Communicating the 'smart' way to improve and support oral health amongst young adults in New Zealand: a mHealth in oral health study

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Abstract

INTRODUCTION

Free dental and oral health care is available to all New Zealanders until their 18th birthday. Despite this, oral disease remains one of the most prevalent, preventable diseases in New Zealand (NZ) communities. The impact of oral disease on individuals and society can be significant. Oral disease is expensive to treat. Therefore disease prevention, through effective oral health promotion messages that incorporate a focus on oral health literacy (OHL), should be a priority in clinical settings. The proliferation of mobile phones in recent years and young people's fascination with this technology has led to mobile phones being identified as a platform for health promotion initiatives. The use of mobile phones in this way is called mobile health (mHealth). Unlike mainstream media campaigns, mobile phones offer an opportunity to communicate directly and personally with individuals using a variety of mobile phone functions. As young adults are now the largest user group of 'smart' mobile phones in NZ, mHealth could provide a novel and innovative platform to improve oral health amongst this group.

AIMS

This mixed methods study, amongst 16 (18 to 24 year old) tertiary students in Auckland, had two aims:

Aim One: Determine if a mHealth intervention
a. could improve their oral health by complementing traditional oral health promotion
b. was considered, by this cohort, to be an acceptable way of communicating oral health promotion messages
c. could improve their OHL

Aim Two: Determine which factors optimised the success of the mHealth intervention

METHOD AND METHODOLOGY

This study was undertaken over six months. Participants were randomly allocated to four sample groups: Control and three intervention (Phone, Text, Video). Data was collected on three occasions (visits one to three) with the study aims assessed as follows:

- Aim One: Quantitative measures of oral health (OHIP-14, Plaque Control Record) and OHL (REALD-30); Qualitative interview data
- Aim Two: Qualitative interview data

All participants received standardised oral health education (OHE) at visit one and oral hygiene instruction (OHI) at visits one and two. Monthly mHealth OHE was provided to the intervention groups, between visits one and three, using different smart phone functions: telephone

conversation (Phone), SMS (Text) and MMS (Video). Semi-structured interviews were undertaken with all participants at visit three. The quantitative data was analysed, as applicable, statistically and descriptively. The qualitative data was analysed thematically.

STUDY RESULTS

Aim One

   a. Overall oral health was not improved as OHRQoL measures were inconclusive. However, increased participant- reported motivation resulted in improved oral health self-efficacy across all intervention groups: Phone (20%), Text (6.5%), Video (3.5%).
   b. All intervention groups considered mHealth to be an acceptable health communication platform.
   c. Two intervention groups showed slight improvements in mean REALD-30 word recognition score: Video (6%), Phone (3%). Text group was unchanged. REALD-30 word comprehension scores were improved in all intervention groups: Text (7%), Video (6%) and Phone (5%)

Aim Two

Participants reported increased engagement, trust and rapport with the oral health professional on receipt of monthly 'personalised' mHealth messages. The messages however, were perceived more as 'reminders', which reinforced the oral health promotion experiences in the clinical setting, than educative interventions.

CONCLUSION

mHealth is an acceptable adjunct to improving oral hygiene practises and increasing OHL. The pivotal factor in its success, however, is the provision of regular oral hygiene self-care information using an intraoral demonstration and two-tone disclosing solution as an educative tool.

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I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signed: _____   Date: 4 May 2017

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> *"The teacher who is indeed wise does not bid you to enter the house of his wisdom but rather leads you to the threshold of your mind."*
>
> Khalil Gibran

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Ethical Approval

This study was granted ethics approval by the Health and Disability Ethics Committees (15/NTA/63) and the AUT Ethics Committee (15/206) under the original title *'Dental hygienist in your pocket: utilising consumer-directed telehealth to promote oral health to young adults in New Zealand'.*

Chapter One

INTRODUCTION

> New Zealand dental care has developed without reference to the changing norms of youth culture. The conventional dental practice setting is not viewed by adolescents as being inviting or appropriate and increasing the uptake of free oral health care by that group will require some innovative approaches. Young people's interest in oral health technology and their deep engagement with the popular media also suggest exciting avenues through which such efforts could be effected (Fitzgerald, Thomson, Schafer & Loose, 2004, p. 62, 70)

It has been thirteen years since Fitzgerald et al. (2004) made the above statement. In it she urges the dental and oral health sectors in New Zealand/Aotearoa to explore new media options as a novel approach to increase young people's engagement in oral health. Since then, there has been a proliferation of widely accessible and user-friendly new media channels and platforms. The opportunity to utilise these options to engage young people has not been widely embraced by the dental and oral health care sectors and, to date, the New Zealand (NZ) model of dental care delivery remains largely unchanged.

PREFACE

New Zealand's publically-funded School Dental Service and the Adolescent Oral Health Scheme provides basic preventive treatment, restorative care and specialist dental services for children and adolescents until their 18th birthday. Despite this, oral disease remains amongst the most prevalent chronic preventable diseases in NZ communities today (Petersen, Bourgeois, Ogawa, Estupinan-Day & Ndiaye, 2005; Jatrana, Crampton & Filoche, 2009).

The individual and social impact of oral disease can be a significant burden on individuals, communities and healthcare systems. At the individual level, oral disease can affect general health and quality of life, regardless of age. The consequence of disease in individuals can, in turn, impact on society. Treating disease is expensive with oral disease being the fourth most expensive disease to treat in most industrialised countries (Petersen et al., 2005). In a small country like NZ where oral health care resources are stretched, a focus on the adage 'prevention is cheaper than cure' should therefore be more relevant than ever before.

Individual and community oral health promotion initiatives focus on preventing disease. These programmes aim to educate people primarily on the importance of oral hygiene self-efficacy and its role in reducing oral disease. They also support and encourage regular engagement with oral health professionals as a means of maintaining oral health.

STATEMENT OF THE PROBLEM

New Zealanders are expected to move from the free public dental and oral health service to the private sector on their 18th birthday. Unsurprisingly, this transition results in a significant reduction in uptake of services (Thomson, Williams, Broadbent, Poulton & Locker, 2010). The impact of this was evidenced in the 2009 NZ National Oral Health Survey. Amongst its findings, this survey identified a high degree of unmet need amongst younger adults, particularly Māori, with cost reported as the key barrier to accessing dental and oral health care services (Ministry of Health, 2010).

In addition to cost, further barriers to oral health amongst young adults may exist. One of these barriers may be poor oral health literacy or the "the ability to obtain, process and understand basic health information and services in order to make informed and appropriate health decisions" (Workbase, 2013, p.4). Oral health literacy (OHL) is now considered to be a possible new determinant of oral health (Naghibi Sistani, Yazdani, Virtanen, Pakdaman & Murtomaa, 2013) as higher levels of OHL are directly linked to better oral health (Kanupuru, Fareed & Sudhir, 2015; Blizniuk, Ueno, Zaitsu & Kawaguchi, 2015).

Unfortunately, more than half of adult New Zealanders have been reported as having poor health literacy, with young adult Māori having the poorest health literacy when compared to the rest of the population (Ministry of Health, 2010). This is significant because low health literacy "has a substantial impact on the use of preventive measures and health outcomes. Individuals with low health literacy are less likely to use preventive regimens and screenings than individuals with high health literacy" (Horowitz and Kleinman, 2008, p. S27).

In summary, the evidence points to four significant issues that may be impacting the oral health of young adult New Zealanders:

- Poor oral health in early adulthood, despite 18 years of eligibility for free oral health care.
- A lack of motivation to engage with dental and oral health services regularly.
- A symptom-driven culture without focus on preventive oral health care.
- Poor oral health literacy.

ACKNOWLEDGING THE CHANGING NORMS OF YOUTH CULTURE

Young people now consider mobile phones and instant messaging integral to their lives. In recent years, mobile phones, using various functions, have been successfully used as intervention tools for health promotion programmes amongst groups of young New Zealanders (Whittaker et al., 2008; Whittaker et al., 2011; Schluter at al., 2015).

According to the National Health IT Board (2015), 18 to 24 year olds are now the largest user group of 'smart' mobile phones in NZ. They further state that there is little digital divide between higher and lower socio-economic groups and that uptake of mobile phones is higher amongst Māori than non-Māori. The use of mobile phones, therefore, provides an excellent health

communication opportunity to provide oral health promotion messages to all socio-economic groups.

'EXCITING POPULAR MEDIA AVENUES' AND 'INNOVATIVE APPROACHES' TO INCREASE ENGAGEMENT

Cognisant of the above challenges and the identified oral health promotion opportunities that mobile phones provide, this thesis will present the findings of a mixed methods study that was undertaken amongst a small, relatively homogenous group of 'tech-savvy' young New Zealand adults. The study's qualitative results aimed to provide insight into this group's views on the use of various 'smart' mobile phone functions (telephone conversation, SMS or text and MMS or video) to promote oral health as an adjunct to traditional oral health promotion delivered in a clinical setting. The quantitative results aimed to measure changes in participant's oral hygiene self-efficacy, oral health literacy and oral health related quality of life over the course of the study. In this study, the quantitative findings and the qualitative findings each provided support to the other.

STUDY HYPOTHESIS

Oral hygiene behaviours (that impact oral health) and oral health literacy are improved when traditional semi-personalised oral health promotion methods are supplemented with educational health messages delivered via various 'smart' mobile phone functions.

STUDY CONCLUSION

mHealth is an acceptable adjunct to improving oral hygiene practises and increasing oral health literacy. These findings, however, appear to be dependent on a pivotal aspect of preventive oral health care: the provision of regular (bimonthly) oral hygiene self-care information by an oral health professional, demonstrated intraorally on the patient in the clinical setting using two-tone disclosing solution as an educative tool. The findings in this prospective study therefore highlight opportunities within clinical settings that could firstly, positively effect oral health amongst adolescents and young adults in NZ/Aotearoa and secondly, increase their engagement with the dental and oral health sector.

ORGANISATION OF THE THESIS

The following is an overview of each chapter that makes up the body of the thesis:

CHAPTER TWO: A REVIEW OF THE LITERATURE

In this chapter, relevant literature is reviewed and critiqued. This chapter consists of five sections:

Section 2.1	Section one provides an outline of how the literature was sourced and selected and provides an outline of the rest of the chapter.
Section 2.2	Section two discusses oral health in NZ/Aotearoa. The discussion includes a description of risk factors for poor oral health, the impact of poor oral health and the aetiology and pathogenesis of oral disease. The section describes the epidemiology of oral disease in NZ with a brief international comparison.
Section 2.3	Section three discusses the role of oral health promotion in the prevention of oral disease. The discussion includes an explanation of health communication (and how it is underpinned by the communication process) and the use of mobile phones to promote health (mHealth). The feasibility and acceptability of this form of health promotion is discussed.
Section 2.4	Section four discusses the development of health literacy and its identified competencies. Measures and potential impacts of oral health literacy are explained. The section concludes with a discussion, supported by current evidence, on why it should be important to increase levels of OHL in individuals and communities.
Section 2.5	Section five discusses the paradigms of research and research methodologies used in mHealth research. The chapter concludes with a discussion on the identified gaps in the knowledge, the aims and objectives of this research and the research questions.

CHAPTER THREE: METHOD AND METHODOLOGY

This chapter describes and justifies the chosen method and methodology for this study. The chapter describes the approvals, permissions and consultations that were undertaken prior to the start of the data collection. Thereafter, information on how the research was carried out is presented. This includes participant recruitment, the collection of data and data analysis.

CHAPTER FOUR: RESULTS

In this chapter, the results are presented in three parts: Section A (description of the sample), Section B (quantitative results) and Section C (qualitative results). The results presented in section B and section C were used to determine if the study aims in this mixed methods study had been met. Where applicable, comparative data for the study's four sample groups (Control, Phone, Text and Video) is presented.

CHAPTER FIVE: DISCUSSION

In this chapter the study results will be critiqued in relation to the study aims and the reviewed relevant literature. The chapter will discuss the significant findings of this study and the potential implications for clinical oral health and dental practice in NZ/Aotearoa. The identified strengths and limitations of this study will presented.

CHAPTER SIX: CONCLUSION

The final chapter provides conclusions for the main points raised in this thesis. Recommended directions and considerations for future research are presented.

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Chapter Two

A REVIEW OF THE LITERATURE

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2.1 OVERVIEW OF THE CHAPTER

Chapter two has five sections (2.1 to 2.5). The chapter will begin with describing the purpose of the literature review that was undertaken for this study and the methodology that was used to identify the relevant literature. Thereafter, the body of the chapter begins in section 2.2 with a discussion on oral health in NZ/Aotearoa. The discussion includes a description of risk factors for poor oral health, the impact of poor oral health and the aetiology and pathogenesis of oral disease. The section describes the epidemiology of oral disease in NZ with a brief international comparison.

Section 2.3 focusses on health communication and new communication technology. It discusses the role of oral health promotion in preventing disease and outlines health communication (and how it is underpinned by the communication process). Finally, it discusses the use of mobile phones to promote health (mHealth) and examines the feasibility and acceptability of this form of health promotion.

Section 2.4 discusses the the development of health literacy and its identified competencies. Measures and potential impacts of oral health literacy are explained. The section concludes with a discussion, supported by current evidence, on why it should be important to increase levels of OHL in individuals and communities.

Section 2.5 discusses the paradigms of research and methodologies used in mHealth research. The 'gaps in the knowledge' are identified and the aims of this study are presented. The chapter concludes by presenting the research questions that underpin the chosen research design.

2.1.1 Purpose of the literature review and the methodology used

Mobile health or 'mHealth', in the context of oral health practice and oral health literacy, is an emergent area of research and the focus of this thesis. Mobile health is defined as "the use of mobile phone technology to deliver healthcare"(Cole-Lewis & Kershaw, 2010, p.56). Systematic reviews of mHealth studies, by Cole-Lewis and Kershaw in 2010 and by Free et al. in 2013, did not identify or include any studies related to mHealth interventions used in dentistry or oral health. In addition, the sweeping review of oral health literacy tools used in studies between 2007 and 2013, undertaken by Dickson-Swift, Kenny, Farmer, Gussy and Larkins (2014), did not identify any NZ focussed studies.

The purpose of this literature review was, therefore, to identify and critique any studies undertaken between 2006 and 2016 that focussed on the use of mHealth to provide oral health education. In addition, studies that specifically focussed on the role of oral health literacy (2006 to 2016) and

its impact on oral health were also reviewed. Where possible, studies that focussed on young adults, aged 18 to 24 years old, in the NZ context were sought.

Narrative and systematic approaches to reviewing the published literature, relevant to this study, were used. The relevant literature was collated after reviewing a variety of resources. These included online resources, books and contemporary oral health education sector textbooks. The following databases were used for the systematic literature review: Ebsco health databases (restricted to 'Medline' and 'Dentistry and Oral Health Sciences'), 'PubMed', 'Cochrane' and 'Scopus' (restricted to dentistry and, where possible, young adult aged 19 to 24).

A narrative approach was used to provide an overview of the oral healthcare system in New Zealand/Aotearoa and its relevance to the epidemiology of oral health in NZ. This approach was also used to provide background and context to the key areas of interest. A systematic methodology was used to provide a rigorous, more defined focus to review the current literature on the use of mHealth in oral health education and the role of oral health literacy (as shown in Figure 1). Relevant citations from any retrieved publications were also included.

FIGURE 1 Flowchart of the systematic literature search and selection process

Systematic search of journal articles: Ebsco health databases (restricted to 'Medline' and 'Dentistry and Oral Health Sciences'), 'PubMed', 'Cochrane' and 'Scopus'

Search of title, abstract, keywords:

- **oral health literacy**

Search of title, abstract, keywords:

- **mobile health** and **oral health** and **text messaging** and **oral health**

Potentially relevant articles n= 525

Potentially relevant articles n= 26

Exclusion of articles where:

- **'oral health literacy or dental literacy' not used in title**
- **not related to oral health**

n = 441

Exclusion of articles where:

- **Articles not related to oral health**
- **Internet interventions used**

n =16

Exclusion of duplicates

n= 18

Exclusion of duplicates

n= 4

Excluded for systematic review by abstract   n = 47

Selected for final review

n = 6

Selected for final review

n = 19

2.2 ORAL HEALTH IN NEW ZEALAND/ AOTEAROA

2.2.1 Overview of section two

The purpose of this section is to provide background and context to this study. The section will begin by defining oral health and describing the risk factors for poor oral health. This will be followed by a brief description of the aetiology and pathogenesis of dental caries and periodontal disease. The psychological and social impact of oral disease on individuals and communities will be discussed thereafter. The section will conclude with a description of the current epidemiology of oral disease. This will focus predominantly on the situation in New Zealand but will also include a brief international comparison.

Whilst this study focussed on young adults, literature in relation to the oral health of adolescents and their uptake of subsidised dental and oral health services in New Zealand has been included. This is due to much of the literature raising concerns about the reduced uptake of free oral health services amongst adolescents and consequently the potential impact of this as this group transitions into a non-publically funded dental and oral health service in early adulthood.

2.2.2. Defining oral health

The oral cavity and its components play a significant role in the overall quality of life of an individual. Poor oral health can impact an individual's ability to communicate and eat. This is acknowledged by the NZ Ministry of Health (2006) in their definition of oral health as "a natural, functional, acceptable dentition which enables an individual to eat, speak, and socialise without discomfort, pain or embarrassment, for a lifetime, and which contributes to general wellbeing" (p.2). The World Health Organisation (2012) expands on this definition stating that oral health must be considered to be

> a state of being free from mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal (gum) disease, tooth decay, tooth loss, and other diseases and disorders that can limit one's capacity to bite, chew, smile, speak or limit an individual's psychosocial wellbeing

2.2.3 Risk factors for poor oral health

Regardless of age, major risk factors for poor oral health include poor diet and nutrition, poor oral hygiene, the use of tobacco and alcohol as well as poor living conditions. These are further compounded by limited accessibility to, and availability of, dental and oral health services.

In NZ, the evidence shows that you are at higher risk of suffering relatively poorer oral health if you are male, Māori or Pasifika (Ministry of Health, 2010; Broughton, Teh Maipi, Person, Randall & Thomson, 2012). In addition to the risk factors mentioned above, Schluter et al. (2015) reported that primary factors associated with increased oral health inequality in NZ include low income, limited education, using a non-fluoridated water supply and poor family dental health. The latter

is supported by Shearer et al. (2012) with findings from the Dunedin Multidisciplinary study showing that people with poor oral health tend to have parents with poor oral health.

2.2.4 The prevalence, aetiology and prevention of oral disease

Dental caries and periodontal disease are the most prevalent of the oral diseases. Despite being considered largely preventable, they remain the most common diseases of humankind. The continued prevalence and resultant impact of these diseases on individuals and communities has been described as a global oral health burden by the World Health Organisation (WHO) (Petersen et al., 2005; FDI World Dental Federation, 2014).

Dental caries and periodontal disease are both multifactorial diseases with a common aetiological factor: the accumulation of microbial dental plaque-biofilm (Axelsson, Nyström & Lindhe, 2004; Young & Featherstone, 2008). Controlling the accumulation of plaque-biofilm is therefore the best option for prevention of these diseases. Encouraging patients to undertake regular tooth brushing and cleaning between teeth combined with individually determined intervals for supportive care is a proven method for prevention of dental caries and periodontal disease (Löe, 2000; Axelsson et al., 2004). Regular exposure to adequate levels of fluoride, adequate amounts of saliva and dietary choices that do not promote dental caries are also important aspects of disease prevention.

2.2.4.1 The aetiology and pathogenesis of dental caries

Dental caries is an infectious disease that is reliant on a combination of aetiological factors. These factors are the presence of a susceptible tooth surface, the accumulation of plaque-biofilm containing significant numbers of the acidogenic and aciduric bacterial groups (*mutans streptococci* and *lactobacilli*) on the tooth surface and the presence of fermentable carbohydrate. For disease to occur and progress, these factors must all be present at the same time.

When the bacteria metabolise the fermentable carbohydrate (sugars and starches), the resultant by-product is organic acid (formic, lactic, acetic and propionic). These acids diffuse into the tooth surface and partially dissolving the carbonated hydroxyapatite mineral crystals which make up the tooth structure. This acid diffusion into the tooth structure subsequently results in minerals (calcium and phosphate) diffusing out of the tooth. This process is called demineralisation. Saliva plays an important role in neutralising acids in the oral cavity. This neutralising process is known as buffering (Featherstone, 2004; Young & Featherstone, 2008).

If calcium, phosphate and fluoride (bio-available in saliva) diffuse back into the tooth, the result is the deposition of new mineral crystal surface (which is more resistant to acid wear). This is called remineralisation (Featherstone, 2004). The demineralisation and remineralisation processes are dynamic and generally occur numerous times daily leading to either cavitation, repair and reversal or maintenance of the status quo (Featherstone, 2004; Young & Featherstone, 2008).

2.2.4.2 The aetiology and pathogenesis of periodontal disease

Periodontal disease is a preventable inflammatory disease characterised by one or more of the clinical signs of inflammation namely erythema (redness), oedema (swelling), heat, pain and loss of function (Serio, 2008). Gingivitis and periodontitis are the two basic categories of periodontal disease. Gingivitis is a reversible bacterial infection that is confined to the gingiva. Periodontitis is a severe bacterial infection affecting the gingiva, periodontal ligament, alveolar bone and cementum that causes permanent tissue damage, connective tissue and alveolar bone loss and apical migration of the junctional epithelium (Gehrig & Willmann, 2011). Gingivitis will not always progress to periodontitis. It has however been established that periodontitis is always preceded by gingivitis (Lang, Schätzle & Löe, 2009).

In addition to the presence of bacterial plaque biofilm, there are additional factors that determine an individual's disease risk related to periodontal disease initiation and progression. These factors include the type of bacteria, the time that the plaque-biofilm is allowed to remain undisturbed on the tooth surface and the host response to the bacteria (Serio, 2008). Additional contributing factors can also include tooth morphology, tooth positioning, the presence or absence of dental prostheses as well as the position, size and contour of the gingiva. (Wilkins, 2013)

Periodontal disease is initiated when irregular tooth brushing and interdental cleaning leads to an accumulation of plaque-biofilm on tooth surfaces. Left undisturbed, these accumulations grow and mature into thick bacterial masses, an ideal environment for predominantly motile, gram-negative, anaerobic bacterial types called cocci, spirochetes, rods and filaments (Serio, 2008). Exposure of the oral tissues to these types of bacteria for an extended period results in gingival inflammation, or gingivitis, which is the body's reaction to injury or invasion by disease-producing organisms (Gehrig & Willmann, 2011). The onset of gingivitis occurs within four to fourteen days after plaque-biofilm accumulation in the gingival sulcus (Gehrig & Willman, 2011; Wilkins, 2013).

2.2.5 The psychological and social impact of oral disease on individuals and communities

The psychological and social impact of chronic oral disease can be significant. These impacts are not just associated with the quality of life, daily functioning and well-being of individuals, but also extend to healthcare systems and economies.

Traditional measures of oral health (discussed in 2.2.6.2.1) provide a measure of the presence or absence of oral disease in the oral cavity. To gain a more holistic picture, though, of the potential impact of poor oral health on an individual an 'oral health-related quality of life' (OHRQoL) assessment should be used as a supplement to traditional clinical measures (Slade & Spencer, 1994; Oscarson, Kallestal & Lindholm, 2007; Öhrn & Jönsson, 2012).

The potential psychological and social impact of oral disease on individuals and communities is best described by Locker's conceptual model of oral health (Locker, 1988). This model comprises seven domains. These domains are functional limitation, physical pain, psychological discomfort,

physical disability, psychological disability, social disability and handicap. Locker's model illustrates how disease leads to impairment and ultimately result in handicap or disadvantage. In other words, if an individual has severe periodontal disease which has resulted in tooth loss, this tooth loss can impact on the individual in daily life e.g. a change of outward appearance. This impediment could change the way the individual is perceived by employers and hypothetically could result in the failure to secure a job. This then 'handicaps' the individual within society (Broughton et al., 2012).

The 'handicap' described in Locker's model can impact individuals of any age. This has was clearly evidenced in Carvalho, Mestrinho, Stevens and van Wijk's (2015) study amongst Belgian adolescents and young adults (sample groupings 16 to 24 years old and 25 to 32 years old). Despite hypothesising that oral conditions would have no impact on their OHRQoL, the outcomes were significantly different. These young people's lives were in fact significantly impacted by their clinically diagnosed oral health conditions (dental caries, gingivitis and periodontitis) and the consequences of these diseases. Of interest was that the oral health conditions of the participants were a more influential determinant on their OHRQoL than differences in age group sample. The prevalence of OHRQoL impacts amongst the young people in this study (18.7%) were comparable to those in Australia (18.2%) with both being lower than NZ (23.4%) (Lawrence, Thomson, Broadbent & Poulton, 2008).

The collective direct impact of poor oral health on individuals can translate into a potential economic burden. Globally, chronic oral disease results in millions of lost school and work hours each year (Petersen et al, 2005). In 2008, ten percent of adult New Zealanders aged 18-64 years, took on average 2.1 days off school or work due to oral health related problems. This equated to an annual economic loss of NZ$86 million (Ministry of Health, 2010).

Oral disease can indirectly impact on healthcare systems and economies too. There is a growing body of evidence connecting periodontal infection to a variety of systemic problems and/or conditions due to the common inflammatory and infectious risk factors they share. These systemic conditions include cardiovascular and cerebrovascular disease, diabetes mellitus, preterm/low-birth-weight infants and hospital-acquired pneumonia (Gehrig & Willmann, 2011). The direct and indirect impacts of oral disease on a social healthcare system in a small country like New Zealand can therefore be significant. This is particularly relevant in light of the knowledge that the oral disease prevalence can be reduced using preventive measures, innovative approaches and reducing barriers to care.

2.2.6 The epidemiology of oral disease

2.2.6.1 A brief overview of the epidemiology of oral disease internationally

The WHO estimate that 60-90% of schoolchildren suffer from dental caries (Petersen et al., 2005). The prevalence of dental caries among adult populations is similar with approximately 91%

experiencing dental caries in their lifetime (Bray & Gluch, 2008). These statistics are applicable to the majority of countries in the world (Burt, 2005).

Periodontal disease is equally prevalent with some form of periodontal disease affecting up to 90% of the worldwide population (Pihlstrom, Michalowicz & Johnson, 2005). Of concern is the prevalence of periodontitis (the severest form of periodontal disease) amongst adult populations. It has been reported that up to 20% of the adult population worldwide suffer from severe periodontitis (Petersen et al., 2005). Young people can also be affected by periodontal disease with statistics from the United Kingdom reporting that, in 1998, 14% of 16 to 24 year olds were suffering from moderate periodontal disease (Clarkson et al., 2013). Further international reports show that 13.8% of 25 to 34 year Americans suffer from early periodontitis (Burt, 2005), almost half the level seen in New Zealanders of the same age (Ministry of Health, 2010).

2.2.6.2 The epidemiology of oral disease in NZ

Significant oral disease is still prevalent in NZ communities. This was evident in the findings of the most recent national oral health survey. The goal of the national oral health surveys, carried out by the NZ Ministry of Health in 1976, 1988 and 2009, has always been to gain an overview of the oral health status of New Zealanders. The surveys gauge any deterioration or improvements in the oral health of the nation as well as the attitudes, knowledge and practices of both children and adults in NZ (Ministry of Health, n.d.). Findings of the 2009 survey, relevant to this study, are discussed in section 2.2.6.2.2. Comparative survey data also showed that NZ adults have poorer oral health across a range of traditional clinical measures (explained below) when compared with Australian adults. They were also less likely to have visited a dental professional in the last year (Ministry of Health, 2010).

2.2.6.2.1 Traditional clinical measures of oral health
Dental Caries

The DMF (decayed-missing-filled) index measures prevalence of disease (coronal dental caries) rather than oral health. The (DMF) index can either be applied at the 'tooth' level or the tooth 'surface' level (Chattopadhyay, Arevalo & Sohn, 2008). The tooth level is measured using the 'decayed, missing and filled teeth' (DMFT) index. The 'surface' level uses the 'decayed, missing and filled surfaces' (DMFS) index. The DMFT measure is based on 28 teeth and the DMFS on the surfaces of 28 teeth equalling 128 surfaces. Both indices record dental caries as being either present or absent (Wyche, 2013).

Periodontal disease

The presence or absence of periodontal disease is measured using a dedicated periodontal probe. Periodontal screening indices (and their recommended choice of probe) differ depending on whether individuals are being screened for periodontal disease in the clinical setting or if the periodontal status of a population (epidemiological measure) is being sought. In both cases, the

measure used gathers data which provides information on the extent or severity of periodontal disease (Gehrig & Willmann, 2011; Wyche, 2013).

2.2.6.2.2 The NZ National Oral Health Surveys

The most recent national oral health survey (undertaken in 2009) collected information on the oral health status of NZ European, Māori, Pacific and Asian NZ adults, adolescents and children. The participants were representative of the NZ demographic at that time and were from varying socio-economic backgrounds. Data published from the survey shows that 4906 New Zealanders participated in the survey interview with 3196 respondents completing a dental examination (Ministry of Health, 2010). Whilst the 2009 survey results indicated that the oral health of New Zealanders has improved, some findings were of significant concern and relevant to this study. These findings were that:

- Adolescents aged 12 to17 years had worse oral health than the younger age groups.

- 65.3% of NZ (62.8% for aged 18 to 24 years and 64.1% for 25 to 34 years) adults brushed their teeth with fluoride toothpaste at least twice a day.
- Only 36.9% of 18–24-year-olds had visited a dental professional in the previous year.
- The prevalence of having one or more teeth missing due to pathology was significantly higher among 25 to 34 year olds (34.7%) than among 18 to 24 year olds (8.8%).
- 46.5% of 25 to 34 year olds that were examined had untreated coronal tooth decay (the highest prevalence of any age group in NZ or Australia) with the highest mean number of decayed coronal surfaces per person of any age group in New Zealand.
- 33% of the examined adults had periodontal disease with the highest prevalence of advanced periodontal disease (likely to result in tooth loss) found in the 25 to 34 year old age group.
- There was a high degree of unmet need among younger adults, with cost identified as a key barrier to access.

Furthermore when comparing periodontitis prevalence between the 1988 and 2009 surveys, Haisman-Welsh and Thomson (2012) concluded that while there had been significant reductions in middle aged and older adults in NZ, no such reductions were observed in 20 to 24 year olds.

2.2.6.2.3 Oral health amongst adolescents in NZ

Studies focussed on NZ adolescents over the last few years have provided insight into the high prevalence of oral disease and rates of inequality amongst this group, corroborating the findings

of the 2009 NZ National Oral Health Survey. Particularly high rates are experienced in areas of high deprivation such as Northland and Te Tai Tokerau. A 2009 study undertaken in these areas found that 85% of 12 and 13 year olds had experienced dental caries (Gowda, Thomson, Foster Page & Croucher, 2009). Similar results were seen in Foster Page and Thomson's (2011) study of Taranaki adolescents, undertaken in 2009, prompting the researchers to comment that

> Adolescents still appeared to be experiencing caries at a clinically significant rate, with social and ethnic inequalities in caries experience continuing to widen as this group of adolescents move from care in the traditional school dental service to that in the private sector. That many adolescents are presenting with decayed surfaces highlights the need for care in this age group to address these inequalities as they move into adulthood (and out of the publicly-subsidised state service for oral health care). (p.95)

These statistics show that even in the child and adolescent dental service in NZ, available at no-cost to users, that dental caries experience is significantly high. Unfortunately, the incidence and prevalence of periodontal disease was not reported in these studies.

2.2.6.2.4 Uptake of subsidised dental and oral health services in NZ

The 'National Survey of the Health and Wellbeing of NZ Secondary School Students' was undertaken in 2007. The aim of this survey was to describe NZ secondary school students' recent use of dental care. In this study 9098 secondary school students from across NZ took part in the survey. The majority lived in urban areas. The survey showed that only 72% of NZ adolescents had seen a dentist in the previous 12 months with lower odds amongst Māori, Pasifika and Asian participants. Of concern was that approximately ten percent of the participants had been unable to see a dentist when needed during the same time period (Areai et al., 2011). By 2008, the national average for uptake of oral health services was 60% (Schluter et al. 2015).

The NZ Ministry of Health has reported that NZ$199 million was spent on oral health care for those eligible to receive services in 2014/2015 (Ministry of Health, n.d.). Despite the government's investment in child and adolescent oral health, oral health amongst this group remains poor and uptake of available services has declined. It is known that young adults, for whom oral and dental care is not a routine or habit, are less likely to access or utilise any service once ineligible for free care (Broadbent et al., 2006; Schluter et al., 2015). The adolescents in the above mentioned studies would now be in the 18 to 24 year old age group, the population of interest that prompted this study.

Fitzgerald et al. (2004) suggested that innovative approaches needed to be explored in order to increase engagement with adolescents. This was reiterated seven years later by Areai et al. (2011) who commented that "despite the existence of a state-funded oral care scheme for all adolescents, access to oral health care remains a major problem among these groups" and that "perhaps it is time to examine and test alternative models of delivering oral care and advice to that group" (p.124).

2.2.7 Section two conclusion

The purpose of this section was to provide background and context to this study. The impact of poor oral health on individuals and communities has been illustrated. The evidence shows that despite New Zealanders having access to a free dental and oral health service for the first 18 years of their lives, that the prevalence of oral disease amongst adolescents and young adults is high. Access to service is declining amongst adolescents and continues to decline, due to cost being a barrier, on transition to the private sector in early adulthood. This appears to have had a significant negative impact on the oral health of young adults in NZ.

2.3 EFFECTIVE HEALTH COMMUNICATION TO PROMOTE ORAL HEALTH

2.3.1 Overview of section three

This section will focus on the role of communication, and in particular health communication, in promoting oral health. Communication is fundamental to interaction with others in all aspects of our lives. Effective communication is an essential aspect of being able to educate individuals and communities about disease prevention.

This section will begin with an overview of the importance of oral health promotion as a key to preventing oral disease. This will be followed by a discussion on the process of communication. This will include an explanation of communication models as a prologue to a discussion on health communication to promote oral health. The section will conclude with a discussion on the role of media in promoting oral health. There will be particular focus on the use of mobile health (mHealth) as an intervention tool to promote health and motivate behaviour change. The feasibility and acceptability of this form of health promotion is discussed in the context of the relevant mHealth studies that were identified and reviewed.

2.3.2 The role of oral health promotion in disease prevention

Dental caries and periodontal disease are both largely preventable diseases of the oral cavity with a primary causative factor: bacterial plaque-biofilm. Oral health promotion programmes should therefore seek to have an effect on the primary cause of disease by educating individuals on healthy lifestyle choices, oral hygiene self-efficacy and the importance of regular engagement with oral health professionals (Bray & Gluch, 2008). Incorporating these factors is considered the most successful approach to reducing plaque-biofilm prevalence in the oral cavity, thereby preventing oral disease, disease relapse or disease progression (Löe, 2000).

Oral hygiene education is fundamental to disease prevention (Lim, Davies, Yuen & Ma, 1996) and thorough and repeated oral hygiene education is the most important factor in patient motivation (Tan & Wade, 1980). Although Watt and Marinho (2005) found that most oral hygiene education and advice interventions only provide a short-term reduction in plaque-biofilm and gingival bleeding of six months or less, other studies have suggested differently. The 30 year Axelsson et al. (2004) longitudinal study (known as the Karlstad Model) provided evidence that patients who regularly engage (two to six times annually) with professional preventive oral health care (which includes the provision of oral health promotion messages) had significantly better oral health.

The Karlstad model included regular tooth debridement in addition to oral health promotion messages. More recent studies, however, have suggested that professional tooth cleaning (tooth debridement) provides no clinical benefit beyond that derived from individual and group-based

health education (Lim et al., 1996; Hugoson, Lundgren, Asklöw & Borgklint, 2007). The literature therefore suggests that bimonthly (every two months) engagement with an oral health professional who provides effective oral health promotion messages appears to provide significant oral health benefit to patients (Axelsson, 1981; Hugoson et al., 2007).

Regardless of mode of delivery or frequency, oral health promotion initiatives rely on patient participation, patient adherence and self-management to be successful (Borkowska, Watts & Weinman, 1998; Löe, 2000). The level of success, however, can depend on how effectively the oral health promotion message is communicated.

2.3.3 The process of communication

According to Schiffman and Kanuk (1991) communication is "the transmission of a message from a sender to a receiver by means of a signal of some sort sent through a channel of some sort" (p. 268). Wyche (2013) defines communication as "a process of defining the meaning of a message shared between a sender and one or more intended recipients" (p.25). 'Noise' is any factor in the communication process that interferes with exchanging messages and achieving common meaning (Bartol & Martin, 1998). One such factor can be 'semantic noise' which will be discussed in detail in section 2.4.1.

Communication can be verbal or non-verbal. There are four basic components of all communication: a source (sender), a destination (receiver), a medium/channel and a message and these are illustrated in the two basic models of communication presented as Figure 2 and Figure 3.

2.3.3.1 Models of communication

2.3.3.1.1 Basic model of communication

The basic model of communication (shown in Figure 2 as model one) is a modified version of the 'transmission' model developed by the engineers Shannon and Weaver (Shannon & Weaver, 1949). In this one-way flow model the sender initiates the message based on a feeling, attitude, belief or fact that they want to convey. The sender then 'encodes' the message using sounds, words, pictures and/or gestures. The 'encoded' message is then transmitted to the receiver via a 'channel' or 'medium' e.g. via telephone. This channel must have direct access to the receiver and the receiver must be ready and willing to accept this message.

FIGURE 2 Model One (Basic communication model)

Channel

| Sender | → | Message | → | Receiver |
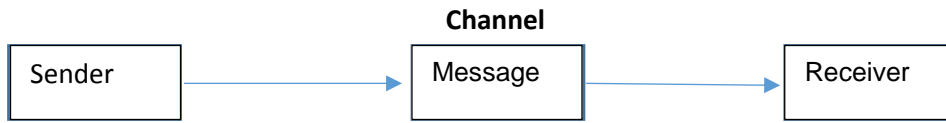
(Schiffman & Kanuk, 1991; derived from Shannon & Weaver, 1949)

Model one illustrates a very simple view of communication, although misleading. This is because it does not take into account whether the 'receiver' has received the message in the first instance or whether the message has been interpreted in the way that the 'sender' intended. For this to happen, feedback to the 'sender' is required.

2.3.3.1.2 Modified multiway model of communication

Recognising the limitations of the one-way flow model, Wilbur Schramm proposed a multi-way, interactive model of communication in 1954. His model, shown in Figure 3, proposed that communication consisted of 'message loops' or feedback whereby each individual message was a part of an on-going exchange between two people (sender and receiver).

FIGURE 3 Model Two (modified multiway communication model)

← **NOISE** →

| Sender | → | Encoded Message | → | Medium / Channel | → | Receiver | ← | Decoded message |
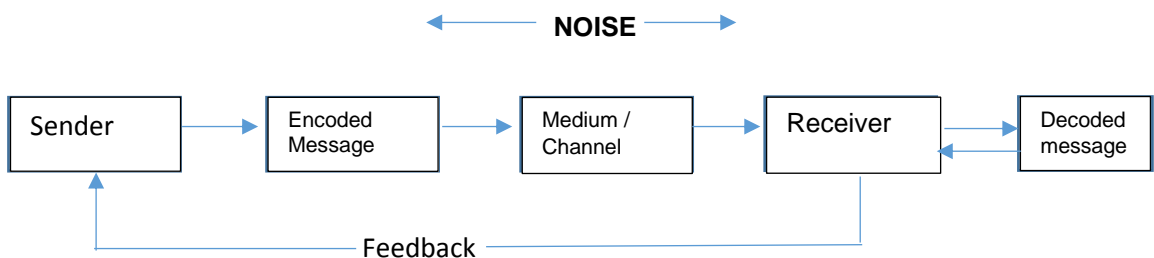
Feedback

(Schiffman & Kanuk, 1991; derived from Schramm, 1954)

In this exchange, feedback represents the 'receiver's' basic response to the interpreted (decoded) message. This response then results in a reversal of the communication process. This means that the 'receiver' becomes the 'sender' and the 'sender' becomes the 'receiver' (Schiffman & Kanuk, 1991; Bartol & Martin, 1998; Corcoran, 2013).

Feedback provides preliminary information to the 'sender' about whether the communication process is successful. For this reason, communication requires constant monitoring to ensure that the 'receiver' of the message is indeed receiving the right message. The interactive

communication process, however, can be interrupted by 'noise'. The relevance of 'noise' in this study is discussed in section 2.4.1.

2.3.4 Health communication

Health communication is defined as

> the use of communication strategies to achieve three goals. Firstly, to enhance the ability to provide patient-centred health information, secondly, to motivate positive changes in health behaviours and finally to achieve improved health outcomes (Wyche, 2013, p. 24).

Efficacy is particularly important in the field of health communication (Corcoran, 2013) if the goal of health communication is to be achieved. Various channels have been used in health communication. These include traditional mass media and, more recently, new media.

