
**Readability, Quality and Suitability of Web-based Consumer Audiological
Health Information for Adults with a Hearing Impairment living in New
Zealand.**

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Audiology at the University of Canterbury

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Abstract

Purpose: To investigate the readability, quality and suitability of online hearing-related written healthcare materials available to New Zealand consumers.

Method: The key terms “hearing loss” and “hearing aids” were entered into Google New Zealand, the most commonly used search engine in New Zealand. The first 10 Websites that matched the study’s inclusion and exclusion criteria were retrieved for each key term, along with each Websites’ origin (commercial, non-profit or government). After removing duplicates, a total of 510 Webpages from 19 different Websites were retrieved and analysed. Readability was analysed using the Flesch-Kincaid (F-K), Flesch Reading Ease (FRE), and Simple Measure Of Gobbledygook (SMOG) readability formulas. Quality was analysed using the DISCERN quality questionnaire, which was completed by two experienced audiological researchers for each of the 19 Websites. Suitability was analysed using the Suitability Assessment of Materials (SAM) questionnaire, completed in the same fashion as the DISCERN questionnaire.

Results: Readability levels were generally high, with consumers needing on average 12-13 years of education to be able to comprehend the materials. When using the F-K as the readability measure, only 13 Webpages (2.5%) were below the 6th grade reading level recommended by health literacy experts. No significant differences in readability levels were found between Websites from different origins. Quality ratings were generally low, with the total mean of the DISCERN scores indicating that the general trend of the Websites was to meet the DISCERN criterion only to *some extent*. Again, no significant differences were found in quality ratings for Websites from different origins. Suitability ratings were similarly low, with all the SAM scores found to be in the “inadequate” range. Websites with a commercial origin were found to have significantly higher suitability ratings than Websites with a non-profit origin.

Conclusion: The readability, quality and suitability levels of online hearing-related written healthcare materials available to New Zealand consumers are generally lower than optimal. A list of recommendations has been provided to assist Website developers in improving online hearing-related written healthcare materials

Table of Contents

Abstract.....	i
List of Tables	iv
Chapter One: Introduction	1
1.1 Study Overview	1
1.2. Hearing Impairment	3
1.2.1 Overview	3
1.2.2 Prevalence	5
1.2.3 Impact of Hearing Impairment.....	7
1.2.4 Effect of intervention on the impact of hearing impairment.....	10
1.2.5 Factors influencing intervention	11
1.3 Health Related Consumer Information	13
1.3.1 Health Literacy.....	17
1.3.2 Readability of Health Information	21
1.3.3 Quality of Health Information.....	24
1.3.4 Suitability of Information.....	26
1.4 Study rationale	29
1.5 Aims and Hypothesis	30
Chapter Two: Method	32
2.1 Part 1 (Readability).....	32
2.1.1 Internet Search	32
2.1.2 Search Engine	33
2.1.3 Website Inclusion/ Exclusion Criteria	34
2.1.4 Search Procedure.....	34
2.1.5 Readability analysis	36
2.1.6 Readability Measures.....	37
2.1.7 Statistical Analysis.....	38
2.2 Part 2 (Discern and SAM Questionnaire).....	38
2.2.1 Procedure	39
2.2.2 Statistical Analyses	39
Chapter Three: Results	41
3.1 Overview	41
3.2 Effect sizes.....	41
3.3 Readability	42
3.4 Quality	44
3.5 Results Summary	48
Chapter Four: Discussion.....	49
4.1 Readability	50
4.2 Quality	51
4.3 Suitability	53
4.4 Clinical Implications	57
4.5 Study Limitations and future research	60
4.5 Conclusion.....	61
References	62

List of Tables

Table 1. Frequency and Website origin for each domain name of the analysed Webpages.....	35
Table 2. Mean, standard deviations, minimum, maximum values, and sample sizes for each readability formula for each of the three Website origins.....	43
Table 3. DISCERN quality criteria adapted from Charnock et al., 1999 with means and standard deviations for the 19 Websites used in the study.	45
Table 4. SAM factors and items (Doak et al.,1996) with means and standard deviations for the 19 Websites used in the study.	46
Table 5. Mean, standard deviations, minimum, maximum values, and sample sizes for both the DISCERN and SAM scores for each of the three Website origins.....	48
Table 6. Specific recommendations and examples to improve hearing-related Internet information.....	54
Table 7. Highest-ranking websites, based on DISCERN, SAM, and readability scores.....	59

Chapter One: Introduction

1.1 Study Overview

The Internet is increasingly becoming a source for individuals with health conditions to access written healthcare materials. The International Telecommunication Union (ITU) released a statement in 2014 indicating by the end of 2014, the number of Internet users would reach nearly 3 billion people world wide, with nearly 3 out of 4 people in Europe and 2 out of 3 people in the United States of America (USA) being Internet users. Similar trends are found in New Zealand, with approximately 80% of households having Internet access (Statistics New Zealand – Tataurangi Aoteroa, 2012a). This increase in Internet availability has led to a significant increase in the use of online written healthcare materials by consumers. A 2006 survey performed by the Pew Internet and American Life Project (2006) estimated that at least 79% of Internet users had searched online for health information on at least 1 of 17 major health topics, and Fox (2011) echoed these results, finding in the USA, accessing health information is the third most common Internet activity.

However, factors such as the readability and quality of the online healthcare information have been shown to be less than optimal for facilitating the maximum understanding of the healthcare information by consumers. In regards to readability, the majority of online healthcare materials have been shown to have readability levels greater than the 6th grade level recommended by health literacy experts (Walsh & Volsko, 2008). This trend has continued within audiology, with multiple studies demonstrating materials such as hearing aid brochures, audiologists communicating (either verbally or with written instructions) during hearing aid orientation appointments, self-report tools and questionnaires, and patient-reported outcome questionnaires, to all have higher than optimal readability levels (Atcherson, Richburg, Zraick, & George, 2013; Atcherson, Zraick, and Brasseux, 2011; Kelly, 1996; Kelly-Campbell,

Atcherson, Zimmerman & Zraick, 2012; Nair & Cienkowski, 2010). In regards to audiological healthcare information found on the Internet, recent studies have found information available via the American Speech-Language-Hearing Association Website, and found using the search engine Google, to similarly have higher than optimal readability levels (Atcherson et al., 2014; Laplante-Lévesque, Brannstrom, Andersson, & Lunner, 2012).

The quality of online healthcare information demonstrates a similar trend, with multiple studies demonstrating online healthcare information to have variable and generally low quality, including audiological information (Berland et al., 2001; Caron, Berton, & Beydon, 2007; Impicciatore, Pandolfini, Casella, & Bonati, 1997; Laplante-Lévesque et al., 2012).

While the literature has examined the readability and quality of online healthcare information relevant to audiology, no such studies exist examining the online information available specifically for New Zealand consumers. Hence, the present study sought to replicate the research performed by Laplante-Lévesque et al., (2012), who examined the readability and quality of online hearing-related healthcare information, but for the New Zealand context. In addition, a measure of suitability of hearing-related Internet healthcare information available to New Zealand consumers was used. The study aimed to assess these aspects of hearing-related health information available to New Zealand consumers by entering in the same search terms used by Laplante-Lévesque et al., (2012) (*hearing impairment* and *hearing aids*), into New Zealand's Google domain, and analysing the first 10 relevant Websites for each search for their readability, quality and suitability.

The following literature review will briefly outline how the human auditory system works and the negative impacts of having a hearing impairment, before reviewing the benefits of rehabilitation and factors that influence the uptake of rehabilitation. Finally, the concepts of health literacy, online healthcare consumer information, information readability, quality and suitability will be reviewed, before outlining the aims and hypotheses of the study.

1.2. Hearing Impairment

1.2.1 Overview

Hearing impairment refers to a multifaceted total or partial loss of an individual's ability to hear (Dillon, 2012). There are many physiological and structural causes of hearing impairment in both the adult and paediatric populations, which can occur in various parts of the auditory system. The human auditory system consists of the outer ear, middle ear, inner ear, the afferent and efferent auditory nervous pathways, and other associated cortical areas and structures. Each structure has a special role to play when perceiving and making sense of sound. The pinna is responsible for collecting and directing sound down the ear canal towards the tympanic membrane. However it is also vital for sound localisation (Blauert, 1997). Once sound hits the pinna, it is directed down the ear canal, where it hits the tympanic membrane. This causes the tympanic membrane to vibrate, which in turn stimulates the inner ear. Sound is transferred from the tympanic membrane to the inner ear via three small ossicular bones, known as the malleus, incus, and stapes. These bones are located in a small, air-filled space within the middle ear, with the manubrium of the malleus being connected to the tympanic membrane. The head of the malleus then connects to the body of the incus, with the long process of the incus connecting to the head of the stapes, which is finally connected to the oval window of the cochlea. These ossicular bones are responsible for transferring the vibrations of the tympanic membrane to the cochlea. The cochlea is then responsible for transducing these vibrations into electrical potentials, which are transmitted up the auditory pathway as action potentials via the auditory nerve to the cortex. The cochlea performs this task via the mechanoelectrical transduction process of the inner hair cells. Finally, sound is then organised and processed in a multitude of different ways by the neural auditory pathway and associated cortical areas.

In regards to hearing impairment itself, there are many pathophysiological and structural changes in the aforementioned structures that can cause an individual's hearing ability to be

impaired. Some examples include the destruction and/or loss of function of the inner and/or outer hair cells of the cochlea, the loss of function or destruction of components of the middle ear that are needed to transduce sound, reduced electrical potentials within the electrically charged fluids of the cochlea, and many more (Dillon, 2012).

The actual aetiology of the physiological deficits stated above varies greatly between the adult and paediatric population. For instance, data on the aetiology of paediatric hearing impairment demonstrate the causes to be approximately 50% a result of environmental factors such as bacterial and viral infections, physical trauma, birth and pregnancy complications, ototoxic antibiotics and acoustic trauma, and approximately 50% hereditary (Gorlin, Toriello, & Cohen, 1995). In regards to the elderly population, hearing impairment is more commonly due to pathophysiological changes in the ageing auditory system, and can include structural and biochemical changes in the function of the sensory, stria, and neural components of the cochlea, a reduction in function of the supporting cells of the cochlea, a reduced processing ability of sounds within the greater auditory pathway, and also changes in the outer and middle ear structures (Chisolm, Willott, & Lister, 2003). If a hearing impairment's root cause is within one of the aforementioned mechanisms of the cochlea, the hearing impairment can be defined as a sensorineural hearing impairment. If the cause of the hearing impairment is from the structures of the middle or outer ear responsible for the transmission of sound to the cochlea, then the hearing impairment can be defined as a conductive hearing impairment. An individual's hearing impairment may also be a combination of both a sensorineural and conductive loss, which is known as a mixed hearing impairment.

A variety of behavioural and objective measures can be used to assess whether an individual has a hearing impairment. The most common of these is puretone audiometry, which is a behavioural assessment commonly performed by an audiologist, or trained hearing professional. This assessment involves the patient responding to the quietest level (in dB HL)

puretone they can detect, at a multitude of frequencies across the speech spectrum (approx. 250-8000 Hz) (Schlauch & Nelson, 2009).

1.2.2 Prevalence

According to the World Health Organisation (WHO; World Health Organisation, 2013), over 360 million people, or approximately 5% of the world's population, have a disabling hearing impairment, defined as more than a 40 dB HL loss in their better ear. Of this number, children account for approximately 9% and adults over the age of 65 years account for nearly a third.

A significant factor in regards to the older population is its expected growth. In the United States of America in 2003, there were approximately 36 million people over 65 years of age, which is estimated to double by 2030 (Weinstein, 2009). With this increase will also come an increase in the number of adults with a hearing impairment (Bertoli et al., 2009), with Traynor, (2011) estimating that worldwide, the number of people with a hearing impairment may reach 900 million by the year 2025.

