



Perceptions of General Health and Root Canal
Treatment in New Zealand General Dental Practice

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Abstract

There are common risk factors between general health and oral health. General dental practitioners (GDPs) are seeing increasing numbers of patients presenting with multiple complex medical conditions. In parallel to managing more medically compromised patients, GDPs must provide holistic and technically challenging root canal treatment (RCT) for teeth that are heavily restored. There is little evidence surrounding the health status and preferences of patients undergoing RCT, and the confidence of GDPs in managing them.

This mixed method research engaged both dentists and their patients in a translational approach within a practice-based research network (PBRN). The goals of this study were to examine the self-perceived confidence and competence of New Zealand (NZ) GDPs managing patients for RCT presenting with a range of medical conditions; and their engagement in continuing professional development (CPD) related to endodontics. It also considered the dental experiences and self-perceived general health status of patients requiring RCT.

This study had three parts: A Pilot study, a PBRN survey of GDPs and patients, and Focus Group interviews of GDPs. Quantitative data from the surveys were entered directly into IBM SPSS Statistics Software, and following descriptive analysis, bivariate analysis was used to quantify differences in proportions using Pearson's Chi square test. Qualitative data was analysed thematically. Focus Group interviews were transcribed verbatim and transferred to NVivo 12 for detailed analysis.

The Pilot study validated the reliability of the survey for use in a larger group. The PBRN survey was implemented in a range of general practices throughout NZ and provided self-reported demographic and health data from patients, as well as perceptions of their

oral health and wellbeing. A positive patient experience of RCT was mostly influenced by clear, empathetic communication, and a professional approach by the practitioner.

GDP confidence in providing RCT was strongly related to procedural and patient-related factors rather than specific medical conditions such as those readily controlled with medications including cardiovascular diseases, and diabetes mellitus. The development of CPD related to medical conditions and pharmacology in dentistry was perceived as important.

With the help of both dentists and patients, this study has provided new knowledge, and improves our understanding of patients' medical status when they present for RCT and how equipped our workforce is to manage endodontic patients. Together this information can inform development of CPD activities and assist NZ GDPs managing patients requiring RCT.

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List of Abbreviations

AAE	American Association of Endodontists
ARCH	Applied Research through Clinicians' Hands
COPD	Chronic obstructive pulmonary disorder
CPD	Continuing professional development
CVD	Cardiovascular diseases
DHB	District Health Board
DM	Diabetes mellitus
E-CAT	Endodontic complexity assessment tool
GDP	General dental practitioner
GI	Gastro-intestinal
GP	General medical practitioner
HbA1c	Glycated haemoglobin
hsCRP	High-sensitivity C-reactive protein
IBD	Inflammatory bowel disease
IL	Interleukin
IV	Intravenous
MIMS	Monthly Index of Medical Specialties
MRONJ	Medication-related osteonecrosis of the jaws
NZ	New Zealand
NZDA	New Zealand Dental Association
NZDJ	New Zealand Dental Journal
OHRQoL	Oral health-related quality of life
PBRN	Practice-based research network
RA	Rheumatoid arthritis

RACDS	Royal Australasian College of Dental Surgeons
RCT	Root canal treatment
SRE	Skeletal-related event
SWB	Subjective wellbeing
T1 DM	Type 1 diabetes mellitus
T2 DM	Type 2 diabetes mellitus
TNF	Tumour necrosis factor
USA	United States of America

Chapter 1

Review of the Literature

1.1 Introduction

An association between oral health and some systemic disease has long been recognised. While the magnitude of this relationship is still unclear, common risk factors between oral and systemic chronic diseases, such as cardiovascular diseases (CVD) and diabetes mellitus (DM) have been identified (Segura-Egea et al. 2012; Berlin-Broner et al. 2017). As the population ages, general dental practitioners (GDPs) managing increased numbers of older patients who have associated medical conditions wanting to retain their natural dentition. Patients' own preferences for treatment must be integrated into a thorough, holistic treatment plan to ensure their wellbeing is maintained. There is little evidence surrounding the preferences of patients undergoing RCT, and the confidence of GDPs in managing them. More investigations are required, and this will inform further continuing professional development (CPD) for the betterment of clinicians, and their patients.

1.2 Oral Health & General Health

Following the discovery of bacteria within the dental pulp (Miller 1894), it was theorised that microorganisms from infected teeth could disseminate throughout the body (Hunter 1900). Researchers suggested that the spreading of microorganisms or their associated toxins could initiate or exacerbate systemic disease in foreign sites (Thomson 1925). This concept became known as the 'Focal Infection Theory' and was popular from around 1910 to 1940 (Murray & Saunders 2000; Gutmann 2017; Gutmann & Manjarrés 2020). Based on limited research involving animals, with unreliable bacterial culture techniques, a lack of control groups and anecdotal evidence, it was recommended to extract all "infected" teeth to cure a variety of systemic conditions (Rhein 1926; Holman 1928; Rhoads & Dick 1932). Many researchers opposed these publications on the basis that the scientific design was flawed. Notably, many patients with no infection had severe

systemic disease and the removal of teeth provided no improvement to their health (Mitchell & Helman 1953).

The ‘Focal Infection Theory’ gradually fell from acceptance as it was disproved but has recently regained interest, both in popular culture and in the scientific literature. Books such as *Root Canal Cover-Up* (Meinig 1993), *The Toxic Tooth* (Kulacz & Levy 2014), and a documentary on DVD (originally available via online streaming services but since removed) titled *Root Cause* (Bailey 2018) have disseminated outdated and low-quality science to the general population.

There are well recognised associations between oral diseases and systemic disease that cannot be overlooked. Periodontitis, the main cause of tooth loss in middle-aged and older adults, may associate with the risk of atherosclerotic vascular disease (Lockhart et al. 2012; Liljestrang et al. 2015). Diabetic control and periodontal disease show some interrelationship (Mealey & Oates 2006; Kuo et al. 2008; Kaur et al. 2009), although causation cannot be determined. Significant associations have also been found between endodontic pathology and various CVDs and CVD-related risk factors, particularly hypertension (Messing et al. 2019). The results of studies carried out both in animal models and humans are not conclusive, but suggest an association between endodontic variables such as apical periodontitis and RCT, DM, tobacco smoking, coronary heart disease and other systemic diseases (Segura-Egea et al. 2015). Even though evidence to support causation is weak, a multitude of shared risk factors exist between periodontitis, endodontic disease, CVD and DM.

1.2.1 Risk factors for oral health & general health

There are common risk factors for general and oral health. Oral diseases qualify as major public health problems owing to their high prevalence and incidence in all regions of the

world, and as for most diseases, the greatest burden is on disadvantaged and socially marginalised populations (Petersen 2003). Worldwide, the contribution of different risk factors to the disease burden has changed substantially, with a shift from high risks for communicable diseases in children, towards those for non-communicable diseases in adults. These changes are related to the ageing population, decreased mortality among children younger than five years, and changes in risk factor exposures (Lozano et al. 2012). Adults and children living in the most deprived areas have higher levels of disease risk factors including smoking, hazardous drinking, and obesity (Lozano et al. 2012). There are particular disparities between Māori and non-Māori people in New Zealand (NZ), especially in smoking status, asthma, obesity, CVD and DM incidence (Ministry of Health 2013).

Oral health programmes focus on individual behaviour change and largely ignore the influence of socio-political factors as the key determinants of health (Sheiham & Watt 2000). Oral health is determined by diet, hygiene, smoking, alcohol use, stress and trauma, and these causes are common to a number of other chronic diseases (Sheiham & Watt 2000). Adopting a collaborative common-risk factor approach may be beneficial to wider populations and not just individuals (Sheiham & Watt 2000).

Dietary risk factors such as consumption of foods high in salt and sugar, and global decreases in physical activity put the international burden of DM at a high level. Most importantly, Type 2 diabetes mellitus (T2 DM) is strongly linked to obesity and subsequent CVD – which accounts for 70-80% of deaths in people with T2 DM (Anderson et al. 2003). These risk factors are preventable. Chronic diseases are frequently the cause of long lasting debilitation and many patients are affected by more than one form of chronic disease (Newnham 2016). The range and severity of medical

diseases, level of control and nature of prescribed medications influence patients' oral health.

How these general health factors impact on dentists' confidence and competence in delivering safe oral care, and their ability to offer appropriate and acceptable treatment options to patients is unclear.

1.3 Odontogenic Infection & Root Canal Treatment

Dental caries is recognised as the most common chronic disease in man (Ozdemir 2013), and left untreated, bacterial entry into dentine may result in pulp necrosis and infection (Kakehashi et al. 1965; Sundqvist 1976). Odontogenic infection may also arise from dental trauma or failed coronal restorations and initiate apical periodontitis (Andreasen 1970; Saunders & Saunders 1994). Apical periodontitis is a term used to define inflammation that occurs within the periodontal structures in the apical region of a tooth. It occurs most commonly in response to microorganisms within the root canal system but may also arise from non-microbial irritants, for example, orthodontic tooth movement or a restoration in hyperocclusion (Abbott 2004; Yamaguchi & Kasai 2007). Where there is a microbial cause, treatment consists of eliminating the root canal microorganisms or reducing the microbial load to the level the host response can manage, and preventing re-infection (Nair 2004).

The presence of apical periodontitis is very common – approximately 10% of all teeth are root canal treated, and 5% of all teeth have apical periodontitis (Pak et al. 2012). Additionally, the prevalence of individuals with one or more infected teeth could be as high as 61% (Jiménez-Pinzón et al. 2004). Endodontic infections contain a mixed microbial flora of mainly facultative anaerobes including bacteria from the genera *Fusobacterium*, *Prevotella*, *Eubacterium*, *Peptostreptococcus*, and *Porphyromonas*

(Siqueira & Rôças 2009). *Porphyromonas endodontalis* is commonly isolated in cases of apical periodontitis, due to its high prevalence and virulence factors (Rôças et al. 2011). Moreover, *P. endodontalis* can invade vascular endothelial and smooth muscle cells, which may indicate an association between root canal infection and the potential for systemic complications (Dorn et al. 2002). RCT is designed to eliminate bacteria from the infected root canal, prevent reinfection of the tooth and save the natural tooth. RCT specifies the removal and disinfection of inflamed and infected pulp inside of the tooth, then filled and sealed (American Association of Endodontists 2020). In the context of this research, other types of endodontic treatments such as vital pulp therapy and surgical RCT are not included unless specified.

While clinical goals of RCT are mostly limited to the eradication of intracanal bacteria, absence of symptoms and a reduction of radiographic periapical signs (where present), patient-centred outcome measurements are also important in evaluating the effectiveness of treatment (Friedman & Mor 2004). Although curing disease is the ultimate goal of care, patients often set treatment goals relevant to them, such as retention of the tooth for aesthetic or partially functional reasons (Friedman & Mor 2004). The patient centred model of healthcare (Apelian et al. 2014) recognises holistic management, so the clinician's knowledge, confidence and competence in managing a patient's associated general health condition will guide the appropriate treatment.

Historically, a paternalistic approach was more common, particularly for managing acute infections where treatment options were limited. Today, the dental clinician must present multiple treatment options based upon best available evidence and integrate patient preference (Apelian et al. 2014). Occasionally, even a tooth of poor restorability may have to be retained; for example, if the patient is on immunosuppression or

bisphosphonate medications, an extraction could risk induction of medication-related osteonecrosis of the jaw (MRONJ).

1.4 Dentists as Oral Physicians

As health professionals, dentists have an important role in educating patients about prevention. Given their understanding of oral disease, and the relationship of this to systemic disease, dentists may identify chronic disorders before they are formally identified by medical practitioners, and have the ability to facilitate referral (Raphael 2010; Giddon et al. 2013). Having a personalised dental experience helps patients to perceive their health differently and enables them to take control of their own oral health (Sbaraini et al. 2012). Increased understanding of the oral and general health interface can only improve treatment outcomes for patients.

With an ageing population, improved diagnostic techniques and pharmacological treatments, dentists are seeing more medically compromised patients in practice, with increasing dental treatment needs. These patients require careful management as their systemic condition can predispose them to biofilm-associated diseases, particularly within the oral cavity (Newnham 2016). Since the pulp and the periodontium are connected to the circulatory system, bacteraemia following dental treatment is almost inevitable. This is in addition to the natural bacteraemia from tooth brushing and is dependent on the amount present, its complexity, and the degree of gingival inflammation (Debelian et al. 1994). A bacteraemia induced by invasive dental treatment does not cause a significant issue in most patients since their immune system is able to manage it successfully. However, individuals who are medically compromised, e.g. T2 DM, long-term steroid therapy, congenital heart disease, artificial heart valves or/and

artificial joints, are more likely to suffer morbidity as a result of bacteraemia (Moloney & Soma 2016).

Current evidence-based research suggests a possible relationship between dental health and systemic health – specifically, infections from the periodontium or root canal. It has been suggested that the bacteraemia, or the associated bacterial endotoxins after RCT may be the origin of systemic complications, such as atherosclerosis and Alzheimer’s disease (Debelian et al. 1998; Olsen et al. 2016). There has been growing research suggesting the involvement of apical periodontitis in establishing systemic inflammatory burden in DM, CVD, arthritis, gastro-intestinal conditions, and physical fitness has been published (Segura-Egea et al. 2005; Salemi et al. 2014; Gomes et al. 2016; Berlin-Broner et al. 2017; Hoppe et al. 2017; Piras et al. 2017). In the development of CVD, low-grade chronic inflammation plays a role as a pathogenetic determinant of atherosclerosis. Research has demonstrated the possible relationship between endodontic disease and CVD, although self-reported by patients (Frisk et al. 2003; Caplan et al. 2006). However, due to the predominantly retrospective nature of these publications, and in some instances self-reported data, there is insufficient evidence to justify a causal relationship, but there is little doubt that some association exists between apical periodontitis and systemic medical conditions (Berlin-Broner et al. 2017).

1.5 General Health & Oral Disease

1.5.1 Diabetes mellitus

Diabetes mellitus is a chronic systemic disease characterised by hyperglycaemia. The prevalence of DM for all age groups worldwide was estimated to be 2.8% in 2000, rising

to 4.4% in 2030 (Wild et al. 2004). Moreover, the total number of people with DM is projected to rise from 171 million in 2000 to 366 million in 2030 (Wild et al. 2004).

DM is diagnosed with blood samples of mean glycated haemoglobin (HbA1c) exceeding a threshold level of 6.5% (American Diabetes Association 2014). HbA1c is a product of haemoglobin and high glucose interaction, thus its elevated level indirectly reflects the hyperglycaemic condition. These disorders are either caused by insulin-deficiency related to autoimmune destruction of pancreatic beta cells (Type 1), or target tissue resistance to the cellular metabolic effects of insulin (Type 2) (American Diabetes Association 2014).

T2 DM is predominantly a lifestyle-related disease that affects as many as 6.4% of New Zealanders but is likely to be much higher due to underreporting (Ministry of Health 2019). T2 DM affects immune cell function, upregulates cytokines from monocytes, and downregulates the various growth factors, predisposing to chronic inflammation, progressive tissue breakdown, and reduced repair capacity (Iacopino 2001). By compromising the effectiveness of the non-specific immune system, this immune phenotype leads to the oral complications of T2 DM, mainly gingivitis, periodontal disease, and apical periodontitis (Moloney & Soma 2016).

A higher prevalence of periapical lesions, greater likelihood of asymptomatic infections, and larger periapical lesions have been observed in teeth that have previously had RCT in patients with T2 DM (López-López et al. 2012; Marotta et al. 2012; Segura-Egea et al. 2012). Due to the disease affecting the integrity of the non-specific immune system involved in the healing of the apical tissues, the pro-inflammatory status and impaired immune response associated can affect the reparative response of the dental pulp and periapical healing in T2 DM (Arya et al. 2017). Furthermore, outcomes for primary RCT

and retreatment may be compromised in patients with T2 DM, although this has yet to be confirmed in prospective studies (Marending et al. 2005; Segura-Egea et al. 2012).

The association between DM and endodontic infection is unclear but recent findings are improving our knowledge. DM does appear to be involved in the immuno-modulation of apical periodontitis and the effects of root canal infections on glycaemic control have been studied (Cintra et al. 2014). HbA1c levels of diabetic patients have been found to be associated with periapical status, where teeth following RCT are more likely to have persistent apical periodontitis, which suggests a relationship between glycaemic control and apical inflammation (Sánchez-Domínguez et al. 2015; Limeira et al. 2020). Moreover, in a prospective study, a significantly higher prevalence of apical periodontitis following RCT has been found in patients with T2 DM, having HbA1c levels exceeding the diagnostic threshold (Arya et al. 2017).

The evidence supporting an association between DM and apical periodontitis is increasing (Tibúrcio-Machado et al. 2017; Pérez-Losada et al. 2020). Understanding patients' general health status when they present may help inform dentists' knowledge of systemic interactions with RCT.

1.5.2 Cardiovascular disease

Cardiovascular disease is a group of illnesses affecting the heart and blood vessels, including coronary heart disease, cerebrovascular disease, peripheral arterial disease, rheumatic heart disease, congenital heart disease, deep vein thrombosis and pulmonary embolism (World Health Organization 2017). CVD is the number one cause of death globally and an estimated 17.9 million people died from CVD in 2016, representing 31% of all global deaths, mostly from heart attacks and stroke (World Health Organization 2017). The aetiology is multifactorial and determined by risk factors including genetic

and environmental factors. Atherosclerosis is one of the most common presentations of coronary heart disease and low-grade chronic inflammation is recognised as a pathogenetic determinant of this process (Stevens et al. 2005). Although dental infections cause a local tissue response, there is also evidence that like periodontal disease, apical periodontitis may contribute to systemic inflammation (Gomes et al. 2013; Cotti & Mercurio 2015; Segura-Egea et al. 2015).

Observational studies have provided evidence signifying that periodontal disease is independently associated with atherosclerosis and CVD (Tonetti & Van Dyke 2013; Liljestrand et al. 2016; Chauhan et al. 2019). While one longitudinal study points to a relationship between chronic periodontal inflammation and the development of coronary heart disease (Caplan et al. 2006), another large cross-sectional study focused on apical periodontitis did not prove to be predictive of CVD (Frisk et al. 2003). Only age and tooth loss were significantly associated with CVD and no significant association between root canal treated teeth, CVD and apical periodontitis was found (Frisk et al. 2003).

A recent publication addressed the relationship of apical periodontitis with associated CVD using both epidemiological and genetic approaches (Messing et al. 2019). They found that significant associations existed between ‘endodontic pathology’ and various CVD and CVD related risk factors, particularly hypertension. Additionally, a trend toward a positive association was also found between apical periodontitis and a single nucleotide polymorphism in *KCNK3*, a gene known to be involved in increased susceptibility to hypertension (Messing et al. 2019). Furthermore, observed tooth loss may be associated with atherosclerosis or early mortality (Gomes et al. 2016). Another study assessed whether apical periodontitis was associated with inflammatory serum markers of CVD, notably high-sensitivity C-reactive protein (hsCRP) (Garrido et al. 2019). The periapical lesions were associated with the systemic inflammatory burden

and cardiovascular risk determined by hsCRP, which supports a potential mechanistic link for CVD in young adults (Garrido et al. 2019). Conversely, a recent animal study found no difference in the degree of atherosclerosis between susceptible rats with apical periodontitis compared with controls (Berlin-Broner et al. 2020).

Although most studies find some positive association between apical periodontitis and CVD in humans, the quality of the existing evidence is moderate–low due to the non-interventional study designs. A definitive causal relationship cannot be established at this time, and more high quality prospective studies are needed (Berlin-Broner et al. 2017).

1.5.3 Immune disorders

Disturbances of the systemic immune system, antibiotic treatments, immunosuppressants, and biologic therapies all may increase the chance of infections such as apical periodontitis (Barta 2020).

1.5.3.1 Inflammatory bowel diseases

Inflammatory bowel diseases (IBDs) include two recurrent and chronic inflammatory diseases of the gastrointestinal tract: Crohn’s disease and ulcerative colitis. In the USA these diseases have a prevalence of approximately 1.3% of adults (3 million people) (Nguyen et al. 2014). Both diseases are characterised by diffuse inflammation of the intestinal mucosa. Four to 16% of patients with IBD present with oral manifestations, including linear ulceration, mucosal oedema, angular cheilitis, and granulomatous gingivitis (Kalmar 1994). These patients also present with higher rates of dental caries and periodontal disease (Koutsochristou et al. 2015). Further, patients with IBD have recently been shown to have greater prevalence of apical periodontitis (Piras et al. 2017; Poyato-Borrego et al. 2020). However, as for other systemic diseases, retrospective and observational study designs limit the ability to extrapolate to populations.

1.5.3.2 Rheumatoid arthritis

Osteoarthritis often has mild inflammation localised to one joint, whereas rheumatoid arthritis (RA) is a chronic polyarthritis, characterised by specific serological alterations which include the expression of antibodies directed against citrullinated protein antigens (anti-citrullinated protein antibodies) (Mikuls et al. 2012). In recent years, there have been important advances in the understanding of RA pathogenesis, together with new diagnostic and therapeutic strategies (Salemi et al. 2014). It has been suggested that periodontitis and apical periodontitis may have a trigger role in RA pathogenesis, which may be explained by the action of *P. gingivalis* and *P. endodontalis*, activating break tolerance (autoimmunity) to collagen (Salemi et al. 2014). Additionally, patients with RA attending a rheumatology clinic have been reported to have more missing teeth and deeper periodontal pockets compared with age and gender-matched controls – but no mention was made regarding their specific levels of immunocompromise (Mercado et al. 2001).

Immunomodulatory drugs are frequently prescribed to these patients, and may have implications for the development, progression, and healing of apical periodontitis (Cotti et al. 2014). Although identification and subsequent treatment of oral infections should be considered in RA prophylaxis and management, prospective research is required to conclusively determine the role of oral disease and its relationship with RA.

1.5.4 Prosthetic joints

Theoretical risks of a prosthetic joint becoming infected by a bacteraemia following a dental procedure exist (LaPorte et al. 1999). However, there has been considerable debate around the need and effectiveness of antibiotic prophylaxis for individuals who have a prosthetic joint. While bacteraemia from an oral source occurs from normal activities

such as eating and performing oral hygiene, certain dental interventions can also produce a bacteraemia of short duration (Tong & Theis 2008; Uckay et al. 2008). In fact, the extent of dental bacteraemia from routine activities, and those associated with a dental procedure is related to the degree of oral and gingival inflammation (Forner et al. 2006; Tong & Theis 2008). To reduce bacteraemic risk, patients should maintain good oral health through effective home care and regular dental examination (New Zealand Dental Association 2018).

Most prosthetic joint infections are caused by staphylococci, beta-haemolytic streptococci or gram-negative enteric bacilli (Moran et al. 2007). Alpha-haemolytic (oral) streptococci and anaerobes are rare causes of prosthetic joint infection and the original seed location of these bacteria is debatable, as they may originate from the digestive tract and not the oral environment (Lockhart et al. 2008). Furthermore, in a prospective case-control study, dental procedures were not risk factors for subsequent total hip or knee infection, and the use of antibiotic prophylaxis prior to dental procedures did not significantly decrease the risk of subsequent total hip or knee infection (Berbari et al. 2010).

Many orthopaedic groups and associations continue to support the use of prophylactic antibiotics (McNally et al. 2016); while other groups of physicians, infectious disease specialists and dentists have suggested that routine antibiotic prophylaxis in such patients is unwarranted (New Zealand Dental Association 2018). It is generally accepted that adverse reactions to antibiotics and the increasing development of drug-resistant bacteria outweigh the benefits of prophylaxis therapy for many patients (Austin et al. 1999; Andersson & Hughes 2011; Segura-Egea et al. 2017).