Mass media broadly comprises print, broadcast and support media (Belch & Belch, 2009). Hongcharu and Eiamkanchanalai (2011) best describe mass media as providing "one-way, non-personal communication, where the audience is unable to interact with the sender of the message and there is no real person to communicate with them" (p. 32). In other words, mass media messages utilise the uni-directional basic communication model, shown in Figure 2, in which recipients receive messages passively and incidentally due to the nature of the channels used.

New media is the term used to describe media that has developed as a result of the advent of the 'world wide web' or cyberspace. New media has been further categorised to include 'interactive media'. This term refers to media associated with internet connectivity. Differing from traditional mass media, the value in interactive media (which includes mobile phones) is in its ability to provide a two-way interaction with the targeted audience (Hongcharu & Eiamkanchanalai, 2011), as shown in Figure 3.

Mobile phones have increasingly gained popularity as a personal communication device (Hongcharu & Eiamkanchanalai, 2011). Communicating via mobile phone is a now a part of people's everyday lives, regardless of age or socio-economic status. Differing from traditional mass media, mobile phones provide an ideal platform to provide cost-effective (Gholami et al., 2017), personal and targeted messages directly to an individual at appropriate times (Hongcharu & Eiamkanchanalai, 2011; Corcoran, 2013). Access to the target audience is facilitated by mobile phone users usually having their phones readily accessible and using them frequently. Recipients of targeted or tailored messages can respond directly to the message sender immediately. Alternatively, messages can be stored until read (Corcoran, 2013), then retained, revisited or deleted as required. This allows the recipient to play an active role in the communication process.

While older generation mobile phone functions included voice communication, short message service (SMS) or text, the technology available in newer generation 'smart' mobile phones provides expanded functionality. These functions include access to email, camera facilities and

internet connections. In addition, these phones allow for video input or MMS (multimedia message service).

2.3.4.1 Using mass media to promote health

For many decades traditional mass media has been a versatile health communication tool. During this time, large scale mass media campaigns have aimed to expose high proportions of large populations to health (or behaviour) promotion and disease (or behaviour) prevention messages. Campaign outcome successes have been varied. One of the campaign success hindrances that has been identified is the increasingly cluttered media environment; one where different, competing products (at times, with opposing messages) vie for adequate exposure time (Wakefield, Loken & Hornik, 2010).

Traditionally in the clinical setting, oral health promotion messages are delivered in a 'one-to-one', intrapersonal manner. Alternative modes of oral health promotion message delivery, in the form of small scale mass media (video, written instructions or a combination thereof), have been trialled in various general dental and specialist clinical settings. Results have shown that no particular type of small scale mass media intervention appears to be a more effective option when used to deliver oral hygiene instruction (Lim et al., 1996; Lees & Rock, 2000).

Large-scale mass media campaigns have also been used to promote oral health. However, to be effective and achieve long-term benefit, longer mass media campaigns (at greater cost) are required to adequately expose the target population to the message (Wakefield et al., 2010). This is relevant as the effects of 'short-term' oral health promotion mass media broadcast campaigns have been shown to diminish within one to three months of the broadcast media campaign ending (Schou, 1987; Gholami, Pakdamen, Montazeri & Virtanen et al., 2017).

To, therefore, evoke greater behaviour change in message recipients, Schou (1987) suggested that future oral health campaigns should include active involvement activities that support print and broadcast campaigns. Recently, a mass media campaign using videos and television coupled with an 'interactive' social media campaign, has been launched to promote oral health amongst pre-schoolers in NZ (Health Promotion Agency, n.d.). This programme has yet to be evaluated.

2.3.4.2 Using new media to promote health

Riley et al. (2011) commented that "the application of mobile technologies to health behaviour interventions is a nascent but rapidly growing field that has only begun to leverage the full capabilities of mobile phones and other mobile technologies" (p.64). As described in section 2.3.4, the advent of new media, and in particular mobile phones, is a global phenomenon that offers alternative and innovative opportunities in health promotion beyond traditional mass media (Klasnja & Pratt, 2012). Providing health promotion interventions in this way is known as mobile health or 'mHealth'.

mHealth interventions, using various mobile phone functions, have been used extensively in recent years as a tool in relation to the disease management of various chronic diseases and conditions. These have included the management of diabetes mellitus, weight management and smoking cessation. In relation to these conditions, a 2012 Cochrane review of the utilisation of mobile phone messaging for facilitating self-management of long-term illnesses concluded that mobile phone messaging was no more effective than usual care or email reminders for glycaemic control, the frequency of diabetic complications, or body weight (Jongh, Gurol-Urganci, Vodopivec-Jamsek, Car & Atun, 2012).

Similarly, Free et al. (2013) concluded, in their systematic review of the effectiveness of mHealth technology-based health behaviour change or disease management interventions for healthcare consumers, that there was mixed evidence for the effectiveness of health intervention delivery to health-care consumers using mobile technologies. In this review, 59 trials that used a variety of mobile technologies to improve disease management and 26 trials aimed at changing health behaviours were investigated. These trials had participants from across the lifespan and represented a wide variety of healthcare practice areas. Dental and oral health practice, however, was not represented in Free et al.'s review.

Despite the increasing use of mHealth, there are still areas to explore and gaps in the knowledge. This was acknowledged in the conclusions of the 2012 Cochrane review of the utilisation of mobile phone messaging for preventive health care. In this review, the authors noted that there were significant information gaps with regards to the long-term effects, risks and limitations of such interventions, including user satisfaction (Vodopivec-Jamsek, Jongh, Gurol-Urganci, Atun & Car, 2012).

2.3.5 Using mHealth to promote health to adolescents and young adults

The highest rates of mobile phone use in the USA are amongst adolescents, younger adults and the socioeconomically disadvantaged (Hashemian, Kritz-Silverstein & Baker, 2015) with text messaging being the primary mode of communication amongst adolescents and young adults (Markowitz et al., 2014). This is comparable to NZ where 18 to 24 year old adults are considered the most technologically literate generation ever and approximately 90% of this group have a smart mobile phones (Horizonpoll, 2014). As such, opportunities to integrate mHealth interventions into these young people's daily lives have been identified. This has led to mHealth intervention studies that have specifically focused on adolescents and young adults having been undertaken.

One of these studies was the one month pilot study undertaken by Markowitz et al. (2014). This study sought to examine the feasibility of a healthy lifestyle text messaging programme amongst adolescent and young adult diabetics. The results of their study showed that a mHealth intervention using SMS, for diabetes management, was rated highly and considered acceptable

by their study cohort. The researchers concluded that positive, daily, motivational text messages may be effective in increasing motivation for small goal changes in the areas of nutrition and physical activity. However, they also noted that there was a need for qualitative feedback from this cohort as this would allow for better tailoring of future mHealth interventions for adolescents and young adults.

Similar outcomes, to the above mentioned study, have been shown in mHealth intervention programmes for smoking cessation amongst adolescents and young adults in NZ (Whittaker et al., 2008; Whittaker et al., 2011). These studies showed that interventions using SMS and/or MMS were considered to be feasible and acceptable to this age group, regardless of ethnicity, with one of the only acknowledged limitations being technical issues with credit on prepaid phones of participants. These studies have served to add new information about young people's interest in, and perspectives on, the use of new mobile phone technology as a platform for delivering health interventions.

2.3.6 mHealth applications and interventions in oral health

As cited in section 2.3.4.2, there are still significant information gaps in regards to utilising mHealth for preventive health care. This includes the use of mHealth as an intervention tool for preventive oral health. In searching the published literature, only six mHealth in oral health studies were identified, with two of those being of particular relevance to this study. Table 1 (p.42) provides a detailed summary of the six study's designs with comparative data to this study with the overall impact and effectiveness of the interventions used in the identified mHealth in oral health studies discussed in section 2.3.6.1.

Three of the six reviewed studies focussed on the use of mHealth interventions amongst the mothers of preschool children. These studies were undertaken in India (Sharma, Hebbal, Ankola and Murugabupathy, 2011), the USA (Hashemian et al., 2015) and in Iran (Makvandi, Karimi-Shahanjarini, Faradmal & Bashirian, 2015). Sharma et al's (2011) study considered the use of traditional media in the form of pamphlets versus text messaging to provide oral health education (OHE) to the mothers (n=150) of pre-schoolers. The oral health knowledge, attitude and practices of the mothers was assessed by closed-questioned questionnaire administered at baseline and then again post-intervention. In addition, a clinical measure in the form of a 'visible plaque index', was utilised to assess plaque-biofilm control changes in their children. This measure was undertaken pre- and post-intervention. The study was undertaken over four weeks. Participants were allocated to either the 'pamphlet' or 'text' groups. Twenty one OHE messages were provided (three per day for a week) to the mothers either by pamphlet or text message. These OHE messages were repeated weekly for four weeks. The OHE covered standard oral health preventive topics such as dental caries, the impact of diet on oral health, tooth brushing techniques and the importance of fluoride.

Subsequent studies (Makvandi et al., 2015; Hashemian et al., 2015) were comparable in aims to Sharma et al. (2011). They did, however, use different methodologies which did not include the

use of a clinical outcome measure. In addition, Makvandi et al. (2012), unlike the other two studies, used the outcomes of motivational interviewing (MI) and a health promotion cognitive theory in their intervention strategy. Motivational interviewing is a patient-centred approach focusing on building inherent motivation for behavioural change (Borrelli, Tooley & Scott-Sheldon, 2015) while health promotion cognitive theories propose that a certain set of perceptions or beliefs will predict the message recipient's behaviour (Corcoran, 2013).

Makvandi et al.'s (2012) study (n=90) had two aims. These aims were firstly, to change dental cleaning behaviour and secondly, to measure changes in knowledge and understanding of the aspects of the chosen cognitive health promotion theory called the 'theory of planned behaviour' (TPB). These TPB aspects were attitude, perceived control and behavioural intention. All mother's enrolled in Makvandi et al.'s study completed a questionnaire at baseline, ten days after intervention and again after three months. This questionnaire was designed to garner information related to their attitude to oral health, perceived behavioural control, intention, oral health knowledge, cleaning of children's teeth and demographic questions. All mothers attended weekly oral health information sessions, run by the principal investigator of the study, for four weeks. These sessions were between 45 minutes and one hour long. Sessions involved interactive lectures and discussions and included receiving a booklet on infant oral health at session two. Interactive discussions used motivational interviewing techniques to elicit the oral health beliefs of mothers. These beliefs were subsequently used to derive suitable, targeted motivational text messages for the intervention group. The text message interventions used in this study were based in a health promotion cognitive theory and again addressed oral health knowledge, attitude and behavioural control. The intervention group received eight different, short text messages twice a day for four days. These were sent 45 days after the last oral health information session.

Hashemian et al's (2015) 'Text2Floss' study aimed to examine the feasibility and utility of a seven day text messaging intervention with the goal of improving oral health knowledge and behaviour in mothers of young children. Unlike the studies by Sharma et al. (2011) and Makvandi et al. (2015), this study measured the mother's own oral hygiene behaviour changes as well as their attitudes and behaviours towards the oral hygiene of their children. One hundred and fifty-six mothers with an average age of 34 years were recruited for the study, which was undertaken in both a private practice and community clinic. Pre- and post- intervention surveys were used as measures. All mothers received an oral health information pamphlet containing answers to the questions posed in the pre- and post-intervention surveys. Daily automated text messages were sent to the sixty mothers in the intervention group. These texts provided OHE and queried whether the mother had flossed their own teeth the previous day. By way of 'feedback', mothers were asked to text 'yes' or 'no' in response. Dependant on the mother's response, a further OHE message was provided. A 'positive reinforcement' oral health promotion message was provided to those who answered 'yes'. Alternatively, a 'behaviour change' motivational message was provided for a 'no' response.

Of the remaining studies, one considered the effects of prompts and reminders, delivered via mHealth, on the preventive oral health behaviours of Taiwanese patients (Cheng, Li, Hu, Shen &

Huang, 2013). In this study, an appointment 'reminder', together with an OHE message was sent to all participants six months after their last debridement treatment. The reminder and OHE message, regardless of mode, was identical for all participants in the intervention group. In addition, each participant was asked about their perceived oral health. The two remaining studies both used mHealth interventions to try to improve the oral health of young adults (Schluter et al., 2015; Jadhav et al. 2016).

Schluter et al. (2015) undertook a ten week study which aimed to improve tooth brushing frequency amongst a cohort (n=171) of unemployed 18 to 24 year olds who were receiving social security payments. Tertiary students, even if unemployed, were deemed ineligible to participate. Automated motivational text (SMS) messages were sent weekly to participants. Feedback was an aspect of this study's design with the expectation that participants would respond to the researchers every third week and provide information about their tooth brushing frequency at that time. Attrition in this study was significant with only one-quarter of the eligible participants providing valid responses at the conclusion of the study.

Jadhav et al.'s (2016) study, amongst 18 to 20 year old tertiary students (n=400) aimed to assess the effectiveness of reinforcing oral health messages by SMS. Unlike the study by Schluter et al. (2015), where assessment of oral hygiene efficacy was self-reported by participants, this study utilised clinical measures (a plaque-biofilm index and a gingival index) and provided traditional oral health promotion in a clinical setting with oral hygiene techniques demonstrated on typodont models. Oral health promotion topics presented in the clinic were again used in the text message intervention as a reinforcement. Clinical data, for all participants, was collected at baseline, one month, two months, three months and six months by previously calibrated examiners.

2.3.6.1 The overall impact and effectiveness of oral health mHealth interventions

Cheng et al's (2013) study (n= 389) found that reminders by telephone were least effective and the most time-consuming of their interventions. Study participants, however, highly endorsed this type of reminder. Regardless of intervention mode, though, patients were almost three times more likely to return for a preventive oral health appointment if they received a reminder. Of interest was that about one quarter of the returning patients did so as a result of trusting the dentist. This trust stemmed from patient satisfaction with the service that they had received at previous appointments.

Evidence strongly supports the use of text messaging (SMS) as an effective means of improving oral health knowledge and attitudes to oral hygiene practices (Sharma et al., 2011; Hashemian et al., 2015; Jadhav et al., 2016). Text messages are also preferable to telephone calls especially when targeting younger or highly educated patients (Cheng et al., 2013). Gender or ethnicity do not appear to be factors that impact on the acceptability or effectiveness of mobile media interventions (Schluter et al., 2015).

In the reviewed studies, text messaging appeared to be the preferred method of providing OHE reinforcement when compared with print media. The mothers in Hashemian et al.'s (2015) study perceived the text messages as useful and an acceptable means of providing OHE. Eighty-five percent of the mothers in Makvandi et al's (2015) study reiterated this, however, the majority still felt that the most useful intervention strategy were the interactive OHE discussions with an oral health professional. This supports the view that personalised professional interaction with an oral health professional plays an important role in oral health promotion strategies.

Jadhav et al.'s (2016) study results take the importance of the patient-clinician relationship further. Their findings indicate that a combination of professional 'personalised' OHE that is reinforced with a mHealth intervention may be the key to improving oral health. Their results showed improved oral health amongst both the intervention and control groups one month after personalised OHE was provided. However, when no further reinforcement was provided to the control group their overall oral health declined. The intervention group, however, showed continued improvement in oral health, even after six months.

2.3.7 Section three conclusion

This section has focussed on the role of communication, and in particular health communication, in promoting oral health. Communication is fundamental to interaction with others in all aspects of our lives. Effective communication is an essential aspect of being able to educate individuals and communities about achieving and maintaining health and preventing disease.

Oral health promotion is expected to be a basis of practice for all oral health professionals. This is because regular dental visits are associated with better oral health in individuals as regular exposure to oral health messages can influence self-care behaviour (Thomson et al., 2010). It appears, however, that patient satisfaction is fundamental to a patient's intent to revisit and reminders, coupled with OHE, serve to strengthen this intention (Cheng et al., 2013).

Small and large scale mass media has been the traditional means of delivering health and oral health promotion information. The advent of electronic mobile media and mobile phones, however, now provide alternative opportunities to disseminate health promotion messages. A large proportion of the global population use mobile phones.

Smart mobile phones and their multiple functions have proved to be cost-effective tools that are able to reach individuals with targeted messages with the goal of promoting health and motivating behaviour change. The use of mobile phones in this way (mHealth) has, to date, not been widely used in oral health care settings. This is despite evidence showing that mHealth can be a useful, feasible and acceptable adjunct to traditional oral health care.

TABLE 1 Summary of reviewed mHealth in Oral Health studies with comparative data to this study

	Sharma et al. (2011)	Cheng et al. (2013)	Hashemian et al. (2015)	Makvandi et al. (2015)	Schluter et al. (2015)	Jadhav et al. (2016)	This study (2016)
Method	Quantitative	Quantitative	Quantitative	Quantitative	Mixed Methods	Quantitative	Mixed Methods
Methodology	Two groups: pamphlet and text message	Two groups: control and intervention (postcard, text, telephone)	Two groups: text and control	Two groups: control and intervention (3x OHE sessions, booklet, text reminders)	All participants provided baseline info. Intervention (text messages) to all participants	Two groups: control and intervention (text message)	Four groups: Control, Phone, Text, Video
Number of participants enrolled	150	389	156	90	171	400	16
Participant age group	No information provided on mean age of mothers	12-80 years with mean = 49 years	Mean age of mothers 33.9 years across all participants	Mean age of mothers control = 32 yrs, intervention = 33 years	18-24 years unemployed beneficiaries	18-20 years tertiary students	18-24 years (mean 20 years) tertiary students
Non-clinical measures	Questionnaire	Paper questionnaire at baseline. Questionnaire by telephone interview post intervention	Survey	Questionnaire: baseline, 10 days, 3 months	Baseline survey on oral health habits		OHIP-14 – baseline,6mo REALD-30 – baseline,6mo Interview
Clinical measures	'Visible plaque index' (VPI) of child	n/a		n/a	n/a	'Oral Hygiene Index' Gingival Index - baseline, 1mo, 2mo, 3mo,6mo	'Plaque Control Record' – baseline, 3mo
Clinical OHE*	n/a	n/a	n/a	n/a	n/a	Powerpoint (PP) presentation. OH demo- Modified Bass brushing method and use of interdental aids	Powerpoint (PP) presentation + pamphlet of PP slides. OH demo- Bass brushing method and use of interdental aids (flossing)
mHealth* intervention mode	SMS*	SMS Telephone	SMS	SMS	SMS	SMS	MMS* SMS Telephone
Frequency of mHealth intervention	3 text messages per day for 7 days then repeated for 4 weeks	Text message sent 6 months after last tooth debridement appointment	Text message once daily for 7 days	8 different motivational text messages - 2x daily for 2 week (4 days per week) sent 45 days after last OHE session	10 weekly text messages (1st message as welcome followed by 9 brushing reminders). Participant response required every 3rd message	2 text messages per week for 3 months sent to intervention group	5 different OHE messages, monthly for five months sent to phone, text and video groups

*OHE (oral health education); mHealth (mobile health); SMS (small message service/text message); MMS (multimedia message service/televisual)

2.4 ORAL HEALTH LITERACY

2.4.1 Overview of section four

Discussed at the outset of Chapter Two, oral disease can have significant impact on individuals, communities and healthcare systems. Oral health promotion and disease prevention messages are vital keys to improving oral health and managing disease risk. Effective health communication ensures that patient-centred health promotion messages are made available in such a way that they motivate changes in health behaviours that will lead to improved health outcomes. In other words, if the prevalence of oral disease is to be reduced, it is vital that the oral health promotion 'message' provided by the 'sender' is fully understood by the 'recipient' as

> preventive dental services might be less effective in patients with low knowledge and a low literacy level because they do not understand instructions or the importance of preventive procedures, so they may be less compliant with recommended practices – thus exacerbating the effects of poverty and other factors contributing to disparities (Jones, Lee & Rozier, 2007, p. 1204).

This section will begin by explaining the role of noise in the communication process. This will include an explanation of how 'semantic' noise is related to health literacy. A short review of the development of the concept of health literacy and its identified competencies is discussed. Thereafter oral health literacy, its measures and potential impacts are explained. The section concludes with a discussion, supported by current evidence, on why it should be important to increase levels of OHL in individuals and communities.

2.4.2 The role of semantic noise in the communication process

The basic models of communication were discussed in section 2.3.3. These models showed 'noise' but did not discuss the concept of 'noise' in the communication process. 'Noise' is a factor that must be considered in communication (Figure 4). Noise can interfere in the communication exchange process and prevent the sender and the receiver achieving message congruence.

Semantics refers to the meanings and choice of words an individual uses. Semantic blockages, or 'semantic noise', are, therefore, the blockages or communication difficulties that arise from word choices. Individuals understand or interpret words differently depending on their life experience, level of education or context. If an individual cannot understand or interpret the meaning of words correctly, this can impact their response or feedback.

FIGURE 4 Modified communication model showing the role of noise
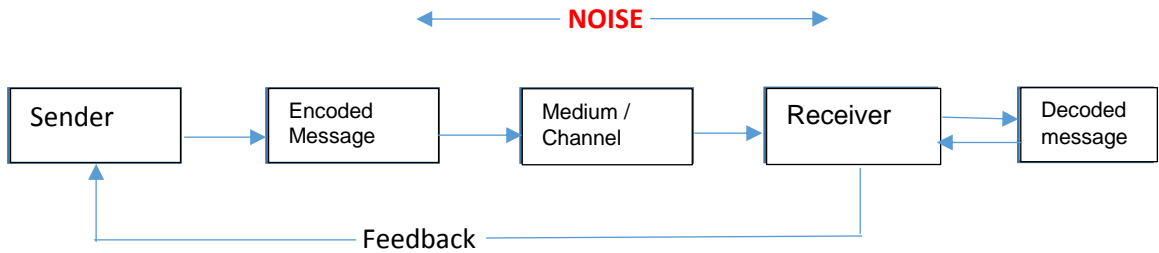
(derived from Schiffman & Kanuk, 1991; Bartol & Martin, 1998)

The use of jargon (language related to a specific profession) is one example of semantic noise (DeVito, 1986). In the context of health care practice, the use of jargon means that a patient may not be able to fully understand or comprehend concepts around achieving and maintaining health. These levels of understanding and comprehension are described as levels of 'health literacy'.

Health literacy can therefore be defined as "the possession of literacy skills (reading and writing) and the ability to perform knowledge-based literacy tasks (understanding and using information) that are required to make health related decisions in a variety of different environments (home, community, health clinic)" (Nutbeam, 2015, p. 17).

Despite this definition highlighting that literacy skills are a requirement of health literacy competence, it should not be assumed that highly literate populations will have high levels of health literacy. Evidence has shown that highly educated populations may actually have low health literacy (D'Cruz and Shankar Aradhya, 2013; Wehmeyer, Corwin, Guthmiller & Lee, 2014). In other words, an individual's ability to be able to read and write articulately does not necessarily equate with their having a good level of knowledge about health or health care. Dental and oral health clinicians should never assume that a highly literate patient has a high level of understanding about oral disease as this may not be so (Wyche, 2013).

2.4.3 The development of health literacy and key competencies

Health literacy is not a new concept. The term 'health literacy' was first used in the United States of America by Simonds in 1974 (Peerson & Saunders, 2009; Sørensen et al., 2012). Since the 1970s the required patient skills and competencies associated with health literacy have evolved to reflect those that patients require to function competently in the healthcare environment today. These competencies are explained below.

2.4.3.1 The key patient competencies of health literacy

Nutbeam has categorised, in ascending complexity, the competencies or skills within his framework of health literacy naming them as 'functional', 'interactive' and 'critical' (Nutbeam, 2000; Nutbeam, 2015). These are illustrated below in Figure 5.

FIGURE 5 Ascending levels of patient competence in health literacy

'Critical' health literacy requires more advanced cognitive skills and when combined with social skills, will allow a person to critically analyse information. In critiquing the information, they then have the ability to exert greater control over life events and situations.

'Interactive' health literacy requires a person to have more advanced literacy skills that would enable them to take and comprehend information from different communication sources, for example, the internet. They must be able to apply new information to changing circumstances. This skill set allows a person to act independently on new information and to interact with information providers, such as clinicians.

'Functional' health literacy describes basic health literacy skills that are sufficient for a person to obtain relevant health information, for example information on health risks, and then be able to apply that knowledge to a limited range of prescribed activities.

Nutbeam (2015)

It is generally accepted that the key required 'health literacy' competencies (in clinical care and public health settings), in ascending complexity, are 'access', 'understand', 'appraise' and 'apply' (Sørensen et al., 2012). An illustration of the application of these skills within the three health domains (health care, disease prevention and health promotion), using the four key competencies described by Sørensen et al. (2012), is shown in Table 2.

TABLE 2 The matrix with four dimensions (competencies) of health literacy applied to three health domains

	Access or obtain information relevant to health	Understand information relevant to health	Process or appraise information relevant to health	Apply or use information relevant to health
Health care	Ability to access information on medical or clinical issues	Ability to understand medical information and derive meaning	Ability to interpret and evaluate medical information	Ability to make informed decisions on medical issues
Disease Prevention	Ability to access information on risk factors for health	Ability to understand information on risk factors and derive meaning	Ability to interpret and evaluate information on risk factors for health	Ability to make informed decisions on risk factors for health
Health Promotion	Ability to update oneself on determinants of health in the social and physical environment	Ability to understand information on determinants of health in the social and physical environment and derive meaning	Ability to interpret and evaluate information on health determinants in the social and physical environment	Ability to make informed decisions on health determinants in the social and physical environment

Note Reprinted from "Health literacy and public health: A systematic review and integration of definitions and models" by K. Sørensen, K., S. van den Broucke, J. Fullam, G. Doyle, J. Pelikan, Z. Slonska, & H. Brand. 2012. BMC oral health, 12(1), p. 80. Copyright 2012 by Sørensen et al.; licensee BioMed Central.

2.4.3.2 Measuring health literacy

To effectively measure health literacy, a measurement tool must be able to assess relative differences in cognitive and social skills (Figure 5). Additionally the measurement tool must be able to measure how a person applies these skills to achieve health outcomes in different circumstances and settings (Table 2). Several measures of health literacy have been tested, refined and validated since 1995 to provide short screening tools for clinicians to use in every day practice (Nutbeam, 2015) including more than fifty tools in the last ten years (Rudd, 2015).

The most commonly used measuring instruments in health literacy are the Rapid Estimate of Adult Literacy in Medicine (REALM) and the Test of Functional Health Literacy in Adults (TOFHLA). Neither test is considered to provide all–inclusive measures of the skills needed by individuals in the health care environment (Lee, Rozier, Lee, Bender & Ruiz, 2007; Berkman, Davis & McCormack, 2010)

2.4.4 Oral health literacy

'Oral health literacy' is a derivative of 'health literacy' and relates directly to oral health and dental practice. In striving to prevent chronic disease, it is important to understand and measure a patient's oral health literacy in relation to behavioral and disease risk (Horowitz & Kleinman, 2008; Taggart et al., 2012). In 2007, it was identified that there was a need for a dedicated instrument to measure oral health literacy. This led to the development of the 30-word 'Rapid Estimate of Adult Literacy in Dentistry' (REALD-30), a derivative of the REALM (Lee et al., 2007). Subsequently, fourteen oral health literacy measurement instruments were developed between 2007 and 2013. Of those, the most commonly used oral health literacy instruments, in that time period, were the REALD, the 'Comprehensive Measure of Oral Health Knowledge' (CMOHK), the 'Test of Functional Health Literacy in Dentistry' (TOHFLiD) and the 'Oral Health Literacy Instrument' (OHLI) (Dickson-Swift et al., 2014). There are challenges for researchers in choosing a measurement instrument as

> several of the general health literacy instruments are not practical for use in a clinical setting such as a busy dental office because they take too long to administer. Although comprehensive tests of oral health literacy are important for research purposes, practical but accurate tools are needed to identify patients with limited literacy in clinical settings (Jones, Lee & Rozier, 2007, p. 1207).

2.4.4.1 Commonly used oral health literacy measures

2.4.4.1.1 The 'Rapid Estimate of Adult Literacy in Dentistry' (REALD)

There are two versions of the REALD: a 99-word version and a 30-word version. The REALD-30 displays good reliability but only partial predictive validity (Lee et al., 2007) when compared with the REALD-99 (Dickson-Swift et al., 2014). Considered to be user-friendly and easier to administer in patient care settings, the REALD-30 measures oral health literacy by testing reading

ability through assessment of word recognition. The REALD-30 does not test understanding or comprehension of the words used.

Studies have shown that word recognition alone may not be a good indicator of oral health literacy (Khan, Ruby, Goldblatt, Schensul & Reisine, 2014; Baskaradoss, 2016). Additional limitations associated with the use of the REALD-30 have been identified. These include firstly, the possibility of inaccurately measuring oral health literacy due to the possibility of guessing words in this type of test (Sabbahi, Lawrence, Limeback & Rootman, 2009) and secondly, having been primarily used in low-income settings among young parents (Khan et al., 2014).

2.4.4.1.2 The 'Comprehensive Measure of Oral Health Knowledge' (CMOHK)

Developed as a conceptual oral health knowledge instrument for use in oral health literacy research and validated in a community setting, the CMOHK's use in a clinical environment still requires further analysis (Baskaradoss, 2016). The CMOHK is a 23-question survey related to four topic areas: basic knowledge of oral health, dental caries prevention and management, periodontal disease prevention and management and oral cancer prevention and management, each measured by a different survey instrument. Decision-making is central to all four components. Scores of 0-11 represent 'poor' conceptual oral health knowledge with 12-14 corresponding to 'fair' and 15-23 representing 'good' oral health conceptual knowledge. (Macek et al., 2010). While this instrument, appears to provide a more complete measure of oral health literacy than the REALD, it is deficient in one aspect: its inability to measure communication skills. This is considered essential in measuring oral health literacy (Baskaradoss, 2016).

2.4.4.1.3 The 'Test of Functional Health Literacy' in Dentistry (TOHFLiD) and the 'Oral Health Literacy Instrument' (OHLI)

The TOHFLiD, based on the TOHFLA, assesses comprehension and numeracy skills in the context of oral health/dentistry but only in paediatric patients (Sabbahi et al., 2009; Torwane et al, 2013). The comprehension assessment requires readers to fill in words that have systematically been deleted from sample texts used in clinical environments. The assumption is that competent readers will understand the context of the passage of text and be able to fill in blank spaces. The TOHFLA was also the model on which the OHLI was developed.

The OHLI also measures a patient's ability to perform oral health literacy related tasks in reading comprehension and numeracy skills. The OHLI is considered to be one of the first reading comprehension tests to be able to assess functional oral health literacy in adults (Sabbahi et al., 2009). As measurement instruments, the TOHFLiD and OHLI are deemed more suited for use in research-focussed environments, rather than fast paced clinical care settings, due to the length of time needed to administer the tests (Sabbahi et al., 2009; Khan et al., 2014). Sabbahi et al., 2009 concluded that additional work needs to be done to investigate the OHLI's predictive validity

and sensitivity to change using oral health outcomes in populations known to be at greater risk of low oral health literacy.

The following pages show firstly, a table showing a chronological overview of the 14 oral health literacy measurement instruments that were developed between 2007 and 2013 (Table 3). The second table (Table 4), shows which OHL measurement instruments were used in studies between 2007 and 2013. Of those, the most commonly used oral health literacy instrument (41%) in that time period was the REALD-30 or its derivative the HKREALD-30.

TABLE 3 Chronological overview of the oral health literacy tools

Abbreviation	Name of tool	Year	Authors	Type of tool
REALD-99	Rapid Estimate of Adult Literacy in Dentistry	2007	Richman et al.	99 item word recognition
REALD-30	Rapid Estimate of Adult Literacy in Dentistry -30	2007	Lee et al.	30 item word recognition common dental words
ToFHLiD	Test of Functional Health Literacy in Dentistry	2007	Gong et al.	Reading comprehension and numeracy 68 item reading comprehension and 12 item numeracy
OHLI	Oral Health Literacy Instrument	2009	Sabbahi et al.	Reading comprehension and numeracy
REALM-D	Rapid Estimate of Adult Literacy in Medicine and Dentistry	2010	Atchinson et al.	84 item word recognition
CMOHK	Comprehensive Measure of Oral Health Knowledge	2010	Macek et al.	44 questions conceptual knowledge
BHLOHKP	Baltimore Health Literacy and Oral Health Knowledge Project survey	2011	Macek et al.	44 item questionnaire conceptual knowledge across 4 domains
HKREALD-30	Hong Kong Rapid Estimate of Adult Literacy in Dentistry	2012 / 2013	Wong et al. / Bridges et al.	Adaptation of the REALD-99 translated to Chinese and shortened to the REALD-30
OHLA-S	Oral Health Literacy Assessment-Spanish	2012	Lee et al.	Developed using the REALD-30 word recognition and comprehension
OHLA-E	Oral Health Literacy Assessment-English	2012	Lee et al.	Developed using the REALD-30 word recognition and comprehension
REALMD-20	Rapid Estimate of Adult Literacy in Dentistry-20	2013	Gironda et al.	20 item word recognition
HKOHLAT-P	Hong Kong Oral Health Literacy Assessment Task for Paediatric Dentistry	2013 / 2013	Wong et al. / Bridges et al.	Mainly literacy and numeracy tasks
OHL-AQ	Oral Health Literacy Adults Questionnaire	2013	Sistani et al.	17 items in 4 sections, reading comprehension, numeracy, literacy and decision making
HeLD	Health Literacy in Dentistry	2013	Jones et al.	Modelled on the HeLMS (Health Literacy Management Scale)

Note Reprinted from "Measuring oral health literacy: A scoping review of existing tools" by V. Dickson-Swift, A. Kenny, J. Farmer, J., M. Gussy, & S. Larkins. 2014, BMC oral health, 14(1), p. 148. Copyright 2014 by Dickson-Swift et al.; licensee BioMed Central.

TABLE 4 Overview of studies using oral health literacy tools 2007-2013

Authors	Year	Title	Journal	Aim	Sample	n=	Setting	Tool used
Gong, D., Lee, J., Rozier, G., Pahel, B., Richman, J., Vann, W.	2007	Development and testing of the Test of Functional Health Literacy in Dentistry (ToFHLiD)	Journal of Public Health Dentistry	To evaluate the reliability and validity of the ToFHLiD	Parents of paediatric patients	102	Caregivers of paediatric dental patients seeking care in two dental clinics in North Carolina	ToFHLiD
Jones, M., Lee, J., Rozier, G.	2007	Oral health literacy among adult patients seeking dental care	Journal of the American Dental Association	To examine the association of knowledge, dental care visits and oral health status with oral health literacy in dental patients	Adult patients	101	Convenience sample of adult patients presenting for treatment at private dental practices in North Carolina	REALD-30 and short interview
Lee, J., Rozier, G., Lee, S., Bender, D., Ruiz, R.	2007	Development of a word recognition instrument to test health literacy in dentistry: The REALD-30- A brief communication	Journal of Public Health Dentistry	To develop and pilot test a dental word recognition instrument	Adult patients	200	Ambulatory Care Centre at the University of North Carolina Hospital	REALD-30 and interview that included the TOFHLA & REALM & OHIP-14
Richman, K., Lee, J., Rozier, G., Gong, D., Pahel, B., Vann, W.	2007	Evaluation of a word recognition instrument to test health literacy in dentistry: The REALD-99	American Association of Public Health Dentistry	To evaluate a dental health literacy word recognition instrument	Parents of paediatric patients	102	Parents and caregivers of paediatric dental patients from the UNC-CH School of Dentistry Paediatric Dental Clinics and from Orange County Dental Clinics	REALD-99
Jackson, R., Eckert, G.	2008	Health literacy in an adult dental research population: A pilot study	American Association of Public Health Dentistry	To gather data concerning the level of health literacy in adults who frequently volunteer for clinical research programs	Adults enrolled in the Oral Health Research Institute School of Dentistry	100	Oral Health Research Institute of Indiana University School of Dentistry	S-ToFHLA

Sabbahi.D., Lawrence, H., Limeback, H., Rootman, I.	2009	Development and evaluation of an oral health literacy instrument for adults	Community Dentistry and Oral Epidemiology	To develop and validate an instrument to measure functional oral health literacy of adults	Adult patients	100	Convenience sample of patients attending the Faculty of Dentistry clinics at the University of Toronto	Oral Health Knowledge test, OHLI, ToHFLA
Atchison, K., Gironda, M., Messadi, D., Der-Martirosian, C.	2010	Screening for oral health literacy in an urban dental clinic	Journal of Public Health Dentistry	To evaluate a health literacy instrument based on the REALM that incorporates dental and medical terms into one 84-item REALM-D measure and determine its association with patient characteristics of a culturally diverse dental clinic population	Adult patients	200	Oral health clinic urban centre Los Angeles, California	REALM-D
Macek, M., Haynes, D., Wells, W., Bauer-Leffler, S., Cotten, P., Parker, R.	2010	Measuring conceptual health knowledge in the context of oral health literacy: preliminary results	Journal of Public Health Dentistry	To assess the validity and reliability of a new instrument and describe conceptual oral health knowledge among a sample of low-income adults	Adult residents of Baltimore	100	Baltimore residents randomly selected from a list of those that had landlines	REALM and the S-ToFHLA to develop CMOHK
Parker, E., Jamieson, L.	2010	Associations between Indigenous Australian oral health literacy and self-reported oral health outcomes	BMC Oral Health	To determine oral health literacy (REALD-30) and oral health literacy-related outcome associations, and to calculate if oral health literacy-related outcomes are risk indicators for poor self-reported oral health among rural-dwelling Indigenous Australians	Indigenous adults	468	Convenience sample of Indigenous adults living in the Port Augusta region of Australia	REALD-30 and measures from OHL-14
Vann, W., Lee, J., Baker, D., Divaris, K.	2010	Oral health literacy among female caregivers: Impact on oral health outcomes in early childhood	Journal of Dental Research	To investigate the association of female caregivers' oral health literacy with their knowledge, behaviours and the reported oral health status of their young children	Child/ caregiver dyads from the Carolina Oral Health Literacy Project	1273	Caregivers and children enrolled in the Women's Infants and Children's (WIC)Supplemental Nutrition Program in North Carolina	REALD-30 and oral hygiene behaviours

Wells, P., Caplan, D., Strauss, R., Bell, D., George, M.	2010	An oral health survey of the Lumbee tribe in South-eastern North Carolina	The Journal of Dental Hygiene	To evaluate access to dental care issues, oral health knowledge and oral health-related quality of life of the Lumbee tribe	Adult Lumbee tribe members	118	Convenience sample of American Indian attending the Lumbee Tribe Homecoming in North Carolina	OHIP-14 and survey
Lee, Y., Divaris, K., Baker, A. Vann, W.	2011	The relationship of oral health literacy with oral health-related quality of life in a multi-racial sample of low-income female caregivers	Health and Quality of Life Outcomes	To investigate the association between oral health literacy (OHL) and Oral-Health Related Quality of Life (OHRQoL) and explore the racial differences therein among a low-income community-based group of female WIC participants.	Low income adult females enrolled in WIC program	1405	Community setting of adult women enrolled in the Women, Infants and Children's(WIC) Supplemental Nutrition Program in 7 counties in North Carolina.	OHIP-14, REALD-30
Lee, J., Divaris, K., Baker, A., Rozier. R., Lee, S., Vann, W.	2011	Oral health literacy levels among a low-income WIC population	Journal of Public Health Dentistry	To determine oral health literacy (OHL) levels and explore potential racial differences in a low-income population	Care givers of paediatric patients	1405	Community setting of adult women enrolled in the Women, Infants and Children's(WIC) Supplemental Nutrition Program in 7 counties in North Carolina.	REALD-30 and survey
Macek, M., Manski, M., Schneiderman, T., Meakin, S., Haynes, D., Wells, W., Bauer-Leffler, S., Cotton, A. Parker, R.	2011	Knowledge of oral health issues among low-income Baltimore adult: A pilot study	Journal of Dental Hygiene	Pilot study to document conceptual knowledge of oral health among low income adults in Baltimore	Low income adults in Baltimore	100	Baltimore residents randomly selected from a list of those that had landlines	BHLOHKP
Stucky, B., Lee, J., Lee, S., Rozier, R.,	2011	Development of the two-stage Rapid Estimate of Adult Literacy in Dentistry	Community Dentistry and Oral Epidemiology	To revise the 30 item Rapid Estimate of Adult Literacy in Dentistry (REALD-30) into a more efficient and easier-to-use two-stage model	Low income adults (primarily women) enrolled in the WIC program	1405	Low income adults (primarily women) enrolled in the North Carolina WIC supplemental nutrition program	REALD-30, TS-REALD