In regards to estimating the worldwide prevalence of hearing impairment, Stevens et al., (2013) performed a study that estimated the global and regional prevalence of hearing impairment using 42 studies from 1973 to 2010, spanning 29 different countries. They utilised data from a systematic review of hearing impairment performed by Pascolini and Smith (2009) and also added further research, to develop a final data set of 42 studies spanning from 1973 to 2010, spanning 29 different countries. From this data, the researchers were able to extract information regarding hearing impairment prevalence in the better ear, which was further disaggregated by region, age, sex and hearing level. The study found the global prevalence of hearing impairment (defined as having hearing thresholds as greater than or equal to 35 dB HL in the better ear) for children aged 5-14 years old to be approximately 1.4%. This figure increased with age, with the prevalence for females and males over the age of 15 years old

estimated to be approximately 9.8%, and 12.2% respectively. The region with the highest prevalence of hearing impairment was South Asia (17.0% for adults older than 15 years), which highlights a significant trend found by the researchers, being that rates of hearing impairment were found to be highest in developing regions, and lowest in high-income regions. This distinction was echoed by Tucci, Merson and Wilson (2010), who estimated that nearly 300 million people in developing countries have a moderate to profound hearing impairment, of which, 50% may have been preventable.

Similar trends can be seen in the USA and European countries. Lin, Thorpe, Gordon-Salant, and Ferrucci (2011) reviewed audiological data collected in 2005 and 2006 from 717 adults aged 70 years and older living in the USA, along with each individual's demographic variables, history of noise exposure and medical history. They found that almost two thirds (63.1%) of their sample had a hearing impairment (defined as having a speech frequency puretone average of greater than 25 dB HL in the better ear). European countries demonstrate similar rates of hearing impairment, with an estimated 17% of the population, or 10 million people, having some form of hearing impairment. This figure is expected to rise to approximately 14.5 million by 2031. Of the estimated 10 million hearing impaired people, approximately 6.4 million of these people were aged over 65 years old, with an estimated 71.1% of Europeans aged over 70 years of age to have some form of hearing impairment (Action on Hearing Loss, 2011).

Unfortunately, recent data specific to the prevalence of hearing impairment within New Zealand is lacking. Greville (2005) produced a report that collated data from a population survey performed in 1991 to 1992, along with two disability surveys performed in 1996 to 1997, and 2001 (completed in conjunction with the census performed during these years). Each survey asked respondents various questions, with the 1991 to 1992 survey asking the respondents directly whether they had a hearing impairment or slight loss, and the 1996 to 1997

and 2001 surveys asking respondents first more general questions about whether they considered themselves to have a disability, and then asking more specific hearing-related questions. The differing methodology and hearing impairment definitions utilised by the surveys does result in the overall prevalence for hearing impairment being difficult to extrapolate. However, some overall estimates were made by the report. Specifically, the researchers estimated that the overall prevalence of hearing impairment within New Zealand was approximately 9.8% for the non-institutionalised population. In regards to the ageing population, the study found approximately 15.3% of adults over 65 years of age identify as having a hearing impairment causing a disability, and 22.7% of adults over 65 years of age identify as having a hearing impairment, regardless of its definition. From this data, it is safe to assume that the rates of hearing impairment within the older adult population within New Zealand are similar to that of the rest of the developed world.

1.2.3 Impact of Hearing Impairment

The WHO developed the International Classification of Functioning, Disability and Health (ICF) to provide definitions and classifications within health and health-related domains (World Health Organisation, 2001). The ICF belongs to the WHO Family of International Classifications and was developed in order to provide a framework and set of definitions of functioning and disability associated with health conditions, that could allow for the international collection of data in a congruent manner (World Health Organisation, 2001). It bases its definitions of disability on what has been termed the biopsychosocial model (Imrie, 2004). This model is the marriage of two previously proposed conceptual models about disability: the medical model and the social model. The medical model theorises how the characteristics or deficits/health conditions of an individual directly cause the disability of the individual, and that treatment of the underlying cause or “problem”, will reduce or remove this disability (Rothman, 2010; World Health Organisation, 2001). The social model of disability

refers to disability as being a construct of society, and that “individuals are not disabled by their impairments, but by the disabling barriers faced in society” (Oliver, 2013, p.1025). The ICF was developed from the idea that although both models are valid to a point, neither is enough on its own to define and classify the complex individual and social issues faced by those with a disability. Hence the ICF links the roles that the body, mind, and society all play in determining an individual’s said disability, and represents an important step forward in acknowledging the role both sociological and biological enquiry have in understanding functioning and health (Imrie, 2004).

Briefly, the ICF model defines impairments as being at the body structure or function level, and involves problems in the functioning of physiological systems, or the organs and limbs of the human body. Activity limitations are defined as occurring at the person level, and involves an individual having problems in performing particular activities. Participation restrictions are defined as occurring at the societal level, and involve problems in life situations. Hence in the light of this model, the ICF uses the term disability as an encompassing term to describe any impairments, activity limitations and participation restrictions an individual may experience because of their health condition. The ICF also takes into account contextual factors that influence an individual’s ability to partake in external activities, being environmental and personal factors. Environmental factors refer to the interaction of an individual’s physical health condition with an aspect of the environment, which either reduces or facilitates their ability to participate in an external activity (Schneidert, Hurst, Miller, & Ustun, 2003). If this interaction is deemed unfavourable for the individual in any way, the individual is said to experience disability. Environmental factors do not only include physical aspects, but also include societal attitudes, support and relationships, technology, natural and human-made changes to the environment, and services, systems and policies, all of which can positively or negatively affect an individual’s functioning.

In the light of the ICF, a hearing impairment can be seen as a truly disabling impairment. Multiple studies on untreated hearing impairment have found associations between hearing impairment and impairments at each of the body, activity and participation levels described by the ICF. At the body level, untreated hearing impairment is associated with decreased cognitive functioning, including reduced mental status, memory and executive functioning (Lin et al., 2011). These researchers demonstrated that greater hearing impairment is associated with greater cognitive decline, specifically in the areas of executive functioning and psychomotor processing speed, and untreated hearing impairment has also been associated with an increased likelihood of individuals subsequently acquiring Alzheimer's disease. Research has also suggested that individuals with an untreated hearing impairment may also suffer from increased mortality rates. Indeed, Appollonio, Carabellese, Frattola, and Trabucchi (1996) demonstrated an increased mortality rate for men over the age of 75, which was nearly double that of men and women utilising hearing aids in the same age bracket. Hietanen, Era, Sorri, and Heikkinen (2004) found an association between self-assessed hearing levels and increased mortality for individuals over 80 years of age.

As hearing is essential for communication in everyday life, one could argue that the most adverse effect of having a hearing impairment is on the activity limitations and participation restrictions it results in during everyday life. Having a hearing impairment means hearing loved ones, friends and family is much more difficult, and often nearly impossible in adverse listening conditions. This results in social isolation and withdrawal from activities where communication is essential (Appollonio et al., 1996; Arlinger, 2003; Mick, Kawachi, & Lin, 2014). Individuals with a hearing impairment may also suffer from reduced quality and quantity of social relationships, and global physical health status, which in turn have been hypothesised to possibly mediate the increased rates of mortality described above (Appollonio et al., 1996; Mick et al., 2014).

Other activity limitations caused by hearing impairment include reduced ability to localise sources of sound, perceive speech in noise or a reverberant room, detect environmental sounds, and perceive radio and television signals (Laplante-Lévesque, Hickson, & Worrall, 2010). Finally, the decreased communication caused by untreated hearing impairments is significantly associated with participation limitations such as withdrawal or avoidance of social and interpersonal interactions, and is also associated with increased depression, decreased self-sufficiency, a general decrease in psychosocial and physical wellbeing, anxiety, embarrassment, loss of intimacy, loneliness, sadness, and unemployment (Appollonio et al., 1996; Bess, Lichtenstein, Logan, Burger, & Nelson, 1989; Goldstein & Shelly, 1981; Herbst & Humphrey, 1980; Laplante-Lévesque et al., 2010).

1.2.4 Effect of intervention on the impact of hearing impairment

Although having an untreated hearing impairment is associated with the many negative physical, social and environmental outcomes described above, there is hope for individuals afflicted with a hearing impairment to reduce, and possibly completely avoid, these negative outcomes. The most common method of hearing rehabilitation involves amplification via the fitting of hearing aids and/or other various listening devices, the benefit of which is most commonly measured using self-report measures like questionnaires. For instance, Gopinath et al., (2009) assessed the effect of having a hearing impairment on health-related quality of life in an older population, and found individuals with a hearing impairment who habitually used hearing aids to have improved physical functioning, and reduced role limitation due to physical problems than those who do not use hearing aids, although these figures were not statistically significant. Similarly, Appollonio et al., (1996) reviewed the effects of hearing aid use on various quality of life outcome measurements on a population of 1192 elderly individuals over 70 years of age. They found individuals who used hearing aids to show a “higher mood level,

richer social relationships, and better performance in the activities of daily living” (p. 93) than their hearing impaired peers who did not use hearing aids.

Kochkin and Rogin (2000) performed a survey of 2069 individuals with hearing impairment and their family members, in order to assess the benefits on quality of life of hearing aid use. The researchers developed an eight-page comprehensive questionnaire, based on quality of life questionnaires that had been previously used and validated in past hearing-related research. A similar but shorter questionnaire was developed for the individuals’ family members. After reviewing their results, the researchers concluded “[h]earing aid instruments are clearly associated with impressive improvements in the social, emotional, psychological, and physical well being of people with hearing impairment in all hearing impairment categories, from mild to severe” (p.11). These improvements included reduced discrimination, improved social relationships, reduced anger and frustration, reduced communication difficulties, improved cognitive functioning, and reduced self-criticism.

Chisolm et al., (2007) performed a systematic review of 16 studies on improvements in the health-related quality of life of adult hearing aid users with a sensorineural hearing impairment. After a careful analysis of the weaknesses and strengths of the available literature on the benefits of hearing aid use, the researchers concluded, “hearing aid use improves the psychological, social and emotional well-being of adults with acquired SNHL” (p.151). Finally, in regards to activity and participation restrictions caused by having a hearing impairment, hearing aids are significantly associated with long-term increased satisfaction and perceived benefit in multiple self-report questionnaires (Cox & Alexander, 2002; Takahashi et al., 2007).

1.2.5 Factors influencing intervention

Although the benefits of hearing aid use are clearly evident, most adults with a hearing impairment do not acquire hearing aids. In fact, multiple studies that examined hearing aid use

for adults with either a subjective or objective hearing impairment have demonstrated that only 14.6% to 20% own a hearing aid (Popelka et al., 1998; Stephens, Lewis, Davis, Gianopoulos, & Vetter, 2001; Stephens et al., 1990). The intervention options available to an individual and an individual's satisfaction with a method of intervention are influenced by many factors.

Knudsen, Oberg, Nielsen, Naylor and Kramer, (2010) performed a literature review of the available studies that examined the correlates of health-seeking behaviour for hearing impairment, hearing aid uptake, hearing aid use, and satisfaction. In regards to amplification, the researchers discussed how the psychological events that an individual experiences when undertaking rehabilitation for a hearing impairment are akin to a psychological journey, which has four crucial junctures: (1) the initial decision to seek help, (2) the decision to try using hearing aids, (3) the decision to keep using the hearing aids, and (4) their satisfaction with the hearing aids. The researchers then based their literature review on studies that examined factors that influenced individuals at each of these junctures. The researchers reviewed a total of 39 papers spanning from 1980 to 2009, that matched the study's inclusion and exclusion criteria.

As could be expected, the study identified many factors that influenced the different stages of the amplification process, many of which had contradictory or inconclusive effects. Overall, the study identified 31 factors, which included personal factors such as sources of motivation and attitudes, demographic factors such as age and gender, and external factors such as cost and counselling. Interestingly, the study only identified one factor that had a pervasive effect over all four of the above junctures. This factor was self-reported activity limitation, which correlated with all four outcome variables. Interestingly, gender and age were found to not be significantly associated with any of the outcome variables. The researchers concluded that this finding was significant in that it highlighted the importance and significance of self-reported activity limitation in each of the four junctures.

The above findings were similar to a systematic review performed by Meyer and Hickson (2012), who reviewed 22 studies that examined factors that influence health-seeking and hearing aid adoption in older adults. Interestingly, the researchers discussed their findings within the framework of the ICF model. The researchers concluded that at the functioning and disability level, individuals are more likely to seek help and adopt hearing aids if they have increased self-reported activity limitations, and have a moderate to severe hearing impairment. At the individual and environmental level, the research suggested individuals are more likely to seek help and adopt hearing aids if they are older adults, consider themselves to have poor hearing, consider their partners to be supportive, and consider there to be more benefits than barriers to amplification.