However, prophylactic antibiotics are warranted for patients with artificial joints who are also immunocompromised e.g. uncontrolled diabetics, organ transplant patients, and oncology patients (Segura-Egea et al. 2017). The clinician needs to consider the potential benefits, risks, and biologic costs of prophylaxis, and whether the treatment plan for the patient is appropriate for their overall wellbeing.

1.5.5 Multimorbidity & polypharmacy

As our population ages, there is an increasing cohort of patients who present with multiple co-morbidities. Co-morbidity refers to the coexistence of two or more chronic diseases in the same individual (Barnett et al. 2012; Bähler et al. 2015), patients with multiple co-morbidities are deemed to have multimorbidity (Marengoni et al. 2011). This group of medically compromised patients places significant stress on healthcare systems (Barnett et al. 2012) and individuals of low socioeconomic status are at greater risk of multimorbidity (Sundqvist et al. 2004; Freedman et al. 2011). Furthermore, the presence of multiple chronic diseases may present a barrier to accessing dental care (Gijssen et al. 2001). Conversely, some authors have suggested that this group of patients are more likely to attend the dentist (Wade et al. 2019). This outlines the importance of dentists in triaging and monitoring patients' medical health alongside their oral health.

In parallel with multimorbidity is an increasing trend in polypharmacy – using multiple medications to manage chronic diseases (Jokanovic et al. 2015). Like multimorbidity, the definition of polypharmacy is not standardised. The common definition of polypharmacy is the prescription of five or more medicines (Masnoon et al. 2017). The risk of adverse systemic effects on patients increases with cumulative medications due to a multitude of factors including drug-drug interactions and drug-disease interactions (Maher et al. 2014). There are age-related changes in the body such as decreased renal

and hepatic function which alter the pharmacokinetics and pharmacodynamics of medications, and make older adults more vulnerable to adverse effects of multiple medications (Bushardt et al. 2008; Singh & Papas 2014). Additionally, patients on ten or more medications are often termed as having ‘excessive polypharmacy’ which is related to an even higher risk of non-therapeutic drug effects and interactions (Walckiers et al. 2015; Dwyer et al. 2016).

Polypharmacy influences oral health significantly, with xerostomia being the most common side effect. Saliva plays an essential role in the homeostasis of the oral cavity because of its protective and functional properties, which include: facilitating speech, swallowing, enhancing taste, buffering and neutralising acid, remineralising teeth, maintaining oral mucosal health, and preventing overgrowth of noxious microorganisms. There are qualitative and quantitative changes in saliva due to medication-induced anticholinergic action (Singh & Papas 2014). In the presence of salivary hypofunction, dental caries, endodontic infections, and periodontal disease are more common (Singh & Papas 2014).

1.5.6 Medication-related osteonecrosis of the jaw

Medication-related osteonecrosis of the jaw (MRONJ) is principally an adverse side effect of monoclonal antibody therapy by RANK-L inhibition (denosumab), tyrosine kinase inhibitors or bisphosphonates – predominantly when high doses are implemented intravenously (IV) to prevent skeletal-related events (SREs) in patients with metastatic cancer (Ruggiero et al. 2014; Otto et al. 2018). Additionally, some anti-angiogenic medications such as bevacizumab have been implicated in MRONJ formation where vascular endothelial growth factor is inhibited (Ruggiero et al. 2014; Rosella et al. 2016).

While the pathogenesis of adverse outcomes remains unclear, limitation of angiogenesis (Yamashita & McCauley 2012), inhibition of osteoclast action, or reduction of osteoclast numbers likely plays a role in the development of MRONJ (Baron et al. 2011). Typically, exposed bone becomes secondarily infected and clinical management with surgical procedures is associated with significant morbidity (Baron et al. 2011; Lacey et al. 2012). Furthermore, non-surgical treatment often decreases the patient's quality of life owing to a long-term therapeutic period, as well as occasionally causing progression of the disease (Hayashida et al. 2017).

Patients may be considered to have MRONJ if all of the following characteristics are present (Ruggiero et al. 2014):

- Current or previous treatment with antiresorptive or antiangiogenic agent
- Exposed bone or bone that can be probed through an intraoral or extraoral fistula in the maxillofacial region that has persisted for longer than eight weeks
- No history of radiation therapy to the jaws or obvious metastatic disease to the jaws

Though the potential for these medications to improve cancer-specific survival remains controversial, the interventions have a significant favourable effect on the quality of life for patients with advanced cancer involving the skeleton (Ruggiero et al. 2014). In addition to IV implementations for the management of SREs, bisphosphonates (such as zoledronate) can be infused once yearly or given orally (such as risedronate or alendronate) for the treatment of osteopaenia and osteoporosis (Delmas 2005). The astute clinician would use a risk-based approach to avoid performing procedures such as extraction for those in danger of MRONJ, but there is debate about what risk truly exists and which protocols are appropriate, given the evidence (Tanna et al. 2017). If the patient

is taking oral bisphosphonate tablets for osteoporosis and they are otherwise well, the risk is likely to be less than 0.5% for MRONJ following simple tooth extraction (Kunchur et al. 2009). If the patient is medically unwell with cancer and on IV bisphosphonates, the risk could lie between 1.6 and 14.8% (Mozzati et al. 2012; Yamazaki et al. 2012; Scoletta et al. 2013). It is important to note that these data are primarily retrospective and captured in a hospital setting which may not translate to general dental practice.

Avoiding bone trauma and preventing and treating dental infections before and during pharmacological therapy is crucial to minimising the risk of MRONJ. Further modifying the risk of MRONJ are factors such as: operative treatment, e.g. tooth extraction, location of the wound (MRONJ is more likely to occur in the mandible), or whether the patient wears a denture (Ruggiero et al. 2014). Additionally, immunosuppressive medications such as corticosteroids (Saad et al. 2012), concomitant systemic diseases such as DM (Peer & Khamaisi 2015), or contributory oral infection such as periodontal disease or apical periodontitis (Tsao et al. 2013) may play a role in increasing MRONJ risk.

In a survey of UK dentists, 58% were not comfortable performing a non-surgical extraction on an osteoporotic patient (with no other medical problems) who had been taking oral alendronic acid for one year, despite a low risk of adverse outcome (Tanna et al. 2017). There is a need to provide further education and training for GDPs to improve confidence, and increase awareness of bisphosphonates, as well as other medications which have the potential to cause osteonecrosis. Importantly, we must ensure patients are fully informed of the risks and benefits of medications such as bisphosphonates, given the potential sequelae.

While generally it is accepted that with patients at risk of MRONJ, RCT is preferred to extraction where appropriate, there are documented cases of osteonecrosis occurring in

patients following non-surgical RCT (Katz 2005; Sarathy et al. 2005). Many occur in those with IV bisphosphonate medications, concurrent medications such as glucocorticoids, and with co-morbidities such as T2 DM. Clearly, surgical endodontics is contraindicated since invasive surgical procedures have been implicated as one of the main risk factors for the development of MRONJ (Marx et al. 2005; Pazianas et al. 2007; Filleul et al. 2010).

If RCT is indicated, procedures minimising trauma to the marginal and apical tissues must be employed. For example, a dental dam clamp positioned improperly (Gallego et al. 2011), or over-instrumentation of apical tissues could be implicated in MRONJ development (Moinzadeh et al. 2013).

1.6 Quality of Life

1.6.1 Oral health, general health & wellbeing

Patients are now living longer and are wanting to retain their natural dentition. Hence, medical co-morbidities and the cumulative effects of caries, large restorations, periodontal disease, and endodontic infections accumulate. In the past five decades, there has been an increase in the global population and demographic changes in birth, death, and growth rates (Ezeh et al. 2012). Between 2010 and 2050, the proportion of older adults (those aged more than 65 years) is projected to rise from 16.3 to 27.4% in Europe, from 13.1 to 22.0% in the United States of America (USA) and Canada, from 22.6 to 37.8% in Japan, and from 8.2 to 23.3% in China (United Nations 2011). While the NZ population is in a stage of ‘moderate growth’, it shares many characteristics with international ageing populations, whereby the 14% of the population currently aged 65 or more is expected to rise to 25% by 2050. Within that group, people aged 80 and above

currently comprise approximately 25%, but that proportion will likely be 40% by 2050 (Thomson 2014).

It has been demonstrated that many older adults have problems chewing, difficulties in eating, chronic pain, and problems in social relationships because of oral disorders (Locker et al. 2000). The relationship between quality of life and oral health problems has been studied in depth, and authors have related such problems to the use of prostheses (Montero et al. 2013; Ali et al. 2019), orthodontics (Manjith et al. 2012), and periodontics (Al Habashneh et al. 2012). Although there is limited research on the impact of RCT on oral health–related quality of life (OHRQoL), pain of pulpal or periapical origin has a major impact on the wellbeing of the general population, justifying further investigation (Montero et al. 2008; Montero et al. 2015). It has been reported that patients with missing teeth have a reduced OHRQoL (McGrath & Bedi 2001), and retaining their natural dentition or replacement with fixed prostheses is much preferred to missing teeth or removable prostheses (Ali et al. 2019).

Subjective wellbeing (SWB) is a self-reported measure of wellbeing and is typically obtained by questionnaire (Diener 2000). SWB encompasses moods and emotions as well as evaluations of one's satisfaction with general and specific areas of one's life and is closely linked to age (Diener 2000). Three aspects of SWB can be distinguished: evaluative wellbeing (or life satisfaction), hedonic wellbeing (feelings of happiness, sadness, anger, stress, and pain), and eudemonic wellbeing (sense of purpose and meaning in life) (Steptoe et al. 2015). Older adults with diseases such as CVD, arthritis, DM, and chronic lung disease show both increased levels of depressed mood and impaired hedonic and eudemonic wellbeing (Steptoe 2006). Wellbeing may also have a defensive role in health maintenance – in an analysis of the English Longitudinal Study

of Ageing, it was recognised that eudemonic wellbeing is associated with improved survival (Stephoe et al. 2013).

1.6.2 Physical fitness

Regular physical activity is viewed as important for a healthy lifestyle, with a significant impact on general health and prevention of multiple noncommunicable diseases such as CVD and obesity (Warburton et al. 2006). In addition, observational data shows an association between physical activity and concentrations of inflammatory biomarker concentration such as interleukin (IL)-1 β , IL-6 and tumour necrosis factor (TNF)- α (Beavers et al. 2010). Given the relationship between physical activity and inflammation, and considering the similar pro-inflammatory biomarkers involved in apical periodontitis (Gomes et al. 2013), periodontal disease (Tonetti & Van Dyke 2013), and muscle metabolism (Beavers et al. 2010), it is plausible that low-grade systemic inflammation from oral diseases could impact on a patient's physical fitness. Although there is limited evidence of this association, subjects with endodontic and periodontal disease were found to have poorer physical fitness in a prospective observational study signifying there may be increased risk (Hoppe et al. 2017).

1.7 General Dental Practitioners

1.7.1 Managing patients with medical diseases

Competency within the scope of general dental practice requires dentists to manage patients of all ages holistically, including those who present with complex medical histories (Dental Council of New Zealand 2016). This aspect of professional practice begins during dental training, and while this skill is essential for delivery of safe dental

care, few studies have considered the self-perceived confidence and competence of dentists in managing patients with a range of medical diseases.

In research from the USA, it has been established that dentists appreciate the importance of medical screening in practice, and are willing to collect health information (Greenberg et al. 2010). However, all respondents cited lack of time as the most important factor related to chairside screening of chronic diseases (Greenberg et al. 2010). In another survey, GDPs in private practice in the USA were well-informed about oral-systemic health associations but had mixed comfort levels translating the evidence into clinical practice (Paquette et al. 2015). They expressed support for interprofessional education to improve readiness to actively participate in their patients' overall health management (Paquette et al. 2015).

As patients age, many present with a complex medical history and the likelihood of encountering a medical emergency in dental practice is growing. In two NZ surveys, more than half the respondents indicated they had received insufficient training in the management of medical emergencies during their undergraduate training, and over 10% still felt inadequately prepared for an emergency in their practice (Broadbent & Thomson 2001; Hong et al. 2017). Further, some clinicians still lacked the required emergency equipment, drugs, and training to safely manage medical emergencies (Hong et al. 2017).

There are few medical contraindications to non-surgical RCT. Only reported allergies or adverse reactions to materials used in the treatment or local anaesthetic could be considered a true contraindication, while the majority are related to the RCT procedure itself (Sperber & Yu 2003). These include the inability to place or tolerate a dental dam, insufficient remaining tooth structure to support a predictable definitive restoration, or unfavourable periodontal conditions that cannot be corrected (Samet & Jotkowitz 2009).

Other technical contraindications that could preclude successful RCT include unusual anatomical variations of root canals, or obstructions that limit the ability to eradicate bacteria. Many of these could potentially be managed by highly skilled operators or endodontic specialists.

RCT poses fewer potential complications than other dental procedures such as tooth extraction and placement of dental implants (Hwang & Wang 2007; Zitzmann et al. 2010). For patients requiring RCT, the most relevant factors to providing successful treatment relate to the mobility and treatment tolerance of the patient rather than their medical problems (Simon 1999; American Association of Endodontists 2019). Furthermore, patient factors such as difficulty obtaining anaesthesia, significant limitations in mouth opening, a significant gag reflex, and specific tooth factors may compromise delivery of high quality treatment compared to a contributory medical condition (American Association of Endodontists 2019).

As NZ's population is ageing and prescribing patterns are changing, it is timely to better understand how GDPs perceive their confidence in managing patients with specific medical conditions. This knowledge can be used to identify gaps and inform areas for development of CPD activities.

1.7.2 The New Zealand general dental practice workforce

The latest published data (2017) indicates that the number of dentists has been slightly increasing yearly. In 2017, there were 2,292 dentists and dental specialists on the Dental Council register holding current practicing certificates (Dental Council of New Zealand 2017). Demographically, there have been increases in the younger age groups (25-29 years and 30-34 years) and a decline in practitioners aged over 50 years. A total of 212 dentists and dental specialists aged 65 years and older had practicing certificates in 2015,

and 21 of these were 75 years or older. Females continue to increase in proportion from 35.1% of practicing dentists and dental specialists in 2012 to 38.1% in 2015 (Dental Council of New Zealand 2017).

New Zealand is a geographically diverse country with a relatively small population spread over multiple land masses. While most registered GDPs operate in main centres such as Auckland, Hamilton, Wellington, Christchurch, and Dunedin, as of the most recently published data some areas have 13 or less dentists per 100,000 people. These include parts of Kaipara, Hauraki, Waikato, Hurunui, and Southland District. Several areas have no recorded dentists or dental specialists (Dental Council of New Zealand 2017).

Primarily, NZ dentists are self-employed in private practice (67.5%), with less than 5% working as employees of District Health Boards (DHBs) (Dental Council of New Zealand 2017). This interesting finding may indicate an unmet need, given the increasing numbers of medically compromised individuals – many of whom will be referred into hospital clinics when they are no longer able to be managed safely in private practice.

1.7.3 Continuing professional development (CPD)

Internationally, there has been a movement towards mandating CPD to fulfil competency and registration requirements in dentistry. Compulsory requirements exist in the United Kingdom (UK), Hong Kong, Singapore, and most states or territories of North America (Best et al. 2005). In Australia, dental practitioners are required to complete a minimum of 60 hours of CPD activities over a three year cycle (Australian Dental Board 2020). CPD has been a requirement for NZ dentists' continued registration since 2006 with an aim to keep practitioners current with best practice. Continued registration has a similar requirement to other countries with a CPD obligation of 70 hours over a three year cycle,

with an additional 10 hours of peer contact – but this is due to change at the time of writing for the period beginning 2022, pending review (Dental Council of New Zealand 2019).

Studies of CPD effectiveness suggest that courses can result in widespread new learning and considerable self-reported change in practice. However, significant barriers to implementing change in workplace practice were noted, and included availability of materials, resources, and support from colleagues (Barnes et al. 2013). The internet and e-learning are common methods of dental CPD, particularly among younger dentists (Barnes et al. 2013). In a recent survey of GDPs in NZ about vital pulp therapy, nearly 10% of respondents reported using online sources as their most common form of CPD (Friedlander et al. 2015).

Contrarily, some GDPs see CPD as an ongoing job stressor affecting the quality of work satisfaction (Ayers et al. 2008). Furthermore, self-perceived educational needs may not be a true indicator of the real educational needs of a practitioner, and therefore may not equate to an improvement in the overall provision of dental care (Best & Messer 2001). It has been shown that course attendance may confirm current practice rather than lead to change, and therefore dentists may self-select courses that reinforce their knowledge or areas they have interest in, rather than address areas of deficiency (Best & Messer 2001; Hopcraft et al. 2010).

Endodontics is a popular discipline in New Zealand, with over 75 percent of respondents having regularly attended refresher courses on how to improve their RCT techniques in a previous NZ survey (Koshy & Chandler 2003). Although CPD is considered important by clinicians, the need and value of continuing education related to managing medically

compromised patients and RCT is not yet established – it could improve outcomes for patients and increase job satisfaction for GDPs.

1.8 Translational Research

Translational research fosters the multidirectional and multidisciplinary integration of basic research, patient-oriented research, and population-based research, with the long-term aim of improving the health of the public (Rubio et al. 2010). A translational research approach will typically explore a topic generated in ‘real world’ practice across multi-centres with many benefits, including enhanced generalisability of results, pooling of resources, rapid patient recruitment, and collaborative opportunities.

1.8.1 Practice-based research networks & research approach

One example of translational research is the use of practice-based research networks (PBRNs). These are characterised by an organisational framework that transcends a single location or study and serves as the clinical research site for conducting comparative-effectiveness studies using patient-oriented measures (Sauers et al. 2012). Traditionally, there has been a translational delay between what research evidence supports as best practice, and what occurs in everyday clinical dentistry (Curro et al. 2012). PBRNs are an expanding area for dental research which supports collaboration between academic institutions and dental practitioners to conduct studies relevant to practice, with outcomes which are of mutual interest. The current study evolved from a NZ General Dental Practice symposium held in 2017 relating to ‘Oral Health and General Health’ in which practitioners wanted improved understanding of endodontic disease and health.

New Zealand's dental PBRN, ARCH (Applied Research through Clinicians' Hands) was founded in 2014 and has been an effective platform for exploring unique research questions in NZ and enables the dispersion of results that are of value to all practitioners. Because of the geographical, ethnic, and socioeconomic differences in the NZ population, it is necessary to consult a spectrum of dentists to best reflect practitioner philosophies, practices, and treatment outcomes. An earlier PBRN survey study resulted in a good response rate with participants geographically representative of NZ's dental workforce (Friedlander et al. 2015). Additionally, many practitioners indicated they would like to be involved in further PBRN studies (Friedlander et al. 2015).

1.8.2 Sampling

Mixed methods study design and a purposeful sampling technique is common in PBRN research and can be used to provide an enquiry-based approach, combining quantitative and qualitative data (Creswell et al. 2003; Johnson & Onwuegbuzie 2004). Purposeful sampling is a technique widely used in qualitative research for the identification and selection of information-rich cases for the most effective use of limited resources (Patton 2002). Implementation involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a particular phenomenon of interest (Creswell & Clark 2017). Moreover, importance is placed on availability and willingness to participate, and the capability to communicate experiences and opinions in an articulate, expressive, and respective manner (Palinkas et al. 2015). In contrast, probabilistic or random sampling is used to ensure the generalisability of research findings by minimising the potential for selection bias (Palinkas et al. 2015).

Although sampling approaches for quantitative methods used in mixed research designs are generally well established and based on probability theory, this is not so for qualitative research. Since samples for qualitative inquiry are generally selected

purposefully to yield cases that are information rich (Patton 2002), there are no clear guidelines for conducting purposeful sampling in mixed methods implementation studies, particularly when studies have more than one specific objective (Palinkas et al. 2015). A key feature of mixed methods research is its methodological pluralism (e.g. different, and even conflicting theories or perspectives can be useful), which frequently results in comprehensive research compared to monomethod investigations (Palinkas et al. 2015).

1.9 Conclusion

There is a well recognised association between general health and oral health, and a link between endodontic disease and health is emerging. GDPs have a key role in promoting health, and the preparedness to manage patients who present with contributing health conditions has not been fully assessed. Many patients with complex chronic diseases are having their RCT with GDPs in private practice and although there are very few medical contraindications for RCT, the confidence and competence of NZ dentists in managing these patients is unclear. Regular contact with patients offers GDPs the opportunity to screen for chronic diseases, but also to modify the systemic effects of these diseases by engaging their patients in health education, evaluating risk, and providing early referral. Consequently, patients retaining their natural teeth may have an increase in their quality of life and wellbeing.

With the help of both dentists and patients, rich information can be gathered to improve understanding of patients' medical status when they present for RCT, and how equipped our dental workforce is to manage these patients. Together these can inform development of CPD activities and assist NZ GDPs to manage patients requiring RCT.

1.10 Study Aims

To investigate the general health and dental experience of patients requiring RCT in NZ general dental practice, alongside the demographic characteristics and perceptions of GDPs providing care.

1.11 Specific Study Objectives

- The demographic characteristics of NZ dentists within a PBRN providing RCT in general practice.
- The self-perceived confidence and competence of a group of NZ GDPs providing RCT to patients who present with a range of medical conditions.
- The engagement of NZ dentists in CPD activities related to endodontics and medical problems in dentistry.
- The demographic characteristics of patients receiving RCT from GDPs participating in a PBRN in NZ.
- The dental experiences and self-perceived general health status of patients receiving RCT in NZ general practices.

1.12 Study Hypotheses

1. There will be differences in endodontic practices of NZ GDPs when managing patients with a range of health status, which are influenced by practitioner perceptions, demographic characteristics, experience, and CPD activities.
2. Patients requiring RCT for endodontic disease will have range of health status, and the decision to proceed with treatment will be influenced by their demographic characteristics and dental awareness.

Chapter 2

Pilot Study

2.1 Introduction

Root canal treatment (RCT) is a common procedure in general dental practice for patients of all ages. It enables individuals to retain teeth and preserve function, address aesthetics, and improve their wellbeing (Gerritsen et al. 2010). In some instances, RCT may be an elective procedure, but it is usually performed to manage endodontic disease resulting from caries, restorative failure, or dental trauma. With an awareness around oral health and general health and an increasing older adult (65+ years) population, treatment planning is often complex with tooth and patient factors to consider (Thomson 2014). Patients frequently present for dental care with an array of co-morbidities and polypharmacy, but we have little understanding of how common medical problems are for patients presenting for RCT (Smith & Thomson 2017; Sohn et al. 2017). A Pilot study was used to validate the survey instrument, and to assess whether the proposed qualitative and quantitative methods for data collection would answer the study objectives in a larger study.

2.2 Aims & Objectives

The primary aim of the Pilot study was to test a survey tool for use in a larger PBRN survey.

2.2.1 Specific objectives

- To develop a survey enabling collection of accurate data from a range of patients and GDPs with different levels of experience.
- To investigate the accuracy, and further refine the survey to collect information from GDPs related to:

- Self-perceived confidence and competence managing patients who present with a range of medical conditions.
- Engagement in CPD activities related to endodontics and medical problems in dentistry.
- To investigate the effectiveness of the proposed survey to collect information from patients receiving RCT from GDPs related to:
 - Demographic characteristics.
 - The dental awareness and self-perceived general health status.