Author	Year	Title	Journal	Aim	Population	Sample	Setting	Instrument
Lee, J., Divaris, K., Baker, A., Rozier, R., Vann, W.	2012	The relationship of oral health literacy and self-efficacy with oral health status and dental neglect	American Journal of Public Health	To examine the association of oral health literacy (OHL) with oral health status (OHS) and dental neglect (DN) and whether self efficacy mediated or modified these associations	Female caregivers	1280	Community setting of adult women enrolled in the Women, Infants and Children's WIC Supplemental Nutrition Program (in 7 counties in North Carolina.	REALD-30
Lee, J., Stucky, B., Rozier, G., Lee, S., Zeldin, L.	2012	Oral health literacy assessment: development of an oral health literacy instrument for Spanish speakers	Journal of Public Health Dentistry	To develop an oral health literacy instrument for Spanish-speaking adults , evaluate its psychometric properties and determine its comparability to the English version	Adults fluent in English or Spanish at various sites in North Carolina	405	Sites that included WIC clinics in various regions of North Carolina, Early Head Start Centre and a continuity care clinic in North Carolina	OHLA, OHLA-S
Parker, E., Misan, G., Chong, A., Mills, A., Roberts-Thomson, K., Horowitz, A., Jamieson, L.	2012	An oral health literacy intervention for Indigenous adults living in a rural setting in Australia	BMC Public Health	To determine if implementation of a functional, context-specific oral health literacy intervention improves oral health literacy-related outcomes measured by use of dental services, and assessment of oral health knowledge, oral health self-care and oral health-related self-efficacy	Indigenous adults	400	RCT with randomisation	Adaptation of the HeLM
Wehmeyer, M., Corwin, C., Guthmiller, J., Lee, J.,	2012	The impact of oral health literacy on periodontal health status	American Association of Public Health Dentistry	To describe the oral health literacy (OHL) among periodontal patients and to examine its association with periodontal health status	Adult patients	121	Convenience sample of adult patients presenting for initial consultation appointment to the University of North Carolina Graduate Periodontology Clinic	REALD-30 and survey and periodontal exam

Author	Year	Title	Journal	Aim	Population	Sample Size	Setting	Instrument
Wong, H., Bridges, S., You. C., McGrath, C., Au, T., Parthasarathy, D.	2012	Development and validation of Hong Kong Rapid Estimate of Adult Literacy in Dentistry	Journal of Investigative and Clinical Dentistry	To develop and validate an instrument , the Hong Kong Rapid Estimate of Adult Literacy in Dentistry	Parents of paediatric dental patients	200	Convenience sample of parents of paediatric patients attending the Paediatric Dentistry Clinic in Hong Kong	REALD-99 translated to Chinese and modified to the HKREALD-30 and clinical examination
Bridges, S., Parthasarathy, D., Au, T., Wong, H., Yiu, C., McGrath, C.	2013	Development of functional oral health literacy assessment instruments: Application of literacy and cognitive theories	Journal of Public Health Dentistry	Development of a new literacy assessment instrument to establish content and face validity.	care givers of paediatric patients	Not specified	Various clinics and community settings in Hong Kong	HKOHLAT-P
Bridges, S., Parthasarathy, D., Wong, H., Yiu, C., Au, T., McGrath, C.	2013	The relationship between caregiver functional oral health literacy and child oral health status	Patient Education and Counselling	To describe the relationship between caregiver's oral health literacy (OHL) and the oral health status of their children in an Asian population	care givers of paediatric patients	301	Child/caregiver dyads from kindergarten in Hong Kong	HKREALD-30 and HKOHLAT-P
Gironda, Der-Martirosian, C., Messadi, D., Holtzman, J. Atchinson, K.	2013	A brief 20-item dental/medical health literacy screen (REALMD-20)	Journal of Public Health Dentistry	To introduce a brief 20 item screener for limited dental/medical health literacy among adult dental patients	Adult patients seeking treatment for the first time	200	Patients seeking treatment for the first time at an Oral Diagnosis Clinic at a School of Dentistry in the US.	REALMD-20
Hom, J., Lee, J., Divaris, K., Baker, A., Vann, W.	2013	Oral health literacy and knowledge among patients who are pregnant for the first time	The Journal of the American Dental Association	To determine the levels of and examine the associations of oral health literacy (OHL) and oral health knowledge in low income patients who were pregnant for the first time	Low income women pregnant for the first time	119	Subset of women pregnant for the first time in WIC project in North Carolina	REALD-30 and OHL survey

Jamieson, L., Divaris, K., Parker, E., Lee, J.	2013	Oral health literacy comparisons between Indigenous Australians and American Indians	Community Dental Health	To compare oral health literacy (OHL) levels between two profoundly disadvantaged groups, Indigenous Australians and American Indians and to explore the differences in socio-demographic, dental service utilisation, self-reported oral health indicators, and oral health-related quality of life correlates of OHL among the above.	Indigenous adults (Australia), American Indians (North Carolina)	468 (Aus) 254 (USA)	Convenience sample of Indigenous adults living in the Port Augusta region of Australia and a convenience sample of caregivers attending the WIC clinics at selected sites in North Carolina	REALD-30 and OHIP-14
Jones, K., Parker, E., Mills, H., Horowitz, A., Brennan, D., Jamieson, L.	2013	Development and psychometric validation of a Health Literacy in Dentistry scale (HeLD)	Community Dental Health	To develop and validate a culturally-appropriate Health Literacy in Dentistry (HeLD) instrument for use amongst Indigenous Australians	Indigenous adults	209	Convenience sample of Indigenous adults living in the Port Augusta region of Australia	HeLD
Sistani, M., Montazeri, A., Yazdani, R., Murtomaa, H.	2013	New oral health literacy instrument for public health: development and pilot testing	Journal of Investigative and Clinical Dentistry	To develop a functional oral health literacy (OHL) instrument for adults including new measures of literacy skills (OHL-AQ)	Adult citizens living in Tehran	97	Randomly selected households in Tehran	OHL-AQ
Sistani, M., Yazdani, R. Virtanen, J., Pakdaman,A., Murtomaa, H.	2013	Determinants of oral health: Does oral health literacy matter?	ISRN Dentistry	To evaluate oral health literacy, independent of other oral health determinants , as a risk indicator for self-reported oral health	Adults living in Tehran	1031	Random area sampling in Tehran	OHL-AQ
Sistani, M., Yazdani, R. Virtanen, J., Pakdaman,A., Murtomaa, H.	2013	Oral health literacy and information sources among dults in Tehran, Iran	Community Dental Health	To assess oral health literacy level and oral health information of Iranian adults in Tehran, and to determine the factors related to oral health literacy	Adults	1031	Multi-stage random sample from Tehran, Iran	OHL-AQ

Ueno, M. Takeuchi, S., Oshiro, A., Kawaguchi, Y.	2013	Relationship between oral health literacy and oral health behaviors and clinical status in Japanese adults	Journal of Dental Sciences	To investigate how oral health literacy relates to oral health behaviors, as well as clinical dental and periodontal conditions.	Adult residents of Akita in Japan	518	Adult residents aged older than 20 living in Akita, Japan	Self-administered questionnaire and dental exam
Wong, H., Bridges, S., Yiu, C., McGrath, C., Au, T., Parthasarathy, D.,	2013	Validation of the Hong Kong Literacy Assessment Task for Paediatric Dentistry (HKOHLAT-P)	International Journal of Paediatric Dentistry	To validate an original instrument. The Hong Kong Oral Health Literacy Assessment Task (HKOHLAT-P) for paediatric dentistry	Parent/ Child dyads	200 pairs	Convenience sample of 200 pairs of parents/children attending the Paediatric Dentistry Clinic in Hong Kong	HKOHLAT-P, ToFHLiD, ECO-HIS and interviews using HKREALD-30
Holtzman, J., Atchison, J., Gironda, M., Radbod, R., Gornbein, J.	2013	The association between oral health literacy and failed appointments in adults attending a university-based general dental clinic	Community Dentistry and Oral Epidemiology	To determine the association between personal characteristics, a person's oral health literacy and failing to show for dental appointments	Adults	200	Secondary analysis of 200 adult patients at a university dental clinic	REALM-D and socio-demographic s

Note Reprinted from "Measuring oral health literacy: A scoping review of existing tools" by V. Dickson-Swift, A. Kenny, J. Farmer, J., M. Gussy, & S. Larkins. 2014, BMC oral health, 14(1), p. 148. Copyright 2014 by Dickson-Swift et al.; licensee BioMed Central.

2.4.5 The social impact of oral health literacy

As with poor oral health, low oral health literacy (OHL) levels can have a significant impact on individuals and communities. Horowitz and Kleinman (2012) noted that low health literacy in society has repercussions as it "contributes to disease which results in increased costs for all of us" (p.S26).

Awareness around the potential impacts of poor health literacy have only recently become a focus in NZ. This is despite the 2010 NZ Ministry of Health report *Kōrero Mārama* describing that 56.2% of adult New Zealanders had poor health literacy skills. Across ethnic groups, Māori were shown to have poorer health literacy statistics across gender, age and location than non-Māori. Māori and non-Māori with a tertiary education, however, were more likely to have higher health literacy skills than those with lower levels of education. Relevant to this study, Māori aged 19 to 24 years old were amongst the age groups identified as having the poorest health literacy when compared to the rest of the population (Ministry of Health, 2010). It is known that differences in OHL between racial groups exist even when adjusting for education and sociodemographic characteristics (Lee et al., 2011). However, further OHL associations have also been made. These include a significant association between ethnicity, OHL, smoking and periodontal health status (Wehmeyer et al., 2014). The significance of these findings are particularly relevant in New Zealand where, in addition to the health literacy statistics, Māori experience worse oral health (Ministry of Health, 2010) and higher levels of tobacco use than other population groups (SmokeFree, n.d).

The resultant financial burden of low levels of health literacy on New Zealand's healthcare system is unknown. International statistics, though, show that the effect on healthcare systems can be significant. Horowitz and Kleinman (2008) estimate that the cost of low health literacy in the USA was reported to be in the range of US$106 billion to US$238 billion (7% to 17% of all personal health care expenditures) annually. The European Union estimates that low health literacy amongst its populations carries a cost burden of £77.5 billion (Torwane et al., 2013).

There is a dearth of information on levels of oral health literacy in NZ populations. The systematic methodology that was used for this study, described in section 2.1.1, did not identify any oral health literacy studies amongst NZ populations. A narrative search, however, uncovered a study undertaken by Veerasamy and Kirk (2013) in Christchurch NZ to assess the OHL of the parents of pre-schoolers. The key objective of the study was to measure the oral health knowledge and comprehension skills of their study sample (n=117). Of the participants, twenty-four were 30 years or younger. Participants completed a self-administered oral health literacy questionnaire. The outcomes of the study showed that the majority of participants had poor to moderate OHL with only 21% of participants being deemed to have good OHL.

2.4.6 Increasing OHL levels in individuals and communities – is it important?

The ultimate goal in health communication is to change the behaviour of the message 'recipient'. The 'sender' can only evaluate the outcomes or effectiveness of a health promotion message if feedback is provided by the 'receiver'. There are however multiple cogs that need to contribute to the ultimate aim of improved oral health in NZ populations. OHL is simply one cog that can impact on achieving this goal.

2.4.6.1 Oral health literacy, oral health and patient-clinician communication

The results of Guo et al.'s (2014) study (n= 1799, aged >25 years) showed that there is a direct relationship between health literacy and oral health status. This has since been corroborated in recent studies (Kanupuru et al., 2015; Blizniuk et al., 2015) using validated OHL and oral health clinical measures. A randomised population sample of Indian tertiary (excluding healthcare) students (n=700, aged 18 to 26), were examined in Kanupuru et al.'s (2015) study. Results indicated that socioeconomic status did not statistically impact the OHL outcomes.

Of greater interest, however, and relevant to this study was the indirect relationship established by Guo et al. (2014). This study established that higher OHL levels corresponded with better patient-clinician communication which eventuated in better patient self-rated oral health. This indirect relationship supported the findings of previous studies where it had been found that effective communication between patient and clinician had lessened dental anxiety in patients. This, in turn, increased the patient's perceptions of clinician competence which resulted in increased dental service utilisation (Logan & Marek, 2007). The indirect relationship is shown below in Figure 6.

FIGURE 6 An indirect effect of oral health literacy

Higher levels of OHL → Effective patient-clinician communication → Regular dental care seeker → Patient better self-rated oral health

Derived from Guo et al. (2014)

Self-rated oral health can be an indicator of OHRQoL. Evidence of a relationship between oral health literacy and OHRQoL was provided by Divaris, Lee, Baker and Vann (2012). The female adult participants completed an OHIP-14 and this was compared with the REALD-30 data. Results showed that the inverse association between OHL and OHRQoL across the entire sample was weak. Despite this, there was evidence to indicate that those participants with low OHL reported significantly more OHRQoL impacts. Findings further indicated that the association between OHL and OHRQoL may be modified by race or ethnicity.

2.4.6.2 Oral health literacy and accessing oral health care services

Three studies provided evidence of the direct impact of an individual's oral health literacy status on accessing oral health care. The first of these studies was undertaken by Holtzman, Atchison, Gironda, Radbod and Gornbein (2014). More recently studies were undertaken by Baskaradoss (2016) and Burgette, Lee, Baker and Vann (2016).

Holtzman et al. (2014) and Baskaradoss (2016) both investigated whether there was an association between missed dental appointments and oral heath literacy. Both studies derived data from an adult study population that attended university-based dental clinics. While Holtzman et al. (2014) undertook secondary data analysis of data collected in 200 adults from January 2005 until December 2006, Baskaradoss (2016) derived data from a convenience, non-probability sample of 150 patients (50 case patients and 100 control patients). Both studies agreed that failing to attend dental appointments was multi-factorial.

Both studies concluded that patients with lower oral health literacy were more likely to miss dental appointments. Holtzman et al. (2014) further added that they specifically found that individuals who used fewer sources of oral health information were more likely to fail to attend dental appointments. Baskaradoss (2016) confirmed this noting that "it may be assumed that improved oral health literacy improves the patient's understanding of the risks of deferring care and the benefits of seeking timely dental care" (p.4). This, however, was contradictory to the findings of Burgette et al. (2016) who found that there was no association between dental utilisation and OHL.

2.4.6.3 Oral health literacy and the oral health of future generations

Until recently, oral health literacy had not been a focus for the NZ Ministry of Health. Whilst not directly relevant to this study, international studies focussed on pregnant women and caregivers provide insight into the broader potential impact of OHL on the oral health of future generations.

To prevent oral disease in infants and early childhood, oral health knowledge in pregnant women should be considered 'vital' (Vilella, Alves, de Souza, Fraiz & Assuncao, 2016). This is because the oral health knowledge has been shown to be significantly associated with OHL levels (Hom, Lee, Divaris, Baker & Vann, 2012; Vilella et al., 2016). Although similar associations have been recorded between the OHL of caregivers and the oral health of the children in their care (Vann Lee, Baker & Divaris, 2010; Bridges et al., 2014), Vann et al's. (2010) study results indicate that while higher caregiver OHL was associated with better reported oral health status of the children in their care, this was independent of caregiver knowledge and other covariates including age, race, education and number of children. They suggested that that an approach be developed that aimed educational messages at the oral health literacy level of the caregiver in order to improve oral health outcomes for children.

The OHL and dental anxiety of parents and caregivers can potentially impact the oral health status and oral health related quality of life in their dependent children. Whilst Divaris et al. (2012) concluded that caregiver OHL was weakly associated with their child's oral health-related quality of life, Shin, Braun and Inglehart (2014) showed that there was a relationship between dental anxiety and OHL status. They did note, however, that these were two of many possible factors that could impact oral health.

2.4.7 Section four conclusion

Oral health promotion and disease prevention messages are vital keys to improving oral health and managing disease risk. Poor oral health literacy can be a barrier in achieving these aims in individuals and communities. This is because if the message is not well comprehended by the recipient, they will not strive to change their health behaviours. Oral health literacy should therefore be recognised as an important determinant of oral health (Naghibi Sistani et al., 2013) and improving health literacy should be a critical goal in improving health outcomes (Kanupuru et al., 2015). Section four has provided an overview of health literacy and its related competencies. Current measures of oral health literacy have been presented along with their limitations. The importance of oral health literacy in relation to achieving oral health was discussed. This included a short review of the potential impact of poor OHL on future generations. To conclude, a flowchart showing the direct and indirect relationships that have been established in this literature review is shown below in Figure 7. These key relationships are the focus of this study.

FIGURE 7 Flowchart of direct and indirect relationships, found in the literature, of relevance to this study

EFFECTIVE COMMUNICATION

Increased dental knowledge

Reduced patient anxiety

Increased oral health literacy

Increased perceptions of clinician competence

Increased dental service utilisation

Improved oral health & better self-rated oral health

Improved OHRQoL

2.5 THE PARADIGMS OF RESEARCH

2.5.1 Section five introduction

The term 'paradigm' has been given at least four meanings in the literature. These meanings include 'a world view', an 'epistemological stance', 'shared beliefs' amongst a community of researchers and a 'model' (Feilzer, 2010; Hall, 2012). When undertaking research, a researcher will adopt a stance within this 'world view' on each of the elements of contrast namely axiology (nature of ethical behaviour), ontology (nature of reality), epistemology (nature of knowledge; relation between knower and would-be-known), and methodology (approach to systemic inquiry).

The four most commonly agreed paradigms are positivism and its successor postpositivism, constructivism, transformative and pragmatism. Positivism and its successor postpositivism are the basic beliefs associated with quantitative research and constructivism with qualitative research.

2.5.2 The positivist paradigm behind quantitative research

Quantitative researchers adopt a positivist or postpositivist 'world view'. This perspective values research as a way of using precise, objective measurement to predict, and subsequently control; a stable 'real' world that is independent of our error-prone perceptions of it. Put simply, this paradigm values a single reality with a 'one and only' truth that is out there waiting to be discovered by objective and value-free inquiry. Quantitative purists believe that social observations should be treated as entities that are subject to observation, and that the observer is separate from these entities (Johnson & Onwuegbuzie, 2004; Feilzer, 2010; Yardley & Bishop, 2015).

2.5.3 The constructivist paradigm behind qualitative research

The positivist paradigm contrasts with the constructivist view of qualitative researchers. Qualitative researchers believe that a single, objective reality does not exist and that all inquiry is subjective. Research is viewed as a way of generating multi-faceted, novel and rich understandings of our environments. Constructivists argue that the world consists of multiple-constructed realities and that generalisations, whether related to time or context, are undesirable or impossible. They further argue that research is value-bound and that causes and effects cannot be fully differentiated; that logic flows from specific to general and that the subjective 'knower' is the only source of reality (Johnson & Onwuegbuzie, 2004; Feilzer, 2010; Hall, 2012; Yardley & Bishop, 2015).

2.5.4 Research methodologies used in mHealth and oral health literacy studies

Quantitative methods encompassing a positivist view is the predominant method utilised to meet the research objectives in health science research. Qualitative feedback, however, allows for information to be gleaned from study participants where research is being undertaken in new or novel areas. Markowitz et al. (2014) acknowledged, in their study conclusion, that there was a need for qualitative feedback by adolescents and young adults on the acceptability of the mHealth intervention used, further stating that feedback would allow for better tailoring of future interventions.

THE GAPS IN THE KNOWLEDGE

On reviewing the literature, the 'gaps in the knowledge', particularly in the NZ context, became increasingly apparent. There is currently a dearth of published research on firstly, mHealth interventions used to promote oral health in NZ and secondly, the oral health literacy levels of NZ populations.

The study by Schluter et al., (2015) is the only published study in NZ using mHealth as an intervention tool in oral health. This study excluded tertiary students and text messaging (SMS) was the only mode of intervention employed. Participants did not undergo a clinical examination to quantitatively determine improvements or decline in the oral health status or oral hygiene self-efficacy of participants. Whilst NZ studies on mHealth interventions using MMS were found and reviewed, none of these studies were in relation to oral health interventions. Veerasamy and Kirk (2013) is the only identified study of oral health literacy in NZ that provided some data in relation to younger adults.

AIMS AND OBJECTIVES

There were two aims in this study, amongst a small group of tertiary students aged 18 to 24 years in Auckland, NZ:

Study Aim One:

Determine if a mHealth intervention using 'smart' mobile phones

a. could improve their oral health, through improved oral hygiene efficacy, by complementing traditional oral health promotion
b. was considered, by this cohort, to be an acceptable way of communicating oral health promotion messages
c. could improve their oral health literacy

Study Aim Two:

Determine which factors optimised the success of the mHealth intervention

RESEARCH QUESTIONS

Drawing on the study hypothesis and the identified aims of this study, the following research questions were developed:

1. **Can a mHealth intervention, using various smart mobile phone functions, improve oral health and oral health literacy when used as an adjunct to traditional oral health promotion?**
2. **Are smart mobile phones considered an acceptable platform to communicate oral health promotion and which function is preferred?**
3. **What factors optimise and best support a mHealth intervention?**

Chapter Three

METHOD AND METHODOLOGY

3.1 INTRODUCTION

This chapter will begin by describing and justifying the method and methodologies that were chosen to address this study's research aims and answer the research questions. This is followed by descriptions of consultations, ethical approvals, project funding and permissions that were obtained for this study. Thereafter a detailed description of the data collection for this project, including sampling, participant selection and recruitment of participants, is provided. In addition to this, there is a description of the oral health promotion methodologies and the mHealth interventions that were used. The chapter concludes with a description of how the data was analysed and a short account of the interface between the derived quantitative and qualitative data in this study.

3.2 STUDY DESIGN

This study aimed to determine if monthly mHealth OHE messaging (using various smart mobile phone functions) could improve oral health and OHL in a small group of young adults (18 to 24 years old) when used as an adjunct to OHE and OHI provision in a clinical setting. Consideration was also given as to whether communicating health promotion educative messages in this way would be acceptable to this cohort and if there were particular factors that could optimise the outcomes.

Based on the review of the literature and the identified 'gaps in the knowledge', three research questions were posed in chapter two of this thesis. As discussed in section 2.5, adopting a purely positivist view and utilising quantitative methodologies allows a researcher to derive objective and precise measures to address a study's aim/s. This approach, however, cannot provide subjective insights into the lived experiences and insights of study participants. This is best approached with a constructivist paradigmatic view and data derived using qualitative methodologies. These differing views or paradigms and methodological approaches, have led to quantitative and qualitative purists arguing that quantitative and qualitative research paradigms (and their associated methods) are incompatible (Hall, 2012) and cannot or should not be mixed (Johnson & Onwuegbuzie, 2004).

mHealth in oral health is an under-researched area with little qualitative data on the acceptability of mobile phones as an intervention tool to provide oral health promotion messages. This study sought to gain a small group of young adult's insights on 'acceptability' by using a qualitative measure. However, this was not the only objective of this study. Measuring changes in oral health and OHL were identified as important parameters in determining the efficacy of mHealth interventions using various smart mobile phone functions. These oral health and OHL measures could only be derived quantitatively. To best address this, a mixed methods study design, defined

by Johnson and Onwuegbuzie (2004) as "the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study", was chosen. The quantitative and qualitative data was collected independently but was interfaced at the interpretation stage (a convergent parallel design).

3.2.1 Overview of the quantitative methodology

Quantitative data was gathered using measures of oral health and OHL.

Oral health measures

- The 'Plaque Control Record' plaque index was used to measure the coverage of plaque-biofilm on teeth. Data was collected at visits one and two. The data was used to measure changes in the mechanical oral hygiene self-efficacy of each participant over three months. Data was explored, analysed and presented descriptively.
- OHRQoL was measured using an oral health questionnaire and the fourteen question 'Oral Health Impact Profile' (OHIP-14). Data was collected at visits one and three. Data was explored, analysed and presented statistically.

Oral health literacy measure
- Participant oral health literacy was measured using the 30 word 'Rapid Estimate in Adult Literacy in Dentistry' (REALD-30). For the purposes of this study, the REALD-30 was modified to assess word recognition and comprehension. Data was collected at visits one and three. Data was explored, analysed and presented descriptively.

3.2.2 Overview of the qualitative methodology

Qualitative data was gathered using a semi-structured interview with all participants at visit three. A question framework was developed that focussed on answering the research questions, posed in chapter two, without directly asking those questions. The goal of the broad, non-leading and open-ended interview questions, developed by the principal investigator, was to differentiate between participant experiences in the Control group from those in the intervention groups (Phone, Text and Video). As the principal investigator was still blinded, at visit three, as to the identity of the participants in each sample group, some latitude and flexibility in approach was needed when developing and subsequently using the pre-set interview questions. The semi-structured format fulfilled this brief as it struck a balance between structure, sufficient flexibility and openness (Gillham, 2005).

The qualitative data in this study was analysed using an inductive thematic analysis with a semantic approach. Considered to be a comprehensive (although time-consuming) approach to qualitative analysis (Burnard et al., 2008), thematic analysis is a way of gaining a deeper understanding from initial observations: a "description and interpretation of participant's perspectives" (Vaismoradi, Jones, Turunen and Snelgrove, 2015, p. 101). This was important as

the insights provided by the participants in this study were key to understanding their experiences of mHealth and the realities and meanings that they attached to life contexts.

An inductive approach was chosen as it tends to yield richer, more descriptive data across the entire data set as the data is analysed without using pre-existing coding frame, theory or frameworks (Braun & Clarke, 2006). In an inductive process, identified themes are organically derived and are therefore strongly linked to the interview data (Braun & Clarke, 2006; Burnard, Gill, Stewart, Treasure & Chadwick, 2008). For this reason, an inductive approach is considered to be particularly useful in under-researched areas (Braun & Clarke, 2006; Smith, Bekker & Cheater, 2011) and therefore applicable to this study. For the purposes of this study, themes were identified at a semantic or surface level. This meant that themes were derived purely from what a participant had said in their interview without seeking any deeper meaning or attaching any further assumptions to those meanings (Braun & Clarke, 2006).

Table 5, which follows, shows the qualitative and quantitative measures that were used in this study and how they related to the study aims. Quantitative and qualitative data collection will be respectively discussed, in depth, in sections 3.8.4 and 3.8.7. Data analysis will be discussed in section 3.9.

TABLE 5 Measures used in this mixed methods study in relation to the study aims

Study Aim One	Measure Used
A. Determine if a mHealth intervention could improve their oral health by complementing traditional oral health promotion	Quantitative: *OHIP-14; Plaque Control Record* Qualitative: *Interview*
B. Determine if a mHealth intervention was considered, by this cohort, to be an acceptable way of communicating oral health promotion messages	Qualitative: *Interview*
C. Determine if a mHealth intervention could improve their OHL	Quantitative: *REALD-30*

Study Aim Two	Measure used
Determine which factors optimised the success of the mHealth intervention	Qualitative: *Interview*

3.3 CONSULTATION WITH MAORI

The research proposal was presented to the AUT University Faculty of Health and Environmental Sciences (FHES) Māori Research Facilitation Committee in May 2015. This committee is mandated to foster research engagement between the FHES researchers and Māori (the indigenous population of New Zealand) communities or groups as well as to encourage research practice that is responsive to issues important to Māori health and Māori development and advancement. The committee endorsed the proposal and acknowledged the relevance and benefit of the study to Māori youth and provided five recommendations (see Appendix A) as follows:

1. That the research be targeted to those youth most likely to be affected by oral health disease.

2. That a check be undertaken that the standardised OHIP-14 questionnaire used in the study would measure success in Māori.
3. That AUT expertise in the development of digital resources and Te reo Māori, in the Faculties of Te Ara Poutama and Design and Creative Technologies be considered.
4. That Māori and Pacific youth be involved in the development of key messages and catch phrases.
5. That a health literacy advisor be consulted.

Where possible, the recommendations were considered within the context of the study methodology, however, some recommendations were not feasible for the following reasons:

- Recommendation one could fundamentally change the focus of the study and this in turn would require an alteration to the submissions provided to the Ethics Committees.
- Due to the time constraints of the study, it was not possible to undertake recommendations three and five.

3.4 ETHICAL APPROVALS

Ethical approval was obtained from both the national Health and Disability Ethics Committees (HDECS) and the AUT Ethics Committee (AUTEC). Application to HDECS was made in May 2015, with the study being granted an expedited pathway. Locality approval to use the AUT Oral Health clinic at the North Shore campus was granted by Dr Peter Larmer, head of the School of Clinical Sciences at AUT University. HDECS approval was granted subject to fulfilling eight non-standard conditions. The non-standard conditions were addressed by the principal investigator and a final approval from HDECS was granted (Appendix B). An ethical approval for this study, valid for three years, was granted by AUTEC in June 2015 (Appendix C).

3.5 FUNDING

The AUT University FHES postgraduate office provided funding of NZ$750 towards the costs of undertaking this research. This is standard practice for all students undertaking research towards a Master of Philosophy degree.

Colgate Oral Care funded a one year secondment, for the AUT Department of Oral Health, which allowed the principal investigator to undertake this study.

3.6 PERMISSIONS

3.6.1 Oral health literacy instrument (REALD-30)

Permission to use the 30- item 'Rapid Estimate of Adult Literacy in Dentistry' (REALD-30) oral health literacy instrument was sought from Dr Jessica Y. Lee of the University of North Carolina.

Dr Lee's consent was provided in March 2015 (Appendix D) together with a copy of REALD-30 scoring sheet (Appendix K).

3.6.2 Reproduction of copyright images

Permission to reproduce copyright images (Figure 10 and Figure 11) was sought from Wolters Kluwer publisher's 'Copyright Clearance Centre'. Written permission was granted on 1 March 2017 (Appendix E).

3.7 CLINICAL CALIBRATION

Prior to the start of data collection, the principal investigator undertook two rounds of self-calibration. The calibration was based on two full periodontal assessments undertaken on two BHSc in Oral Health students who volunteered for the calibration exercise. After obtaining a verbal consent from each volunteer and ascertaining that their health history did not preclude them from undergoing the procedure, two rounds of measures were undertaken, alternatively, on each student over two clinical sessions. These rounds of measures were recorded, using Williams (Hu-Friedy) manual periodontal probes. The principal investigator was blinded to all recorded measurements until the second and final rounds of measures were complete. The final round of calibration had a margin of error of 2.5% (Appendix P).

3.8 DATA COLLECTION

3.8.1 Sample size

Previous studies, that had used similar measures to the current study, provided information in regards to quantitative sample sizes that were used in those studies. One of these studies was undertaken by Wehmeyer et al. (2014) who had noted that "previous studies using the REALD-30 established the minimum sample size of 102 to detect enough power at a=0.05" (p.82). Similar calculations by Jadhav et al. (2016), whose study's quantitative data included the use of a plaque-biofilm index, determined that their minimum sample size was 200 per sample group. Similar sample sizes were not feasible for the current study as the design utilised mixed methods and was predominantly qualitative in nature. An adequate qualitative sample size was therefore determined, as described below.

In health science qualitative research, 'saturation' has become the gold standard by which sample sizes are determined (Guest, Bunce & Johnson, 2006). 'Saturation' is the point at which "the data set is complete, as indicated by data replication or redundancy" (Bowen, 2008, p.140). In the current study, it was identified that the sample size could not purely be determined on reaching saturation as the study design framework required that the qualitative data only be collected at visit three (end of the study). It therefore became necessary to determine a minimum qualitative sample size early in the study.

Previous studies had identified that there was often a need to numerically determine a sample size (that was likely to achieve saturation) prior to the start of a study (cited in Guest et al., 2006). In such cases, Kuzel (1992) had recommended six to eight interviews for a homogenous sample and twelve to twenty data sources in cases where researchers were trying to achieve maximum variation. Guest et al. (2006) supported this when they concluded that "for most research enterprises in which the aim is to understand common perceptions and experiences among a group of relatively homogenous interviews, twelve interviews should suffice" (p. 79). They did however caution that their results may not be generalisable and that larger samples would be needed to assess variation between distinct groups.

Cognisant of this information, three factors consequently influenced the final sample size of sixteen individuals for this study:

1. The principal investigator identified that the targeted demographic sample for this study would have a relative homogeneity and similar life context.
2. Pre-set semi-structured interview questions were used to derive the qualitative data and therefore all participants would be asked similar or the same questions.
3. The quantitative and qualitative findings would act in support of each other.

3.8.2 Recruitment of participants

Convenience sampling was used in this study. The following inclusion and exclusion criteria were applicable to participation in the study:

Inclusion criteria:
- Aged 18 to 24 years old (inclusive)
- Resident in the greater Auckland area
- Currently enrolled in tertiary education course in Auckland
- Must own and be a regular user of a 'smart' mobile phone
- Must be able to give legal, valid consent
- Fluent in English

Exclusion criteria:

1. Inability to give legal, valid consent
2. An oral health professional, a student in the area of oral health/dentistry or associated with the oral health industry or a close relative of an oral health professional
3. Unable to communicate fluently in English
4. Diagnosed blindness and/or deafness
5. Diagnosed dyslexia
6. Any participant who has a diagnosis of, or found to have, clinical signs consistent with periodontitis and/or acute necrotising ulcerative gingivitis (ANUG) or acute necrotising ulcerative periodontitis (ANUP)

7. Any participant who suffers from a chronic condition that may impact the health of the oral cavity or who is taking immunosuppressant therapy or long-term antibiotics
8. Any participant with a diagnosed heart murmur
9. Any participant who is at risk of endocarditis or who requires prophylactic antibiotics prior to dental treatment.
10. Edentulous

Participants were recruited by the principal investigator using the following methods:

- 'Word of mouth'
- Tertiary institution intranet, with the help and permission of staff members of that institution
- Hard copy advertising on student notice boards
- Student unions
- Social media

Individuals who were interested in participating in this study were asked to contact (via email or text message) an AUT university administrator who had agreed to be the initial point of contact for this study. The administrator collated the names and email addresses of these individuals and this information was provided to the principal investigator for further follow-up.

The principal investigator provided each potential participant with an introductory email (Appendix F) which explained her background and an overview of the study. In addition, a participant information sheet (PIS) was provided (Appendix G). Potential participants were invited to ask questions or to confirm any detail of the study design or methodology of which they were unsure. Potential participants were asked to confirm their interest in participating in the study by contacting the principal investigator either by telephone or email.

Those who confirmed their interest were invited by the principal investigator to attend an initial appointment (visit one). At visit one, the principal investigator met each potential participant personally and discussed further detailed information about the study requirements as follows:

- The inclusion and exclusion criteria were disclosed to determine eligibility to participate in the study.
- Each potential participant was advised of the voluntary nature of the project.
- Potential participants were informed that data would be collected by the principal investigator at three visits, scheduled bi-monthly, over six months.
- Potential participants were advised that they would be contacted via email to arrange each visit to the AUT oral health clinic.
- Potential participants were asked not to attend routine clinical care appointments with their dentist or dental hygienist during their six month participation in the study.

The research team felt that the participant's oral health would not be adversely impacted by the last requirement as the timing of the study fell within the patient 'recall' parameters of most dental practices. Participants were advised that they should, however, seek dental care in the case of a dental emergency. Individuals who fulfilled the inclusion criteria and who wished to participate in the study were consented by the principal investigator. Each participant indicated their willingness to participate in the study by signing the participant consent form (Appendix H).

At visit one, a full mouth periodontal assessment was undertaken on each participant to ascertain that they did not have clinical signs consistent with periodontitis. Gingival sulci measurements in excess of five millimetres which would have excluded them from participating in this study. Measurements were recorded on a dedicated paper periodontal assessment chart that is currently used in the AUT oral health clinic. Gingival sulci depths were measured using a 'Hu-Friedy' manufactured (Chicago, IL, USA) 'Williams' periodontal probe. This probe had calibrated markings in millimetres. Six measured sites were recorded around each tooth, three from the facial/buccal and three from the lingual or palatal, incorporating mesial and distal measures. Sulcular depths were measured from the gingival margin to the attached sulcular periodontal tissue. If the gingival margin was between two probe calibration markings, the higher mark was used for the final reading.

3.8.3 Randomisation of sample groups

Following visit one, participants were randomly divided into four sample groups by the primary study supervisor. Randomisation was undertaken to prevent selection bias to ensure that each participant had an equal chance of allocation to each of the four sample groups, 'control', 'phone', 'text' and 'video' (Table 6). Due to the small sample size and the need to achieve balance among groups as recruitment progressed, a simple, stratified randomisation method was utilised. Furthermore, the principal investigator was blinded as to the identity of the participants in each group and only provided with the mobile telephone numbers of the participants in each sample group. This occurred after four or more participants had attended visit one. This ensured an even distribution of participants across the 'control', 'phone', 'text' and 'video' groups and maintained blinding.

TABLE 6 Randomised study sample groups

Control	Phone	Text	Video
TH04	TH02	TH03	TH01
TH05	TH06	TH08	TH07
TH11	TH12	TH10	TH09
TH16	TH14	TH13	TH15

3.8.4 Quantitative data collection

Data was collected at baseline and then bimonthly over six months as shown in Table 7 on the following page. Data collection was undertaken in the 'AUT University oral health clinic' and in an 'Akoranga Integrated Health (AIH) clinic' teaching room, both located at the AUT North Shore campus. Quantitative data for each participant was recorded, at each visit, on paper records.

Electronic back up of paper records

After each participant visit all paper records from that visit were scanned to create electronic copies. These scanned records were sent to the principal investigator's email address. Once accessed, these electronic records were copied to a universal serial bus (USB) device. Back-up electronic copies of the data were emailed to the study supervisor and subsequently permanently deleted from the principal investigator's email stream. All paper and electronic records were securely stored in a locked filing cabinet in the principal investigator's office.

Data entry

Electronic 'Microsoft Excel' spreadsheets were created to electronically record the quantitative data. All scores were entered manually after each visit, into the allocated spreadsheet, by the principal investigator. Data entry of scores was checked for accuracy by a colleague. The 'Excel' spreadsheets were stored electronically on a USB device which was stored securely in a locked cabinet, accessed only by the principal investigator.

TABLE 7 An overview of the data collection schedule, provision of clinic-based OHI/OHE and mHealth interventional messages

	Baseline AUT OH Clinic	one month	two months	three months AUT OH Clinic	four months	five months	six months AUT OH Clinic
Control	OHIP-14 REALD-30 Plaque Control Record OHI and OHE			Plaque Control Record OHI			OHIP-14 REALD-30 Interview
Phone	OHIP-14 REALD-30 Plaque Control Record OHI and OHE	mHealth message	mHealth message	Plaque Control Record OHI mHealth message	mHealth message	mHealth message	OHIP-14 REALD-30 Interview
Text	OHIP-14 REALD-30 Plaque Control Record OHI and OHE	mHealth message	mHealth message	Plaque Control Record OHI mHealth message	mHealth message	mHealth message	OHIP-14 REALD-30 Interview
Video	OHIP-14 REALD-30 Plaque Control Record OHI and OHE	mHealth message	mHealth message	Plaque Control Record OHI mHealth message	mHealth message	mHealth message	OHIP-14 REALD-30 Interview

3.8.4.1 Data collection and data scoring for the quantitative measures

3.8.4.1.1 Oral health questionnaire and OHIP-14

The OHIP-14, a valid and reliable measure of OHRQoL (Locker & Allen, 2007), is intended to be a measure of self-perceived oral health and the extent to which oral health problems (associated with teeth, mouth or dentures) affect overall quality of life (Slade & Spencer, 1994; Locker, 2004; Lee et al., 2007).

Data collection

At visits one and three each participant completed a paper copy of a seven question oral health questionnaire and OHIP-14 (Appendix I). Each participant was asked to answer all the questions by circling the answer that was most applicable to them in pen.

Data scoring

The oral health questionnaire and OHIP-14 data were scored, by the principal investigator, according to the set protocol which allocates a numerical value to an answer. The oral health questionnaire uses a scoring scale of one to five. The OHIP-14 uses a scale of zero to four.

3.8.4.1.2 Plaque Control Record

Plaque-biofilm indices provide a measure of an individual's tooth cleaning efficacy rather than a direct measure of an individual's oral health or level of disease (Hugoson et al., 2007; Serio, 2008). Measured changes in plaque-biofilm coverage on teeth are therefore useful in determining improvement or decline in an individual's oral hygiene homecare routines and practises.

Data collection

This study used the 'Plaque Control Record' plaque-biofilm index (O'Leary, Drake & Naylor, 1972) and measures were recorded for each participant at visits one and two. Prior to recording, teeth were 'dyed' using a two-tone disclosing solution called '*2Tone*' (Young, Earth City, MO, USA)*.* The two-tone solution was dispensed into a dappen dish. A small dental cotton ball was soaked in the solution. Holding the soaked cotton ball with a dental tweezer, the principal investigator applied the solution to all surfaces of each participant's teeth. All teeth were then rinsed with water using the triplex syringe. Excess solution and water was suctioned from the participant's mouth.

The two-tone disclosing solution stains newer plaque-biofilm a red colour while older plaque-biofilm is stained blue. The presence or absence of older and newer plaque-biofilm was recorded for the mesial, distal, facial or buccal and palatal or lingual surfaces of each fully-erupted tooth present in the participant's mouth. This data was recorded, in pen, on a paper 'plaque control record' form.

Data scoring

To gain a measure for each participant's dentition, the total number of tooth surfaces where plaque-biofilm was present were summed. This number (maximum obtainable was 128) was then calculated as a percentage of the total number of tooth surfaces in their mouth (Figure 8).