Other factors have an important influence on whether individuals decide to pursue intervention strategies. These include interacting with clinicians who have a genuine interest in the client's wellbeing, and who focus on aspects of the hearing aid fitting, such as how to manage the hearing aids, more than the technical aspect of a fitting (Laplane-Lévesque, Hickson & Worrall, 2012). Other factors that have been shown to have a significant, albeit more inconsistent, influence on hearing aid uptake are stigma, degree of hearing impairment, personality factors and coping strategies, and stages of change (Jenstad & Moon, 2011; Laplane-Lévesque et al., 2012).

1.3 Health Related Consumer Information

Health information is available to the public through many different mediums. Traditionally, health information has been provided to the public via formal sources such as physicians and healthcare providers, less formal sources such as family members or friends, and media sources such as the radio, television, magazines, or newspapers (Pennbridge, Moya, & Rodrigues, 1999; Rice & Katz, 2001). These various types of information sources can be classified based on their primary purpose, as serving either individuals' entertainment needs, or

their informational needs (Vivian, 2002, as quoted in Dutta-Bergman, 2004). These information sources also differ in the way that their audience absorbs the information obtained within them. Specifically, mediums may require a more active participation from their audience, or can be more passively absorbed (Dutta-Bergman, 2004).

Each of the above stated methods of communication tends to lend itself to differing styles of learning and differing purposes. For instance, interpersonal communication is well-established as a source of healthcare information for individuals who are health orientated and interested in actively seeking out health-related information (Brashers, Goldsmith, & Hsieh, 2002; Dutta-Bergman, 2004). Information from physicians and healthcare providers is also commonly accepted by the public as being reliable and remains to be one of the most influential sources of healthcare information (Couper et al., 2010; Hesse et al., 2005). This trend is seemingly stable, as research has indicated no evidence for the substitution of physician visitations by the increased access to Internet information (Lee, 2008). Media sources such as newspapers are also considered by the public to be reliable sources of health information and are an example of information-orientated media that, prior to the Internet, were an influential and commonly used source of health information (Dutta-Bergman, 2004). However, with the increasing and pervasive use of the Internet, the manner in which individuals can search for healthcare information is dramatically changing.

In recent years, the Internet has become one of the most commonly used sources of healthcare information, providing a novel way to obtain health information for the public. The International Telecommunication Union (ITU) released a statement in 2014 that predicted that, by the end of 2014, the number of Internet users would reach nearly 3 billion people world wide, with nearly 3 out of 4 people in Europe, and 2 out of 3 people in the USA being Internet users. Internet use decreases with age, with only 53% of individuals over the age of 65 years, accessing the Internet from home. Similar trends are found in New Zealand, with approximately

80% of households having Internet access (Statistics New Zealand – Tatauranga Aoteroa, 2012a). Again, Internet use is seen to decline with age, with approximately 80% of younger and middle aged people using the Internet, which drops below 80% for Individuals aged 65 to 74 years old, and to 50% for Individuals over 75 years old (Statistics New Zealand – Tatauranga Aoteroa, 2012b). A 2006 survey performed by the Pew Internet and American Life Project (2006) estimated that at least 79% of Internet users had searched online for health information on at least 1 of 17 major health topics, and Fox (2011) echoed these results, finding that, in the USA, accessing health information is the third most common Internet activity. Various other health literature has confirmed this trend, such as a study performed by Baker, Wagner, Singer, and Bundorf (2003) who found that approximately 40% of Internet users aged 21 years or older used the Internet to search for healthcare information or advice. Information regarding the prevalence of individuals with a hearing impairment accessing relevant health information on the Internet is not available at this time. However research performed by Hunter and Bridger (2008) found that 62% of otolaryngology patients would like Websites to be recommended to them by their physician. Laplante-Lévesque et al., (2010) also found that some adults in Australia with a hearing impairment do use the Internet to search for information before making decisions about hearing-related interventions. Hence it is probable that individuals with a hearing impairment would likely search the Internet for relevant health information concerning their impairment.

The Internet has become popular as a source of health information for many reasons. It provides advantages such as anonymity, access to vast amounts of information, opportunities to interact with others and receive social support, and the ability to tailor information to specific purposes (Cline & Haynes, 2001). The rise of the Internet has also brought with it the concept of healthcare “consumers” (Dutta-Bergman, 2004). The Internet facilitated the rise in healthcare consumerism by allowing for goal-directed searches for specific information and by providing

multiple services that the consumer can browse and eventually explore. However, this independence from traditional health institutions has been shown to not always be positive. Due to the lack of compulsory quality controls on the Internet, there is little regulation of the information available to these consumers. Such factors as the readability, reliability, and comprehensiveness of healthcare information on the Internet have been implicated as negatively affecting the conclusions drawn by healthcare information consumers, and may be fraught with misinformation.

To ensure optimal health outcomes for the greater New Zealand public, it is imperative that health information available on the Internet is of satisfactory quality. Hence, every New Zealand healthcare provider has the obligation to their consumers to provide comprehensive, reliable, and understandable information in order to facilitate optimal health outcomes. This obligation stems from the Patient Code of Rights, which states that every patient and consumer has the right to effective communication in a form, language, and manner that enables the consumer to understand the information provided and be able to make informed decisions based on this communication (Health and Disability Commissioner – Te Toihau Hauora, Hauātanga (n.d.)). In regards to the obligations of New Zealand based audiological institutions, the New Zealand Speech-language Therapists Association (2013) and New Zealand Audiological Society (2012) codes of ethics state that all members must hold the welfare of their clients as paramount. This includes ensuring each client is fully informed of the services they will be provided with and the possible effects of the services provided. Also, members must ensure that each client is treated with respect and in a non-discriminatory manner and their consent is obtained whenever necessary. The importance of the provision of accessible audiological healthcare materials can be seen here as being a central component of ensuring clients are fully informed of any and all treatments and services provided in order to make informed and optimal hearing-related health decisions.

1.3.1 Health Literacy

An important factor that contributes to how well consumers are able to use Internet healthcare information is health literacy. The concept of health literacy has been an important topic of focus within health literature in the recent past, and has undergone a myriad of changes as it has been developed in an attempt to reduce the gaps in knowledge between patients and healthcare providers. Historically, health literacy was defined as being an important factor at an individual level and related to the functional and cognitive capacity and behaviours of an individual to function as a patient in the healthcare system (Prins & Mooney, 2014; Sorensen et al., 2012). However, the need to review this individualistic definition was recognised, as it failed to incorporate individuals in a greater context, which may limit the extent to which they can utilise their health literacy skills. It also failed to recognise the role health institutions and other societal factors have in affecting an individual's health outcomes (Nutbeam, 2009; Prins & Mooney, 2014). Hence, the research concerning health literacy has moved towards a more holistic approach, which recognises the role institutions must play in effectively communicating with the public, and also the variable nature of individuals' health literacy in differing contexts (Ronson & Rootman, 2012, as cited in Prins & Mooney, 2014; Nutbeam, 2009). Sorensen et al., (2012) performed a systematic review of the literature concerning the various concepts and dimensions of health literacy in order "to develop an integrated definition and conceptual model capturing the most comprehensive evidence-based dimensions of health literacy" (p.2). The researchers developed the following definition: "[h]ealth literacy is linked to literacy and entails people's knowledge, motivation and competences [sic] to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course" (p.3).

Low health literacy has been found to be associated with poor health outcomes. A systematic review of studies examining the effect of health literacy on health outcomes in the USA found low health literacy to be associated with many negative healthcare outcomes. These include increased hospitalisations, inability to interpret medication labels and demonstrate taking medication properly and, in the elderly population, it was associated with higher mortality rates and poorer overall health status (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011). This is concerning due to the high rates of poor health literacy seen globally.

Health literacy itself is inherently difficult to predict (Nair & Cienkowski, 2010). Dewalt, Berkman, Sheridan, Lohr, and Pignone (2004) performed a literature review that found evidence for reading level to be positively associated with health knowledge, healthcare, and other global measures of health and disease. Hence health literacy has commonly been approximated by determining an individual's reading grade level, that is, the average reading ability obtained by students at each year of schooling in the American school system. Individuals who can read at a 5th grade level or higher have been considered to be literate and those who cannot to be functionally illiterate (Doak, Doak, & Root, 1996). Health literacy can also be approximated by measuring individuals' functional competency level, which examines the ability of individuals to perform different health literacy tasks as they increase in difficulty. Functional competency is measured on a scale of 1 to 500, which is then separated into five groups (1-5), where one classifies individuals with the lowest functional competency and five the highest. Approximately 80 million adults living in the USA are thought to have poor health literacy. The 2003 National Assessment of Adult Literacy found that 22% of American adults had basic health literacy, and also found higher rates of poor health literacy in the elderly, ethnic minorities, poor persons, and people with less than a high school level of education. Additionally, data indicate that the average reading grade level in the USA is at the 8th to 9th grade level, but 1 in 5 Americans can only read at a 5th grade level or below. This figure

increases to 2 out of 5 for ethnic minorities and the elderly (Doak et al., 1996). In New Zealand, approximately 56% of adults have low health literacy skills, with approximately 70% of Māori adults demonstrating low health literacy skills (Ministry of Health - Korero Marama, 2010).

As a result of these poor health outcomes, there has been a global movement to address issues of low health literacy. Efforts such as facilitating better health communication by establishing literacy guidelines and encouraging the co-operation of individuals from differing academic and health backgrounds to confer when constructing written health materials (Lloyd, Ammary, Epstein, Johnson, & Rhee, 2006; Sorenson et al., 2012), have been shown to be effective in reducing the difficulty of written healthcare materials. Health institutions should provide clear and concise materials written at a 5th to 6th grade reading level or lower to ensure a greater proportion of the population will understand the materials (Weiss, 1998). Medical institutions and physicians should similarly assess the difficulty of the health materials they provide and ensure they are easy to read (Ferguson & Pawlak, 2011).

It is useful to view the importance of effective construction of health materials through the framework of the Health Belief Model (HBM). The HBM was developed as a psychosocial model that attempts to explain what factors influence individuals to utilise health services and cause a behavioural change (Meyer, Hickson, Lovelock, Lampert & Khan, 2014; Rosenstock, 2000). The HBM describes how decisions individuals make are influenced by five belief constructs. Specifically, individuals will be more likely to adopt healthy behaviours and accept health preventative strategies when they perceive they are susceptible to a serious risk and that the severity of the health impairment is or would be significant. They also must feel that a behaviour change will result in significant benefits, feel the barriers to this behaviour change are not too great, and feel confident in their ability to take action (Rosenstock, 2000). The HBM states that the extent to which each of these constructs varies between individuals will determine their likelihood of undertaking a health prevention strategy.

Each of the above belief constructs provides important insights into how health materials must be constructed in order to optimally communicate with the public. For instance, in regards to perceived susceptibility, health materials should clearly and simply outline the rates of hearing impairment in all age groups and describe factors, such as noise exposure, that can increase individuals' likelihood of developing a hearing impairment. Similarly, materials should outline the social and clinical consequences of having an untreated hearing impairment, such as social isolation and reduced cognitive abilities, in order to help individuals perceive the negative consequences of having a hearing impairment. Likewise, hearing-related health materials should highlight the many significant benefits of treatment outlined above to portray the benefit that hearing aids can provide. In order to address perceived barriers, materials should address the major reasons why individuals choose not to try hearing aids, such as cost, perceived stigmas and other psychological and physical barriers, and attempt to reduce their negative perception. This is important as when individuals are deciding to undertake a particular health action, they perform a subconscious cost-benefit analysis of the perceived benefits and barriers of their actions (Rosenstock, 2000). Hence, it is essential to reduce individuals' perception of the barriers of undergoing treatment in order to increase the likelihood of them taking action. Confidence in individuals' ability to utilise treatment options such as hearing aids should also be ensured, with materials demonstrating clearly how hearing aids function and should be managed by the client.

