Readability of Patient-Reported Outcome Measures in Adult Audiologic Rehabilitation

Alana Douglas

A thesis submitted in partial fulfilment of the

requirements for the Degree

of Master of Audiology

Department of Communication Disorders

University of Canterbury

2017

Acknowledgements

I would like to thank my supervisor Dr Rebecca Kelly-Campbell for her support and guidance throughout the entire thesis process. Your dedication to the Canterbury Master of Audiology program is exceptional, and you have been a wonderful teacher and supervisor over the past two years.

I would also like to thank the many clinical and academic staff members within the Department of Communication Disorders who work tirelessly to see us through our studies. This also extends to all of the audiologists around the country who have been gracious enough to welcome us into their places of work, and who have taken the time to share their wisdom, personal experience, and clinical skills for our benefit, providing us with the opportunity to learn in a real world environment.

I would like to thank the clients who visit the University of Canterbury Speech and Hearing Clinic for your enthusiasm and interest in us students and our studies. It can be daunting for students to perform a clinical skill for the first time, but a kind smile and a patient attitude can make all the difference.

To the MAud class of 2016 I say congratulations on completing this degree. It’s been a rough road but we have finally made it in the end.

To my parents I would like to say I am so grateful for all the endless love and support over the years, and particularly throughout this (very long) university chapter of my life. I could not have done it without you. You have been there for me throughout all the meltdowns and the tears. I hope that I have made you proud.

And finally, I would like to thank my husband Anthony. You amaze me every day, and I am so blessed to have you in my life. I dedicate this thesis to you.

Abstract

Purpose: The purpose of this study was to examine the readability of several published Patient-Reported Outcome Measures (PROMs) designed for use within the field of adult audiologic rehabilitation. The readability results were then compared to the readability levels recommended for health information by health literacy experts.

Method: Ten published audiologic PROMs were identified for use within this study. Reading grade levels were calculated using four readability formulas: Flesch-Kincaid Grade Level (F-K), Gunning Fog Index (FOG), Simple Measure of Gobbledygook (SMOG), and FORCAST, as computed by the readability calculations software package Oleander Readability Studio 2012.1. Descriptive statistics were computed across the different PROM sections: instructions, items, response scale, and the overall contents of the measure directed towards the respondent.

Results: The results of this study demonstrate that the majority of the PROM sections exceed the 4^{th} to 6^{th} grade reading level recommended by health literacy experts, regardless of the formula applied. All PROM sections exceeded the 4^{th} to 6^{th} grade reading level when calculated according to the FORCAST formula, the most appropriate readability formula for use with a non-narrative text format, such as the format of the PROMs encountered within this study.

Conclusion: When developing or re-evaluating PROMs designed for use within the field of adult audiologic rehabilitation, researchers should consider ways to improve the readability of their measure, as poor readability may affect the validity of the empirical data collected using the PROM. Additionally, the adequate readability of audiologic PROMs is required if patient/family-centred care values are to be adhered to within the field of adult audiologic rehabilitation.

List of Abbreviations

AIADH	Amsterdam Inventory for Auditory Disability and Handicap
ART	Acoustic Reflex Threshold
ASHA	American Speech-Language-Hearing Association
CPHI	Communication Profile for the Hearing Impaired
dB HL	Decibel Hearing Level
DOSO	Device Oriented Subjective Outcome Scale
F-K	Flesch-Kincaid Grade Level
FOG	Gunning Fog Index
FRE	Flesch Reading Ease
GHABP	Glasgow Hearing Aid Benefit Profile
HII-SOP	Hearing Impairment Impact-Significant Other Profile
IOI-HA	International Outcome Inventory for Hearing Aids
MARS-HA	Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids
NZAS	New Zealand Audiological Society
OAEs	Otoacoustic Emissions
PROs	Patient-Reported Outcomes
PROMs	Patient-Reported Outcome Measures
RGL	Reading Grade Level
SADL	Satisfaction with Amplification in Daily Life Scale
SMOG	Simple Measure of Gobbledygook
SOS-HEAR	Significant Other Scale for Hearing Disability
SSQ	Speech, Spatial, and Qualities of Hearing Questionnaire
WHO	World Health Organisation

Contents

List of Figures

List of Tables

Chapter One: Introduction

1.1 Overview

Audiologists, in addition to other members of the modern interdisciplinary healthcare team, are increasingly being urged to shift their thinking away from a traditional physician-centred care approach to that of a more holistic, patient-centred care model (Gilligan & Weinstein, 2014). Audiologists may incorporate values central to patient-centred care (such as patient engagement, patient narrative, and mutual understanding) into their clinical practice through the use of patient-reported outcome measures (PROMs). Previous research suggests that the readability of many patient-reported outcome measures available for use within the field of adult audiologic rehabilitation exceed the 4^{th} to 6^{th} grade reading level recommended by health literacy experts (Atcherson, Richburg, Zraick, & George, 2013; Atcherson, Zraick, & Brasseux, 2011; Kelly-Campbell, Atcherson, Zimmerman, & Zraick, 2012).

By inadvertently jeopardising a client's ability to read, comprehend, and appropriately answer these measures, ideals surrounding communication, active participation, and patient narrative promoted by the patient-centred care model cannot be achieved. Moreover, questionnaires that are difficult to read impose an unfair burden upon clients, and ultimately impact the reliability and validity of these tools (Atcherson et al., 2011). As such, the readability of patient-reported outcome measures for use within the field of adult audiologic rehabilitation remains an area of significant importance.

1.2 Prevalence of Hearing Impairment

The World Health Organisation reports that globally, 360 million people, or just over 5% of the world's population, are impacted by a "disabling hearing loss" (with a disabling hearing loss being defined as a "loss greater than 40 dB in the better hearing ear in adults, and a hearing loss greater than 30 dB in the better hearing ear in children”) (WHO, 2015). WHO also reports that approximately one-third of adults over the age of 65 years are affected by a disabling hearing loss of the same criterion, and that the prevalence in this age group is greatest in sub-Saharan Africa, South Asia, and the Asia-Pacific region (WHO, 2015).

Despite the bulk of the 360 million people affected by a disabling hearing loss residing in lower and middle-income countries, hearing impairment still represents a significant issue for New Zealand (Bird & O'Beirne, 2015). The 2001 New Zealand Census data (which has provided the most recent estimate of hearing impairment within New Zealand) suggest that the prevalence of hearing impairment among non-institutionalised adults ≥ 15 years of age is approximately 7.5% (Exeter, Wu, Lee, & Searchfield, 2015; Greville, 2005). It is anticipated that the prevalence of hearing impairment among those aged 70 years or older will increase by more than three-fold by the year 2061 (Bird & O'Beirne, 2015; Exeter et al., 2015). Likewise, the proportion of adult males (≥ 14 years of age) affected by hearing impairment is expected to increase from 7.11% in 2011, to 9.81% in 2061. The proportion of adult females (≥ 14 years of age) affected by hearing impairment is projected to grow from 5.08% in 2011 to 7.02% by 2061 (Exeter et al., 2015). Exeter et al. (2015) claim that this substantial increase in hearing impairment is the result of a rapidly ageing population.

1.3 The Hearing System

The hearing system of humans is an incredibly intricate and complex mechanism. The ear has been described by some as the most complex of all our sensory organs (Møller, 2013). The hearing system consist of the ears and multiple connections to, and within, the central nervous system of the body (Gelfand, 2010). The ear itself has traditionally been categorised into three different parts: the outer, middle, and inner ear (Gelfand, 2010).

The outer ear consists of the external auricle or pinna, and the ear canal or external auditory meatus. The main function of the pinna is to modify incoming sound, especially in the high frequencies (Moore, 2012). This modification significantly contributes to the ability of our auditory system to localise sound (Moore, 2012). The ear canal is approximately 2.5 cm long and resembles a "lazy" S shape (Møller, 2013). The outer portion of the ear canal is lined by skin that produces wax or cerumen, which possesses antibacterial and antifungal properties (Møller, 2013). Likewise, tiny hairs lining the canal contribute to the ear's defense against foreign objects and debris (Gelfand, 2010).

The middle ear contains the eardrum (tympanic membrane) and three small bones known as ossicles. The ossicles are individually named the malleus, incus, and stapes for their distinctive shapes (commonly known as the hammer, anvil, and stirrup) (Gelfand, 2010). The main function of the ossicles is to efficiently transfer the sound vibrations from the eardrum to the inner ear (Moore, 2012). Two small muscles known as the tensor tympani and the stapedius are also located inside the middle ear (Møller, 2013). These muscles contract in response to loud sounds, providing a protective mechanism, or startle response (Gelfand, 2010).

The inner ear consists of the cochlea and vestibular system, both safely enclosed within the bony labyrinth. The cochlea is a tiny snail-shaped structure which contains the sensory organ of hearing (Møller, 2013). This sensory organ of hearing (known as the organ of Corti) contains tiny hair cells which act as sensory receptors (Pickles, 2012). There are two different varieties of hair cells within the organ of Corti, the outer and the inner hair cells. The outer hair cells perform a mechanical amplification role, whilst the inner hair cells convert the sound signal into an electro-chemical message which is then sent to the brain (Pickles, 2012).

The hair cells of the cochlea are intricately connected to the nervous system by way of the vestibulocochlear, or eighth cranial nerve (Gelfand, 2010). The vestibulocochlear nerve is aptly named due to its two functionally discrete portions, or sets of fibres, which combine to form it. The cochlear branch, or cochlear nerve (also known as the auditory or acoustic nerve) is the portion of the vestibulocochlear nerve that sends auditory information from the cochlea directly to the brain. Similarly, the vestibular portion of the vestibulocochlear nerve sends signals regarding balance and spatial orientation to the brain from the vestibular system located within the inner ear.

1.4 Hearing Impairment

When describing a hearing impairment, it is important to consider three main aspects: the type of hearing impairment, the degree of the hearing impairment, and the configuration of the hearing impairment. Hearing impairment can be categorised according to which part of the hearing system is affected. There are currently three different categories used to describe a hearing impairment: conductive, sensorineural, or mixed (American Speech-Language-Hearing Association, 2015).

A conductive hearing impairment occurs when the damage to (or problem with) the hearing system occurs at the level of the outer and/or middle ear. Subsequently, it is more difficult for sound to travel through the outer ear canal to the eardrum and through the middle ear (American Speech-Language-Hearing Association, 2015). A conductive hearing impairment can often be treated or corrected medically or surgically, making it the likely cause of a temporary hearing loss. Some common causes of conductive hearing impairments include ear infections (otitis media), eustachian tube dysfunction, perforated eardrums, damage to, or malformation of the ossicles, impacted ear wax, presence of foreign bodies, or any malformation of the outer and/or middle ear (American Speech-Language-Hearing Association, 2015).

A sensorineural hearing impairment occurs when the damage to the hearing system is located at the level of the inner ear (cochlea), or at the level of the nerve pathways leading from the inner ear to the brain. More often than not, a sensorineural hearing impairment cannot be treated medically or surgically, hence it is the most common cause of permanent hearing loss (American Speech-Language-Hearing Association, 2015). Some common causes of sensorineural hearing impairment include ototoxic drugs or medications, viral or bacterial infections, genetics or family history, ageing (presbycusis), long-term noise exposure, head trauma, or congenital malformations of the inner ear (Møller, 2013).

A mixed hearing impairment occurs when there is both a conductive and sensorineural component contributing to the hearing impairment. Therefore, the level of the hearing system that is affected will include either the outer or middle ear in addition to the inner ear (cochlea) or auditory nerve pathway (American Speech-Language-Hearing Association, 2015).

1.4.1 Degree and Configuration of Hearing Impairment

The degree of hearing impairment is a classification assigned to the impairment based upon the severity of the hearing loss in dB HL (decibels hearing level). There are a number of different decibel (dB) scales that can be used for the measurement of sound intensity. The dB HL scale is used for audiometric assessments because the human ear is not equally sensitive to all of the frequencies within the speech frequency range (Westhorp, 2000). The dB HL scale provides a normative threshold sensitivity value for each of the frequencies based off a young, normal hearing population (Westhorp, 2000). There are currently a number of different classification systems available for use when categorising the degree of hearing impairment. One of the more commonly used scales was developed by Goodman (1965) and modified by Clark (1981). This scale has been embraced by the American Speech-Language-Hearing Association (ASHA) and by the New Zealand Audiological Society (NZAS) (Purdy

& Williams, 2012).

Table 1

Degree of Hearing Impairment

Degree of Hearing Impairment	**Hearing Impairment Range (dB HL)**
Normal	-10 to 15
Slight	16 to 25
Mild	26 to 40
Moderate	41 to 55
Moderately-severe	56 to 70
Severe	71 to 90
Profound	91+

Note. Adapted from "Uses and abuses of hearing loss classification" by J. G. Clark, 1981, *ASHA*, *23* (7), p. 497.

The configuration, or shape, of a hearing impairment describes the pattern the impairment takes as it is exemplified upon an audiogram across the frequency range (American Speech-Language-Hearing Association, 2015). For example, a flat configuration would indicate that the hearing thresholds in dB HL are relatively similar across all of the frequencies tested (American Speech-Language-Hearing Association, 2015). A sloping or falling configuration would indicate that the hearing thresholds in the higher frequencies were more elevated (a greater loss of hearing) as compared to the lower frequencies. Some additional configuration descriptions for hearing impairment include a rising, notched, corner, peaked or saucer, cookie-bite or u-shaped configuration (Carhart, 1945; Lloyd & Kaplan, 1978).

Some further descriptors of hearing impairment include whether or not one or both ears are affected (unilateral vs. bilateral), whether the hearing impairment is a similar degree/configuration in both ears (symmetrical vs. asymmetrical), whether the hearing impairment developed very rapidly or slowly over time (progressive vs. sudden), and whether or not the hearing impairment changes significantly over time (fluctuating vs. stable) (American Speech-Language-Hearing Association, 2015).

1.5 Audiological Assessment

In order to determine the location of a problem within the hearing system, and to glean further insights about the disorder, an audiological assessment must be performed. When performing an audiological assessment, it is important that audiologists and other healthcare professionals make use of a diagnostic test battery. This allows the cross-check principle to be applied (Kreisman, Smart, & John, 2015). An audiologic test battery can be described as a mixture of diagnostic tests or measurements which are used to assess the auditory system. The test battery generally contains a mixture of both objective and subjective/behavioural measurements. By performing multiple tests or measurements, audiologists are able to compare the results of each individual test with the others, increasing the likelihood of a correct diagnosis whilst simultaneously decreasing the likelihood of an incorrect diagnosis (Kreisman et al., 2015). The concept of the cross-check principle was first introduced to the field of audiology by Jerger and Hayes (1976).

1.5.1 Audiologic Test Battery

Some diagnostic tests routinely performed within an audiological assessment include pure-tone audiometry (both air and bone-conduction), speech testing, tympanometry, acoustic reflex thresholds (ARTs), and otoacoustic emissions (OAEs) (Kreisman et al., 2015). Pure-tone audiometry is generally considered to be the gold standard for the assessment of a hearing loss (Sindhusake et al., 2001). Pure-tone audiometry is the most commonly used behavioural test measurement capable of assessing both the degree and etiology of a hearing impairment (Welling & Ukstins, 2015). Speech testing is an additional behavioural test that can provide a more realistic evaluation of speech perception abilities, as opposed to pure-tone stimuli. Speech in noise testing can also provide valuable information as the pure-tone audiogram does not necessarily correlate with the degree of difficulty a listener may face when situated in a challenging, noisy environment (Kreisman et al., 2015).

Immittance testing (consisting of both tympanometry and acoustic reflex thresholds) provides additional objective information that can be used to cross-check results gained from subjective/behavioural measures, particularly when a conductive element is suspected (Kreisman et al., 2015). Tympanometry is a procedure that provides information about the health status of the middle ear by way of measuring the compliance, or mobility, of the eardrum as pressure is applied to the external auditory canal (Welling & Ukstins, 2015). Acoustic reflex thresholds (ARTs) can also provide additional objective information and are particularly useful for cases where behavioural measures may not be entirely reliable or valid. Such cases may include very young children, or adults with language or cognitive issues (Kreisman et al., 2015). Because the pathway involved with the acoustic reflex is complex, ARTs can also indicate retrocochlear (occurring beyond the cochlea) pathology, or help to determine a possible site of lesion within the auditory pathway.

Otoacoustic emissions (OAEs) are another objective measure that can be used as a cross-check for the results obtained via behavioural testing. They provide information regarding the health status of the outer hair cells within the cochlea, and can be affected by conductive pathology in the outer or middle ear. This means that in addition to immittance testing, OAEs can also be used as a way to verify/rule out middle ear pathology (Kreisman et al., 2015). It is important to remember that whilst objective measures play a vital role in audiological assessment, behavioural measures are the only true and direct measures of hearing itself (Hicks, Tharpe, & Ashmead, 2000; Madell, 2011; Welling & Ukstins, 2015).

1.5.2 Patient-Reported Information

The role of a test battery in audiological assessment is vital, but does not provide the audiologist with a complete picture on its own. Patient-reported information has been described by some as a cross-check of the audiologic test battery itself (Kreisman et al., 2015). A comprehensive case history is just one example of patient-reported information required for a holistic approach to audiological assessment and management. Whilst pure-tone audiometry is considered the gold standard measure for the assessment of hearing impairment, it provides very little information surrounding the psychosocial consequences of hearing impairment, such as activity limitations or participation restrictions (Engdahl et al., 2013). In fact, previous studies have shown that the correlation between average pure-tone thresholds and self-reported measures of activity limitations and participation restrictions tend to be very small indeed (Engdahl et al., 2013).

1.6 Patient-Centred Care

The move towards a patient or person-centred care model has become increasingly popular in the modern healthcare delivery process (Rao, 2015; Yorkston, 2015). Patient-centred care can be described as a concept aiming to shift the focus of healthcare delivery away from the traditional "practitioner-centred" approach, to one where the patient or client are actively encouraged to participate in the delivery of their own healthcare, creating a power-balance between practitioners and the client (Grenness, Hickson, Laplante-Lévesque, & Davidson, 2014b). The Institute of Medicine defines patient-centred care as "providing care that is respectful of, and responsive to, individual patient preferences, needs and values, and ensuring that patient values guide all clinical decisions" (Committee on Quality of Health Care in America & Institute of Medicine, 2001, p. 6). The patient-centred care model encourages the client to be viewed as an individual in their entirety, rather than simply focusing upon the physical symptoms of a disorder. This requires the consideration and inclusion of a number of additional aspects, including psychological, social, and environmental factors.

Adopting a patient-centred care model has proven to be particularly beneficial when dealing with chronic health conditions (Michie, Miles, & Weinman, 2003). Numerous studies have demonstrated a higher rate of patient satisfaction among those who have received their treatment aligned with patient-centred care values, as opposed to those whose interactions with their healthcare professionals were less patient-centred (Krupat et al., 2000; Ong, de Haes, Hoos, & Lammes, 1995; Stewart et al., 2000; Wolf, Lehman, Quinlin, Zullo, & Hoffman, 2008). It is important to note, however, that the vast majority of research investigating the relationship between patient-centred care and client satisfaction has been conducted within primary medical care, as opposed to allied health (Grenness et al., 2014b).