2.3 Methods

A mixed methods approach was used to collect quantitative and qualitative data (Creswell & Plano Clark 2007). Ethical approval was obtained from the University of Otago Human Ethics Committee (Health) (Approval Number H18/019; Appendix 1) and Māori consultation (Appendix 2) was entered with the Ngāi Tahu Research Consultation Committee.

The Pilot study was designed to test and validate the survey tool using a small group of GDPs within the University of Otago, and at a nearby specialist practice. These GDPs did not meet the inclusion criteria for the main study (Chapter 3 and performed RCT. The survey contained Likert scale items (one 4-point, two 5-point and one 10-point), and open-ended questions. Qualitative data from open-ended responses were used to triangulate the quantitative data and provided context on the validity of the survey for a larger study.

2.3.1 Study sample

Two self-reported surveys were developed:

1. Survey for GDP/dental student clinician participants, to explore their self-perceived confidence in managing a range of medical conditions, as well as their CPD experience (Appendix 3).
2. Survey for patient participants who were receiving RCT from the GDPs above, to explore their demographic characteristics, dental awareness and self-reported health and wellbeing (Appendix 4).

Patient age was used as a basis for providing a range of health status and recruiting a range of participants from different clinics and purposeful sampling was employed to match a range of RCT difficulty. These patients were recruited from undergraduate and postgraduate endodontic clinics at the University of Otago Faculty of Dentistry or in a specialist private practice. Five patients from three age range groups were recruited from each clinic (Figure 2.1).

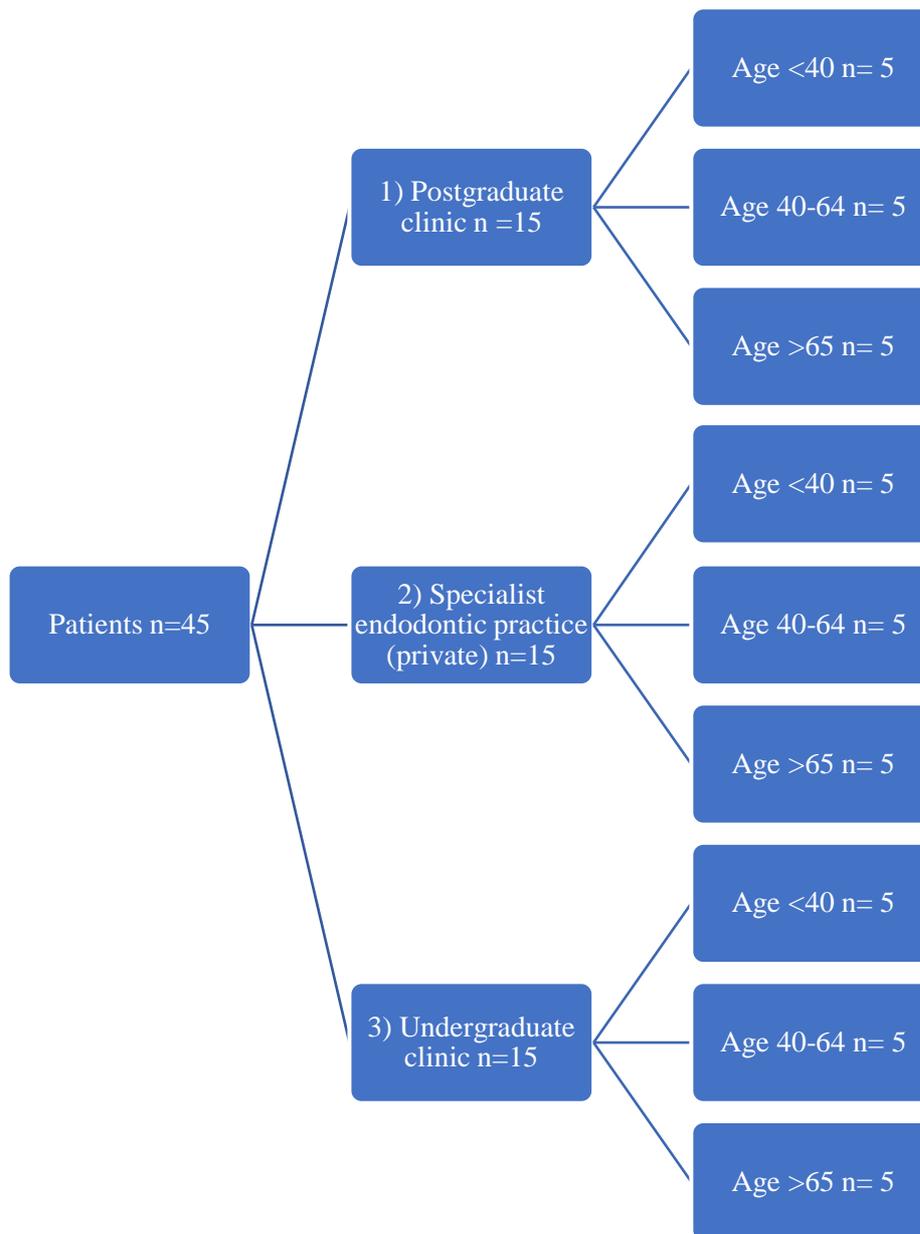


Figure 2.1 Flow diagram explaining patient groups

Practitioner Inclusion Criteria

The inclusion criteria for the GDPs were:

1. Undergraduate students (under the supervision of registered NZ dentists) providing RCT to patient participants.

2. NZ registered GDPs in specialist endodontic training providing RCT to patient participants.
3. An endodontic specialist providing RCT to patient participants.

Practitioner Exclusion Criteria

1. GDPs/dental student clinicians were excluded if they were not treating patient participant.

Patient Inclusion Criteria

The inclusion criteria for patients were:

- 1) Those being treated at the Faculty of Dentistry or in a specialist private practice requiring primary RCT on a permanent tooth.
- 2) Patients of any ethnic group falling into the age categories (Figure 2.1)
- 3) Patients with any health status or medical condition.

Patient Exclusion Criteria

Patient participants were excluded if they were:

- 1) Under the age of 18.
- 2) Requiring endodontic retreatment.
- 3) Requiring RCT of a primary (deciduous tooth).

Patients who were potential participants were recruited as part of their clinical treatment plan. The purpose of the study was explained by the lead researcher or by specifically calibrated GDPs. Patients were provided with an information sheet and given time to ask questions to decide whether they would like to participate. Each clinical group was provided a numerical code and surveys were completed anonymously, with no

identifying information collected. Paper surveys were returned to the lead researcher for data entry.

2.3.2 Analysis

Data from practitioner and patient surveys were considered independently. Quantitative data from the surveys were collated directly into IBM SPSS Statistics Software (Version 25. Armonk, NY, USA). Exploratory data analysis was performed, and descriptive statistics were calculated. Pearson's Chi square test was utilised to compare relevant data for analysis of statistical significance.

A general inductive approach was employed to identify key emerging themes from the qualitative data. Themes and associated quotations were cross-validated by the lead researcher and one of the research supervisors. Face and content validity of this Pilot for the newly developed survey was assessed by multiple researchers with extensive previous survey experience.

2.4 Results

Thirteen GDPs or dental student clinicians (hereafter both will be referred to as 'GDPs') (Table 2.1) and 45 patients from the age categories participated in the survey.

2.4.1 Practitioner survey

Practitioner responses indicated the survey was valid, however some sections were revised for use in the upcoming PBRN survey to increase accuracy. The question: 'What do you think influences patients' decision making the most when deciding between root canal treatment and extraction?' was added to give broader insight into GDPs' awareness, as a similar question was asked in the patient survey surrounding their preferences for selection of RCT. The medical conditions confidence section was revised following the

Pilot survey and made synonymous across both the patient and practitioner surveys as some inconsistencies were present. Additional questions on liver disease, kidney disease and gastro-intestinal diseases were added. Lastly, the questionnaire was structured to provide space for GDPs to expand on CPD activities. Overall, the practitioner survey was answered within expectations and no ambiguous questions were detected.

Descriptive statistics

The survey tool was able to generate meaningful quantitative data that was able to be collated for analysis. GDPs varied in their time since graduation, their University awarded dental degree, and their experience in providing RCT (Table 2.1). The private endodontist was experienced and had worked in the area for an extended period, while the postgraduate students varied in their experience and location of initial dental studies. All undergraduate GDPs were under the age of 25.

Confidence of practitioners in managing medical conditions

The use of Likert scale questions provided a range of meaningful findings. Other than the specialist endodontist who was ‘very confident’ in handling all medical conditions, a broad range of confidence levels in the management of medical conditions was reported by postgraduate and undergraduate participants (Table 2.2). All, including undergraduate students, felt confident in managing patients with bleeding disorders, DM, prosthetic joints, and patients taking multiple medications.

Patients who were undergoing oncology treatment or had a history of cancer were the only group all GDPs (except the endodontist) said they were not confident managing. However, many GDPs were neutral in reporting their confidence for managing patients with lung disease, epilepsy, previous stroke, bisphosphonates, immunosuppressed patients, patients with multimorbidity, and patients with organ transplants.

Table 2.1 Practitioner demographics

Characteristics	Number of practitioners (%)
Survey group	
Postgraduate endodontics	3 (23.1)
Specialist private practice	1 (7.7)
Undergraduate GDP	9 (69.2)
Area of practice	
South Island main centre	12 (92.3)
South Island regional	1 (7.7)
Age	
< 25	9 (69.2)
26-30	1 (7.7)
31-40	2 (15.4)
> 65	1 (7.7)
Country of training for primary dental degree	
New Zealand	10 (76.9)
Australia	1 (7.7)
South Africa	1 (7.7)
India	1 (7.7)
Perceived age of patients normally treated for RCT	
18-40	3 (23.1)
41-65	4 (30.8)
> 65	1 (7.7)
All ages	5 (38.4)

Table 2.2 Confidence of practitioners in managing medical conditions

Medical condition	Number of practitioners unconfident (%)	Number of practitioners neutral (%)	Number of practitioners confident (%)
Bleeding disorders	4 (31)	4 (31)	5 (38)
Diabetes mellitus	1 (8)	3 (23)	9 (69)
Lung disease (COPD, asthma)	5 (38.5)	3 (23)	5 (38.5)
Prosthetic joints	1 (8)	2 (15)	10 (77)
Epilepsy	2 (15.5)	6 (46)	5 (38.5)
History of stroke	2 (15.5)	6 (46)	5 (38.5)
Polypharmacy	2 (15.5)	2 (15.5)	9 (69)
Bisphosphonate therapy	4 (31)	4 (31)	5 (38.5)
Immunosuppressive therapy	5 (38)	4 (31)	4 (31)
Anticoagulation	2 (15.5)	4 (31)	7 (54)
Multimorbidity	4 (31)	5 (38.5)	4 (31)
Organ transplant recipients	4 (31)	4 (31)	5 (38.5)
Previous or current cancer	7 (54)	5 (38.5)	1 (8)

GDPs also suggested that important factors influencing their confidence were predominantly related to previous experience, case difficulty, and patient factors. Previous experience was more important to undergraduate students, with comments such as:

“I personally feel theoretical knowledge does not guarantee my confidence in performing RCT. A real-life case exposure is the best way to improve my confidence in doing a better job”

“Previous exposure to managing emergency [an] situation halfway through treatment [would help my confidence]”

Effective management of a case was said to be dependent on clinical confidence, irrespective of experience:

“Presence of pulp stones/sclerosed canals. MB2s [mesiobuccal 2 canals] and canals that fuse at the tip of the canal morphology (sic) [influences confidence]”

GDPs indicated that patient-related factors influenced their confidence when performing RCT. Some described behaviour and attitudes as being important considerations when managing patients with a range of medical problems:

“The patients’ attitude to RCT [influences confidence]”

“Behavioural issues with children who are unable to comply with instruction [reduces confidence]”

Patient factors such as mobility and their ability to cope with RCT were often stated to affect confidence more than the problems related to systemic health. These two comments below are from postgraduate students:

“Endodontic management is tied more to [patient] mobility and functional requirements than specific medical conditions per sé. Mouth opening/TMD [temporomandibular disease], mobility in getting to appointments, how far can they recline? How long can they remain in the chair? You can be medically healthy but unable to keep [your] mouth open or tolerate the dental dam.”

“[The] inability of patients to recline, consent issues or [mouth] opening difficulties I find more difficult to manage than a lot of 'controlled' medical conditions, especially if they're chronic and not higher than ASA [American Society of Anesthesiology] II”

When GDPs were not confident in managing patients with medical conditions, generally they would seek advice from other GDPs, dental specialists, or from the medical doctor providing care. It was more common for dental students to enter discussions with peers, supervising staff, and dental specialists:

“[If I am not confident in treating a patient I would] research online, seek tutor/mentor opinion and refer if still not confident”

“[If I am not confident in treating a patient I would] seek advice from a colleague”

GDPs expressed little concern with conditions that they deem as ‘controlled’, and generally rated hypertension, DM, asthma, and high cholesterol as conditions that do not

significantly influence delivery of care. When asked ‘what medical conditions are you most confident in managing?’ many GDPs indicated they were confident in dealing with many medical conditions. For example, some stated:

“Diabetes, HTN [hypertension], high cholesterol, kidney and liver problems, angina and asthma [do not concern my provision of RCT]”

“Any condition provided it is controlled. Patients well informed, and who take their medications are of little concern. HTN, diabetes, mild anticoagulation, bisphosphonate usage, mild immunosuppression are all [a] day-to-day [occurrence] for me”

Several GDPs said they were less confident managing epilepsy, “uncontrolled” medical conditions, and conditions affecting the patients’ ability to engage in the consent process:

“Oncology – chemo[therapy] and radiation [treatment]. Severe mental health conditions that limit the ability to provide informed consent. Respiratory conditions such as emphysema and COPD [chronic obstructive pulmonary disorder] that will reduce dental dam tolerance [reduce my confidence in delivering RCT]”

Bisphosphonate therapy was identified by undergraduate students as important when planning RCT, but they did not elaborate why.

Continuing professional development

Over half of GDPs (61.5%; n=8) rated their knowledge of medical problems relevant to dentistry as ‘neutral’, and only three individuals rated themselves as having ‘good’ or ‘very good’ knowledge.

Due to the large sample of undergraduate students in the Pilot study, prior CPD knowledge was excluded from analysis. The only GDPs required to be undertaking CPD courses were the registered dentists, who comprised of four from the 13 GDPs in the Pilot survey.

2.4.2 Patient survey

Following review of responses, it was necessary to revise some items in the patient PBRN survey. The following amendments were made for the larger study:

- The age category question was modified from an open-ended space to a tick-box style to allow easier data entry and statistical analysis.
- More space was added for written sections across the whole survey as participants were frequently writing down margins and possibly limiting their answers.
- The question ‘Which best describes the tooth requiring root canal treatment?’ was modified to reduce ambiguity as it previously required two boxes to be ticked, but some patients only ticked one.
- For the question ‘Do you know why you are having root canal treatment?’, added ‘My tooth has cracked or split’ to capture a common response.
- A new question, ‘Have you needed to take pain relief e.g. Panadol, ibuprofen?’, was added to exclude these pain medications from drugs related to management of medical conditions.
- ‘Do you take any medications or supplements?’ was separated into two questions to better identify those with medications for chronic medical conditions:
 - ‘Do you take any medications or supplements prescribed by your doctor?’
 - ‘Do you take any other medications or supplements bought over the counter from a pharmacy or supermarket?’

- Larger tick-boxes to the medical conditions question were added to allow for clarity for participants and easier data entry.
- The prior qualification section was removed due to difficulty in statistical analysis and it lacked relevance to the overall study aims.
- The validated questionnaire section about exercise was removed, as it provided ambiguous answers and was deemed too complex.

Descriptive statistics

Forty-five patients participated in the Pilot study and there were similar numbers of males (49%; n=22) and females (51%; n=23). The purposeful sampling approach enabled recruitment of patients from different age groups with a range of health conditions. Only four patients were under the age of 25 and these were tertiary students, while 15 patients were over the age of 65. Over two thirds of patients (n=31) identified as being of NZ European descent, 7% identified as NZ Māori (n=3) and 5% as Samoan or Cook Island Māori (n=2). Slightly over half of the patients (56%; n=25) were in full or part-time paid work, while seven patients (16%) were retired.

More than half (53%; n= 25) of the patients indicated that they see the dentist regularly for routine examination appointments, rather than for relief of pain. The majority (62%; 28) attended yearly, regardless of the reason for visit.

General dentistry experience

When asked ‘How would you describe the health of your teeth and mouth?’ approximately half of the patients (51%; n=23) indicated that it was ‘good’ or ‘very good’. Forty-two percent (n=19) rated their oral health as ‘fair’, while 7% felt it was ‘poor’ (n=3). Generally, patients expressed that their oral health was determined by what their dentist told them:

“I always feel like there’s something wrong with my teeth when I visit the dentist”

Additionally, there appeared to be a link between how patients viewed their oral and general health, and how this relates to their concept of age and its effect on the dentition:

“My teeth are in reasonable condition given my age. [I have] been on steroids for Addison’s [disease] for twenty years”

“Because I never looked after them when I was young. Had quite a few removed”

“I am [a] Type 1 diabetic, so I am always having difficulty with my teeth”

A small group of patients said that keeping good oral hygiene and eating a balanced diet were important for good oral health:

“I clean thoroughly, eat sensibly, and see the dentist yearly or when necessary”

“Since I recently needed treatment, I think I could be more effective in my tooth cleaning and diet.”

Although the majority indicated they had not been told they have “gum disease” (62%; n=28), there were frequent comments about how their previous smoking status, periodontal health, and prior dentistry experience affects their overall oral health status:

“Previous smoker”

“There have been underlying tissues with my teeth and gums”

“[I have a] history of gum disease. [A] number of root canals and crowns. Lots of amalgam. Stable at last, but occasionally problems do occur”

Only one respondent wore a denture, and two others indicated that they had an implant. Four stated they have had a fixed partial denture (bridge), but most (82%; n=37) said that they do not have any prosthetic tooth replacements.

Overall, despite the varying ages, demographics, pre-operative factors of patients receiving care and multiple GDPs of varying ability, many patients were very positive about the care they received from their dentist or dental student, with specific comments relating to communication and professionalism:

“I am extremely grateful for the competence and care of [postgraduate student] and the training [they] have received to achieve these skills”

“The treatment has been done very professionally and [the] student was excellent”

Patterns of root canal treatment

Most patients in the Pilot study indicated that this was not their first RCT (62%; n=28). Sixty-four percent (n=18) stated that their previous experience with RCT was ‘good’ or ‘very good’. For the most part, patients viewed their previous experiences with RCT positively:

“Treatment here has always been excellent”

“Quality dentist, explained what was happening throughout the procedure”

“Very professional. Well explained, good communication and follow-up”

“Quick and efficient with no ongoing issues”

However, there were some comments regarding the length of the procedure, especially from the patients being treated by the undergraduate students:

“[It] took many hours to complete over a year!”

“Lots of appointments – time consuming!”

Results suggest that posterior teeth were the most common teeth requiring RCT, especially mandibular molars. Nearly a third reported ‘an upper back tooth’ (29%; n=13) was being treated, compared with ‘a lower back tooth’ (42%; 19). Nine ‘upper front’ teeth (20%) were being treated and only one ‘lower front’ tooth. Most of the anterior teeth were being treated by the specialist in practice following referral by a GDP.

Patients provided several reasons why they required RCT with similar proportions for caries “dental decay” (24.4%; n=11) and heavily restored teeth ‘I have a big filling and the nerve has died’ (22.2%; n=10). Three responded that they were having RCT as part of a prosthodontic treatment plan e.g. crowns, bridges, or partial dentures, and seven were not sure why they were having the treatment. One participant indicated that the need for RCT was established after a crown preparation:

“I can’t chew on that side of my mouth. Sharp, sore sensations when I do. I have a temporary crown on it at the moment, but it still hurts – hence the root canal”

Maintenance of the dentition was the main reason for choosing RCT instead of extraction. When asked about their reasons for selecting RCT over extraction, most replied ‘I don’t like losing teeth’ (44%; n=20). This was followed by the realisation that tooth loss may affect other teeth, “*balance of the bite*”, or for relief of pain. One

participant mentioned that infection was detected as part of screening initiated by a medical practitioner:

“Mouth check prior to surgery – detected an abscess”.

Pain was the most frequent reason for presentation. Thirty-four patients (76%) stated that the tooth was giving pain before it was treated, and 13 of these people indicated that it was painful for more than three months (29%).

When asked ‘On a scale of 1-10, how bad was the pain [from the tooth] at its worst?’, patients gave a wide range of responses. Many described pain on hot and cold foods or drinks:

“Cold and hot water is where it was really sensitive and like [a] sharp pain that comes from inside the tooth”

Although the pain experience was variable, 17 individuals (38%) rated it as 7/10 or higher, and many expressed the significant effect it had on their daily lives:

“[The] filling became infected, [I had] 10 out of 10 pain and it was very hard to cope with life”.

“Very, very distracting – nothing made it completely better. The pain grew from a little tiny tingle to full-blown in 3-4 days. [My] face eventually swelled in the jaw area to [make me] look like a ‘Sesame Street’ character”

Patients strongly expressed their desire to avoid extraction if possible, even though they were in discomfort and extraction seemed more efficient at relieving pain:

“Because I knew the tooth was dying and I wanted to keep it”

“It was very painful at the time, but I didn’t want to lose my tooth”

“I dread having teeth pulled, and this one was sore as”

Patients were generally well informed about RCT, and the role of the dentist in explaining the procedure and engaging in the consent process was mentioned as being important:

“They remove the nerve and fill [the tooth] up. They put something in there for the infection. Various minor risks and discolouration. Around \$[redacted] in total, two initial visits and follow-up is important”

“File may break or [canal] may be too long or infection may not resolve. At least two visits needed”

“My dentist explained the procedure and he explains what is going to happen before each session as well as how many visits and what is the cost”

Some patients mentioned they prepare and read about the procedure prior to having the treatment, and discussed this with the dentist:

“I had researched online about possible failures and problems. My dentist at the Dental School gave me extensive information about the above points”

“[My] wife is a DA [dental assistant], info from the internet”

Otherwise, many patients stated that they have had the treatment before, they were aware of what was required, and they were aware of the cost associated with the treatment:

“I’ve had two before, [I] know the process and cost”

Health, medications & fitness

Some patients indicated that they do not regularly visit their general medical practitioner (40%; n=18). Eleven patients (29%) suggested that they visit their GP every three to six months. No patients rated their general health as poor, with 96% rating it positively (n=43). Specifically, they considered it as ‘good’ (33%), ‘very good’ (44%), or ‘excellent’ (18%). There was no statistical significance regarding self-rated general health, age groups and medical conditions. Common themes identified in the responses to the open-ended questions across patients were related to how they ‘feel’, and how their current good health corresponds with an absence of sickness. For example:

“I’m fit and healthy and rarely get sick”

“[I] don’t often see the doctor”

Others indicated that they saw their health within their control – specifying that their diet and frequency of exercise plays a role in their wellness:

“I am sick only once or twice yearly, and I keep fit and reasonably well”

“I am fit and fine”

“Only need to exercise more, otherwise [I] would’ve put excellent”

One participant shared their views on holistic health practice, stating that:

“I know the truth of what foods to eat for health and which ones not to. The outcome being great health (blood tests show)”

Patients identified the impact of chronic medical conditions on their perception of overall health. As they referred to the relevance of age to their teeth, patients also viewed their

health relative to their age, a common phrase could include, “*And apart from age-related problems like arthritis I feel very good*”. Other examples were:

“[My] health [is] great except from COPD and arthritis in ankles”

“I have health issues, but they are being taken care of and I feel my age now and then”

Two thirds of patients (66.7%; n=30) indicated that they take medications or supplements, including those from the supermarket, pharmacy medicines, or for pain relief. Common medications included paracetamol and ibuprofen for dental pain. Other common self-prescribed medicines mentioned were glucosamine, zinc, magnesium, fish oil, and other supplements to “*support the immune system*”. Patients presented with a range of medical conditions and over three quarters reported having one or more conditions. Eleven patients see a medical specialist for their condition. The most common condition was hypertension (n=10), with arthritis (or another disorder affecting mobility) being the next most common (n=6) (Figure 2.2).