In this way, the HBM provides a framework for the construction of hearing healthcare materials that will be most effective in influencing a behavioural change. For instance, the HBM highlights how healthcare materials must be written in a way that raises the awareness of the perceived risks of the reader to a certain extent, but also provides clear and simple actions that the individual can take in order to cause a lasting change (Haynes, 1980, as cited in Doak et al., 1996). It also provides the opportunity for healthcare providers to communicate with

individuals with low health literacy via the use of the plain language that can be used when describing behaviours, as opposed to when describing complex health conditions.

Recently, Meyer et al., (2014) described how the framework of the HBM relates to individuals with a hearing disorder. The researchers state that individuals discussing their hearing impairment with a health professional and deciding upon an intervention (typically amplification) require both a behavioural and attitudinal change. This change is regulated by the belief constructs described above. The researchers found the framework of the HBM model to provide a valuable tool when determining factors that influenced individuals with hearing impairment to seek a consultation and continue with an intervention strategy (specifically, hearing aids). In relation to the HBM belief constructs, the researchers determined that for individuals, the factors most influential in causing the above attitudinal and behavioural change were a positive attitude about hearing aids (perceived benefit), confidence in their ability to manage a hearing aid (self-efficacy), their being paid a pension (perceived barriers), and their admission of having communication difficulties as a result of their hearing impairment (perceived severity).

1.3.2 Readability of Health Information

Linked closely to the idea of health literacy is the concept of readability of healthcare information. Readability refers to the ease with which written information can be read and understood (Laplanche-Lévesque et al., 2012) and “what makes some texts easier to read than others” (DuBay, 2004, p. 3). If the readability of a document is higher than the reading level of the intended audience, the audience will stop reading the document and may also misinterpret the information provided (DuBay, 2004). Hence, satisfactory readability levels of health information are vital for consumers to be able to understand complex health messages. Readability is affected by the style and structure of language used in texts such as sentence

length, the use and frequency of polysyllabic words, and the use of jargon (Laplante-Lévesque et al., 2012).

Healthcare information must be written at a reading level that is comprehensible by the majority of the public in order to facilitate maximum understanding and use of the information. The United States Department of Health and Human Services describes a text with a readability level of above nine years of education (9th grade) as being considered difficult for many people to read (Walsh & Volsko, 2008). The 2003 National Assessment of Adult Literacy performed in the USA revealed the average reading grade level of English-speaking adults to be only at the 8th to 9th grade level, and approximately 1 out of 5 Americans can only read at a 5th grade level or below (Doak et al., 1996). This number increases for inner city minorities and adults aged over 65 years old to 2 out of 5. Hence research has suggested that to facilitate optimal health literacy and understanding, healthcare information should be written at a 5th to 6th grade reading level to ensure maximum understanding by the greater adult population (Atcherson et al., 2014). Doak et al., (1996) similarly agree that materials written below or at a 5th grade reading level should be considered as superior, those written from a 6th to 8th grade level as adequate, and those written at or above a 9th grade level as not suitable.

Research has shown the readability level of online healthcare information often exceeds the above recommended 5th to 6th grade reading level (Walsh & Volsko, 2008). In relation to the readability of relevant audiological information, studies have found common sources of information such as hearing aid instructional and educational brochures and common self-report assessment tools to consistently exceed the recommended levels for healthcare information. For instance, Kelly (1996) assessed the readability levels of hearing aid instruction manuals and found nearly 73% to be written at a university reading level. Nair and Cienkowski (2010) analysed the reading grade level used by audiologists when communicating (either verbally or with written instructions) during hearing aid orientation appointments. They found the language

used by audiologists and also written information in the form of hearing aid brochures, to both be higher than the predicted patient literacy level, indicating the patients would have likely not understood at least some of the information directed at them during the appointments. Similarly, Atcherson et al., (2011) found the readability of tinnitus specific patient-reported outcome questionnaires to be predominantly above the recommended 5th to 6th grade reading level. Kelly-Campbell et al., (2012) also examined the readability of self-report tools that are specific to assessing the hearing difficulty experienced by adults. They found the reading grade level of the 4 assessment tools to range from 7.8 to 11.2, all of which are greater than the recommended levels. Atcherson et al., (2013) also examined questionnaires used to assess listening difficulties associated with auditory processing disorder (APD) and found when using the FORCAST formula, which is most appropriate for assessing the readability of questionnaires, that all the questionnaires were written at or above an 8th grade reading level.

In regards to audiological healthcare information found on the Internet, Atcherson et al., (2014) performed a readability analysis of all audiology and speech-language pathology-related information available to the public on the Website of the American-Speech-Language-Hearing Association (ASHA). They found approximately 85% of the materials to be written at a level that exceeded the recommended 5th to 6th grade and concluded that a vast majority of consumers would be susceptible to misinterpreting or misusing the information available to them. Finally, Laplante-Lévesque et al., (2012) performed an analysis of the quality and readability of audiological information found when using Google to search for audiology-relevant information. The researchers entered the key terms “hearing loss” and “hearing aids” into the Google search domains of Australia, Canada, India, the United Kingdom, and the USA, and they retrieved the first 10 Websites that matched the study’s inclusion/exclusion criteria. The readability of the Websites was then analysed using 3 readability formulas. In addition, they also compared the readability levels between the origins of the Websites (commercial, non-

profit and government). The researchers found the reading level of the majority of the audiological information available to consumers through Google to be higher than a 9th grade level. This suggests that only consumers with approximately 11-12 years of education would be able to read and understand the information presented. No significant difference was found between Website origin.

1.3.3 Quality of Health Information

The ease with which healthcare information can be obtained from the Internet has highlighted the importance of ensuring the quality and accuracy of the information available to consumers. Due to the lack of regulation of the quality of information on the Internet, information quality can be highly variable and, at times, potentially misleading and misinformative. Multiple studies have been performed that demonstrated the variable quality of Internet healthcare information on many different health-related topics (Berland et al., 2001; Caron et al., 2007; Impicciatore et al., 1997). Eysenbach, Powell, Kuss, and Sa (2002), performed a systematic review of studies examining the quality of Internet healthcare information and found over 70% of the reviewed studies to conclude that the quality of the information available was inadequate. This is a significant problem due to the widespread use of the Internet when searching for healthcare information and the influence that the information has on the people that access it (Couper et al., 2010). Laplante-Lévesque et al., (2012) describe three ways in which the poor quality of Internet health information can be addressed. First, consumers themselves can assess the quality of the materials. Secondly, the Website developers can abide by ethical (but voluntary) guidelines. Thirdly, medical professionals can assess the quality of the information themselves and then recommend accurate and reliable materials to their patients. Laplante-Lévesque et al., (2012) reviewed each of the above points, which will be briefly summarised here.

There are over 250 tools available to consumers to assess the quality of Internet health information (Bernstam, Shelton, Walji, & Meric-Bernstam, 2005). However, of these tools, a large proportion are trustmarks or seals of approval from consumer organisations that were unintended for Internet use and less than 30% actually disclosed their criteria. Tools that are most appropriate for consumer use are predominantly questionnaires such as the DISCERN questionnaire (Charnock, Shepperd, Needham, and Gann, 1999) which involves consumers answering quality criteria questions, in order to determine the overall quality of the Website. However, consumers may not always methodically analyse and review health information on the Internet, read disclaimers, or have prior knowledge of the topic or authors of the materials (Eysenbach & Kohler, 2002).

Another method of assessing the quality of Websites is by the Website creators themselves adhering to ethical guidelines to ensure the quality of the material they present. In 2001, there were 98 Website schemes that Website developers could adhere to in order to demonstrate to consumers that their material was of high quality (Gagliardi & Jadad, 2002). An example is the Health On the Net (HON) foundation, which is a Swiss non-profit organisation that provides guidelines that Web developers can follow to demonstrate their intent to publish objective and transparent information on their Websites. New Zealand Websites are not typically endorsed by HON. However, a Website called Health Navigator New Zealand has recently been developed, which is a non-profit initiative the aim of which is to provide consumers with reliable and trustworthy health information. They have identified a quality framework based on national and international quality standards, which provides consumers with high quality Websites and online resources. Similarly, a Website called Health Info run by the Canterbury District Health Board recommends online healthcare materials that they claim have been approved or written by healthcare professionals. However, at this point in time, Health Navigator has very little hearing related information, and none of the Websites identified

in the present study were recommended by the Website. Similarly, only one Website in the current study was recommended by Health Info.

Lastly, clinicians and medical professionals can use assessment tools in order to assess whether the written health information is of high quality. Again, a relevant example is the DISCERN questionnaire, which was developed by Charnock et al., (1999) and will be utilised in the current study. The DISCERN is a tool that can be used to rate the quality of health information on treatment choices. It contains 16 quality criteria items that are rated from 1 to 5. A rating of 1 indicates the criterion has not been met. Ratings of 2 to 4 indicate the criterion has been partially met. A rating of 5 indicates the criterion has definitely been met. Ratings are averaged across the 16 criteria to derive a DISCERN score between 1 and 5. Higher scores on the DISCERN indicate higher quality.

In regards to the quality of relevant audiological information, Laplante-Lévesque et al., (2012) reviewed the quality of information of 66 websites after entering relevant hearing-related key terms into five different countries' Google search engines. The researchers assessed the quality of the Websites by recording whether they were HON certified, and also had two clinically experienced audiological researchers answer DISCERN questionnaires about each Website. Of the Websites assessed the researchers found only 14% of the assessed Websites to have HON certification. Similarly, the mean DISCERN score for the 23 Websites that the DISCERN questionnaire was completed for was 2.05, indicating the Websites only partially met the quality criteria of the DISCERN questionnaire. Websites with a non-profit origin scored significantly higher on the DISCERN questionnaires than Websites with a commercial or government origin.

1.3.4 Suitability of Information

Lastly, content and design, or suitability, is also an important component of healthcare materials that can be assessed. These terms refer to components of healthcare material such as

cultural factors, layout, graphics and organisation (Doak et al., 1996). Suitability is an undervalued component of healthcare information and can help predict the level that information will be understood by the target population (Nasser, Mullan, & Bajorek, 2012). The need for suitability assessment arose from the suggestion by Meade and Smith (1991) that human factors such as culture, motivation, visual attractiveness and experience should be considered when developing healthcare materials, all of which can affect the suitability of the materials (Shieh & Hosei, 2008).

The most commonly used assessment tool used to assess these factors is the Suitability Assessment of Materials, or SAM (Doak et al., 1996). The SAM was developed and validated in response to the need of researchers to be able to systematically assess the suitability of written information in an efficient and timely manner. It has been validated by 172 healthcare providers from multiple different cultures and was originally intended to be solely for print materials with illustrations, but has been successfully used to assess the suitability of video materials. It contains 44 items that assess a material's suitability. The respondent answers each question by rating the material as not suitable (0), adequately suitable (1) and suitable (2). The items are based on the following factors: (1) content, (2) literacy demand, (3) graphics, (4) layout and typography, (5) learning stimulation and motivation, and (6) cultural appropriateness. The score on the SAM is calculated by adding the total points and dividing by the total possible score to derive a percentage score. A percentage score is deemed to be inadequate if it is less than 39%, adequate if it is between 40 to 69%, and superior if it is 70% or above.

The content factor includes an evaluation of (a) how well the title, introduction, or graphics clearly state the purpose, (b) how well the main content of the material is application of knowledge or skills aimed at the reader, and (c) how well the scope is limited to the essential information directly related to the topic, and (d) a summary of the information. The literacy

demand factor includes (a) an evaluation of the reading grade level, (b) the writing style (conversational, active voice, simple sentence with little or no embedded information), (c) vocabulary that contains common and explicit words, explanation of technical words with examples, and use of imagery words, (d) provision of context before presentation of new information, and (e) use of learning aids such as “road signs” that precede topics. The graphics factor includes an evaluation of (a) how well the cover image – in this case the images on the homepage of the Website – conveys the content or purpose, (b) the appropriateness of the illustrations: adult-like, simple, and familiar to the reader, (c) how well the illustrations present the key information without being distracting, (d) the explanations of the graphics, and (e) the use of captions to introduce and/or explain the graphics. The layout and typography factor includes an evaluation of (a) how well the information is presented coherently, e.g., whether images are near the text they refer to, use of color and spacing, and visual cueing such as arrows or shading, (b) typography such as use of both upper and lower case lettering, sans-serif typeface, use of cueing such as bolding, color, and size, (c) the use of subheadings to “chunk” information. The learning stimulation and motivation factor includes an evaluation of (a) elements of interaction such as problems or questions for reader response, (b) modeling desired behavior for daily living, and (c) motivation for self-efficacy accomplished by dividing complex topics into smaller units to allow readers an opportunity to experience success during reading. Finally, the cultural appropriateness factor includes an evaluation of (a) a match between the material and the culture of the intended audience and (b) images and examples that are culturally appropriate for the intended audience and are presented in a positive way.