1.6.1 Patient-Centred Care in Audiology

The patient-centred care model is not limited in its application to primary medical care. A patient-centred care approach is also appropriate for use within the field of audiology (English, 2005; Gagné & Jennings, 2011; Grenness, Hickson, Laplante-Lévesque, & Davidson, 2014a; Laplante-Lévesque, Knudsen, et al., 2012). This would involve a substantial shift in thinking away from the traditional physician-centred approach focusing solely upon the “ear”, to one where the patient’s own personal understanding of their condition plays an integral part in the diagnostic and management process (Gilligan & Weinstein, 2014). However, whilst several healthcare vocations such as occupational therapy, medicine, and physiotherapy have all developed models for the implementation of patient-centred care into their specific clinical practice, the application of patient-centred care within the field of audiology remains less well-defined (Grenness et al., 2014a). Likewise, patient-centred care has received far less attention within the field of audiology as compared to other healthcare professions (Grenness et al., 2014b).

1.6.2 Third-Party Disability

Patient-centred care is now widely advocated due to its positive effects on patient satisfaction, adherence to treatment, and overall health outcomes (Grenness et al., 2014b). However, one caveat to the concept of patient-centred care is the sole or narrow focus upon the patient-practitioner relationship (Grenness, Meyer, Scarinci, Ekberg, & Hickson, 2016).

Consequently, the model fails to include or acknowledge the contributions of significant others, family members, or close friends within the healthcare delivery process. Nor does it acknowledge the effect of the health condition on these individuals, an impact known as "third-party disability" (Grenness et al., 2016).

The concept of third-party disability was first identified by the WHO in 2001 as an area for future development (WHO, 2001). They defined third-party disability as the "study of disability and functioning of family members due to the health condition of significant others" (WHO, 2001, p. 251). That is to say that although a family member or significant other may not themselves be subject to a health condition, they can still be affected by the health condition of their significant other in the form of impairments, activity limitations, and participation restrictions (Scarinci, Worrall, & Hickson, 2009b).

The significance of third-party disability and its effects within the realm of hearing impairment has received considerable attention in recent literature (Preminger & Meeks, 2012; Scarinci et al., 2009b; Scarinci, Worrall, & Hickson, 2012). Because hearing impairment affects communication, the resultant disability extends beyond the hearing impaired individual to their significant others as well (Grenness et al., 2016; Scarinci, Worrall, & Hickson, 2009a). The resulting effects upon the spouse or significant other are not a direct result of the hearing impairment per se, but of the consequences of communication difficulties resulting in an increased demand for emotional support and communicative assistance via the spouse (Danermark, 2005; Scarinci et al., 2012).

In order to include significant others in the healthcare delivery process, and to actively acknowledge the effects of third-party disability, it is appropriate to expand the patient-centred care approach beyond the isolated patient-practitioner dynamic to include significant others, family members, and friends. This adapted model is more appropriately known as family-centred care (Grenness et al., 2016). Family-centred care promotes a healthy partnership between the clinician, the client, and the significant other during rehabilitation efforts, whilst also considering the needs of the significant other in any clinical exchange (Grenness et al., 2016; Hughes, Bamford, & May, 2008).

1.6.3 Patient-Reported Outcome Measures

With the shift towards patient-centred/family-centred care becoming more prevalent, it is important that clinicians incorporate the use of patient-reported outcome measures, or PROMs, into their daily healthcare practice (Yorkston, 2015). Patient-reported outcomes (PROs) represent the impact that a health condition is having on a client's life, whilst a PROM is "a measurement of any aspect of a client's health status that comes directly from the person, without the interpretation of the person's responses by the clinician" (Jette, 2015, p. 26). PROMs can be particularly useful within the field of audiology as they enable the assessment of self-perceived limitations and participation restrictions in real life listening situations (Boeschen Hospers et al., 2016). PROMs are also inexpensive to administer, convenient, and align with the fundamental principles of patient-centred care (Taylor & Weinstein, 2015).

Dawson, Doll, Fitzpatrick, Jenkinson, and Carr (2010) define PROMs as questionnaires that are both standardised and validated; completed by patients to measure their own personal perceptions pertaining to their functional status and wellbeing. PROMs can be used to facilitate a shared decision making process, monitor treatment efficacy, engage patients with prioritising competing demands, and may simplify potential treatment options for patients, significant others, and clinicians (Taylor & Weinstein, 2015). There are a number of PROMs currently available for use within the field of audiology (Boeschen Hospers et al., 2016). Some well-known audiologic PROMs include the Amsterdam Inventory for Auditory Disability and Handicap (AIADH) (Kramer, Kapteyn, Festen, & Tobi, 1995), the Glasgow Hearing Aid Benefit Profile (GHABP) (Gatehouse, 1999), and the

Communication Profile for the Hearing Impaired (CPHI) (Demorest & Erdman, 1987).

1.7 Adult Audiologic Rehabilitation

Audiologic rehabilitation (also known as auditory, aural, or hearing rehabilitation) involves the provision of training and/or treatment options in order to facilitate improvements in the hearing abilities of those who are hearing impaired (American Speech-Language-Hearing Association, 2016). Appropriately, the provision of audiologic rehabilitation services specifically targeting adults (to be distinguished from rehabilitation efforts directed towards infants and children) is termed adult audiologic rehabilitation.

Boothroyd (2007) defined a holistic approach to adult audiologic rehabilitation as the "reduction of hearing-loss-induced deficits of function, activity, participation, and quality of life through a combination of sensory management, instruction, perceptual training, and counselling" (p. 63). A traditional approach to audiologic rehabilitation tends to see audiologists focus solely upon the sensory management aspect of the rehabilitation process, whilst failing to adequately incorporate instruction, perceptual training, and counselling into their clinical practice. This traditional approach does not facilitate optimal health outcomes, nor does it align with the ideals surrounding patient/family-centred care. In fact, when adult audiologic rehabilitation efforts are limited solely to sensory management, there is more often than not a discrepancy between clinical measures of assisted auditory function and self-assessed benefit as reported by the patient (Boothroyd, 2007). The four categories of adult audiologic rehabilitation as classified by Boothroyd (2007) include sensory management, instruction, perceptual training, and counselling.

1.7.1 Sensory Management

The goal of sensory management is to "target and enhance auditory function" (Boothroyd, 2007, p. 69). This is achieved through the provision of hearing aids, cochlear implants, and other assistive listening devices. The immediate goal of sensory management is to provide improved audibility of sounds, particularly within the important speech frequency range. Ideally, this improved audibility would be impervious to talker distance, talker effort, and background noise/reverberation (Boothroyd, 2007). Of course this ideal goal is not achievable in most real world situations, and the benefit received from sensory management is always limited to some extent. More importantly, clinicians must not assume that improved audibility automatically correlates with improved participation and quality of life. Differences between individuals, particularly with regards to expectations, can lead to selective non-use, emphasising the importance of a holistic approach to adult audiologic rehabilitation (Boothroyd, 2007).

1.7.2 Instruction

Instruction is used to complement sensory management by informing the client on how to use the technology provided to them and how to control their listening environment. The immediate goal of instruction is to enable the client to become a knowledgeable and effective user of their hearing device (Boothroyd, 2007). This encompasses understanding how to maintain and operate their own personal hearing devices, as well as being aware of the potential benefits and limitations of the technology. It is also important that clients be instructed on how to enhance communication with others through the use of communication techniques and strategies (Boothroyd, 2007). Boothroyd (2007) also emphasises that instruction has not occurred for the client until learning has occurred. In order to encourage learning, an audiologist should not only provide verbal instruction, but written materials as well. In addition to this, multiple sessions involving demonstration and coaching may also be required.

1.7.3 Perceptual Training

The goal of perceptual training is not to target function, but rather to enhance or improve perceptual skills allowing better use of that function (Boothroyd, 2007). With regards to adult audiologic rehabilitation, perceptual training targets both communication and speech perception through the enhancement of auditory-visual skills specifically involved with spoken language perception. This can also be known as auditory training (Boothroyd, 2007). Everyday communication provides users of hearing devices with some opportunity to learn and enhance their perceptual skills, however, only formal perceptual training provides clients with increased opportunity to hone these skills in a non-threatening environment, whilst also providing positive feedback to boost confidence. While it differs per individual, it can generally be assumed that any improvement in perceptual/communicative skill directly correlates with increased participation and quality of life (Boothroyd, 2007).

1.7.4 Counselling

The final category of Boothroyd's holistic approach to adult audiologic rehabilitation is counselling. The ultimate goal of counselling is to dually enhance participation, whilst also dealing with the residual limitations of hearing impairment in an emotional/practical manner. The focus of counselling is to address both participation and quality of life. The results are highly dependent upon a number of factors including the clients own personal characteristics, the content of the counselling program, and the development of rapport between the client, the clinician, and other participants within the counselling session (Boothroyd, 2007). Topics which may or may not be discussed include personal relationships, feelings of anger, shame, or guilt, issues surrounding employment, and the difference between an external vs. internal locus of control (Noble, 1996; Stephens, 1996). It is often beneficial to conduct counselling sessions within a group setting in order to maximise patient benefit, and to decrease the associated costs (Boothroyd, 2007).

1.7.5 Validation of Adult Audiologic Rehabilitation

Historically, audiologists have tried to quantify the benefits of audiologic rehabilitation efforts through the use of objective outcome measures, including the estimated degree of improvement in communication function after intervention (Bess, 2000). Such objective outcome measures may include speech perception testing, aided loudness judgements, and real ear insertion gain measurements (Cox, 2003; Öberg, Wänström, Hjertman, Lunner, & Andersson, 2009). Whilst performance measures are an essential component of the validation procedure, they alone do not provide a holistic evaluation of rehabilitation efforts aligned with patient/family-centred care principles (Gatehouse, 1999). For example, direct estimates of perceived activity limitations and participation restrictions can only be obtained through the use of patient-reported outcome measures (PROMs). Outcome measures which fall within a "patient-level" category investigate whether the intervention made a significant difference to the client's wellbeing, functional status, and psychosocial needs (Weinstein, 2015).

1.7.5.1 Patient-Reported Outcome Measures

As previously mentioned, the use of PROMs within the field of audiology has been encouraged by a growing body of literature (Boeschen Hospers et al., 2016; Taylor & Weinstein, 2015). Adult audiologic rehabilitation is no exception. The patient's opinion regarding the quality of the treatment (sensory management, counselling, etc.) is considered to be a "highly significant indicator of treatment excellence" (Cox, 2005, p. 149). Attempting to quantify the client's opinion regarding rehabilitative efforts in a systematic and accurate way requires the use of self-report measures (Cox, 2005). PROMs also provide a more meaningful estimation of real world benefit as compared to traditional, laboratory-based exercises (Cox, 2003). If clinicians wish to comply with an evidence-based practice paradigm, they must exemplify the benefits of intervention within a real world environment (Taylor, 2007). As a result, PROMs have become the new gold standard for measuring and reporting the success of intervention efforts within the field of adult audiologic rehabilitation (Taylor, 2007).

1.7.6 Self-Efficacy

The outcomes of adult audiologic rehabilitation can be greatly affected by the self-efficacy beliefs of the client. Self-efficacy can be defined as the “confidence an individual has for performing a set of skills required to succeed at a specific task or goal” (Smith & West, 2006, p. 46). When a client has a high self-efficacy for their own personal health-management skills, they will continue to persevere with their treatment despite any initial setbacks, and are therefore more likely to succeed at managing their health condition overall as compared to a client with a comparatively lower self-efficacy (Bandura, 1998; West & Smith, 2007). In relation to audiologic rehabilitation, self-efficacy for hearing device care and use (such as hearing aids or cochlear implants) stands to be a useful indicator, or predictor, of rehabilitative success. For example, if an individual has a low self-efficacy for the use and care of their own hearing aids, they are more likely to stop using them all together (Smith & West, 2006).

The concept of self-efficacy is therefore an important factor that must be considered when adhering to the values of a patient/family-centred care model. The patient and their significant other must both learn to adopt new behaviours and skills in order to effectively manage their hearing impairment within a real world environment (Smith, 2014). Therefore, the level of self-efficacy that both the patient and their significant other have for managing their hearing impairment plays a vital role at multiple points along the care continuum (Smith, 2014). This could occur at the point in the continuum before a hearing device is even made available to the client, as they may decline amplification on the grounds of low self-efficacy beliefs (Kricos, 2000; Smith, 2014; Smith & West, 2006).

1.8 Readability

Readability is a measure used to describe the ease with which a passage of text can be read by an individual (Mcinnes & Haglund, 2011). It can be more analytically defined as the "determination by systematic formulae of the reading comprehension level a person must have to understand written materials" (Albright et al., 1996, p. 139). An earlier definition presented by Dale and Chall (1949) defined readability as "the sum total (including the interactions) of all those elements within a given piece of printed material that affects the success a group of readers have with it" (p. 23). Readability can be influenced by a number of factors including layout, sentence length, typography, legibility, jargon, polysyllabic words, personal factors (such as comprehension or motivation), and the use of illustrations (Hayden, 2008). Consequently, it is the readability of a document that makes it comparably easier, or more difficult, to read than another (DuBay, 2004). If the reading level of a document exceeds that which the intended audience is capable of comprehending, they are at risk of not only failing to understanding the material, but also of giving up entirely (Atcherson et al., 2014; DuBay, 2004). As such, the concept of readability poses a difficult question for healthcare providers. How can patients become active contributors and make informed decisions relating to the delivery of their healthcare services (aligning with the core principles of patient/family-centred care) if they are unable to comprehend the written materials provided to them at multiple stages throughout the care continuum, from the initial written consent, to the PROMs used to evaluate rehabilitative efforts.

1.8.1 Measuring Readability

Readability can be measured, or quantified, in a number of different ways. Some techniques include vocabulary analysis, the Cloze procedure, pre-testing of written materials with *ad hoc* comprehension tests, and the use of readability formulas (Ley & Florio, 1996). The use of readability formulas continues to be the method of choice for most applications. Objective, fast, and simple; readability formulas have become so mainstream that many software packages (including Microsoft Word) include readability formulas within their available features (Mcinnes & Haglund, 2011). There are several formulas available that have been specifically developed to measure readability (Mcinnes & Haglund, 2011). They accomplish this by assigning a numeric value to the readability of the analysed written information (Mcinnes & Haglund, 2011). This numeric value often reflects the equivalent academic grade level in the American educational system required to understand the text (Wong & Levi, 2016). The formulas themselves are multiple regression equations incorporating a combination of factors pertaining to the written material, such as the average word length in syllables, the average sentence length in words, and the proportion of common, monosyllabic, or polysyllabic words within the text (Ley & Florio, 1996).

1.8.2 Readability Formulas

Since the 1920s, educators have been using vocabulary and sentence length as a way to predict the apparent difficulty, or readability, of a text (Atcherson et al., 2013; DuBay, 2004). This method has been firmly entrenched with the use of readability formulas, a practice which can boast more than eighty years of application (DuBay, 2004). Since the 1980s there have been more than two-hundred formulas created and over one-thousand studies published relating to, or involving, readability formulas (DuBay, 2004). This alone demonstrates their “strong theoretical and statistical validity” (DuBay, 2004, p. 2).

However, readability formulas are still subject to limitations. The formulas themselves are based upon inferences, or correlations, with particular measures of comprehension; they do not directly identify the root cause of a problem individuals might face when attempting to read or understand materials (Redish, 1981). They do not attempt to measure or quantify typographic features such as font-size or type, illustrations, the use of white space, or the overall attractiveness of the presentation (all features that will have some level of impact upon the readers of the text) (Redish, 1981). They fail to provide any insight into the relevance of a text’s content in relation to a particular audience (something that will significantly impact the audience’s overall understanding of the material). As an example, the contents of Plato's *Parmenides* (considered by many to be one of the most challenging and enigmatic of Plato's dialogues) was translated into English and subsequently deemed suitable reading material for 4th to 8th graders by two popular readability formulas (Gordon, 1980).

An additional problem is the outdated research forming the foundation of readability formulas used today (Redish, 2000). Are readability formulas created for use with school children more than fifty years ago still suitable for application today, given that more than twenty years ago it was demonstrated that the reading abilities of school children had significantly changed (Jacobson, Kirkland, & Selden, 1978; Redish, 2000). Table 2 provides a summary of the advantages and disadvantages of readability formulas.

Table 2

Advantages and Disadvantages of Readability Formulas

Advantages	Disadvantages
• Ability to measure quantitative features such as sentence length, number of words, and number of syllables. • Provides an objective measure of readability. • Provides a method for screening old documents for readability before revising them. • Prove useful when writing/revising educational material when used in conjunction with additional evaluation methods.	• Incapable of measuring the appropriateness of the written material. • Incapable of measuring the accuracy of the written information. • Unable to measure the organisation of written material. • Incapable of measuring the overall appearance of the written material. • Unable to evaluate the readability of graphics, charts, tables or illustrations. • Provides no guarantee surrounding the usefulness of the publication, despite evidence of an appropriate reading grade level.

Note. Adapted from “Readability of educational materials for clients with cleft Lip/Palate and their families” by A. Kahn and M. Pannbacker, 2000, *American Journal of Speech-Language Pathology*, 9(1), p. 7.

Today, new readability formulas are constantly being developed (Benjamin, 2012). Moreover, with the number of readability formulas available for use since the 1980s reaching in excess of two-hundred, it can be a challenge for researchers to decide upon a formula appropriate for use within the field of audiology (DuBay, 2004). This thesis will employ the use of four readability formulas commonly used within the healthcare literature base: Flesch–Kincaid Grade Level Formula, the Gunning Fog Index, Simple Measure of Gobbledygook (SMOG), and the FORCAST formula (Donald & Kelly-Campbell, 2016; Klingbeil, Speece, & Schubiner, 1995; Ley & Florio, 1996; Wang, Miller, Schmitt, & Wen, 2013).

1.8.2.1 Flesch–Kincaid Grade Level Formula (F-K)

Despite Rudolf Flesch publishing his PhD dissertation *Marks of a Readable Style* in 1943, the Flesch–Kincaid grade level formula was not developed until a project sponsored by the U.S. Navy in 1975 recalculated Flesch’s 1948 Reading Ease formula to provide a US grade-level score (DuBay, 2004; Kincaid, Fishburne, Rogers, & Chissom, 1975). This extremely popular modified formula can also be known as the “Flesch-Kincaid formula, the Flesch Grade-Scale formula, or the Kincaid formula” (DuBay, 2004, p. 22). The F-K formula represents the most commonly used readability measure (Fitzsimmons, Michael, Hulley, & Scott, 2010). Despite its popularity, the F-K formula has been criticised due to its apparent underestimation of text readability. This criticism relates to the calculation’s assumption of 75% comprehension (D'Alessandro, Kingsley, & Johnson-West, 2001). Fitzsimmons et al. (2010) also heeds caution when using the F-K readability formula, despite its enduring popularity and easy accessibility in commercial word-processing software. The authors claim that the F-K formula significantly underestimates “reading difficulty, presumably due to its grading for less than complete comprehension of written material” (Fitzsimmons et al., 2010,

p. 295). Furthermore, the F-K formula can only provide a valid score between the US grade levels 3 and 12. This creates an additional limitation in that the formula it is unable to differentiate written materials that are easier, or more difficult, than these grade levels (D'Alessandro et al., 2001).