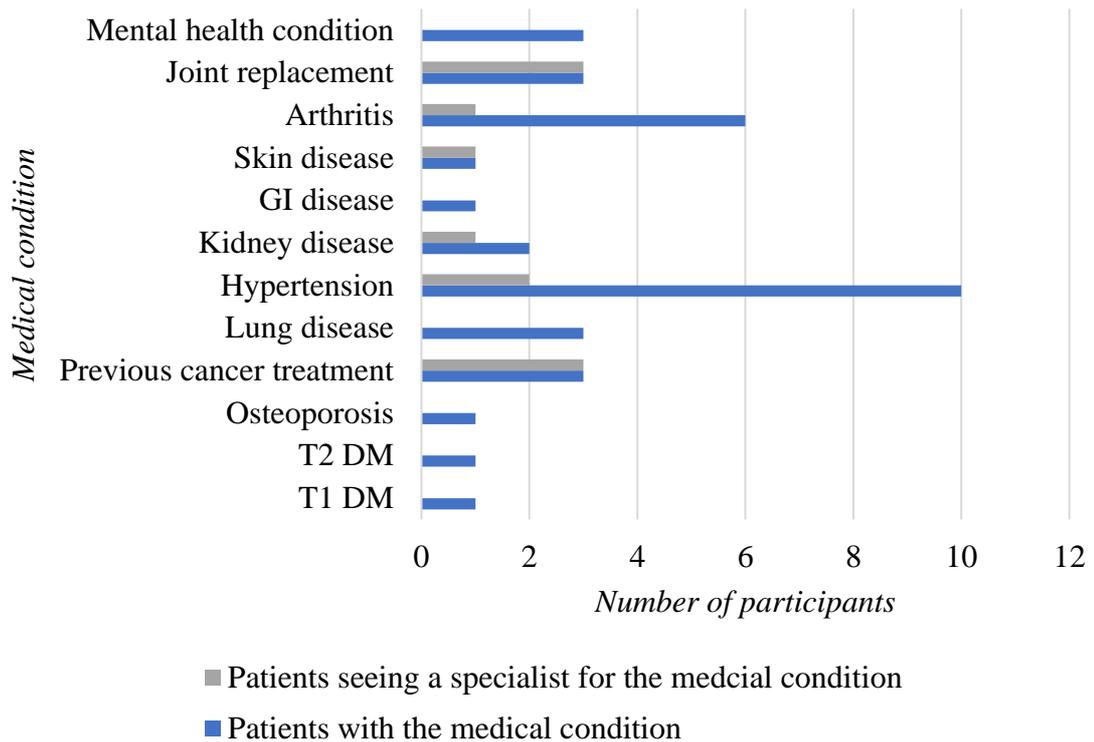


Figure 2.2. Medical conditions reported by patients in the Pilot study

There was evidence of polypharmacy in all age groups:

“Bisoprolol, amlodipine, losartan – for hypertension

letirizine – for hay fever”

There were some patients on so many medications that there were “too many to list”.

Only one individual was on a variety of medications that could result in them being immunocompromised:

“Hydrocortisone, fludrocortisone for Addison’s disease

Simvastatin, metoprolol, omeprazole, Zopicone”

Over half (53%; n=24) indicated they had ‘never smoked’ while 38% (n=17) indicated they were ‘ex-smokers (gave up more than five years ago)’, but it was common for

patients to write a specific number of years next to this, even though a space was not provided. Only two patients indicated they currently smoked more than ten cigarettes per day.

Overall, patients did not frequently consume alcohol in large amounts. Nineteen (52%) said that they drink 'on special occasions', and five 'only on weekends'. Seven (16%) consumed alcohol three to five times per week or every day.

The majority considered that their health did not limit them in moderate activities such as moving a table or pushing a vacuum cleaner (82%; n=37). Additionally, more than three-quarters of patients (76%; n=34) indicated that they were not limited in more rigorous exercise such as climbing two flights of stairs. Most patients reported exercising 2-4 days in a week (49%; n=22), with exactly one fifth exercising 5-7 days (n=9), and 18% exercising daily (n=8). Six individuals (13%) indicated that they do not regularly exercise.

2.5 Discussion

The Pilot study performed its role in validating the design of the larger study and identified areas that could be revised to improve data collection, analysis, and presentation. The practitioner participants were part of a purposeful sample that included a specialist, registered dentists, and undergraduate students. These groups were chosen to somewhat represent GDPs with a range of clinical experiences, so the findings cannot be extrapolated to a general dental practice setting. Analysis was undertaken to evaluate the use of the data and inform protocols for use in the larger study.

Practitioner participants

Although a small sample of GDPs were involved, patterns emerged across the groups who had different experience in practice. This indicated that the pilot study tool was able to capture the data necessary for a larger sample. More experienced GDPs were less concerned with chronic disease provided it is “*well controlled*” with medications – although the metrics they use to establish this were not explained. Many rated patient factors such as the ability to recline and tolerate the dental dam for extended periods as more important to the effective delivery of care.

Despite limited evidence available for the implications of bisphosphonate therapy in non-surgical RCT (Moinzadeh et al. 2013), GDPs indicated they were generally not confident in managing patients on these medications. RCT is commonly recommended as an alternative to extraction to minimise the development of MRONJ (Marx et al. 2005; Pazianas et al. 2007; Filleul et al. 2010). Although caution must still be taken to deliver treatment carefully, the potential MRONJ risks for non-surgical RCT appear to be minimal, highlighting the need for CPD in this area. A lack of confidence with managing patients undergoing bisphosphonate treatment was especially common throughout the undergraduate results compared with the registered GDPs in the Pilot study. In a study carried out in Spain, undergraduate students were receptive to further training about the clinical management of patients taking bisphosphonates, scoring better than students with less teaching during testing periods (Escobedo et al. 2017).

GDPs across experience levels were often confident in managing patients with prosthetic joints. While this was a small Pilot study with a very limited number of participants, the transparent guidelines within the profession, and specific to the Faculty of Dentistry regarding the management of these patients is probably contributory (New Zealand

Dental Association 2018). Conversely, guidelines for managing other chronic diseases and conditions in dental practice are scarce or based internationally.

Patient participants

Due to the purposeful sampling based on patients' ages, and the limited numbers of participants, few relevant conclusions can be drawn from the data.

The numbers of patients medicated for hypertension (16.2%) nationally is lower compared with our study population (29%) (Ministry of Health 2019). This could reflect purposeful sampling of people within the group 'over the age of 65' or that frequently patients seen at the Faculty of Dentistry for RCT have complex medical histories irrespective of age. Other health conditions reported in the Pilot survey compared very similarly to current NZ health data – asthma (11.5%), arthritis (16.2%), diabetes (excluding diabetes during pregnancy) (5.8%) (Ministry of Health 2019), which may imply that patients presenting for RCT have comparable health status with the general population in NZ. Unfortunately, the Pilot study did not specify whether the medications they were taking were prescribed by medical professionals or bought over the counter. This was addressed in the larger PBRN study.

2.6 Conclusions

The Pilot questionnaire was found to be suitable for use in a national PBRN study of patients requiring RCT and has proved to be effective in providing information related to the demographic, dental, and general health of patients presenting for RCT at the Faculty of Dentistry at the University of Otago. Additionally, the survey tool is appropriate for assessing the confidence of GPs providing RCT. The tool provided necessary data for analysis and amendments were made for use in the larger study.

Practitioner confidence in providing RCT was more strongly related to procedural and patient-related factors rather than specific medical conditions. Patients have differing perceptions of their general and dental health, and their experience of RCT is mostly influenced by clear, empathetic communication, and a professional approach by the practitioner.

Chapter 3

A New Zealand Practice-Based Research Network Survey of General Dental Practitioners & their Patients

3.1 Introduction

New Zealand registration in the scope of general dental practice requires that dentists be competent in diagnosing odontogenic pain, endodontic disease and performing RCT. RCT is a common procedure which enables patients to retain teeth, preserve function and improve their wellbeing (Montero et al. 2015). In some instances, RCT may be an elective procedure, but it is usually performed to manage disease resulting from caries, restorative failure, or dental trauma. With an awareness around oral health and general health and an increasing older adult (65+ years) population, treatment planning is often complex with tooth and patient factors to consider (Thomson 2014). There is an established relationship between periodontal disease and systemic disease (Cullinan & Seymour 2013) and common risk factors exist between oral disease and other chronic diseases (Murray & Saunders 2000), but the association between endodontic disease and health remains unclear (Gutmann 2017; Gutmann & Manjarrés 2020). Patients frequently present for dental care with an array of co-morbidities and polypharmacy is common but evidence is still emerging (Smith & Thomson 2017; Sohn et al. 2017). An appreciation of the demographic characteristics and health status of patients requiring RCT throughout NZ will inform and assist in understanding the preparedness of the dental workforce to manage the endodontic needs of patients presenting with an associated medical history.

Continuing professional development activities in endodontics including hands-on workshops have been popular for some time (Koshy & Chandler 2003). These have commonly been provided in main centres where there is support from specialist endodontists. Those in regional areas of NZ often do not have support for challenging RCT due to distance and financial barriers. It is necessary for current GDPs to be confident in managing medically compromised patients requiring RCT.

3.2 Aims & Objectives

The aims of this study were to investigate:

- The demographic characteristics of NZ dentists within a PBRN providing RCT in general practice.
- The self-perceived confidence and competence of NZ GDPs providing RCT to patients in general practice who present with a range of medical conditions.
- The engagement of NZ dentists in CPD activities related to endodontics and medical problems in dentistry.
- The demographic characteristics of patients receiving RCT from GDPs participating in a PBRN in NZ.
- The dental experiences and self-perceived general health status of patients receiving RCT in NZ general practices.

3.3 Methods

A mixed methods research approach was used to collect quantitative and qualitative data (Creswell & Plano Clark 2007). Ethical approval was obtained from the University of Otago Human Ethics Committee (Health) (Approval Number H18/019 [Appendix 1]) and Māori consultation (Appendix 2) was entered with the Ngāi Tahu Research Consultation Committee. Following critique and minor amendments to the Pilot Study (Chapter 2), the two survey instruments (one for practitioners and one for patients) were refined and delivered. They contained Likert scale items as well as open-ended questions to provide context for interpretation. Qualitative data from opinions and comments were used to corroborate and enhance the quantitative data.

3.3.1 Study sample

Participants

There were two groups of participants:

1. GDPs providing RCT for patients – these were the primary participants.
2. Patients receiving RCT – these participants were recruited by the GDPs providing RCT.

Practitioner Inclusion Criteria

1. GDPs willing to be involved with practice-based research.
2. GDPs from different geographic locations within NZ.
3. GDPs providing primary RCT to patients.

Practitioner Exclusion Criteria

1. GDPs not treating a patient participant were excluded.
2. Registered endodontic specialists who also hold registration in the scope of general practice.

Patient Inclusion Criteria

1. Patients over 18 years of age.
2. Patients of any ethnicity and from any location in NZ who are receiving primary RCT.

Exclusion Criteria

1. Patients under 18 year of age.
2. Patients receiving RCT retreatment.

3. Patients requiring RCT on a primary (deciduous) tooth.

Sampling technique

This PBRN study used a purposeful sampling technique for the identification and selection of information-rich cases for the most effective use of limited resources (Patton 2002). The significance of availability and willingness to participate, and the ability to communicate experiences and opinions was also important to gaining insight. In contrast, probabilistic or random sampling is used to ensure the generalisability of findings by minimizing the potential for bias in selection and to control for the potential influence of known and unknown confounders (Palinkas et al. 2015). GDPs were the primary participants and were part of NZ's PBRN, ARCH. GDPs were selected to provide a group with a range of clinical experience from different areas of NZ. The sample included dentists located in North and South Islands from main centres and regional areas: North Island main centres (Auckland, Hamilton, Wellington), North Island regional, South Island main centres (Christchurch & Dunedin), and South Island regional.

This sampling technique enabled the collection of quantitative and qualitative data and did not require a power analysis as required for purely quantitative research (Johnson & Onwuegbuzie 2004).

General dental practitioner survey questionnaire

GDPs were asked to complete a 5-10 minute survey questionnaire related to their demographic characteristics, relevant training, experience, understanding, attitudes, and practices for managing oral health for patients with a range of medical histories. They were also asked about their engagement with CPD activities related to endodontics and medical problems in dentistry (Appendix 5). In addition, they were asked to recruit

participants who were their patients requiring RCT, inviting them to take part by completing a separate questionnaire about their health and wellbeing.

GDPs were required to complete a consent form related to Health Information Privacy when recruiting patients for this study. Calibration of GDPs was provided by the lead researcher, specifically providing an explanation of the study to patients and how to obtain informed consent to participate in the research. GDPs were not asked to differ from their usual practice when performing RCT. Consent forms and completed survey questionnaire forms from GDPs and patients were returned to the lead investigator at the Faculty of Dentistry via prepaid tracked courier bags.

Patient survey questionnaire

Over a six month period, patients receiving primary RCT were provided with an information sheet about the study and were invited to participate. A consent form to complete a 15 minute survey questionnaire containing Likert scale and open ended questions was given. The survey covered themes related to demographic characteristics, dental history and experiences, and general health and wellbeing (Appendix 6). Participants were able to take the survey form home and return it at their next appointment.

Analysis

Data from practitioner and patient surveys were considered independently. Quantitative data from the surveys were entered directly into IBM SPSS Statistics Software (Version 25. Armonk, NY, USA), and qualitative sections were entered into Microsoft® Excel® (Version 2005, WA, USA), then transferred to NVivo 12 (Version 12.8.0. QSR International, Melbourne, VIC, Australia) for thematic analysis. For the quantitative data,

following descriptive analysis, bivariate analysis was used to quantify differences in proportions using Pearson's Chi square test (X^2).

For the qualitative data, a general inductive approach was employed to identify key emerging themes from the qualitative data. Themes and associated quotations were cross-validated by the lead researcher and one of the research supervisors. Themes were identified from the transcripts and placed them into 'nodes' in NVivo. These nodes were then compared, and the most cited areas were identified. Information-rich anecdotes and contrary views were highlighted and included in the analysis.

3.4 Results

Of the 24 practices that were initially contacted and agreed to participate, eighteen dentists from 16 practices contributed to the research. Moreover, 135 patient surveys were gathered and returned for analysis.

3.4.1 Practitioners

Demographic characteristics

The 18 GDPs represented a range of clinical experience with a third in the 50-65 age category (n=6). The largest age category was '50-65' (33%; n=6), and only two GDPs were recent graduates under the age of 25. There was a slight male predilection in the sampled dentists (56%; n=10) (Table 3.1).

The majority of those surveyed received their training in NZ (89%) and were from throughout NZ, although more from the South Island participated (56%; n=10) (Table 3.1).

Table 3.1 Demographic characteristics of GDPs providing RCT in PBRN group

Characteristics	Number of practitioners (%)
Age	
< 25	2 (11)
26-30	4 (22)
31-40	4 (22)
41-50	2 (11)
50-65	6 (34)
Gender	
Male	10 (56)
Female	8 (44)
Year of graduation (BDS)	
1971-1985	5 (28)
1986-1999	2 (11)
2000-2012	5 (28)
After 2013	6 (33)
Country of primary dental degree	
NZ	16 (88)
UK	1 (6)
South Africa	1 (6)
Location of practice	
North Island main centre (Auckland)	3 (17)
North Island regional	5 (28)
South Island main centre (Christchurch & Dunedin)	6 (33)
South Island regional	4 (22)

Perceptions of practitioners providing root canal treatment

Half of the GDPs (n=9) stated that they provide RCT to patients of all ages while one third (33%; n=6) felt they mostly provided RCT to patients older than 40 years, with no clear relationship between perceived patient age and years since graduation. Almost 90%

of GDPs stated that they treat all the teeth in the mouth (n=16), however two GDPs reported that they treat only premolars, canines, and incisors – referring molars and other complicated teeth to endodontic specialists (Table 3.2).

Table 3.2 Practitioner perceptions on providing RCT

Characteristics	Number of practitioners (%)
Age of patients having RCT	
< 18 years	1 (6)
18-40	2 (11)
41-64	6 (33)
All Ages	9 (50)
Teeth practitioners treat	
All teeth	16 (89)
All incisors, canines, and premolars	2 (11)
Practitioners' perceptions on patient decision-making for RCT	
Financial cost	15 (83)
Patients do not like losing their teeth	3 (17)
Pain	0 (0)
Fear of dentists	0 (0)
Medical risks relating to extraction	0 (0)
Time off work/multiple visits	0 (0)

More than 80% of GDPs (n=15) remarked that financial costs are the most limiting factor when deciding if a tooth should have RCT or extraction, for instance one practitioner commented that, “*financial cost influences decision making the most*” and another stated that, “*It is mainly the price that puts people off*”.

Additionally, one participant mentioned that the desire of patients to retain their natural teeth outweighed the above issues with statements such as “*patients don't like losing*”

teeth". Additionally, there was some comment regarding the longevity of teeth following RCT, since one participant said, *"patients sometimes are concerned that it may not be successful in the long run"*.

Confidence of practitioners managing medical conditions

Commonly, GDPs were confident in managing a variety of medical conditions in practice – especially Type 1 diabetes mellitus (T1 DM) (83%), T2 DM (89%), patients who have had previous cancer treatment (83%), gastro-intestinal (GI) diseases (89%) and skin disorders (89%). In general, the GDPs were comfortable managing common medical conditions e.g. hypertension and previous myocardial infarction, particularly those that were well controlled. Nearly 95% of the dentists were confident in managing patients with joint replacements.

Further, GDPs perceived that there were few medical conditions contraindicating RCT, one stated:

"Pretty much anything. We all know things 'like diabetes increasing the risk of endo failure' but as long as the patients are informed about how their medical condition could impact the treatment outcomes [then it's okay to proceed with treatment]. Medical problems very rarely preclude patients from having RCT, they become more of an issue when extraction is indicated."

Fewer numbers of GDPs felt confident managing patients with a history of a stroke (72%) while those with a bleeding disorder were generally managed with confidence (83%). Patients immunocompromised with organ transplants (61%), patients with mental health conditions (61%), and patients with epilepsy (66%) were of concern for the GDPs (Table 3.3).

Nearly 85% of GDPs (n=15) perceived their knowledge of medical conditions relevant to dentistry as ‘Good’ or ‘Very good’, the other three rated their confidence as ‘Neutral’. There was no statistically significant relationship between the year of graduation and the knowledge of medical conditions.

Table 3.3 Practitioner confidence managing patients requiring RCT who have a medical condition

Medical condition and perceived confidence	Number of practitioners (%)
Type 1 DM	
Unconfident	0 (0)
Neutral	3 (17)
Confident	15 (83)
T2 DM	
Unconfident	0 (0)
Neutral	8 (44)
Confident	10 (56)
Osteoporosis	
Unconfident	0 (0)
Neutral	4 (22)
Confident	14 (78)
Previous cancer treatment	
Unconfident	0 (0)
Neutral	3 (17)
Confident	15 (83)
Bleeding disorders	
Unconfident	4 (22)
Neutral	3 (17)
Confident	11 (61)
Lung disease	
Unconfident	1 (6)
Neutral	6 (33)
Confident	11 (61)
Hypertension	
Unconfident	0 (0)
Neutral	2 (11)

Confident	16 (89)
Previous heart attack	
Unconfident	0 (0)
Neutral	3 (17)
Confident	15 (83)
Liver disease	
Unconfident	0 (0)
Neutral	4 (22)
Confident	14 (78)
Kidney disease	
Unconfident	0 (0)
Neutral	5 (28)
Confident	13 (72)
GI disease	
Unconfident	0 (0)
Neutral	2 (11)
Confident	16 (89)
Skin disorders	
Unconfident	0 (0)
Neutral	2 (11)
Confident	16 (89)
Stroke	
Unconfident	0 (0)
Neutral	5 (28)
Confident	13 (72)
Arthritis & mobility disorder	
Unconfident	3 (17)
Neutral	3 (17)
Confident	12 (66)
Joint replacement	
Unconfident	0 (0)
Neutral	1 (6)
Confident	17 (94)
Organ transplant	
Unconfident	5 (28)
Neutral	2 (11)
Confident	11 (61)
Mental health conditions	
Unconfident	1 (6)
Neutral	6 (33)
Confident	11 (61)

Epilepsy

Unconfident	1 (6)
Neutral	5 (28)
Confident	12 (66)

Bisphosphonates

Unconfident	0 (0)
Neutral	4 (22)
Confident	14 (78)

Polypharmacy

Unconfident	0 (0)
Neutral	4 (22)
Confident	14 (78)

When asked which medical conditions reduce GDPs' confidence, mobility issues and conditions affecting the ability of patients to cope with RCT in the dental chair were common:

“Osteoporosis – where access becomes more difficult due to reduced mouth opening or difficulty laying back”

“Those affecting access to the tooth such as TMJ problems, dementia, severe gagging”

“COPD, mental disorders which would prevent a patient from being able to sit in the chair and open their mouth for an extended period of time”

One practitioner mentioned the difficulty and reduced confidence that may result when managing patients with *“mental health issues that impair obtaining consent to a satisfactory level”*.

When GDPs were not comfortable managing the medical aspects of a patient, they would unanimously seek help from others but there were differences based on the age and

working situation of the GDPs. For example, younger GDPs were more likely to seek advice from experienced clinicians within the practice:

“Discuss with senior colleagues. If it's a mobility issue discuss with patient/carer that good endo may be difficult as access is compromised”

Experienced GDPs on the other hand, were more likely to *“seek medical advice, GP [general medical practitioner] or relevant hospital specialist”*.

Participants suggested that contacting endodontic specialists would be sensible, but only when the tooth to be treated was complex and suitable for referral. Several GDPs commented that they would be unlikely to refer a medically compromised patient to an endodontist for a straightforward RCT. The exception was patients taking bisphosphonate medications, which contrasted with the response that most 78% of GDPs felt confident providing RCT to patients taking these medications.

Continuing professional development

Over half (61%) indicated that they have undertaken some CPD related to medical conditions relevant to dentistry in the last year. There was no statistical significance when relating the year of graduation of GDPs to the likelihood of having undertaken recent CPD.

The responses from the GDPs indicated that GDPs need to be *“updated”* on current guidelines and specific management of medically compromised patients:

“I think generally, dentists would benefit from the updated guidelines regarding antibiotic prophylaxis with joint replacements, MRONJ, anticoagulation etc. at Branch Meetings [of the NZ Dental Association]. I hear anecdotally that many

dentists, especially the older generation, are still practicing to old and outdated recommendations and perhaps aren't going to CPD on the subject”

Provision of more CPD programmes characterising common and novel pharmacological treatments was emphasised as being important and relevant to all GPDs, with comments such as:

“A pharmacological update with new drugs, interactions, and recommendations relevant to dentistry [would be good CPD to deliver]. Alternative therapies to RCT such as indirect pulp treatment outside of trauma cases [would also be useful].”