Previous analysis of healthcare materials has shown the majority of healthcare information to be written at unsatisfactory suitability level. Nasser et al., (2012) analysed the readability, suitability and quality of online patient information regarding the use of Warfin. They found only half of the 11 Websites assessed gained a *suitable* rating, with no Websites

gaining a *superior* rating. Similarly, Shieh and Hosei (2008) performed a study that examined the readability and suitability of multiple written healthcare materials. They found 6 of the 15 health materials to gain a *superior* rating, with the 9 others only gaining a *suitable* rating. The only example of the use of the SAM in audiology is a study performed by Caposecco, Hickson, and Meyer (2014), who used the SAM to assess hearing aid user guides. The researchers analysed the content, readability and design of 36 written hearing aid user guides using the FRE, F-K, FOG and Fry readability formulae, and the SAM. They found that the majority of the hearing aid brochures (69%) were not adequate while only 31% were found to be adequate. The brochures tended to score the lowest in the scope, learning stimulation and motivation, vocabulary, and layout and typography components of the SAM. They also had a overall mean reading grade level of 9.6, which led the researchers to conclude that the hearing aid brochures were, overall, not suitable for their target population and were not facilitating positive outcomes in respect to hearing aid use. This is especially interesting since, when constructing healthcare materials for such a specific target population (i.e., older adults with a hearing impairment), the developers should be even more aware of the importance of ensuring the materials have satisfactory readability and suitability levels.

1.4 Study rationale

The above research shows that the majority of audiological healthcare information is written at a higher reading level than is considered appropriate, which may significantly reduce the amount of helpful information consumers are able to extract from it. This issue must be addressed as accurate and assessable Internet information can provide a good resource for helping those affected by hearing impairment to learn about their condition and assess potential rehabilitation services that could help improve their quality of life. Laplante-Lévesque et al., (2012) did not include the New Zealand Google user domain in their study, so they did not assess the audiological information most readily available to New Zealand consumers. As a

large population of New Zealanders have low health literacy, it is important that we ensure the information available to those interested in or suffering from hearing impairment is written at an accessible level to help them make the most informed decisions possible.

The present study seeks to replicate the research performed by Laplante-Lévesque et al., (2012), who examined the readability and quality of online hearing-related healthcare information, but for the New Zealand context. In addition, a measure of suitability of audiological Internet healthcare information available to New Zealand consumers has been used. The study aims to assess these aspects of audiological information available to New Zealand consumers by entering in the same search terms used by Laplante-Lévesque et al., (2012) (“hearing impairment” and “hearing aids”), into New Zealand’s Google domain, and analysing the first 10 relevant Websites for each search for their readability, quality and suitability.

1.5 Aims and Hypothesis

In regards to readability, the study aims to address the following research questions: (1) What is the readability of the top Google New Zealand Websites when searching for consumer information for adults with a hearing impairment? (2) Are there significant differences in the readability levels for Websites with different origins (commercial, non-profit or government)? The null hypothesis is that there will be no significant differences in the readability level based on Website origin. It is expected to be supported due to the results of Laplante-Lévesque et al., (2012), who found no significant differences in the readability level depending on Website origin.

In regards to quality, the study aims to address the following research questions: (3) What is the quality of the top Websites, based on the DISCERN rating scale? (4) Are there significant differences in quality based on origin of Website (commercial, non-profit or government)? The null hypothesis is that there will be no significant differences between

Website quality based on origin. This is expected to be supported due to the results of Laplante-Lévesque et al., (2012) who found non-profit Websites to have higher quality ratings than commercial or government Websites.

In regards to suitability, the study aims to address the following research questions: (5) How suitable are the Internet health materials concerning hearing impairment that are available to consumers, as assessed using SAM? (6) Is there a difference in the suitability level of Websites based on origin? The null hypothesis is that there will be no significant differences between health information suitability based on Website origin. This is expected to be supported, due to the lack of any available evidence to suggest otherwise.

Chapter Two: Method

The current study was performed at the University of Canterbury and investigated the readability, quality and suitability of online hearing-related healthcare materials available to New Zealand consumers. For the readability component, the study consisted of an analysis of the top 10 Websites retrieved using the New Zealand Google domain, for the key terms “hearing loss” and “hearing aids.” Readability was analysed using three readability formulas, specifically the Flesh Reading Ease (FRE; Flesh, 1948), Flesch-Kincaid (F-K; Kincaid, Fishburne, Rogers, & Chissom, 1975), and Simple Measure Of Gobbledygook (SMOG; McLaughlin, 1969). Website quality was assessed using the DISCERN questionnaire, which was completed for each Website independently by two experienced audiological researchers. Website suitability was assessed using the SAM questionnaire, which was also completed for each Website by the same audiological researchers.

2.1 Part 1 (Readability)

2.1.1 Internet Search

It was decided that the current study would make use of the search terms used by Laplante-Lévesque et al., (2012) due to the similarities of the purpose of the two studies, but the fact that the latter study did not include Websites found using the New Zealand Google domain. In accordance with their study, the search terms selected for use in the present study were “hearing loss” and “hearing aids.” Laplante-Lévesque et al., (2012) decided upon these search terms by recruiting a panel of twelve individuals with extensive audiological experience and expertise as either (or both) researchers, clinicians or educators, to provide 38 key words they considered “adults with hearing impairment and their significant others are most likely to use as search terms when looking for information on hearing impairment and its treatment” (p. 619). Eight keywords or keyword pairs that were identified by at least 2 of the above experts were

entered into Google trends (www.google.com/trends), which detailed the relative frequency that each word has been used in Google over time. The keywords “hearing loss” and “hearing aids” were third and fourth in frequency of the eight keywords, but were chosen as they predominantly retrieved information relevant to an adult population in regards to hearing aids and hearing loss. The key words that were first and second in frequency (“hearing” and “deaf”) were not used due to them retrieving information concerning judicial matters or information relevant only to deaf individuals.

Each Webpage within each Website was used as the unit of analysis for the readability portion of the study. Nineteen as opposed to 20 Websites were retrieved in total, due to one Website being retrieved in both searches. A Webpage was defined as the information that appeared on the screen after clicking on a hyperlink. The rationale for this was to obtain a larger sample of health information for the readability analyses. A total of 510 Webpages were analysed from the 19 Websites retrieved. There was a total of 249 Webpages with a commercial origin, a total of 125 Webpages with a non-profit origin, and a total of 136 Webpages with a government origin.

2.1.2 Search Engine

To obtain the hearing-related Websites to be assessed, a Google New Zealand search was performed using the relevant key terms described above. Google New Zealand was chosen as the Internet search engine for the following reasons. First, as stated above, the present study is in essence a continuation of the Laplante-Lévesque et al., (2012) study, which performed readability and quality analyses of Websites found when entering the key terms into five different countries’ Google domains. These Google domains were American, Australian, British, Canadian and Indian, and were chosen because the key terms of the study are searched for with the highest frequency in these domains. Second, Google New Zealand is by far the most common search engine used by New Zealanders, owning approximately 92% of all

searches in New Zealand (“2013 Search Engine Market Share by Country,” 2013). Therefore, Google was selected as the search engine that was used to search for the Websites to be analysed (specifically www.google.co.nz).

2.1.3 Website Inclusion and Exclusion Criteria

The first ten relevant Websites that matched the inclusion and exclusion criteria were selected for a readability and quality analysis. Websites were included if they contained relevant information regarding hearing, the treatment of hearing loss with hearing aids, information on hearing loss, or other treatments of hearing loss. Websites were excluded if they were yellow or white page advertisements (identified by Google by marking them with a yellow colour, and usually being the first two or three Websites that were shown), map directions or images for local businesses, videos, directory listings, images, or news articles. Website origin (commercial, non-profit, government) was not a factor in the inclusion and exclusion of Websites.

2.1.4 Search Procedure

When performing the search, each of the key terms was entered into Google New Zealand, and the first 10 Websites meeting the inclusion and exclusion criteria for each key term were retrieved. Once the relevant Websites were identified, each Webpage from the Websites was saved as either an .html, or .htm file using Mozilla Firefox on a Mac personal computer, by one of the two researchers performing the study. Files that could not be saved as either an .html, or .htm file were copied and pasted into a Microsoft Word document, and saved.

The origin of each Website was also recorded during this process. Each Website origin was categorised using the domain name of the Uniform Resource Locator (URL) of the Website, which commonly indicates the purpose or origin of the Website. The domain name for each Website was recorded, and classified as either being commercial, non-profit, or government in origin. Table 1 shows all of the domain names that were recorded, their

respective frequencies, and their categorised origins. When the URL domain name did not provide enough information to determine the origin of the Websites, the origin was determined by researching who actually owned the Website, and determining whether the owner was a commercial, non-profit or government institution.

Table 1. Frequency and Website origin for each domain name of the analysed WebPages.

<i>Domain name</i>	<i>Frequency</i>	<i>Origin</i>
.org	4	Non-profit
.org.nz	2	Non-profit
.co.nz*	1	Government
.co.nz*	5	Commercial
.gov	2	Government
.govt.nz	1	Government
.com*	1	Commercial
.com*	2	Non-profit
.uk	1	Government

* Although the .com and .co.nz domain names typically demonstrate the Website has some form of commercial purpose, Websites can also have these domain names and be of non-profit or government origins.

When reviewing the Websites for analyses, the content of the Websites was initially assessed to discern how much of the Website would be saved and analysed. For instance, for Webpages dedicated entirely to hearing loss or hearing aids, each Webpage of the Website was saved as an .html file and analysed (excluding pages with just pictures or videos, and pages containing just contact details). However, for Internet healthcare Websites that contained large amounts of information irrelevant to the purpose of our study, the two researchers reviewed pages that seemed unrelated to the purpose of the study, and agree upon whether the Webpage and its links should be included in the analysis or not. In this instance, the initial Webpage that

was retrieved from the Google New Zealand search acted as the starting point for each assessment. Each link from this page was then reviewed, and if it was deemed relevant to the purpose of the study, it was saved and analysed. Similarly, each link from the Webpage deemed relevant was also then reviewed, and saved and analysed. This process was continued until all relevant Webpages of the Website were saved, and no links relevant to the purpose of the study were left unanalysed. In order to be included in the study, the main topic of the Webpage needed to be based specifically on information related to the key terms “hearing loss” or “hearing aids.” For example, the starting point of the Website medicinenet.com, which was a page dedicated to the different types of hearing loss, also linked to pages that focused on topics such as “Paget’s disease”, and “STDs in Men Overview.” These Webpages were not be the focus of the study, and were therefore not saved or analysed.

2.1.5 Readability analysis

To perform the readability analysis of the relevant Webpages, Readability Studio (Oleander Software, 2012) software was used to assess each of the 510 Webpages from the 19 different Websites. This software allows the user to analyse the readability of a text using multiple readability formulas simultaneously on a given saved document (.txt; .htm; .html; .xhtml; .rtf; .doc; .docx; .dot; .wri; .odt; .ott; .ps). It also provides explanations of the results, ideas on how to improve the readability of a document, highlights polysyllabic words, and provides a sentence and syllable count breakdown. The analysis was performed as follows:

1. Readability Studio (Oleander Software, 2012) was opened, and the “Create a New Project” button clicked.
2. A saved Webpage document (.html, .htm or .doc) was selected.
3. English was selected as the document’s language.
4. The parameters describing the document structure were selected. Specifically, the “Non-narrative, fragmented text”, for the document composition, and “Sentences are split by

illustrations or extra spacing” and “Centered/ left-aligned text” for the document layout, were all selected.

5. The F-K, FRE and SMOG readability formulas were manually selected.
6. The software then produced the readability scores for each of the above readability formulas. These scores were then recorded by the researcher onto a Microsoft Excel spreadsheet, under a tab specifically for the Website.
7. The above steps were then repeated for each individual saved file for each page of each Website.