1.8.2.2 Gunning Fog

The Gunning Fog, or Fog Index, was developed by Robert Gunning in 1952. Gunning was a graduate of Ohio State University, and later worked as a textbook publisher. He often perceived what he called "fog", or unnecessary complexity, within written materials (DuBay, 2004). He attributed this writing problem to the mounting reading problem plaguing an increasing number of high school graduates, who seemed incapable of reading or comprehending simple texts such as newspapers (DuBay, 2004). He published his readability formula in his 1952 book *The Technique of Clear Writing*. The Fog Index quickly grew in popularity due to its ease of use and simplicity (DuBay, 2004). The Fog index was developed using a 90% correct-score with the McCall-Crabbs reading tests (DuBay, 2004). As a result, this formula tends to predict grade-level scores slightly higher than other readability formulas (with the exception of the SMOG formula). Moreover, the FOG formula takes into consideration the number of hard words within the text (hard words being defined as having two syllables or more) unlike some other readability measures, such as the FORCAST or the Flesch Reading Ease formula (Zraick, Atcherson, & Ham, 2012). The FOG formula has proven to be a popular readability formula for use within the healthcare and business industries (Zraick, Atcherson, & Ham, 2012).

1.8.2.3 Simple Measure of Gobbledygook (SMOG)

The SMOG formula (acronym for Simple Measure of Gobbledygook) was developed by G. Harry McLaughlin in 1969 as a substitute for the Fog Index. He claimed that the SMOG formula was more accurate and easier to calculate. McLaughlin believed that word/sentence length should be multiplied, rather than added (DuBay, 2004). McLaughlin validated his formula against the McCall-Crabbs passages using a 100 percent correct-score criterion (a much higher grade criterion than other formulas) (DuBay, 2004). Because of this, the SMOG formula tends to score written materials one-to-two grade levels higher than the Flesch–Kincaid readability tests. As such, Fitzsimmons et al. (2010) recommends that "SMOG should be the preferred measure of readability when evaluating consumer-orientated healthcare material" due to its grading for complete comprehension (p. 295). The SMOG formula is valid from grades 3 through to 19 (a much larger grade range than the F-K formula). However, accuracy may be reduced for materials below the 6th grade level (D'Alessandro et al., 2001).

1.8.2.4 FORCAST

The FORCAST formula was developed in 1973 by The Human Research Organisation of Alexandria, Virginia. The US military commissioned a study aimed at examining the reading requirements of military occupational specialties in the U.S. Army (Caylor, Sticht, Fox, & Ford, 1973). The participants of the study were Vietnam draftees who were entering basic training, and job-specific training (Caylor et al., 1973). Unlike other readability formulas, the FORCAST formula focuses on functional literacy, and does not use a sentence-length measurement (Atcherson et al., 2011; DuBay, 2004). This makes it a particularly useful formula when examining non-narrative or short texts such as questionnaires, forms, tests, quizzes, or any other written materials containing incomplete sentences (Atcherson et al., 2011). Additionally, FORCAST can be labelled different or distinct from other readability formulas due to the fact that it also ignores the number of sentences and any hard punctuation within the text (Zraick, Atcherson, & Ham, 2012).

1.9 Health Literacy

Readability is a central component of health literacy (Kasabwala, Agarwal, Hansberry, Baredes, & Eloy, 2012). The concept of health literacy is a relatively recent addition to the healthcare industry, first appearing within the literature base around the early-to-mid 1990s (Cutilli, 2007). The World Health Organisation defines health literacy as "the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand, and use information in ways which promote and maintain good health." (WHO, 1998, p. 10). Health literacy is a significant factor impacting access to healthcare information and empowering individuals to take charge of their health (Friedman & Hoffman-Goetz, 2006). An individual with an appropriate level of health literacy has the ability to take responsibility for their own health, in addition to the health of their family and community (Sørensen et al., 2012).

Despite the obvious benefits of attaining an adequate level of health literacy not only for one's self, but also for the immediate community, the National Assessment of Adult Literacy discovered that only a mere 12% of the US population has a proficient level of health literacy (Gilligan & Weinstein, 2014; Kutner, Greenburg, Jin, & Paulsen, 2006). Possibly more concerning was the proportion of those deemed as having a "low", or "limited" level of health literacy; approximately 33% of the population, or ninety million Americans (Gilligan & Weinstein, 2014; Kutner et al., 2006). The 2013 WHO publication *Health Literacy: The Solid Facts* reported that nearly half of all adults in eight European countries (Austria, Bulgaria, Germany, Greece, Spain, Ireland, Netherlands and Poland) have inadequate health literacy skills (Gilligan & Weinstein, 2014; WHO, 2013). Closer to home, a 2006 Adult Literacy and Life Skills Survey revealed that on average, New Zealanders have poor health literacy skills (Manatū Hauora, Ministry of Health, 2010).

Groups particularly susceptible to low health literacy rates are those aged 65 years or older, those who did not complete a high school level of education, and those who live in a rural setting (Gilligan & Weinstein, 2014; Manatū Hauora, Ministry of Health, 2010). In New

Zealand, Māori who fall within the age brackets of 16−18, 19−24 and 50−65 years have the poorest health literacy as compared to the rest of the population (Manatū Hauora, Ministry of Health, 2010). This pattern remains consistent with Māori across all job-types and income levels possessing poorer health literacy skills as compared to non-Māori; whilst Māori who are unemployed or looking for work rate the poorest in terms of health literacy across all groups (Manatū Hauora, Ministry of Health, 2010).

International research continues to demonstrate the relationship between a person's level of health literacy and their health status (Canadian Council on Learning, 2008; Nutbeam 2008). The consequences of low health literacy rates on an individual and to society as a whole are considerable. A 1998 analysis estimated that low levels of health literacy costs the US healthcare sector in excess of 50 billion dollars per year (Friedland, 1998; Mårtensson & Hensing, 2012). People with poor health literacy are less likely to use prevention services such as healthcare screenings, have less knowledge surrounding their illnesses/associated treatments, are more likely to be hospitalised/require the use of emergency services, and are less likely to manage their long-term chronic health conditions (Manatū Hauora, Ministry of Health, 2010).

The US Institute of Medicine has identified health literacy as a national priority area that needs to be addressed in order to transform the quality of healthcare (Paasche-Orlow, Schillinger, Greene, & Wagner, 2006). Multimedia presentations, community-based/participatory approaches, and the simplification of reading materials through the use of clear language, pictures, and symbols, are just a few of the solutions to have been put forward (WHO, 2009). The simplification of reading materials is by far the most widespread initiative reported within the literature base (WHO, 2009). Health information that is hard to read may inadvertently cause it to become inaccessible for people with low levels of health literacy (Mcinnes & Haglund, 2011).

1.9.1.1 Health Literacy and Readability

The gap between the readability of written health information and the average literacy skills of individuals is well-documented (Rudd, Moeykens, & Colton, 2000; Zorn, Allen, & Horowitz, 2004). Health information is often written at a reading grade level far beyond that which the average patient is capable of comprehending (D'Alessandro et al., 2001; Paasche-Orlow, Taylor, & Brancati, 2003; Svarstad, Bultman, Mount, & Tabak, 2003). In order to maximise the number of adults who are able to read and comprehend health information, the general consensus is that materials should be written at the 4^{th} to 6^{th} grade reading level (Matthews & Sewell, 2002; Wang et al., 2013; Weis, 2003). At a very minimum, the readability of health information should not exceed the 6^{th} grade level (Doak, Doak, & Root, 1996; Donald & Kelly-Campbell, 2016; Friedman & Hoffman-Goetz, 2006; Yin, Forbis, & Dreyer, 2007). The recommended reading grade level of health information for elderly clients is even lower (Caposecco, Hickson, & Meyer, 2014). Their reading and comprehension abilities are particularly affected due to their cognition, vision, and hearing status (Safeer & Keenan, 2005).

Despite these recommendations, Safeer and Keenan (2005) found that the majority of healthcare materials are written at the 10^{th} grade level or above. Kong and Hu (2015) investigated the readability of online tracheostomy care resources and found that all of the resources examined within the study were written at a level more difficult than the recommended 4^{th} to 6^{th} grade level for written health information. Similar results have been shown across multiple fields of medicine (Kong & Hu, 2015). Studies within the fields of orthopaedics, ophthalmology, radiology, and neurology have all reported that none of the analysed resources met current readability guidelines (Edmunds, Barry, & Denniston, 2013; Hansberry et al., 2014; Sabharwal, Badarudeen, & Unes Kunju, 2008; Sharma, Tridimas, & Fitzsimmons, 2014).

1.9.1.2 Readability of Health Materials within Audiology

The readability of health information has also been examined within the field of audiology. Laplante-Lévesque, Brännström, Andersson, and Lunner (2012) evaluated the readability of internet information for adults with hearing impairment and their significant others. They found that on average, only people who had been subject to at least eleven-to-twelve years of education could read and understand the internet information presented. Donald and Kelly-Campbell (2016) evaluated a typical paediatric diagnostic audiology report in order to establish its readability and comprehensibility for parents. Their results confirmed that the original report was indeed difficult for parents to read and understand. Additionally, they found that the readability estimates calculated for this report exceeded those of other audiology parental resources previously evaluated within the literature (Atcherson et al., 2013; Joubert, & Githinji, 2014; Swartz, 2010). However, this may be attributed to the type of diagnostic audiology report analysed (one which was specifically addressed to other health professionals and simply copied to the parents) (Donald & Kelly-Campbell, 2016).

Atcherson et al. (2014) examined the readability of audiology and speech language pathology related consumer materials available to the public on the ASHA website. The readability of the materials was calculated according to four different formulas (Flesch Reading Ease, Flesch-Kincaid, Gunning FOG, and FORCAST). They found that the majority (85.4% or more) of the two-hundred and twenty-five documents analysed had a reading grade level of the ninth grade or higher. These reading grade levels are significantly higher than the fourth-to-sixth grade level recommended by health literacy experts. Given ASHA's commitment to promoting effective communication as an accessible and achievable human right for all, it is clear more work is required in order to improve the readability of audiology-related health materials, transforming them into accessible and comprehendible resources for individuals with limited health literacy skills. Ritchie, Tornari, Patel, and Lakhani (2016) also examined health information available to the general public on the internet, specifically in relation to glue ear. Readability scores were calculated using the Flesch–Kincaid readability formula. They found that there was significant variation in the quality of information available to patients on the internet, however, most websites scored highly in terms of either readability or consumer health information quality, but rarely both.

1.9.1.3 Readability and Audiologic Patient-Reported Outcome Measures

The readability of audiologic PROMs has also received a considerable amount of attention in recent years. When the reading level of a patient-reported outcome questionnaire is too high, patients may "reject the questionnaire, may provide missing or partial information, or may complete the questionnaire with responses that are incongruent with their health status" (Zraick, Atcherson, & Brown, 2012, p. 21). As a result, the treatment, planning, and outcomes suggested by practitioners based off responses obtained from these questionnaires may be unsuitable (Zraick, Atcherson, & Brown, 2012). By inadvertently jeopardising a client's ability to read, comprehend, and appropriately answer questionnaires due to the high level of health literacy required to read such a text, ideals surrounding communication, active participation, and patient narrative promoted by patient/family-centred care models cannot be achieved. As such, the readability of patient-reported outcome measures for use within the field of audiology remains an area of utmost importance.

Atcherson et al. (2011) examined the readability of fifteen tinnitus-focused, patient-reported outcome questionnaires using the Flesch Reading Ease, FOG, and FORCAST readability formulas. They found that majority of the questionnaires exceeded the recommended 4^{th} to 6^{th} grade reading level, regardless of the formula applied. In a similar study, Atcherson et al. (2013) analysed the readability of eight (central) auditory processing disorder questionnaires designed for students using the Flesch Reading Ease, FOG, and FORCAST readability formulas. Their results showed similar findings to previous studies, with the FORCAST formula (the readability formula most suited for use with questionnaires) revealing that all eight questionnaires were written at reading levels between the 8th and the 10th grade.

Kelly-Campbell et al. (2012) was the first study of its kind to examine the readability of self-report hearing disability measures. The Hearing Handicap Inventory for the Elderly (HHIE), Hearing Aid Performance Inventory (HAPI), Hearing Handicap Inventory for Adults (HHIA), and the Abbreviated Profile of Hearing Aid Benefit (APHAB) were all assessed using the Flesch Reading Ease, FOG, and FORCAST readability formulas. They found that the reading level of all four questionnaires exceeded the 4th to 6th grade reading level recommended by health literacy experts when calculated using the FORCAST readability formula. Again, this emphasises the need to address the readability of audiologic PROMs in order to verify their worth as a quantitative outcome measures, in addition to fulfilling the core values of patient/family-centred care.

1.10 Patient-Reported Outcome Measures used in Adult Audiologic Rehabilitation

Today there is an abundance of PROMs available for use within the field of adult audiologic rehabilitation. One of the first audiologic PROMs ever published was the Scale of Self-Assessment of Hearing Handicap developed by High, Fairbanks, and Glorig (1964). The last two decades in particular have seen a significant proliferation of PROMs developed for use within the field of audiology. These measures can follow either that of an open-ended or closed-ended structure. An open-ended structure is one which allows the client the ability to suggest and target their own areas of improvement. Comparatively, a closed-ended structure permits the patient to complete the self-report scale using a list of pre-determined areas of concern (Taylor, 2007). One benefit when using a closed-ended structure is that it allows the resultant scores to be more readily quantified and directly compared to normative data. However, a benefit of using an open-ended structure is that it allows for greater flexibility, and can be tailored to meet the unique needs of all individuals seen within a clinical setting (Taylor, 2007). For the purposes of this thesis, ten closed-ended PROMs commonly used within the field of adult audiologic rehabilitation are discussed briefly below.

1.10.1 The Amsterdam Inventory for Auditory Disability and Handicap (AIADH)

The Amsterdam Inventory for Auditory Disability and Handicap (AIADH) is a self-assessment questionnaire consisting of thirty questions which deal with a variety of everyday listening situations (Kramer et al.,1995). The original AIADH was developed in Dutch and translated into English by Kramer et al. (1995). It has since been translated into Spanish, Swedish, and Cantonese (Fuente, McPherson, Kramer, Hormazábal, & Hickson, 2012; Fuente, McPherson, Kwok, Chan, & Kramer, 2012; Hallberg, Hallberg, & Kramer, 2008). Moreover, it has been widely used in a number of different clinical populations (Kramer et al.,1995; Meijer, Wit, Tenvergert, Albers, & Kobold, 2003; Molander et al., 2013; Neijenhuis, Stollman, Snik, & Van den Broek, 2001).

1.10.2 The Communication Profile for the Hearing Impaired (CPHI)

The Communication Profile for the Hearing Impaired (CPHI) is a one hundred and forty-five item self-assessment inventory specifically designed for adults (Demorest & Erdman, 1987). It consists of twenty-five scales encompassing four different areas: communication performance, communication environment, communication strategies, and personal adjustment (Demorest & Erdman, 1987). Since its development in 1987, the CPHI has been frequently used world-wide, including a number of studies involving adult cochlear implant recipients conducted at the University of Iowa and Washington University School of Medicine (Binzer, 2000; Knutson & Lansing, 1990; Lansing & Davis, 1990; Lansing & Seyfried, 1990; Mokkink, Knol, Zekveld, Goverts, & Kramer, 2009).

1.10.3 The Speech, Spatial, and Qualities of Hearing Scale (SSQ)

The Speech, Spatial, and Qualities of Hearing Scale (SSQ) is a forty-nine item PROM of auditory disability designed by Gatehouse and Noble (2004). The items of the SSQ are grouped into three main subscales: speech perception, spatial hearing, and qualities of hearing. These items ask the listener to assess different scenarios through the depiction of real world hearing situations (Gatehouse & Noble, 2004; Moulin, Pauzie, & Richard, 2015). The SSQ is quickly becoming one of the most widely used PROMs within the field of audiology (Ahlstrom, Horwitz, & Dubno, 2014; Anderson, Parbery-Clark, White-Schwoch, & Kraus, 2013; Firszt, Holden, Reeder, Cowdrey, & King, 2012; House, Kutz Jr, Chung, & Fisher, 2010; Noble, Tyler, Dunn, & Bhullar, 2008, 2009; Van Wieringen, De Voecht, Bosman, & Wouters, 2011).

1.10.4 The Hearing Impairment Impact-Significant Other Profile (HII-SOP)

The Hearing Impairment Impact-Significant Other Profile (HII-SOP) is a twenty item self-assessment scale designed by Preminger and Meeks (2012). Its purpose is to measure/quantify third-party hearing loss-related quality of life (or third-party disability) in spouses of people with hearing loss. It consists of three subscales which measure “the emotions that arise when having a spouse with hearing loss as well as the impact of the hearing loss on the marital relationship, the impact of the hearing loss on the social life of the spouse, and the communication strategies used by the spouse” (Preminger & Meeks, 2012, p. 807).

1.10.5 The Significant Other Scale for Hearing Disability (SOS-HEAR)

The Significant Other Scale for Hearing Disability (SOS-HEAR) is a twenty-seven item self-assessment scale designed by Scarinci et al. (2009a) as a measure for third-party disability experienced by spouses of older people with hearing impairment. The items of the SOS-HEAR measure six domains of third-party disability and functioning: relationship changes, communication changes, communicative burden, going out and socialising, emotional reactions, and concern for partners (Scarinci et al., 2009a). These domains of third-party disability and functioning are consistent with previous qualitative studies (Scarinci, Worrall, & Hickson, 2008).

1.10.6 The Device Oriented Subjective Outcome Scale (DOSO)

The Device Oriented Subjective Outcome Scale (DOSO) is a forty item questionnaire designed to measure self-report hearing aid outcomes (Cox, Alexander, & Xu, 2014). It consists of six subscales: speech cues, listening effort, pleasantness, quietness, convenience, and use (Cox et al., 2014). There are currently three versions of the DOSO available for use, one long form (40-items) and two short forms (28-items). The two short forms can be distinguished by the items present within the "speech cues" and "listening effort" subscales (Hearing Aid Research Lab, 2016). The DOSO can be particularly useful for comparing outcomes with different hearing aids (Cox et al., 2014).

1.10.7 The Glasgow Hearing Aid Benefit Profile (GHABP)

The Glasgow Hearing Aid Benefit Profile (GHABP) is a questionnaire developed by Gatehouse (1999) capable of "evaluating the efficacy and effectiveness of rehabilitative services for hearing-impaired adults" (Gatehouse, 1999, p. 80). The questionnaire asks respondents to reflect upon four different situations involving speech, and to rate their perceived initial hearing disability, initial handicap, aided benefit, aided handicap, hearing aid use, and hearing aid satisfaction using a five-point scale (Whitmer, Howell, & Akeroyd, 2014). The GHABP has played an important role in the modernisation of hearing aid services within the United Kingdom, and has been routinely administered to participants of the Institute of Hearing Research for around a decade, whether they wore no, one, or two hearing aids (Davis, Smith, Ferguson, Stephens, & Gianopoulos, 2007; Whitmer et al., 2014).

1.10.8 The International Outcome Inventory for Hearing Aids (IOI-HA)

The International Outcome Inventory for Hearing Aids (IOI-HA) was developed in order to create a standardised and internationally useful PROM (Thunberg Jespersen, Bille, &

Legarth, 2014). It is the product of an international workshop focusing on self-report outcome measures for use within the field of audiologic rehabilitation (Cox et al., 2000). The participants of the workshop all agreed that there was a significant need for the ability to combine and compare data from differing investigations, hearing healthcare settings, and nations (Cox, Stephens, & Kramer, 2002). The IOI-HA has not been designed to replace existing outcome measures, but rather to serve as a useful addition to existing measures used within a research setting.

