemedicine Journal, 1*(3), 227-235. doi:10.1089/tmj.1.1995.1.227

American Academy of Audiology (n.d.). *AuD Facts.* Retrieved from http://www.audiology.org/education-research/education/students/aud-facts

American Academy of Audiology (2008). *The use of telehealth/telemedicine to provide audiology services.* Retrieved from http://audiology-web.s3.amazonaws.com/migrated/TelehealthResolution200806.pdf_5386d9f33fd359.83214228.pdf

American Speech-Language-Hearing Association (2002). *Survey report on telepractice use among audiologist and speech-language pathologists.* Retrieved from http://www.asha.org/uploadedFiles/practice/telepractice/SurveyofTelepractice.pdf

American Speech-Language-Hearing Association (2014). *Highlights and trends: Member and affiliate counts, year-end 2014.* Retrieved from http://www.asha.org/uploadedFiles/2014-Member-Counts-Year-End-Highlights.pdf

American Speech-Language-Hearing Association (2016). Audiologists' use of telepractice grows. *The ASHA Leader, 21*, 28. doi:10.1044/leader.AAG.21012016.28

Bashshur, R. L., Reardon, T. G., & Shannon, G. W. (2000). Telemedicine: a new health care delivery system. *Annual Review of Public Health, 21*, 613–637. doi:10.1146/annurev.publhealth.21.1.613

Center for Medicare and Medicaid Services. (n.d.). *National Health Expenditures 2013 Highlights.* Retrieved from http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and Reports/NationalHealthExpendData/downloads/highlights.pdf

Choi, J. M., Lee, H. B., Park, C. S., Oh, S. H., & Park, K. S. (2007). PC-based tele-audiometry. *Telemedicine Journal and E-Health, 13*(5), 501–508. doi:10.1089/tmj.2007.0085

Eikelboom, R. H., & Atlas, M. D. (2005). Attitude to telemedicine, and willingness to use it, in audiology patients. *Journal of Telemedicine and Telecare, 11*(2), 22-25.

Ferrari, D.V. & Bernardez-Braga, G.R. (2009). Remote probe microphone measurement to verify hearing aid performance. *Journal of Telemedicine and Telecare, 15*(3), 122–124. doi: 10.1258/jtt.2009.003005

Freeman, B. A. (2010). Technology, legislators, associations, and companies are encouraging tele-audiology. *The Hearing Journal, 63*(6), 50-51.

Ghia, C. J., Patil, A. S., Ved, J. K., & Jha, R. K. (2013, January). Benefits of telemedicine and barriers to its effective implementation in rural india: A multicentric e-survey. *Indian Medical Gazette,* 1-7.

Givens, G. (2004). Telepractice brings new challenges to audiologists: Issues to consider for audiology telepractice. *The ASHA Leader, 9*, 21-41. doi:10.1044/leader.FTR4.09102004.21

Givens, G. & Elangovan, S. (2003). Internet application to tele-audiology:'Nothin' but net.' *American Journal of Audiology, 12*, 50–65.

Hughes, M. L., Goehring, J. L., Baudhuin, J. L., Diaz, G. R., Sanford, T., Harpster, R., & Valente, D. L. (2012). Use of telehealth for research and clinical measures in cochlear implant recipients: A validation study. *Journal of Speech Language and Hearing Research, 55,* 1112–1127. doi:10.1044/1092-4388(2011/11-0237)

Krumm, M. (2007). Audiology telemedicine. *Journal of Telemedicine and Telecare, 13*(5), 224-229. doi:10.1258/135763307781458912

Krumm, M., Huffman, T., Dick, K. & Klich, R. (2008). Telemedicine for audiology screening of infants. *Journal of Telemedicine and Telecare, 14* (2), 102–104.

Krumm, M., Ribera, J., & Klich, R. (2007). Providing basic hearing tests using remote computing technology. *Journal of Telemedicine and Telecare, 13* (8), 406–410.

Kvedar, J., Coye, M. J. & Everett, W. (2014). Connected health: A review of technologies and strategies to improve patient care with telemedicine and telehealth. *Health Affairs, 33* (2), 194-199. doi:10.1377/hlthaff.2013.0992

Lancaster, P., Krumm, M., Ribera, J., & Klich, R. (2008). Remote hearing screenings via telehealth in a rural elementary school. *American Journal of Audiology, 17*, 114–122.