FIGURE 8 Calculation of the plaque control record score

___counted plaqued **surfaces** ÷ ____TOTAL tooth surfaces (___ teeth x 4] x 100 = % ____ Index

3.8.4.1.3 REALD-30

Health literacy was defined in section 2.4.2 as "the possession of literacy skills (reading and writing) and the ability to perform knowledge-based literacy tasks (understanding and using information) that are required to make health related decisions in a variety of different environments (home, community, health clinic)" (Nutbeam, 2015, p. 17). These skills and competencies are extended to oral health literacy.

The REALD-30 (using a modified protocol) was used to measure oral health literacy for all participants at visit one (prior to the OHE presentation) and visit three. Vann et al. (2010) cited that "oral health literacy estimates derived from word recognition tests such as REALD-30 have been previously shown to correlate well with comprehension and functional health literacy" (p.1399). However, when modifying the REALD-30 to test for word recognition and comprehension, the results of Khan et al.'s, (2014) study showed that word recognition was weakly correlated with comprehension. To address these differing outcomes and to simplify the presentation of the REALD-30 words for this study, two modifications were made to the original instrument protocol. These modifications were:

1. Word comprehension was tested using a methodology that departed from that described by Khan et al. (2014). Their methodology relied on using a definition checklist that was developed from Google searches, dictionaries and other online resources. Participants undertook the REALD-30 test with trained interviewers who, individually, decided whether the participant understood the meaning of the word based on the definition checklist.
2. The prescribed REALD-30 words were presented, to each participant, using a "PowerPoint" presentation instead of manually presented 'word cards' (Appendix J). The thirty words were presented on thirty individual slides using an electronic tablet. The PowerPoint presentation was set to advance each slide at seven second intervals. This

interval was pre-tested on non-participants to ensure that this was a suitable timing interval.

Before each test, the principal investigator explained how the test was to be undertaken. Participants were told of the time restriction and that the presentation would not be stopped once started. The following standardised explanation was provided to each participant:

- Read each presented word aloud, if able
- After reading the word, provide a short explanation of the meaning of that word, if able
- For unknown words or where the meaning of the word is unknown, say "I don't know"
- Do not guess any words of which you are unsure

Data collection

Each participant was tested individually and their answers were recorded by the principal investigator, in pen, on the REALD-30 paper score sheet. The principal investigator recorded participant responses to word 'recognition' as either a score of 'one' (for correct words) or 'zero' (for incorrect words). Participant definitions for each REALD-30 word were written down, verbatim, by the principal investigator, on the REALD-30 score sheet. These definitions were used to assess word 'comprehension'.

Data scoring

Scoring of word 'recognition'

A measure of what constitutes low and high OHL levels when using the REALD-30 varies between studies (Jones et al., 2007; Divaris, Lee, Baker & Vann, 2012). Wehmeyer et al's (2014) study used the REALD-30 to investigate the impact of OHL on periodontal health status. The principal investigator selected to score OHL using Wehmeyer et al.'s (2014) methodology as follows:

- Low OHL: Score of 21 or less
- Moderate OHL: Score of 22-25
- High OHL: Score of 26 or greater

The total score for each participant was recorded on the paper record at the conclusion of each testing session. The REALD-30 paper records were electronically transcribed, by the principal investigator, into a 'Microsoft Word' document, created for this purpose, at the conclusion of each participant appointment.

Scoring of word 'comprehension'

Scoring of word 'comprehension' was undertaken by three assessors (the principal investigator and two senior academics in the AUT University Department of Oral Health) independently of each other. Prior to assessor scoring, the principal investigator developed a list of REALD-30 word definitions, for use in this study, (Appendix L) from three credible online resources:

- http// oxforddictionaries.com
- http//medicinenet.com and
- http//medical-dictionary.thefreedictionary.com

At the end of visit three, each assessor was provided with three identical 'sets' of the participant 'comprehension' responses, recorded at visits one and three. In addition, each assessor received a copy of the principal investigator's REALD-30 word definitions list.

To ensure intra-observer reliability, scoring of each 'set' of data was undertaken by each assessor, independently of each other, on alternate days over six days (three data scoring sessions). At each scoring session, the assessor compared the participant definition for each word with the developed 'definitions list' definition for that word. Scores were then allocated using the following protocol:

0 = no comprehension or no explanation provided

1 = evidence of some comprehension and understanding

2 = evidence of comprehension and understanding

After the three independent scoring sessions, all scores were returned to the principal investigator to derive a final score for each participant for visits one and three. To start the process, the principal investigator calculated a single score from each of the assessor's three data scoring sessions. This was done by allocating a majority score for visit one and then again for visit three. Where assessors had scored each 'set' differently for a word e.g. a 'zero' at the first scoring session, a 'two' at the next and a 'one' at the last session, a score of 'one' was allocated to the word as it was midway between scores.

Thereafter, the principal investigator calculated a final word 'comprehension' score for each participant (for visits one and three). This was done by further consolidating the assessors' derived single scores into a final score. A majority score methodology was used again, in other words where the same score had been allocated twice, this 'majority score' was allocated as the final score for the participant.

Unfortunately, in four percent of the final score calculations undertaken for visit one there was no majority score. This also occurred in five percent for visit three. In these cases, the scoring team reconsidered the scores they had allocated during the initial independent scoring sessions. The team decided that where a majority score could not be calculated, that a score of 'one' would be allocated (Appendix Q). A diagram showing how the final REALD-30 word comprehension score for each participant was calculated is illustrated below in Figure 9.

FIGURE 9 Diagram showing how the final REALD-30 word comprehension score for each participant was calculated
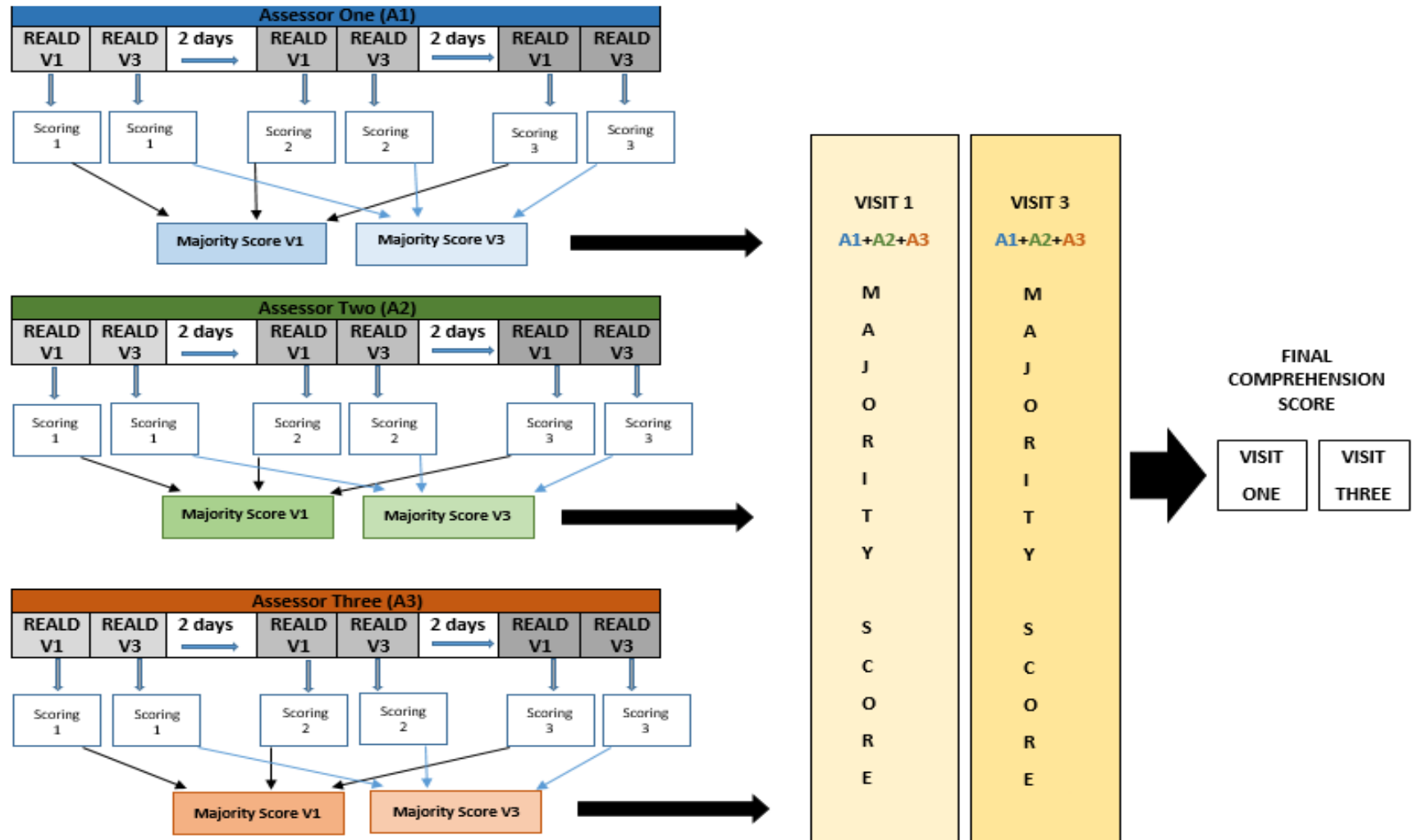
3.8.5 The oral health promotion methodologies undertaken in the oral health clinic

3.8.5.1 Oral hygiene self-care information and demonstration (OHI)

A demonstration of recommended tooth brushing and dental flossing techniques coupled with oral hygiene self-care information was provided to each participant at visit one and visit two. At both visits this demonstration, by the principal investigator, took place

- immediately after the plaque control record had been completed and while the stained plaque-biofilm (from disclosing solution) was still evident on participant's teeth
- while participants were lying down in the dental chair

Each participant was asked to hold a hand-held mirror to view the demonstration. This was done for two reasons. Firstly, the individual could view the coverage of plaque-biofilm on their 'disclosed' teeth prior to tooth brushing and flossing. Secondly, participants were able to watch and experience effective oral hygiene self-care techniques. In other words they could see the removal of plaque-biofilm from their own teeth and feel how the tooth brush bristles and floss were used for optimal effect.

The principal investigator began the demonstration, in the participant's mouth, by using a pea-sized amount of fluoride toothpaste on a 'soft, ultra-compact head' manual toothbrush (Colgate, Sanxiao, China) to intraorally show the technique for the 'Bass' tooth brushing method (Figure 10). The sulcular or "Bass' brushing method is a professionally endorsed and recommended method (Wainwright & Sheiham, 2014) that focusses on effectively cleaning the gingival sulcus by directing toothbrush bristles apically at a 45 degree to the long axis of the tooth.

The tooth brushing demonstration was followed by a demonstration of dental flossing. Flossing instruction was personalised to each participant's situation. An example of this was where a participant had a fixed orthodontic retainer and a modified flossing technique, to accommodate this, was taught. Shown in Figure 11, the standard recommended flossing method uses 30 to 40 centimetres of dental floss that is wound onto the middle finger of each hand. Approximately one centimetre of dental floss is used, in a c-shape around each tooth, to access and clean the interdental areas.

The principal investigator thoroughly brushed and flossed all tooth surfaces until the disclosing solution was no longer visible. The principal investigator recommended that each participant brush their teeth twice a day (after breakfast and before bedtime) and floss once a day (in the evening, prior to tooth brushing). It was further recommended that participants stand in front of- and looked into a mirror while undertaking these procedures. Each participant was provided with a new Colgate 'soft, ultra-compact head' manual toothbrush at visit one and two.

FIGURE 10 The Bass or sulcular brushing method (taught to participants in this study).

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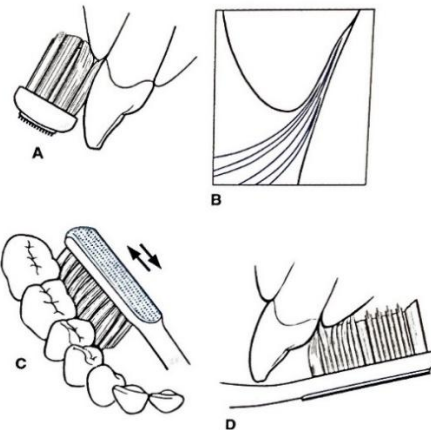
FIGURE 11 Use of dental floss (the flossing method taught to participants in this study).

Reprinted from Clinical Practice of the Dental Hygienist 11th ed (p.412), by E.M. Wilkins, 2013, Philadelphia: Lippincott Williams & Wilkins. Copyright 2013 by Lippincott Williams & Wilkins. Reprinted with permission.
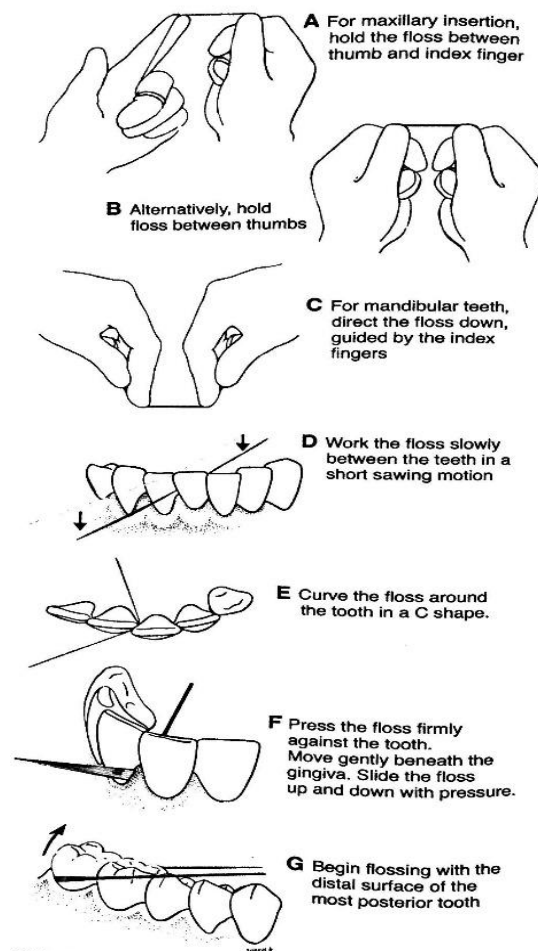
Oral health education (OHE) was provided in the clinical setting, by the principal investigator, to each participant. This occurred following the OHI demonstration. The OHE was presented using a seven-slide 'PowerPoint' show on an electronic 'tablet' screen. The presentation discussed six oral health topics or themes with their associated 'catch phrases' (Table 8). Twelve of the words that were tested in the 'REALD-30' oral health literacy test were used in the "PowerPoint" slides. These words were sugar, smoking, pulp, floss, brush, fluoride, enamel, plaque, gingiva, caries, periodontal and halitosis. Verbal explanations to clarify each PowerPoint side were provided, at the time, by the principal investigator. Each participant received a paper copy of the presentation to take away with them at the conclusion of the presentation.

TABLE 8 PowerPoint oral health education topics

Slide	Oral Health topic/theme	Catch phrase	REALD-30 word
Slide one	Introduction: Let's talk oral health		
Slide two	Physiology of the teeth and periodontium	*'Get to know your teeth'*	*enamel* *pulp*
Slide three	The impact of oral health on systemic health	*'Healthy Mouth = Healthy Body'*	*caries* *periodontal*
Slide four	The importance of daily tooth brushing and interdental cleaning	*'Be a control freak'*	*floss* *brush* *fluoride* *plaque* *caries* *periodontal*
Slide five	Early signs of gingival inflammation/periodontal disease	*'Healthy gums do not bleed'*	*halitosis* *periodontal* *gingiva*
Slide six	Dietary considerations for oral health	*'The SAD truth (sugar-acid-decay)'*	*sugar*
Slide seven	The impact of tobacco on oral health	*'Smoking is not hot'*	*smoking*

3.8.6 The mHealth messages

Participants in the intervention groups (Phone, Text and Video) were placed onto a monthly schedule of mHealth communications (Table 7 on p.76). The principal investigator used an iPhone (dedicated for this use and called the 'study iPhone') to manually provide the mHealth communications to the participants in these groups. No automated systems were used. The mHealth communications to the Text and Video groups used the same 'catch phrases' as the PowerPoint oral health education topics (Table 8). The Phone group versions of the message were modified slightly to allow for a 'conversational' message delivery. This is described, alongside an overview of the content of the monthly mHealth communications for the Text and Video groups in Table 9.

3.8.6.1 Phone group

The Phone group communications were pre-scripted. Each month, the principal investigator telephoned each participant in this group. If the call was answered by the participant, the principal investigator introduced themselves saying that they were from the 'telehealth study', delivered the 'prescripted' message and then asked the participant if they had any questions in regards to how to maintain their oral health. If questions were asked, the principal investigator answered the question in a succinct manner and recorded notes of the question/s asked and the answer/s provided. If calls were not answered, the principal investigator left a message on the participant's voicemail. This message included an introduction and the prescripted oral health message. The message asked the participant to call the principal investigator back with any questions about taking care of their oral health.

3.8.6.2 Text group

Each participant in the Text group received a monthly SMS (text) message from the principal investigator. These text messages were 'pre-scripted' and saved on the study iPhone. The text messages were not 'signed' by the principal investigator, nor was there any reference to the 'telehealth study'. Participants were not required or expected to respond to the principal investigator.

3.8.6.3 Video group

Each participant in the Video group received a monthly 'televisual' (MMS) message. These messages were pre-recorded 'videos' of the principal investigator providing a brief, persuasive oral health 'pitch' which included references to the 'catch phrases'. The videos had been filmed using the study iPhone. In addition to the 'pitch', the video message also posed a question related to that month's message theme (Table 9).

Each MMS message had an attached SMS (text) message. Each SMS message contained a hyperlink to a credible health related website that provided more information related to the monthly theme. The principal investigator selected these websites based on their ease of use and quality of information. In each video message, the participants were asked, by the principal investigator, to access the hyperlink and read the additional information in order to answer the question that had been posed in the video. Participants were asked to text (SMS) the answer back to the principal investigator. There was no time limit on providing a reply.

TABLE 9 mHealth interventional oral health promotion and education communications used in this study

	Phone	Text (SMS)	Video (MMS)
Theme 1: **Healthy Mouth = Healthy Body**	"Just a reminder that keeping your mouth healthy can result in keeping your body healthy. Do you have any questions for me about maintaining good oral health?"	Healthy mouth = Healthy body. Good oral hygiene & oral health can improve your overall health & reduce your risk of serious disease	**http://www.webmd.com/oral-health/gum-disease-health** A healthy mouth equals a healthy body. Take a look at this website and text back 3 ways that oral hygiene can keep you well
Theme 2: **Be a control freak**	"Just a reminder to brush your teeth twice a day and floss once a day. Do you have any questions for me about maintaining good oral health?"	Be a control freak: Replace your toothbrush every 3-4 months, or sooner if the bristles are frayed. A worn toothbrush won't do a good job of cleaning your teeth.	**http://www.mouthhealthy.org/en/az-topics/b/brushing-your-teeth** Remember to be a control freak: Brush and floss for 5+ minutes a day. According to this website, how often should you replace your toothbrush? Text back the answer.
Theme 3: **Healthy gums do not bleed**	"Just a reminder that healthy gums don't bleed. Bleeding gums can be a sign of gum disease. Do you have any questions for me about maintaining good oral health?"	Healthy gums do not bleed: brush and floss every day to prevent gingivitis. Visit your dentist/hygienist every 6 months.	**http://www.nlm.nih.gov/medlineplus/ency/article/001056.htm** Healthy gums do not bleed. According to this website, what is the best way to prevent gingivitis? Text back the answer.
Theme 4: **The SAD truth (sugar-acid-decay)**	"Just a reminder that even sugar-free fizzy drinks still contain acid. Acid dissolves teeth and causes decay. Do you have any questions for me about maintaining good oral health?"	The SAD truth (Sugar-Acid-Decay). How much acid is in your drink? Diet or sugar free fizzy drinks still contain acid. Acid makes holes in teeth.	**http://www.rethinksugarydrink.org.au/facts/tooth-decay.html** SAD: sugar-acid-decay. Take a look at this website. Is the following statement true or false? "It is best to sip a sugary or acidic drink slowly or over a long duration." Text back 'T' for true of 'F' for false.
Theme 5: **Smoking is not hot**	"Just a reminder that smoking is not hot! Visit your oral health professional regularly for early detection of oral cancer. Do you have any questions for me about maintaining good oral health?"	Smoking is not hot! Regular dental check-ups are the best way to detect the early signs of oral cancer.	**http://www.health.govt.nz/your-health/healthy-living/teeth-and-gums/keep-your-smile-looking-good-easy/smoking-and-oral-health** Smoking is not hot! Usually the first sign of oral cancer is a sore or lump in the mouth that doesn't heal. According to this website, what is the best way to detect the early signs of oral cancer? Text back the answer.

3.8.7 Qualitative data collection

3.8.7.1 Preparation of interview questions

The principal investigator developed an initial set of questions which were later refined and used at visit three to guide the participant interviews (Appendix M). Nine key questions were developed with five of those having additional supplementary questions or prompts. The prompts were used to increase the equivalence of answers to specific questions (Gillham, 2005). The first five questions asked of participants were designed to elicit data that would allow the principal investigator to identify the participant's sample group. Where it was identified that a participant was a 'Control' group participant, the prompts for question six were left out as they were not applicable.

Throughout the question development process, the principal investigator consulted with and sought approval from the secondary supervisor, who has experience with qualitative interview processes. The principal investigator acknowledges that 'pilot' or practise interviews are desirable when undertaking qualitative data collection and that this should have occurred prior to visit three. Unfortunately, two factors did not allow for this. These factors were firstly, the participant's restricted availability due to their academic commitments and secondly, the allowable time frames for a Master of Philosophy degree which limited the principal investigator's time to undertake pilot interviews.

3.8.7.2 Interviews

Interviews took place either in the AUT oral health clinic, in a teaching space within the AIH clinic or in the university libraries, either on the city or north shore campuses. These spaces were considered to be a neutral environment where participants could speak freely and without interruption. The interviews were digitally recorded using the 'voice memo' application on two iPhones. The study iPhone was used for the primary recording of voice data and the second was used as a 'back-up' in case of equipment failure. Participants were reminded that they were being recorded. They were also told that that the principal would not identify them by name, in the recordings, but only by study identification number.

3.8.7.3 Transcription of interview data

Each interview was transcribed by the principal investigator, within a day of the conclusion of the interview, using 'Microsoft Word'. Interviews were transcribed in an orthographic or 'verbatim' format. This format included all verbal or non-verbal sounds or utterances such as laughter. Any identifying information provided by the participants during the interview was changed to be non-identifying in the transcription e.g. Mary was changed to M***.

The digital recordings and transcription data were copied to a USB for secure storage in a locked cabinet in the principal investigator's office. All digital recordings stored on the iPhones were subsequently permanently deleted.

3.9 DATA ANALYSIS

3.9.1 Quantitative statistical analysis

3.9.1.1 OHIP-14

The oral health questionnaire and OHIP-14 spreadsheet data from visit one and visit three was combined to allow for comparison. Due to the small numbers in the study cohort, statistical analysis was undertaken using the methodology of Locker (2004). Comparative data showing either a decline, maintenance of status quo or improvement of OHRQoL between sample groups (Control, Phone, Text and Video) over six months was calculated.

3.9.2 Quantitative descriptive analysis

3.9.2.1 Plaque Control Record

A Plaque Control Record score was calculated for each participant at visit one and again at visit two. As per the protocol for this measure, these scores were expressed as percentages. Each participant's final score was calculated by subtracting their score at visit two from their score at visit one.

Individual scores were subsequently categorised into sample groups (Control, Phone, Text or Video). A mean score was calculated for each group for visit one and visit two. The mean scores for visit two were subtracted from the visit one scores to calculate the overall change in oral hygiene efficacy for each sample group.

3.9.2.2 REALD-30

A score was calculated for each participant's word 'recognition' at visit one and visit three (minimum possible score is 0, maximum is 30). These individual scores were grouped into sample groups (Control, Phone, Text and Video). Individual mean scores for visits one and three were calculated separately for each sample group. The difference in scores was calculated as a percentage to reflect an improvement or a decline in word 'recognition'.

The methodology used in this study to measure word 'comprehension' (scoring either zero, one or two) meant that each participant could achieve a total possible score of 60. To calculate a score that could be compared with the 'recognition' score, each of the participant 'comprehension' scores were halved. This derived a score (out of 30) represented the participant's individual word 'comprehension' scores. These derived scores were then categorised into sample groups (Control, Phone, Text or Video). Mean scores for visits one and three were calculated separately

for each sample group. The difference in scores was calculated as a percentage to reflect an improvement or a decline in word 'comprehension'.

3.9.3 Qualitative thematic analysis

As discussed in section 3.2.2, the qualitative data was analysed using thematic analysis. The principal investigator undertook the analysis using an inductive, semantic approach and following the six-phase approach described by Braun and Clarke (2006) and Clarke and Braun (2013). The six phases undertaken were called 'familiarisation with the data', 'coding', 'searching for themes', 'reviewing themes', 'defining and naming themes' and finally 'writing up'. The structure of the questions and prompts that were used in the semi-structured interviews facilitated the analysis of the qualitative data. Even so, the principal investigator did not approach the six phases in a 'linear' or 'one-directional' manner but rather, where required, as a flexible, recursive process without 'hard and fast' rules. Each phase of the thematic analysis process that was used is described below:

Phase one: *familiarisation with the data*

As the principal investigator had undertaken the transcription of the interview data herself, she already had some familiarity with the data. However, prior to the start of coding, all transcriptions were re-read twice by the principal investigator for re-familiarisation. This initial phase allowed the principal investigator to begin to cognitively recognise commonalities or repeated sentiments in the interview scripts that could be further explored in phase two of the analysis process.

Phase two: *generating initial coding*

Once the principal investigator felt sufficiently familiar with the interview data, initial coding was begun. 'Coding' is the term given to providing an initial data 'label' using a simple phrase or word that describes a specific idea or action evident in the interview data. In this study, all 'coding' was undertaken manually by the principal investigator in an electronic format using Microsoft Word. Electronic 'highlighters' in different colours, as well as other indicators such as underlined text, were used to distinguish codes from each other in the transcribed interview data.

Before undertaking the coding process, the individual interview transcriptions were categorised according to their study sample group (Control, Phone, Text or Video). The participant's transcription data, in each of the four sample groups, was combined into one electronic document per sample group. Each sample group's data was then coded separately. This initial coding process allowed the principal investigator to further categorise the data into participant described similar experiences or observations.

The 'control' group was coded first and an initial list of codes was generated. These codes were derived purely from the explicit data without any 'interpretation' of underlying meanings. Simple

code names were chosen to enable easy identification of explicit meaning. Further coding of transcripts was undertaken in the following order: 'video', 'text', 'phone'. As each group of interview data was coded, further identified codes were added to the existing list of codes. Any interview data where participants had provided hypothetical viewpoints was excluded from the coding process.

It appeared that no new codes were being generated when coding of the final group (phone) occurred and the principal investigator was satisfied that a point of saturation had been reached. Once coding of all data was complete, data with the same (repeating) codes was collated together, within each group. A list of initial codes and associated 'highlighter' colour key can be found in Appendix N.

Phase three: *searching for themes*

During phase three, the initial codes that was generated in phase two were electronically printed onto a sheet of blank paper. The principal investigator then separated the codes from each other by cutting up the printed sheet. This method allowed for the manual manipulation of the identified sixteen codes to start to create a 'map' that best illustrated of the interviewee's verbal expressions and explanations. Thereafter, the identified codes were then further grouped or categorised into three initial or candidate themes. These initial themes were named:

- possible barriers to oral health knowledge
- mobile phone as a lifestyle tool
- provision of oral health knowledge and education

Once the principal investigator was satisfied that the correct relationships between codes and candidate themes existed, the paper thematic visual map was re-created electronically using Microsoft Word. This initial thematic map was called Thematic Map One (TM1) and is shown in Figure 12 on page 93. These initial themes were reviewed in phase four of the thematic analysis process, described below.

Phase four: *reviewing themes*

This phase used two levels of review: the initial theme review and the final theme development. The initial review started with a revision of TM1. On re-consideration, the principal investigator recognised that some of the initial themes were complementary. There were also areas of overlap and redundancy. Where this was identified, the relevant codes were combined and re-named to better describe the new, more comprehensive, theme. An example of this was the amalgamation of the codes 'perceptions of oral health procedures' and 'perceptions of oral health professionals' into a single code. This refinement of codes and themes resulted in the development of a condensed thematic map. This emergent and refined thematic map was called Thematic Map Two (TM2) (Figure 13 on p. 94).

Thematic Map Two (TM2) retained the candidate themes along with their revised attached subthemes. On re-reading of the interview data at this stage, the principal investigator identified that further refinement was needed. Thematic examples of this were that 'self-perceived lifestyles' of the participants was more thematically dominant than initially thought. 'Motivation' was identified as a key link to increasing provision of oral health knowledge and education amongst this study cohort. Further refinement of TM2 also identified the need to further code 'In-surgery OHE' and 'mHealth intervention' so as to better reflect details of the participants' reported experiences.

Phase five: *defining and naming themes* and Phase six: *producing the report*

A final consolidation of themes was undertaken in phase five. The final theme development began with the creation of an electronic document showing all key themes and sub-themes as per TM2. To better manage all sample group data within the 'key theme and sub-theme' document, the principal investigator chose to use colour grouping. This meant that the font colour of each sample group's data was changed as follows: 'Control' =Black, 'Phone' = Green, 'Text' = Orange, 'Video' = Blue. The data from each sample group document was then transferred to its assigned theme within the new 'over-arching' document to allow for comparison between sample groups. In combining the interview transcription data in this way, the principal investigator was able to see the overlap of interviewee statements (Intra- and inter- sample group) and how the data contributed to the identified theme. This provided confirmation that the identified themes were representative of the participant's experiences and that the analysis process had captured their insights in a meaningful way.

Further refinement of the themes and sub-themes was subsequently undertaken and the final thematic map was developed. This final map was called thematic map three (TM3). Shown as Figure 14 on page 95, TM3 not only represented the views of participants as a collective group but additionally also provided a representation of the insights of those in the intervention groups. The results of the thematic analysis are discussed in Chapter Four (section C) of this thesis.

FIGURE 12 Thematic Analysis - Thematic Map One

THEMATIC MAP 1
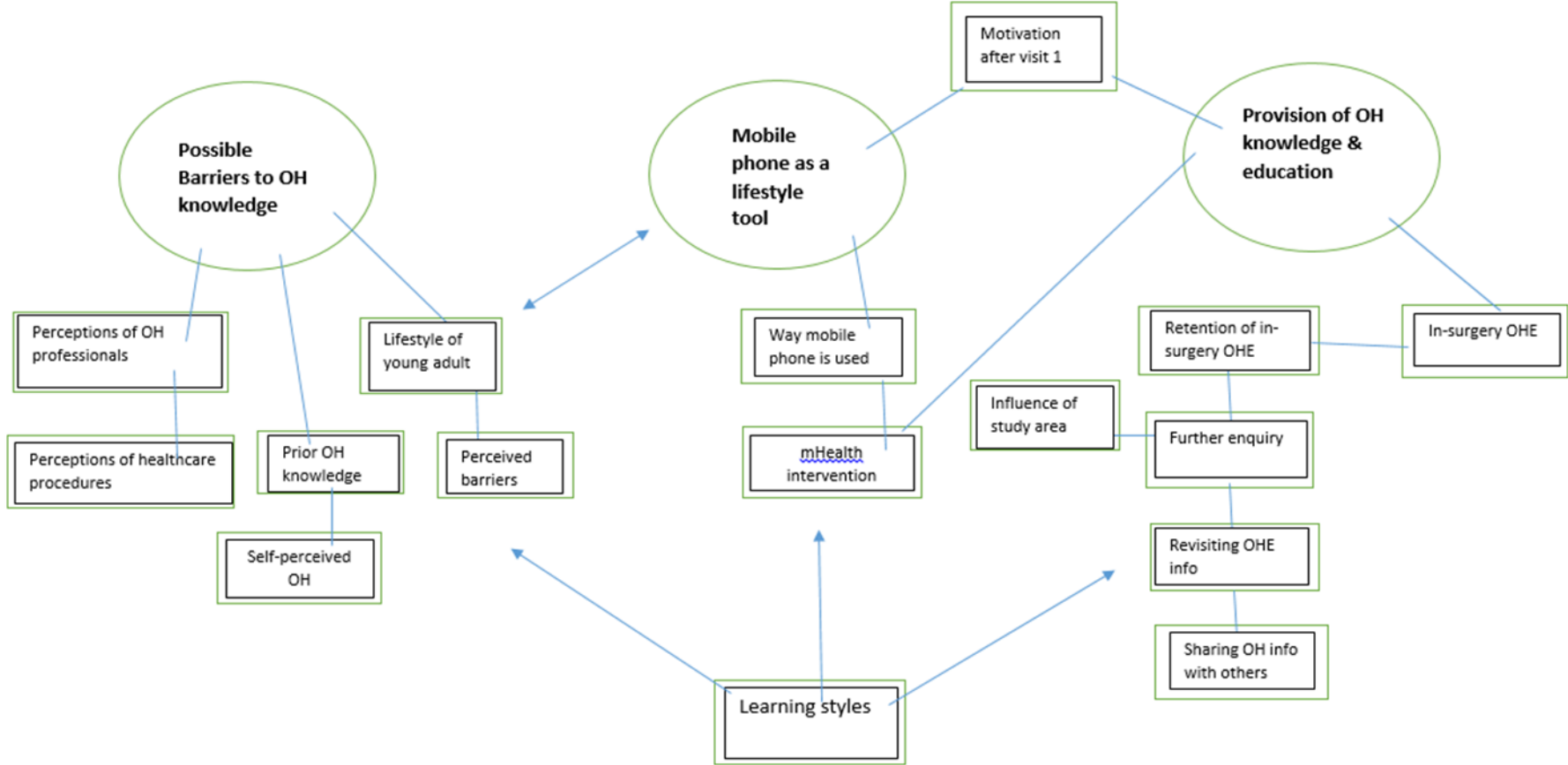
FIGURE 13 Thematic Analysis - Thematic Map Two

THEMATIC MAP 2

Lifestyle of young adult

Possible Barriers to OH knowledge

Mobile phone as a lifestyle tool

Provision of OH knowledge & education

Perceptions of OH professionals

Perceived barriers

Prior OH knowledge

Motivation

In-surgery OHE

Sharing OH info with others
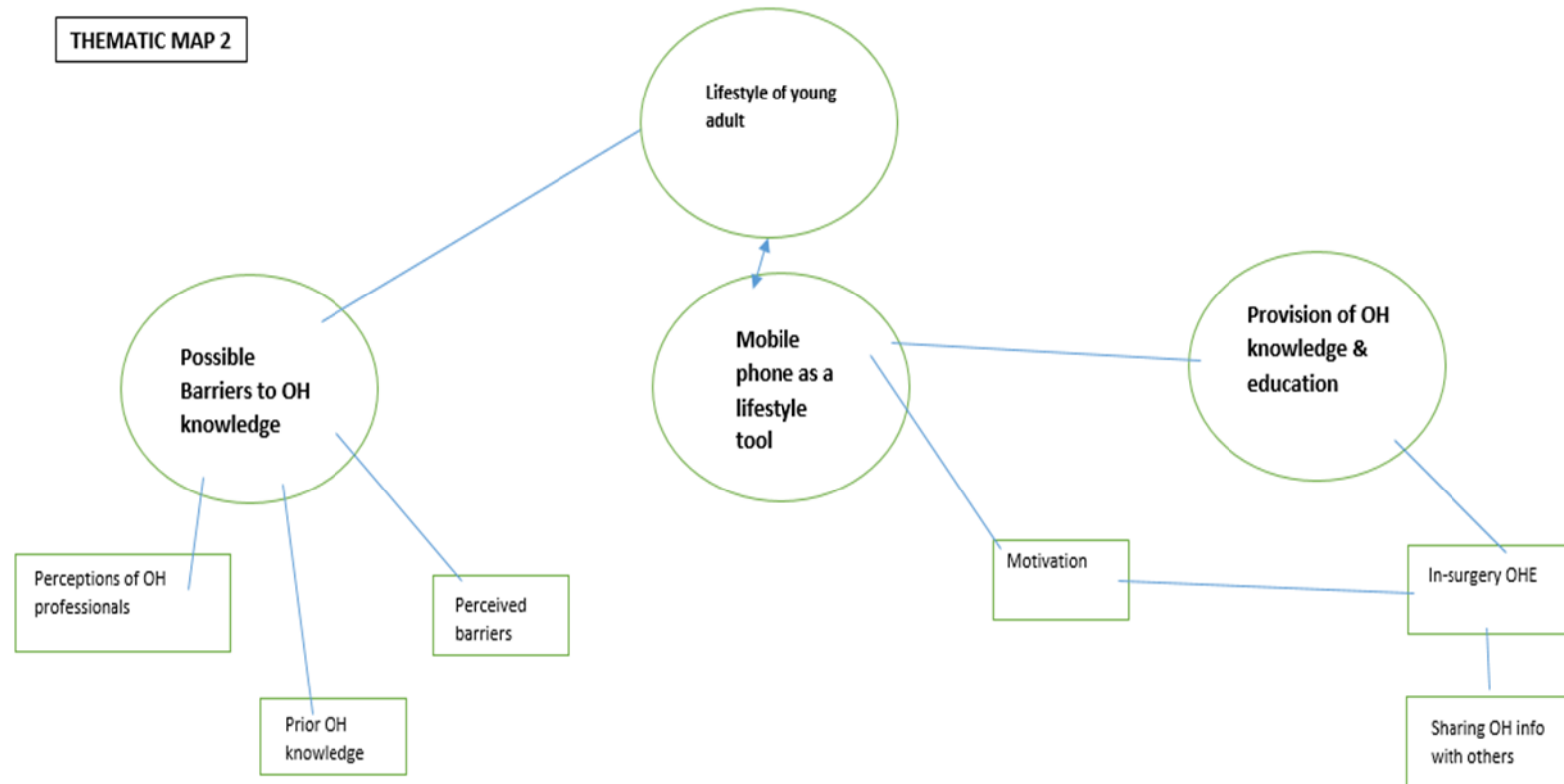
FIGURE 14 Thematic Analysis - Thematic Map Three
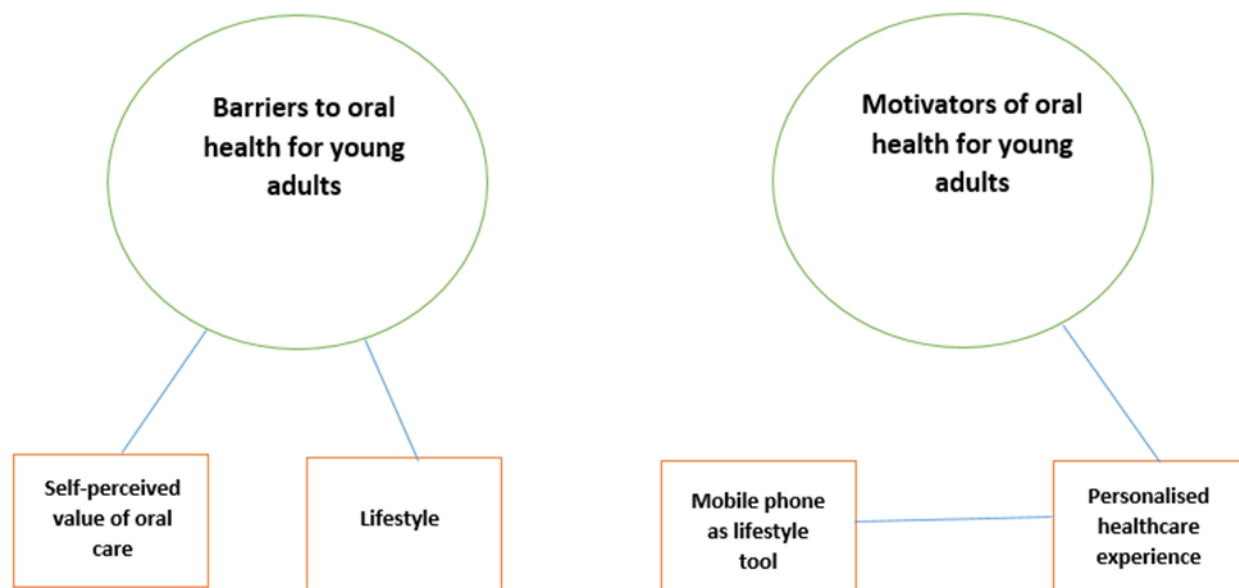
3.9.4 The interface between the quantitative and the qualitative data

An important aspect of a mixed methods study is to integrate the data in order to draw inferences (Johnson & Onwuegbuzie, 2004). A convergent parallel design allowed for complementary qualitative and quantitative data to be derived in this study. Owing to the size of the study cohort, this design enabled the quantitative data to support the qualitative data when integrated at the interpretation stage (presented in chapter five of this thesis).