“Managing polypharmacy patients – run by dentists not pharmacists as I have attended [a] course before run by the latter and find that they are not quite what I needed. Or perhaps a course run by both together”

Additionally, delivery of these courses seems to be currently limited to main centres, which is undesirable for many GDPs around NZ:

“Bring a course to regional areas like Nelson or Blenheim etc. so they are more available to practitioners. [An] online course through the NZDA [New Zealand Dental Association] website would be great. Or even just a comprehensive article in the NZ Dental Journal on this topic would be good”

3.4.2 Patients

Demographic characteristics

One hundred and thirty-five (135) patient surveys were completed and returned from the 16 practices. More surveys were received from South Island practices (56%; n=75), and

28 surveys in total from North Island main centres Auckland, Hamilton, Wellington (18) and Christchurch and Dunedin (48) (Table 3.4).

Table 3.4 Numbers of patients from participating practices

Location	Number of patient surveys returned (%)
North Island main centre (Auckland, Hamilton, Wellington)	18 (13)
North Island regional	42 (31)
South Island main centre (Christchurch & Dunedin)	48 (36)
South Island regional	27 (20)

Nearly two thirds (62%; n=84) of patient participants were female. Those receiving RCT were mostly in the 50-65 age group (30%; n=41) and a further 22% of respondents were 65 years or older (n=30). Less than one fifth of participants were younger than 30 years of age (16%; n=21).

A high representation of people of NZ European ethnicity were surveyed (80%; n=108), with only 8% of participants identifying of NZ Māori descent (n=11). Some patients identified their ethnicity as ‘Other’, and this was commonly ‘European’, ‘Japanese’, or ‘South African’. Nearly three quarters of patients were in some form of employment (71%; n=96). The largest group of participants were working full-time (30 or more hours per week) (44%; n=59), with more than one fifth working part-time (16%; n=22). Almost 20% of participants were retired (n=24) and only three individuals (2%) were not employed (Table 3.5).

Table 3.5 *Descriptive statistics of patient participants*

Characteristics	Number of patients (%)
Gender	
Male	51 (38)
Female	84 (62)
Age	
25 years or under	9 (7)
26-30 years	12 (9)
31-40 years	22 (16)
41-50 years	21 (16)
50-65 years	41 (30)
Over 65 years	30 (22)
Ethnicity	
New Zealand European	108 (80)
New Zealand Māori	11 (8)
Chinese	2 (1)
Indian	1 (1)
Other	13 (10)
Employment status	
Full-time (work 30 or more hours per week)	59 (44)
Part-time	22 (16)
Contract, freelance or casual employee	2 (1)
Self-employed	13 (10)
Retired	24 (18)
Stay-at-home parent	8 (6)
Full-time student	4 (3)
Unemployed	3(2)

Patterns of dental attendance

Over half of the patients attended their dentist for routine check-ups (54%; n=73) and this was usually annually (62%; n=84). Around three-quarters of patients (78%; n=105) had attended within the past two years for a recall appointment or because of a specific problem. There was no relationship between patient age and routine attendance, however the patients who attended when they only had a problem attended less frequently overall

($p < 0.01$). Over a third of patients indicated they had been attending the same practice for 10 years or longer (35%; $n=47$) with a little over 10% ($n=16$) reporting their first time visiting the practice was to have this RCT completed.

Self-reported oral health

Most participants rated their oral health positively (70%), with over 30% ($n=42$) rating it as 'Very good' or 'Excellent'. Patients who regularly attended the dentist for check-up appointments also reported better oral health, and this finding was statistically significant ($p < 0.01$). Older patients in the 65+ age category did not report a significantly different oral health status compared with younger age groups.

Less than 15% ($n=20$) reported that a dentist had told them they have periodontal disease or gingivitis. A high proportion (79%) reported that they did not have a prosthesis for replacing a lost tooth (fixed partial denture [bridge], dental implant or removable denture).

Thematically, many expressed that their oral health was generally not within their own control. Some patients indicated that oral health is predetermined by their previous dental experiences stating that, "*because my teeth were constantly drilled as a child*", and:

"My teeth always need general maintenance such as redoing fillings, one tooth extracted and a hygiene clean. Root canal work, although major, keeps my mouth in good order and is essential for my overall wellbeing and health"

In contrast to how patients of all ages perceived their overall oral health, patients commonly indicated that they thought the state of their dentition was greatly influenced by their age, with comments such as "*[I have] elderly teeth*" and:

"One tooth is missing. [I am] encountering more problems as I age"

Patients took pride in retaining their natural teeth, stating:

“I haven't got the greatest teeth but they're all mine”

“At 76 I have all [of] my own teeth”

Many patients also acknowledged the role of the dentist or dental hygienist in determining their oral health:

“Because my dentist / hygienist has said I have healthy gums and low calculus”

Patients perceived regularly seeing an oral health professional as important for determining good health, although many expressed barriers to receiving care such as:

“Some repair and fillings work are necessary but keeps getting put off due to the cost”.

A few patients regarded their oral health to be good because they rarely needed to attend the dentist:

“I've only had to go to the dentist twice as an adult”

Some patients cited some other uncontrollable factors such a medication causing teeth to ‘crumble’ or the presence of tooth wear and malocclusion, stating:

“[The] medication I've taken for five years has damaged my teeth”

“Teeth seem to get holes easily”

“I have had a few fillings in the past also have crooked teeth with an overbite”

Less commonly, some patients described their oral health as determined by preventive homecare, and believed it may need improving since they are currently having RCT:

“Over the past years I thought/knew my teeth were in good condition, however I knew I had brushed my gums too hard and I didn't floss regularly. No fillings until now (since my teenage years where I had many fillings)”

“I have had some fillings done when I was in my teens but haven't had any for the past five years plus. Routine check-up once per year, brush x2 and floss x1 per day”

Patient experiences; root canal treatment and pain

Patients in the 50-65 and 65+ age categories were significantly more likely to have had a previous RCT ($p= 0.043$). Of those who had RCT in another tooth, 72% had a positive experience. Patients who had positive experiences characterised expectations being met or exceeded. Important factors were lack of pain, retention of the tooth, and the thorough explanation/communication they had received from their dentist and the dental team:

“It was quick, painless and effective”

“Previous root canals appear to have lasted (my opinion only) for 20 odd years. However, from memory the procedures were a little more painful”

“Both the dentist and assistant were very calm and patient. I was given all the information as to what was being done and updated at all stages. I feel that the procedure was not rushed, and my teeth were done in a thorough way and not watching the clock. I was given enough appointments to see it done this way”

Additionally, many suggested that they had minimal post-operative pain following the procedure which further exemplified a good outcome for them:

“Hardly any pain after treatment”

“The care I received was above and beyond good, resulting in no pain”

Conversely, negative previous experiences were dictated by pain being higher than anticipated, a lack of care or explanation from the dentist, or by treatment failing unexpectedly:

“[The] procedure wasn't explained before. [The] cost wasn't clear. Sometimes I didn't even know it was a root canal. [It was] often painful. Sometimes [I felt that I] should not have been let loose immediately – I think I was suffering from shock. [I] often had tenderness and soreness for years and [it is] sometimes still like that”

“I lost the tooth two days later due to swelling and infection”

“[I had] horrendous pain after first treatment that lasted 6 days. I had to take Panadol and ibuprofen 4 hourly around the clock as [the] pain woke me. I couldn't do anything during the day, not nice. I wish that I had been advised to expect this and [had] been advised accordingly.”

Posterior teeth were more commonly treated (66%; n=94), and the single most treated teeth overall were posterior mandibular teeth (36%; n=49). Some patients (n=10) reported having multiple teeth root canal treated.

The most common reason reported for RCT was related to large or deep restorations resulting in damage to the pulp: ‘I have a big filling and the nerve has died’ (31%; n=42), followed by dental caries (28%; n=38). Slightly less than 10% (n=11) reported that they were having their RCT due to trauma. Occasionally patients cited *“infection”* and to accommodate other treatment needs as reasons for RCT:

“I had a crown fitted and suffered ongoing pain”

A frequent theme across many patients was the preference to retain their natural dentition. Notably, 40% (n=53) of patients answered that the main reason they were having the tooth root canal treated rather than extracted was because they ‘don’t like losing teeth’. Aesthetic reasons (19%; n=26) and to avoid masticatory problems (17%; n=23) were the next most common responses. Otherwise, there was further discussion on decision-making, such as “*I always take my dentist's advice as to what the best dental treatment is to have*” and to prevent the disruption of occlusion “*so my other teeth don’t move*”.

While 14% reported that their tooth was asymptomatic prior to RCT (n=19), over one third (n=46) reported that they had pain for more than one month before treatment was sought. Conversely, many commented that they sought treatment early to avoid further problems:

“I had prior tooth pain experience in a different area, and it was unbearable. That's the reason I came in right away when the pain started”

“I obtained the necessary treatment before pain became a worse problem”

Some patients acknowledged that the tooth was not causing pain but the “*most significant pain was due to jaw strain during the procedure*”.

Patients who reported higher pain levels also conveyed the need for pain relieving medication, and this was statistically significant ($p < 0.01$). The majority (62%) commented that they needed to take pain relief for their dental pain and more than half (52%; n=70) of respondents rated their pain as 7/10 or greater, with 8% (n=11) reporting 10/10 on a pain scale:

“My tooth was very painful before the treatment. I was unable to withstand hot, cold, touching, or breathing cold air. It was making my life very difficult. It was a relief to have the local anaesthetic and the nerve removed - free from pain!”

Patients typically indicated that their prior knowledge of RCT was through previous experiences. It was very common to mention the “high monetary cost” and “painful” treatment, with one patient saying:

“Service and procedure and result is excellent. However, I am very lucky to be able to afford the treatment cost... but [I] also understand the machinery and material cost are a major part of this”.

Some patients “had it many times before...” and suggested that their treatment history meant that they could give informed consent. There were also several patients participating in the survey with familiarity from within the oral health workforce/industry:

“Full knowledge of treatment as I was a dental assistant”

“[I] have been working in the dental industry for more than 12 years”

On the other hand, several patients who had little prior knowledge of RCT felt well-informed by the treating clinician, with several citing the value of verbal, visual and written information:

“I have had earlier root canal treatment but there is always more to learn each time. Discussion with the dentist and X-rays / photos on screen helped to illustrate what work was required”

“Had discussed it with my dentist years ago – this time I was also given an advice sheet about it – it was very informative!”

“Treatment uses all the latest technology. Root canal treatment was explained to me carefully with each step. Use of X-rays and photos magnified on the screen so I can see what is being done was excellent. [It was] useful to see before and after results of root canal treatment”

Some patients chose to ask friends and read online about the procedure:

“[I have] done a lot of Google research and spoke to friends who work with dentists”

On the other hand, there were some outliers to the above themes. One patient preferred not to know about the treatment because of fear:

“I chose not to know too much”

Another opposed the common views of other patients:

“I thought they were more expensive and didn't last long. I'm assured this isn't the case anymore”

Patients strongly value two-way communication with the treating practitioner; patients rated their RCT more positively when they felt cared for, and when the procedure was explained thoroughly:

“Very well explained, shown what was done and very good patient care. Awesome to talk to”

“Dentist [name redacted] was great. Explained what he was doing and why. Checking I was okay during the procedure”

“My dentist also followed up with me the next day to see if I was having any problems after each treatment session”

“[Survey completed on behalf of (dementia) patient by her daughter]. As a daughter and carer, [dentist]'s personality matters a lot for Mum. This is an observation as well as direct comments from her”

There was a common theme of loyalty to a dentist or dental practice, especially from the older adult patients:

“Root canal treatment is excellent by my dentist (I've been seeing the same one for 38 years since 1981). Good research study – very important and good effort, thank you for taking the time”

“I have an outstanding dentist and so much confidence in his ability. He has always given me lots of information about any treatments and fits me in if [it is] urgent. [He is] excellent at giving pain-free injections as I come from the 'old' generation of the 'Murder House' dental clinics, so [there is] past trauma for me from those visits”

Self-reported general health

While some respondents stated that they see their medical doctor very frequently, half indicated that they only attend when they are unwell (n=67). There was a number (17%; n=22) of individuals that attended less than every three months but there was no statistical significance relating to the age of patients and the frequency of their visit. Patients stated many factors for determining their good health; generally, people considered their health to be good for reasons related to lifestyle, such as diet and exercise:

“I eat fish / vegetarian food. I exercise regularly”

“I do regular exercise, [and I am] relatively healthy. I have good sleep patterns and only work part-time”

“[I] don't get sick much, still playing sport and physical work. No medical conditions, no pills etc.”

Overwhelmingly, the participants rated their health positively (93%; n=126). There was a tendency for patients who rated their oral health positively to also rate their general health positively, and this was statistically significant ($p < 0.01$). Patients often related their health positively if they were rarely sick, especially when compared to their peers. Common comments included:

“[I] still work full-time and only have the occasional sick day. I am the oldest in my workplace (a community home) and have the least sick days”

“I am in good health, rarely sick and only visit my GP when I need to”

Others believed that good health could be maintained by regularly visiting their doctor, and felt that with the help of medications, their chronic illness was negated:

“I maintain reasonable health and go for all the regular check-ups i.e. breast exam and smear test”

“My medications manage [my] existing conditions”

“No disability, generally I am good with the help of medication”

Only one response from the 135 participants reported ‘poor’ health, despite several other patients suggesting they have significant multimorbidities and extensive lists of medications. Patients rated factors such as the lack of exercise, poor diet, excessive weight, and having significant illness to affect their health negatively:

“[I] don't exercise much”

“I have Type 2 diabetes and I am overweight”

“Have an auto-immune condition called lupus”

“Six months ago, I had just had (6 weeks of) radiation for cancer of the uterus – had a big operation 12 months ago”

Others cited their general health status to be significantly determined by their age, and they compared themselves to those around them of a similar age:

“Because my health issues are age and gender related”

“I am very fit and healthy for a 71-year-old”

“For my age; I never take pills, shake off colds very easily and quickly, live an active life”

Only a very small proportion of the patients reported that they were current smokers (5%; n=7) and only 2 patients smoked more than ten cigarettes in a day. These patients did not have self-reported higher levels of periodontal disease. Over 90% of patients were non-smokers (n=127). Nearly three quarters (74%; n=99) reported that they have never smoked and 21% were ex-smokers (n=28).

While 87% of the respondents indicated that they drink alcohol, 34% only consume it on special occasions.

Approximately half of the patients (52%; n=70) were taking regular prescribed medications, and this included 37% (n=50) who were also taking over-the counter medications or supplements. More older patients were on prescribed medications compared with those in the younger age categories ($p < 0.01$), with 82% of patients over

65 years-of-age stating that they took prescribed medications. Additionally, a linear relationship in the number of prescribed medications patients take as they age was present (Figure 3.1).

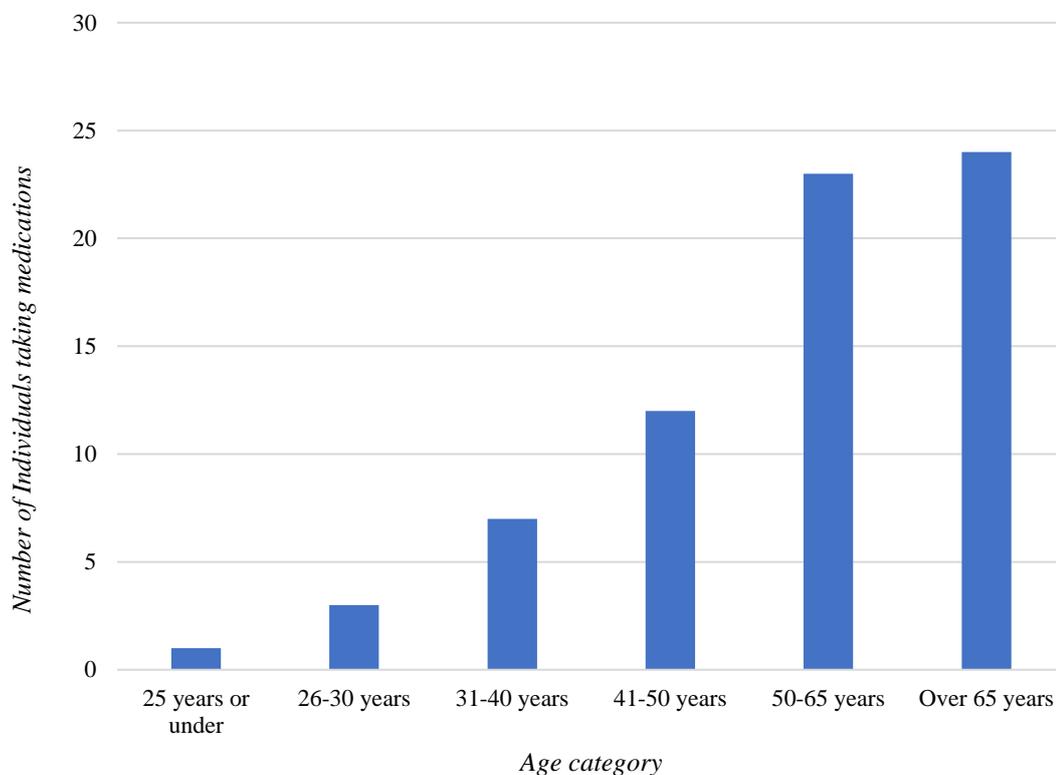


Figure 3.1 Medications being taken in related to patients' age

There were several examples of polypharmacy in the self-reported lists of medications, one example includes a patient living with chronic illness following cancer, a stroke, and with concurrent T2 DM:

Patient 1

“Cilazapril – following stroke

Aspirin – following stroke

Metformin – diabetes (Type 2)

Atorvastatin – cholesterol

Hydroxocobalamin – injected once every three months

Oxybutynin – bladder due to radiation damage

Paracetamol – only when I need it (not too often now)”

There were other examples of immunosuppressed patients:

Patient 2

“Prednisone – rheumatoid arthritis (all meds are)

Methotrexate

Etanercept

Folic acid

Laxsol

Multivitamins, Vit C

Paracetamol and ibuprofen as needed”

Four patients indicated that they were taking bisphosphonate medications, all of them were oral formulations with one taking alendronic acid (Fosamax[®]) and the others taking risedronate. There were examples of patients who, despite being treated for osteoporosis, were otherwise seemingly healthy:

Patient 3

“Residronate - osteoporosis

B12 and Vitamin D”

Others revealed that they had further immunosuppressive illnesses and medications prescribed concurrently with bisphosphonates – which would put them at significant risk of MRONJ if oral surgery were carried out:

Patient 4

“Synthoid – hypothyroidism

Levothyroxine – hypothyroidism

Letriazole – cancer hormone suppression

Losartan – hypertension

Cholecalciferol

Vitamin D

Risedronate tablets for osteoporosis”

Cardiovascular diseases were commonly reported, particularly hypertension (16%; n=21). One individual reported having angina, and four reported having a previous stroke. Another five participants indicated they have had a previous heart attack (3.7%). Only two patients reported having a bleeding disorder, with one under specialist care. Five patients self-reported that they were taking aspirin, two taking clopidogrel, one on warfarin and one on dabigatran. Medications for impaired thyroid function (such as thyroxine) were commonly taken by participants (Figure 3.3).

Seven patients (5%) remarked on having a lung condition. Qualitative data suggested that these were mostly controlled asthmatics, and one patient had COPD. Only 4% (n=5) of participants reported having osteoporosis. Around 10% (n=14) of patients indicated that they had arthritis and while they did not specify osteo- or rheumatoid arthritis (RA), we can assume from the lists of medications that very few patients have RA. Almost 4% (n=6) stated they had a prosthetic joint.

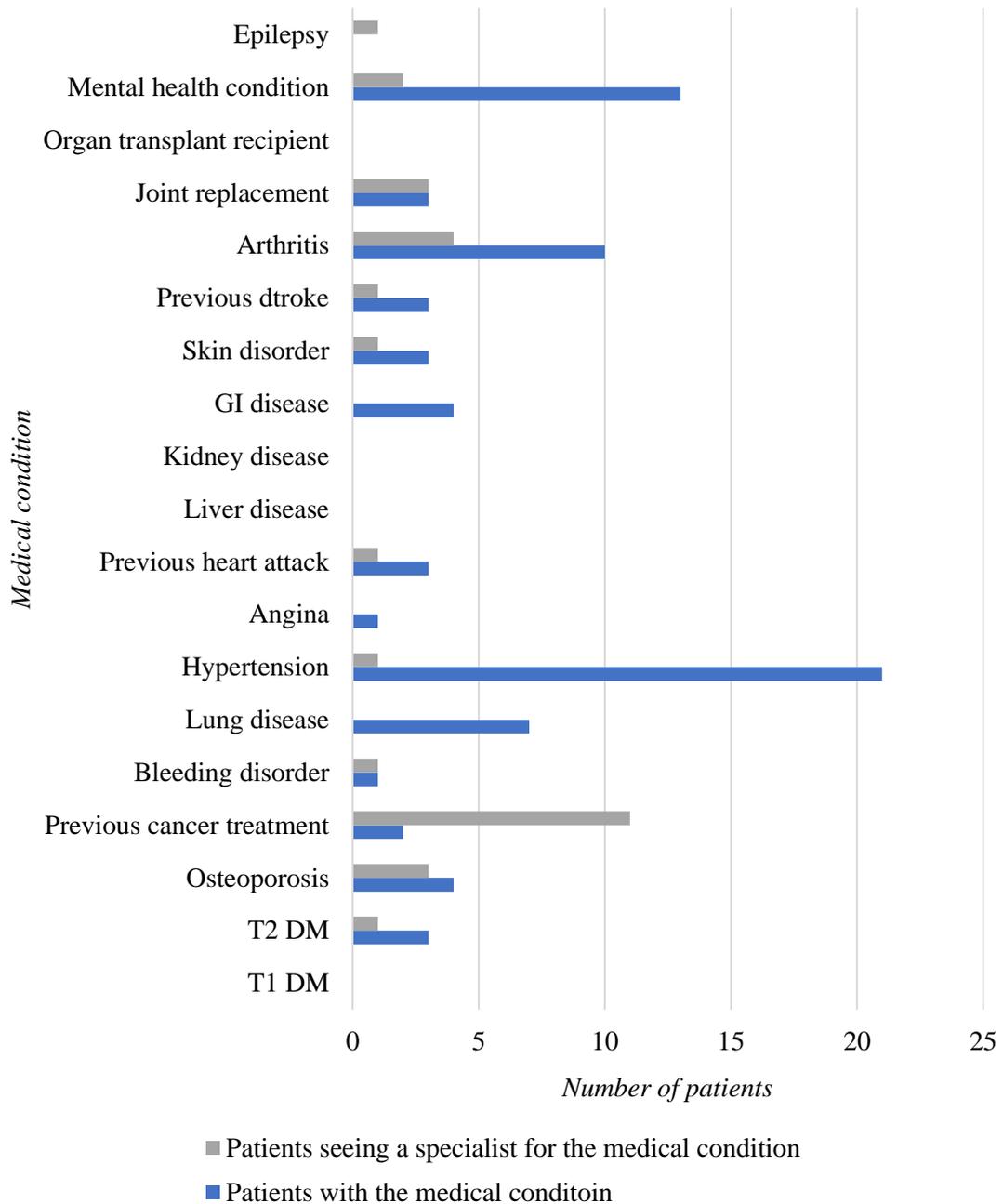


Figure 3.3 Patients' self-reported medical conditions

Around 10% (n=13) of patients reported they were being currently treated or had a history of oncology treatment. No patients reported any liver disease, kidney disease, GI disease (despite many patients being medicated for gastric reflux) or stated that they were organ transplant recipients. Other uncommon conditions among the participants included skin disorders (4 patients), and epilepsy (1 patient).