1.10.9 The Satisfaction with Amplification in Daily Life Scale (SADL)

The Satisfaction with Amplification in Daily Life Scale (SADL) was developed by Cox and Alexander (1999). The scale attempts to quantify satisfaction using a global score and four subscales: positive effect, service and cost, negative features, and personal image (Cox & Alexander, 1999). The SADL consist of fifteen items, each of which is scored based upon a seven point rating scale (the higher the score, the greater the reported satisfaction) (McLeod & Upfold, 2003). The questionnaire is commonly used to measure the overall satisfaction of individuals who are currently using hearing aids (Hosford-Dunn & Halpern, 2000, 2001). Aside from the original English version, there are also translations available in Spanish, Portuguese, Swedish, Danish, German, and Odia (Fang, Chang, Wan, Wang, & Chen, 2013).

1.10.10 The Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids (MARS-HA)

The Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids (MARS-HA) is a twenty-four item self-assessment questionnaire developed by West and Smith (2007). Its main purpose is to measure/quantify hearing aid self-efficacy in order to assist clinicians with the identification of low-confidence areas that would benefit from additional audiologic training (West & Smith, 2007). The MARS-HA investigates hearing aid related behaviours such as the ability to manipulate batteries and controls, as well as the ability to hear/communicate effectively in a variety of aided listening situations (Smith & West, 2006). The items can be categorised into four different subscales: basic handling of hearing aids, advanced handling and knowledge of hearing aids, adjustment to hearing aids, and aided listening skills (Smith & West, 2006).

1.11 Study Rationale

Previous literature has established that the readability of the majority of health information available to the public and to patients exceeds the recommended 4th to 6th grade reading level. This phenomenon has been observed throughout multiple medical disciplines including, but not limited to, ophthalmology, orthopaedics, radiology, and neurology (Kong & Hu, 2015). Research within the field of audiology has also shed light upon this issue. The high readability of patient-reported outcome measures poses a significant problem within the healthcare sector. Not only does it call into question the validity of the data collected using such an outcome measure, it also excludes clients with low levels of health literacy from actively participating in their own healthcare, a principle central to the application of a patient/family-centred care model (Gilligan & Weinstein, 2014). In order for a patient/family-centred care model to be applied within the field of adult audiologic rehabilitation, PROMs must be written at a level that aligns with the levels recommended by health literacy experts. Additionally, with the demographic shift to an aging population occurring throughout most of the western world, (resulting in an increasing prevalence and severity of hearing impairment) this issue is more pressing than ever; given that the health literacy of older adults is, on average, particularly limited (Gilligan & Weinstein, 2014).

Whilst research surrounding health literacy and readability within the field of audiology is lacking, research specifically focusing on the readability of audiologic PROMs is even sparser. To date, only a few studies have attempted to analyse and report on the readability of such PROMs within the field of audiologic rehabilitation (Atcherson et al., 2011, 2013; Kelly-Campbell et al., 2012). This study aims to further investigate the issue of health literacy within the field of audiology by specifically examining the readability of a number of PROMs commonly used within an adult audiologic rehabilitative setting.

1.12 Aim and Hypothesis

The main purpose of this study is to report upon the readability of several patient-reported outcome measures (PROMs) commonly used within the field of adult audiologic rehabilitation. The second purpose of this study is to compare the resultant readability scores to the readability levels recommended for health information by health literacy experts. Ultimately, the aim of this study is to answer the following research questions:

1) What is the readability in reading grade level (RGL) of a range of PROMs aimed at adults with hearing impairment and their significant others?
2) What proportion of the PROMs exceed the recommended 4^{th} to 6^{th} grade reading level?

Previous research has consistently found that the readability of health information (including patient-reported outcome measures used within the healthcare field) has exceeded those levels recommended by health literacy experts (D'Alessandro et al., 2001; Edmunds et al., 2013; Hansberry et al., 2014; Kong & Hu, 2015; Paasche-Orlow et al., 2003; Rudd et al., 2000; Sabharwal et al., 2008; Safeer and Keenan, 2005; Sharma et al., 2014; Svarstad et al., 2003; Zorn et al., 2004). The field of audiology is no exception (Atcherson et al., 2013, 2014; Donald & Kelly-Campbell, 2016; Joubert & Githinji, 2014; Laplante-Lévesque, Brännström, et al., 2012; Ritchie et al., 2016; Swartz, 2010). More specifically, recent research into the readability of audiologic PROMs continues to reveal that the reading grade levels of these questionnaires consistently exceed the recommended 4^{th} to 6^{th} grade (Atcherson et al., 2011, 2013; Kelly-Campbell et al., 2012).

Based upon a review of previous literature within this field, the following hypothesis was proposed:

That the readability of the majority of the ten PROMs assessed will exceed the recommended 4th to 6th grade reading level.

Chapter Two: Methods

2.1 Overview

The purpose of this study was to report on the readability of several PROMs commonly used within the field of adult audiologic rehabilitation, and to compare the resultant readability scores to the readability levels recommended for health information by health literacy experts. The ten PROMs chosen for readability analysis were the AIADH, CPHI, SSQ, HII-SOP, SOS-HEAR, DOSO, GHABP, IOI-HA, SADL, and the MARS-HA. Readability was analysed using four readability formulas commonly used within healthcare and audiologic readability studies: F-K, Gunning Fog, SMOG, and FORCAST. The FORCAST formula is particularly suited for the format of these PROM questionnaires due to its focus on functional literacy.

2.2 Literature Search

A literature search for self-assessment tools used as outcome measures within recent audiologic research studies was performed. Databases used in the search process include:

1. Cumulative Index of Nursing and Allied Health Literature (CINAHL)
2. Cochrane Library
3. Medline
4. PsychINFO
5. PubMed
6. Web of Science

2.2.1 Inclusion Criteria

Inclusion criteria for the PROMs analysed in this study include:

1. English language self-assessment tools used within the field of audiologic rehabilitation.
2. Published in a peer-reviewed journal article

a. Developed after 2012

b. Used in research after 2012

2.2.2 Exclusion Criteria

Exclusion criteria for the PROMs analysed in this study include:

1. PROMs included in Kelly-Campbell et al. (2012) study. This included the:
    a. Hearing Handicap Inventory for the Elderly (HHIE)
    b. Hearing Handicap Inventory for Adults (HHIA)
    c. Abbreviated Profile of Hearing Aid Benefit (APHAB)
    d. Hearing Aid Performance Inventory (HAPI)
2. PROMs with open-ended items only
3. Studies focusing on children with hearing impairment.

2.2.3 Search Results

Tools were selected in order to obtain a variety of constructs. The search resulted in the following list of PROMs commonly used within adult audiologic rehabilitation:

1. Amsterdam Inventory for Auditory Disability and Handicap (AIADH)
2. Communication Profile for the Hearing Impaired (CPHI)
3. Speech, Spatial, and Qualities of Hearing Scale (SSQ)
4. Hearing Impairment Impact-Significant Other Profile (HII-SOP)
5. Significant Other Scale for Hearing Disability (SOS-HEAR)
6. Device Oriented Subjective Outcome Scale (DOSO)
7. Glasgow Hearing Aid Benefit Profile (GHABP)
8. International Outcome Inventory for Hearing Aids (IOI-HA)
9. Satisfaction with Amplification in Daily Life Scale (SADL)
10. Measure of Audiologic Rehabilitation Self-Efficacy for Hearing Aids (MARS-HA)

2.3 Readability Measures

Four readability formulas, specifically the F-K, Gunning Fog, SMOG, and FORCAST were used in this study. There are no specific standards for choosing readability formulas, hence the above formulas were chosen predominantly due to their frequent use within healthcare and audiology-specific literature (Breese & Burman, 2005). For this study, readability formulas were selected based upon:

1. Their suitability for use with questionnaire data
2. Their comparability to existing literature
3. Their ability to report readability in the form of a reading grade level (RGL).

2.3.1 Flesch–Kincaid Grade Level Formula (F-K)

The F-K formula is specifically designed for use with technical documents. It is most applicable for use with manuals and forms as compared to schoolbook text or literary works. Interpreting the resultant score is relatively simple. For example, a score of 9.2 indicates that a ninth grader (according to the US education system) should be able to read the document. The formula calculation is based upon an assumption of 75% comprehension. The grade level is calculated using the following formula (adapted from Kincaid et al., 1975):

$$\text{Grade} = 0.39\left(\frac{\text{Total Words}}{\text{Total Sentences}}\right) + 11.8\left(\frac{\text{Total Syllables}}{\text{Total Words}}\right) - 15.59$$

2.3.2 Gunning Fog (FOG)

The Gunning Fog formula is useful for business publications and journals. The formula requires a minimum of 100 sample words. The grade level is calculated using the following formula (adapted from Gunning, 1952):

$$\text{Grade} = 0.4\left[\left(\frac{\text{Words}}{\text{Sentences}}\right) + 100\left(\frac{\text{Complex Words}}{\text{Words}}\right)\right]$$

2.3.3 Simple Measure of Gobbledygook (SMOG)

The SMOG formula is useful for most texts. Additionally, the formula tests for 100% comprehension. This differs to most other formulas which only test for around 50% to 75% comprehension. For this reason, SMOG is particularly ideal for healthcare information as even the smallest quantity of misconstrued information can lead to poorer health outcomes (Wang et al., 2013). The SMOG formula yields a U.S. school grade level indicating that the average student in that grade level can adequately read and comprehend the text. The formula calculation involves selecting ten consecutive sentences from the beginning, middle and end of the text, giving a total of thirty sentences. The total polysyllabic word count from these thirty sentences is applied to a SMOG conversion table in order to determine the corresponding reading grade level (Kahn & Pannbacker, 2000). This calculation can be visualised using the following formula (adapted from McLaughlin, 1969):

$$\text{Grade} = 1.0430\sqrt{\text{Number of Polysyllables} \times \frac{30}{\text{Number of Sentences}}} + 3.1291$$

2.3.4 FORCAST

The FORCAST formula is particularly suited for use with questionnaires. It is the only formula not designed for running narrative. As a result, it is the most appropriate formula for use with multiple-choice quizzes, applications, and entrance forms, etc. The grade level is calculated using the following formula (adapted from Caylor et al., 1973):

$$\text{Grade} = 20 - \left(\frac{\text{Number of Monosyllabic Words in the Sample Text}}{10}\right)$$

2.4 Source and Conversion to Microsoft Word Documents

The source of the ten PROMs chosen for readability analysis were as follows:

1. AIADH = Appendix of Kramer et al. (1995).
2. CPHI = Print copy © 1984
3. SSQ = MRC Institute of Hearing Research website: SSQ Version 5.6 (minor revision to the 2004 published SSQ with various spelling mistakes corrected).
4. HII-SOP = Appendix of Preminger and Meeks (2012).
5. SOS-HEAR = Appendix of Scarinci et al. (2009a).
6. DOSO = Hearing Aid Research Lab (HARL) website: English [DOSO] PDF © University of Memphis (2009).
7. GHABP = Appendix B - Prespecified Element of the Glasgow Hearing Aid Benefit Profile of Gatehouse (1999).
8. IOI-HA = Appendix of Cox et al. (2002).
9. SADL = Hearing Aid Research Lab (HARL) website: SADL Questionnaire PDF © University of Memphis (1999).
10. MARS-HA = Appendix of West and Smith (2007).

The PROMs were then transferred from the source PDF/ hard copy documents via the copy/paste function (or typing where required) and divided into separate Microsoft Word documents according to the following sections:

1. Instructions (if applicable. The AIADH, GHABP, HII-SOP, IOI-HA did not contain any instructions).
2. Items
3. Response scale
4. Overall outcome measure including title, instructions (if applicable), items, and response scale. Any section headings, page numbers, or information relevant to the client (such as client information sections to be filled out) present within the original document were included within this Microsoft

Word document.

Any written information in the original document directed towards the clinician/audiologist (such as clinician instructions or hospital ID number) were excluded from the Microsoft Word documents.

2.5 Readability Analysis

Readability was assessed using the Windows-based software Readability Studio (Oleander Software, 2012.1 © 2013 Oleander Software). Readability Studio 2012.1 offers many popular readability tests for English (in addition to Spanish/German) text, including the required F-K, Gunning Fog, SMOG, and FORCAST formulas. The software also supports importing text from many file formats, including: ANSI and Unicode text, Microsoft Word 95-2003 documents, Microsoft Word 2007 documents, Microsoft PowerPoint 2007 documents, OpenOffice documents, HTML, Rich text, and Postscript. Additionally, the software also provides the user with detailed explanations surrounding the results, a sentence and syllable count breakdown, numerous sentence and word statistics, ideas on how to improve the readability of a document, and highlights difficult/polysyllabic words for easy identification.

The analysis was performed as follows:

1. Oleander Readability Studio was opened, and the “Create a New Project” button was clicked.
2. “English” was selected as the document’s language.
3. “Read text from a file or webpage” was selected, and a saved Microsoft Word document was chosen containing a PROM segment (instructions, items, response scale, or entire questionnaire).
4. The parameters describing the document composition and layout were selected (specifically “Non-narrative, fragmented text” and “Centered/ left-

aligned text”).

5. “Manually select tests” was selected, and the F-K, Gunning Fog, SMOG, and FORCAST readability formulas were ticked.
6. The software then produced the readability scores for each of the above readability formulas.
7. The data were then exported and saved under the appropriate heading (i.e. HII-SOP Items).

2.6 Statistical Analyses

All analyses were completed using Microsoft Excel 2013. Descriptive statistics were used to quantitatively describe/summarise the reading grade levels obtained for each section of each PROM (instructions if applicable, items, response scale, and the overall questionnaire). PROM sections that did not contain at least one hundred words were excluded from the statistical analyses due to inaccuracies associated with an inadequate text length.

Chapter Three: Results

3.1 Readability

The readability of the ten PROMs included within this study was analysed according to their separate sections (if applicable): respondent instructions, items, response scale, and the overall/entire measure (including all text relevant to the respondent). Readability scores (RGL) were calculated using the four readability formulas: F-K, FOG, SMOG, and FORCAST.

3.1.1 Instructions

Of the ten PROMs analysed, six contained written instructions directed towards the respondent (CPHI, DOSO, MARS-HA, SADL, SOS-HEAR, and SSQ). Of the six PROMs that contained instructions, only two met the minimum required word count (100 words or more) for accurate readability analysis: the CPHI and the SSQ. Table 3 provides a summary of the readability results for each of the four readability formulas used to analyse the CPHI and SSQ user instructions. Figure 1 displays the median reading grade level (calculated using the combined F-K, FOG, SMOG, and FORCAST scores) of the individual CPHI and SSQ user instructions, and compares these medians to the maximum reading grade level recommended by health literacy experts. The median RGL of both the CPHI and SSQ user instructions exceeds the recommended 4^{th} to 6^{th} grade reading level.

Table 3

Readability Statistics of the CPHI and SSQ instructions reported in Reading Grade Level

PROM	Readability (RGL)			
	F-K	FOG	SMOG	FORCAST
CPHI	11.4	12.7	13.1	11.0
SSQ	6.1	8.5	9.3	9.0
Mean	8.8	10.6	11.2	10.0
Median	8.8	10.6	11.2	10.0

SD	3.7	3.0	2.7	1.4
Range	6.1 – 11.4	8.5 – 12.7	9.3 – 13.1	9.0 – 11.0

Note. F-K = Flesch-Kincaid Readability Formula; FOG = Gunning Fog Index Readability Formula; FORCAST = FORCAST Readability formula; SMOG = Simple Measure of Gobbledygook Readability Formula.

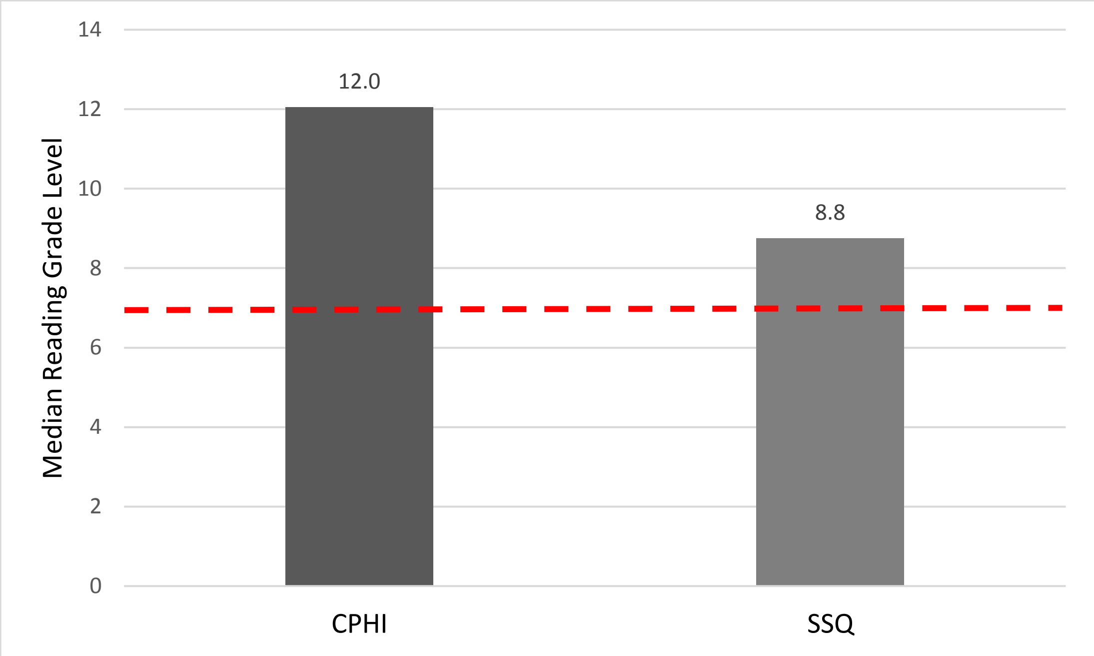

Figure 1. Median reading grade level of the CPHI and SSQ user instructions. Median calculated using the combined F-K, FOG, SMOG, and FORCAST scores. The maximum reading grade level recommended for health materials is indicated by the red dashed line.

3.1.2 Items

Nine of the ten PROMs chosen for use within this study contained items with a total word count exceeding the minimum sample size (100 words) required for accurate readability analysis. Due to the inadequate word count of the items contained within the pre-specified element of the GHABP, the readability results of this measure's items were omitted from the study. Table 4 provides a summary of the readability results for each of the four readability formulas used to analyse the items of the nine eligible PROMs. Figure 2 compares the median reading grade level (calculated using the F-K, FOG, SMOG, and FORCAST scores) of the individual PROM items to the maximum reading grade level recommended by health literacy experts. All of the median RGLs for all PROM items exceed the recommended 4th –

6th grade reading level.

Table 4

Readability Statistics of PROM items reported in Reading Grade Level

PROMS	Readability (RGL)			
	F-K	FOG	SMOG	FORCAST
AIADH	6.5	9.9	10.1	10.0
CPHI	6.5	8.6	9.4	10.1
DOSO	6.1	7.7	8.6	11.0
HII-SOP	6.0	7.4	8.6	8.6
IOI-HA	7.9	9.9	9.9	9.4
MARS-HA	15.5	18.9	15.3	9.5
SADL	6.4	8.0	9.0	9.8
SOS-HEAR	11.1	11.7	11.5	11.6
SSQ	5.6	8.0	8.8	9.0
Mean	8.0	10.0	10.1	9.9
Median	6.5	8.6	9.4	9.8
SD	3.3	3.6	2.1	0.9
Range	5.6 – 15.5	7.4 – 18.9	8.6 – 15.3	9.0 – 11.6

Note. F-K = Flesch-Kincaid Readability Formula; FOG = Gunning Fog Index Readability Formula; FORCAST = FORCAST Readability formula; SMOG = Simple Measure of Gobbledygook Readability Formula.