3.10 CONCLUSION

This chapter has focussed on describing the chosen method and methodologies that were used to meet the aims of this study and to answer the research questions that were derived from the identified gaps in the knowledge. The chapter provided an overview of consultations that were undertaken, permissions sought and ethical approvals undertaken prior to the start of the study. Data collection for this project was described as were the oral health promotion methodologies and mHealth interventions undertaken with participants. The chapter concluded with a detailed description of how the data was analysed and a description of the interface between the methods used. A description of the sample and the quantitative and qualitative results will be provided in chapter four.

Chapter Four

RESULTS

4.1 INTRODUCTION

This chapter is divided into three parts (Section A, Section B and Section C) which are described below. The results presented in sections B and C were used, where applicable, to determine if the following aims in this mixed methods study had been met:

Study Aim One: Determine if a mHealth intervention using 'smart' mobile phones

    a. *could improve the oral health of the cohort, through improved oral hygiene efficacy, by complementing traditional oral health promotion*

    b. *was considered, by the study cohort, to be an acceptable way of communicating oral health promotion messages*

    c. *could improve the study cohort's oral health literacy*

Study Aim Two: Determine which factors optimised the success of the mHealth intervention

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Section A Description of the sample	This section describes the study sample.

Section B Quantitative results	This section presents the results of the quantitative measures. The quantitative results are presented in the following order: • Oral health questionnaire and OHIP-14 • The Plaque Control Record • The REALD-30 These measures were used to in support of study aim one (a) and (c). Comparative data for the study's four sample groups (Control, Phone, Text and Video) will be presented.

Section C Qualitative results	This section presents the qualitative results. Chapter Four (section C) describes, in detail, the two overarching themes, their related sub-themes and adjunct theme that were derived from the thematic analysis of the interview data. This data was used in support of study aim one (a) and (b) and study aim two and comparative data for the study's four sample groups (Control, Phone, Text and Video) will be presented.

Chapter Four (Section A)

DESCRIPTION OF THE SAMPLE

4A.1 SECTION A INTRODUCTION

In this section, the overall sample in this study is described. This includes a description of the recruitment process that was undertaken and the participant interview process. Participant characteristics that have been included are gender, ethnicity, area of study and tertiary provider attended. Data has been presented in study sample groups (Control, Phone, Text and Video), where applicable. Individual participant characteristics have also been presented.

4A.2 PARTICIPANT CHARACTERISTICS

Advertising for participants for this study took place from 17 June to 31 October 2015. At visit one, sixteen eligible individuals were enrolled after being consented by the principal investigator. Shown in Figure 15, thirty-three individuals had initially responded to the study advertisement. Of those, fourteen chose either not to participate after receiving the introductory email and PIS or did not make any further contact. Three respondents were ineligible to participate due to either having a parent who was an oral health professional or making contact after the recruitment period was closed.

At 'visit one', one of the potential participants disclosed a diagnosis of dyslexia related to 'quality of handwriting'. This was discussed with the primary study supervisor. On consideration, the participant was enrolled as it was felt that this type of learning disability would not impact on the potential outcomes of the study. Contact was lost with two of the consented participants after visit one. Despite numerous attempts to re-establish contact with the participants, there was no further response from them.

Fourteen participants attended all three visits. Twelve of those participants were seen at twelve week intervals. An unforeseen surgical procedure resulted in a 15 week delay between visit one and visit two for one of the participants. Examination timetable clashes resulted in another of the participants having a four week interval between visits two and three. The participant appointment intervals and time commitment per appointment is shown in Appendix O.

FIGURE 15 Flowchart showing attrition of study respondents and participants from initial contact to visit three
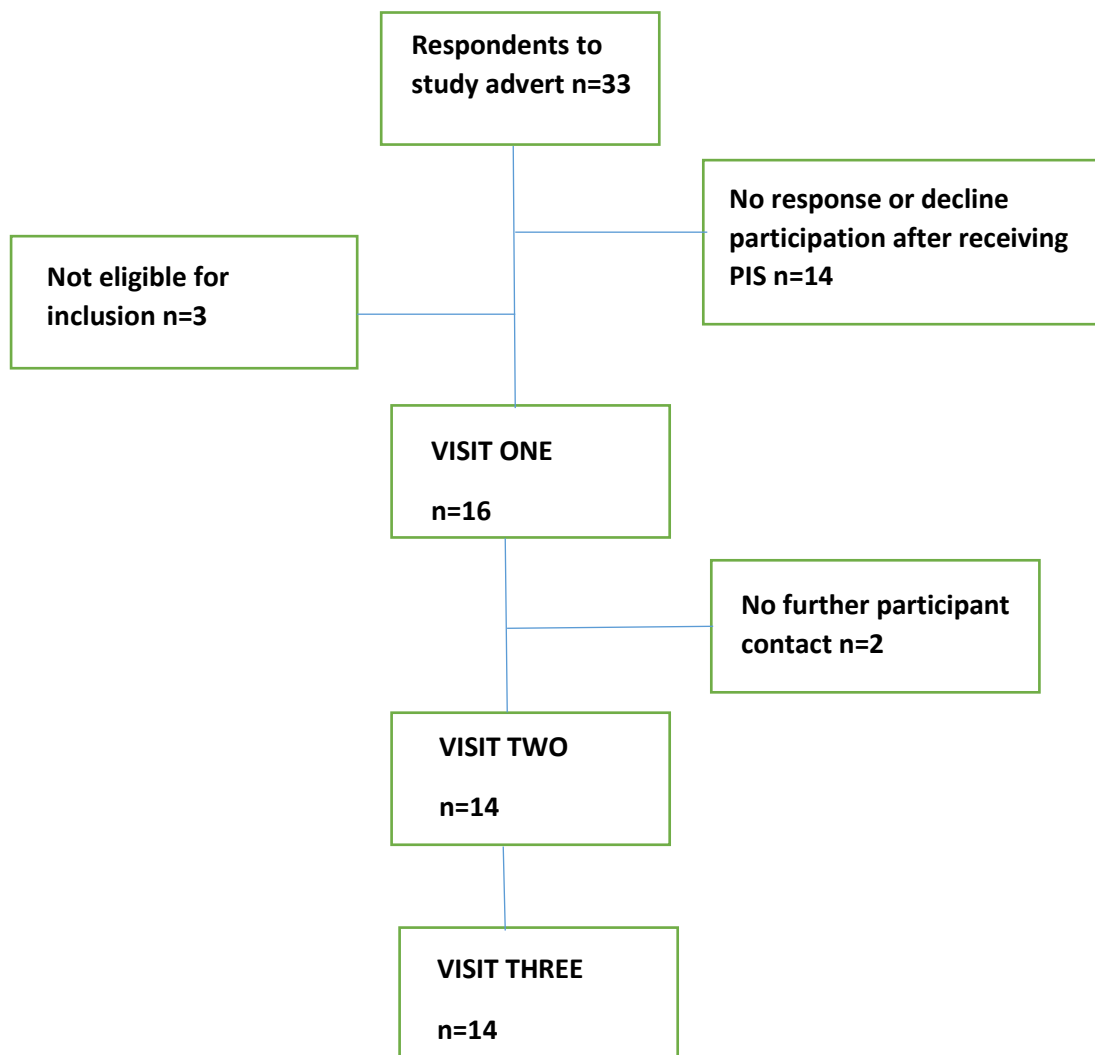
4A.2.1 Participant interviews

Participant interviews took place at visit three. At that time, the principal investigator was still 'blinded' to which participants had been in each of the sample groups. Pre-set, open-ended questions were used for the interviews. Despite this, the principal investigator required some flexibility in the interview questioning process so that the participant's sample group would be revealed. This flexibility also allowed the participants to freely express their views without any time constraint. The fluidity of the resultant conversations resulted in variations in interview lengths and transcribed interview word counts between participants. The average interview length was 17 minutes and 42 seconds equating with an average transcribed word count of 2848 words. The longest participant interview was almost double the average time (32 minutes and 19 seconds) with a significantly increased corresponding word count (4975). The shortest interview time was 10 minutes and 44 seconds long with a corresponding word count of 1695 words. This

is shown in Table 10. Despite these significant differences, when comparing average interview times and transcription word counts between sample groups and also to the average overall, the findings show that similar times and word counts were recorded. Copies of the transcribed participant interviews have been provided on the attached universal serial bus (USB) labelled as Appendix R.

TABLE 10 Details of participant interview data in sample groups

	Participant Study ID	Interview length (mins:seconds)	Transcription word count
CONTROL	TH04	22:54	4528
	TH05	19:06	2939
	TH11	15:05	2603
	Group Average	**19 mins**	**3356**
PHONE	TH02	15:40	2627
	TH06	18:07	2441
	TH12	14:23	2238
	TH14	15:31	2520
	Group Average	**16 mins**	**2456**
TEXT	TH03	10:44	1695
	TH08	16:39	2684
	TH10	18:25	2909
	TH13	22:17	3333
	Group Average	**17 mins**	**2655**
VIDEO	TH01	12:41	2110
	TH09	12:39	2273
	TH15	32:19	4975
	Group Average	**19 mins**	**3119**
OVERALL GROUP AVERAGE		**17 mins**	**2848**

4A.2.2 Overall participant demographics

Five (31%) study participants were male and eleven (69%) were female with an average age of 20 years old (age range shown in Figure 16). The group was ethnically diverse with nine (56%)

identifying as being NZ European (NZE), three (19%) Māori, two (13%) Asian, one (6%) Pasifika and one (6%) African (shown in Figure 17).

Participants were students enrolled at one of four different tertiary education providers in the Auckland region. These providers were the Auckland University of Technology (AUT), the University of Auckland (UoA), Massey University and New Zealand Career College (NZCC)). Nine (56%) participants were health science students, four (25%) participants were social sciences students, one (6%) was a design student and two (13%) were foundation health students (Figure 18 and Figure 19). The overall participant demographic in sample groups is illustrated in Table 11.

TABLE 11 Overall participant demographics in sample groups

		CONTROL	PHONE	TEXT	VIDEO
Age (years)	**Mean**	**20.5**	**20.25**	**19.25**	**19.75**
	Min	**19**	**18**	**18**	**18**
	Max	**24**	**23**	**21**	**21**
Gender	**Male**	**1**(25%)	**2**(50%)	**2**(50%)	**0** (0%)
	Female	**3**(75%)	**2**(50%)	**2**(50%)	**4**(100%)
Ethnicity	**NZE**	**3**(75%)	**3**(75%)	**2**(50%)	**1**(25%)
	Māori			**1**(25%)	**2**(50%)
	Pasifika		**1**(25%)		
	Asian	**1**(25%)		**1**(25%)	
	African				**1**(25%)
Area of study	**BHSc. Paramedicine**	**1**(25%)	**1**(25%)	**1**(25%)	
	BHSc. Physiotherapy	**1**(25%)			
	BHSc. Occupational Therapy			**1**(25%)	**1**(25%)
	BHSc. Nursing			**1**(25%)	
	BHSc. Health Promotion	**1**(25%)			
	B. Speech and Language				**1**(25%)
	B. Design		**1**(25%)		
	BA (Law)		**1**(25%)		
	B.Communication			**1**(25%)	**1**(25%)
	B. Communication & Business		**1**(25%)		
	Cert.Health	**1**(25%)			**1**(25%)

FIGURE 16 Age range of study participants (mean 19.94 yrs; SD 2.80 yrs)
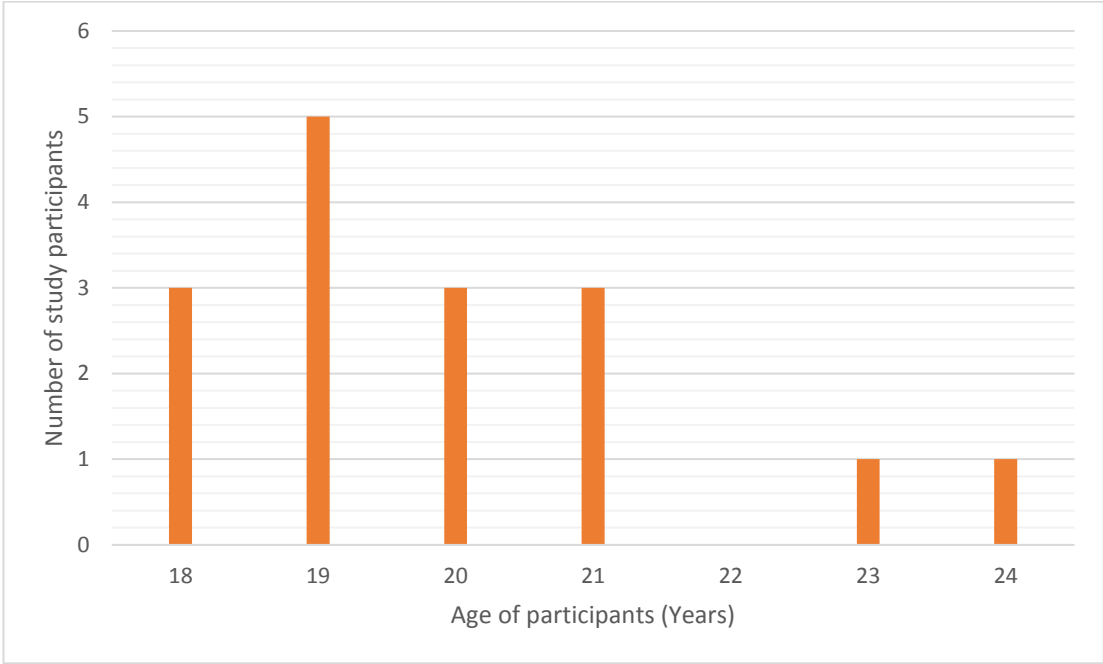
FIGURE 17 Ethnicities of study participants
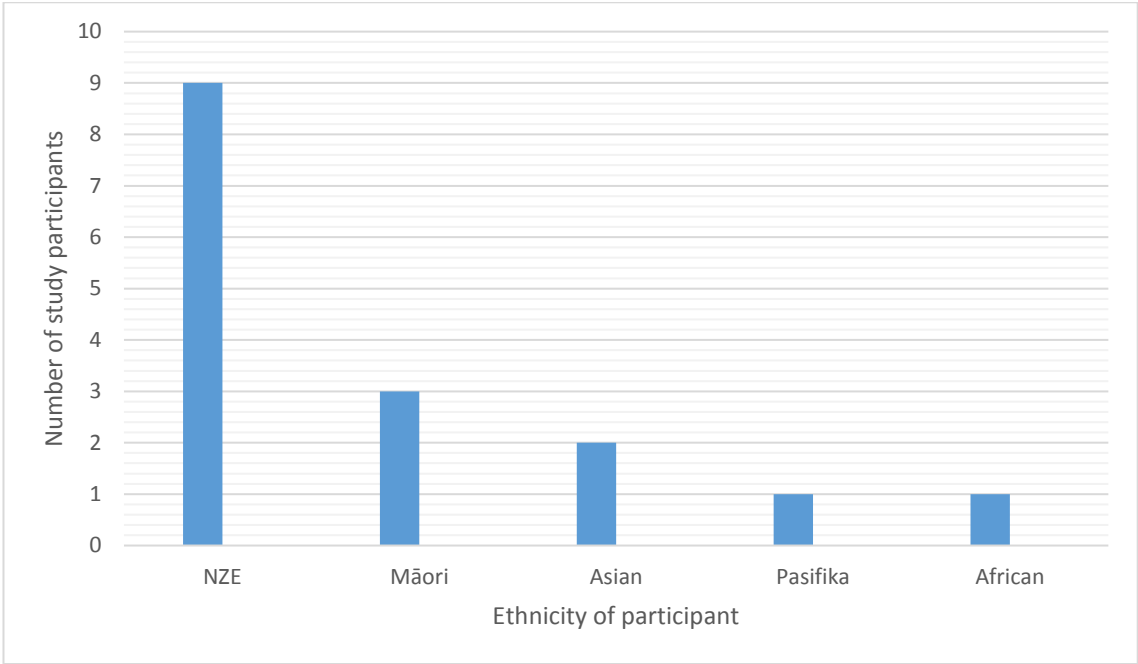
FIGURE 18 Tertiary education providers attended by study participants
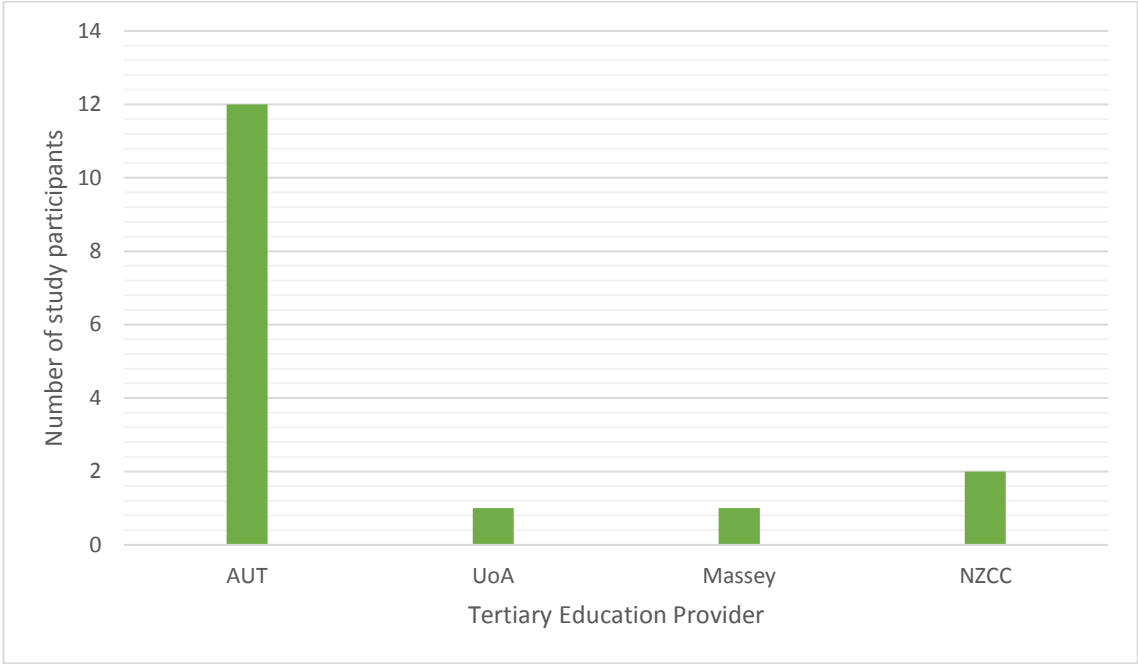
FIGURE 19 Areas of study undertaken by study participants and number of participants in each area
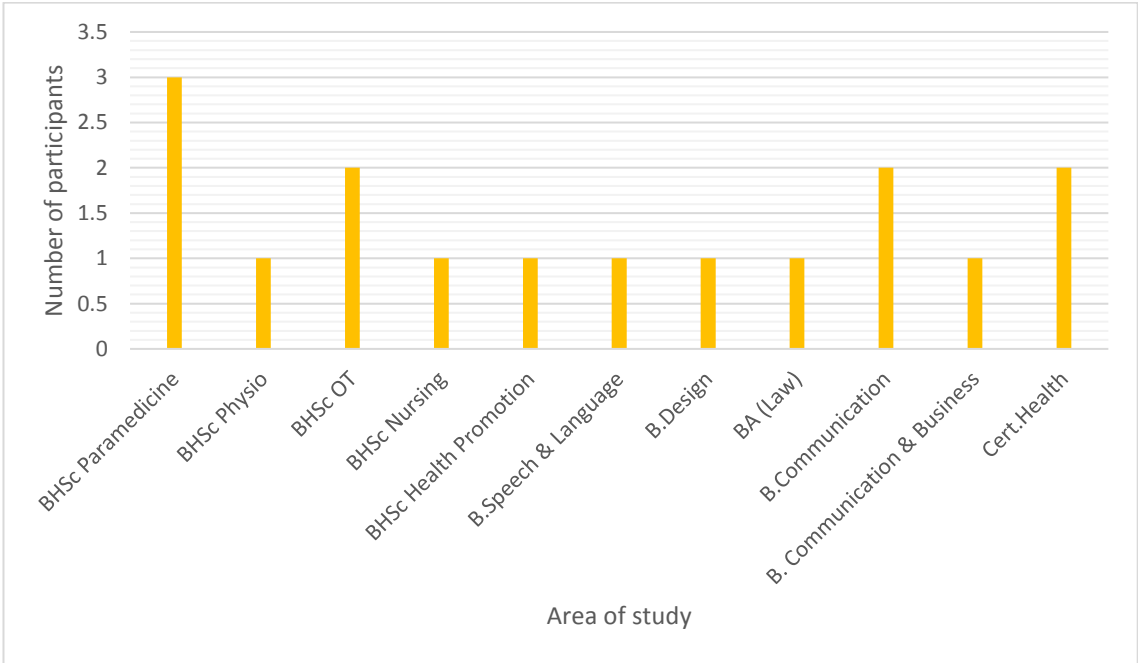
Chapter Four (Section B)

QUANTITATIVE RESULTS

4B.1 SECTION B INTRODUCTION

The results of the quantitative measures are presented in this section in the following order:

- Oral health questionnaire and OHIP-14
- The Plaque Control Record
- The REALD-30

The results for each measure have been presented in sample groups (Control, Phone, Text and Video) to allow for direct comparison of the impact of various 'smart' phone functions. The oral health questionnaire, OHIP-14 and the Plaque Control Record results were used in support of study aim one (a):

- *Determine if a mHealth intervention using 'smart' mobile phones could improve the oral health of the study cohort, through improved oral hygiene efficacy, by complementing traditional oral health promotion.*

The REALD-30 results were used in support of study aim one (c):

- *Determine if a mHealth intervention using 'smart' mobile phones could improve the study cohort's oral health literacy.*

4B.2 ORAL HEALTH QUESTIONNAIRE AND OHIP-14

The results of the OHIP-14 did not show any consistency in OHRQoL results between sample groups from visit one to visit three. The results, across all sample groups, over six months are shown in Figure 20. The OHRQoL of the majority of participants in each sample group remained unchanged over six months. The Control group was the only group that did not show any decline in OHRQoL over the same time period.

FIGURE 20 Changes in OHRQoL from visit one to visit three for each sample group
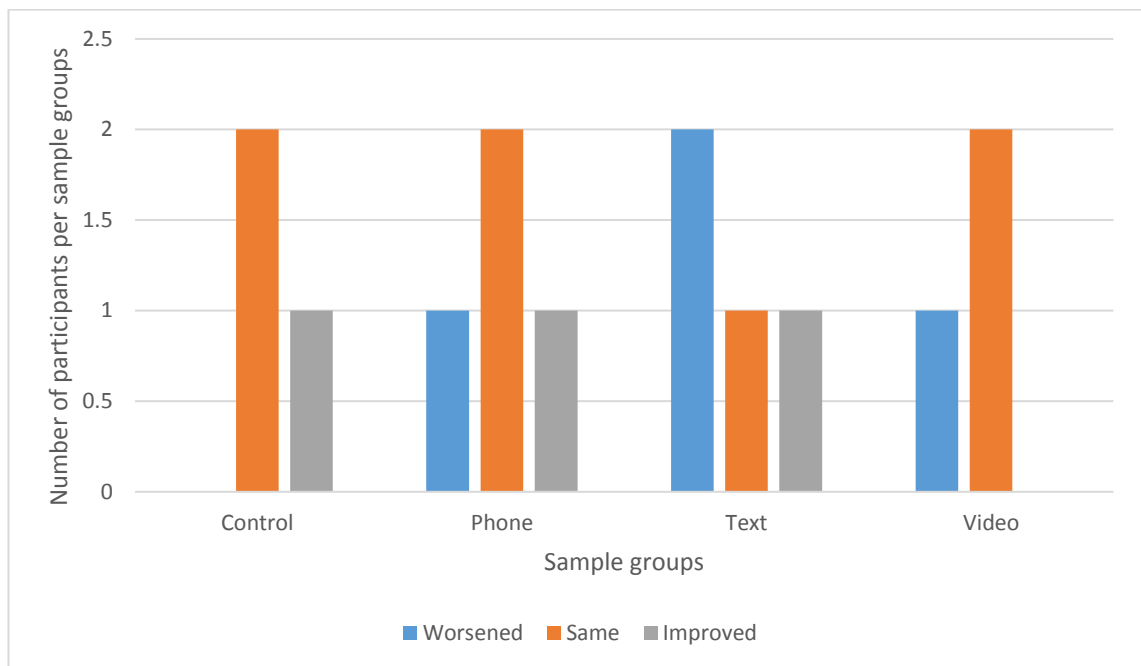
4B.3 PLAQUE CONTROL RECORD

At visit one, individual Plaque Control Record scores varied greatly between participants. The highest individual score was 67% and the lowest 21% with an average of 42%. At visit two, individual scores ranged from 53% to 19% with an average score of 30%. These results reflected a decline in plaque-biofilm coverage on the teeth of 12 (86%) participants between visits one and two. Of the remaining participants, one participant in each of the Text and Video groups showed increases, of 12% and 7% respectively over the same time period. All participants scored significantly higher than the suggested guideline in periodontal therapy of 10% or less (Wyche, 2013) at visit one. Despite overall declines in scores, this remained the same at visit two. The individual participant scores for visit one and visit two relative to the suggested guideline of 10% (shown in green) are shown in Figure 21.

When comparing sample groups, the results showed a mean overall percentage decrease in the plaque control record across all groups (Figure 22). The greatest percentage change occurred in the Phone group (20%) with a similar change seen in the Control group (18.1%). The mean percentage changes in the Text (6.5%) and Video (3.5%) groups were impacted by the score increases observed in TH08 (Text group) and TH01 (Video group) from visit one to visit two (Figure 23).

FIGURE 21 Graph showing plaque-biofilm coverage on teeth for each sample group from visit one to visit two
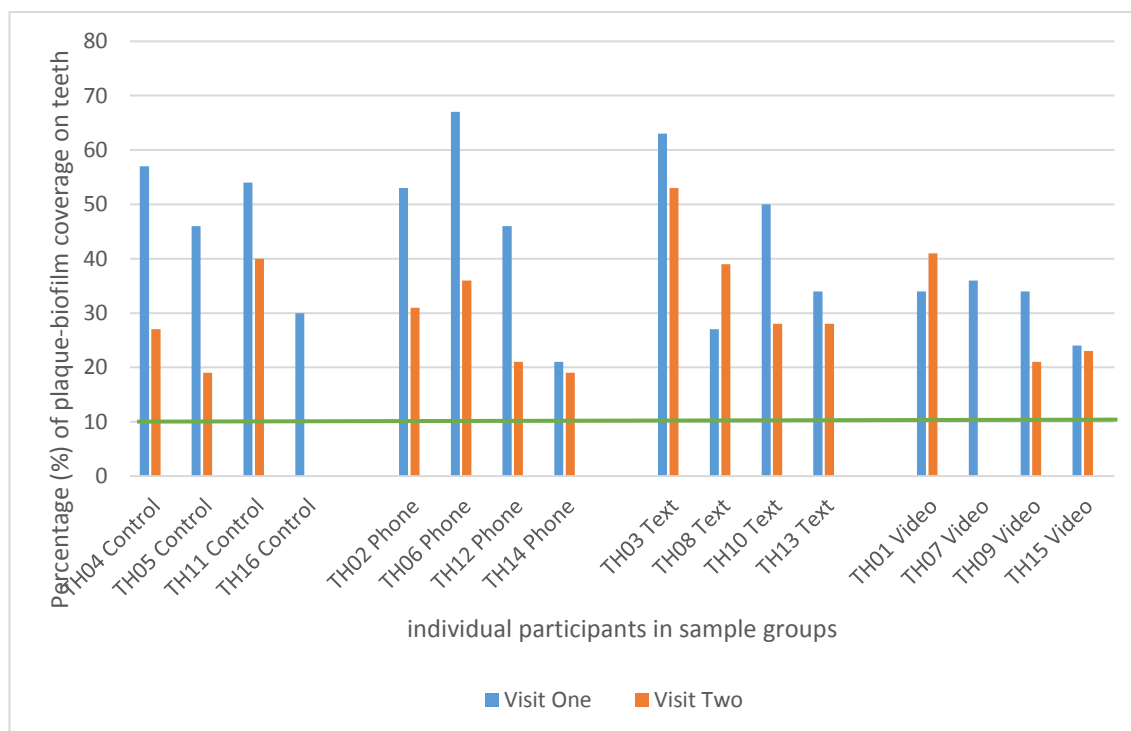
FIGURE 22 Graph showing mean percentage plaque-biofilm coverage on teeth for each sample group for visit one and visit two
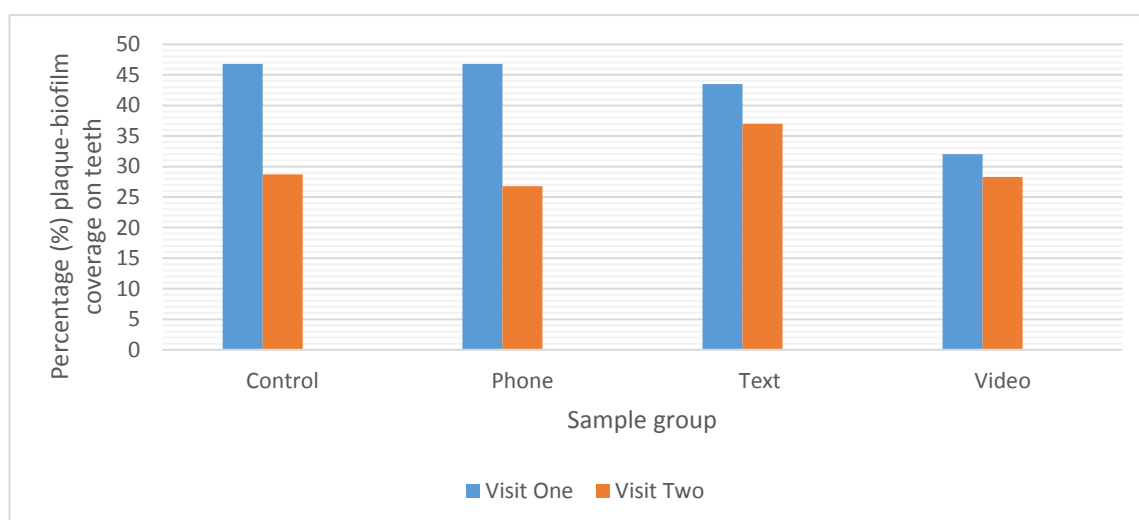
FIGURE 23 Graph showing total percentage change in plaque-biofilm coverage on teeth for each sample group from visit one to visit two
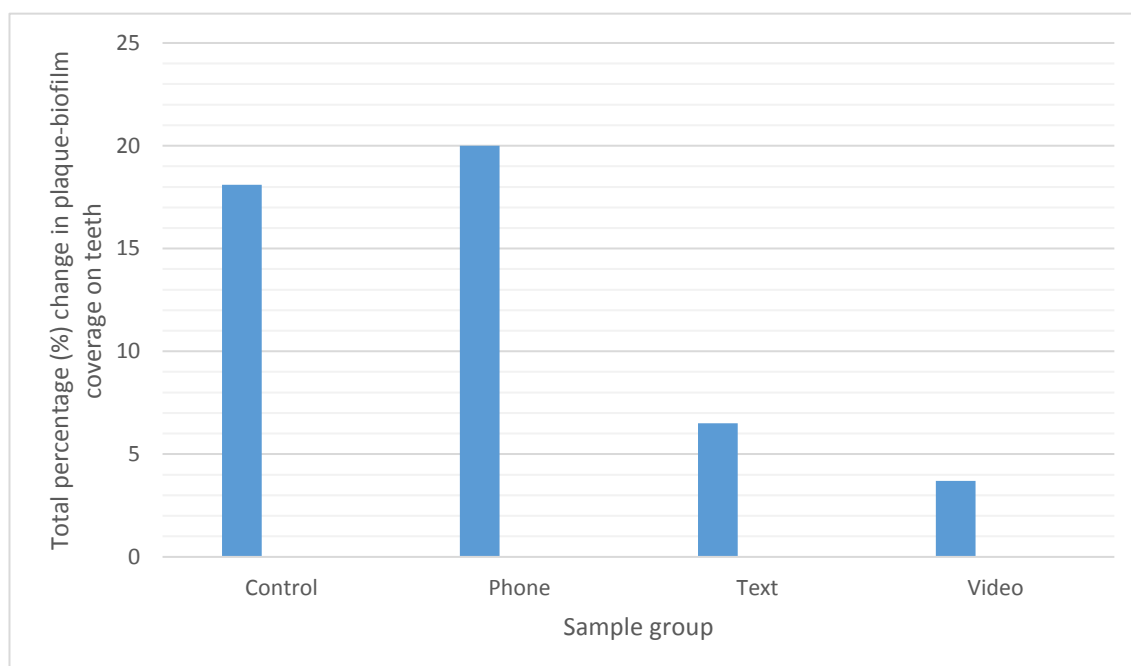
4B.4 REALD-30

Calculations for REALD-30 word recognition and word comprehension were discussed in section 3.9.2.2.

4B.4.1 REALD-30 word recognition

At visit one, the lowest individual REALD-30 score for word recognition was 12 and the highest score was 28. At visit three, these scores ranged from 18 to 29 (Figure 24). Mean word recognition scores were similar between sample groups at visit one (Figure 26). The lowest mean sample group score was 22 (Phone) followed by a score of 23 (Control and Video). The highest score was 25 (Text).

Three groups (Control, Phone and Video) showed slight increases in mean word recognition score at visit three. This equated to an increased score of one for the Phone group (3% improvement) and two for the Control and Video groups (6% improvement). Scoring for the Text group remained unchanged meaning that no improvement was seen from visit one to visit three (Figure 28). The final mean group scores at visit three for the Control, Text and Video groups was 25. The final Phone group score was 23 (Figure 26).

When using Wehmeyer et al. (2014) REALD-30 scoring calculation for word recognition, the results of this study showed that overall 25% of the cohort would be considered to have high OHL, 43.8% moderate OHL and 31.3% low OHL at visit one. When comparing this result with that

obtained at visit three, there was a small overall increase in participant OHL across all levels (Table 12).

TABLE 12 Study participants OHL levels based on REALD-30 word recognition scoring (Wehmeyer et al., 2014)

	Low OHL **Score of 21 or less**	Moderate OHL **Score of 22-25**	High OHL **Score of 26 or greater**
Visit One	n = 5 (31.3%)	n = 7 (43.8%)	n = 4 (25%)
Visit Three	n = 4 (28.5%)	n = 5 (35.7%)	n = 5 (35.7%)

4B.4.2 REALD-30 word comprehension

At visit one, the lowest individual participant REALD-30 score for word comprehension was 1.5 and the highest score was 14.5 (shown in Figure 25). Mean word comprehension scores in sample groups showed that the lowest mean score result, at that visit, was shown in the Text group (5.4) with the Control (8), Phone (7.8) and Video (8.4) groups showing similar scores. The scores for visit three showed that word comprehension scores were increased in all sample groups (Figure 27). The greatest percentage increase in word comprehension was in the Control group (15%) followed by the Text (7%), Video (6%) and Phone (5%) groups (Figure 29).

Shown in Table 12, the results show that the majority (69%) of participants had moderate to high OHL based on word recognition alone. However, when comparing the mean sample group recognition scores (Figure 26) and the mean sample group comprehension scores (Figure 27) at visits one and three, scores were significantly lower for comprehension than for recognition of the same group of words.