Finally, 11% (n=15) indicated having a mental health condition, and this was the second most reported complaint. From medications lists provided, most suggested a diagnosis of depression and/or bipolar disorder (Figure 3.3).

Exercise and fitness

Many respondents rated their own fitness positively (74%; n=100). While one fifth (n=27) stated that they did not exercise regularly, over one quarter (26%; n= 35) exercised between five and seven days per week. There was no statistical relationship between the ages of patients and their self-reported fitness.

3.5 Discussion

Managing patients in general practice is more than treating ‘teeth and gums’. This study has highlighted the importance of general health in oral health and has reinforced the importance of general dentists in health promotion.

Due to variation within the purposeful sample and the sampling period, which began in early 2019, the survey was extended to GDPs who later participated in Focus Groups (Chapter 4) to better ensure saturation of patient data and themes. There were differences in the number of dentist and patient participants based on practice and geographical location.

The collection of valuable data from dentists and patients within a PBRN study has provided evidence that NZ dentists have a good awareness of medical problems in dentistry, and mostly feel confident in managing patients for RCT regardless of patients’ medical status. However, they value the importance of CPD and recognise the merit of developing targeted activities which can directly translate to practice. Patients present

with a range of medical conditions and have a generally positive perception of their oral and general health.

3.5.1 Practitioners

Despite outreach across a multitude of dentists and practices around the country, our 18 dentists across 16 participating practices is not representative of the 2,292 currently practicing dentists in NZ (Dental Council of New Zealand 2017). Nonetheless, gender diversity amongst dentists could be considered representative (61.9% male in NZ), but our GDPs differed in other demographic statistics such as age, and country of original qualification, where likely more than 22.6% qualified overseas (Dental Council of New Zealand 2017).

Geographically, our sample of practices was predominantly from the South Island, with a bias towards more rural practices than those in main centres such as Auckland and Wellington. There are likely to be more than 600 dentists practicing in Auckland City treating more than 1.5 million people, with a diverse range of demographics to those in other parts of NZ (Dental Council of New Zealand 2017; Statistics New Zealand 2020).

One strength of this purposeful sampling, however, is the capture of data from GDPs and patients from more rural locations, which could provide understanding of practices with less referrals to specialists, and potentially more management of medically compromised patients due to limited access to DHB dental facilities.

Perceptions of practitioners providing root canal treatment

GDPs indicated the financial cost of RCT was the main barrier to patients agreeing to treatment, and wanting to retain their natural dentition was the main motivation for care. Both of these findings are consistent with international studies in London (UK), Seattle

(USA) and Riyadh (Saudi Arabia) (Croucher & Sohanpal 2006; Gatten et al. 2011; Doumani et al. 2017). Patients in the current study indicated that keeping their own teeth was important, which is consistent with a qualitative study that found over 97% of patients felt that it was important to keep their teeth and would do ‘whatever they can to keep them’ (Gatten et al. 2011).

Confidence of practitioners in managing medical conditions

The GDPs were generally confident in managing most medical conditions when providing RCT to their patients. They were especially confident in managing chronic diseases that were easily quantifiable and measurable – for example, hypertension can be measured by checking blood pressure chairside or by screening the medications patients take (Law et al. 2009). With DM, an efficient clinical ‘snapshot’ of T2 DM control can be taken by comparing the current blood glucose level to when the patient last ate, or by a recent HbA1c result (American Diabetes Association 2014).

GDPs were also confident in managing illnesses that they felt had little effect on the RCT procedure, such as GI disorders and skin conditions. The management of prosthetic joints was rated confidently and may reflect the recently published NZ guidelines which are easily accessible in practice (New Zealand Dental Association 2018).

Experiences of GDPs managing patients who present with chronic diseases affecting mobility, physical access to the dental clinic, ability to recline in the chair and tolerate treatment for extended periods were also common. If patients cannot be safely or comfortably reclined in the chair and dental treatment must be performed standing or at a non-ergonomic position, musculoskeletal disorders can occur (Morse et al. 2010). Dentists generally have a high experience with musculoskeletal disorders of the head and neck, which may result in poorer work performance and absences for recovery

(Alexopoulos et al. 2004; Morse et al. 2010). This study has highlighted the reported difficulties and frustrations that can occur while performing RCT on patients who cannot cope with keeping their mouths open for long periods, as also supported by research from Sweden (Dahlström et al. 2017).

The misconception that DM reduces the prognosis of RCT was raised. One older study showed that when only teeth with preoperative lesions are considered, and when controlling for confounding variables, teeth from patients with DM were more significantly classified as uncertain or failing at two or longer years after treatment (Fouad & Burleson 2003). Available scientific evidence indicates that DM is significantly associated with a higher prevalence of periapical radiolucencies in previously root canal treated teeth (Segura-Egea et al. 2016), and this is particularly so for those with poor glycaemic control (Sánchez-Domínguez et al. 2015; Limeira et al. 2020). The presence of apical pathology and diabetic control are variable amongst patients presenting for RCT, and this must be considered when discussing prognosis.

Use of a dental dam for endodontics is considered a practice standard for clinical competence when providing RCT in NZ (Dental Council of New Zealand 2018a). This is due to potential inhalation or swallowing of fine instruments and disinfectant solutions, and to prevent contamination of the root canal system from the patient's saliva. Patients with chronic lung diseases may be unable to breathe when lying flat, and the use of the dental dam can further complicate maintaining an adequate airway, which could explain why GDPs were less confident managing these patients.

Although the most common conditions were mostly managed confidently, the exception was mental health problems. The specifics of this were not mentioned but GDPs associated this with the difficulty to communicate or engage in consent, and the effects

of dry mouth on caries progression. Late-life depression may be frequently associated with a disinterest in performing oral hygiene, a cariogenic diet, diminished salivary flow, rampant dental caries, advanced periodontal disease, and oral dysesthesias in patients (Friedlander et al. 2003). Although most research concerning patients with mental illness discusses institutionalised patients with severe dental disease (Phan et al. 2005; Kilbourne et al. 2007), it is unlikely that many of these patients attend general practice for RCT. Nevertheless, GDPs need to be aware of the increased dental needs of these patients. With the increased prevalence and diagnosis of mental illness in NZ (Roberts et al. 2018), a deeper understanding of how this impacts on delivery of dental care is warranted.

Polypharmacy and excessive polypharmacy is becoming common in patients presenting for dental care (Singh & Papas 2014). This study found that despite GDPs being generally confident in managing polypharmacy and patients on bisphosphonate medications when delivering RCT, this confidence was not reflected in decision-making for specialist referrals. GDPs perceived the outcome for RCT to be better if performed by an endodontist. Endodontic specialists attaining higher levels of RCT ‘success’ is uncertain at the highest levels of evidence (Ng et al. 2008), but more recent literature suggests that more challenging molars may have a better prognosis in the long term when treated by specialists (Burry et al. 2016). GDPs’ perceptions of managing patients with polypharmacy is scarce and this study has provided some insight into the opinions of NZ dentists.

While polypharmacy is not a contraindication for providing RCT, patients in pain usually require administration of local anaesthetic and may require sedation which could create uncertainty around prescription and delivery of drugs (Meechan 2002). GDPs reported considerable confidence in quantitative parts of the survey, yet its consequences to oral

health (dry mouth and increased caries rate) were frequently discussed – indicating that further CPD would be appropriate.

Markedly, there was a tendency for more recently graduated GDPs to seek help from within a group practice, rather than to turn to medical doctors or dental specialists. It is therefore paramount that experienced GDPs are well educated on the safe management of chronic diseases in general practice, how they relate to providing RCT and that they are encouraged to share their knowledge and experience with junior colleagues.

Continuing professional development

Life-long learning and engagement with CPD is a core competency for practice in NZ (Dental Council of New Zealand 2016). GDPs emphasised the importance of delivery of appropriate CPD for GDPs that is directly relevant to patients. Many reported that they have remained as current as possible with the information available to them but proposed that information on recent medications and guidelines for providing treatment to patients with chronic disease needs to be delivered outside of main centres. Moreover, the desire for CPD with a focus on the dental practitioner rather than on complex pharmacology irrelevant to daily practice was indicated.

GDPs will be expected to treat an increasingly elderly population and will enter a climate in which remuneration for RCT could have an effect on the cases treated and the pattern of referral (Qualtrough 2014). There is a need for more targeted CPD for GDPs to increase their endodontic skillset for treating an increased complexity of cases when providing RCT for these patients.

3.5.2 Patients

Almost a quarter (22%) of patients in the study were over 65 years old, which is a lower proportion than the most recent NZ census data (30.4%) (Statistics New Zealand 2020). Many of these individuals are more likely to have fewer of their own teeth remaining, may be older adults in care with limited access to dentists, and may have a higher prevalence of edentulism (Thomson 2012). Additionally, the ethnicity of study participants differed from NZ statistics. Notably, 15.1% of New Zealanders identify with Asian ethnic groups, while only two patients of Asian ethnicity participated in the study. Also, the proportion of participants of NZ Māori ethnicity (8%) was less than half of the 2018 NZ population data (16.5%). This may be reflective of the lower utilisation of healthcare services by Māori and Pacific people, and/or the inclusion of higher numbers of South Island and rural patients (Ministry of Health 2019).

Self-reported oral health

The present study had a high representation of regular attenders overall, with over 63% of participants attending the dentist at least yearly. In NZ, it is reported that only 38% have visited a dental health care worker in the last 12 months (Ministry of Health 2019) but the present study cohort may represent those who do not have financial barriers to accessing care. Our study captured only a small number of irregular attenders with pain, so we can speculate that many of these patients attend less overall and may be more likely to opt for extractions rather than RCT.

‘Excellent’, ‘Very Good’ or ‘Good’ self-rated oral health in NZ is reported to be 78.4% (Ministry of Health 2019), while the same levels of perceived oral health in this survey were recorded by 70% of participants. Since patients were only selected to participate if RCT was already planned, these patients may report their oral health lower than if they

did not currently need dental treatment. In addition, few people under the age of 30 (16%) participated. Younger people in NZ report that their oral health is better than that of older people and this may explain the difference in self-reported oral health (Ministry of Health 2019).

Participants rated having lost few natural teeth as an indicator for good health, and this is supported by other research (Nordenram et al. 2013). Loss of teeth is associated not only with compromised oral function, but also with loss of social status and diminished self-esteem (Nordenram et al. 2013). It was common for participants to assume age-related tooth loss as normal and “*part of life*’. They also cited that they were proud to not follow this trend.

While uncommon, some patients expanded on the overall oral health theme of ‘loss of control’ with their dentition, indicating that their medications were ‘damaging’ teeth or causing them to ‘crumble’. Although there are qualitative and quantitative changes in saliva due to the anticholinergic action of medications such as antidepressants, these medicines have no direct effect on tooth structure (Singh & Papas 2014). Nevertheless, the importance of saliva as a protective agent for caries and subsequent pulpal infection cannot be understated. Even with careful oral hygiene, fluoride exposure and cariogenic diet restrictions, an increased caries rate can ensue. Additionally, some illnesses and medications can induce gastric reflux, causing erosion to tooth surfaces which will be amplified without the buffering capacity of saliva (Holbrook et al. 2009).

Few patients mentioned how factors within their control such as their daily oral care habits and attending regular check-ups have prevented them from dental diseases. Despite better oral health being reported by those who attend the dentist more frequently, many patients cited uncontrollable external factors as prime determinants for their poor

oral health. Many adults are not regular users of dental services and may experience substantial barriers to receiving necessary dental care. Internationally, low income patients and those without dental insurance were most likely to report financial barriers to care (Locker et al. 2011). Those reporting such barriers visited the dentist less frequently and had poorer oral health outcomes after controlling for the effects of income and insurance coverage (Locker et al. 2011). Attitudes and perceptions influence dental attendance patterns and include anxiety, cost of treatment concerns, value placed on restored teeth, and beliefs regarding the importance of regular dental attendance (Abrahamsson et al. 2001; Bagewitz et al. 2002; Riley et al. 2006). Overcoming barriers to regular dental attendance for low socioeconomic groups may reduce oral health inequalities and serve as future directions for oral health policy.

Patients' perspectives on root canal treatment and pain

Patients and dentists shared the same opinions around why patients choose RCT over extraction. Retaining teeth has been reported as the primary reason patients opt for RCT, as well as the reason for their satisfaction with the treatment when compared to extraction and implant therapy (Gatten et al. 2011). In addition, having natural teeth generally has been shown to have a positive effect on quality of life in research from Denmark (Nielsen et al. 2012). Positive effects through pride, intactness, and sense of control are most apparent with older people and they compared themselves with peers who are more often edentate (Nielsen et al. 2012). In the PBRN survey, qualitative results directly align with these themes. More qualitative information regarding the reasons for selecting RCT over other treatments such as extraction and tooth replacement, and its relation to health awareness would be interesting for future research.

A wide range of pre- and post-operative pain was reported by patients, but it was contextualised by the experience of the treatment by the dentist and team. Overall, patients often rated the pain before treatment as more severe, but occasionally mentioned discomfort in muscles of mastication related to the length of treatment time. Patients consistently reported a positive experience when they felt they were cared for and the treatment was explained fully with visual aids. Additionally, they greatly appreciated a telephone call from the dentist on the following day. Patients took pride in being cared for by a clinician for a long time and considered this relationship predictive of a good RCT or dental experience. The role of patient education in dental procedures has shown increased patient understanding, reduction in post-operative complications, and a reduction in patient anxiety (Armfield & Heaton 2013). A recent NZ study found that the presentation of additional educational material (regardless of the mode) prior to RCT increases understanding, reduces anxiety, and increases perception of successful treatment for patients (Sullivan 2019).

Patients' self-reported general health and exercise

Plentiful and rich data was provided by patients regarding their medical status which provides an understanding of how patients perceive 'health'. One weakness of this self-reporting is the lack of validation by a medical practitioner. Engaging with medical colleagues and access to medical records in tandem to corroborate the information received would strengthen the data but significantly alter the study design and time required to conduct this research. This may be considered in future but would necessitate a modified study design and amended ethical approvals to uphold confidentiality.

Results indicate that most patients visited their dentist or oral health professional more frequently than their medical doctor, emphasising the importance of the dental

practitioner being confident in screening and managing various chronic illness (Greenberg et al. 2010).

Patients' perceptions of their own health when taking medications for chronic disease was conflicting. While few patients reported their health poorly due to their illnesses and necessary medications, the majority perceived themselves to be in good health because these conditions are now 'controlled'. This theme may be important, since if patients perceive less problems with their health, they may under report or regard it as irrelevant to the dentist. GPs may have this normative perception as well, so it is important to thoroughly screen patients' medical histories and confirm with their medical doctor if inconsistencies arise.

Compared with NZ data, smoking prevalence was much lower in our survey, despite the different metrics in use for NZ statistics for smoking and for alcohol consumption. In NZ, smokers account for 14.2% of people and the mean number of cigarettes smoked per day is 10 (Ministry of Health 2019). This difference is likely related to the higher proportion of routine attenders sampled in the survey, as smoking prevalence is associated with lower socio-economic status and ethnicity relating to the selection of extraction over RCT (Scragg et al. 2008). Four in five adults drank alcohol in the past year in NZ (Ministry of Health 2019), which is likely to be similar in our survey, but cannot be directly compared.

Many chronic diseases present in the NZ population were reported in this study with similar frequency. Patients having RCT in general practice are seemingly no less likely than any other patient to have underlying chronic illness which could affect safe delivery of care. The occurrence of the most common reported chronic conditions in NZ data, including medicated hypertension (16.1%), stroke (1.6%), angina and myocardial infarct

cumulatively (4.3%) (Ministry of Health 2019), was comparable to the reported statistics of this survey, if not slightly higher among the patients having RCT. This may be accounted for by the higher numbers of people aged 50+ in this study compared with the NZ population (Statistics New Zealand 2020).

Diabetes mellitus (Type 1 and 2) was under-represented in this study (4%) compared with national data (6.4%), with only patients with T2 DM participating (Ministry of Health 2019). Speculatively, this could be due to the patterns of dental attendance of study participants, ethnicities, or due to chance. The frequency of asthmatics in our study population was less than the NZ average of 11.5% and similar findings were observed for epilepsy (1-2%) and depression (15.9%) (Ministry of Health 2019; Health Navigator NZ 2020).

The number of patients in the survey with cancer experience (almost 10%) was substantial, but it is difficult to compare with NZ data due to differing methods of reporting. Other rare conditions such as organ transplant recipients, liver, and kidney diseases were not translatable to NZ data and were very uncommon or absent in surveyed patients. This may explain the reduced confidence from GPs in the survey for managing these illnesses.

The comparison of patients with joint replacements in our data (4%) may be similar to NZ national numbers. The total number of registered joint arthroplasties as of December 2016 was 259,859 (performed on 178,442 individual patients) which estimates an approximate 3.8% of New Zealanders as having a prosthetic joint (New Zealand Orthopaedic Association 2017).

The prevalence of patients with arthritis in NZ is 16.2% (Ministry of Health 2019) which is less than reported in our survey. While patient participants were not asked to

differentiate between OA and RA, NZ data records these chronic diseases as affecting 10.2% and 2.6% of the population respectively (Ministry of Health 2019). Based on lists of medications, the numbers of patients immunosuppressed due to RA are likely three or fewer in the survey.

Due to different metrics, the levels of fitness and activity cannot be directly compared. The Ministry of Health recommends that adults aged 18+ years do at least 30 minutes of moderate-intensity physical activity on most if not all days of the week. In NZ, physically active people (defined as: 'did at least 2.5 hours of activity in the past week, spread out over the week') account for 50.8% of this population, though this reduces with age (Ministry of Health 2019). In our study, only 25% did not exercise regularly and more than one quarter exercised five to seven days per week.

Most patients with high self-reported oral health also reported high general health – implying there may be an association with overall wellbeing. It is unlikely that patients consider the condition of their whole mouth when discussing oral health. In one study from the USA, most individuals prioritised the numbers of remaining teeth, fillings, root canal treated teeth, and presence of a prosthesis as determinants of self-reported oral health (Pitiphat et al. 2002). In contrast, prevalence of periodontal disease and carious teeth were under-reported compared with accurate clinical notes (Pitiphat et al. 2002). Certainly, many patients emphasised the dramatic effect the pain from their tooth before RCT had on their daily quality of life and were very grateful that the treatment could ease this, whilst retaining their natural tooth or teeth.

The quantitative aspects of the survey face limitation due to the size and spread of the samples across NZ. The limited number of practices meant that extrapolation of findings to the NZ population should be approached cautiously, however the qualitative data has

provided insight into areas not revealed in a purely quantitative study. It is also possible that GDPs participating in research for the betterment of the profession are more likely to be compassionate and skilled GDPs. Future research could include a more random sample of patients or GDPs, with wider representation of practices from NZ main centres, and where there is access to specialist endodontists.

3.6 Conclusion

The open-ended aspects of the survey provided valuable clinical insights from a range of GDPs and perceptive comments from patients of different ages and health status, despite some limitation in qualitative elements.

Practitioner confidence in providing RCT was more strongly related to procedural and patient-related factors rather than specific medical conditions, and development of targeted CPD was perceived as important. Feedback from patients receiving RCT has provided insights into patterns of care, treatment experience, and the health of patients having RCT. This research has produced valuable insight into how patients with chronic illness are treated in general dental practice.

Chapter 4

Practitioner Focus Group Interviews

4.1 Introduction

The use of qualitative methods in research provides a 'deeper' understanding of social phenomena than would be obtained from purely quantitative methods (Silverman 2013). Focus group interviews are useful where there is little known about the study phenomenon or where detailed insights are required (Gill et al. 2008). Further investigations of practicing dentists' opinions, and additional exploration of themes from the PBRN survey was important to enrich the data gathered already. Focus Group interviews including a wide range of dentists with different experiences from throughout NZ were able to explore the collection of health information, and to address the development of suitable CPD activities.

4.2 Aims and Objectives

Focus Group interviews with GDPs further explored themes identified in the Pilot study (Chapter 2), and the PBRN survey data (Chapter 3) from patients and GDPs.

Specific Objectives

- The demographic characteristics of NZ dentists within a PBRN providing RCT in general practice.
- The self-perceived confidence and competence of NZ GDPs providing RCT to patients in general practice who present with a range of medical conditions.
- The engagement of NZ dentists in CPD activities related to endodontics and medical problems in dentistry.
- The demographic characteristics of patients receiving RCT from GDPs participating in a PBRN in NZ.

- The dental experiences and self-perceived general health status of patients receiving RCT in NZ general practices.

4.3 Methods

Ethical approval was obtained from the University of Otago Human Ethics Committee (Health) (Approval Number H18/019 [Appendix 1]) and Māori consultation (Appendix 2) was entered with the Ngāi Tahu Research Consultation Committee as explained previously. Two Focus Group interviews were held at the University of Otago in Dunedin. A purposeful sampling technique was used to recruit GDPs who perform RCT from a database in Otago's PBRN, ARCH. Additionally, interested GDPs throughout NZ were also contacted from the NZ Dental Council register. Purposeful sampling and thorough planning of the sessions ensured that each Focus Group included GDPs with a range of clinical experience from main centres and regional areas of NZ. Written consent to participate was obtained prior to discussion and anonymity of the data was assured. All discussions were audio-recorded and transcribed verbatim.

A moderator (DClinDent candidate) conducted each interview session, and an experienced endodontic specialist assisted the facilitation process. The group discussions were conducted using prepared open-ended questions, which were structured to expand on previous survey responses, and to enrich the quality of the data. Each participant was allowed the opportunity to answer each question and was only prompted when the question was not answered in its entirety. Questions explored themes relating to the collection of health data, the consent process for RCT, the effect of patients' medical conditions when providing the treatment, views on the relationship between overall

health and RCT, and engagement in CPD activities related to medical problems in dentistry and endodontics.

4.3.1 Focus Group questions

The questions asked in the Focus Group interviews were:

1. Can you tell me about the types of patients that present for RCT at your practice?
 - Prompts: discuss socio-economic status, does your practice treat children and adolescents?
2. How do you collect their health information?
 - Prompts: how often and what method?
3. What are the barriers for patients in having RCT?
4. How do you obtain consent for RCT?
5. What are the most common medical conditions patients present with?
 - Prompts: are there medical conditions that impair consent?
6. Are there particular medical conditions that make RCT difficult for you, how do they affect your confidence?
7. How do you manage patients with joint replacements?
8. Do you modify how you provide RCT for patients on bisphosphonates?
9. Do patients with epilepsy affect how you provide care?
10. Do you have patients that present with concern about how RCT could affect their general health?
 - Prompts: Have you been asked about the Netflix show 'Root Cause' by patients? (A documentary in 2019 supplying misinformation about the adverse effects of RCT on general health).

11. Patients with medical problems commonly have associated oral health problems such as periodontal disease. How does this affect your treatment?

- Prompts: does it affect your recall periods?

12. What is your relationship with general medical practitioners in your area?

13. Do you see benefit in CPD related to medical conditions and providing RCT?

- Prompts: What is your experience with this and has it benefitted you? Have you attended online CPD?