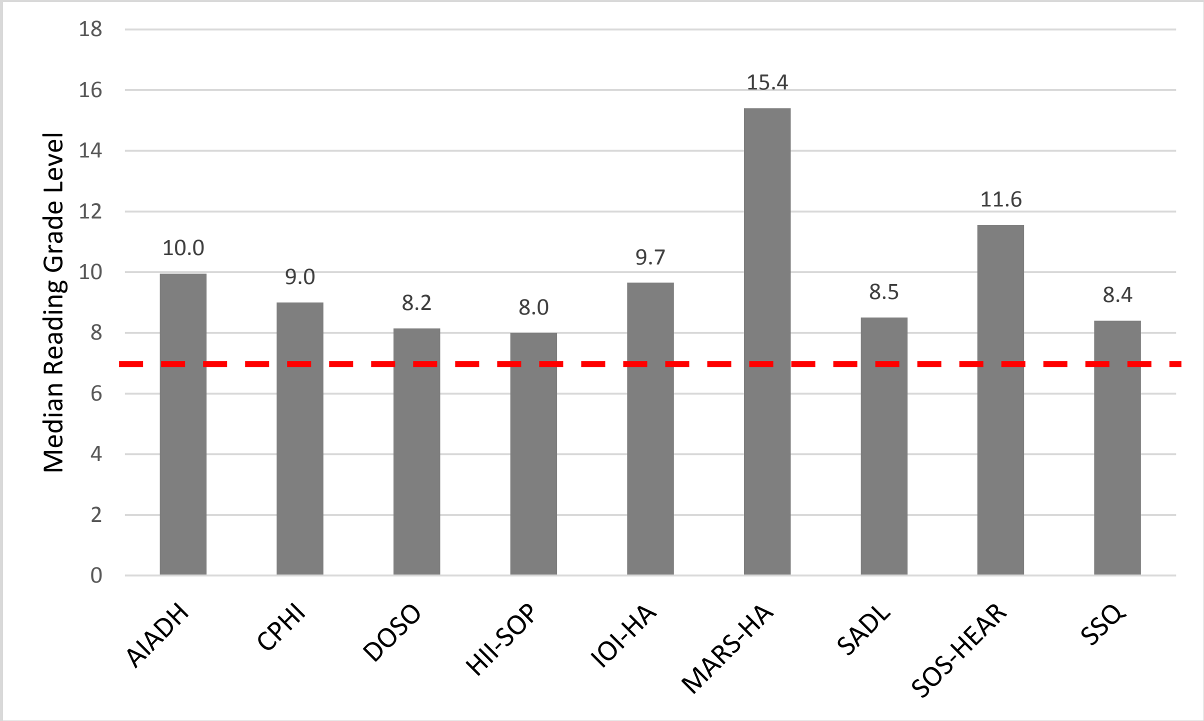

Figure 2. Median reading grade level of the individual PROM items. Median calculated using the combined F-K, FOG, SMOG, and FORCAST scores. The maximum recommended reading grade level for health materials is indicated by the red dashed line.

3.1.3 Response Scale

Of the ten PROMs chosen for use within this study, four contained a response scale which met the minimum required word count (100 words or more) for accurate readability analysis: the AIADH, CPHI, GHABP, and IOI-HA. Due to the inadequate word count of the response scales within the DOSO, HII-SOP, MARS-HA, SADL, SOS-HEAR, and SSQ, readability results from these measures' response scales were omitted from the study. Table 5 provides a summary of the readability results for each of the four readability formulas used to analyse the eligible PROM response scales. Figure 3 displays the median reading grade level (calculated using the combined F-K, FOG, SMOG, and FORCAST scores) of the individual PROM response scales, and compares these results to the maximum reading grade level recommended by health literacy experts. All of the median RGLs for the PROM response scales, with the exception of the IOI-HA, exceed the recommended 4th – 6th grade reading level.

Table 5

Readability Statistics of PROM response scales reported in Reading Grade Level

PROMS	Readability (RGL)			
	F-K	FOG	SMOG	FORCAST
AIADH	6.8	7.9	8.3	11.4
CPHI	12.8	14.2	8.5	16.5
GHABP	4.8	7.7	7.8	10.0
IOI-HA	3.4	4.8	6.9	9.4
Mean	7.0	8.7	7.9	11.8
Median	5.8	7.8	8.1	10.7
SD	4.1	4.0	0.7	3.2
Range	3.4 – 12.8	4.8 – 14.2	6.9 – 8.5	9.4 – 16.5

Note. F-K = Flesch-Kincaid Readability Formula; FOG = Gunning Fog Index Readability Formula; FORCAST = FORCAST Readability formula; SMOG = Simple Measure of Gobbledygook Readability Formula.

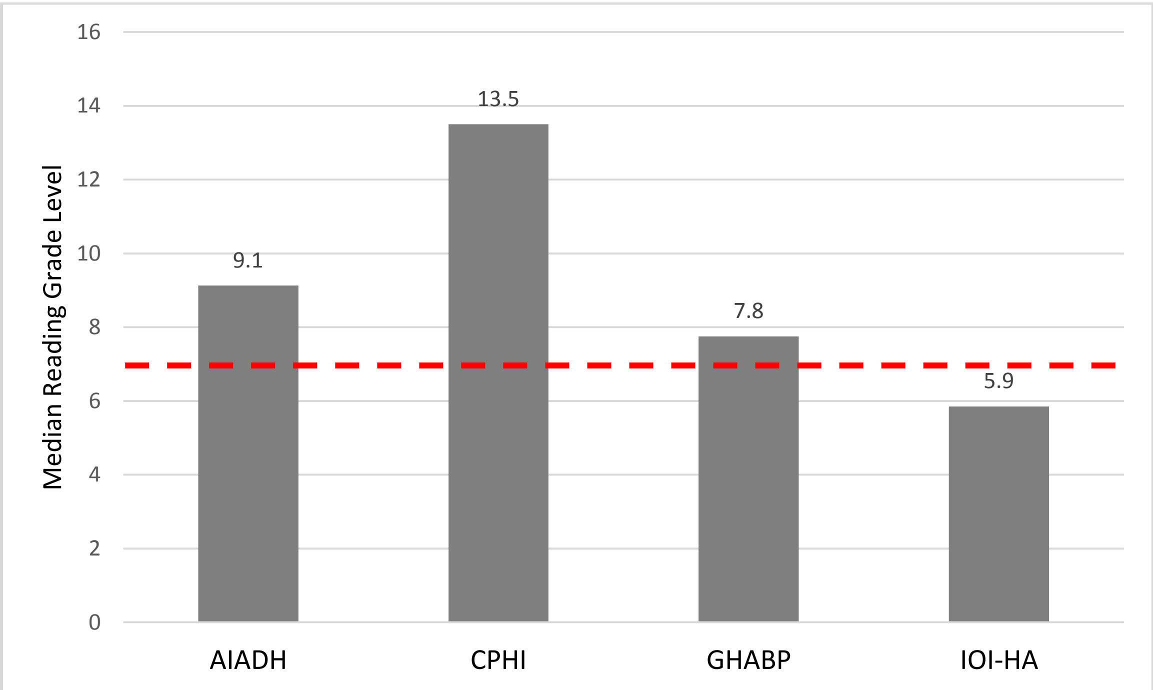

Figure 3. Median reading grade level of the individual PROM response scales. Median

calculated using the combined F-K, FOG, SMOG, and FORCAST scores. The maximum recommended reading grade level for health materials is indicated by the red dashed line.

3.1.4 Entire Measure

All ten PROMs were analysed according to their entire contents (including the instructions if applicable, items, and response scale) provided it was directed towards, or likely to be read by the respondent. Any text directed specifically towards the clinician administering and scoring the questionnaire was excluded from the analyses. Table 6 provides a summary of the readability results for each of the four readability formulas used to analyse all ten PROMs included within this study. Figure 4 compares the median reading grade level (calculated using the F-K, FOG, SMOG, and FORCAST scores) of the individual PROMs to the maximum reading grade level recommended by health literacy experts. Figure 5 illustrates the difference in reading grade levels assigned to the overall PROMs according to the four readability formulas used. The entire contents of all ten PROMs exceeded the recommended 4th to 6th grade reading level when the readability was calculated using either the SMOG or FORCAST formula.

Table 6

Readability Statistics of the entire PROM measure reported in Reading Grade Level

PROMS	Readability (RGL)			
	F-K	FOG	SMOG	FORCAST
AIADH	6.4	9.1	9.5	10.3
CPHI	7.2	9.0	10.0	10.5
DOSO	6.0	6.7	8.1	10.7
GHABP	5.0	7.7	7.9	10.0
HII-SOP	4.3	5.6	7.0	10.3
IOI-HA	4.5	5.8	7.9	9.6

MARS-HA	3.8	6.5	7.7	9.1
SADL	5.2	6.8	7.2	10.6
SOS-HEAR	5.4	5.8	7.2	11.6
SSQ	4.6	7.5	8.5	9.6
Mean	5.2	7.1	8.1	10.2
Median	5.1	6.8	7.9	10.3
SD	1.0	1.3	1.0	0.7
Range	3.8 – 7.2	5.6 – 9.1	7.0 – 10.0	9.1 – 11.6

Note. F-K = Flesch-Kincaid Readability Formula; FOG = Gunning Fog Index Readability Formula; FORCAST = FORCAST Readability formula; SMOG = Simple Measure of Gobbledygook Readability Formula.

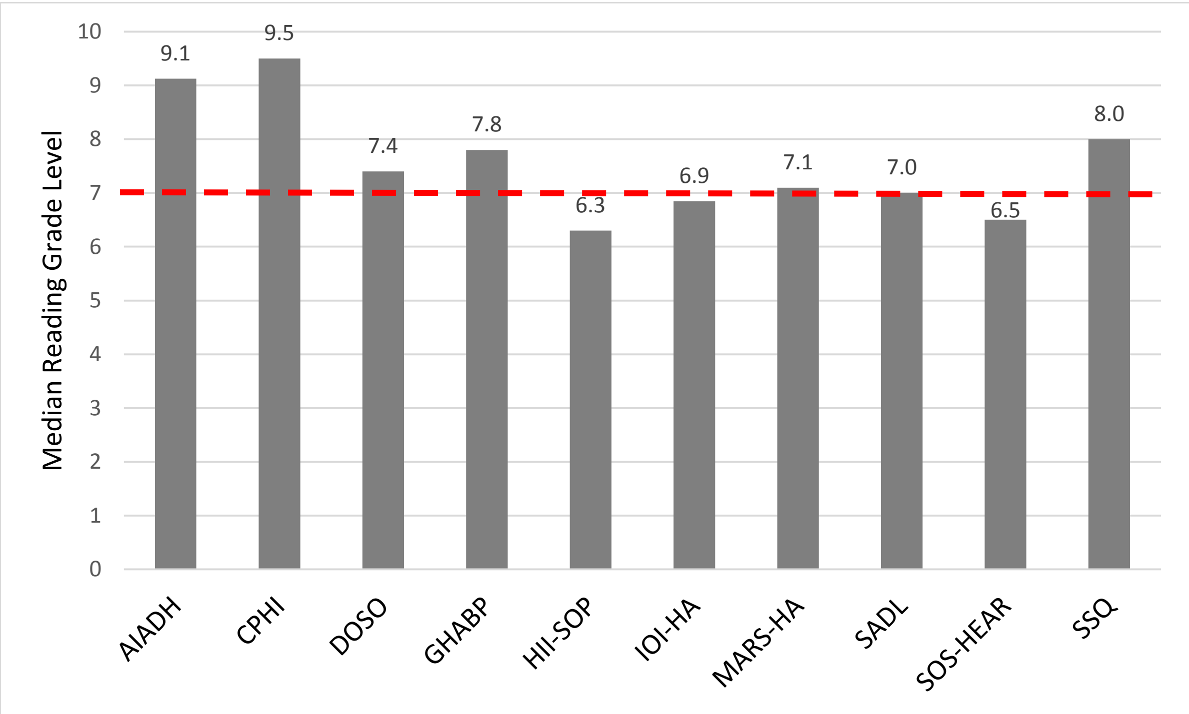

Figure 4. Median reading grade level of the individual PROMs. Median calculated using the combined F-K, FOG, SMOG, and FORCAST scores. The maximum recommended reading grade level for health materials is indicated by the red dashed line.

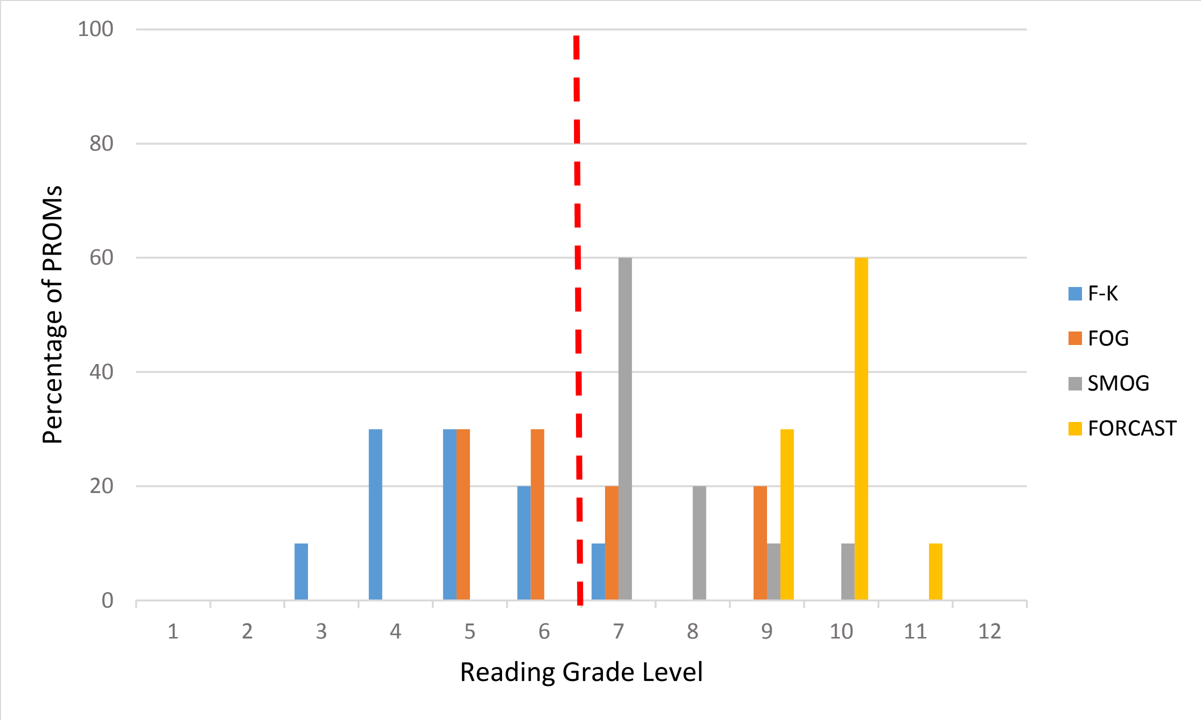

Figure 5. Percent of PROMs by Reading Grade Level for Four Readability Formulas: F–K, FOG, SMOG, and FORCAST. The maximum recommended reading grade level for health materials is indicated by the red dashed line.

3.2 Text-based Quantitative Features

Table 7 demonstrates the text-based quantitative variables used in the calculations of the chosen readability formulas (F-K, FOG, SMOG, and FORCAST). The variables include the number of words, number of syllables, number of monosyllabic words, number of words with three or more syllables, number of hard words (FOG), number of hard words (SMOG), and the number of sentences present within the entire measure.

Table 7

Text-Based Quantitative Features of the PROMs

PROM	Words	Syllables[a]	Monosyllabic words[b]	Words of 3 or more syllables[b]	Hard words (FOG)[b]	Hard words (SMOG)[b]	Sentences[c]
AIADH	441	687 (1.6)	285 (64.6%)	60 (13.6%)	60 (13.6%)	60 (13.6%)	48 (9.2)
CPHI	2961	4632 (1.6)	1871 (63.2%)	384 (13%)	352 (11.9%)	384 (13%)	266 (11.1)

DOSO	381	595 (1.6)	236 (61.9%)	45 (11.8%)	43 (11.3%)	52 (13.6%)	69 (5.5)
GHABP	798	1275 (1.6)	530 (66.4%)	129 (16.2%)	120 (15%)	129 (16.2%)	184 (4.3)
HII-SOP	390	595 (1.5)	253 (64.9%)	38 (9.7%)	36 (9.2%)	38 (9.7%)	81 (4.8)
IOI-HA	292	435 (1.5)	203 (69.5%)	32 (11%)	24 (8.2%)	32 (11%)	46 (6.3)
MARS-HA	1024	1446 (1.4)	745 (72.8%)	96 (9.4%)	94 (9.2%)	96 (9.4%)	147 (7)
SADL	542	878 (1.6)	341 (62.9%)	75 (13.8%)	73 (13.5%)	79 (14.6%)	152 (3.6)
SOS-HEAR	1045	1671 (1.6)	585 (56%)	99 (9.5%)	95 (9.1%)	99 (9.5%)	196 (5.3)
SSQ	1797	2672 (1.5)	1246 (69.3%)	242 (13.5%)	223 (12.4%)	244 (13.6%)	274 (6.6)
Mean	967.1	1488.6	629.5	120.0	112.0	121.3	146.3
Median	670.0	1076.5	435.5	85.5	83.5	87.5	149.5
SD	836.1	1294.6	540.3	111.3	101.7	110.8	84.7

Note. [a] Parentheses indicate average number of syllables per word. [b] Parentheses indicate percentage of words out of total number of words. [c] Parentheses indicates average number of words per sentence.

3.3 Summary

Overall, the hypothesis predicting that the majority of the ten PROMs would exceed the recommended 4th to 6th grade reading level was supported. The respondent instructions of the two PROMs suitable for accurate readability analysis (the CPHI and SSQ) both exceeded the readability levels recommended by health literacy experts, with a median RGL (calculated using all four formulas) of 12.0 and 8.8, respectively. The average RGL (calculated using both sets of respondent instructions from the CPHI and SSQ) also exceeded the recommended readability levels for each of the four readability formulas applied (8.8 for the F-K formula, 10.6 for the FOG formula, 11.2 for the SMOG formula, and 10.0 for the FORCAST formula).

The average RGL calculated using all nine sets of PROM items suitable for readability analysis exceeded the recommended 4^{th} to 6^{th} RGL, with an average score of 8.0 for the F-K formula, 10.0 for the FOG formula, 10.1 for the SMOG formula, and 9.9 for the FORCAST formula. The individual median RGL (calculated using all four formulas) for each of the nine PROM items also exceeded the recommended 4^{th} to 6^{th} grade reading level, with a median RGL of 10.0 for the AIADH, 9.0 for the CPHI, 8.2 for the DOSO, 8.0 for the HII-SOP, 9.7 for the IOI-HA, 15.4 for the MARS-HA, 8.5 for the SADL, 11.6 for the SOS-HEAR, and 8.4 for the SSQ.