2.1.6 Readability Measures

The readability of the relevant Websites was assessed using the Windows-based software Readability Studio (Oleander Software, 2012). Three readability formulas, specifically the FRE, F-K, and SMOG were used. There is no specific standard for choosing readability formulas, hence the above formulas were chosen predominantly due to their common use within healthcare literature. Each formula brings different elements to the table when assessing readability.

The FRE formula is considered to be the most widely used readability formula for materials written for adults, and has been incorporated into the popular Microsoft Word software. The FRE formula scores materials from 0-100, with a lower score indicating a more difficult reading level, although the score can be converted to a corresponding approximate reading grade level (Kelly-Campbell et al., 2012). The FRE calculates a readability score by analysing the average words per sentence and the average syllables per word (Flesch, 1948). A score of 70 or above is defined as “easy” and is written at the grade school level, a score of 60 to 70 is described as “standard” and is written at the high school level, and a score below 60 is described as “difficult” (D’Alessandro, Kingsley, Johnson-West, 2001). It also has a correlation of 0.70 with performance on a standardized reading test (DuBay, 2004). The F-K is

a modified version of the FRE formula that produces a US reading grade-level score for readability, rather than the above 0-100 scoring of the FRE formula (DuBay, 2004).

The SMOG formula is commonly used to assess healthcare information by producing a reading grade level based on the square root of the number of words with three or more syllables in three ten-sentence samples of the material. The total number of words containing more than 2 syllables is counted and inserted into the formula. This final polysyllabic word count is applied to a conversion table to calculate the corresponding grade level for the text (Kann & Pannbacker, 2000). The SMOG has previously been successfully used to analysis healthcare consumer information, demonstrated by a study by Fitzsimmons, Michael, Hulley, and Scott (2010) who performed an analysis of online healthcare consumer information for people suffering from Parkinson's disease, who concluded that "SMOG should be the preferred measure of readability when evaluating consumer-orientated healthcare material." Its popularity stems from the SMOG classifying reading grade levels based on 100% comprehension, which some researchers argue is necessary in a healthcare setting as even small miscomprehensions can lead to poor health outcomes (D'Alessandro et al, 2001; Wang, Miller, Schmitt & Wen, 2013).

2.1.7 Statistical Analysis

For the readability component of the study, the planned statistical analysis was an ANOVA to test for differences in readability between the different Website origins.

2.2 Part 2 (Discern and SAM Questionnaire).

The quality of the relevant Websites was assessed using a questionnaire based off the DISCERN questionnaire used in Laplante-Lévesque et al., (2012), and the Suitability Assessment of Materials (SAM questionnaire).

2.2.1 Procedure

To assess the quality of the Websites using the DISCERN, all study Websites were evaluated. Two PhD-level audiologists conducted the evaluation. One has 14 years of clinical and academic experience working with adults with hearing loss, and the other has 10 years of experience. Each audiologist reviewed the DISCERN questionnaire, read the background literature, and collaboratively evaluated 2 Websites that were not part of the study. The background literature included the DISCERN handbook (Charnock et al., 1999), which helps users to understand and utilise the DISCERN effectively, by providing clear definitions, instructions and examples of the rating process.

Each audiologist then independently evaluated 2 additional Websites (again, that were not part of the study) and discussed any discrepancies in scores. Finally, they independently evaluated the study Websites to derive a DISCERN score for each Website. When performing this evaluation, each Webpage of the Website that was included in the initial readability analysis of the Website was read and analysed.

The same two raters also performed the SAM ratings. First, they read the criteria for each factor described in Doak et al., (1996). They then collaboratively rated non-study material, discussing discrepancies in ratings. They then independently rated non-study material and finally, rated the study material independently.

2.2.2 Statistical Analyses

The inter-rater reliability of the completed DISCERN and SAM questionnaires for the study Websites was assessed using the intra-class correlation coefficient (ICC) and Cronbach's Alpha. In relation to inter-rater reliability, the kappa generated from the ICC provides an indication of inter-rater reliability by indicating "the proportion of agreement corrected for chance." (Fleiss & Cohen, 1973, p.613). The kappa value ranges from 0 to +1, with values greater than .75 representing excellent agreement between raters beyond chance, and values

between .40 and .75 representing fair agreement beyond chance (Fleiss, 1981). The ICC assesses the reliability of coding by using an analysis of variance. A two-way mixed model was selected for this analysis because the DISCERN and SAM scores were derived from the same two raters for each Website. The single measures results was used as the reliability analysis was for the mean DISCERN and SAM scores for each Website, rather than for each DISCERN or SAM item. The ICC for the DISCERN scores was .876, $p < .001$, indicating excellent agreement between the two raters. The ICC for the SAM scores was .994, $p < .001$, also indicating excellent agreement between the two raters.

SPSS also generates a Cronbach's Alpha within the ICC analysis. Cronbach's Alpha is typically used to assess internal consistency within a scale. However, it can also be used to measure the extent to which a group of values measure a single thing (in this case, DISCERN or SAM score). The alpha can range from 0 to + 1. The higher the value, the higher the internal consistency and the more likely the scores are measuring a single thing. The Cronbach's Alpha for the DISCERN scores was .934, indicating the raters were measuring the same construct: DISCERN score. The Cronbach's Alpha for the SAM scores was .997, also indicating the raters were measuring the same construct: the SAM score.

Once reliability was established, the first rater's DISCERN and SAM ratings for each Website were used for the planned analyses to test for between group differences of the quality levels of Websites from different origins, using a Univariate (one-way) Analysis of Variance (ANOVA) in SPSS (version 20). Specifically, the null hypothesis was tested, being that there are no significant differences between the DISCERN or SAM scores based on Website origin.

Chapter Three: Results

3.1 Overview

In total, the readability and quality of audiological material relevant to the purpose of the current study were analysed for 19 Websites (510 Webpages). This analysis included the top 10 results for the searches of “hearing aids” and “hearing loss” using the Google New Zealand search engine. One Website was retrieved for both search terms, hence only 19 Websites were analysed in total. Also, because Atcherson et al., (2014) previously performed a thorough readability analysis of the information provided to the public by the American Speech-Language-Hearing Association (ASHA) Website, that Website was excluded from the analysis (it was in the top 10 search results for “Hearing loss”).

3.2 Effect sizes

As the few statistically significant findings in the below results were influenced by their effect sizes, it is important to review how effect sizes should be interpreted in the context of the results.

When interpreting the results of a Univariate (one way) analysis of variance (AVOVA), effect sizes refer to the amount of variance in the outcome variables (i.e. readability levels, DISCERN scores or SAM scores) that are accounted for by the predictor variable (Website origin). The value represents a proportion that can be converted to a percentage by multiplying the decimal by 100. For example, if the partial eta squared value is .39, then 39% of the variance in readability (or DISCERN or SAM) can be accounted for by Website origin and 61% of the variance remains unaccounted for in this model. When interpreting Cohen’s d , the effect size represents the difference between two group means divided by their pooled standard deviations (which takes different sample sizes into account). Hence Cohen’s d represents the amount of difference between the group means, in terms of standard deviations. For example a

Cohen's d of 1 would mean that the group means were 1 standard deviation different and a Cohen's d of .5 would mean that the group means were half a standard deviation apart.

Effect sizes need to be interpreted with caution as the values are only relative in the context of the specific research being performed. Fleiss and Cohen (1973) provided suggestions for adjective descriptors for the d effect size ("small" = 0.2, "medium" = 0.5, and "large" = 0.8). However, the relative importance of the groups being half a standard deviation apart will be different in different contexts.

3.3 Readability

The readability of the relevant Websites was analysed using the FRE, F-K and SMOG readability formulas. The current study aimed to investigate the following research questions: (A) What is the readability of the top Google New Zealand Websites when searching for consumer information for adults with hearing impairment? and (B) Are there significant differences in the readability levels for Websites with different origins (commercial, non-profit or government)? In general, the Webpages had high readability levels compared to the recommended 6th grade level. When using the F-K as the readability measure, 13 Websites (2.5%) were within the recommended reading levels for health information (i.e. below the 6th grade level). However, no webpage fell within the recommended levels when using the SMOG as the readability measure. The lowest readability level was 7.60, indicating the need for at least 7 years of formal education to effectively read the material. Only three of the analyzed Webpages (0.58%) had FRE scores that were 70 or above (i.e, considered "easy" to read and requiring only a grade-school level reading ability). Specifically for the FRE formula, Flesch, (1948) provides classifications for the readability level of materials based on their FRE score, and also converts this score to an estimated reading grade. According to his classifications, the FRE mean score of 42.98 would fall into the "Difficult" category, and correspond to a 13th to 16th reading grade level.

Table 2. Means, standard deviations, minimum, maximum values, and sample sizes for each readability formula for each of the three Website origins.

<i>Website Origin</i>	<i>F-K</i>	<i>FRE</i>	<i>SMOG</i>
Commercial			
<i>M</i>	12.08	42.59	13.24
<i>SD</i>	3.68	16.60	3.04
<i>Min - Max</i>	5.20 – 19.00	.00 – 68.00	7.60 – 19.00
<i>n</i>	249		
Non-Profit			
<i>M</i>	12.97	42.02	12.88
<i>SD</i>	1.99	14.72	1.66
<i>Min - Max</i>	6.70 – 19.00	.00 – 77.00	8.00 – 18.20
<i>n</i>	125		
Government			
<i>M</i>	12.18	44.58	13.57
<i>SD</i>	2.48	12.60	1.87
<i>Min - Max</i>	5.90 – 19.00	.00 – 71.00	9.70 – 19.00
<i>n</i>	136		

Table 2 provides a summary of the descriptive statistics for each of the three readability formulas, for each of the three Website origins. Inspection of the skewness and kurtosis statistics of the F-K, FRE and SMOG formulas indicated that the assumption of normality was supported for each of the 3 formulas.

Univariate analyses of variance (ANOVA) were used to investigate whether there were significant differences in the readability levels for Websites with different origins (commercial, non-profit or government). For the F-K readability formula, Levene's statistic was significant, $F(2, 507) = 30.8, p < .001$, indicating the assumption of homogeneity of variance was violated. This was likely due to the Levene's test being overpowered due to the large sample size. However as the data met the assumptions of normality, it was decided to proceed with the ANOVA. For the F-K, significant differences were found based on origin, ($F(2,507) = 3.8, p = .023, \eta^2 = .015$). However, the effect size was small, indicating only 1.5% of the variance in the F-K readability levels could be explained by Website origin. Post hoc testing revealed small, but statistically significant differences between commercial and non-profit Websites ($p = .022$,

$d = 0.34$), with lower reading levels for the commercial Websites. As there were a large number of Websites in the analysis, the sample size could have provided too much statistical power, hence the ANOVA detected small but not meaningful differences in the F-K levels based on Website origin.

For the FRE readability formula, Levene's statistic was significant, $F(2, 507) = 7.43, p = .001$, indicating the assumption of homogeneity of variance was violated. The univariate analysis of variance (ANOVA) was not statistically significant, $F(2, 509) = 1.09, p = .336, \eta^2 = .004$, and had a small effect size, indicating no significant difference in the readability levels of the Websites assessed, based on their origin.

For the SMOG readability formula, Levene's statistic was significant, $F(2, 507) = 31.71, p < .001$, indicating the assumption of homogeneity of variance was violated. The univariate analysis of variance (ANOVA) was not statistically significant, $F(2, 509) = 2.49, p = .084, \eta^2 = .010$, and had a small effect size, indicating no significant difference in the readability levels of the Websites assessed, based on their origin.

3.4 Quality

In regards to quality, the study aimed to address the following research questions: (A) What is the quality of the top Websites, based on the DISCERN rating scale? (B) Are there significant differences in quality based on origin of Website (commercial, non-profit or government)? (C) What is the suitability of Internet health materials concerning hearing impairment that are available to consumers, as assessed using SAM? (D) Is there a difference in the suitability level of Websites based on origin?

Two researchers independently used the DISCERN and SAM tools to rate the quality and suitability of each Website. The reliability of the ratings of the two researchers was initially assessed using Cronbach's alpha and intra-class correlation coefficient (ICC), as previously

described. For both the DISCERN and SAM measures, because the reliability was excellent between the two raters, the scores for rater 1 were used in the ANOVA.