FIGURE 24 Comparative individual REALD-30 word recognition scores in sample groups between visits one and three
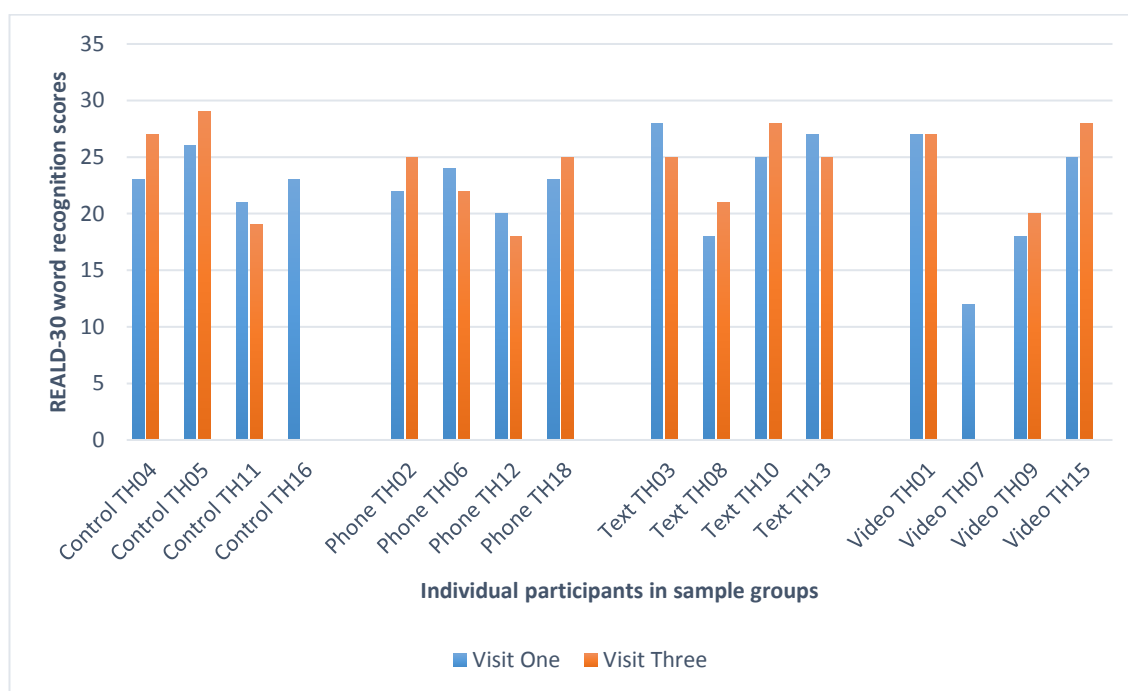
FIGURE 25 Comparative individual REALD-30 word comprehension scores in sample groups between visits one and three
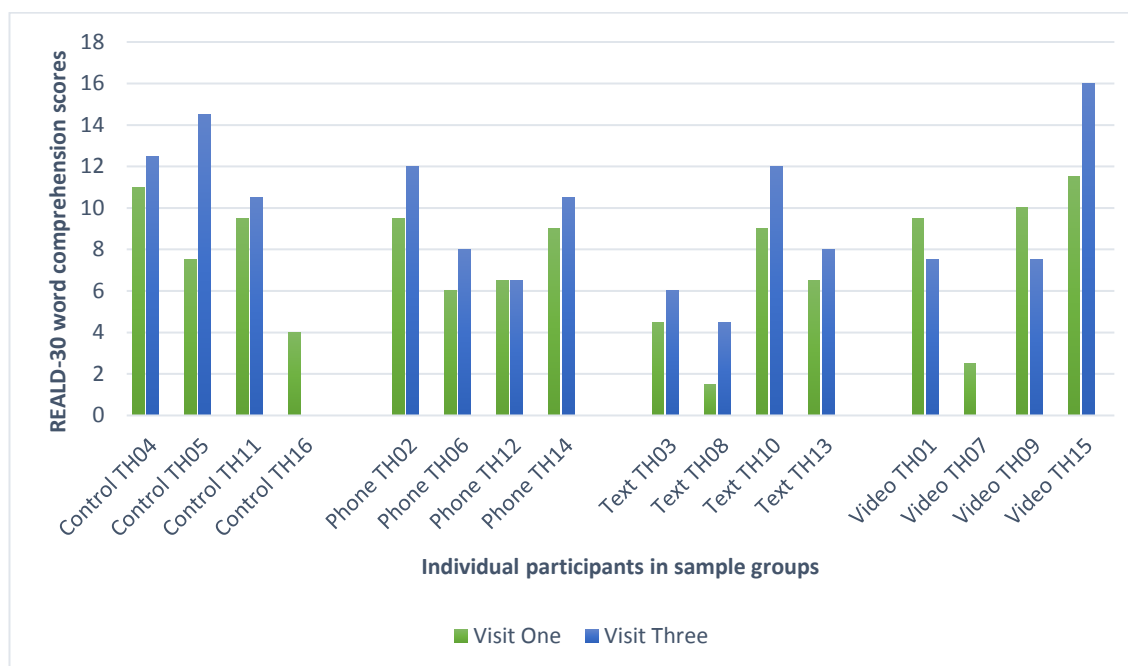
FIGURE 26 Comparative mean REALD-30 word recognition scores between sample groups between visits one and three
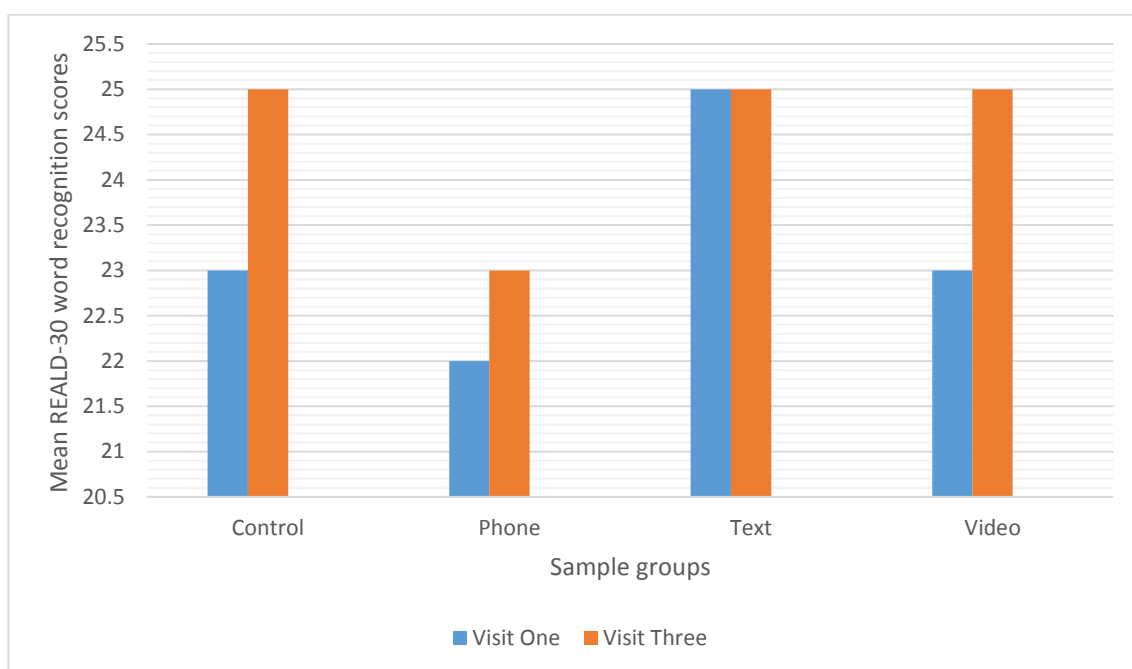
FIGURE 27 Comparative mean REALD-30 word comprehension scores between sample groups between visits one and three
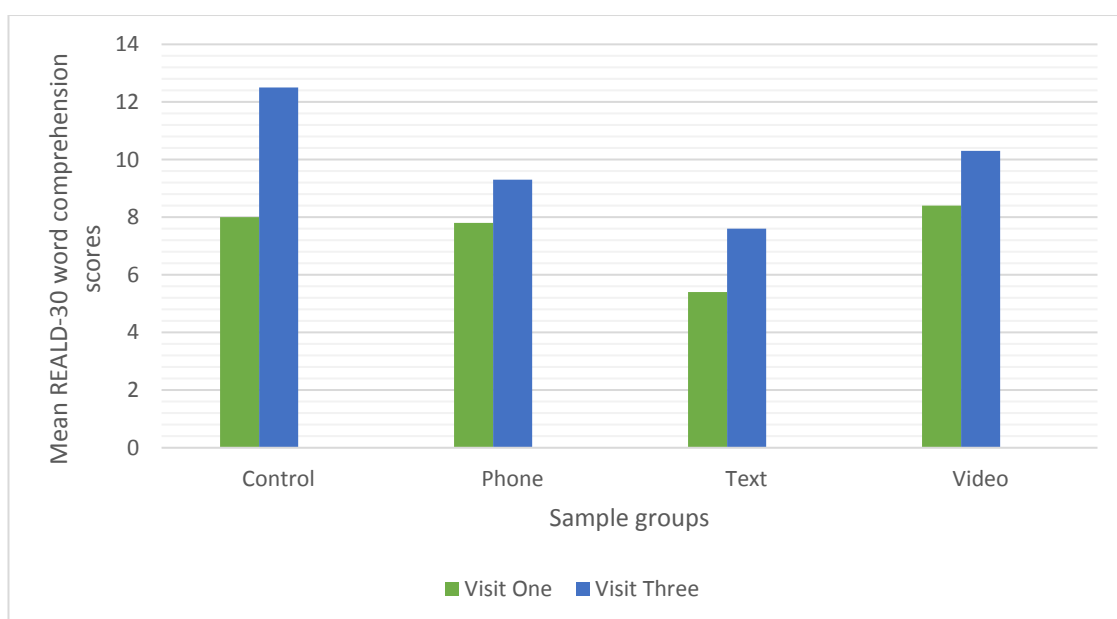
FIGURE 28 Comparative mean percentage increase in REALD-30 word recognition scores between sample groups between visits one and three
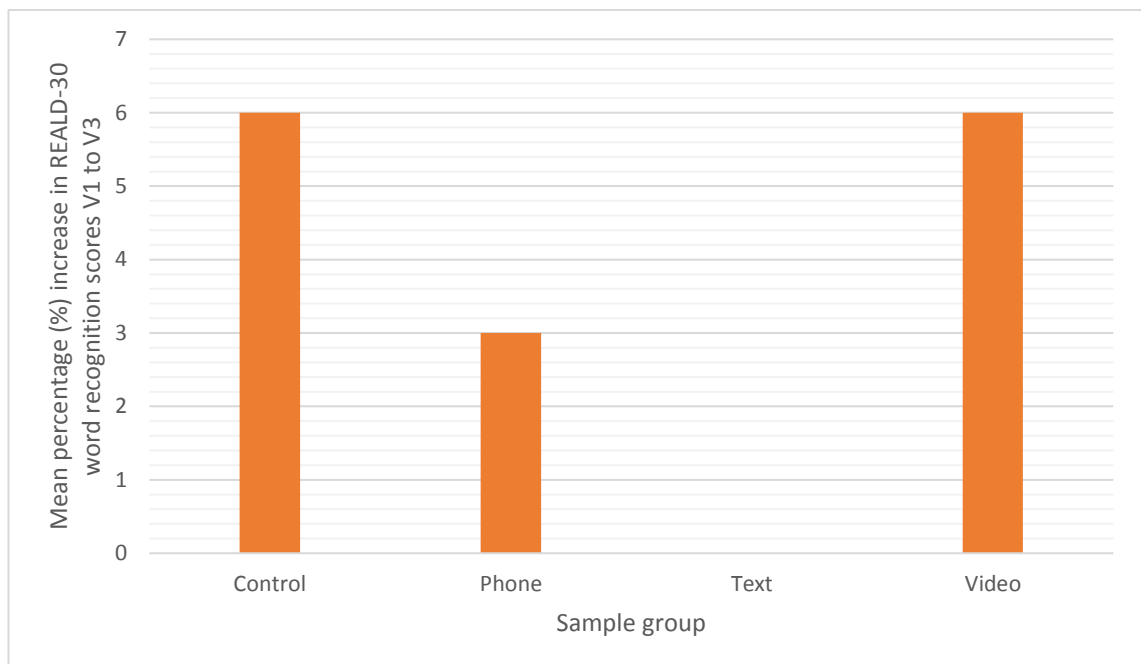
FIGURE 29 Comparative mean percentage increase in REALD-30 word comprehension scores between sample groups between visits one and three
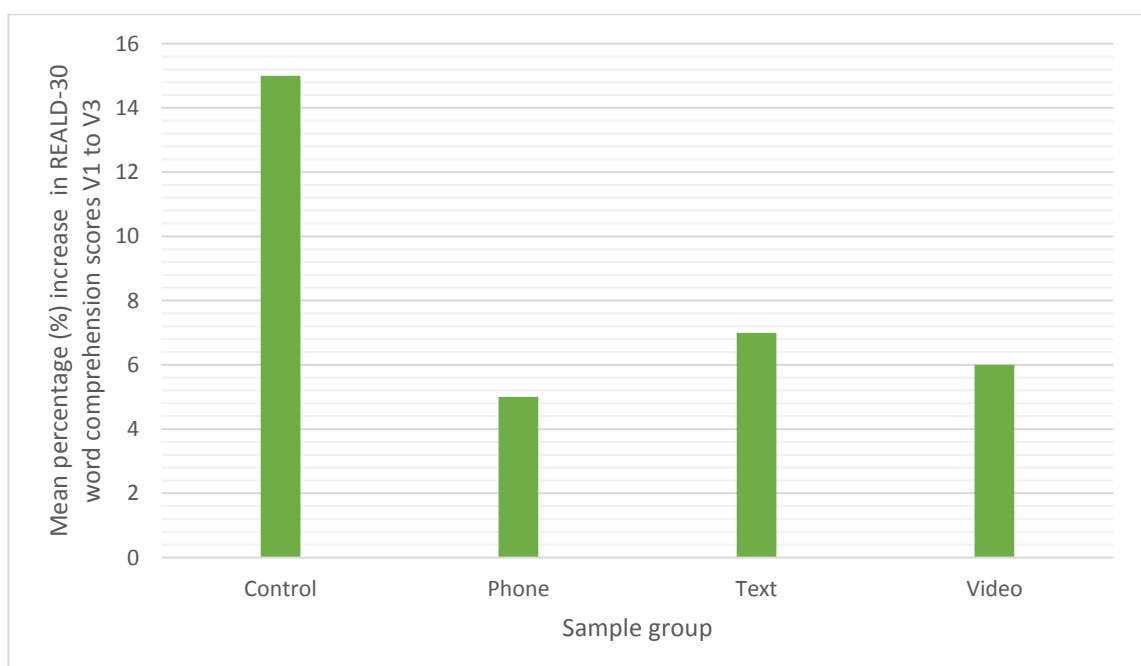
Chapter Four (Section C)

QUALITATIVE RESULTS

4C.1 SECTION C INTRODUCTION

Interviews were undertaken with all participants at visit three (described in section A of this chapter). The interviews provided insights into the experiences of the participants. This allowed a deeper understanding of their perceived realities, related to this study, to be recorded. This study's use of a semi-structured interview format using pre-set questions and prompts resulted in 'anticipated' themes more so than 'emergent' themes, particularly in relation to the mHealth intervention. The anticipated themes were the patterned responses or common experiences of participants while emergent themes were the unexpected perceptions and experiences that participants raised (Anderson, 2010). The 'anticipated' themes had direct correlation to study aim one (a), study aim one (b) and study aim two:

Study Aim One: Determine if a mHealth intervention using 'smart' mobile phones

> a. *could improve the oral health of the cohort, through improved oral hygiene efficacy, by complementing traditional oral health promotion*
> b. *was considered, by the study cohort, to be an acceptable way of communicating oral health promotion messages*

Study Aim Two: Determine which factors optimised the success of the mHealth intervention

The overarching themes that were derived from the thematic analysis were 'Barriers to oral health for young adults' and 'Motivators of oral health for young adults'. The data supporting these overarching themes, their related sub-themes and adjunct theme will be presented in Chapter Four (section C).

'Barriers to oral health for young adults' had two sub-themes: Self-perceived value of oral health and Lifestyle (of young adults). 'Motivators of oral health for young adults' had a sub-theme (Personalised healthcare experience) and an adjunct theme. This adjunct theme, titled 'Smart mobile phone as a lifestyle tool' and discussed in detail in section 4C.4.2, revealed the experiences of the participants in the Phone, Text and Video sample groups. These participants discussed their views and perceptions on the impact of receiving monthly mHealth messages as an adjunct to the traditional oral health promotion that had been provided in the clinical setting.

4C.2 THEMATIC MAPPING RESULTANT THEMES

The development of thematic maps one, two and three (TM1, TM2, TM3) was described in section 3.9.3 and shown as Figures 12, 13 and 14 (p.93-95). Regardless of sample group, TM3 best reflected the overall common experiences of the study cohort. Thematic Map Three (TM3) had two over-arching themes:

- **Barriers to oral health for young adults**
- **Motivators of oral health for young adults**

'Barriers to oral health for young adults' reflected factors that the study cohort collectively felt prevented them from having or maintaining good oral health. 'Motivators of oral health for young adults' were factors that participants felt encouraged and incentivised them to improve their oral hygiene efficacy and engage with oral health professionals.

4C.3 THEME ONE: BARRIERS TO ORAL HEALTH FOR YOUNG ADULTS

The over-arching theme 'Barriers to oral health for young adults' had two sub-themes: 'self-perceived value of oral care' and 'lifestyle of young adults' (shown in Figure 30). The participants provided insights indicating that these barriers are the result of a combination of factors: their lack of understanding around oral healthcare procedures, their ignorance about the impact of poor oral health and their predominantly negative impressions of oral health professionals. Put simply, the participants 'don't know what they don't know' and preventive oral health is not understood or valued as an integral part of general health. The 'busyness' of young people's lives was frequently raised by participants.

FIGURE 30 The relationship of the theme 'Barriers to oral health for young adults" to its sub-themes
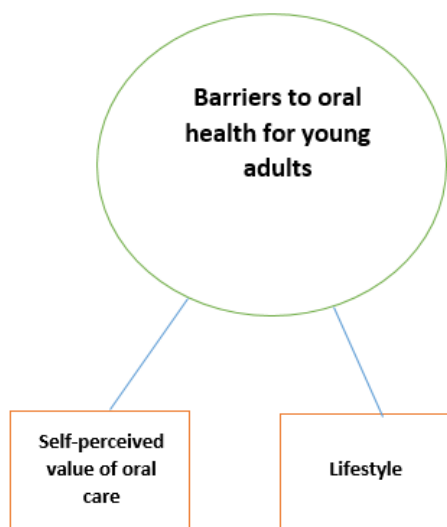
4C.3.1 Sub-Theme One: self-perceived value of oral health care

Participant's predominantly discussed three areas related to this sub-theme: firstly their oral health knowledge prior to enrolment in this study. Secondly, perceptions of their own oral health and self-care efficacy. Finally, participants shared their impressions of oral health professionals in NZ based on their prior experiences within the publically-funded child and adolescent dental service as well as non-funded private dental care.

Eleven participants provided insight on their oral health knowledge with most saying that they had limited oral health knowledge prior to coming into the study *("like I came into this study obviously not really knowing that much about oral health. Like I knew the basics or whatever")* with some of the knowledge gained whilst still at school (*I know that information because I've kind've had it all through school*).

Although participant awareness around the 'brush your teeth' message was evident, *("brush twice a day but I've always known that"; "yup, so I have always brushed my teeth, you know, twice a day…")*, the message appeared to be perceived as 'something one just does', without insight or understanding of the underlying disease prevention aspects (**"***cause you didn't actually want clean teeth, you just wanted white teeth or I did"*).

Further to this, three participants noted that they thought that they knew how to brush their teeth properly with a realisation that their tooth brushing efficacy was not as good as they had perceived it to be.

> *"especially considering yeah, especially considering I have being doing that for 20 years, I didn't know how to do it properly…perhaps I've heard…I think I've heard a lot of that stuff kinda before but yeah, but that was definitely not so kinda memorable"*

Four participants commented that they did not floss their teeth at all with one participant commenting that floss was only used to remove food that was stuck between teeth. Four participants commented that they did not perceive brushing and flossing to be important.

> **"***I didn't quite understand how important it was and how much it affects your overall health um, so this has definitely changed the way I think about oral health and like its importance I guess***"**

> *"where like before I wasn't really too like fussed if I didn't brush my teeth or floss"*

The influence of parents, rather than oral health professionals, on oral care habit formation was mentioned by two participants. Views were varied.

> **"***'cause I think I attribute my lack of teeth care to her. I actually blame it on her"*

> *"I think like I've always been…like the way my parents brought me up and stuff…like "you have to brush twice a day", there's no exceptions to it"*

The cohort seemed to have little knowledge of the role of the dental hygienist and the importance of preventive oral health care prior to coming into the study commenting that

> *"like while the dentists do work on oral health I feel that the oral hygienist kind of, kind've really focusses on…I'm not making this very clear but I feel like they really kinda focus on oral health and um, yeah…and the importance of that"*

> *"my first initial thought of oral hygiene and dental like hygienists were they were…they're…it's like a cosmetic thing not really so much a health thing but after talking to you about it and having the consultations and stuff I can kinda see that it really is directed towards health like just as much for me, probably more than cosmetic"*

No participants described dentists using positive terminology. Dentists were described as **"scary'"** by two participants, with a third commenting that **"people aren't fans"** of dentists. Dentists were also perceived as being **"pushy'"**, **"inspecting'"** rather than **"checking"** teeth and that they did this because they **"owned"** their patient's teeth. This sense of being 'judged' was described by one of the participants as

"you just go to the dentist six months later and they're like "why have you not being doing this?" and another who commented further that **"I know too many people who are like "ah, I never go to the dentist…you know they always give me a hard time for my teeth not being clean and this and that like""**. Although four participants assured the principal investigator that, personally, they did not mind the dentist, they still had strongly held negative views on dentists summed up by one participant:

> **"because it's really expensive and it's always relating to like bad things and they probably feel like in a way that they're getting told off indirectly for not maintaining their, you know, dental health properly".**

The perceived professional intent of dentists was raised with the credibility and motivation **("in it for the money")** of dentists brought into question by some participants:

> **"'cause, I'm not gonna lie, 'cause I remember when going to the dentist when I was in Year 9, Year 10, end of Year 12…I always go and I'd be told "ah your teeth are fine, teeth are fine, teeth are fine. You've got no um, fillings or caps or nothing" and I never really took care of them"**

> **"usually you know when you go to a dentist it's very "you pay a hundred bucks, they clean your teeth, tell you that you're doing alright, take some x-rays and you're out the door again".**

Cost was mentioned by four participants who described dental check-ups as *"expensive"*, with one participant citing this as the reason for non-attendance since turning 18. One participant had never been to a dentist and another cited being prompted to attend by symptoms.

"the last time I went to the dentist was when I had a wisdom tooth out and I went because I had to"

Unfortunately, dentists were not perceived to be 'engaged' in providing oral health education to their patients in any meaningful way. The oral hygiene education provided, if provided, was perceived as 'routine' and impersonal.

""oh you should brush better" but they didn't really specifically show or do it to me to show me exactly how to do it"

One participant's perceived dentists as *"just trying to fix the bigger problems, never really get time to talk about the underlying issues or maybe they don't want to? Maybe they're just going to wait until the teeth are falling out".* One participant commented that patients are expected to seek out their own oral health information.

"I hardly receive any information from my dentist. Yeah, there's pamphlets there, you can pick it up yeah"

4C.3.2 Sub-Theme Two: lifestyle (of young adults)

Participant's commented on the impact of their work and study commitments on receiving health information, regardless of the medium used to convey these messages.

'Busyness', mentioned by nine participants, was a strong focus. The role of technology adding to 'busyness' was cited by three participants

"you can get so easily distracted with today's timetable with technology and stuff"

Two participants mentioned this in relation to flossing their teeth:

"it's kinda time consuming as well doing the flossing"

"so it was like you know exams and stuff like that and then I kinda didn't floss as much, I'd maybe do it once a week"

Six participants cited the 'smoking is not hot' message as being the oral health message that was least memorable or least relevant to them.

"well I guess like the smoking thing because I don't smoke so it doesn't apply to me"

"I don't smoke so I didn't actually care about it to be honest"

These participants all commented that, in general, regardless of how a health message was relayed to them, that they ignore any message that they do not perceive to be applicable to their lifestyle.

For the study cohort as a collective, there were barriers to retrieving electronic messages or voicemail. These barriers were varied and ranged from 'busyness' leading to forgetting about received messages *("I was busy at the time so I kind've saw it, didn't really…like skimmed*

over it but didn't really read it and didn't go back to reading it either 'cause I'm bad for doing that um…yeah so that's probably why I…also a reason why I haven't taken it all in") to cost barriers in retrieving electronic messages.

> *"it just depends on whether I had credit at the time"*

> *"as long as it doesn't like cost me in any way it's fine".*

These identified barriers did not pertain specifically to any sample group (Control, Phone, Text or Video). The barriers related to the general experiences of all the young adults in the study, all of whom used mobile phones as a lifestyle tool.

4C.4 THEME TWO: MOTIVATORS OF ORAL HEALTH IN YOUNG ADULTS

The second over-arching theme 'motivators of oral health in young adults' had one sub-theme: 'personalised healthcare experience'. This sub-theme had an attached adjunct sub-theme: 'smart mobile phone as a lifestyle tool'. The adjunct sub-theme specifically described the experiences of each sample group where mHealth interventions had been provided. The relationship between the overarching theme and its sub-theme and adjunct theme is shown in Figure 31.

FIGURE 31 The relationship of the theme 'motivators of oral health in young adults", its sub-theme and attached adjunct sub-theme
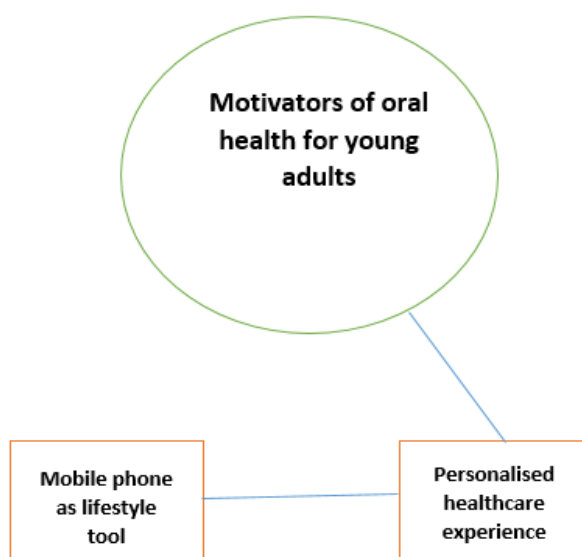
4C.4.1 Sub-Theme: personalised health care experience

Regardless of the participant's sample group (Control, Phone, Text or Video), the results of the thematic analysis showed that young adults were motivated to improve their oral health when they perceived two things. These were firstly, that the oral health professional 'cared' about them as a patient and secondly, that the oral health professional was focussed on helping them, as a 'valued' individual, achieve and maintain a healthy mouth through a personalised approach to oral health education and oral hygiene information.

> *"…that first appointment it was quite like focussed on my oral health and how I was going to better it and kind've…without sounding like selfish…but it was more focussed on me you know and it was very one-on-one"*

> *"whereas a lot of clinicians don't do that…they just say "this is what's wrong with you, you know, this is how you fix it" that's it. They don't really give you that depth"*

> *"Um and I think that was quite good 'cause I trusted you a bit more, I guess. I don't know if trust is the right word but kind've respected you because you gave me knowledge"*

> *"I would like to say thank you for changing my perspec (sic)…that word (laughter)…yeah, it has impacted me a lot"*

In-surgery oral health education and oral hygiene instruction was provided to all participants in this study. The perceived personalised provision of this oral health education, delivered in a hands-on manner, was impactful on the participants in this study. Participants claimed that they were keen to learn new skills and felt empowered by new knowledge. This resulted in an increased trust and rapport with the clinician, described by participants, and a sense of self-empowerment. The importance of preventive oral health care was highlighted for some participants.

> *"I think just because of how the study was set up I felt more respected and trusted I guess"*

> *"…doing that follow up from the diagnosis to the follow up was more specific to my needs rather than just saying like…you know you go to a doctor and say this is what's wrong with you, take these drugs and you'll be fine whereas this was more focussed on for the future so it doesn't happen again, let's take these steps so I think that was really good um and I think if people started doing that a bit more it would probably make everyone's oral health a little bit better"*

Participants discussed their experiences of the oral health education and oral hygiene instruction sessions with particular reference to three impactful experiences: the principal investigator demonstrating correct brushing and flossing techniques in the participant's mouth; the visual impact, for participants, of seeing disclosed (dyed) plaque-biofilm on their own teeth; and the provision of five directed oral health education messages via a PowerPoint slide presentation.

Ten participants commented on the way in which they were taught how to brush and floss their teeth correctly. The principal investigator's approach to teaching these techniques was well received by participants who said that the demonstrated brushing and flossing techniques

appeared 'achievable' *("aah, it's actually really easy")*. One of the participants described how, since the study, they now floss using a 'c-shape', a description used by the principal investigator during oral hygiene instruction, illustrating participant focus on the delivered message. Others remembered the personalised aspect of the message.

> *"I definitely floss properly now with the c-shape"*

> *"it was 'cause like you demonstrated on me pretty much so I could feel what…what it was meant to feel like whereas which can actually impact how you brush your teeth quite a lot because you know it's about how you… you know…you can't really see unless you look in a mirror so it's about how you feel. Um, so I think that was really good"*

> *"yeah and then even in the first appointment like I remember you asking me if I was left or right handed and, cause one of the sides weren't getting as well brushed as the other one which is why I make sure I do it evenly now"*

Seven participants further commented that the teaching technique used raised their awareness and motivated them to brush and floss better and more frequently after visit one. Words that were frequently used to describe the participant's experiences were 'helpful', 'motivated', 'useful' and 'valuable' as well as making them more 'aware':

> *"being shown how to do stuff I found really helpful"*

> *"more motivated to brush my teeth the way you showed me"*

> *"I think knowing the places I need to brush like gives me a really good motivation to keep that up"*

> *"I think the information that you gave me about flossing and about brushing and how…you know a better way to brush my teeth, I found that that was very useful"*

> *"and then you also taught me how to brush and floss properly Well it made me a lot more aware of why um flossing is good and I hadn't really done that up until you told me about it"*

Self-perceived personalisation of messages pertaining to oral hygiene techniques was viewed positively by participants, but the use of disclosing solution (dye) as a visual aid to oral hygiene instruction, was hugely impactful as a motivator for participants. Using disclosing solution was considered to be a "*really good way to learn 'cause you're shocked by your own poor oral health".*

The impact of seeing the amount and distribution of plaque-biofilm on their own teeth, as an adjunct to oral hygiene instruction, acted as a non-verbal 'communicator' and 'motivator' for participants.

> *"I think because I could see that the, um, that the plaque between my teeth…it was, it was mainly between my teeth and I really did need to floss um, and that you were kind've showing that there was quite a lot…quite a lot actually around my gums and that kind've flossing up into the gums would help clean that out, um, that kind've motivated me to floss more"*

> *"so I started actually focussing on trying to get it good. I think that kinda actually really motivated me that first session, just seeing the dye and then going back for*

the second session getting the dye again and it was not as bad the second time and I was like "I actually doing alright" so I'll keep doing what I'm trying to do so…"

Nine participants discussed the impact of seeing the 'dye' on their teeth. Participants described the visual in various ways which included being 'shocked', being 'fascinated' or feeling 'embarrassed'. One participant described the visual as being 'stuck in my mind' further commenting that this was not a literal thing but more of a 'call to action':

"but do I see like blue dye on my teeth, probably not but it does definitely trigger something in my mind if I'm kinda being a bit lazy and just go "aaah" (demonstrates) to do it properly"

Similar thoughts were expressed by a second participant who commented that

"the one thing that I think about almost every time I brush now is with the dye"

One of the participants described disclosed teeth as being 'beneficially gross'! This reflected the feelings of five of the other participants who described how they felt about being able to 'see' the amount of plaque-biofilm and the impact of the realisation of how poor their oral hygiene techniques had been:

"they had a lot of plaque on them, um, and I think seeing that…and seeing that, I think you just showed me that my gums were inflamed and that they were red and they shouldn't be red, that they should be pink, um, I think those particular things were quite helpful"

"but also the dye really showed me where I wasn't brushing"

"like the dye umm thing that we did made me realise how little I was getting in there and needing to brush two teeth at a time"

"ah well like when you did that blue thing and I could see like, like the plaque and stuff that sort of motivated me to brush my teeth a bit more"

"I think definitely after the first time I'd seen visually like the…like the dye in my mouth, I think that was like good motivation to like floss and like brush more and stuff…cause it's definitely shocking like seeing…visually seeing that"

Whilst participants provided insights into their perceptions of receiving oral health educational messages via a 'PowerPoint' presentation, this aspect appeared less impactful or motivating than intraoral OHI or the use of disclosing solution.

The most memorable oral health education message for participants was the 'impact of oral health on systemic health' message. The gist of the message was remembered, clearly understood and commented on by four participants:

"I think the most memorable thing for me and this for me was probably because I wasn't expecting this, um, was that oral health is actually related a lot holistically to your health and if you have bad oral hygiene it can actually affect other kinda subsystems within your body, um, yeah, I think that was kind've the most, the most memorable message for me yeah, 'cause I wasn't expecting that and I thought it was all quite isolated and it's actually not"

> *"I think that main thing was when you were telling me about how like how oral health was kinda connected with all other health so like a healthy mouth is a healthy body type thing so that was kinda the main thing that stuck with me"*

Four participants recalled the 'impact of tobacco on oral health' message. Some participants remembered aspects of the delivered content of messages or their attached catch phrases. Some foci of the messages or catch phrases was forgotten over time or the message intent was distorted.

> *"I remember at the first appointment seeing information about like smoking possibly and like how it's bad for like your health and how it affects like your overall health or…no it was about how your overall mouth health…oh, there was something about smoking as well and then there's something about how your overall mouth health affects and is like connected with your overall health of your body, something like that"*

The oral health education message focussed on the importance of twice daily tooth brushing and daily interdental cleaning with the attached catch phrase of 'be a control freak' was remembered as

> **"maybe like…be a perfectionist twice a day or something…something like that. That's the only one I remember. It's the only thing I…it's the only one I remember"**

Five participants spoke about the 'hard copy' pamphlet of the PowerPoint slides that they were given to take away with them after visit one. Two reported losing the pamphlet straight away. Three retained the pamphlet with one reporting that it got lost during a subsequent house move. The remaining two kept the information but did not refer to it again.

> *"Yeah, I kept the piece of paper that had like the slides on it and the definitions of the words but I didn't really look at them again"*

Five participants felt that being a part of the study had directly increased their understanding about oral health and oral hygiene and that they felt more educated in this area.

> *"first I used to think about my diet, now my oral health is another thing…because of the study"*

> *"I think I'll carry on doing what I was doing before because I now have the education to be able to look after my teeth more"*

> *"I've learned, like I've learned quite a lot so that's good. Yeah, it's been good"*

> *"Um, flossing…I started that because of the telehealth study"*

> *"I think afterwards I realised that you do actually need to like brush your teeth to keep on top of it to maintain like healthy gums"*

> *"I think 'cause you taught me how to brush and how to floss properly I was more likely to go and actually do it now that I know that I need to do it and I need to do it properly so…"*

Twelve participants reported increased motivation around brushing and flossing immediately after visit one with three participants reporting that they went out and bought floss with one buying a powered toothbrush.

> *"then after my first appointment I went out and I kinda bought it…flossing. It used to bleed…my teeth used to bleed so I stopped and then I started again for…after the second appointment"*

> *"so you told me about flossing and I rarely flossed before that and I really wanted to floss and I bought some floss maybe few days later and then I used it and it ran out and I just never bought it again until the second appointment, um, until after the second appointment, um but I did make more of an effort to take more time to brush my teeth, to brush on the sides that were showing the most plaque, um, behind as well 'cause that had a lot of plaque there as well, um, so yeah I was a lot more motivated after the first, yup"*

> *"um, I'm definitely going to continue flossing that's for sure 'cause every time you start out flossing again you just see that…your mouth just red and that manky stuff all over the floss and it's just like "I don't want that ever again. That just smells grotty. I don't want that near any other people". Um, so that is definitely gonna change. Um, I'm pretty sure I'm going to keep it up. Um, I'm quite certain of that 'cause it's a routine now"*

> *"probably reasonably motivated I'd say 'cause I remember there was a feeling that I wasn't doing the flossing or umm brushing twice a day at some point umm like so I went from maybe brushing once a day to trying to make an effort to brush twice a day and flossing at all as opposed to never"*

Five of those participants, though, felt that over time their motivation waned, but that subsequent appointments or other forms of reminders did impact and increase motivation levels again.

> *"I feel like coming straight out of that appointment I was "okay, I am going to try really hard" and then it kind've died off but then I saw you the next time and then it…I would receive a text in between there and I'd try really, really hard. I think…so I think it was quite high and just actually knowing what to look for and like what spots in the mouth I hadn't been cleaning is much, has really made me become aware of where I need to clean them like a lot more"*

> *"um and then after that visit I kinda got more active in brushing my teeth and then there was a period I did fall off for a little bit and I got straight back onto it but a lot more motivated"*

> *"so after that first appointment you were like "you need floss, try to floss" so I went and bought floss and I flossed for like a month every day and I actually did it and then at the second appointment I remembered about it all and then I started doing it again. Um and now I don't do it again"*

The impact of the overall in-surgery oral health education experience motivated and empowered the participants to not only strive to improve their own oral health, after visit one, but also to share oral health messages with others. In most cases, the oral health message that had impacted the participant the most was the message that was shared with others.

Messages were shared with close family and associates of the participants including friends, partners, flatmates, immediate family, classmates and workmates. Many participants used words of empowerment and intent like 'told them' when describing how they had shared the message.

In some cases this extended to the participant's expectation that the shared oral health message should provoke action in those with whom they had shared the message!

> **"it's made me learn things like it's made me look after my oral health a little bit better and have conversations with other people about theirs and stuff like that yeah"**

> *"like I make sure he like gets up and brushes his teeth and flosses them with me as well so and I've encouraged him that he needs to go get like a check-up 'cause he hasn't been since he left school"*

> *"cause I got really preachy to mum 'cause she brushes her teeth like 10 seconds and thinks she's fine. I tried to force mum into brushing her teeth more which I think is a good thing"*

> *"I shared like how to floss and brush with my family because my dad was showing um how he brushes his teeth. I don't know how it came up and then I was like "Ah, I know how to…" and then I told them how you hold the floss as well"*

> *"yeah, or like if I had…not necessarily an argument, but like a debate with someone else about…like my flatmates…I would always tell them "make sure you brush your teeth before you go to bed" just because I'm like the mum of the flat essentially so it would always feel like a little joke and then they'd like try and bring up some fancy rule and I was like "well actually, I'll tell you what the dentist told me""*

> *"if we're like brushing our teeth together I think I might have told her a few times when she's flossing that she could be doing it a bit differently"*

Participants in the 'phone', 'text' and ''video' sample groups discussed the impact of receiving monthly motivational and educational oral health messages as an adjunct to the in-surgery information and education that they had received.

4C.4.2 Adjunct sub-theme: smart mobile phone as a lifestyle tool

The primary themes discussed by participants in the Phone, Text and Video groups related to firstly, the acceptability of the content and format of the mHealth message, secondly, the educational and motivational impact of the mHealth message on the participant and finally, the impact of the perceived 'personalisation' of the mHealth message received.

A summary of the qualitative findings related to research questions one and two are presented in Table 13 under the following headings:

- Acceptability of message format
- Educational and motivational impact

Comparative participant 'key quotes' in support of these findings are provided in Table 14.

A summary of the qualitative findings related to research questions one and three are presented in Table 15. Participant 'key quotes' in support of these findings are presented in Table 16 under the headings:

- mHealth as an adjunct to professional clinical care
- The perceived 'personalisation' of the message received

Table 13 Summary of the thematic analysis findings related to the acceptability of the smart phone format and the educational and motivational impact of the mHealth intervention

	Acceptability of message format
Phone	The majority of participants in this group thought that receiving a phone call message from a clinician was an acceptable way to communicate oral health promotion messages. One participant commented that it was unusual for young adults to receive phone calls of this nature, describing the experience as both 'awkward' and 'interesting'! Another participant commented that the messages all sounded the same and described the voicemail message as 'not memorable', although, at the time of the interview, this participant said that the voicemail, left by the principal investigator, had not been deleted from their phone.
Text	All participants in this group liked the SMS format due to its familiarity as a form of communication frequently used by young adults, regardless of ethnicity. In this regard, one of the participants commented that "I **mean, I wouldn't really say that Māori people are less likely to look at their texts than…I mean we're just 18 or 19 or 20…"** The participants spoke positively of the content of the messages describing that they had read them because they were 'clear and concise', 'easy to understand', 'small' and used 'simple' language. All participants had retained the messages on their phones, although seldom re-read them once received.
Video	All participants in this group liked the 'innovative' format and content of the messages that they received, describing the message as 'nice and simple'; a 'quick read and a little reminder' about oral hygiene. The interactive nature of this format was described as an appropriate approach for young adults and a better option than using email to send information. Participants liked learning new information from the video clips but also commented that the format didn't require immediate feedback and that they could 'do it in their own time'. Participants did make an effort to respond to the principal investigator. Responses showed evidence of seeking out the correct information and responding, as requested, to the principal investigator in a timely manner.

Educational and motivational impact	
Phone	Overall, participants in this group felt that the phone calls acted more as motivational oral hygiene behaviour 'reminders' rather than as an means of providing oral health education. However, two participants did comment that the phone calls did impact positively on changing their dietary choices in regards to their frequent consumption of carbonated soft drinks.
Text	The texts messages were predominantly described as 'reminders' which impacted on the participant's motivation in regards to their oral hygiene practises and lifestyle choices. Despite, participants commenting on the messages having been read, participants could not recall details about the messages.
Video	All participants in this group liked being provided with further learning opportunities to support the oral health information that they had already been given. The websites provided were considered to be 'informative' and to have provided 'reinforcement' of the information already provided to participants.

TABLE 14 Key quotes from 'phone', 'text' and 'video' groups in support of acceptability and the educational and motivational impact of the messages

	Phone	Text	Video
Acceptability of the content and format of the message	*TH02: Umm, yeah I thought it was good. I thought it was a little bit awkward on the phone call 'cause it was kinda like I was being told a fact but then that was it like…I mean I'm probably just not used to getting phone call reminders so yeah, it was interesting.* ***Did you like the format that I communicated with you?*** *TH06 Ah yeah* *TH12 Um, to me they kinda almost all sounded the same like um, it kind've just felt like the same thing, I guess maybe 'cause I…I mean voice messages for me…I don't pay partic (sic)…a huge amount of attention. I kind've get the gist of it* *TH14 the phone calls were pretty good, I'd say*	***Did you like the format that you received those messages in?*** *TH03: Yeah* *TH08: It was just one sentence like simple and clear rather than like a block of information…I used to read them because they were little* *TH10: Aha, they were clear and concise, um not too many words…yeah, just straight to the point yeah* *TH13: Um….yeah, yeah I guess 'cause it's something that I use every day so it's not going to go un-noticed. Um, like all my texts, I read them and…just I guess took the information in…yeah*	*TH01: Yeah, I thought it was really innovative and um, it's nice 'cause obviously I've always got my phone with me so it's nice to just have those little reminders coming through.* *TH09: Um, so I like went on the links and had a look at those, um, and then like I said it was a good reminder for me to that I need to do like the flossing and the brushing twice a day…those sort of things* *TH15 I think having the video message was nice because I could do it when I needed to.* *Um, I think particularly in this age group, um, it's good to have things that…where you're getting us to do things, so getting us to go and read an article and find a particular ah, a particular thing in the article and then text it back. I thought that was quite good um and specifically for this age group*

	Phone	Text	Video
The educational impact of the message	*TH02 I think the least memorable one was the smoking one. I didn't really remember much…something about smoking and it being bad for your teeth* *TH06 Um I think the last one you…that was the most memorable…I still remember what you said when I asked about "is teeth whiteners okay?" and you said it was okay as long as it's got fluoride.* *TH12 Like they were like a good reminder about the things that you told me on the first session but I wouldn't say I picked up anything extra from the actual messages.* *TH14 No there really wasn't any that I thought weren't worth listening to. Like they were all very helpful but I just can't like…it was a while ago. I just really remember the soft drink one.*	*TH03 the most memorable ones were just the…the facts that you wouldn't really expect to be facts* *TH08: I remember tooth decaying…was there one about smoking…I don't know…yeah, yeah I think the tooth decay, I remember. It's the only thing I remember…the word* *TH10 Yup, I got some texts um about smoking…um, I can't remember all of them* *TH13 I know some of them were like anti-smoking that's bad for your teeth and I know some of them were "remember to floss"…like flossing's good. Um…I couldn't tell you the rest, I'm sorry but I…*	*TH01: Umm, the sugary drinks one was definitely the most memorable and the probably least memorable…I think there was one about smoking and just 'cause I don't smoke, I was like oh that's not really, like applying to me.* *TH09: Um that…I think it was the five or six wayses (sic) of brushing your teeth or the brushing your teeth one anyway…that's probably the one that's like stick…stuck to me the most* *TH15 Um I think the most memorable thing for me and this for me was probably because I wasn't expecting this, um, was that oral health is actually related a lot holistically to your health and if you have bad oral hygiene it can actually affect other kinda subsystems within your body. Um, I think potentially the least, the least memorable message for me, um, was maybe about smoking.*

	Phone	Text	Video
The motivational impact of the message	TH02 'cause I was reminded that I had to keep on top of it like…like it wasn't like a guilt trip but it was like a gentle reminder that "by the way you need to remember" and like I thought "ah, yes, I'd better remember to floss and brush and all those sorts of things" TH06 It was sort of like a reminder like every time you called like "ah I gotta keep up", like for myself I have to keep push.., ah your calls were sort of like a reminder to…that my teeth are important and it does affect everything else like my health TH12 I would say it was like a good reminder to remind me and like motivate me to keep brushing but I wouldn't say I'd like…it was more of like a reminder than anything else I guess. TH14 Yeah, it was a really good reminder…ah, every time I got the reminders I would put more effort in as well for that week	TH03: I felt like it was useful. It kept on reminding me to take better care of my teeth in terms of hygiene TH08 um, the effect of the text messages was like I only drink fizzys once a week now, yeah…Ah, sometimes I'd be eating food at MacDonald's and drinking and I'd get a message. Sometimes it did stop me. I didn't drink…it reminded me about that. I think it's pretty good, for me and for my teeth ***Do you think that in any way, that motivation was impacted by you receiving messages from me in the interim period?*** *TH10: I don't think so I think it was me wanting to do…to have healthy teeth* TH13: it was a reminder yeah	TH01 Just getting that kind of "remember brush your teeth, dental health is important is really good to think oh yeah. I think dentists should definitely take up the whole sending messages. I think it's a really good idea. It's really motivated me to be better with oral health TH09 and then like I said it was a good reminder for me to that I need to do like the flossing and the brushing twice a day…those sort of things TH15: I think particular ones helped to motivate me.