The average RGL calculated using all four PROM response scales suitable for readability analysis exceeded the recommended RGL for all four formulas applied, with an average RGL of 7.0 for the F-K formula, 8.7 for the FOG formula, 7.9 for the SMOG formula, and 11.8 for the FORCAST formula. However, the individual median RGL (calculated using all four readability formulas) for one PROM response scale (the IOI-HA) did meet the recommended 4^{th} to 6^{th} grade reading level, with a median score of 5.9. The median RGL of each of the remaining three PROM response scales did not meet the readability levels recommend by health literacy experts (9.1 for the AIADH, 13.5 for the CPHI, and 7.8 for the GHABP).

The readability results for the overall contents of all ten PROMs (including all relevant written material directed towards the respondent) yielded mixed results according to which readability formula was applied. The F-K formula yielded an average RGL (calculated using all ten PROMs) of 5.2, meeting the 4^{th} to 6^{th} grade reading level recommended by health literacy experts. However, the average RGL attained using the other three readability formulas did not meet the recommended RGL (Table 6). Additionally the majority of the individual median RGLs for all ten PROMs (calculated using all four readability formulas) did not meet the recommended 4^{th} to 6^{th} grade reading level (9.1 for the AIADH, 9.5 for the

CPHI, 7.4 for the DOSO, 7.8 for the GHABP, 7.1 for the MARS-HA, 7.0 for the SADL, and 8.0 for the SSQ) whilst three did (6.3 for the HII-SOP, 6.9 for the IOI-HA, 6.5 for the SOS-HEAR). Figure 5 illustrates the difference in allocation of RGL according to which formula was applied. All of the RGLs falling within the recommend 4^{th} to 6^{th} grade reading level only did so when the RGL was calculated using either the F-K or FOG formula, with RGLs calculated using either the SMOG or FORCAST formula tending to result in much higher values.

Chapter Four: Discussion

4.1 Introduction

This study aimed to report upon the readability of several patient-reported outcome measures (PROMs) commonly used within the field of adult audiologic rehabilitation. The second purpose of this study was to compare the resultant readability scores to the readability levels recommended for health information by health literacy experts. The readability of ten widely-used audiologic PROMs (AIADH, CPHI, SSQ, HII-SOP, SOS-HEAR, DOSO, GHABP, IOI-HA, SADL, and MARS-HA) were analysed using four readability formulas commonly used within healthcare and audiologic readability studies: F-K, SMOG, FOG, and FORCAST. The results support the hypothesis that the readability of the majority of the ten PROMs assessed would exceed the recommended 4^{th} to 6^{th} grade reading level. These results are discussed below in relation to previous readability studies. The final sections address the study's clinical implications, limitations, and provide suggestions for future research and development.

4.2 Readability

The results of this study demonstrate that the majority of the ten PROMs exceed the 4^{th} to 6^{th} grade reading level recommended by health literacy experts, irrespective of the formula applied. Whilst a few of the PROMs had an overall reading grade level as low as the 4^{th} or 6^{th} grade (when calculated using either the F-K or FOG formula), none of the overall PROMs were written at the recommended reading grade level according to the FORCAST formula, which is believed to be the most appropriate readability formula for non-narrative text, such as the format of the PROMs analysed within this study (Atcherson et al., 2011; Kelly-Campbell et al., 2012).

Whilst some of the individual PROM sections were allocated a reading grade level that fell within the recommended 4^{th} to 6^{th} grade range by either the F-K or FOG formula, neither of the two sets of PROM respondent instructions analysed (CPHI and SSQ) met these requirements according to all four formulas. Both of these respondent instructions were allocated an arithmetic median grade between the 8th to 12th US grade level (calculated using the results obtained from all four readability formulas); well in excess of the levels recommended by health literacy experts. The reading grade level allocated to the CPHI and SSQ respondent instructions by the FORCAST formula (the most appropriate readability formula for the PROM questionnaire format) was 11.0 and 9.0, respectively. This indicates that the minimum level of education required for accurate reading and comprehension of the written material is at least comparable to that of a US high school freshman. Given that those who have not completed a high school level of education are at a particularly high risk of inadequate levels of health literacy (Gilligan & Weinstein, 2014; Manatū Hauora, Ministry of Health, 2010), it is likely that such at risk individuals would encounter difficulty when required to read and complete such a PROM for audiologic rehabilitative purposes (Gilligan & Weinstein, 2014). If the respondent does not fully understand and comprehend the respondent instructions, they are at risk of incorrectly completing the PROM, and as such, greatly affect the validity of the empirical data collected (Atcherson et al., 2011; Kelly-Campbell et al., 2012). That is to say, if the readability of a PROM is inadequate, is it capable of measuring what it has been designed to measure (Kelly-Campbell et al., 2012).

The individual items for all analysed PROMs exceeded the recommended 4th to 6th grade reading level when calculated using the FOG, SMOG, and FORCAST formulas. Some individual sets of PROM items did meet the recommended reading grade level when calculated using the F-K formula. However, the F-K formula does not calculate for complete comprehension, and as such, has been cautioned by some as less than appropriate for use with healthcare information (Fitzsimmons et al., 2010). Moreover, all reading grade levels for each set of PROM items as calculated by the more appropriate FORCAST formula ranged from

9.0 to 11.6. This indicates that the respondent would require at least a minimum level of education comparable to that of a US high school freshman in order to fully read and comprehend the individual PROM items, and to appropriately and accurately answer such questions. Again, this puts those individuals with low levels of health literacy at particular risk of misinterpreting or inaccurately completing these measures.

The readability results of the individual PROM response scales varied considerably according to which formula was applied. For example, the reading grade level as calculated by the F-K formula for the individual IOI-HA response scale resulted in a score as low as 3.4, whilst the reading grade level as calculated by the FORCAST formula was comparatively higher, resulting in a score of 9.4. The large difference in reading grade level as calculated by the different readability formulas can be attributed to the non-narrative format of the PROM response scales, which contain a significant number of incomplete sentences. Unlike other PROM sections which contained relatively flowing sentences, such as the respondent instructions, or the items; the response scales for these measures were most often formatted in the style of bullet-point lists. This makes the FORCAST formula the most suitable formula for the assessment of the individual PROM response scales, as unlike other readability formulas, the FORCAST formula focuses upon functional literacy, and does not use a sentence-length measurement (Atcherson et al., 2011; DuBay, 2004).

The reading grade levels for the four PROM response scales deemed suitable for readability analysis calculated according to the FORCAST formula ranged from 9.7 to 16.5. This indicates that analogous to the analysed PROM respondent instructions and items, the PROM response scales require an education level comparable to that of a US high school freshman in order to fully read and comprehend the text; with some response scales requiring a level of education as advanced as that of a university senior.

When the entire contents of each of the ten PROMs were analysed (this included all written material relevant to/likely to be read by the respondent including, but not limited to, respondent instructions if applicable, items, and response scales) the reading grades assigned to each PROM varied considerably according to which readability formula was applied. Similar to the readability results obtained for the PROM response scales, the overall readability of a PROM according to the F-K formula could be as low as 3.8, and as high as 9.1 for the FORCAST formula (see Table 6). As previously mentioned, the FORCAST formula is deemed the most appropriate readability formula for accurate readability analysis of non-narrative text, such as the format of the PROMs encountered within this study. All ten of the overall PROMs analysed obtained a readability score between 9.1 and 11.6 when analysed using the FORCAST formula. All of these reading grade levels exceed those levels recommended by health literacy experts. The US Department of Health and Human Services states that material is considered difficult to read if written above the 9th grade level (Walsh & Volsko, 2008).

Figure 5 illustrates that those PROMs (entire contents) which met the recommended 4th to 6th grade reading level only did so when analysed using either the F-K or FOG formula. No PROM met the recommended levels when analysed using the SMOG or FORCAST formula. Table 7 illustrates the different text-based quantitative features that contribute to the apparent discrepancies observed in the readability results obtained using the four different formulas. The most significant contributor to the discrepancies observed are the different variables used by the different formulas in their calculations (please see the adjoining Appendix). This also includes the different criterion scores applied during their development (Zraick & Atcherson, 2012).

4.3 Relation to the Literature

An overview of recent literature investigating the readability of published PROMs designed for use within the field of communication disorders can be found in Table 8 below.

Table 8

Recent Literature Investigating the Readability of PROMs within the Field of Communication Disorders

Study	PROMs Analysed	Formulas Used	Results
Atcherson et al. (2013)	8 PROMs designed for use with (central) auditory processing disorders	FRE, FOG, FORCAST	All eight of the PROMs exceeded the 4th to 6th grade reading level according to the FORCAST formula. Disparity was observed within the results obtained from the FRE and FOG formulas.
Kelly-Campbell et al. (2012)	4 PROMs commonly used in the field of rehabilitative audiology	FRE, FOG, FORCAST	All four PROMs exceeded the 4th to 6th grade reading level according to the FORCAST formula. Some PROMs met the recommended level when the readability was calculated according to the FRE/FOG formulas.
Zraick and Atcherson (2012)	12 different voice-related (dysphonia) PROMs	FRE, FOG, FORCAST	Most of the PROMs exceeded the 4th to 6th grade level recommended by health literacy experts. None of the PROMs were written at the recommended reading grade level according to the FORCAST formula.
Zraick, Atcherson, and Brown (2012)	10 PROMs designed for use with persons who stutter	FRE, FOG, FORCAST	Many of the PROMs exceeded the reading levels recommended by health literacy experts. None of the PROMs were written at the recommended grade level according to

			the FORCAST formula.
Zraick, Atcherson, and Ham (2012)	4 swallowing-related PROMs	FRE, FOG, FORCAST	All four PROMs exceeded the 4th to 6th grade reading level recommended by health literacy experts regardless of the formula applied.
Atcherson et al. (2011)	15 tinnitus-focused PROMs	FRE, FOG, FORCAST	The majority of the PROMs exceeded the 4th to 6th grade reading level regardless of the formula applied. None of the PROMs were written at the recommended reading grade level according to the FORCAST formula.

Analogous to the results obtained from this study, the readability of all the PROMs analysed in the above mentioned studies exceeded those levels recommended by health literacy experts when the reading grade level was calculated according to the FORCAST readability formula. However, some PROMs did meet the recommended level when the reading grade was calculated using other readability formulas, such as the FRE or FOG formula. A similar pattern can be observed within the results of this study according to the F-K and FOG formula results.

With all PROMs analysed exceeding readability levels recommended by health literacy experts according to the most appropriate readability formula for use with non-narrative text (FORCAST) within this study in addition to previous literature, there is ample evidence to suggest that that researchers and clinicians alike should pay greater heed to readability. This may involve including readability as a testable construct when developing and designing new PROMs within the field of adult audiologic rehabilitation.

4.4 Clinical Implications

The clinical implications of the high reading grades obtained for the majority of the PROMs analysed are wide-reaching. If the field of adult audiologic rehabilitation is to move towards a patient/family-centred model of care, the voices of both the clients and their significant others must be incorporated within the decision making process. PROMs are a simple, convenient, and low-cost means of enabling the client and their significant other to voice their opinions and concerns within an audiologic rehabilitation setting. Given that these text-based measures are often completed individually using a paper-and-pencil method of administration, adequate levels of health literacy are essential for both the accurate comprehension and completion of this written task.

It is reasonable to infer that audiologists will more often than not encounter patients with health literacy challenges (Gilligan & Weinstein, 2014). This is due to the significant proportion of older individuals seeking audiologic services, who may already have an existing or underlying communication disorder in addition to belonging to one or more of the other high risk categories associated with low health literacy (Gilligan & Weinstein, 2014). As previously mentioned, the population of New Zealand is ageing. This is likely to lead to a substantial increase in the proportion of adults affected by hearing impairment by the year 2061, subsequently increasing the demand for audiological services (Exeter et al., 2015).

When clients with low levels of health literacy are required to complete PROMs which are written at reading levels exceeding those which they are able to adequately comprehend, some patients may reject the PROM, may provide missing and/or partial information, or may even complete the questionnaire with responses that do not accurately represent or align with their current health status (Atcherson et al., 2011). This will in turn affect the validity of the empirical data collected via the PROM (Atcherson et al., 2011; Kelly-Campbell et al., 2012). Furthermore, PROMs that can be classified as difficult to read impose an additional and unfair burden upon the respondents (Atcherson et al., 2011; Scientific Advisory Committee of the Medical Outcomes Trust, 2002).

A patient/family-centred care model promotes and encourages patient engagement within the treatment process. It also encourages patients to contribute to the rehabilitative plans intended to alleviate/resolve the perceived illness and its associated disability. Individuals with low levels of health literacy are at risk of being unintentionally excluded from the decision making process on account of their inability to read, comprehend, and adequately complete text-based PROMs. Despite recent efforts to inform practitioners/researchers about the issues surrounding readability, it is clear that many PROMs within the field of adult audiologic rehabilitation do not meet the recommend reading grade level suggested by health literacy experts.

4.5 Limitations

As previously mentioned, readability formulas do not provide a perfect estimate of readability. Whilst taking into consideration simple quantitative features of text such as word count, number of syllables, monosyllabic and hard words, the formulas ultimately fail to incorporate the effects of multiple other factors upon a particular text's readability. These factors include visual layout, typographic features, illustrations, the use of white space, or the overall attractiveness of the presented written material (Redish, 1981). Readability formulas fail to provide any indication surrounding the appropriateness of a text's content with regards to a particular audience. Additionally these formulas are outdated, most being created for use with school children as early as the 1940s (Redish, 2000).

Additional limitations can be observed with the F-K and FOG formulas. Given their grading for less than complete comprehension (75% for F-K and for 90% for FOG), readability scores calculated using these two formulas generally underestimate the readability of a text, and on average provide a score one-to-two US grades lower to that of their SMOG counterpart (which grades for 100% comprehension). The F-K formula can only provide a meaningful score between the US 3^{rd} and 12^{th} grade levels, leading to inaccuracies in grades allocated to materials which may be more or less difficult to read. Whilst the SMOG formula can provide a valid score between a slightly larger range (3^{rd} to 19^{th} US grade level), this limitation may still cause extremely easy/difficult to read texts to be inaccurately graded.

The FORCAST formula has been deemed most suitable for use with non-narrative texts, such as PROM questionnaires, due to its focus upon functional literacy (Atcherson et al., 2011; Kelly-Campbell et al., 2012). Due to the non-narrative format of the PROM response scales, readability analyses using other formulas designed for running narrative (such as the F-K, FOG, and SMOG) may lead to inaccuracies in grade allocation. This is visually demonstrated in Figure 5, with the FORCAST formula grading the readability of all ten PROMs between the 9^{th} to 11^{th} grade levels. This was closely followed by the SMOG formula, which graded all ten PROMs between the 7^{th} and 10^{th} grade. Only the FOG and F-K formulas provided certain PROMs with a grade falling within the recommended 4^{th} to 6^{th} grade level. This emphasises the importance of choosing an appropriate readability formula for the analysis of non-narrative texts, particularly within a healthcare setting, as only the slightest of miscomprehensions can have significant implications for a patient's well-being (Wang et al., 2013).

An additional limitation of this study was the inability to accurately measure the reading grade level of PROM sections containing less than one hundred words. Most readability tests require a minimum of one hundred words in order to generate accurate readability estimates. Whilst it was necessary to exclude PROM sections which did not meet the minimum required word count, this ultimately limited the number of PROM readability results available for discussion.

4.6 Future Research

When designing or revising PROMs intended for use within the field of adult audiologic rehabilitation, it is important that researchers acknowledge the impact of readability upon the reliability and validity of their outcome measure. When developing a PROM, factors that influence its readability such as the font-size or type, the presence or absence of illustrations, graphics, or tables, the use of white space, and the overall attractiveness of the presentation, should be considered in conjunction with its readability according to appropriate readability formulas (Kelly-Campbell et al., 2012; Zraick, Atcherson, & Brown, 2012). The reading grade level of the PROM should be written as low as possible, provided it does not affect the validity or reliability of the questionnaire (Atcherson et al., 2011; Kelly-Campbell et al., 2012). Whilst readability formulas do not provide a perfect estimate of readability, they do provide researchers with a useful starting point in order to address comprehension based off the use of plain language (Atcherson et al., 2013).

In addition, the contents of the PROM should contain plain language in order to facilitate clear communication (Kelly-Campbell et al., 2012). This can be accomplished through the provision of simple respondent instructions and PROM items containing a minimal number of polysyllabic words, whilst aiming to include as many familiar words as possible (Kelly-Campbell et al., 2012). The complete exclusion of polysyllabic words however, is not advisable (Atcherson et al., 2013). If respondent instructions are to be included within the PROM, it is imperative that researchers provide these instructions within the appendix of the publication (Atcherson et al., 2011). This will discourage third parties from creating their own set of respondent instructions, which may not be suitably aligned with the readability recommendations of health literacy experts. Table 9 below provides some example instructions which meet the 4^{th} to 6^{th} grade reading level recommended by health literacy experts. These instructions were revised from the instructions contained within the SSQ Version 5.6. The original instructions do not meet the recommended 4th to 6th grade reading level (see Table 3).

Table 9

Revised SSQ Instructions

"Please read this to help you fill out this form. The form asks you what it is like for you to hear in many places. It asks you how easy or how hard it is to hear in these places. To fill out the form, put a mark on the scale next to the question. The scale starts at 0 and goes up to 10. A mark at 10 means you can hear well in this place. A mark at 0 means you would find it very hard to hear in this place. To show you how to fill out this form, Question 1 asks you what it is like to talk to someone when the TV is on. If this is easy for you, put a mark near 10 on the scale. If this is hard for you, put the mark near 0. The form asks what it is like to hear in places you visit most days. If you do not visit these places or cannot answer, mark the "N/A" box. If you mark this box, tell us why you cannot answer. Please mark all of the boxes."				
Readability Formula	F-K	FOG	SMOG	FORCAST
Reading Grade Level (RGL)	3.2	5.5	5.8	6.4

Existing PROMs developed for use within the field of audiologic rehabilitation may need to be revised in order to improve their readability, or clinicians may consider an alternative method of administration (such as face-to-face as opposed to paper-pencil) when the health literacy skills of a client may be questionable. However, clinicians must take care when addressing their concerns surrounding the health literacy of their clients, as low literacy skills have been known to be associated with shame and embarrassment (Friedman &

Hoffman-Goetz, 2006). Some individuals may attempt to hide their reading difficulties in order to avoid stigmatisation by others (Friedman & Hoffman-Goetz, 2006). Individuals with low functional health literacy have admitted to having feelings of shame due to their poor reading skills (Parikh, Parker, Nurss, Baker, & Williams, 1996). Additionally, difficulties associated with comprehension are not entirely exclusive to patients with low levels of health literacy (El-Daly, Ibraheim, Rajakulendran, Culpan, & Bates, 2016). Even patients with a proficient level of health literacy may deliberately not seek clarification in order to avoid embarrassment or appearing foolish (El-Daly et al., 2016).

4.7 Conclusion

The readability of ten PROMs designed for use within the field of adult audiologic rehabilitation were analysed according to four readability formulas commonly used when evaluating the readability of consumer-orientated healthcare materials: the F-K, FOG, SMOG, and FORCAST formulas. The most appropriate readability formula for use with the non-narrative PROM format encountered within this study, FORCAST, suggests that a minimum of an 8^{th} US grade reading level was required in order to adequately read and comprehend the majority of the PROM sections, with the readability of many PROM sections exceeding the 10^{th} to 11^{th} grade. This does not align with the recommended 4^{th} to 6^{th} grade reading level promoted by health literacy experts. The other three formulas, F-K, FOG, and SMOG were found to have a high degree of variability (the F-K formula in particular). This indicates that the use of these three formulas may not be appropriate for the analysis of the PROMs encountered within this study, as these formulas were specifically designed for use with flowing, narrative-style text structures. However, the SMOG formula did tend to, on average, calculate a higher reading grade level as opposed to its F-K or FOG counterparts due to its strict criterion of complete comprehension.