Table 3 provides a summary of the mean and standard deviations for each of the DISCERN questions for all 19 Websites assessed. No Website earned a DISCERN rating of 4 or 5. Eight Websites (42.1%) earned a rating of 3, 7 Websites (36.8%) earned a rating of 2, and 4 Websites (21.1%) earned a rating of 1. The total mean of the DISCERN scores shown in Table 5, was 2.19, which indicates that the general trend of the Websites was to meet the DISCERN criterion only to *some extent*.

Table 3. DISCERN quality criteria adapted from Charnock et al., 1999 with means and standard deviations for the 19 Websites used in the study.

<i>Item</i>	<i>Criterion</i>	<i>Mean (SD)</i>
1	Are the aims of the Website clear?	1.68 (.67)
2	Does the Website achieve its aim?	1.47 (.51)
3	Is the information in the Website relevant to hearing loss and/or hearing aids?	2.37 (1.21)
4	Does the Website make it clear what sources of information were used to compile the information about hearing loss and/or hearing aids?	2.26 (1.37)
5	Does the Website make it clear when the information about hearing loss and/or hearing aids was reported?	1.84 (.83)
6	Is the Website balanced and unbiased?	1.58 (.51)
7	Does the Website provide details of additional resources of support for and information about hearing loss and hearing aids?	1.63 (.50)
8	Does the Website refer to areas of uncertainty about hearing loss and/or hearing aids?	1.68 (.48)
9	Does the Website describe how each treatment about hearing loss discussed works?	3.05 (1.31)
10	Does the Website describe the benefits of treatments for hearing loss?	3.05 (1.68)
11	Does the Website describe the risks of treatments for hearing loss?	2.05 (.91)
12	Does the Website describe what would happen if no treatment for hearing loss is used?	2.16 (.90)
13	Does the Website describe how the treatment choices for hearing loss affect overall quality of life?	2.11 (.88)
14	Does the Website make it clear that there may be more than one possible treatment for hearing loss?	3.00 (1.76)
15	Does the Website provide support for shared decision-making about hearing loss and/or hearing aids?	2.68 (1.25)

16	Based on the answers to all of the above questions, rate the overall quality of the Website as a source of information about the treatment choices for hearing loss.	2.37 (.90)
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Table 4 provides a summary of the mean and standard deviations for each of the SAM quality criteria for each of the 19 Websites assessed. All the SAM scores were found to be in the “inadequate” range (i.e. score of less than 39%).

Table 4. SAM factors and items (Doak et al.,1996) with means and standard deviations for the 19 Websites used in the study.

<i>Factor</i>	<i>Item</i>	<i>Mean (SD)</i>
Content	Purpose is evident	1.32 (.75)
	Content is about behaviors	.95 (.52)
	Scope is limited	1.05 (.52)
	Summary or review is included	.56 (.51)
Literacy Demand	Reading grade level	0 (0)
	Writing style	1.0 (.47)
	Vocabulary uses common words	.53 (.61)
	Context is given first	1.16 (.50)
	Learning aids via “road signs”	.58 (.61)
Graphics	Homepage graphics shows purpose	1.05 (.78)
	Type of graphics	1.42 (.69)
	Relevance of illustrations	1.16 (.60)
	Lists, tables, graphs, etc. explained	1.00 (.67)
	Captions used for graphics	1.26 (.6)
Layout and Typography	Layout factors	1.32 (.75)
	Typography	1.47 (.61)
	Subheads used	1.05 (.52)
Learning Stimulation, Motivation	Interaction used	.05 (.23)
	Behaviors are modeled and specific	.42 (.51)
	Self-efficacy	.37 (.50)
Cultural Appropriateness	Match in logic, language, experience	.37 (.50)
	Cultural image and examples	.32 (.67)

Table 5 shows a summary of the descriptive statistics of both the DISCERN and SAM scores for Websites from all three origins. A Univariate (one-way) ANOVA was used to test the null hypothesis that there are no significant differences between the DISCERN scores based on Website origin. Levene’s statistic was non-significant, $F(2, 18) = 2.18, p = .145$, indicating the assumption of homogeneity of variance was not violated. Inspection of the skewness and

kurtosis statistics of the DISCERN scores indicated that the assumption of normality was supported. Inspection of the relevant boxplots and histograms also indicated that there were no outliers. The ANOVA was statistically not significant, indicating that there was no evidence for a difference in the quality of the Websites as assessed by the DISCERN tool, based on their origin, $F(2, 16) = .190, p = .829, \eta^2 = .023$.

A Univariate (one-way) ANOVA was used to test the null hypothesis that there are no significant differences between the SAM scores based on Website origin. Levene's statistic was non-significant, $F(2, 18) = .41, p = .67$, indicating the assumption of homogeneity of variance was not violated. Inspection of the skewness and kurtosis statistics of the SAM scores indicated that the assumption of normality was supported. Inspection of the relevant boxplots and histograms also indicated that there were no outliers. The ANOVA was statistically significant, indicating that there was a difference in the suitability of the material of the Websites assessed, depending on their origin, $F(2, 16) = 4.73, p = .024, \eta^2 = .372$. The ANOVA had a moderate effect size, indicating 37.2% of the variance of the SAM scores could be explained by Website origin. Post hoc analyses using the Bonferroni post hoc test revealed that Websites with a commercial origin had a significantly higher suitability levels than Websites with a non-profit origin, which had a large effect size ($p = .022, d = 1.67$).

Table 5. Means, standard deviations, minimum, maximum values, and sample sizes for both the DISCERN and SAM scores for each of the three Website origins.

<i>Website Origin</i>	<i>DISCERN</i>	<i>SAM</i>
Commercial		
<i>M</i>	2.23	23.13
<i>SD</i>	.66	7.55
<i>Min - Max</i>	2 – 3	8.00 – 32.00
<i>n</i>	8	8
Non-profit		
<i>M</i>	2.05	12.00
<i>SD</i>	.64	5.22
<i>Min - Max</i>	1 – 3	3.00 – 17.00
<i>n</i>	6	6
Government		
<i>M</i>	2.30	18.60
<i>SD</i>	.83	6.77
<i>Min - Max</i>	1 – 3	8.00 – 26.00
<i>n</i>	5	5
Total		
<i>M</i>	2.19	18.42
<i>SD</i>	.67	7.97
<i>Min - Max</i>	1 – 3	3.00 – 32.00
<i>n</i>	19	19

3.5 Results Summary

In summary, the majority of the Websites analysed had higher than optimal readability levels, with consumers needing approximately 12-13 years of education to comprehend the information provided to them. No significant differences were found for readability levels for Websites with a different origin. Similarly, all Websites assessed had low quality levels, and “unsuitable” suitability levels, as determined by the DISCERN and SAM scores. No significant differences for DISCERN scores for Websites with a different origin. However Websites with a commercial origin had significantly higher suitability levels than Websites with a non-profit origin.

Chapter Four: Discussion

Overall, a total of 19 different Websites, comprised of 520 individual Webpages, were assessed for their readability, quality and suitability. Each Website was retrieved from the Google New Zealand user domain using the key terms “hearing aids” and “hearing loss.” A similar inclusion and exclusion criteria to the Laplante-Lévesque et al., (2012) study focusing on hearing-related health material relevant to older adults was used to ensure only relevant Webpages were analysed. This was done, because the present study is in essence a continuation of the Laplante-Lévesque et al., (2012) study, but for New Zealand Websites found using the New Zealand Google domain. The researchers consulted each other on all material that was deemed borderline in relevance to ensure consistency in the selection of Webpages. Websites from a commercial, non-profit and government origin were retrieved, with commercial Websites comprising the majority of the Website origins. Websites with a commercial origin tended to be Websites for hearing aid manufacturers or hearing aid companies. These Websites focused predominantly on material about adult sensorineural hearing loss and adult rehabilitation (predominantly amplification), with a smaller emphasis on hearing loss and rehabilitation for younger children. Websites from a non-profit and government origin had a more limited scope and tended to focus on the purpose of their organisation, and information specific to this purpose. For example, the Accident Compensation Corporation (ACC) Website for New Zealand provided information predominantly on hearing aid funding schemes, and how to apply for them for older adults in New Zealand.

The following sections discuss the results of the readability, quality and suitability analyses of the aforementioned Websites. Recommendations on how Website developers could improve each construct when creating a health-related Website have also been made in Table 6.

4.1 Readability

Overall, the information contained within the Websites assessed was written at a higher readability level than is recommended. Specifically, the F-K formula had a mean of 12.32, the FRE formula a mean of 42.98, and the SMOG formula a mean of 13.24. These figures demonstrate that the hearing-related health information contained within the assessed Websites was significantly higher than the 5th to 6th grade recommended reading level, with individuals needing approximately 12-14 years of education to effectively read and understand the information presented. In regards to Website origin, the F-K formula found Websites with a commercial origin to have significantly higher readability levels than Websites with a non-profit origin. However, it is important to highlight the associated effect size was small, and does not likely reflect a meaningful difference based on Website origin. These findings are similar to the findings of Laplante-Lévesque et al., (2012) who also found the Websites they assessed to have higher than optimal readability levels, with individuals on average needing 11-12 years of education to effectively read and understand the information presented. That study also found no differences in readability based on Website origin.

In the current study, the SMOG readability formula produced higher overall readability values than the F-K and FRE readability formulas, with no analysed Websites falling within the recommended reading levels. This is a reflection of the SMOG formula assuming 100% comprehension when calculating its readability level, making it more conservative than the F-K formula. Given the apparent lack of balanced and unbiased information and the relatively high literacy demand placed on the reader (such as passive voice and lack of subheadings), it is perhaps appropriate to use the more conservative SMOG as the estimate of reading level required for this information. Similarly, it is also important as people will likely review the Websites without the assistance of a hearing healthcare professional, meaning they cannot ask questions about the material to clarify any queries they may have.

As reviewed previously, researchers have consistently found the readability of audiological written materials to be significantly higher than the recommended levels. Unfortunately, the readability results of the Websites analysed in the present study are consistent with this negative trend, and do not offer much hope that this issue is being addressed. However, providing clear, simple, and concisely written healthcare materials is of the utmost importance in facilitating positive client/ clinician interactions and other positive health outcomes, and must be aspired to by all institutions and individuals that are involved. Clinicians must make a concerted effort to supply simple healthcare materials within their own clinics, and must also be able to direct their clients towards other satisfactory sources of information, including online information, when requested. Clinicians must also ensure they remain aware of the importance of providing material written at the recommended reading grade levels, so they can take the necessary steps in ensuring other commercial and governmental health institutions begin to similarly recognise its importance, and become part of the solution, not the problem. This includes ensuring Web developers begin to perform simple readability analyses, such as the ones performed in the present study, to ensure the material they are providing is written to a satisfactory level. Web developers can lower the reading grade level of their material by incorporating the recommendations provided in Table 6.

4.2 Quality

Of the Websites assessed, the DISCERN scores varied from 1.00 to 3.00 out of 5.00. No significant differences for DISCERN scores were found based on Website origin. This finding is slightly different from the results of Laplante-Lévesque et al., (2012) who found Websites with a non-profit origin to have significantly higher DISCERN scores than Websites from a commercial and government origin. Similarly, the DISCERN scores for the present study were in general higher than the DISCERN scores for the Laplante-Lévesque et al., (2012) study, with the exception of Websites from a non-profit origin.

In regards to the DISCERN scores themselves, the items which received the highest mean scores (i.e, a score of 3.00 or above) were 10 - Does the Website describe the benefits of treatments for hearing loss? 9 - Does the Website describe how each treatment about hearing loss discussed works? and 14 - Does the Website make it clear that there may be more than one possible treatment for hearing loss? Items that obtained the lowest scores were 2 - Does the Website achieve its aim? 6 - Is the Website balanced and unbiased? and 7 - Does the Website provide details of additional resources of support for and information about hearing loss and hearing aids? The above DISCERN scores indicate that New Zealand Websites tend to focus on and provide satisfactory information regarding the treatment options for hearing loss, such as amplification, assistive listening devices and communicative strategies. Similarly, the Websites ensure the benefit of the above rehabilitative strategies is clearly communicated. Although these trends are positive, they likely stem from the high number of Websites with a commercial origin that were present in the assessed Websites. It is the goal of such Websites to champion hearing aid use and its benefits in order to increase business, hence the focus on providing information regarding hearing aid use.