4.3.2 Data analysis

Responses from both Focus Group interviews were transcribed verbatim by a third party into Microsoft Word® and then amended by the DClInDent candidate. Responses were pooled and NVivo 12 (Version 12.8.0. QSR International, Melbourne, VIC, Australia) software was used to perform coded thematic analysis. Themes were identified from the transcripts and placed into ‘nodes’ in the software. These nodes were then compared and the most cited areas for discussion were identified. Information-rich anecdotes and contrary views were highlighted and included in the analysis. Nodes were checked by an independent researcher to ensure they were valid (Ebbeling et al. 2018)

4.4 Results

Practitioners were all registered GDPs in practice in NZ with varying backgrounds and experience. Key themes were identified, and these are supported by relevant quotations, represented with an anonymous letter.

4.4.1 Demographic information of practitioners and patients

Despite the variation of experiences, type of practice and age of GDPs participating, it was apparent that most GDPs treat a broad range of patients. When asked about the types of patients that GDPs would see in their practice, some responses included:

“All ages from pre-schoolers to people from rest homes.”

– FG (Focus Group) 1, P (Participant) C

“Really across the board, [I have had] a recent spate of young guys around their late 20s... they’re ageing as well. I’ve got quite a few old ones who had root canals through crowns and 89, a 90-year-old lady. So, a big range...” – FG1, PJ

It was common amongst many GDPs that their patients were ageing along with them, and as the patients age, the complexity of care they require is increasing:

“My practice is in [redacted] – that’s rural. I’ve been there 20 years and my patients are all... well, late 40s is young. A lot of them are really old that I’m doing root canals on, through crowns and sclerosed canals and I’m trying to hold them together.” – FG1, PK

“I graduated in 1978. I’m in general dental practice. As I’ve aged, my patients have aged with me so, we’ve gone from [baby] changing tables to special chairs so that people can get up more easily from the waiting room.” – FG2, PC

“Well I’ve been in practice... in the middle of the city for 45 years and my patients are ageing at least as old as I and as quickly as I am, so I don’t see too many youngsters.” – FG1, PH

One particularly insightful summarising comment was:

“I work in a suburban practice, city fringe, quite close the city. Most of my root canals are teeth that slowly grumble and eventually die, either heavily filled or crowned. The patients’ age range generally I’d say are from 30 up to early 90s but most of them are probably around my age as I’ve been in the practice 20 years. A lot of them are retreats so they go off to their endodontist. Very few root canals on front teeth. We get the odd WINZ [Work and Income, New Zealand] quote, I’ve just recently done a central incisor on a young woman and I couldn’t say the last time [I had done one] and it was very straight-forward. It was the last time I felt like that was a very easy root canal, most of them are quite challenging through crowns, hard to find the openings, sclerosed canals etcetera. So, my heart sinks a lot of the time for endo.” – FG1, PG

It was also frequent for many of these GDPs to send these patients to receive specialist endodontic care:

“I see a lot of patients who’ve had lots of restorative work over a long time and a gradual progression of pulp death... The retreats I take the same attitude... and we’re lucky to have some really good endodontists in [the city] and they’re pretty busy because the age of all of our patients is increasing steadily. Most of the patients I’ve seen want to retain their teeth so they don’t choose extractions very often, they would be most inclined to go for endodontic treatment.” – FG1, PH

More recently graduated dentists saw urgent cases more frequently. Additionally, they see school age patients and acute appointments for people with more medical co-morbidities. This was not so common for experienced dentists that have been established in one location for a longer period:

“... I’m working in the hospital at [main centre in the North Island] but we do see a lot of low income patients, and there’s also medical patients and children... So probably most of our root canals are on the children in response to the trauma and patients having bisphosphonate treatment as well.” – FG2, PE

4.4.2 Collection of health information

GDPs all collected health information from their patients frequently and diligently. The groups conveyed the high importance that was placed on the timely gathering of this information, the accuracy of the data, and its safe storage. Collection of this vital data however, created many challenges for GDPs to overcome – almost universally, GDPs encountered problems with complex, and sometimes unexpected medication lists from patients:

“A lot of elderly patients don’t remember their medications so sometimes it’s making sure they’ve got a current [medical] GP, and we just get onto them [to] make sure they’ve got an up-to-date medical history ‘cause some patients don’t really know. I had one guy who, he said ‘I can’t tell you everything’, and he emailed me an A4 document of his medical history and medications and my jaw dropped ‘cause I never would’ve guessed that he had all those things wrong with him, so never judge a book by its cover.” – FG1, PD

“Recently we found that as the patient population ages, we’ve had to have a whole new sheet on the back for medications and get them checked regularly as well and still strike [problems]... Anyway, you still have to dig a bit with some patients to find out exactly what they’re taking because often they’ll forget – like aspirin or Cartia gets left out frequently particularly with the older ones or they

just say, 'no, no, it's not changed' when it actually has. It is challenging at times."

– FG1, PG

Although all GDPs stated that they collect information regularly, there was some inconsistency among the GDPs regarding the frequency and method of update. Additionally, some relied more heavily on this information being gathered at reception, and others shifting this discussion into the surgery for privacy. With no clearly defined intervals between appointments supplied, GDPs updated the medical histories of individuals via risk assessment, and there was considerable variation:

"We have a paper medical history chart the patient fills out and updates it six monthly when they come in." – FG1, PG

"We have a routine questionnaire that we get them to sign, that's scanned into their Exact [dental software] file. We go over that verbally during a check-up. That's verbally updated every recall and the written questionnaire is updated every three years." – FG2, PH

"We have a new patient questionnaire which is also updated. [Mostly] it will be every two years..." – FG2, PE

Despite the difficulties in obtaining this information, it was evident that the GDPs understood the importance of this information, and would persist outside of their working hours to do so:

"It's the [medical] general practitioners I'm always happy to ring. It's receptionists you'll have to battle [with], and they put you through to a nurse and they protect the GPs... it's difficult to just get the full medical history, but usually we get there eventually." – FG2, PK

Some GDPs had developed relationships with local medical practices to circumvent issues with obtaining accurate information:

“Yes, [the] elderly often forget to bring in their lists of medications... but we’ve got a good relationship with the local doctors and pharmacy who will email us lists, or family members will email in the lists of medications...” – FG1, PI

“[I] do a lot of ringing the doctors though and getting their med lists ‘because they might have a few extra things... and they often do ...” – FG1, PJ

This process was more straightforward in smaller communities:

“Because it’s a small town, we can easily ring up the pharmacy or trot on down, it’s not really a problem if we’re missing stuff.” – FG1, PK

Certain practices and reception staff took different attitudes towards the gathering of medical information. While upholding patient confidentiality, some of the busier practices with large reception areas had begun to avoid disclosing any medical information verbally at the front desk, and this was described as challenging for the GDPs who were used to having their receptionist prompt patients for useful information. Consequently, new initiatives have been developed:

“Yes, we find some resistance to release of information and especially with our front office staff. They won’t fill out forms [for the patients], they won’t answer questions, so we have to disengage quickly and do that in the surgery. We have an online medical history form with all the demographic details of the patients, new patients fill that out before they come in.” – FG1, PH

“... We’ve actually stopped [receptionists] asking anything verbally, patients can choose what they fill out and everything’s just done in private in confidence and you tend to sense those patients that might be able to disclose everything or you might even ask a nurse [dental assistant] to leave... in very few cases.” – FG1, PD

One of the challenges identified in collecting health information was related to the growing cultural diversity in NZ and from international tourists. The impact of patients with incomplete treatment histories from other countries, and non-English speaking patients attending general practices was commented upon frequently:

“[We use the same] history form which we update regularly when the patients come... we have language issues [with visiting tourists] and it’s often about gathering data internationally or from other specialists around the world” – FG1, PF

A common approach to reducing barriers is to use language translators or family members in the surgery. Some examples highlight the challenges encountered:

“If they’re unable to fill out the form, either the receptionist will try and speak to them about it. Frequently if they have difficulty communicating, they often have a son or daughter that comes in with them to help them through it and that’s quite useful for informed consent too.” – FG2, PC

“... we have patients coming in who are refugees and so we treat, or have treated them within the practice... so that’s when we’d have a designated translator to come in. Often their children know English quite well and they can actually

communicate between their parents or their grandparents or even their uncles and aunts.” – FG2, PG

Some GDPs described the discrepancies in translation, even when their patients spoke English well:

“Sometimes I find that the language that people might use might be different. For example, my Indian patients will say I have a gum boil whereas that’s not a term that we’d use particularly, [or] that I am particularly familiar with in our Kiwi population. So sometimes... it takes clarification to establish exactly what the person’s talking about in their own context and make sure we speak the same language.” – FG2, PE

One practitioner explained an extreme example of overcoming a language barrier:

“Most other nationalities which have English problems have generally brought a family member. I had one unusual one quite a few years ago though. The patient came from China and was deaf. She had a relative [who] came along who could sign language to her but only spoke Cantonese [group laughter]. She translated to another person who spoke Mandarin and could also speak English, so I was going through two translators and three languages to get to her. I kept things to ‘yes or no’ questions and the patient would look at me and say ‘yes or no’ once again through the translation, I just hope that whatever got said [was accurate] ...” – FG2, PG

Frequently, GDPs doubted the accuracy of the information being translated to them, more so if the translator was a member of the family rather than a professional:

“... If it’s a Red Cross translator, it seems safe and accurate. Sometimes with family members, I’m never quite sure whether it’s an accurate translation, then they say a lot, and then the family member just gives you a one-word response.”

– FG2, PK

The multi-cultural diversity of the dental workplace has also developed – with many practices employing dentists or other staff members with a variety of language skills who have developed documents with different language versions:

“We also have a lot of dentists in our practice, so we have quite a few people who are multi-lingual... We can cover over ten languages in our group practice.” –

FG2, PH

“We see a lot of Chinese patients so we’ve got Mandarin versions of all our consent forms, medical history, and we’ve generally at least got one Chinese speaking assistant and one of the dentists [also] speaks Chinese ...” – FG2, PJ

One theme from the interviews was the introduction of new technology for medical history-taking and patient registration. GDPs were interested in adopting technology with tablets to mitigate errors in translating patients’ handwriting to digitised medical records, but this does come with some consequences. GDPs outlined the strategies at their practice:

“We have an iPad system which works really well [for updating medical histories], plus a paper format for those who don’t know how to use the iPad, but there is quite a bit of resistance to the release of information often and that has to be dealt with very carefully.” – FG1, PH

“We use the Software of Excellence medical history and demographic data. Patients fill that in on an iPad, elderly patients or people with visual impairments ... find that very hard to do and our practice manager will sit with them... and patients don’t usually have any problem with giving her their information and she would fill it in on the iPad for them.” – FG1, PI

Other GDPs shared their experience with the use of tablets, and some other GDPs had questions about the feasibility and advantages of the technology:

“We also use an iPad system but I find that misses heaps of stuff off anyway so we’re always asking everybody when they come in but for a list, because I’ve had my patients forever in one practice, we remind them to bring in their list or remind the wives actually, they’re much more reliable [group laughter] or email them in” – FG1, PK

Despite the adoption of tablet technology into the surgery, most GDPs still maintained a paper form that they had developed themselves based on their own practice needs:

“We’ve got our own form... Yes, so it’s fairly basic but it picks up their medications and what they’re taking and then [we] ask them verbally as well because they quite often forget.” – FG1, PC

“We’ve developed them ourselves; we use Software of Excellence... it does warn us [when] it’s time to check medical histories... We don’t scan the paper document in, we just keep the file.” – FG2, PF

4.4.3 Consent for root canal treatment

When GDPs were asked about their informed consent process for RCT, responses were generally similar, regardless of clinical experience or location. GDPs most commonly spend considerable time on the informed consent process, and some included a written consent form. Examples of responses included:

“... A lot of time is spent with a verbal consent. We do have a written consent form as well, and I’m guilty of not always getting people to sign that off. I feel a bit more confident giving it to them now, and should they not wish to sign it, I believe that’s their choice... [But] if I feel like there’s a bit of a difficult patient and tricky case, I won’t hesitate to bring the paper out.” – FG1, PD

“Verbal and written consent [for me]. We use the AAE endo flow chart [American Association of Endodontists Endodontic Case Difficulty Assessment Form] ... going through that chart very quickly and [I] decide whether it’s something that I should be doing... or referring.” – FG1, PF

Commonly, GDPs used the NZDA pamphlet for patient information, and wrote extra details onto it relevant to their treatment:

“I just do verbal consent. I use the NZDA information sheet and I’ll go through that with the patient. I’ll talk about complications that can occur, risks if I’m cutting through a crown, stats on longevity, what we can and can’t expect so it’s a very full verbal, I haven’t any written [forms] other than giving them the NZDA sheet which I’ll also just write on for their specific case, the estimated number of appointments should everything be going well, and an estimate of the cost.” – FG1, PI

“... I tend to talk to them and explain it to them and discuss whether it’s a referral to a specialist or whether to take the tooth out... then I would write down on their file exactly the conversation that we’ve had rather than getting them to sign a form.” – FG2, PD

The potential for fractured instruments was a common complication discussed in more detail:

“... We specifically talk about fractured files because that’s something that we hate happening...” – FG1, PH

GDPs were also asked if they approached the consent process differently for patients who have had RCT in the past. Most regarded the consent process as the same regardless of the patients’ previous experience:

“No... I mean they know the process... that eliminates the fear of the procedure unless they’ve had something really horrible happen...” – FG2, PC

“Probably previously I would’ve just said, ‘okay so you’ve [had] a root canal before, you know what it’s like, you know what the procedure’s like’. And I’ve been caught out because, then I’ve gone to put the rubber dam on, and they’re like, ‘what the heck is that?’ so now they still go through the same conversation about their informed consent and about what the process is like. You just can’t assume.” – FG2, PE

Some GDPs took the opportunity to spend extra time outside the clinical environment, and utilise new technology to make an engaging presentation for patients:

“... We have a consultation room where we look at a PA [periapical radiograph], draw on it, talk about the complications and write it up. There’s a consent form they sign, and we scan it in, and they take a copy home.” – FG2, PK

“CliniPad [Clinical iPad] on Exact’s programme has got an option now that you can have the consent form for different procedures... and the patient digitally signs it and it just goes directly into [the notes]...” – FG2, PF

While verbal consent and explanation was common, some GDPs placed importance on a written consent form that was saved to the patient’s file:

“We also have a written consent form now we’ll go through with the patient... obviously if they’ve got questions, they’re free to ask and they’ll sign it, and we scan it to into their notes.” – FG2, PJ

GDPs agreed that it was important to give the option for patients to see an endodontist, even with cases that did not appear difficult. It was perceived by the GDPs that the specialist would complete the treatment to a higher standard which would increase the prognosis of the tooth:

“I’ll often give the option to see a specialist. I love endo, I do a lot of endo, and I’ll add that into conversation since if I ever needed anything done, I’d probably have it done by the specialist, they do more.” – FG2, PJ

4.4.4 Patient access for root canal treatment; the barriers

Participants identified a variety of barriers for patients receiving RCT in general practice. Most common was the financial cost, fear, as well as the time commitment involved. Common answers included:

“Cost, financial, time commitments” – FG2, PE

“... A lot of it is time and cost, and that’s probably the main barrier.”

– FG1, PC

“... People who are finding it hard to get away from work or from family or who are travelling from a distance, and unrealistic expectations of outcomes.” – FG1,

PF

Although financial and time costs, as well as fear of the RCT procedure were identified as barriers, some dentists cited the lack of positive publicity from online education influencing the patients’ ability to select appropriate treatment.

“Quite often it’s associated with what they’ve heard...”

“There’s also some misinformation that sometimes surfaces in patients’ minds about safety procedure and the materials are used, and of course the longevity of treatment.” – FG1, PH

The viewing of misinformation throughout unverified sources, and the lack of concise, information for patients was identified as a barrier to RCT:

“... I have some patients who’ve gone on Doctor Google or something like that and heard, or they practice alternate health, and make their own toothpaste and don’t use fluoride and they don’t want root fillings ‘cause they’ve heard that they’re bad for you and might cause cancer or something... but there’s something out there that they have this fear about it.” – FG1, PH

One practitioner conveyed potential cultural implications about the preservation of natural teeth with an anecdote from a Pacifica patient:

“Sometimes it’s a cultural thing there to have your teeth out when you have a problem, not to go down any means to save the tooth...” – FG2, PI

Participating GDPs thought that while the number of misinformed patients is concerning, they identified that there has been recent interest with younger patients who want to make informed decisions:

“... [The] perceived success rate that they’ve heard of from other people maybe [acts as a barrier to treatment], and they want to know whether it’s actually gonna work for them for the amount of money that they’re gonna pay for it.”
– FG2, PF

“The other thing I’ve noted more recently [with] slightly younger people is, ‘how long is this going to last? What’s the duration of the expectancy when I get this done?’” – FG1, PG

Some GDPs listed age, illness, and mobility as barriers to RCT:

“... it’s a bit of a constraint for lots of elderly people [if] they’ve got quite bad scoliosis or lung disease, and you can’t lay them back in a chair. So, the actual physical difficulties in doing an endo, and are they up to sitting in a chair that long as well?” – FG1, PK

“Mobility in terms of can they get to surgery [is important for delivery of root canal treatment], what’s their schedule like? Do they travel? And [if] they’re overseas a lot, and the actual physical limitations and of the appointments required” – FG2, PE

4.4.5 Medical conditions of patients receiving root canal treatment

GDPs were asked about the common medical conditions they encountered in general practice and were later questioned about specific diseases that may limit or alter the provision of safe care. Increasingly, patients with chronic illness such as CVD and DM are being treated. Additionally, patients taking bisphosphonate medications and for pharmaceutical management of mental illness is becoming more common. GDPs outlined a variety of more commonly presenting patients and illnesses:

“We see some very healthy patients but then some really unwell patients with a whole range of medical conditions, heart problems, bisphosphonates, you know, all sorts.” – FG1, PE

“From my experience, the first things that come to mind are cardiac issues... asthma next, depressive illness and then probably slightly less common are a lot of GI issues. Gout is a big one, I see it a lot, those are the main ones.” – FG2, PH

“A lot of healthy patients. A lot of smokers and recreational pharmacology in the demographic we have there. A lot of standard chronic illness, high blood pressure, diabetes, osteoporosis, those sorts of things and then some very unwell people, people in the middle of chemo, in the middle of IV bisphosphonates, people who have just had heart attacks, so quite a range.” – FG1, PF

Frequently, GDPs regarded the conditions as a reflection of the age-range of patients in the practice, but there were individual variations within this:

“The young population often nothing, they’re fit and healthy, so we do quite a lot of those.... There’s an 89-year-old I’ve got and he’s amazing and not on anything

and we're doing a root canal on him, so it really does seem to vary. Same things, the antihypertensives, the bisphosphonates..." – FG1, PJ

"Same, diabetes, heart disease, lots of depression, medications and then there's a 92-year-old who's taking nothing. Most, since I've got elderly people, are taking something, or lots." – FG1, PK

"... I see a lot of kids in our practice, asthma and eczema related conditions. Also, ADHD [attention deficit hyperactivity disorder] and the behaviour-related ones because they tend to be the ones that I get referred rather than the easy ones [laughter]." – FG2, PF

Further, dentists had noticed an increased number of patients reporting allergies, especially severe latex reactions:

"We see an increasing numbers of those with latex allergies, [there is one patient] I've treated for ages in her mid-twenties now, and she's [got] such a severe allergy that we referred her in to hospital... She's had anaphylaxis I don't know how many times. She's in resus [resuscitation ward] now [from] the last anaphylactic episode since she hopped into the car with other people who had been blowing up balloons, and that was enough to trigger her." – FG2, PK

Some GDPs doubted the validity of the reported allergies considering them to be more of an adverse reaction than true allergy. Where there was concern, they contacted the patient's medical practitioner:

"I've only seen one true anaphylaxis, latex allergy patient. Everyone else seemed to have some reaction but nothing specific." – FG2, PH

GDPs had some remarks for patients with uncontrolled medical conditions such as DM:

“I’d be very wary of the unstable diabetic with longer appointments, and also severe asthmatics.” – FG1, PC

GDPs were asked about their views on managing patients with epilepsy and how this affected their provision of RCT. Most comments related to the scarcity of the condition and its unlikely potential complications when providing RCT. GDPs suggested establishing a patient’s triggers for a seizure were important:

“Yeah for me pretty rare even though I don’t know if I’ve ever done an endo on someone with epilepsy, I may have. Certainly, discussing do they get any signs? Are they taking any medication? What severity? how often does it happen? That sort of thing and just for general treatment anyway let alone endo.” – FG1, PJ

“We’d just talk about getting stuff out of their mouth quickly, basically.” – FG1, PK

“... I know there are certain factors that can predispose it in a well-controlled patient so endo, fear, anxiety comes into it so they’re trying to manage that aspect of the person’s treatment as much as possible knowing epilepsy and certain anxiety and stress can bring it on.” – FG1, PC

GDPs were asked about how patients’ specific diseases influenced their confidence in providing RCT. While individual conditions arose in conversation, generally, the impression from the Focus Groups was that conditions affecting mobility, ability for patients to recline, and the mechanical factors affecting the procedure directly created the greatest difficulty and reduced their overall work satisfaction:

“... I think it’s related more to the patient, and sometimes with people who are quite healthy, and medications aren’t really an issue, the person themselves makes the issue and you’d rather not do the endo on them. And other people with medications [are fine] ... but it’s things like ‘can they actually lie in the chair for the time?’ ... It’s perhaps that, that might be the limiting factor.” – FG1, PC

“... respiratory is another thing... as well in some of the older patients that just can’t lie back in the chair without coughing frequently and that combined with rubber dam just about makes their life unbearable... [so we need to] weigh that up against the advantage of keeping the tooth versus not in terms of where it is in their mouth so, I try and get them off to see a specialist.” – FG1, PG

“So not so much medications but the conditions leading to the medications perhaps.” – FG1, PH

GDPs also remarked on the physical exertion for the clinician performing RCT on a patient who could not recline, and cope with longer appointments:

“... I’ll be sitting there thinking, ‘how much can my back stand?’ And, ‘can I physically prepare this or am I gonna make myself unwell doing this and not be able to do anything for the rest of the day?’” – FG1, PK

“...But the other one that I find more challenging for myself is if a patient has limitations and how far they can recline, because my back suffers and that’s probably my biggest week to week challenge.” – FG2, PE

The emotional status of patients was also recognised as important when providing RCT:

“Probably the patient’s ability to cope with the treatment is a really big part of it along with long appointments...” – FG1, PE

“... maybe anxiety, having this anxious patient that you have trouble trying to explain to them that you’re putting rubber dam on for their [benefit]... [they] might be finding it a bit invasive, which would really be my concern.” – FG2, PD

Bisphosphonate medication

Patients taking oral bisphosphonates, or regularly receiving the drug through intravenous delivery was a significant topic of group discussion. Patient awareness of the dental effects, both negative and positive were considered important. Additionally, GDPs shared their thoughts regarding treating patients on the medication for RCT, and while they agreed to be wary, they decided that the management of the whole patient took priority over an added risk for dental extractions:

“... I guess the people I see are the ones whose doctors have referred them for a dental consultation before they start the bisphosphonates.” – FG2, PC

“... [The patient] was about to start infusions and hadn’t been advised by their GP that they should get a dental check first, so it’s getting better but still not good.” – FG2, PK

However, one clinician did describe a recent frustrating example more indicative of past interactions with patients on bisphosphonate treatment:

“... generally, not taking the tooth out seems to be the main thing and you can encourage them to keep it and usually they’re of the understanding of that when they tell me they’re on bisphosphonates. Often, they don’t know that that is a

problem, I find that is a big thing with bisphosphonates. [They say], 'I had no idea, I would never have gone on it' ... They find it a bit hard to understand and, 'why wasn't I told?'" – FG1, PJ