It is imperative that researchers and clinicians alike consider the effect that readability has upon the validity of the data collected via PROMs administered within the field of adult audiologic rehabilitation, as even the slightest of miscomprehensions within a healthcare setting can lead to significant implications for a patient's well-being (Wang et al., 2013). If a patient/family-centred care model is to be aspired and adhered to, clients and their significant others must be able to adequately read, comprehend, and appropriately complete PROMs administered to them within the clinical setting, allowing their voices, concerns, and opinions to contribute to, and influence, the overall decision making processing surrounding their audiologic care and wellbeing.

References

Ahlstrom, J. B., Horwitz, A. R., & Dubno, J. R. (2014). Spatial separation benefit for unaided and aided listening. *Ear and Hearing, 35*(1), 72-85. doi:10.1097/AUD.0b013e3182a02274

Albright, J., de Guzman, C., Acebo, P., Paiva, D., Faulkner, M., & Swanson, J. (1996). Readability of patient education materials: Implications for clinical practice. *Applied Nursing Research, 9*(3), 139-143. doi:10.1016/S0897-1897(96)80254-0

American Speech-Language-Hearing Association. (2015). *Audiology Information Series: Type, Degree, and Configuration of Hearing Loss*. Retrieved from http://www.asha.org/uploadedFiles/AIS-Hearing-Loss-Types-Degree-Configuration.pdf

American Speech-Language-Hearing Association. (2016). *Audiologic (Hearing) Rehabilitation*. Retrieved from http://www.asha.org/public/hearing/Audiologic-Rehabilitation/

Anderson, S., Parbery-Clark, A., White-Schwoch, T., & Kraus, N. (2013). Auditory brainstem response to complex sounds predicts self-reported speech-in-noise performance. *Journal of Speech, Language, and Hearing Research, 56*(1), 31-43. doi:10.1044/1092-4388(2012/12-0043)

Atcherson, S. R., DeLaune, A. E., Hadden, K., Zraick, R. I., Kelly-Campbell, R. J., & Minaya, C. P. (2014). A computer-based readability analysis of consumer materials on the american speech-language-hearing association website. *Contemporary Issues in Communication Science and Disorders, 41*(Apr), 12-23.

Atcherson, S. R., Richburg, C. M., Zraick, R. I., & George, C. M. (2013). Readability of questionnaires assessing listening difficulties associated with (central) auditory processing disorders. *Language, Speech, and Hearing Services in Schools, 44*(1), 48-

60. doi:10.1044/0161-1461(2012/11-0055)

Atcherson, S. R., Zraick, R. I., & Brasseux, R. E. (2011). Readability of patient-reported outcome questionnaires for use with persons with tinnitus. *Ear and Hearing, 32*(5), 671-673. doi:10.1097/AUD.0b013e3182134654

Bandura, A. (1998). Health promotion from the perspective of social cognitive theory. *Psychology & Health, 13*(4), 623-649. doi:10.1080/08870449808407422

Benjamin, R. G. (2012). Reconstructing readability: Recent developments and recommendations in the analysis of text difficulty. *Educational Psychology Review, 24*(1), 63-88. doi:10.1007/s10648-011-9181-8

Bess, F. H. (2000). The role of generic health-related quality of life measures in establishing audiological rehabilitation outcomes. *Ear and Hearing, 21*(4 Suppl), 74S-79S.

Binzer, S. M. (2000). Self-assessment with the Communication Profile for the Hearing Impaired: Pre-and post-cochlear implantation. *Journal of the Academy of Rehabilitative Audiology, 33*, 91-114.

Bird, P. A., & O'Beirne, G. (2015). Hearing loss in New Zealand-planning for the future. *The New Zealand Medical Journal, 128*(1419), 6-8.

Boeschen Hospers, J. M., Smits, N., Smits, C., Stam, M., Terwee, C. B., & Kramer, S. E. (2016). Re-evaluation of the amsterdam inventory for auditory disability and handicap using item response theory. *Journal of Speech, Language, and Hearing Research, 59*(2), 373-383. doi:10.1044/2015_JSLHR-H-15-0156

Boothroyd, A. (2007). Adult aural rehabilitation: What is it and does it work? *Trends in Amplification, 11*(2), 63-71. doi:10.1177/1084713807301073

Breese, P., & Burman, W. (2005). Readability of notice of privacy forms used by major health care institutions. *Journal of the American Medical Association, 293*(13), 1588-1594.

Canadian Council on Learning (2008). *Health Literacy in Canada: A healthy understanding 2008*. Retrieved from http://www.bth.se/hal/halsoteknik.nsf/bilagor/HealthLiteracyReportFeb2008E_pdf/$file/HealthLiteracyReportFeb2008E.pdf

Caposecco, A., Hickson, L., & Meyer, C. (2014). Hearing aid user guides: Suitability for older adults. *International Journal of Audiology, 53*(S1), S43-S51. doi:10.3109/14992027.2013.832417

Carhart, R. (1945). An improved method of classifying audiograms. *Laryngoscope, 5*, 1-15.

Caylor, J. S., Sticht, T. G., Fox, L. C., & Ford, J. P. (1973). *Methodologies for determining reading requirements of military occupational specialties* (Technical report No. 73-5). Alexandria, VA: Human Resources Research Organisation.

Clark, J. G. (1981). Uses and abuses of hearing loss classification. *ASHA, 23*(7), 493-500.

Committee on Quality of Health Care in America & Institute of Medicine. (2001). *Crossing the quality chasm: A new health system for the 21st century*. Washington, D.C: National Academy Press.

Cox, R. M. (2003). Assessment of subjective outcome of hearing aid fitting: Getting the client's point of view. *International Journal of Audiology, 42*(S1), 90-96. doi:10.3109/14992020309074629

Cox, R. (2005). Choosing a self-report measure for hearing aid fitting outcomes. *Seminars in Hearing, 26*(3), 149-156. doi:10.1055/s-2005-916378

Cox, R., & Alexander, G. (1999). Measuring satisfaction with amplification in daily life: The SADL scale. *Ear and Hearing, 20*(4), 306-306. doi:10.1097/00003446-199908000-00004

Cox, R., Alexander, G., & Xu, J. (2014). Development of the device-oriented subjective outcome (DOSO) scale. *Journal of the American Academy of Audiology, 25*(8), 727-

736. doi:10.3766/jaaa.25.8.3

Cox, R., Hyde, M., Gatehouse, S., Noble, W., Dillon, H., Bentler, R., . . . Hallberg, a. L. (2000). Optimal outcome measures, research priorities, and international cooperation. *Ear and Hearing, 21*(4 Suppl), 106S-115S.

Cox, R., Stephens, D., & Kramer, S. (2002). Translations of the international outcome inventory for hearing aids (IOI-HA). *International Journal of Audiology, 41*(1), 3-26.

Cutilli, C. C. (2007). Health literacy in geriatric patients: An integrative review of the literature. *Orthopaedic Nursing, 26*(1), 43-48.

Dale, E., & Chall, J. S. (1949). The concept of readability. *Elementary English, 26,* 23.

D'Alessandro, D. M., Kingsley, P., & Johnson-West, J. (2001). The readability of pediatric patient education materials on the world wide web. *Archives of Pediatrics and Adolescent Medicine, 155*(7), 807-812.

Danermark, B. (2005) A review of the psychosocial effects of hearing impairment on the working-age population. In D. Stephens & L. Jones (Eds.), *The Impact of Genetic Hearing Impairment* (pp. 106–136). London, England: Whurr Publishers.

Davis, A., Smith, P., Ferguson, M., Stephens, D., & Gianopoulos, I. (2007). Acceptability, benefit and costs of early screening for hearing disability: A study of potential screening tests and models. *Health Technology Assessment, 11*(42), 1-1.

Dawson, J., Doll, H., Fitzpatrick, R., Jenkinson, C., & Carr, A. J. (2010). Routine use of patient-reported outcome measures in healthcare settings. *British Medical Journal, 340*(7744), 464-467. doi:10.1136/bmj.c186

Demorest, M. E., & Erdman, S. A. (1987). Development of the communication profile for the hearing impaired. *Journal of Speech and Hearing Disorders, 52*(2), 129-143. doi:10.1044/jshd.5202.129

Doak, C., Doak, L., & Root, J. (1996). *Teaching patients with low literacy skills* (2nd ed.).

Philadelphia, PA: J. B. Lippincott.

Donald, A. J., & Kelly-Campbell, R. J. (2016). Pediatric audiology report: Assessment and revision of an audiology report written to parents of children with hearing impairment. *Journal of Speech, Language, and Hearing Research, 59*(2), 359-372. doi:10.1044/2015_JSLHR-H-15-0120

DuBay, W. H. (2004). *The principles of readability*. Costa Mesa, CA: Impact Information.

Edmunds, M., Barry, R., & Denniston, A. (2013). Readability assessment of online ophthalmic patient information. *JAMA Ophthalmology, 131*(12), 1610-1616. doi:10.1001/jamaophthalmo1.2013.5521

El-Daly, I., Ibraheim, H., Rajakulendran, K., Culpan, P., & Bates, P. (2016). Are patient-reported outcome measures in orthopaedics easily read by patients? *Clinical Orthopaedics and Related Research, 474*(1), 246-255. doi:10.1007/s11999-015-4595-0

Engdahl, B., Tambs, K., & Hoffman, H. J. (2013). Otoacoustic emissions, pure-tone audiometry, and self-reported hearing. *International Journal of Audiology, 52*(2), 74-82. doi:10.3109/14992027.2012.733423

English, K. (2005). Page ten: Get ready for the next big thing in audiologic counseling. *Hearing Journal, 58*(7), 10-15.

Exeter, D. J., Wu, B., Lee, A. C., & Searchfield, G. D. (2015). The projected burden of hearing loss in New Zealand (2011-2061) and the implications for the hearing health workforce. *The New Zealand Medical Journal, 128*(1419), 12-21.

Fang, T., Chang, H., Wan, T., Wang, P., & Chen, Y. (2013). Validation of the chinese version "satisfaction with amplification in daily life (SADL)" survey for hearing-aid users. *International Journal of Audiology, 52*(7), 478-484. doi:10.3109/14992027.2013.773406

Firszt, J. B., Holden, L. K., Reeder, R. M., Cowdrey, L., & King, S. (2012). Cochlear implantation in adults with asymmetric hearing loss. *Ear and Hearing, 33*(4), 521-533. doi:10.1097/AUD.0b013e31824b9dfc

Fitzsimmons, P. R., Michael, B. D., Hulley, J. L., & Scott, G. O. (2010). A readability assessment of online parkinson's disease information. *Journal of the Royal College of Physicians of Edinburgh, 40*(4), 292-296. doi:10.4997/JRCPE.2010.401

Friedland, R. (1998). New estimates of the high costs of inadequate health literacy. In Pfizer Inc. (Ed.), *Promoting Health Literacy: A Call to Action* (pp. 6–10). Proceedings of the Pfizer Conference, October 7-8. Washington, DC: Pfizer Inc.

Friedman, D. B., & Hoffman-Goetz, L. (2006). A systematic review of readability and comprehension instruments used for print and web-based cancer information. *Health Education & Behavior, 33*(3), 352-373. doi:10.1177/1090198105277329

Fuente, A., McPherson, B., Kramer, S. E., Hormazábal, X., & Hickson, L. (2012). Adaptation of the Amsterdam Inventory for Auditory Disability and Handicap into Spanish. *Disability and Rehabilitation, 34*, 2076–2084.

Fuente, A., McPherson, B., Kwok, E. T. T., Chan, K., & Kramer, S. E. (2012). Adaptation of the Amsterdam Inventory for Auditory Disability and Handicap into Cantonese. *The Australian and New Zealand Journal of Audiology, 32*, 115–126.

Gagné, J., & Jennings, M. B. (2011). Incorporating a client-centered approach to audiologic rehabilitation. *ASHA Leader, 16*(8), 10.

Gatehouse, S. (1999). Glasgow Hearing Aid Benefit Profile: Derivation and validation of a client-centred outcome measure for hearing aid services. *Journal of the American Academy of Audiology, 10*, 80-103.

Gatehouse, S., & Noble, W. (2004). The speech, spatial and qualities of hearing scale (SSQ). *International Journal of Audiology, 43*(2), 85-99. doi:10.1080/14992020400050014

Gelfand, S. A. (2010). *Hearing: An introduction to psychological and physiological acoustics* (5th ed.). London: Informa Healthcare.

Gilligan, J., & Weinstein, B. E. (2014). Health Literacy and Patient-Centered Care in Audiology – Implications for Adult Aural Rehabilitation. *Communication Disorders, Deaf Stud*ies & *Hearing Aids*, *2*(2), 110. doi:10.4172/2375-4427.1000110

Goodman, A. (1965). Reference zero levels for pure-tone audiometer. *ASHA*, *7*(262), 1.

Gordon, R. M. (1980). The readability of an unreadable text. *The English Journal, 69*(3), 60-61.

Grenness, C., Hickson, L., Laplante-Lévesque, A., & Davidson, B. (2014a). Patient-centred audiological rehabilitation: Perspectives of older adults who own hearing aids. *International Journal of Audiology, 53*(S1), S68-S75. doi:10.3109/14992027.2013.866280

Grenness, C., Hickson, L., Laplante-Lévesque, A., & Davidson, B. (2014b). Patient-centred care: A review for rehabilitative audiologists. *International Journal of Audiology, 53*(S1), S60-S67. doi:10.3109/14992027.2013.847286

Grenness, C., Meyer, C., Scarinci, N., Ekberg, K., & Hickson, L. (2016). The international classification of functioning, disability and health as a framework for providing patient- and family-centered audiological care for older adults and their significant others. *Seminars in Hearing, 37*(3), 187-199. doi:10.1055/s-0036-1584411

Greville A. (2005). *Hearing Impaired and Deaf People in New Zealand: An Update on Population Numbers and Characteristics*. Auckland: Greville Consulting.

Gunning, R. (1952). *The Technique of Clear Writing*. New York: McGraw-Hill.

Hallberg, L. R. M., Hallberg, U., & Kramer, S. E. (2008). Self-reported hearing difficulties, communication strategies and psychological general well-being (quality of life) in patients with acquired hearing impairment. *Disability and Rehabilitation, 30,* 203–

212.

Hansberry, D., Ramchand, T., Patel, S., Kraus, C., Jung, J., Agarwal, N., . . . Baker, S. (2014). Are we failing to communicate? internet-based patient education materials and radiation safety. *European Journal of Radiology, 83*(9), 1698-1702. doi:10.1016/j.ejrad.2014.04.013

Hayden, J. D. (2008). Readability in the british journal of surgery. *British Journal of Surgery, 95*(1), 119-124. doi:10.1002/bjs.5994

Hearing Aid Research Lab (HARL). (2016). *Device Oriented Subjective Outcome (DOSO) Scale*. Retrieved from http://www.harlmemphis.org/index.php/clinical-applications/doso/

Hicks, C. B., Tharpe, A. M., & Ashmead, D. H. (2000). Behavioral auditory assessment of young infants: Methodological limitations or natural lack of auditory responsiveness? *American Journal of Audiology, 9*(2), 124-130. doi:10.1044/1059-0889(2000/015)

High, W., Fairbanks, G., & Glorig, A. (1964). Scale for self-assessment of hearing handicap. *Journal of Speech and Hearing Disorders, 29*, 215-230.

Hosford-Dunn, H., & Halpern, J. (2000). Clinical application of the satisfaction with amplification in daily life scale in private practice I: Statistical, content, and factorial validity. *Journal of the American Academy of Audiology, 11*(10), 523-539.

Hosford-Dunn, H., & Halpern, J. (2001). Clinical application of the SADL scale in private practice II: Predictive validity of fitting variables. *Journal of the American Academy of Audiology*, *12*(1), 15-35.

House, J. W., Kutz Jr, J. W., Chung, J., & Fisher, L. M. (2010). Bone-anchored hearing aid subjective benefit for unilateral deafness. *Laryngoscope, 120*(3), 601-607. doi:10.1002/lary.20802

Hughes, J. C., Bamford, C., & May, C. (2008). Types of centredness in health care: Themes and concepts. *Medicine, Health Care and Philosophy, 11*(4), 455-463. doi:10.1007/s11019-008-9131-5

Jacobson, M. D., Kirkland, C. E., & Selden, R. W. (1978). An examination of the McCall-Crabbs standard test lessons in reading. *Journal of Reading, 22*, 224-230.

Jerger, J. F., & Hayes, D. (1976). The cross check principle in pediatric audiometry. *Archives of Otolaryngology, 102*(10), 614-620.

Jette, A. M. (2015). *Advancing the Science and Use of Patient-Reported Outcome Measures (PROMS).* Presentation at the 2015 Researcher-Academic Town Meeting. Retrieved from http://www.asha.org/uploadedFiles/2015-Researcher-Academic-Town-Meeting-Presentation.pdf

Joubert, K., & Githinji, E. (2014). Quality and readability of information pamphlets on hearing and paediatric hearing loss in the Gauteng province, South Africa. *International Journal of Pediatric Otorhinolaryngology, 78*(2), 354-358. doi:10.1016/j.ijporl.2013.12.018

Kahn, A., & Pannbacker, M. (2000). Readability of educational materials for clients with cleft Lip/Palate and their families. *American Journal of Speech-Language Pathology, 9*(1), 3-9. doi:10.1044/1058-0360.0901.03

Kasabwala, K., Agarwal, N., Hansberry, D. R., Baredes, S., & Eloy, J. A. (2012). Readability assessment of patient education materials from the american academy of Otolaryngology—Head and neck surgery foundation. *Otolaryngology–Head and Neck Surgery, 147*(3), 466-471. doi:10.1177/0194599812442783

Kelly-Campbell, R. J., Atcherson, S. R., Zimmerman, K. R., & Zraick, R. I. (2012). Readability of audiologic self-report assessment tools. *Journal of the Academy of Rehabilitative Audiology, 45*, 63-73.

Kincaid, J. P., Fishburne, R. P., Rogers, R. L., & Chissom, B. S. (1975). *Derivation of new* *readability formulas (automated readability index, fog count, and flesch reading ease formula) for Navy enlisted personnel.* Research Branch Report 8–75. Chief of Naval Technical Training: Naval Air Station Memphis. Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/a006655.pdf

Klingbeil, C., Speece, M. W., & Schubiner, H. (1995). Readability of pediatric patient education materials: Current perspectives on an old problem. *Clinical Pediatrics, 34*(2), 96-102. doi:10.1177/000992289503400206

Knutson, J. F., & Lansing, C. R. (1990). The relationship between communication problems and psychological difficulties in persons with profound acquired hearing loss. *Journal of Speech and Hearing Disorders, 55*(4), 656.

Kong, K., & Hu, A. (2015). Readability assessment of online tracheostomy care resources. *Otolaryngology–Head and Neck Surgery*, *152*(2), 272-278. doi:10.1177/0194599814560338

Kramer, S. E., Kapteyn, T. S., Festen, J. M., & Tobi, H. (1995). Factors in subjective hearing disability. *International Journal of Audiology*, *34*, 311–320.

Kreisman, B. M., Smart, J. L., & John, A. B. (2015). Diagnostic Audiology. In J. Katz, M. Chasin, K. English, L. J. Hood, & K. L. Tillery (Eds.), *Handbook of Clinical Audiology* (7th ed., pp. 119-133). Philadelphia: Wolters Kluwer Health.