However, the lowest DISCERN scores highlighted more concerning trends of hearing related health information available to New Zealand consumers. Specifically, the Websites available to consumers in New Zealand did not generally achieve the aims they were striving for, provided information in an unbalanced or biased manner, and did not provide satisfactory links of additional information for individuals with hearing loss. These trends are concerning as they may potentially misinform individuals, and continue the trend of low quality Internet information. Lastly, only two of the Websites assessed had HON certification, only one Website was recommended by Health Info, and none were recommended by Health Navigator. Although the low number of Websites with HON certification was to be expected, having high quality hearing-related health information recommended by Health Info or Health Navigator, or

more Websites with HON certification could provide a satisfactory method for New Zealand consumers to be able to more easily discern the quality of Websites. Additional recommendations for improving hearing health-related Internet information are provided in Table 6.

4.3 Suitability

No previous studies have been published that have used the SAM to evaluate the suitability of Internet health-related information. Of the Websites assessed, the SAM scores varied from 3.00 to 32.00 out of 44, with a mean score of 18.42. Overall, all of the Websites assessed were rated as being not suitable. However, Websites with a commercial origin were found to have significantly higher SAM scores than Websites with non-profit origins. As shown in Table 2, the items with the highest SAM ratings were typography, type of graphics, and layout factors and purpose is evident. The items with the lowest ratings were: reading grade level, use of interaction, and appropriate use of cultural images and examples. In general, the graphics, layout, and typography of the assessed Websites were found to be suitable. However, literacy demand, learning stimulation, motivation, and cultural appropriateness were found to be unsuitable.

The above SAM scores indicate that New Zealand Websites, particularly Websites with a commercial origin were suitable when using the correct text size and fonts to make Websites easier to read, used simple or familiar illustrations such as line drawings and sketches, had an adequate layout, and at least implied their purpose or had multiple purposes. However the Websites were especially inadequate in presenting material written below a 9th grade reading level, providing interactive questions and quizzes for the consumers to complete, or providing culturally sensitive images or examples in positive ways. Again, these trends are concerning not only due to the overall inadequate scores of all Websites, but due to the lack of material presented at a reading level that the majority of the New Zealand public could comprehend, and

the lack of culturally diverse material. This is concerning as New Zealand is becoming increasingly multicultural, and it is important to foster positive attitudes towards hearing impairment and rehabilitation among all ethnicities.

Table 6. Specific recommendations and examples to improve hearing-related Internet information.

<i>Aspect</i>	<i>Recommendation</i>	<i>Examples</i>
Aims	<ul style="list-style-type: none"> Clearly state the aims of the Website in simple to understand language. Use clear titles of Webpages or articles to state the aims. Achieve the aims stated in the titles of Websites or articles. 	Use a series of questions and answers to states and achieve the aims of the Webpage or article.
Bias & Balance	<ul style="list-style-type: none"> Present information in an unbiased manner by reporting where information was obtained. Discuss areas of uncertainty by presenting evidence that supports multiple points of view. Provide up to date information. Provide dates for information cited in the Website. 	Use a reference list to state where information was obtained. Provide links to the references.
Content	<ul style="list-style-type: none"> Limit the scope of the Webpage to the aim. Provide a summary of the main 	Include a question and answer section about hearing aids that allows the

	<p>points.</p> <ul style="list-style-type: none"> • Ensure the content of the Webpage or article allows the reader to apply knowledge or skills in a practical way. 	<p>reader to apply knowledge.</p> <p>Hide the answer, and let the reader “click here” to see the correct answer.</p>
Culture	<ul style="list-style-type: none"> • Tailor the material to the intended audience. • Provide specific, positive examples that are culturally appropriate. • Use images that are culturally appropriate and relevant to the intended audience. 	<p>Use images and examples of people in the age range of the intended audience.</p> <p>Include stories of people with various backgrounds (if that is the intended audience).</p>
Graphics	<ul style="list-style-type: none"> • Use graphics that are relevant to the topic. • Use simple graphics that are easy to understand. • Do not overuse colour in the graphics. • Ensure that graphics are near the text they support. • Explain graphics in detail so they can stand alone. 	<p>Use simple line or schematic drawings of anatomical concepts rather than complex coloured images with too much detail.</p>
Literacy Demand	<ul style="list-style-type: none"> • Perform readability analyses (available in MS Word) to ensure 	<p>Using topic headings in the form of a question that will</p>

	<p>the reading levels are within the recommend levels.</p> <ul style="list-style-type: none"> • Use common words where possible, defining uncommon words before using them. • Write in an active rather than passive voice. • Use short, simple sentences. • Use “road signs” to help the reader navigate the content and alert the reader to a change in topic. 	<p>be answered in plain language. Include one topic per question.</p>
Learning	<ul style="list-style-type: none"> • Engage the reader by making the Webpage or article interactive. • Include a question and answer section. • Include examples that model the desired behaviour. • Provide opportunities for the reader to experience success by dividing complex topics into smaller, interactive sections. 	<p>Present quizzes in the article about the material presented to encourage learning. Use embedded links to allow the reader to answer the questions and stimulate interaction.</p>
Support	<ul style="list-style-type: none"> • Acknowledge the limitations of your organisation. • Provide contact information about where readers can get support or 	<p>Provide links to other Websites or contact information for organisations that can</p>

	additional assistance.	provide additional information.
Treatment Options	<ul style="list-style-type: none"> • Provide information about various treatment options. • Provide evidence for the various treatment options. • Describe the risks and benefit of all treatment options. • Promote shared decision making by providing information for readers to discuss with clinicians. 	Provide a list of questions for readers to take to their doctor or hearing care professional.
Typography	<ul style="list-style-type: none"> • Use typeface that is sans serif. • Use typeface that can be increased in size. • Do not let these features such as bolding and colour distract the reader. • Avoid UPPER CASE writing. 	Use colour or bold type to direct the reader around the Webpage. Use simple images such as arrows to direct the reader. Avoid animated pop-up ads, particularly when they are not relevant to the topic.

4.4 Clinical Implications

As it is likely that individuals with a hearing impairment living in New Zealand will consult the Internet for relevant hearing-related health materials, it is essential the information available to them is of high quality, and able to be understood by the majority of the New

Zealand public. The results of the present study indicate the information available to healthcare material consumers in New Zealand is not of satisfactory readability and quality, and hence efforts must be made by clinicians to find ways to point their patients towards materials of a higher quality.

Research has shown that when clinicians collaborate with patients to analyse and guide them towards quality healthcare materials, greater client satisfaction is achieved (Bylund et al., 2007; McMullan, 2006). Hence, when clinicians evaluate and provide context for Internet healthcare materials to their clients, it can help provide important self-empowerment to the client (Sommerhalder, Abraham, Zufferey, Barth & Abel, 2009). Laplante-Lévesque et al., (2012) provides examples of how a clinician can achieve this, such as by ensuring the materials and advice the client has accessed are relevant, further explain any rehabilitative or assessment recommendations they might have had, and explain any contraindications.

Similarly, while referring patients to Internet healthcare resources can be seen as a collaborative, facilitative activity (Laplante-Lévesque et al., 2012), clinicians should take care in deciding which Websites they recommend to their patients, and should ensure the Websites are of satisfactory quality and readability. A list of Websites with high quality and readability ratings is available in the Laplante-Lévesque et al., (2012) article and the top-ranked Websites from this study are shown in Table 7. The list was generated by summing the quality ratings (DISCERN and SAM) and then ranking the Websites based on that value, with higher values representing higher quality. Then, the mean readability levels were calculated and ranked so that lower levels received higher ranks. The ranks were summed for each Website to derive a readability and quality ranking. The Websites with the 6 highest combined rankings are shown in Table 7.

The prevalence of Internet search use for healthcare materials and the likelihood of its popularity continuing to increase as more of the world gains access to the Internet highlights the

importance of how clinicians must interact with patients who have accessed online materials. Eberhart-Phillips et al., (2000) performed a survey of general practitioners in New Zealand and found that nearly half of the doctors reported concerns that the Internet could have negative effects on their relationships with patients. Similarly, Gauld & Williams (2009) reported that approximately 15% of their survey respondents felt their doctors were uncomfortable when they presented Internet information and Murray et al., (2003) found that 4% of their sample felt that sharing Internet information with their doctors hurt their relationships with their doctors. However, rather than being threatened by patients who conduct research on the Internet, clinicians can view this behaviour in a positive way. Patients are actively seeking information, suggesting they are likely motivated to learn about and possibly undergo treatment. Hence, clinicians can work collaboratively with their patients to find satisfactory hearing-related Internet healthcare information, which the client can take home and review. This can help the client become more informed about their impairment, reducing the knowledge gap between the clinician and client. The clinician and client can then discuss treatment options using a rehabilitative model, thereby improving the client-clinician relationship.

Table 7. Highest-ranking websites, based on DISCERN, SAM, and readability scores.

Government:

National Health Service (NHS): <http://www.nhs.uk/conditions/Hearing-impairment/Pages/Introduction.aspx>

Non-profit:

Mayo Clinic: <http://www.mayoclinic.org/diseases-conditions/hearing-loss/basics/definition/con-20027684>)

Commercial:

Dilworth Hearing: <http://www.dilworth.co.nz/>

GN ReSound: <http://www.gnresound.co.nz/>

Hearing Aid Specialists: <http://www.hearingaidspecialists.co.nz/>

Widex: <http://www.widex.co.nz>

4.5 Study Limitations and future research

Similarly to the Laplante-Lévesque et al., (2012) study, although efforts were made to replicate the search method of the target population, the present study's search strategy may differ from how adults of the target population actually search for hearing-related healthcare information. This may include the use of other keyword combinations, or differing browsing strategies compared to the present study's researchers when reviewing the Websites from the Google search.

More information is needed to understand how consumers who search for hearing-specific health information on the Internet actually conduct their searches, how they select the information to be explored, and how they make decision about the quality and reliability of that information. For example, many of the Websites retrieved in the Google New Zealand search originated from organisations outside of New Zealand. It is not known to what extent that may influence the decision to reject or explore the Website.

In regards to the quality portion of the study, the DISCERN questionnaire was chosen due to its previous use with audiological healthcare information on the Internet, and its known psychometric properties. However, as clarified by Laplante-Lévesque et al., (2012) the DISCERN and SAM tools provide more of an indication of information completeness, rather than veracity and whether the information is supported by scientific evidence. Similarly, quality was only assessed by "experts" in this study. Future research could employ tools such as DISCERN and SAM from the viewpoint of the consumer of the health information. Finally, in regards to the DISCERN and SAM, there is large potential for inter-rater reliability between studies to be poor, as demonstrated by the DISCERN scores of the present study and the scores obtained by of Laplante-Lévesque et al., (2012). This could be reduced by establishing standardised training protocols for when the DISCERN and SAM are used to assess hearing-

related health information, which would increase inter-rater reliability between studies, and also make these tools more widely used in research and clinical settings.

In this study, each of the analysed Websites was only assessed for its readability, with no focus on individuals' comprehension of the materials. Readability and comprehension are related concepts, and should be assessed together. However, readability formulas do not provide any information about comprehension that is not determined from mathematical calculations on physical aspects of the written material and do not encompass all the factors which influence the reading process (Bruce, Rubin, & Starr, 1981; Klare, 1976; Meade & Smith, 1991). Comprehension is influenced by many human and non-human factors such as familiarity with the topic, the individual's motivation to educate themselves about the topic, and the appropriate use of language by the authors (Doak et al., 1996; Meade & Smith, 1991).

4.5 Conclusion

This study examined the readability, quality and suitability of online hearing-related healthcare materials available to New Zealand consumers. Readability was analysed using the F-K, FRE, and SMOG readability formulas, quality analysed using the DISCERN questionnaire, and suitability using the SAM questionnaire.

Overall, the readability, quality and suitability levels were all lower than optimal, suggesting a large proportion of New Zealand consumers searching for hearing-related health information may not be able to make use of the online information available to them. Although the implications of these results are bleak, there are many simple techniques that Web developers and clinicians can use to improve the readability, quality, and suitability of information on the Internet, resulting in greater comprehension of the information and, in turn, greater health outcomes.

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