Merwin, E., Snyder, A., & Katz, E. (2006). Differential access to quality rural healthcare: Professional and policy challenges. *Family & Community Health, 29*(3), 186–194. doi:10.1097/00003727-200607000-00005

Modahl M. (2015, January). *Telehealth index: 2015 consumer survey.* Retrieved from http://cdn2.hubspot.net/hub/214366/file-2374840622-pdf/TelehealthConsumerSurvey_eBook_NDF_Electronic_Version_(2).pdf

Molini-Avejonas, D. R., Rondon-Melo, S., de La Higuera Amato, C. A., & Samelli, A. G. (2015). A systematic review of the use of telehealth in speech, language and hearing sciences. *Journal of Telemedicine and Telecare, 21*(7), 367-376. doi: 10.1177/1357633X15583215

Mosby's Dictionary of Medicine, Nursing & Health Professions (8th ed.). (2008). St. Louis, MO: Elsevier Health Sciences

Pawlson, L. G., Glover, J. J., Petrosyan, V., & Anderson, G. F. (2004). Healthcare systems. In S. G. Post (Ed.), *Encyclopedia of Bioethics* (3rd ed., Vol. 2, pp. 1116-1122). New York: Macmillan Reference USA. Retrieved from http://go.galegroup.com/ps/i.do?id=GALE%7CCX3402500231&v=2.1&u=umd_towson&it=r&p=GVRL&sw=w&asid=88d58e8ad599bcfb6c93cda58e434224

Poe, K. (2001). Telemedicine liability: Texas and other states delve into the uncertainties of health care delivery via advanced communications technology. *The Review of Litigation, 20*(3), 682-708.

Ramos, A., Rodriguez, C., Martinez-Beneyto, P., Perez, D., Gault, A., Falcon, J. C., & Boyle, P. (2009). Use of telemedicine in the remote programming of cochlear implants. *Acta Oto-Laryngologica, 129,* 533–540. doi:10.1080/00016480802294369

Reinhardt, U. E. (1993). Reforming the health care system: The universal dilemma. *American Journal of Law and Medicine, 19*(1-2) 21-36.

Ribera, J. E. (2005). Interjudge reliability and validation of telehealth applications of the hearing in noise test. *Seminars in Hearing, 26*(1), 13–18. doi:10.1055/s-2005-863790

Saunders G. (2014). Teleaudiology. Institute of Medicine and National Research Council. Hearing Loss and Healthy Aging: Workshop Summary. Chapter 6 Innovative Models: Teleaudiology 61-64. Washington, DC: The National Academies Press, 2014.

Singh, G., Pichora-Fuller, M. K., Malkowski, M., Boretzki, M., & Launer, S. (2014) A survey of the attitudes of practitioners toward teleaudiology. *International Journal of Audiology, 53*(12), 850-860. doi: 10.3109/14992027.2014.921736

Socialized Medicine. (2014). *Funk & Wagnalls New World Encyclopedia*.

Swanepoel, D. W., Clark, J. L., Koekemoer, D., Hall, J. W., Krumm, M., Ferrari, D. V, … Barajas, J. J. (2010a). Telehealth in audiology: The need and potential to reach underserved communities. *International Journal of Audiology, 49*(3), 195–202. doi:10.3109/14992020903470783

Swanepoel, D. W. & Hall, J. W. (2010). A systematic review of telehealth applications in audiology. *Telemedicine and e-Health, 16*(2), 1-20. doi: 10.1089=tmj.2009.0111

Swanepoel, D. W., Koekemoer, D., & Clark, J. (2010b). Intercontinental hearing assessment – a study in tele-audiology. *Journal of Telemedicine and Telecare, 16*(5), 248-252. doi: 10.1258/jtt.2010.090906

Swanepoel, D. W. Olusanya, B. O., & Mars, M. (2010c). Hearing health-care delivery in sub-saharan africa – a role for tele-audiology. *Journal of Telemedicine and Telecare, 16*(2), 53-56. doi:10.1258/jtt.2009.009003

Towers, A. D., Pisa, J., Froelich, T. M., & Krumm, M. (2005). The reliability of click-evoked and frequency-specific auditory brainstem response testing using telehealth technology. *Seminars in Hearing, 26*(1), 26–34. doi:10.1055/s-2005-863792

United States Bureau of Labor Statistics. (2009). *Healthcare*. Retrieved from http://www.bls.gov/spotlight/2009/health_care/pdf/health_care_bls_spotlight.pdf

Weiner, J. & White, L. J. (1995) Rural primary care. *Annals Of Internal Medicine, 122*(5), 380-390.

Wootton, R., Patil, N. G., Scott, R. E., & Ho, K. (2009). Bridging the digital divide: Linking health and ICT policy. In J. Dzenowagis (Eds.), *Telehealth in the Developing World* (pp. 9-26). London, UK: Royal Society of Medicine Press Ltd.

World Health Organization. (2010). Telemedicine: Opportunities and developments in member states. *WHO Library Cataloguing-in-Publication Data, 2*, 3-88. Retrieved from http://www.who.int/goe/publications/goe_telemedicine_2010.pdf

Yao, J., Wan, Y., & Givens, G. D. (2010). Using web services to realize remote hearing assessment. *Journal of Clinical Monitoring and Computing*, *24*(1), 41–50. doi:10.1007/s10877-009-9208-6

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