TABLE 15 Summary of the thematic analysis findings of factors that optimised and best supported the mHealth intervention

mHealth as an adjunct to professional clinical care	
Phone, Text and Video	At least one participant in every group commented that the oral health professional's mHealth intervention messages served to reinforce the oral health promotion information provided at the clinical appointments.

Impact of the 'personalisation' of the message	
Phone	Of the three mHealth methods used in this study, the phone group experienced the most personally 'interactive' form of communication. One of the participants thought that this was an effective form of communicating oral health messages because "I was talking to somebody about it". Words used by participants to describe the interactions were 'friendly' and 'helpful'. Further to this, the interaction was described by participants as 'personal' and was positively perceived because the principal investigator was 'investing time wise' in them.
Text	One of the participants reported feeling more 'rapport' with the principal investigator because of the text messages received between professional clinical care appointments. For one of the participants, a text message without an attached sender's name meant less 'connection' to, and ''trust' towards, the sender. The rest of the participants were indifferent to this aspect of 'personalising' text messages, although they did comment that they had just presumed that that the oral health promotion messages were sent by the principal investigator. Interestingly, no participant texted the principal investigator back to check the source of the messages.

Video	Participants said that they liked seeing a 'familiar' face on the MMS message that they received. They felt that this 'interaction' made them feel more 'comfortable' and 'connected' with the principal investigator who was perceived to 'really care'. One participants felt that this was the result of being able to 'see' the principal investigator on the video and being able to 'read' her intentions through her 'non-verbal' communication.

TABLE 16 Key quotes supporting factors that optimised and best supported the mHealth intervention

	Phone	Text	Video
mHealth as an adjunct to professional clinical care	TH12: …like being busy with like Uni and like everything like that, like I'd kind've forget about it so I feel like when…the message would reiterate kind've the whole message I took away from like the first sessions and stuff	**Do you think that in terms of your motivation…um, just having had those two appointments, would that have been enough or do you think receiving the messages…**TH08: I think both…both impacted, yeah TH13: Yeah, it brought my….everything that you kinda told me in those…in that first session…kinda just brought it back up to the front. When you receive those texts and you'd see telehealth study I would be (clicks fingers) "back up to the front" and "oh, this, this, this and this" yeah.	TH09: I thought it was really good because it was like a little reminder for me to be doing the things that you've told me that I need to do and learning more about like the little clips and the links that you'd send me to TH15: Yeah…I think it did reinforce and I remember specifically the first message that I got…and I, I forgot the question um, which is odd but I remember the information and the information was about um, what…like how um bad oral hygiene affects…um, affects someone and I think one of them was talking about…it affects someone's…someone's perception of their, of themselves and I remember that being, particularly being reinforced and remembering "ah yeah, that's right". Um, yeah I hadn't thought of that before so I think it was…yeah it definitely did reinforce the information.

	Phone	Text	Video
The perceived 'personalisation' of the message received	*TH02 no it probably was effective the way I got it because I was talking to someone about it. I think that it was effective enough. TH02 it was probably laziness but it didn't feel like it was all down to me. It was actually like "I'm going to remind you to do it".* *TH06 Ah yeah, it makes it more like personal and like you…sort of following up for like you. Um it's more than a clinical patient relationship when you call…yeah* *TH14 Yeah, I'd prefer it to be someone I know saying the message 'cause otherwise if you don't know them you don't really know to believe them or trust them sort of thing*	*TH03: No like 'cause I wasn't certain that the message was from you but I think it kinda makes it better if you know who the message is from* **So if I'd put my name to it, would that have been more positive for you?** *TH03: Yeah, 'cause there is more of like a sense of trust there. I don't know, I think that there's people behind the messages that are being given and that just makes it more authentic and something that I can connect to 'cause there's a person behind it but if it's just like a blank message it's kinda hard to connect to* **Okay, ah the fact that it wasn't signed from me, was that an issue for you?** *TH10: I think maybe the first one I was a bit confused but then realised that it would have been from you* *TH10: I think so. I think that, that enables more rapport to be built instead of just not*	***Do you think having received these messages or communications from me personally altered your relationship with me?*** *TH01: Yeah, I think it makes you kinda a bit more…I don't know, it's hard to explain…Just kinda like a bit more open kind of, but having that kinda 'back and forth' communication made it a lot more comfortable, I'd say* ***And if it had've been someone else's face, do you think that would have made a difference?*** *TH01: Umm, if I was coming to see you as a dentist and it was someone else it probably would have made a difference. But also it was really nice just kinda thinking like "oh my dentist actually really cares about my teeth". Like that was a really nice aspect of it.* ***So I was obviously on the video that you got…If it had been somebody else, how would you have felt about that?*** *TH09: Um…I guess I, we…I probably wouldn't be as connected 'cause I wouldn't know who they were but I don't think it would make that much of a difference*

		hearing from you um yeah, I think it did make a bit of a difference *TH13: I knew that the only person that I'd seen about my teeth and that wasn't the dentist that usually sends stuff in the physical mail was you and I thought "okay well there's only one person this could be from". All my texts don't have like signed off by Rachel so it was a normal text*	***so it was more about the message for you*** *TH09: Yeah and that reminder, yeah* ***So if it had been somebody else in the video…****TH15: Um, I think because I know you and because we kinda built, um, a relationship through the sessions that we had, um, I don't think it would have changed what I did but it was, it was kinda nice having a familiar face* *TH15 I get to see you and your emotions around things and like sometimes in messages you can misread a person's um…like if someone's cross with you and not that any of the messages that you sent were of that nature, um but, yeah, I think that your intentions were more clear and I think that that kind've did reinforce the relationship because I didn't think "oh she's…she's cross with me or she's um.. yeah kind've misread your intention behind it.* *TH15 I feel like we've kind've developed quite a good professional relationship that I feel quite comfortable telling you things and I think potentially if that relationship hadn't been developed I might not have told you certain things that, yeah, might be a bit, a bit more personal um…*

4.3 CHAPTER FOUR CONCLUSION

Chapter Four has presented the descriptive results (Section A), quantitative results (Section B) and qualitative results (Section C) for this mixed methods study. Section A described the sample and included a description of the recruitment and interview processes. Participant characteristics for the study cohort which included descriptions of gender, ethnicity, area of study and tertiary provider attended were described. Section B presented the quantitative results (Oral health questionnaire, OHIP-14, Plaque Control Record and REALD-30) in support of study aim one (a) and (c). Section C presented the qualitative results. A description of the analysis of the qualitative data, using thematic analysis, was provided. The qualitative results presented in Section C were used in support of study aim one (a) and (b) and study aim two. A discussion pertaining to the integrated quantitative and qualitative results, and how they relate to the research aims and research questions posed in Chapter Two, will be presented in Chapter Five.

Chapter Five

DISCUSSION

5.1 OVERVIEW OF THE CHAPTER

This chapter will discuss the results, presented in chapter four, in relation to the hypothesis and the study aims. The chapter will begin by reiterating the opportunities that mHealth offers and the aims of this study in that context. This will be followed by a discussion of the significant findings in relation to each of the study aims as well as the findings of other mHealth studies. The unexpected findings of this study will be discussed. The strengths and limitations of this study will be identified and acknowledged in relation to the results. The chapter will conclude with a discussion on the possible implications of the findings in this study on dental and oral health clinical practice in NZ/Aotearoa.

5.2 BACKGROUND TO DISCUSSION

A global proliferation of mobile phones in recent years has led to their use as a cost-effective platform for the delivery of health services and messages (mHealth) across geographic boundaries. mHealth has been touted as "an important tool to reduce the global burden on health care by providing more effective disease prevention and management support" (Cole-Lewis & Kershaw, 2010, p. 67). This is because mHealth has the ability to provide reminders, cues to action, prompts, reinforcement and feedback, all of which promote behaviour change (Riley et al, 2011; Hashemian et al, 2015).

Acknowledging the opportunities that mHealth offers, this mixed methods study set out to determine if monthly mHealth OHE messaging could improve oral health and OHL in a small group of young adults (18 to 24 years old) when used as an adjunct to OHE and OHI provision in the clinical practice environment. Consideration was given to whether this form of health communication would be acceptable amongst this cohort and whether there were particular factors that could optimise the outcomes. Three different smart mobile phone functions (telephone conversation, SMS or MMS) were used to deliver OHE messages respectively to participants in the Phone, Text or Video sample groups over five consecutive months. These OHE messages were designed to support the oral health promotion provided to all sample groups (Control, Phone, Text and Video) in an oral health clinic at baseline and after three months.

An overview of the significant findings of this study in relation to the aims can be found in Table 17. The principal investigator in this study accepts that the sample size, together with random sampling and participants all being resident in one New Zealand city may have impacted on the generalisability of this study. This in turn may have resulted in an unintentional bias. However, equally, as the participants had equivalent levels of education and came from the same

geographic region, there were fewer variables to influence the outcomes of this study. These factors may therefore be both an acknowledged limitation and a strength of this study and the findings should therefore be interpreted accordingly.

The qualitative data that was derived as a result of mixing methodologies in this study provided some unexpected findings that could be of significance in clinical dental settings. These will be discussed in the context of the significant findings and the possible implications for oral health and dental clinical practice in NZ/Aotearoa.

TABLE 17 Overview of the significant findings in this study in relation to the study aims

Aim One	Results
Determine if a mHealth intervention could improve oral health by complementing traditional oral health promotion **Measures:** *OHIP-14* *Plaque Control Record* *Interview data** ** educational and motivational impact* relates to aim one and aim two.	*OHIP-14* The OHRQoL of the majority of participants in each sample group remained unchanged over six months. The Control group was the only group that did not show any decline in OHRQoL over six months. *Plaque Control Record* There was a mean overall percentage decrease in the plaque control record across all groups: Phone (20%), Control (18.1%), Text (6.5%) and Video (3.5%). *Thematic analysis theme 'Motivators of oral health for young adults' and sub theme 'smart mobile phone as a lifestyle tool' (mHealth as an adjunct to clinical care* **and** *educational and motivational impact*):* At least one participant in every group commented that the oral health professional's mHealth intervention messages served to reinforce the oral health promotion information provided at the clinical appointments. Detailed results are provided under aim two in this table.
Determine if a mHealth intervention was considered, by the study cohort, to be an acceptable way of communicating oral health promotion messages **Measure:** *Interview data*	*Thematic analysis theme 'Motivators of oral health for young adults' (mHealth as an adjunct to clinical care)* **Phone** - The majority of participants in this group thought that receiving a phone call message from a clinician was an acceptable, although unusual, way to communicate oral health promotion messages. **Text** - All participants in this group liked the SMS format as it is a familiar form of communication frequently used by young adults, regardless of ethnicity. **Video** - All participants in this group liked the 'innovative' format and content of the messages that they received. The interactive nature of this format was described as an appropriate approach for young adults and a better option than using email to send information. Participants liked learning new information from the video clips but also commented that the format didn't require immediate feedback and that they could 'do it in their own time'.
Determine if a mHealth intervention could improve OHL **Measure:** *REALD-30*	**REALD-30** **Word recognition** Three groups showed slight increases in mean word recognition score: Control and Video (6% improvement), Phone (3% improvement), Text group unchanged. <td>**REALD-30** **Word comprehension** The scores for visit three showed that word comprehension scores were increased in all sample groups: Control (15%), Text (7%), Video (6%) and Phone (5%)</td>

Aim Two	Results
Determine which factors optimised the success of the mHealth intervention	*Thematic analysis theme 'Motivators of oral health for young adults' (mHealth as an adjunct to clinical care)*

Measure:

Interview data

* educational and motivational impact relates to aim one and aim two.

Impact of the 'personalisation' of the message

Phone - Words used by participants to describe the interactions were 'friendly' and 'helpful'. Further to this, the interaction was described by participants as 'personal' and was positively perceived because the principal investigator was 'investing time wise' in them.

Text - One of the participants reported feeling more 'rapport' with the principal investigator because of the text messages received between professional clinical care appointments. For one of the participants, a text message without an attached sender's name meant less 'connection' to, and ''trust' towards, the sender. The rest of the participants were indifferent to this aspect of 'personalising' text messages.

Video - Participants said that they liked seeing a 'familiar' face on the MMS message that they received. They felt that this 'interaction' made them feel more 'comfortable' and 'connected' with the principal investigator who was perceived to 'really care'. One participants felt that this was the result of being able to 'see' the principal investigator on the video and being able to 'read' her intentions through her 'non-verbal' communication.

* Educational and motivational impact

Phone - Overall, participants in this group felt that the phone calls acted more as motivational oral hygiene behaviour 'reminders' rather than as an means of providing oral health education. However, two participants did comment that the phone calls did impact positively on changing their dietary choices in regards to their frequent consumption of carbonated soft drinks.

Text - The texts messages were predominantly described as 'reminders' which impacted on the participant's motivation in regards to their oral hygiene practises and lifestyle choices. Despite, participants commenting on the messages having been read, participants could not recall details about the messages.

Video - All participants in this group liked being provided with further learning opportunities to support the oral health information that they had already been given. The websites provided were considered to be 'informative' and to have provided 'reinforcement' of the information already provided to participants.

5.3 OVERVIEW OF THE SIGNIFICANT FINDINGS OF THIS STUDY

This study hypothesised that oral hygiene behaviours (that impact oral health) and oral health literacy would be improved when traditional semi-personalised oral health promotion methods were supplemented with educational health messages delivered using various 'smart' mobile phone functions. Differing from previous mHealth in oral health studies amongst young adults (Schluter et al., 2015; Jadhav et al., 2016), this study used a variety of smart mobile phone functions for its mHealth interventions. This provided insights into the effects of different smart phone functionalities as intervention tools and the experiences of the individuals who received the messages via these different channels. Significant findings in relation to this hypothesis and each of the study aims will be discussed in the context of the research questions that were posed in chapter two.

5.3.1 Can a mHealth intervention, using various smart mobile phone functions, improve oral health and oral health literacy when used as an adjunct to traditional oral health promotion?

The impact on oral health

The principal investigator could not conclusively determine that a mHealth intervention improved oral health by complementing traditional oral health promotion in a clinical setting. However, the findings of this study suggest that a mHealth intervention can improve oral hygiene self-efficacy when delivered in support of effective oral hygiene self-care information and education in a clinical setting. This finding was across the range of smart phone functions (telephone conversation, SMS, MMS) that were used.

In comparing the outcomes of this study with previous studies, only one of the mHealth in oral health studies amongst young adults (Jadhav et al., 2016) used clinical measures in their study design. These measures (gingival index and plaque index) were used to reflect changes in participant 'oral health'. In defining 'oral health' for the current study, the principal investigator took a more holistic view of the term by including an OHRQoL measure (OHIP-14) alongside a clinical plaque index measure (plaque control record). As an OHRQoL measure strives to include patient's values and preferences (Gill & Feinstein, 1994), combining these measures sought an outcome that would provide a more accurate view of the participants' oral health statuses.

The use of the OHIP-14, as an OHRQoL measure amongst adults, has been found to have varying results dependant on the prevalence of disease in the study population. In Belgium, the OHIP-14 was found to be effective in differentiating between high caries experience and low or no caries experience as well as periodontal disease (Carvalho et al., 2015). However, these findings contrasted with those of Oscarson et al. (2007) who found that the OHIP-14 was not able to discriminate between high and no caries experience amongst young adults in Sweden, a country with low caries prevalence rates.

In this study, the OHIP-14 results were inconsistent and inconclusive. Some improvement and some decline was seen across all groups with the exception of the Control group where no participant reported a decline in OHRQoL over six months. The most likely explanation for this was the small number of study participant numbers which resulted in each sample group participant having a disproportionate weighting that impacted on the overall findings. However, there may also be alternative explanations. These explanations include Öhrn & Jönsson's (2012) suggestion that the OHIP-14 may not be as useful as other OHRQoL measures in patients with periodontal disease. Another explanation may simply be the effect of participating in a study.

The effects of being observed in a study has been found to exist although presently little is known of the conditions under which they operate (McCambridge, Witton & Elbourne, 2014). The thematic analysis findings in this study showed that most participants described having minimal oral health and oral hygiene self-efficacy knowledge prior to the start of the study but that this changed over the course of the study. This new focus on oral health and better understanding of oral disease processes may have contributed negatively to the participant's self-rated oral health and the perceived impact of this on their lives over the duration of the study. In summary, as participants OHRQoL could not be conclusively determined amongst the participants in this study, the principal investigator's viewpoint was that a true and holistic measure of their 'oral health' could not be determined.

The 'plaque control record' index was used to measure oral hygiene self-efficacy amongst participants in this study. When comparing the impact of the efficacy of SMS, MMS and telephone calls on participant's oral hygiene self-efficacy, the Phone group showed similar improvement to the Control group with both groups showing significantly more improvement than the Video and Text groups. As mean scores for all sample groups were similar at baseline, these results appear to indicate that the more 'personalised' the mode of mHealth intervention, the greater the impact on the oral hygiene self-efficacy of the cohort. Supported by the qualitative participant feedback, it is therefore suggested that the 'personal' and interactive nature of a telephone conversation which allowed for immediate feedback served to provide a verbal continuum of the relationship forged between the principal investigator and the participants in this study (a clinician-patient relationship in a clinical setting). Throughout the study, the professional relationship between the principal investigator and the study participants remained equal and in no way varied from a traditional clinician-patient relationship in other clinical settings. The principal investigator had no prior relationship with any of the study participants prior to the start of the study and thereby the results obtained should not reflect any possible perceived bias.

The impact on oral health literacy

Wehmeyer et al. (2014) suggested that "it would be valuable to perform a prospective study evaluating oral health and the effectiveness of various communication and education methods aimed at increasing a subject's oral health literacy" (p.86). Acknowledging firstly, this identified

'gap in the knowledge' and secondly, the dearth of information available on the OHL levels of NZ populations, this study sought to measure any change in participant OHL over six months which could be directly attributed to mHealth. Unfortunately due to the study design, the OHL results could not be related to changes in oral health over the same time period (Table 7).

The principal investigator chose the REALD-30 with a modified protocol (described in section 3.8.4.1.3) to measure OHL in this study. The decision to modify the REALD-30 to include a 'comprehension' component was based on two factors. The first factor was Khan et al.'s (2014) study outcome showing that word recognition does not correlate well with word comprehension in older adults. The second factor was in attempting to find a more holistic OHL measure within the identified parameters: the choice of OHL assessments considered suitable for use in the clinical setting and this study's time limitations.

The results in this study showed that, overall oral health literacy (OHL) measuring word 'recognition' and word 'comprehension' was improved in all sample groups over six months. Of interest was that the effect of oral health promotion in the clinic appears to have been more impactful on participant's OHL levels than the mHealth intervention. This may therefore indicate that frequent interpersonal contact with an oral health professional primarily contributes to greater awareness and understanding of oral health, thereby positively impacting on an individual's OHL (word recognition and comprehension). While levels of word recognition in the text group remained unchanged over the course of the study, it was noted that this group had a significantly higher score than other groups at the outset (visit one). Based on the demographic of the groups (Table 11), there is no obvious explanation for this observation. Of interest though, was that the Text group's comprehension of those same words was the lowest of any group at visit one. These results, however, should be interpreted cautiously for the reasons explained below.

There are limited options available to researchers seeking a fast and user-friendly assessment of a patient's OHL. The REALD-30 has been recognised as an OHL measure that is easy to administer in the patient care setting and has therefore been frequently used in past studies (Dickson-Swift et al., 2014). Studies have suggested that an OHL assessment should, amongst other competencies, measure word comprehension (Macek et al., 2010; cited in Harper, 2014). However, the traditional REALD-30 protocol does not do this. As a result, the REALD-30 has been highly criticized for its inability to comprehensively determine a measure of an individual's OHL (Sabbahi et al, 2009; Baskaradoss, 2016). In its defence, the REALD-30 was never intended to be a measure of word 'comprehension'. Its design facilitates the measurement of word 'recognition' only due to the singular fashion in which the words are presented by the tester (Lee et al., 2007).

If OHL is determined on word recognition alone, then the word 'recognition' results in this study reflect OHL levels that could, where applicable, be compared to the results of previous OHL studies that used the standard protocol REALD-30 (Table 4). However, if OHL is deemed to be a measure of word 'recognition' and 'comprehension' then the results may be considered a limiting

aspect of this study and they should be interpreted accordingly. The principal investigator acknowledges that there were 'challenges' in scoring word 'comprehension' (described in section 3.8.4.1.3). These challenges pertained predominantly to the semantic interpretation of some REALD-30 words that can be influenced by grammar. Examples of this were words such as 'brush' and 'floss' which can be used as nouns or verbs. The determination of a participant's understanding of these words can be therefore be influenced by the way that they interpret them. This may, in turn, impact on quantitatively scoring them as a measure of 'comprehension'.

5.3.2 Are smart mobile phones considered an acceptable platform to communicate oral health promotion and which function is preferred?

Text (SMS) messaging has been the predominant mode of health communication used in other mHealth in oral health studies (Table 1). A strength of this study was in firstly, being able to qualitatively gain the insights, experiences and perceptions of participants on mHealth interventions that used newer technology modalities such as MMS and secondly, in being able to support these findings, where applicable, with quantitative measures.

User satisfaction has previously been raised as a concern related to the use of mHealth interventions in preventive health care (Vodopivec-Jamsek, Jongh, Gurol-Urganci, Atun & Car, 2012). This was a concern reiterated by Markowitz et al., (2014) who suggested that there was a need for qualitative feedback by adolescents and young adults on the acceptability of mHealth interventions. Their study, however, focused on using a mHealth intervention for the management of a long-term illness (diabetes mellitus) rather than as a preventive healthcare tool.

The findings in this study aligned with those of other preventive healthcare studies (Whittaker et al., 2008; Whittaker et al., 2011; Hashemian et al., 2015; Schluter et al., 2015) whereby mHealth interventions were found to be an acceptable way of receiving health promotion messages. This was not dependent on whether SMS or MMS was used to deliver the message, age, gender or ethnicity.

Despite text messages being found, in a previous study (Cheng et al., 2013), to be a preferable choice to telephone calls when targeting younger or highly educated patients, in this study participants in the intervention groups (Phone, Text and Video) endorsed all channels equally but for various reasons. The 'telephone' function on a mobile phone is not commonly used by young people to communicate with others. This group therefore collectively found the experience of having to listen to a 'live' person deliver a message in 'real time' to be unusual. This was not the experience of those in the Text group for whom SMS communication is a way of life. These participants liked the familiarity of the format and the short educative messages (under 130 characters). The MMS messages were considered an 'innovative' way of providing messages through a channel that is familiar to young adults.

mHealth interventions can be considered 'unacceptable' when messages are delivered too frequently and are thereby deemed to be an intrusion into individual's lives (Sharma et al., 2011).

In this study, however, there were further provisos on 'acceptability' (although not directly relatable to the intervention groups). Participants expressed that messages could be 'lost' in the busyness of their lives. This related, on a literal level, to missing a message due to the overwhelming amount of information that they receive via electronic devices on a daily basis. Their 'busyness' however, also meant that they are selective in the messages that they consider to be important. Any message that is not applicable to their lifestyle is ignored or disregarded.

5.3.3 What factors optimise and best support a mHealth intervention?

Evidence has shown (Axelsson, 1981; Axelsson et al., 2004; Hugoson et al., 2007) that continued, regular preventive clinical care appointments, where the primary focus is on the provision of intensive OHI and OHE, improves and maintains oral health. Half of the mHealth in oral health studies that were reviewed for this thesis (Sharma et al., 2011; Hashemian et al., 2015; Schluter et al., 2015) sought to use their interventions to replace personalised oral health promotion in the clinical setting while the others (Cheng et al., 2013; Makvandi et al., 2015; Jadhav et al., 2016) focussed on supporting it. This study's design supported the latter approach. In taking this approach some significant and unexpected findings revealed the factors that this study's cohort felt optimised and best supported the mHealth interventions.

In this study, the 'visual' experiences in the clinical setting were fundamental factors in motivating participants, regardless of sample group, to maintain oral hygiene self-efficacy. These 'visual' experiences were firstly, the use of a two-tone disclosing solution allowing for each participant to 'see' the old and new plaque-biofilm on their teeth and secondly, a demonstration of recommended tooth brushing and flossing techniques in the participant's own mouth. The use of disclosing solution was in accordance with the protocol for the plaque control record and had not been an intentional aspect of the study design. In addition, the qualitative findings showed that sending monthly mHealth messages, regardless of intervention group, served two purposes:

- The first purpose was a belief amongst participants that the principal investigator 'cared' about them and their oral health. The receipt of monthly mHealth messages increased the participant's trust in- and rapport with the principal investigator. This finding was of interest as trust has been shown to be a factor in engagement with oral health care services (Cheng et al., 2013).
- The second purpose was to remind and reinforce the oral health promotion in the clinical setting (and particularly the 'visual experiences'), which, in turn, led to greater motivation to improve their oral health. In this study, the educative aspect of the mHealth messages was secondary to the 'reminder' aspect.

5.4 THE SIGNIFICANCE OF THIS RESEARCH AND THE IMPLICATIONS FOR CLINICAL PRACTICE IN NZ/AOTEAROA

Pertinent to dental and oral health practice in New Zealand, the World Health Organisation (WHO) concedes that

> optimal intervention in relation to oral disease is not universally available or affordable because of escalating costs and limited resources in many countries. The major challenge for the future will be to translate knowledge and experiences of disease prevention into action programmes (Petersen et al., 2005, p. 73).

Oral disease is expensive to treat and the long-term social and psychological impacts of chronic oral disease are significant. Young NZ adults do not appear to positively benefit from 18 years of free oral health care with clinical evidence showing considerable unmet need amongst this group (Ministry of Health, 2010). The long-term consequence of this will be significant when considering the findings of the NZ national health survey 2014-2015 report which showed that less than half of NZ adults with natural teeth had visited a health care worker in the past year (Ministry of Health, n.d.).

While mHealth offers a novel approach to promoting oral health, it is not the single 'silver bullet' that will cost-effectively increase engagement of young people with the oral health sector in NZ or improve their oral health. A focus on effective health communication in oral health care clinical settings, has been shown in this study, to potentially be more effective. While the limitations of this study have been acknowledged, there were also strengths. These strengths included the prospective design of the study which was undertaken over six months and the frequent follow up of participants using objective clinical measures, recorded consistently, by the same operator (principal investigator). These strengths in the context of this study's findings highlight opportunities that could positively effect oral health in clinical settings in NZ.

Fitzgerald et al. (2004) and Areai et al. (2011) urged the dental and oral health sectors to explore innovative approaches and alternative models of care to engage young people in oral health. In seeking a novel approach, perhaps, though, the positive effect of focussed and personalised oral health promotion in the clinical setting has been overlooked and underestimated. Oral health promotion is a prescribed competence expected of all qualified and registered oral health professionals practising in NZ. Oral health promotion (which includes oral health education and oral hygiene self-care) and health communication strategies are taught to- and undertaken by all oral health and dental students in NZ universities. Unfortunately, this knowledge and experience is not always applied as standard practice for graduands once working in a clinical setting (public or private). Insights into the consequences of this were gleaned from the study participants. Oral health professionals (particularly dentists) were negatively perceived by the cohort. In part, these negative perceptions were derived from the participant's impressions that oral health professionals were 'uncaring' if they did not take the time to provide personalised oral health promotion information. As a result, the oral health professional's motivations for not doing so and their professional ethics were questioned.

Knowledge of oral disease is a significant predicator of oral health and oral health literacy (Hugoson et al., 2007; Jones, Lee & Rozier, 2007). Prior to enrolment in this study, participants reported a general lack of knowledge and understanding of oral diseases including their aetiology and prevention. However, the provision of regular, personalised oral health promotion motivated participants to improve their oral health. This resulted in increased oral hygiene self-efficacy and a reduction in plaque-biofilm (up to 31% in three months) amongst most participants. This was achieved without additional clinical interventions such as tooth debridement or polishing.

The lack of participant oral disease prevention knowledge observed in this study raises the issue of oral health literacy. Oral health literacy levels amongst all participants at the outset of this study (a highly literate group) were concerning (75% low/moderate OHL, 25% high OHL). The results in this study were comparable to those measured in Veerasamy and Kirk's (2013) study (79% low/moderate, 21% high OHL) amongst 117 adults in Christchurch. It is acknowledged, however, that direct comparison between these study outcomes may not be possible as different OHL measurement instruments were used.

There is value in focussing on OHL when delivering every day oral health promotion activities in clinical settings. As shown in Table 12, the cohort in this study showed an overall positive shift in OHL levels (64% low/moderate OHL, 36% high OHL) over six months. Every oral health professional in NZ should therefore have an understanding of oral health literacy (OHL), its competencies and potential impacts. Determining the patient's existing knowledge, according to Nutbeam (2015), is the first step in developing basic or functional health literacy skills in a clinical setting.

In view of young people's fascination with electronic media, and in particular mobile phones, there is an argument that mHealth may offer the 'action programme', suggested by the WHO, that is needed to increase young New Zealanders engagement with the dental and oral health sectors. There is a caveat though. The greatest benefit of mHealth in oral health promotion interventions appears to be when the interventions are used in conjunction with a clinic-based oral health promotion programme that includes the use of disclosing solution as an educative tool and personalised oral hygiene instruction. The patient-clinician relationship is very important and in fact, a mHealth-only approach may actually lessen engagement amongst young adults. The lack of patient-clinician interpersonal contact in the 'Keep on Brushing' study in Canterbury may have been a factor in the significantly lower participant retention rates (25% after ten weeks) that were reported when compared with this study (88% after six months). Despite, smart mobile phones utilising new technologies that allow for a greater utilisation of communication functions, this study has shown that new technology is not necessarily more effective. mHealth interventions can be equally effective using basic mobile phones functions.

Chapter Six

CONCLUSION

This thesis has presented the study entitled "Communicating the 'smart' way to improve and support oral health amongst young adults in New Zealand: A mHealth in oral health study". In this prospective study over six months, the perspectives and experiences of a small, homogenous group of young NZ adult patients were gained through qualitative methodologies that were supported by quantitative measures of oral health and oral health literacy.

At the outset of this study, it was suggested that the empirical evidence and the current literature pointed to four significant issues that were identified as impacting on the oral health of young adult New Zealanders:

- Poor oral health in early adulthood, despite 18 years of eligibility for free oral health care.
- A lack of motivation to engage with dental and oral health services regularly.
- A symptom-driven culture without focus on preventive oral health care.
- Poor oral health literacy.

Cost of non-subsidised oral health care had been cited as the reason for young adults' lack of engagement with the oral health sector in NZ. The findings of this study, however, suggest that there may be additional barriers. These barriers include poor knowledge of oral disease and its impacts, a lack of understanding of oral disease prevention, poor oral hygiene self-efficacy, negative impressions of oral health care professionals and deficient oral health literacy skills. Put simply, this group 'doesn't know what they don't know' and this has impacted on the significant issues mentioned above.

This study proposed the use of smart mobile phones and mHealth interventions, to support oral health promotion delivered in a clinical setting, as an alternative and innovative approach to re-engaging young adults with the dental and oral health sector. Young people's interest in the use of mobile phones as a lifestyle facilitation tool shows no sign of abating. It was therefore hypothesised that this would be the key to improved engagement with the potential to improve oral health and oral health literacy. The outcomes of this study, however, have shown an alternative view based on young people's perspectives on mHealth and the factors that support its success.

In conclusion, this study has shown that while mHealth can be an acceptable and complementary aid to improving oral health practises and increasing oral health literacy amongst young people, another pivotal aspect was more impactful. This aspect was the provision of regular (bimonthly) oral hygiene self-care information using an intraoral demonstration and two-tone disclosing solution as an educative tool. Shown in Figure 32, this 'visual' experience in the clinical setting

was reinforced with each monthly mHealth contact, despite the participant being geographically removed from the principal investigator. The resultant rapport with- and trust in the principal investigator resulted in a high level of engagement amongst this cohort.

If, as the findings of this study suggest, this cycle continued over a longer period of time it could result in a positive effect on the oral health of young people. In turn, this could result in a reduction of oral disease prevalence amongst NZ communities in the future. The proviso, however, will be in the effectiveness of NZ oral health professionals' health communication (Figure 7, p.62) skills as this appears to be fundamental to improved oral health outcomes.

FIGURE 32 The impact of using the 'visual' OHI experience when combined with monthly mHealth educative reminders
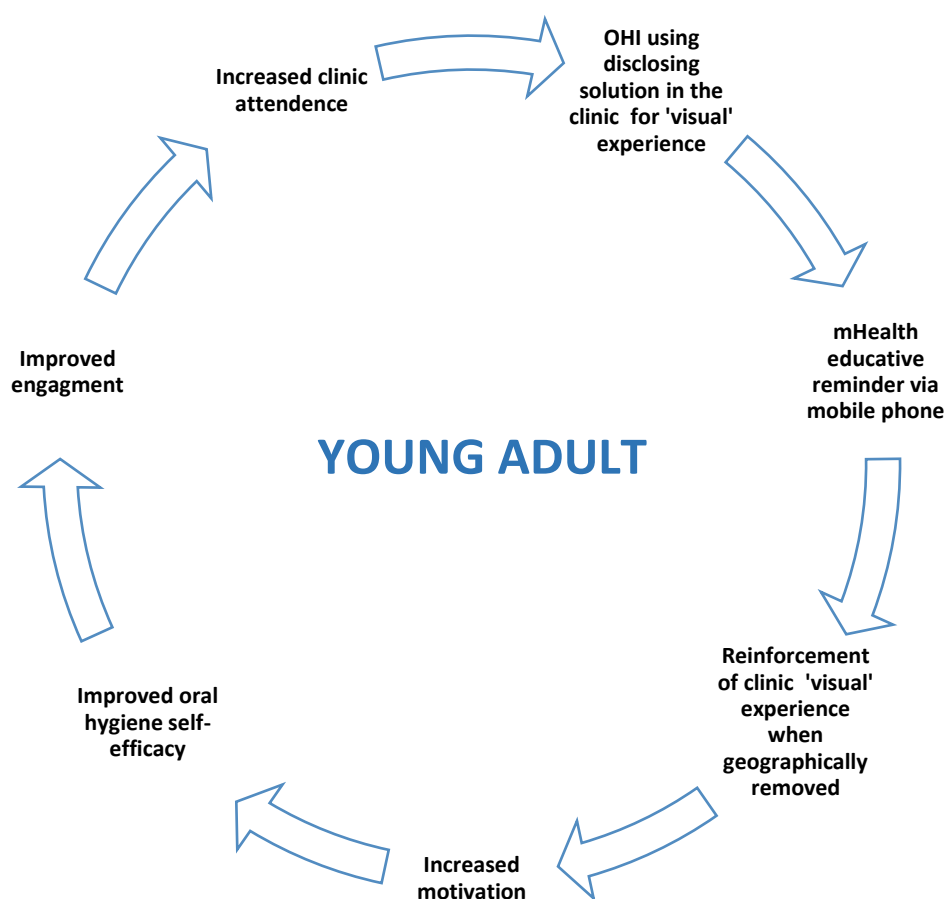
DIRECTIONS AND CONSIDERATIONS FOR FUTURE RESEARCH

The value of the Karlstad model in preventive oral health care, discussed in section 2.3.2, has been shown. From a cost perspective, this model is not feasible in its original guise in NZ. It could, however, be modified by using mobile phones to provide a continuum of the patient-clinician relationship developed in the clinical setting.

It is therefore suggested that future research should focus on developing a model of care for young New Zealanders to support their transition from the public to the private oral health care service based on a modified Karlstad model. This model should include, as standard practice, the use of a two-tone disclosing solution coupled with regular, intensive and personalised oral health promotion in clinical settings. Used as an adjunct, regular mHealth educative and motivational messaging could serve to further engage technologically literate populations, thereby reinforcing effective oral health promotion experiences.

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Glossary of Terms

AIH   Akoranga Integrated Health (AUT University interprofessional health clinic)

AUT   Auckland University of Technology

AUTEC   Auckland University of Technology Ethics Committee

CMOHK   Comprehensive Measure of Oral Health Knowledge

DMF   Decayed, Missing, Filled

FHES   Faculty of Health and Environmental Sciences

HDECS   Health and Disability Ethics Committees

mHEALTH   Mobile Health (health promotion intervention delivered by mobile phone)

NZ   New Zealand

OHE   Oral health education

OHI   Oral hygiene instruction

OHIP-14   Oral Health Impact Profile (14 questionnaire version)

OHL   Oral health literacy

OHLI   Oral Health Literacy Instrument

OHRQoL   Oral health related quality of life

PIS   Participant information sheet

REALD-30   Rapid Estimate of Adult Literacy in Dentistry (30 word version)

TM 1,2,3   Thematic Map (one, two, three)

TOHFLiD   Test of Functional Health Literacy in Dentistry

TPB   Theory of Planned Behaviour (cognitive health promotion theory)

USB   Universal Serial Bus

V1,V2,V3   Visit One, Visit Two, Visit Three

WHO   World Health Organisation

Appendices

AUT
UNIVERSITY

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Auckland 1142, NZ
T: +64 9 921 9999
www.aut.ac.nz

29 May 2015

Sharmyn Turner
School of Clinical Sciences
AUT University

Tēnā koe

This letter is in relation to the study entitled '*Dental hygienist in your pocket: Utilising consumer-directed telehealth to promote oral health to young adults in New Zealand*' presented by Sharmyn Turner, Lecturer in oral health, AUT, to the AUT Faculty of Health and Environmental Sciences Māori Research Facilitation Committee on 21 May 2015.

The Committee comprises representatives from the District Health Boards and community Hauora Māori sectors, along with senior AUT academics. The purpose of the Committee is to foster research engagement between faculty research staff and Māori communities or groups and research practice responsive to issues important to Māori health and Māori development and advancement.

The committee commended Sharmyn for the presentation and her passion for improving the oral health of young people. The committee acknowledged the relevance and benefit of the study to Māori youth and supports it. The following recommendations are qualifications to this support:

- The research is to be targeted to those youth most likely to be affected by oral health disease, Māori and Pacific youth.
- A check is to be made that the standardised questionnaire to be used in the study will measure success for Māori. A Māori academic Professor, John Broughton (Otago), was recommended as a possible advisor on this.
- AUT expertise in digital resource development and in Te reo Māori, in the Faculties of Te Ara Poutama and Design and Creative Technologies should be employed.
- Māori and Pacific youth are to be involved in the development of key messages and catch phrases. The committee recommended this as essential to successful engagement with youth in the study.
- A health literacy advisor identified by the committee, Susan Reid, was also recommended.

Sharmyn Turner is required to submit a progress report to the Faculty administrator within one year of this presentation, i.e. no later than 21 May 2016. No further presentations to the Māori Research Facilitation Committee can occur until progress in response to the recommendations outlined above, has been reported.

If further information is required please contact Brigitte van Gils, Administrator, Faculty Postgraduate and Research Office, on 09 921 9999 extension 7775, or e-mail: bvangils@aut.ac.nz

Nāku noa, nā

Kate Haswell, Associate Dean (Māori Advancement)

APPENDIX B

26 May 2015

Professor Anita Nolan
Auckland University of Technology
90 Akoranga Drive
Northcote
Auckland 0627

Dear Professor Nolan

Re:	Ethics ref:	15/NTA/63
	Study title:	Dental hygienist in your pocket: utilising consumer-directed telehealth to promote oral health to young adults in New Zealand

I am pleased to advise that this application has been _approved_ by the Northern A Health and Disability Ethics Committee. This decision was made through the HDEC-Expedited Review pathway.

Conditions of HDEC approval

HDEC approval for this study is subject to the following conditions being met prior to the commencement of the study in New Zealand. It is your responsibility, and that of the study's sponsor, to ensure that these conditions are met. No further review by the Northern A Health and Disability Ethics Committee is required.

Standard conditions:

1. Before the study commences at _any_ locality in New Zealand, all relevant regulatory approvals must be obtained.

2. Before the study commences at _a given_ locality in New Zealand, it must be authorised by that locality in Online Forms. Locality authorisation confirms that the locality is suitable for the safe and effective conduct of the study, and that local research governance issues have been addressed.

Non-standard conditions:

Summary of ethical issues (outstanding)

The main ethical issues considered by the Committee and which require addressing by the Researcher are as follows.