Kricos, P. B. (2000). The influence of non-audiological variables on audiological rehabilitation outcomes. *Ear and Hearing, 21*(Supplement), 7-14S. doi:10.1097/00003446-200008001-00003

Krupat, E., Rosenkranz, S. L., Yeager, C. M., Barnard, K., Putnam, S. M., & Inui, T. S. (2000). The practice orientations of physicians and patients: The effect of doctor–patient congruence on satisfaction. *Patient Education and Counseling, 39*(1), 49-59. doi:10.1016/S0738-3991(99)00090-7

Kutner, M., Greenburg, E., Jin, Y., & Paulsen, C. (2006). *The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy* (NCES 2006-483). Washington, DC: National Center for Education Statistics.

Lansing, C. R., & Davis, J. M. (1990). Evaluating the relative contribution of aural rehabilitation and experience to the communication performance of adult cochlear implant users: Preliminary data. In L. D. Olswang, C. K. Thompson, S. F. Warren, & N. Minghetti (Eds.), *Treatment efficacy of research in communication disorders* (pp. 215 – 221). Rockville, MD: American Speech-Language-Hearing Foundation.

Lansing, C. R., & Seyfried, D. N. (1990). Longitudinal changes in personal adjustment to hearing loss in adult cochlear implant users. *Journal of the Academy of Rehabilitative Audiology*, *23*, 63-77.

Laplante-Lévesque, A., Brännström, K. J., Andersson, G., & Lunner, T. (2012). Quality and readability of English-language internet information for adults with hearing impairment and their significant others. *International journal of audiology*, *51*(8), 618-626.

Laplante-Lévesque, A., Knudsen, L., Preminger, J., Jones, L., Nielsen, C., Berg, M., . . . Kramer, S. (2012). Hearing help-seeking and rehabilitation: Perspectives of adults with hearing impairment. *International Journal of Audiology, 51*(2), 93-102. doi:10.3109/14992027.2011.606284

Ley, P., & Florio, T. (1996). The use of readability formulas in health care. *Psychology, Health and Medicine*, *1*(1), 7-28. doi:10.1080/13548509608400003

Lloyd, L. L., & Kaplan, H. (1978). *Audiometric Interpretation: A Manual for Basic Audiometry*. Baltimore, U.S.A.: University Park Press.

Madell, J. R. (2011). Testing babies: You can do it! *Behavioral Observation Audiometry*, *21*(2), 59-65.

Manatū Hauora, Ministry of Health. (2010). *Kōrero Mārama: Health Literacy and Māori Results from the 2006 Adult Literacy and Life Skills Survey*. Wellington: Ministry of Health. Retrieved from http://www.health.govt.nz/system/files/documents/publications/korero-marama.pdf

Mårtensson, L., & Hensing, G. (2012). Health literacy–a heterogeneous phenomenon: a literature review. *Scandinavian journal of caring sciences, 26*(1), 151-160.

Matthews, T.L., & Sewell, J.C. (2002). *State official's guide to health literacy*. Lexington, KY: The Council of State Government.

Mcinnes, N., & Haglund, B. J. A. (2011). Readability of online health information: Implications for health literacy. *Informatics for Health and Social Care, 36*(4), 173-189. doi:10.3109/17538157.2010.542529

McLaughlin, G. H. (1969). SMOG grading-a new readability formula. *Journal of Reading, 12*(8), 639-646.

McLeod, B., & Upfold, L. (2003). The effect of passing time on self-reported satisfaction with hearing aid amplification. *The Australian and New Zealand Journal of Audiology, 25*(1), 28-35. doi:10.1375/audi.25.1.28.31123

Meijer, A. G., Wit, H. P., Tenvergert, E. M., Albers, F. W., & Kobold, J. P. M. (2003). Reliability and validity of the (modified) Amsterdam Inventory for Auditory Disability and Handicap. *International Journal of Audiology, 42*, 220–226.

Michie, S., Miles, J., & Weinman, J. (2003). Patient-centredness in chronic illness: What is it and does it matter? *Patient Education and Counseling, 51*(3), 197-206. doi:10.1016/S0738-3991(02)00194-5

Mokkink, L. B., Knol, D. L., Zekveld, A. A., Goverts, S. T., & Kramer, S. E. (2009). Factor structure and reliability of the dutch version of seven scales of the communication profile for the hearing impaired (CPHI). *Journal of Speech, Language, and Hearing*

Research, 52(2), 454-464. doi:10.1044/1092-4388(2008/08-0036)

Molander, P., Nordqvist, P., Oberg, M., Lunner, T., Lyxell, B., & Andersson, G. (2013). Internet-based hearing screening using speech-in-noise: Validation and comparisons of self-reported hearing problems, quality of life and phonological representation. *BMJ Open, 3*(9), e003223. doi:10.1136/bmjopen-2013-003223

Møller, A. R. (2013). *Hearing: Anatomy, physiology, and disorders of the auditory system* (3rd ed.). San Diego, CA: Plural Pub.

Moore, B. C. J. (2012). *An introduction to the psychology of hearing* (6th ed.). Bingley: Emerald.

Moulin, A., Pauzie, A., & Richard, C. (2015). Validation of a french translation of the speech, spatial, and qualities of hearing scale (SSQ) and comparison with other language versions. *International Journal of Audiology, 54*(12), 889-898. doi:10.3109/14992027.2015.1054040

Neijenhuis, K. A., Stollman, M. H., Snik, A. F., & Van den Broek, P. (2001). Development of a Central Auditory Test Battery for adults. *International Journal of Audiology, 40*, 69–77.

Noble, W. (1996). What is a psychosocial approach to hearing loss? *Scandinavian Audiology. Supplementum, 43*, 6.

Noble, W., Tyler, R., Dunn, C., & Bhullar, N. (2008). Unilateral and bilateral cochlear implants and the implant-plus-hearing-aid profile: Comparing self-assessed and measured abilities. *International Journal of Audiology, 47*(8), 505-514. doi:10.1080/14992020802070770

Noble, W., Tyler, R. S., Dunn, C. C., & Bhullar, N. (2009). Younger- and older-age adults with unilateral and bilateral cochlear implants: Speech and spatial hearing self-ratings and performance. *Otology and Neurotology, 30*(7), 921-929.

doi:10.1097/MAO.0b013e3181b76b3b

Nutbeam, D. (2008). The evolving concept of health literacy. *Social Science & Medicine, 67*(12), 2072-2078. doi:10.1016/j.socscimed.2008.09.050

Öberg, M., Wänström, G., Hjertman, H., Lunner, T., & Andersson, G. (2009). Development and initial validation of the 'clinical global impression' to measure outcomes for audiological rehabilitation. *Disability & Rehabilitation, 31*(17), 1409-1417. doi:10.1080/09638280802621408

Ong, L. M. L., de Haes, J. C. J. M., Hoos, A. M., & Lammes, F. B. (1995). Doctor-patient communication: A review of the literature. *Social Science & Medicine, 40*(7), 903-918. doi:10.1016/0277-9536(94)00155-M

Paasche-Orlow, M. K., Schillinger, D., Greene, S. M., & Wagner, E. H. (2006). How health care systems can begin to address the challenge of limited literacy. *Journal of General Internal Medicine*, *21*(8), 884-887. doi:10.1111/j.1525-1497.2006.00544.x

Paasche-Orlow, M. K., Taylor, H. A., & Brancati, F. L. (2003). Readability standards for informed-consent forms as compared with actual readability. *The New England Journal of Medicine*, *348*(8), 721-726. doi:10.1056/NEJMsa021212

Parikh, N. S., Parker, R. M., Nurss, J. R., Baker, D. W., & Williams, M. V. (1996). Shame and health literacy: The unspoken connection. *Patient Education and Counseling, 27*(1), 33-39. doi:10.1016/0738-3991(95)00787-3

Pickles, J. O. (2012). *An introduction to the physiology of hearing* (4th ed.). Bingley, United Kingdom: Emerald Group Publishing, Limited.

Preminger, J. E., & Meeks, S. (2012). The hearing impairment impact-significant other profile (HII-SOP): A tool to measure hearing loss-related quality of life in spouses of people with hearing loss. *Journal of the American Academy of Audiology, 23*(10), 807-823. doi:10.3766/jaaa.23.10.6

Purdy, S., & Williams, W. (2012). *Guideline for diagnosing occupational noise-induced hearing loss: Part 3 Audiometric standards*. Retrieved from http://www.acc.co.nz/PRD_EXT_CSMP/groups/external_communications/documents/reference_tools/wpc091007.pdf

Rao, P. R. (2015). Outcomes and quality: Key characteristics of a successful SLP value journey. *SIG 2 Perspectives on Neurophysiology and Neurogenic Speech and Language Disorders, 25*, 94–106. doi: 10.1044/nnsld25.3.94.

Redish, J. (1981). Understanding the limitations of readability formulas. *IEEE Transactions on Professional Communication, PC-24*(1), 46-48. doi:10.1109/TPC.1981.6447824

Redish, J. (2000). Readability formulas have even more limitations than klare discusses. *ACM Journal of Computer Documentation (JCD), 24*(3), 132-137. doi:10.1145/344599.344637

Ritchie, L., Tornari, C., Patel, P., & Lakhani, R. (2016). Glue ear: How good is the information on the World Wide Web? *Journal of Laryngology and Otology, 130*(2), 157-161. doi:10.1017/S0022215115003230

Rudd, R., Moeykens, B. A., & Colton, T. C. (2000). Health and literacy: A review of the medical and public health literature. In J. Comings, B. Gerners, & C. Smith (Eds.), *Annual review of adult learning and literacy*. New York: Jossey-Bass.

Sabharwal, S., Badarudeen, S., & Unes Kunju, S. (2008). Readability of online patient education materials from the AAOS web site. *Clinical Orthopaedics and Related Research, 466*(5), 1245-1250. doi:10.1007/s11999-008-0193-8

Safeer, R. S., & Keenan, J. (2005). Health literacy: The gap between physicians and patients. *American Family Physician, 72*(3), 463-468.

Scarinci, N., Worrall, L., & Hickson, L. (2008). The effect of hearing impairment in older people on the spouse. *International Journal of Audiology, 47*(3), 141-151.

doi:10.1080/14992020701689696

Scarinci, N., Worrall, L., & Hickson, L. (2009a). The effect of hearing impairment in older people on the spouse: Development and psychometric testing of the significant other scale for hearing disability (SOS-HEAR). *International Journal of Audiology, 48*(10), 671-683. doi:10.1080/14992020902998409

Scarinci, N., Worrall, L., & Hickson, L. (2009b). The ICF and third-party disability: Its application to spouses of older people with hearing impairment. *Disability & Rehabilitation, 31*(25), 2088-2100. doi:10.3109/09638280902927028

Scarinci, N., Worrall, L., & Hickson, L. (2012). Factors associated with third-party disability in spouses of older people with hearing impairment. *Ear and Hearing*, *33*(6), 698-708. doi:10.1097/AUD.0b013e31825aab39

Scientific Advisory Committee of the Medical Outcomes Trust (SACMOT). (2002). Assessing health status and quality-of-life instruments: attributes and review criteria. *Quality of Life Research*, *11*, 193–205.

Sharma, N., Tridimas, A., & Fitzsimmons, P. (2014). A readability assessment of online stroke information. *Journal of Stroke & Cerebrovascular Diseases*, *23*(6), 1362-1367. doi:10.1016/j.jstrokecerebrovasdis.2013.11.017

Sindhusake, D., Mitchell, P., Smith, W., Golding, M., Newall, P., Hartley, D., & Rubin, G. (2001). Validation of self-reported hearing loss. The Blue Mountains hearing study. *International Journal of Epidemiology*, *30*(6), 1371-1378. doi:10.1093/ije/30.6.1371

Smith, S. L. (2014). Promoting Self-Efficacy in Patient-Centered Audiologic Rehabilitation for Adults with Hearing Loss. *SIG 7 Perspectives on Aural Rehabilitation and Its Instrumentation*, *21*(1), 24-32.

Smith, S. L., & West, R. L. (2006). The application of self-efficacy principles to audiologic rehabilitation: A tutorial. *American Journal of Audiology, 15*(1), 46-56.

doi:10.1044/1059-0889(2006/006)

Sørensen, K., Van Den Broucke, S., Fullam, J., Doyle, G., Pelikan, J., Slonska, Z., . . . (HLS-EU) Consortium Health Literacy Project European. (2012). Health literacy and public health: A systematic review and integration of definitions and models. *BMC Public Health, 12*(1), 80-80. doi:10.1186/1471-2458-12-80

Stephens, D. (1996). Hearing rehabilitation in a psychosocial framework. *Scandinavian Audiology, Supplement, 25*(43), 57-66.

Stewart, M., Brown, J. B., Donner, A., McWhinney, I. R., Oates, J., Weston, W. W., & Jordan, J. (2000). The impact of patient-centered care on outcomes. *Journal of Family Practice, 49*(9), 796-804.

Svarstad, B. L., Bultman, D. C., Mount, J. K., & Tabak, E. R. (2003). Evaluation of written prescription information provided in community pharmacies: A study in eight states. *Journal of the American Pharmacists Association, 43*(3), 383-393. doi:10.1331/154434503321831102

Swartz, E. N. (2010). The readability of pediatric patient information materials: Are families satisfied with our handouts? *Paediatric Child Health, 15*, 509–513.

Taylor, B (2007). *Self-Report Assessment of Hearing Aid Outcome - An Overview*. Retrieved from http://www.audiologyonline.com/articles/self-report-assessment-hearing-aid-931

Taylor, B., & Weinstein, B. (2015). *Outcome Measures beyond the Audiogram: Putting Non-Audiological Measures into Practice*. Presentation at the 2015 Academy of Doctors of Audiology (ADA) Annual Convention, Washington DC, USA. Retrieved from http://www.audiologist.org/_resources/2015_convention_presentations/Taylor-Weinstein.pdf

Thunberg Jespersen, C., Bille, M., & Legarth, J. V. (2014). Psychometric properties of a revised danish translation of the international outcome inventory for hearing aids

(IOI-HA). *International Journal of Audiology, 53*(5), 302-308. doi:10.3109/14992027.2013.874049

Van Wieringen, A., De Voecht, K., Bosman, A. J., & Wouters, J. (2011). Functional benefit of the bone-anchored hearing aid with different auditory profiles: Objective and subjective measures: Functional benefit of the bone-anchored hearing aid with different auditory profiles. *Clinical Otolaryngology, 36*(2), 114-120. doi:10.1111/j.1749-4486.2011.02302.x

Walsh, T. M., & Volsko, T. A. (2008). Readability assessment of internet-based consumer health information. *Respiratory care, 53*(10), 1310-1315.

Wang, L.-W., Miller, M. J., Schmitt, M. R., & Wen, F. K. (2013). Assessing readability formula differences with written health information materials: Application, results, and recommendations. *Research in Social & Administrative Pharmacy, 9,* 503–516.

Weinstein, B. E. (2015). Outcome measurement in audiology: A call to action. *Hearing Journal, 68*(7), 24-26. doi:10.1097/01.HJ.0000469512.69675.4f

Weis, B. D. (2003). *Health Literacy: A Manual for Clinicians*. Chicago, IL: American Medical Association, American Medical Foundation.

Welling, D. R., & Ukstins, C. A. (2015). *Fundamentals of audiology for the speech-language pathologist.* Burlington, MA: Jones & Bartlett Learning.

West, R. L., & Smith, S. L. (2007). Development of a hearing aid self-efficacy questionnaire. *International Journal of Audiology, 46*(12), 759-771. doi:10.1080/14992020701545898

Westhorp, S. (2000). *Decibel Scales in Audiology*. (PDF). Retrieved from http://www.batod.org.uk/content/resources/audiology/refreshers/general/G3-decibels.pdf

Whitmer, W. M., Howell, P., & Akeroyd, M. A. (2014). Proposed norms for the Glasgow hearing-aid benefit profile (GHABP) questionnaire. *International Journal of Audiology, 53*(5), 345-351. doi:10.3109/14992027.2013.876110

Wolf, D. M., Lehman, L., Quinlin, R., Zullo, T., & Hoffman, L. (2008). Effect of patient-centered care on patient satisfaction and quality of care. *Journal of Nursing Care Quality*, *23*(4), 316-321.

Wong, K., & Levi, J. R. (2016). Readability of pediatric otolaryngology information by children's hospitals and academic institutions: Pediatric otolaryngology readability. *The Laryngoscope,* doi:10.1002/lary.26359

World Health Organisation. (1998). *Health Promotion Glossary*. Retrieved from http://www.who.int/healthpromotion/about/HPR%20Glossary%201998.pdf?ua=1

World Health Organisation. (2001). *International classification of functioning, disability and health, ICF*. Geneva: World Health Organisation.

World Health Organisation (2009). *Health Literacy and Health Promotion*. Retrieved from http://www.who.int/healthpromotion/conferences/7gchp/Track1_Inner.pdf

World Health Organisation (2013) *Health literacy: The solid facts*. Copenhagen, Denmark: WHO Regional Office for Europe.

World Health Organisation. (2015). *Deafness and hearing loss*. Retrieved from http://www.who.int/mediacentre/factsheets/fs300/en/

Yin, H. S., Forbis, S. G., & Dreyer, B. P. (2007). Health literacy and pediatric health. *Current Problems in Pediatric and Adolescent Health Care*, *37*, 258–286.

Yorkston, K. (2015). *Selecting Patient-Reported Outcomes Measures: A Committee Update*. Retrieved from http://www.asha.org/Academic/questions/Selecting-Patient-Reported-Outcomes-Measures/

Zorn, M., Allen, M., & Horowitz, A. (2004). *Understanding health literacy and its barriers* (Current Bibliographies in Medicine 1). Bethesda, MD: National Library of Medicine.

Zraick, R. I., & Atcherson, S. R. (2012). Readability of patient-reported outcome questionnaires for use with persons with dysphonia. *Journal of Voice, 26*(5), 635-641. doi:10.1016/j.jvoice.2011.01.009

Zraick, R. I., Atcherson, S. R., & Brown, A. M. (2012). Readability of patient-reported outcome questionnaires for use with persons who stutter. *Journal of Fluency Disorders, 37*(1), 20-24. doi:10.1016/j.jfludis.2011.10.004

Zraick, R. I., Atcherson, S. R., & Ham, B. K. (2012). Readability of patient-reported outcome questionnaires for use with persons with swallowing disorders. *Dysphagia, 27*(3), 346-352. doi:10.1007/s00455-011-9373-x

Appendix

Readability formulas as calculated by Oleander Readability Studio 2012.1:

The Flesch-Kincaid (or F-K) Readability Formula

$G = (11.8*(B/W)) + (0.39*(W/S)) – 15.59$

Where:

G	Grade Level
W	Number of words
B	Number of syllables
S	Number of sentences

The Gunning Fog Index (or FOG) Readability Formula

$G = 0.4*(W/S + ((C/W)*100))$

Where:

G	Grade Level
W	Number of words
C	Number of complex words
S	Number of sentences

The Simple Measure of Gobbledygook (or SMOG) Readability Formula

$G = 1.0430* \sqrt{C} + 3.1291$

Where:

G	Grade Level
C	Number of complex words (3+ syllables)

The FORCAST Readability Formula

$G = 20 – (M/10)$

Where:

G	Grade Level
M	Number of monosyllabic words