— Data should be stored for a minimum of 10 years and not five as stated in your application.
— Please provide HDEC with a copy of the advertisement being used.
— In the Participant Information Sheet (PIS) there is mention of digital recording being used. What is being recorded?
— Please provide HDEC with evidence of consultation with Maori.

APPENDIX B con'd

- — Please ensure that study ID is used on questionnaires and not names.
- — Is this study being sponsored by Colgate?
- — There are no HDEC contact details on the PIS. Please include them.
- — Please make it clear in the PIS that Professor Nolan is the Co-ordinating Investigator.

Please submit your non-standard conditions by email to HDECS@moh.govt.nz

Please note HDEC review is not required for non-standard conditions however they must be completed prior to commencing your study. Do not submit non-standard conditions as a post approval form (PAF).

For information on non-standard conditions please see section 128 and 129 of the Standard Operating Procedures at http://ethics.health.govt.nz/home.

After HDEC review

Please refer to the *Standard Operating Procedures for Health and Disability Ethics Committees* (available on www.ethics.health.govt.nz) for HDEC requirements relating to amendments and other post-approval processes.
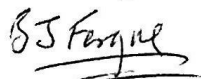
Your **next progress report** is due by **25 May 2016**.

Participant access to ACC

The Northern A Health and Disability Ethics Committee is satisfied that your study is not a clinical trial that is to be conducted principally for the benefit of the manufacturer or distributor of the medicine or item being trialled. Participants injured as a result of treatment received as part of your study may therefore be eligible for publicly-funded compensation through the Accident Compensation Corporation (ACC).

Please don't hesitate to contact the HDEC secretariat for further information. We wish you all the best for your study.

Yours sincerely,

Dr Brian Fergus
Chairperson
Northern A Health and Disability Ethics Committee

Encl: appendix A: documents submitted
        appendix B: statement of compliance and list of members

Appendix A
Documents submitted

Document	Version	Date
Protocol: Study Protocol	1	21 April 2015
Survey/questionnaire: OH questionnaire	1	21 April 2015
Survey/questionnaire: REALD30	1	21 April 2015
Survey/questionnaire: Interview	1	21 April 2015
Evidence of scientific review: Scientific Review	1	21 April 2015
CV for CI: AN CV	1	29 April 2015
Application		11 May 2015
PIS/CF: ST participant consent form.docx		12 May 2015
PIS/CF: ST participant information sheet.docx		12 May 2015

Appendix B
Statement of compliance and list of members

Statement of compliance

The Northern A Health and Disability Ethics Committee:

— is constituted in accordance with its Terms of Reference

— operates in accordance with the *Standard Operating Procedures for Health and Disability Ethics Committees*, and with the principles of international good clinical practice (GCP)

— is approved by the Health Research Council of New Zealand's Ethics Committee for the purposes of section 25(1)(c) of the Health Research Council Act 1990

— is registered (number 00008714) with the US Department of Health and Human Services' Office for Human Research Protection (OHRP).

List of members

Name	Category	Appointed	Term Expires
Dr Brian Fergus	Lay (consumer/community perspectives)	01/07/2012	01/07/2015
Dr Karen Bartholomew	Non-lay (intervention studies)	01/07/2013	01/07/2016
Ms Susan Buckland	Lay (consumer/community perspectives)	01/07/2012	01/07/2015
Ms Shamim Chagani	Non-lay (health/disability service provision)	01/07/2012	01/07/2015
Dr Christine Crooks	Non-lay (intervention studies)	01/07/2013	01/07/2015
Mr Kerry Hiini	Lay (consumer/community perspectives)	01/07/2012	01/07/2015
Mr Mark Smith	Non-lay (intervention studies)	01/09/2014	01/09/2015
Ms Michele Stanton	Lay (the law)	01/07/2012	01/07/2015

http://www.ethics.health.govt.nz

APPENDIX B con'd

From: Tania_Siwatibau@moh.govt.nz [Tania_Siwatibau@moh.govt.nz]
Sent: 08 July 2015 09:59
To: Anita Nolan
Subject: Re: FW: 15/NTA/63_Utilising telehealth to promote oral health

Good morning, thank you for providing further clarification in the participant document. I will upload this version of PIS to our records.

Best wishes,

Tania

Tania Siwatibau
Administrator
Health & Disability Ethics Committees
Ministry of Health
tania_siwatibau@moh.govt.nz
DDI: 04 819 6818

From:	Anita Nolan <anita.nolan@aut.ac.nz>
To:	"Tania_Siwatibau@moh.govt.nz" <Tania_Siwatibau@moh.govt.nz>,
Date:	08/07/2015 06:54 a.m.
Subject:	FW: 15/NTA/63_Utilising telehealth to promote oral health

```
Dear Tania

The following changes have been made on the PIS (attached):

Once you have agreed to take part in the study, any information held
separately from your clinical notes will be held securely. The
interview with you will be digitally recorded. Any recordings of the
interview with you will be used for transcription purposes only and
will not be disseminated (sent to anyone else). Any digitally recorded
data will be held securely and transcribed as soon as possible. Once
transcribed, the digital recording will be saved to a USB before being
permanently deleted from the recording device. The USB will be stored
securely, along with all other data, for 10 years. Any documents,
forms, digital recordings or transcriptions will identify you only by
number and only the co-ordinating researcher will be able to match
your numbered data to your name.


Kind regards,

Anita Nolan
**************************************************************************
```

APPENDIX B con'd

Hello, thank you for your reply of 9 June,2015. We have a few more questions for you.

In relation to this statement from the PIS;

" Once you have agreed to take part in the study, any information held separately from your clinical notes will be held securely.Digital recordings of the interview with you will be used for transcription purposes only and will not be disseminated (sent to anyone else). Documents will identify you only by number and only the coordinating researcher will be able to match your numbered data to your name."

1) It is not clear how you plan to protect confidentiality of the digital recordings.

2) Will it be possible to identify the participant from the recordings?

3) Please clarify these issues in the PIS.

We look forward to hearing from you soon.

Kind regards,

Tania Siwatibau

Tania Siwatibau

Administrator

Health & Disability Ethics Committees

Ministry of Health

tania_siwatibau@moh.govt.nz

DDI: 04 819 6818

APPENDIX C

AUT | **AUTEC SECRETARIAT**
UNIVERSITY
TE WĀNANGA ARONUI O TĀMAKI MAKAU RAU

16 June 2015

Anita Nolan
Faculty of Health and Environmental Sciences

Dear Anita

Ethics Application: **15/206 Dental hygienist in your pocket: utilising consumer-directed telehealth to promote oral health to young adults in New Zealand.**

Thank you for submitting your application for ethical review to the Auckland University of Technology Ethics Committee (AUTEC). I am pleased to confirm that your ethics application has been approved for three years until 15 June 2018.

As part of the ethics approval process, you are required to submit the following to AUTEC:

- A brief annual progress report using form EA2, which is available online through http://www.aut.ac.nz/researchethics. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 15 June 2018;

- A brief report on the status of the project using form EA3, which is available online through http://www.aut.ac.nz/researchethics. This report is to be submitted either when the approval expires on 15 June 2018 or on completion of the project;

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to obtain this.

To enable us to provide you with efficient service, we ask that you use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at ethics@aut.ac.nz.

All the very best with your research,

APPENDIX D

FW: USE of REALD
Anita Nolan
Sent: 24 March 2015 14:04
To: Sharmyn Turner

Attachments: REALD_30.pdf (79 KB)[Open as Web Page];
REALD30_Publication.pdf (74 KB)[Open as Web Page]

From: Lee, Jessica Y. [jessica_lee@unc.edu]
Sent: 24 March 2015 00:45
To: Anita Nolan
Subject: RE: USE of REALD

Sure. Please see attached. Thank you.

Jessica Y. Lee DDS, MPH, PhD
Chair and Demeritt Distinguished Professor
Department of Pediatric Dentistry
University of North Carolina
228 Brauer Hall
Chapel Hill, NC 27599-7450
Phone: 919-537-3955
Fax: 919-537-3950
Email: jessica_lee@unc.edu

From: Anita Nolan [mailto:anita.nolan@aut.ac.nz]
Sent: Monday, March 23, 2015 1:52 AM
To: Lee, Jessica Y.
Subject: USE of REALD

Dear Dr Lee,

I am supervising an M PHIL student at AUT in New Zealand. As part of her research, she would like to use your REALD to check the dental literacy of a 18-24 year old population.

Would this be possible please and could you forward to me, please.

many thanks

Anita Nolan, Head of Department, Oral Health, AUT

Dear Sharmyn Turner,

Wolters Kluwer Health has approved your recent request described below. Before you can use this content, **you must accept** the license fee and terms set by the publisher.

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2015

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Requestor type
academic/educational

Format
print and electronic

Portion
figures/tables/illustrations

Number of figures/tables/illustrations
2

Figures/tables/illustrations to be used
Figure 27-5 Sulcular Brushing (p. 393) Figure 28-3 Use of Dental Floss (p. 412)

Will you be translating?
no

Reusing current or a previous edition
previous edition

Previous edition being used...
Wilkins, E. M., & Wyche, C. J. (Eds.). (2013). Clinical practice of the dental hygienist (11th ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.

Circulation/distribution
1000

Order reference number

Title of your thesis / dissertation
"Communicating the 'smart' way to improve and support oral health amongst young adults in New Zealand: A mHealth in oral health study".

Expected completion date
Apr 2017

Estimated size (number of pages)
170

Requestor Location
Sharmyn Turner
Dept. Oral Health
AUT University
90 Akoranga Drive
Auckland, 1142
New Zealand
Attn: Sharmyn Turner

Billing Type
Invoice

Billing address
Sharmyn Turner
Dept. Oral Health
AUT University
90 Akoranga Drive
Auckland, New Zealand 1142
Attn: Sharmyn Turner

Total
0.00 AUD

APPENDIX F

Kia Ora

Thank you for indicating that you are considering being a participant in the study that I am undertaking for my Master of Philosophy degree.

I would like to take this opportunity to introduce myself:

I am a registered dental hygienist and a lecturer in the AUT University department of oral health. I have chosen this area of study as I have a keen interest in how we, as oral health professionals in NZ, can improve the way we approach oral health promotion in communities, particularly amongst young adults. As you are considered to be a 'digital native' (a young adult who has grown up with communication technology and comfortably interacts with it), your participation in this research will be able to provide valuable insight into preferred options of promoting oral health amongst young adult New Zealanders.

I will be sending you some further, detailed information about my study in a few days' time for your further consideration. If you would prefer to not participate or receive any further information from me, please email me on sharmyn.turner@aut.ac.nz as soon as possible.

I really appreciate you taking the time to read this – thank you!

Cheers

Sharmyn

INFORMATION SHEET FOR POTENTIAL PARTICIPANTS

Study Title: *Dental hygienist in your pocket: utilising consumer-directed telehealth to promote oral health to young adults in New Zealand.*

Coordinating Investigator (CI):

Anita Nolan, Professor of Oral Medicine, Dept. Oral Health, AUT University Auckland

Supporting investigator:

Sharmyn Turner, Lecturer, Dept. Oral Health, AUT University

How to contact the investigators:

- Sharmyn Turner - 0273696004
- Professor Anita Nolan – anita.nolan@aut.ac.nz

Introduction

You are invited to take part in a study organised by the Department of Oral Health, AUT University, Auckland. The purpose of this research is to determine if communications to patients between dental hygiene appointments (using smart phones) can be used to improve the overall oral health of young New Zealanders, aged 18-24 years, as an alternative to traditional oral health promotion methods. The research also examines the acceptability and convenience of telecommunication to patients and the clinician. The research will use questionnaires and an interview to establish the feasibility and acceptability of this means of communication. The oral examination will establish if this means of health promotion has an actual effect in terms of improving oral health.

This leaflet will tell you about the project and how you would be involved. When you have read it carefully, you will be given an opportunity to discuss the study with one of the investigators. Please feel free to ask questions if there is anything you do not understand.

Your participation is entirely voluntary (your choice). You do not have to take part in the study, and if you choose not to take part it will not affect your care in any way.

If you do agree to take part, you are free to withdraw from the study at any time, without having to give a reason and this will in no way affect your future health care**.**

If you need time to consider whether you wish to take part, just explain this to the investigator.

If you agree to take part you will be asked to complete a written consent form.

Outline of the project

The 2009 New Zealand (NZ) Oral Health Survey showed a high level of oral disease amongst young adults in New Zealand. For various reasons, many young adults do not regularly engage with oral health professionals who could help them maintain good oral health. We wish to improve communication between consumers and dental hygienists in New Zealand so that they may understand how to maintain healthy mouths. This research aims to investigate if young adults would find communication through smart phones convenient and informative and, in particular, if this communication results in a better awareness of oral health maintenance and an actual improvement of the health of their mouths.

What is involved?

If you agree to be involved in this research, you will be randomly allocated to one of four patient groups and invited to the AUT Oral Health clinic where you will be asked to fill in questions about your oral health, your oral hygiene practices, your medical history and details that are relevant to your general and oral health. Your mouth and teeth will be examined to assess your current oral health. This will include the gentle placement of a dental instrument just beneath the gum line to measure your gum health and the use of a dye to colour the dental plaque (the soft layer that builds up around teeth and gums) enabling the dental hygienist to measure the amount of dental plaque present on your teeth more easily. The dye is non-toxic and removed by brushing your teeth. No samples of you will be taken. Radiographs (X-rays) will not be taken.

The Dental Hygienist will educate you on how to clean your teeth correctly and provide some oral health promotion/disease prevention advice. You will be given a follow up appointment after 3 months to review your oral health. Six months after your initial examination, you will visit the clinic again to complete questionnaires and undertake a semi-structured interview to enable you to give feedback on how you found this oral health promotion program. The interview will be recorded for transcription purposes.

Each of the three appointments will last about 60 - 75 minutes and you will receive a reminder by text message prior to your scheduled appointment.

If you do agree to take part, you are free to withdraw at any time, without having to give a reason, and this will in no way affect your future health care.

Please also note that if you agree to take part, we request that you do not visit a dental hygienist or undertake any dental hygiene treatment for the time that you are involved with the study. This should not impact your health in any way.

What are the risks of the study?
There are no risks in being part of this study. The examinations will be painless and no x-rays will be taken of you.

Where can I get more information about the study?

Further information can be obtained from the principal researcher whose contact details are given at the beginning of this information sheet.

How will the Study Affect my Care?

This study is what we call an observational study. This means that no new treatments, other than advice by your dental hygienist, will be given to you. All the advice will involve established and safe products and oral hygiene practices.

The detailed assessment performed will be recorded in your confidential patient notes so that it can help your future oral health.

Will I be compensated?

Participants will not be paid or receive *koha* to participate in this research. As a 'thank you' to each participant who undertakes the semi-structured interview, a dental hygiene appointment with an AUT BHSc. in Oral Health student practitioner will be provided free of charge. Additionally, if you are an AUT student willing to participate but primarily located on the AUT city or south campuses, the cost of travel on the AUT campus shuttle bus to the north campus will be covered for study participants for the purposes of the study only.

What will happen to the results of this research?

It is intended that the results of the study will be published in a thesis and scientific journal. The results may also be presented at conferences. Participants in the study will always remain anonymous. Copies of the article will be available to those participants who request it. There is often a considerable delay between data collection and publication /presentation. A public meeting will be held to give a simple summary of the results and all participants will be invited to attend.

Privacy and Confidentiality

Once you have agreed to take part in the study, any information held separately from your clinical notes will be held securely. The interview with you will be digitally recorded. Any recordings of the interview with you will be used for transcription purposes only and will not be disseminated (sent to anyone else). Any digitally recorded data will be held securely and transcribed as soon as possible. Once transcribed, the digital recording will be saved to a USB before being permanently deleted from the recording device. The USB will be stored securely, along with all other data, for 10 years. Any documents, forms, digital recordings or transcriptions will identify you only by number and only the co-ordinating researcher will be able to match your numbered data to your name.

You will be asked at the beginning of the study if you agree to your dentist or doctor knowing that you are taking part in the study. Generally, it is best that your medical GP is aware that you have taken part in a study, as there may be instances where information from the study may be

useful in managing your general health. Since no drug treatment is involved in this study it is not essential for this to happen.

__Compensation Arrangements__

If physical injury results from your participation in this study, you should visit a treatment provider to make a claim to ACC as soon as possible.   ACC cover and entitlements are not automatic and your claim will be assessed by ACC in accordance with the Injury Prevention, Rehabilitation and Compensation Act 2001.   If your claim is accepted, ACC must inform you of your entitlements, and must help you access those entitlements. Entitlements may include, but not be limited to, treatment costs, travel costs for rehabilitation, loss of earnings, and/or lump sum for permanent impairment.   Compensation for mental trauma may also be included, but only if this is incurred as a result of physical injury. If your ACC claim is not accepted you should immediately contact the researcher. The researcher will initiate processes to ensure you receive compensation equivalent to that to which you would have been entitled had ACC accepted your claim. If you have any questions about ACC please feel free to ask the researcher for more information before you agree to take part in this trial. If you have any questions about ACC, contact your nearest ACC office. If you have any queries or concerns about your rights as a participant in this study you may wish to contact a Health and Disability Services Consumer Advocate on 0800 377 766.

If there is a concern or issue specific to Māori please contact 0800 377 766.

Should you have ethical concerns in regards to this study, please contact the Health and Disability Ethics Committees (HDEC) by telephone on 0800 4 ETHICS (438 442) or by email hdecs@moh.govt.nz

Thank you for taking the time to consider this study. Please feel free to discuss your participation in this study with family and whanau.

This study has received ethical approval from the Health and Disability Ethics Committee (HDEC) (NZ/1/E0F706) and the AUT Ethics Committee (AUTEC) (Ref no 15/206). A consultation has also been undertaken with the AUT Māori Research Facilitation Committee

__For further information on this study, please email Sharmyn Turner at sharmyn.turner@aut.ac.nz__

PARTICIPANT CONSENT FORM

Telehealth in Oral Health

Participant Study ID…………………………….

Please circle your answer:

1. I have read the Participant Information Sheet concerning this project and understand what the study is about. I understand that I am free to request further information at any stage.   Yes / No

2. I have had the opportunity to use whanau support or a friend to help me ask questions and understand the study.   Yes / No

3. I know that my participation in the project is entirely voluntary.   Yes / No

4. I know that I am free to withdraw from the project at any time without any disadvantage.   Yes / No

5. I understand that any raw data on which the results of the study depend will be retained in secure storage for 10 years, after which it will be destroyed.   Yes / No

6. I know that the results of this project may be published but my anonymity will be preserved.   Yes / No

7. I wish to receive a copy of the results.   Yes / No

8. I understand that I may not attend a dental hygiene appointment or undertake dental hygiene treatments until the conclusion of the study (approximately 6 months).   Yes / No

9. I understand that any information/communication that I receive from the investigators may not be reproduced or transmitted in any form, by any means, whether electronic, mechanical, photocopying, recording or otherwise without the written permission of the co-ordinating investigator.   Yes / No

Please circle the ethnic group that you most identify with:

Māori   NZ European   Pasifika   Asian

Middle Eastern   African   Latin American   Other European

<u>**Coordinating Investigator**</u>:

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**I _____ (full name) hereby consent to take part in this
project.**

....
     (Signature of participant)   (Date)

This project has been explained to me by:

....

(Please print full name)   (Date)

APPENDIX H con'd

<u>Investigating Clinician:</u>

....
(Please print full name)   (Date)

Oral Health Questionnaire:

Participant Study ID:

PLEASE CIRCLE THE ANSWER THAT BEST APPLIES TO YOU

When do you usually brush your teeth?

More than once a day   Once a day   Not every day   Less than once/week   Never

How would you describe the health of your teeth and mouth?

Excellent   Very good   Good   Fair   Poor

When did you last see a dentist?

In the last year   1-2 years ago   2 or more years ago   Never been

What is the usual reason for seeing a dentist?

Check-up   Problem   Never been

What was the reason for your last dental visit?

Check-up   Problem   Never been

All things considered, would you say that, over the past year, the health of your mouth has:

Improved   Stayed the same   Got worse

In general, compared to other people your age, would you say your dental health is:

Among the nicest   Better than average   Below average   Among the worst

For each of the following questions, please <u>circle</u> the answer which <u>best</u> applies to you during the last 4 weeks.

Because of trouble with your teeth, mouth or dentures:

	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you had trouble pronouncing any words?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you felt that your sense of taste has worsened?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you had painful aching in your mouth?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you found it uncomfortable to eat any foods?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you been self-conscious?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you felt tense?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Has your diet been unsatisfactory?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you had to interrupt meals?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you found it difficult to relax?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you been a bit embarrassed?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you been a bit irritable with other people?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)

	NEVER	HARDLY EVER	OCCAS-IONALLY	FAIRLY OFTEN	VERY OFTEN
Have you had difficulty doing your usual jobs?	(0)	(1)	(2)	(3)	(4)
Have you felt that life in general was less satisfying?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)
Have you been totally unable to function?	NEVER (0)	HARDLY EVER (1)	OCCAS-IONALLY (2)	FAIRLY OFTEN (3)	VERY OFTEN (4)

APPENDIX J

SUGAR	BRUSH	BRACES
SMOKING	PULP	GENETICS
FLOSS	FLUORIDE	RESTORATION

BRUXISM	DENTURE	PLAQUE
ABSCESS	ENAMEL	GINGIVA
EXTRACTION	DENTITION	MALOCCLUSION

INCIPIENT	SEALANT	ANALGESIA
CARIES	HYPOPLASIA	CELLULITIS
PERIODONTAL	HALITOSIS	FISTULA

TEMPOROMANDIBULAR
HYPEREMIA
APICOECTOMY

Study ID Number ___ ___ ___ ___ ___

REALD-30

Rapid Estimation of Adult Literacy in Dentistry
30 word version

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University of North Carolina at Chapel Hill
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919-966-2739

Interview/ REALD-30 Start Time: _____ Study ID Number __ __-__ __ __

REALD-30

YOU WILL NOW ADMINISTER THE DENTAL LITERACY TEST

READ THE FOLLOWING TO THE PARTICIPANT:

Now, I am going to show you cards with one word on every card. I would like you to read the word out loud. If you do not know the answer, please say, "don't know." Do not guess.

Dental REALM end time: _____

Score: _____

1. Sugar _____	11. Abscess _____	21. Periodontal _____
2. Smoking _____	12. Extraction _____	22. Sealant _____
3. Floss _____	13. Denture _____	23. Hypoplasia _____
4. Brush _____	14. Enamel _____	24. Halitosis _____
5. Pulp _____	15. Dentition _____	25. Analgesia _____
6. Fluoride _____	16. Plaque _____	26. Cellulitis _____
7. Braces _____	17. Gingiva _____	27. Fistula _____
8. Genetics _____	18. Malocclusion _____	28. Temporomandibular _____
9. Restoration _____	19. Incipient _____	29. Hyperemia _____
10. Bruxism _____	20. Caries _____	30. Apicoectomy _____

READ WORDS FORMAL DEFINITIONS	
SUGAR	Sweet crystalline substance obtained from various plants, especially sugar cane and sugar beet, consisting essentially of sucrose, and used as a sweetener in food and drink
SMOKING	The action or habit of inhaling and exhaling the smoke of tobacco or a drug
FLOSS	Short for dental floss, clean between (one's teeth) with dental floss.
BRUSH	Clean (one's teeth) with a brush.
PULP	Vascular tissue filling the interior cavity and root canals of a tooth.
FLUORIDE	Sodium fluoride or another fluorine-containing salt added to water supplies or toothpaste in order to reduce tooth decay.
BRACES	A wire device fitted in the mouth to straighten the teeth.
GENETICS	The study of heredity and the variation of inherited characteristics.
RESTORATION	A structure provided to replace or repair dental tissue so as to restore its form and function, such as a filling, crown, or bridge.
BRUXISM	Involuntary habitual grinding of the teeth, typically during sleep
ABSCESS	A swollen area within body tissue, containing an accumulation of pus
EXTRACTION	The action of extracting something, especially using effort or force, *a dental extraction*
DENTURE	A removable plate or frame holding one or more artificial teeth

ENAMEL	The hard glossy substance that covers the crown of a tooth
DENTITION	The arrangement or condition of the teeth in a particular species or individual
PLAQUE	A sticky deposit on teeth in which bacteria proliferate
GINGIVA	The gums
MALOCCLUSION	Imperfect positioning of the teeth when the jaws are closed
INCIPIENT	Beginning to happen or develop
CARIES	Decay and crumbling of a tooth
PERIODONTAL	The structures surrounding and supporting the teeth
SEALANT	Material used for sealing something so as to make it airtight or watertight
HYPOPLASIA*	Underdevelopment or incomplete development of a tissue or an organ.
HALITOSIS	Technical term for bad breath.
ANALGESIA	The inability to feel pain
CELLULITIS	Inflammation of subcutaneous connective tissue.
FISTULA	An abnormal or surgically made passage between a hollow or tubular organ and the body surface, or between two hollow or tubular organs
TEMPOROMANDIBULAR	Refers to the relationship of the temporal bone to the lower jaw e.g. temporomandibular joint.

HYPEREMIA	An excess of blood in the vessels supplying an organ or other part of the body
APICOECTOMY**	Surgical removal of a tooth root apex (end)

Definitions obtained from:

http://oxforddictionaries.com

*http://medicinenet.com

**http://medical-dictionary.thefreedictionary.com

<u>Semi-structured interview questions:</u>

Participant Study
ID:………………………………………………………………………………..

- **Did you receive any information from the research team after your first examination?**

- **How did you feel about the content of the information you received?**

  1. Did you understand the information that you received? Was the message clear?
  2. Did you keep/retain any of the information that you received? Was it deleted? How quickly?
  3. Did you revisit the information that you received? When? Why?

- **How did you feel about the way the messages were communicated to you?**

  1. Did you like the format?
  2. Describe how you would change them to make them more effective?
  3. From a social marketing perspective, what are your thoughts on a 'one size fits all' approach with health messaging - would you change the messages for your ethnic group to make the message more effective? How and why?

- **Which oral health promotion message was most memorable / least memorable for you?**

  1. Why?

- **Describe your levels of motivation in regards to your oral health between examination 1 (start of study) and examination 2 (after 3 months).**

- **In what way did your motivation improve / decline?**
    1. Did monthly messages improve your motivation?
    2. How frequently, do you think, should these type of messages be sent to make them more effective?

- **Describe any behaviour changes to your oral hygiene homecare routines you have noticed as a result of information you received.**

- **Would you think it best to receive 5 different oral health promotion messages over 5 months or the same message 5 times and why?**

- **Describe any conversations or interactions that you have had with somebody else where you have shared information that you have received from the researcher.**
    1. Do you think that receiving frequent messages/communications from the researcher/clinician altered your relationship, in any way, with her? Was this positive or negative?
    2. Has this experience changed the way you perceive the value of oral health or dental professionals? How and why??

Thematic Analysis Key (list of codes)

In-surgery OHE/ Confirmation of understanding of OHE

Prior knowledge

Retention of in-surgery OHE

mHealth intervention

Revisiting OHE information

Further enquiry

Sharing of OHE information with others

Learning styles

Motivation after visit 1

Barriers

Perceptions of OH professionals

Perceptions of healthcare procedures

Way mobile phone is utilised

Influence of area of study on receiving information

Lifestyles

Self-perceived oral health

	Visit One (1.5 hours)	Visit Two (1 hour)	Visit Three (1 hour)
TH01	28 July	30 October	27 January
TH02	29 July	29 October	26 January
TH03	17 August	27 October	27 January
TH04	14 September	14 December	23 March
TH05	15 September	8 December	22 March
TH06	29 September	14 January	22 March
TH07	29 September	Did not arrive	Did not arrive
TH08	29 October	25 January	26 April
TH09	30 October	16 February	26 April
TH10	30 October	20 January	26 April
TH11	30 October	27 January	27 April
TH12	16 November	16 February	26 April
TH13	16 November	22 March	19 April
TH14	17 November	16 February	20 April
TH15	17 November	17 February	19 April
TH16	17 November	Did not arrive	Did not arrive

APPENDIX P: Clinical calibration exercise

Periodontal Chart

Participant Study ID: Nicky

Date PP1

Date PP2

MAXILLA — Facial

	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Bleed																
PP2		223	323	322	211	211	123	111	232	322	322	312	323	223	322	
PP1		223	223	212	212	211	211	111	211	212	312	212	323	322	332	

Facial

R 8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8 L

MAXILLA — Palatal

	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
PP1		123	223	222	222	222	111	211	211	111	122	222	223	222	332	
PP2		223	223	122	223	223	112	222	222	222	222	212	223	322	332	
Bleed																

Palatal

MANDIBLE — Lingual

	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Bleed																
PP2		333	222	322	211	211	111	111	111	111	222	233	223	223	333	
PP1		222	212	322	222	211	122	111	111	111	111	232	112	322	332	

Lingual

R 8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8 L

MANDIBLE — Facial

	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
PP1		222	322	211	111	111	211	111	112	212	212	212	212	222	222	
PP2		222	222	221	212	212	111	111	223	212	212	212	112	231	213	
Bleed																

Nicky ±15

PP1 78 + 78 + 71 + 66
293

PP2 89 + 89 + 78 + 67
325

10%

ST V2 May 2015

Periodontal Chart

Participant Study ID: Sam

Date PP1

Date PP2

Bleed																	
PP2		235	323	323	312	312	312	222	222	323	323	323	322	322	322		
PP1		223	322	312	313	312	212	212	212	222	313	323	312	313	323		
	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Facial			55	54	53	52	51	61	62	63	64	65	Facial			

R 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 L

MAXILLA

Palatal			55	54	53	52	51	61	62	63	64	65	Palatal			
	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
PP1		223	223	213	313	212	32x	222	222	123	323	312	322	322	322		
PP2		123	223	223	223	212	22x	221	112	223	323	222	222	322	223		
Bleed																	

Bleed																	
PP2		322	222	222	222	221	111	111	111	111	123	322	222	222	322		
PP1		323	223	322	322	322	211	111	222	111	112	213	322	322	222		
	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Lingual			85	84	83	82	81	71	72	73	74	75	Lingual			

R 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 L

MANDIBLE

Facial			85	84	83	82	81	71	72	73	74	75	Facial			
	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
PP1		232	322	212	313	313	313	312	113	313	313	312	212	222	212		
PP2		222	323	212	213	312	212	212	212	212	223	212	212	212	312		
Bleed																	

±17.

Sam   ⟨346⟩

PP1 90 + 90 + 82 + 84

PP2 99 + 87 + 74 + 78

⟨338⟩

⟨2.5 %⟩

ST V2 May 2015

APPENDIX Q: REALD-30 assessor inter-reliability calculations undertaken for visit one* (word comprehension) and visit three (word comprehension)

VISIT ONE: INITIAL SCORES SHOWING ASSESSOR SCORE VARIATION

	TH01	TH02	TH03	TH04	TH05	TH06	TH07	TH08	TH09	TH10	TH11	TH12	TH13	TH14	TH15	TH16
SUGAR	1	1	1	0+1+2	1	1	1	1	1	2	1	0	1	2	1	1
SMOKING	1	0+2+1	1	2	1	1	1	0	1	0	1	1	1	0+1+2	1	0+2+1
FLOSS	2	1	1	1	0+2+1	2	0	0	0+2+1	1	2	1	1	2	2	1
BRUSH	1	1	0	1	2	2	1	1	2	2	2	2	2	2	2	1
PULP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FLUORIDE	2	1	0	0	0	0	0	1	1	1	1	0	1	0	1	0
BRACES	1	2	2	2	2	1	1	0	2	2	1	2	0	2	2	2
GENETICS	1	2	1	2	0+2+1	1	1	0	2	1	1	1	1	1	0+1+2	1
RESTORATION	1	0	0+2+1	0	0	1	0	0	0+2+1	0+2+1	1	0+2+1	0	1	0+2+1	0
BRUXISM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ABSCESS	1	1	0	1	0	0	0	0	1	2	1	0	1	1	0	0
EXTRACTION	1	2	1	2	1	1	0	0	2	1	2	1	1	2	1	0
DENTURE	1	1	0	2	2	0	0	0	2	2	2	2	0	0	2	0
ENAMEL	2	1	0	2	1	0	0	0	0	1	0+2+1	1	1	1	2	0
DENTITION	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PLAQUE	1	1	1	1	0+2+1	1	0	0	0+2+1	1	0+2+1	1	1	1	1	1
GINGIVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
MALOCCLUSION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
INCIPIENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARIES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERIODONTAL	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
SEALANT	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0

HYPOPLASIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HALITOSIS	2	0	0	0	0	1	0	0	0	0	2	0	0	2	2	0
ANALGESIA	0	2	0	2	0	0	0	0	1+2+0	0	0	0	0	0	0	0
CELLULITIS	0	1	0	2	0	0	0	0	1	1	0	0	1	0	0	0
FISTULA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEMPOROMANDIBULAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
HYPEREMIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
APICOECTOMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

VISIT ONE: CALCULATED FINAL ASSESSOR SCORES USING A MAJORITY SCORING METHOD

	TH01	TH02	TH03	TH04	TH05	TH06	TH07	TH08	TH09	TH10	TH11	TH12	TH13	TH14	TH15	TH16
SUGAR	1	1	1	1	1	1	1	1	1	2	1	0	1	2	1	1
SMOKING	1	1	1	2	1	1	1	0	1	0	1	1	1	1	1	1
FLOSS	2	1	1	1	1	2	0	0	1	1	2	1	1	2	2	1
BRUSH	1	1	0	1	2	2	1	1	2	2	2	2	2	2	2	1
PULP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FLUORIDE	2	1	0	0	0	0	0	1	1	1	1	0	1	0	1	0
BRACES	1	2	2	2	2	1	1	0	2	2	1	2	0	2	2	2
GENETICS	1	2	1	2	1	1	1	0	2	1	1	1	1	1	1	1
RESTORATION	1	0	1	0	0	1	0	0	1	1	1	1	0	1	1	0
BRUXISM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ABSCESS	1	1	0	1	0	0	0	0	1	2	1	0	1	1	0	0
EXTRACTION	1	2	1	2	1	1	0	0	2	1	2	1	1	2	1	0
DENTURE	1	1	0	2	2	0	0	0	2	2	2	2	0	0	2	0
ENAMEL	2	1	0	2	1	0	0	0	0	1	1	1	1	1	2	0

DENTITION	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
PLAQUE	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
GINGIVA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
MALOCCLUSION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
INCIPIENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARIES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERIODONTAL	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
SEALANT	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0
HYPOPLASIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HALITOSIS	2	0	0	0	0	1	0	0	0	0	2	0	0	2	2	0
ANALGESIA	0	2	0	2	0	0	0	0	1	0	0	0	0	0	0	0
CELLULITIS	0	1	0	2	0	0	0	0	1	1	0	0	1	0	0	0
FISTULA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TEMPOROMANDIBULAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
HYPEREMIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
APICOECTOMY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

VISIT THREE: INITIAL SCORES SHOWING ASSESSOR SCORE VARIATION

	TH01	TH02	TH03	TH04	TH05	TH06	TH07	TH08	TH09	TH10	TH11	TH12	TH13	TH14	TH15	TH16
SUGAR	0+1+2	1	1	1	1	1		1	1	2	1	0	1	2	1	
SMOKING	2	1	1	1	0+2+1	1		0	1	2	1	0	2	1	1	
FLOSS	1	1	1	2	2	2		1	0+2+1	2	2	1	2	0+1+2	2	
BRUSH	1	1	1	2	2	1		2	2	2	2	2	0+1+2	2	2	
PULP	0	1	0+2+1	0	1	0		0	0	0	0	1	0	0	2	
FLUORIDE	0+1+2	1	1	1	0	0		1	1	1	1	0	1	1	1	
BRACES	2	2	2	2	2	2		2	0	2	2	2	0+2+1	2	2	
GENETICS	2	2	1	2	2	1		1	0+2+1	2	2	1	1	2	2	
RESTORATION	0	0	0+2+1	1	1	1		0	0	0+2+1	1	0	1	1	1	
BRUXISM	0	0	0	0	0	0		0	0	0	0	0	0	0	0	
ABSCESS	0	2	0	1	0	1		0	2	2	1	0	0	1	0	
EXTRACTION	2	2	1	1	1	1		0	2	1	2	2	0+2+1	2	2	
DENTURE	2	1	0	2	2	2		0	1	2	2	2	0	0+2+1	1	
ENAMEL	2	1	0	2	2	1		1	0	1	0+2+1	1	1	2	2	
DENTITION	0	0	0	0	2	0		0	0	0	0	0	0	0	2	
PLAQUE	1	1	0	0+2+1	2	2		0	0+2+1	2	1	0+2+1	1	1	0	
GINGIVA	0	1+2+0	0	0	2	0		0	0	0	0	0	0	0	2	
MALOCCLUSION	0	0	0	0	1	0		0	0	0	0	0	0	0	1	
INCIPIENT	0	0	0	0	0	0		0	0	0	0	0	0	0	0	
CARIES	0	2	0	0	0	0		0	0	0	0	0	0	0	2	
PERIODONTAL	0	0	0	0	1	0		0	1	0	0	0	0	0	0	
SEALANT	0	1	1	1	1	0		0	0	0+2+1	0	0	1	0	1	

	TH01	TH02	TH03	TH04	TH05	TH06	TH07	TH08	TH09	TH10	TH11	TH12	TH13	TH14	TH15	TH16
HYPOPLASIA	0	0	0	0	0	0		0	0	0	0	0	0	0	0	
HALITOSIS	0	0	0	0	0	0		0	0	0	2	0	0	2	2	
ANALGESIA	0	2	0	2	0	0		0	1+2+0	0	0	0	0	0	1	
CELLULITIS	0	1	0	2	2	0		0	0	1+0+2	0	0	2	0	0	
FISTULA	0	0	0	0	0	0		0	0	0	0	0	0	0	0	
TEMPOROMANDIBULAR	0	0	0	1	1	0		0	0	0	0	0	0	0	2	
HYPEREMIA	0	0	0	0	0	0		0	0	0	0	0	0	0	0	
APICOECTOMY	0	0	0	0	0	0		0	0	0	0	0	0	0	0	

VISIT THREE: CALCULATED FINAL ASSESSOR SCORES USING A MAJORITY SCORING METHOD

	TH01	TH02	TH03	TH04	TH05	TH06	TH07	TH08	TH09	TH10	TH11	TH12	TH13	TH14	TH15	TH16
SUGAR	1	1	1	1	1	1		1	1	2	1	0	1	2	1	
SMOKING	2	1	1	1	1	1		0	1	2	1	0	2	1	1	
FLOSS	1	1	1	2	2	2		1	1	2	2	1	2	1	2	
BRUSH	1	1	1	2	2	1		2	2	2	2	2	1	2	2	
PULP	0	1	1	0	1	0		0	0	0	0	1	0	0	2	
FLUORIDE	1	1	1	1	0	0		1	1	1	1	0	1	1	1	
BRACES	2	2	2	2	2	2		2	0	2	2	2	1	2	2	
GENETICS	2	2	1	2	2	1		1	1	2	2	1	1	2	2	
RESTORATION	0	0	1	1	1	1		0	0	1	1	0	1	1	1	
BRUXISM	0	0	0	0	0	0		0	0	0	0	0	0	0	0	
ABSCESS	0	2	0	1	0	1		0	2	2	1	0	0	1	0	
EXTRACTION	2	2	1	1	1	1		0	2	1	2	2	1	2	2	
DENTURE	2	1	0	2	2	2		0	1	2	2	2	0	1	1	
ENAMEL	2	1	0	2	2	1		1	0	1	1	1	1	2	2	

DENTITION	0	0	0	0	2	0		0	0	0	0	0	0	0	2
PLAQUE	1	1	0	1	2	2		0	1	2	1	1	1	1	0
GINGIVA	0	1	0	0	2	0		0	0	0	0	0	0	0	2
MALOCCLUSION	0	0	0	0	1	0		0	0	0	0	0	0	0	1
INCIPIENT	0	0	0	0	0	0		0	0	0	0	0	0	0	0
CARIES	0	2	0	0	0	0		0	0	0	0	0	0	0	2
PERIODONTAL	0	0	0	0	1	0		0	1	0	0	0	0	0	0
SEALANT	0	1	1	1	1	0		0	0	1	0	0	1	0	1
HYPOPLASIA	0	0	0	0	0	0		0	0	0	0	0	0	0	0
HALITOSIS	0	0	0	0	0	0		0	0	0	2	0	0	2	2
ANALGESIA	0	2	0	2	0	0		0	1	0	0	0	0	0	1
CELLULITIS	0	1	0	2	2	0		0	0	1	0	0	2	0	0
FISTULA	0	0	0	0	0	0		0	0	0	0	0	0	0	0
TEMPOROMANDIBULAR	0	0	0	1	1	0		0	0	0	0	0	0	0	2
HYPEREMIA	0	0	0	0	0	0		0	0	0	0	0	0	0	0
APICOECTOMY	0	0	0	0	0	0		0	0	0	0	0	0	0	0

APPENDIX R: A copy of the transcribed participant interviews is available on the attached CD