The GDPs felt there was a lack of public awareness around the dental risk associated with bisphosphonate therapy:

"Probably about half of them I always think would come along and have been taking either bisphosphonates or [have] been taking, only about half of them actually know there's any dental risk but they don't know what area of dentistry the risk is." – FG2, PF

GDPs were asked if they managed patients on bisphosphonates differently. Generally, they suggested that the decision-making was risk-based, and considered the patients' views after consultation – but ultimately preservation of the natural dentition was the main aim where possible:

"To be honest, the only thing I was aware of bisphosphonates was pushing towards not moving the tooth." – FG2, PI

"I'd be more inclined [to offer] a root canal, than to take the tooth out if that was the case." – FG1, PH

"A lot of our referrals do come in prior to bisphosphonate treatment so I feel like probably I do have quite a big part in trying to help patients understand what that means for them long term as well. But generally, if the patient feels that they can only have the tooth out, then we're not too concerned with the oral bisphosphonates..." – FG1, PE

GDPs outlined the importance of ensuring that the RCT was done to the highest standard for those taking bisphosphonates – often suggesting to the patient that the RCT ought to be completed by a specialist, even if the tooth itself was straightforward or completing the treatment quickly after it was started:

“One thing I do take a little bit more care with is how good of an outcome we give that patient who’s on that medication... and maybe it’s an endodontist who does the treatment and that’s it without having to do it again...” – FG1, PD

“Try keep the tooth, do endodontics, and I wouldn’t want them sitting on the ‘dressing’ for too long, I don’t want any flare-ups because quite a few of my patients get the ‘dressing’ done, and there’s nothing wrong and don’t want to come back.” – FG1, PC

Many GDPs emphasised the importance of individualised risk management for treatment planning. Furthermore, they related this back to their patient’s systemic health:

“It depends how long they’ve been on it and especially what type they’re on, whether it’s intravenous or oral, so I’m more comfortable in the early stages of doing root fillings. It just again depends on their overall health as well.” – FG2, PG

“[Regarding bisphosphonate treatment] it’s very much dependent on whether it’s intravenous or oral and the duration, particularly if it is intravenous or what are they taking for? If it is intravenous... particularly if it’s for malignancy, then you’ve got a whole different set of priorities.” – FG2, PE

Immunocompromised and oncology patients

The GDPs were asked about their thoughts and recommendations regarding patients on long-term oral steroids, or those with a history of, or undergoing oncology treatment. GDPs indicated they were seeing fewer patients on long-term steroid therapy and were largely unaware of any current recommendations for their dental management:

“My impression is that I’m seeing fewer patients on prednisone... and it wouldn’t influence my decision making in terms of endodontic care that much as long as they’re basically healthy...” – FG2, PC

“... I have a number of patients who are on 5 mg, 10 mg and that doesn’t tend to warrant [steroid cover].” – FG2, PG

But there was some general confusion for one younger practitioner:

“I was very confused last year of when to do it or not because I read a study, that one of our senior dentists put me onto and it said the actual risk of anything going wrong is so low that it’s not even worth giving cover [at all]. I have patients on quite high doses and the consensus was there’s no need because the risk of them actually going into [adrenergic] crisis is [so low].” – FG2, PJ

One dentist explained their experiences as very individualised to the specific patient, as different patients will be affected by the treatment differently. One practitioner shared their experience with an oncology patient:

“... each person is different... If it’s quite recent, then they don’t know what’s ahead of them but if they’re mid treatment or towards the end of treatment or beginning, often their care is cyclical and they’ll know when is a good time for

them to come and have treatment... They'll know when they're gonna be feeling their best and it might be just the week before they start their next round of chemo[therapy]. So, I think it's really an individual discussion... the actual patient usually drives what's appropriate.” – FG2, PE

“... [If] they are medically compromised the treatment needs to have a higher success rate perhaps for them.” – FG2, PE

One clinician related some personal experience with difficult decision-making surrounding the risk of osteoradionecrosis:

“I'm comfortable treating patients with oncology problems. Often, they'll come in when they know they've got cancer, they're about to go for treatment, they'll come in and make sure they have a check-up. If they're regular patients, generally there's nothing wrong, and they're really relieved...

The harder ones to deal with I think are the ones who have head and neck radiotherapy. Do you do endo treatment, or do you take them out? I think it's probably a higher risk removing the teeth and you end up with osteonecrosis, than doing the endo treatment... so I tend to veer them that way and they are generally trying to keep as many [teeth] as possible in that situation, trying to make them as comfortable as possible” – FG2, PF

Furthermore, the idea of treating oncology patients with a team approach was put forward to the group and was met with considerable agreement. Utilising the expertise of doctors, specialists and other care providers was vital to delivering a person-centred outcome:

“I'm comfortable treating them. I feel completely out of my depth sometimes, so I use a team approach. I get as much advice as I possibly can from many people

within their team as I possibly can so that we can make the right decision and the right call for them.” – FG2, PG

GDPs said that from a medical standpoint, they would prefer RCT to extraction for most patients:

“... again, compared to extraction, I’m much more happy putting a rubber dam on and playing around in root canals than swinging on teeth.” – FG2, PC

However, one clinician opposed this, citing that due to the time required for RCT, extraction could be preferred depending on the medical condition:

“... It depends how severe it is. From what we saw last year, there was one patient I had who [had] almost everything wrong with him that could be wrong, and he nearly died, and it was just numbing him up to get some teeth out. So, a situation like that I would not even have thought to attempt root canal because he’s obviously not suitable to sit in the chair for a long period of time” – FG2, PJ

GDPs also displayed a sense of caution with treating patients who were medically compromised, even if they felt their patient was okay to receive the care:

“... I probably would verify it with their specialist or their GP just to make sure to get the heads-up on what could go wrong because the patient may have an idea but not a total idea.” – FG2, PD

Prosthetic joint replacements

GDPs were asked about how they managed patients with prosthetic joints when providing RCT, and their responses were varied. Some GDPs based their practice solely

on the current (October 2018) NZDA Code of Practice: Antibiotic prophylaxis for patients with prosthetic joint replacements undergoing dental treatment:

“No, I’ve had no problem adopting the no special treatment approach for joint patients. I mean there are some orthopaedic surgeons early on [that did not agree with the new recommendations from NZDA] but they’re becoming rare now.” –

FG1, PH

While most GDPs knew about this Code of Practice, the majority implemented a tailored approach – respecting the views of the supervising specialist, medical doctor, and that of the patient as well, while considering the perceived risks and benefits:

“Generally for endodontia, I don’t tend to cover for any. But for a joint we have a close association with the orthopaedic surgeons and if they say, ‘[own name], you will’. Then I’ll say, ‘yes Sir’... and generally that’s for two years, the majority of them will say for two.” – FG2, PG

“I don’t any longer. The recommendations I think were that New Zealand is one of the last countries in the world to have stopped giving antibiotic prophylaxis for joint replacements and so I just stopped...” – FG2, PC

“... I just follow the most recent guidelines. I do probably go on the side of caution and do give [antibiotic] prophylaxis if there’s a concern or I’d just get in touch with the specialist or GP.” – FG2, PH

Pregnancy

When asked about how they managed pregnant patients when providing RCT, GDPs were accommodating to minimise perceived risk. There was some concern regarding the

limitation of radiography to reduce scattered radiation doses, and fair concern with staging the treatment to ensure the patient will return to get the procedure completed:

“[When] treating late third trimester patients I don’t like to lie them down so [the treatment] might be [delayed] until after the baby’s born. But perhaps first and second trimester they’re better lying down, but first trimester they’re quite ill, so I try and do second trimester. Otherwise ‘dress’ and wait until after baby’s born.”

– FG1, PC

Although concerns with radiation dose are mostly historical, GDPs chose to make extra effort to reduce this dose:

“[I perform] a lot of open ‘dressings’ with good temporisation until post-partum. [I’m] not too concerned about radiography nowadays at any stage of the pregnancy due to the shield in the machines and after those explanations we have with the patients and the risks, patients seem to understand that.” – FG1, PF

GDPs shared some concern that the likelihood of treatment success would be lower if the treatment was not completed soon after the pulpectomy and medication placement:

“I do tend to ‘dress’ twice during the pregnancy as well then I do kind of a reminder then to come back and finish... I’d see them in their third trimester and hopefully quite soon after the baby’s born as well so usually I don’t just extirpate, leave after... [They will] come and see me before the baby is born for a quick fifteen minutes, irrigate and ‘dress’.” – FG1, PD

“... I do remind them. I say, ‘the longer this stays ‘dressed’, the less the success rate’.” – FG1, PI

4.4.6 General health and root canal treatment

The researcher was interested in the recall timeframes for medically compromised patients. GDPs indicated that their recall protocols were determined by patient risk profiles. GDPs did not change their endodontic recall period based on patients' health status:

“Depending on the person and what they’ve got on they can have a lot of medical problems and not a lot of oral problems, but if they do... especially if it’s periodontal disease, they get a lot more recall and they’re at the hygienist regularly. And does it affect endo... maybe I’d take follow-up X-rays a bit more often just to make sure that it was still good...” – FG1, PJ

“I’ve got patients on one month, three month, four month, six month, and annual recalls. There isn’t a recall per person as such, it depends on their medical history and periodontal disease with one of those complications that makes a recall more frequent.” – FG1, PI

GDPs highlighted the increased caries risk associated with xerostomia:

“If they’ve got dry mouth, definitely they’re on a very close recall and monitoring.” – FG1, PG

“... If they’ve got medical problems that are causing things like dry mouth... then yes [I] would be seeing them more often, but only if they’ve got dental problems as a result of the medical problem.” – FG1, PK

GDPs perceived patients with complex medical needs as having more physical and financial barriers to receiving dental care, which could magnify existing oral health problems:

“Patient focused treatment is what we do, depends on the situation. Unfortunately, [in] my limited experience, the more high needs patients are the ones that can least afford the regular care.” – FG1, PF

*“... I do change recalls with patients that are undergoing chemo and radiotherapy, and get them into more regular recalls as well after that and also how much dentistry they’ve had in the past is taken into account when we decide how frequently we recall them and how heavily restored their mouths are (sic).”
– FG1, PD*

Later in the Focus Group sessions, GDPs were asked about their experiences with patients who expressed concerns about information they had viewed or heard, which indicated RCT could negatively affect their general health. For example, information on social media, via internet search engines, or in response to a Netflix documentary in 2019 entitled ‘Root Cause’, which displayed misleading information on the systemic effects of RCT. GDPs also took the opportunity to discuss patients with alternative health ideas, and the difficult conversations they have had over the years. Despite the misinformation, GDPs were empathetic towards the patients’ opinions, and sought to respectfully advise them as part of the informed consent process:

“I haven’t had anyone ask me about ‘Root Cause’. I didn’t know about it either, but I do have patients that have heard that root canals are dangerous to their health.” – FG1, PI

“... People do bring it up now and again, but not very often. It’s either a matter of you having to persuade them that what they’ve heard or read, it’s not a serious issue and that they can safely take the root canal therapy or not. Often their minds are pretty closed and made up... they’d rather not have a dead pulp and have the tooth removed.” – FG1, PH

“I’ve had a few patients concerned about the systemic health effects of root canal treatment. In most cases, they can be reassured through discussion.”
– FG1, PF

“... Google is very prevalent, especially with the idea of the potential that this is going to be toxic in my body... time and historic thoughts of what has happened to family members in the past.” – FG2, PG

Unfortunately, some stated unscientific views from other health professionals in the area they practice in as influencing patients’ decision-making:

“I can think of two dentists who are actually not convinced about root canal treatment so the whole [professional] body is not on board with it – just as an aside.” – FG1, PK

Patients with alternative ideas towards RCT tended to be middle-aged, but also prevalent were younger patients who were especially health-conscious:

“The educated middle [aged]...” – FG2, PC

“... Not quite for root canals but I’ve had similar discussion about fluoride, but the age group ... tends to be in the 20s, quite young. They happen to also be

vegan, sugar free, dairy free or everything free, that's the sort of demographic."

– FG2, PH

4.4.7 Continuing professional development and interprofessional communication

In the final part of the Focus Group interviews, the GDPs were invited to talk about their CPD experiences, particularly with regards to managing patients with medical conditions in general practice. This did not include mandatory basic life support training. There was agreement that general medicine is advancing at speed and more CPD in this area would be beneficial to their safe practice. The NZDA News (quarterly magazine) was identified as valuable for providing updates. Younger graduates said that undergraduate teaching was limited for managing medically compromised patients, and most GDPs felt that the speed of medical advancement was outpacing their knowledge:

"I think that I need CPD... I would've gone to that pharmacy update lecture they've got on at the moment, but it didn't fit in with my timetable and I still would quite like to..." – FG1, PK

"I'd love to do a CPD course on medications and medically compromised patients... Definitely need more." – FG1, PK

"There's the NZDA News [that] often has something in it, they've done an article about the modern blood thinners and... the New Zealand Dental Journal often has articles as well so that would be where I'd get more information from."

– FG1, PI

“Around this time last year, I finished my membership with RACDS [Royal Australasian College of Dental Surgeons] ... and there was a module for that because there was some medicine and therapeutics.” – FG2, PE

The ability to keep up with advances in medical diagnosis and treatment was concerning for general dentists:

“I went to a course... which was fantastic... That helped clarify things a lot for me ‘cause I was feeling a little bit ‘at sea’ and getting my MIMS [Monthly Index of Medical Specialties] out every second patient and trying not to look a fool... it’s changing faster than we can keep up really and as dentists, we’re not GPs, we don’t have all that wide knowledge.” – FG1, PG

“... it needs to be more regular, like we do our CPR [cardiopulmonary resuscitation] every two years, I feel like... it would be great to... have some sort of a document that’s distributed to dentists on a two yearly basis with relevance to dentistry so that if we don’t have time to go to a course, we’ve something that we can achieve over time to read and know we are up-to-date... It’s quite scary with all these medications coming in and how they work and how they affect what we do.” – FG1, PE

The location of a CPD course impacts on the GDPs’ ability to engage. Busy schedules and other commitments make attendance difficult for those practicing outside of main centres:

“... They’re always Auckland, Wellington, Christchurch so it makes it a lot harder.” – FG1, PJ

The GDPs were also asked about online CPD courses, and were generally hesitant on their value:

“... We want to make sure we’re actually getting accurate information across, not just finding someone random [course] with it and is it supported by NZDA? A lot of companies are trying to make money off online CPD points.” – FG1, PD

Recently graduated dentists indicated that CPD was less of a priority:

“So, I haven’t done anything outside of work but last year, I guess working in the hospital was kind of CPD every day...” – FG2, PJ

Nevertheless, most indicated that more CPD in managing dental patients with medical conditions would be of interest to them:

“I think there’s an awareness amongst people providing courses that it is, there is a demand for it or a need for it which I don’t think it has been acknowledged quite as much in the past.” – FG, PC

One clinician explained the benefits of a new dental practice with close associations to other medical professionals:

“I’m really fortunate in that the practice where I work is connected to a GP, a pharmacy, we’ve got acupuncture and a clinical psychologist – quite an integrated care centre... if we have queries or when I’m up in the tea room, I can tap [the doctor] on the shoulders [and ask], ‘what do you think?’ That’s a really free and easy way to make sure the consent issues are covered and I did have one particular patient where I was really concerned about her ability to consent and

thankfully I know that her GP [is] in the next room so the doctor could reassure that she is fine to consent... so that's really convenient." – FG2, PE

Again, GDPs outlined that sometimes it was challenging to get information from medical colleagues. However, with some persistence, the GDPs indicated that it would happen eventually, but could delay providing treatment on the day for patients:

"We don't have any problems working or getting in touch with GPs or specialists at the hospital. If I do speak to them, it would be verbally then it does take a bit of time but usually just we can leave it as an email." – FG1, PH

4.5 Discussion

The insights gained from interviewing a range of GDPs of varying experience and expertise was invaluable for providing context in understanding how GDPs manage patients with medical conditions. While providing an in-depth perspective on their daily practice and discussing their thoughts openly with other GDPs, participants in the Focus Group interviews emphasised the importance of thorough communication, understanding patients, and developing individualised care plans. Not only did they provide rich feedback related to CPD, the act of participating with like-minded colleagues for a day of discussion strengthened professional relationships across NZ.

Demographic information of practitioners and patients

The demographics of the GDPs and the patients that they treat were reflected in their experience and time since graduation. The more senior GDPs in long-established practices stated that their patients were ageing along with them, and the complexity of the RCT required was increasing. It was rare for the GDPs to treat simple single-called

teeth, and most of their patients required RCT due to the cumulative replacement of restorations over Fa lifetime.

The complexity of providing RCT on heavily restored teeth in older patients necessitates more specialist endodontist referrals for many GDPs. Changes to the pulp-dentine complex, such as the dimensions of the pulp space reducing over time due to deposition of secondary and tertiary dentine can pose practical challenges for the clinician (Johnstone & Parashos 2015). Historically, in a private practice in Australia, specialist referrals were mostly comprised of management of pain, calcified/blocked canals, and endodontic retreatment (Abbott 1994). Amongst a group of Dutch general GDPs, there was a substantial perceived need for referring endodontic cases to specialists, specifically regarding the presence of an obstruction in the canal, followed by the presence of a perforation or resorption (Ree et al. 2003). Little recent research has been gathered regarding recent referral patterns, which is likely to have considerably changed due to changes in edentulism trends (Thomson 2012) and the dental workforce in NZ (Dental Council of New Zealand 2017).

The American Association of Endodontists provides a case difficulty assessment form to help general dentists and students treat cases within their expertise or refer advanced cases to reduce the risk of iatrogenic errors (American Association of Endodontists 2019). Since evidence exists that poorer outcomes may be associated with increased difficulty, referral should be considered for more difficult clinical scenarios (Shah & Chong 2018; Fezai & Al-Salehi 2019; Shah et al. 2020). Additionally, the endodontic complexity assessment tool (E-CAT), recently developed in at the University of Liverpool in the UK, provides an efficient and reliable platform to assess the complexity of RCT (Essam 2018). Furthermore, literature from the UK suggests that referral to an

endodontic specialist is not always due to difficulty alone. GDPs often feel that complex endodontic treatments are financially unviable due to the length of time required to complete them successfully (Davies & MacFarlane 2010). Recently, educational benefits to undergraduate students were assessed with two different case difficulty assessments and proved to be reliable in helping with decisions to treat or refer (Shah et al. 2020). More research is required to test the reliability of assessment tools for endodontic referral in NZ to help with the guidance of appropriate patient referral for RCT.

Collection of health information

Despite the wide ranges of GDP experience and practice location for GDPs in the Focus Groups, all were resourceful and solution-oriented when it came to gathering medical information. Although there was no consensus on the frequency and method of collection of the data, GDPs strove for accurate information to make informed decisions on treatment for their patients.

According to the Health Information Privacy Code 1994, all health information is confidential and sensitive (Privacy Commissioner NZ 2017). While the NZ Code of practice specifies: “A concise and relevant signed medical history which is updated at appropriate intervals” must be taken (Dental Council of New Zealand 2018b), it does not mandate a particular time-frame for regular re-collection. In Australia, relevant medical and dental history must be clearly updated and documented at each appointment (Australian Dental Association 2018). In the UK, dentists must make and keep complete and accurate patient records, including an up-to-date medical history, each time that a patient is treated (General Dental Council 2019).

Additionally, health information must be collected directly from the patient concerned where possible (Dental Council of New Zealand 2018b). Dental practitioners should be careful to ensure permission has been granted from the patient when information is collected from another source such as their medical practitioner, and not requested for completeness or if the dentist is doubtful of the accuracy of the information provided. The practitioner must also “recognise and respect the patient’s right not to supply any requested information” (Dental Council of New Zealand 2018b).

Many GDPs in the Focus Group interviews said that their practice has transitioned into digital upkeep of patient records, including medical information. Indeed, it has been demonstrated that the trend towards increased adoption of electronic records in the USA is continuing, potentially making more data in electronic form available for research (Schleyer et al. 2013). The responsible clinician however must take into consideration the implications regarding privacy of this information and should be cautious if non-clinical staff members are entering this information on behalf of patients.

It was common for the patient-centred culture of a dental practice to extend to the community with relationships between different health providers, such as pharmacies and medical practices, facilitating safe delivery of care.

Consent for root canal treatment

GDPs were aware of their obligations under the New Zealand Dental Council Codes of Practice: effective communication, provision of information, empowering patients to make an informed choice and to give informed consent (Dental Council of New Zealand 2016; 2018c). The informed consent process acknowledges patients’ rights to autonomy and freedom of choice – it recognises that patients have the right to make their own

decisions about their health taking into account their own beliefs and values, their culture and family life, and make choices which are most appropriate to their own circumstances (Dental Council of New Zealand 2018c). It also specifies that if treatment is wrongly provided that has not been consented to, the informed consent that was obtained is not considered ‘valid’, which implies that an ongoing process of communication is required between the GDP and patient, keeping them fully informed regarding their condition and the progress of treatment (Dental Council of New Zealand 2018c).

Particular attention is made in the Code of Practice to ensuring different options are available to patients, prognosis is discussed, and advising that separated instruments are a risk during treatment (Dental Council of New Zealand 2016; 2018c). While there were a variety of methods of attaining informed consent, GDPs employed their own personal strategies to communicate effectively for their patients’ wellbeing. Although signed and written consent forms were not unanimously used among the Groups, they were perceived as being sensible and appropriate for most RCT, especially where success was expected to be lower than average, or if significant risks were associated.

The Informed Consent Practice Standard (Dental Council of New Zealand 2018c) does not specify that all RCT requires a written consent:

“Oral consent is considered sufficient when minor procedures are involved in the patient’s care, and no sedation or general anaesthesia is used. Written consent is advisable when the patient’s care is complex and/or major procedures are involved; and is required in specific circumstances:

- If the patient is to participate in any research; or
- the procedure is experimental; or
- the patient will be sedated or under a general anaesthetic; or

- there is a significant risk of adverse effects on the patient.”

(Dental Council of New Zealand 2018c)

In the USA, despite different laws across states, emphasis is placed on a written consent form being used in addition to a thoughtful, well-documented dialogue between the practitioner and the patient (American Association of Endodontists 2020). Like NZ, the Australian Dental Association Guidelines for Consent for Care in Dentistry state that:

“Whenever in doubt about whether a procedure is major or minor, written consent should be obtained. An appropriate alternative may be to have adequately written records of the information given, shown to and initialed by the patient. The signed consent form, whilst a useful tool, is not conclusive”

(Australian Dental Association 2019)

While some RCT could be deemed a minor procedure, most treatment is technically demanding of any experienced GDP and written consent should be considered. This would be especially true if the tooth to be treated is complex, has compromised restorability, or the roots are close to other anatomical structures that could result in complications, such as the maxillary sinus, or inferior alveolar canal. The Council also regards consent as an ongoing requirement; “You must ensure informed consent remains valid throughout the period of care.” (Dental Council of New Zealand 2018c), emphasising the importance of ongoing dialogue between the clinician and patient across multiple visits for RCT. Importance was placed on patients making their own informed decisions and discussing the aspects of the treatment that were most relevant to them with GDPs.

Patient access for root canal treatment; the barriers

While the perceived barriers expressed by the GDPs were often cost, fear, and potential longevity of the procedure, GDPs suggested that no one barrier was synonymous for all patients, and a bespoke consultation was always required. Consistently, GDPs conveyed that they were happy to spend considerable time discussing the RCT procedure with patients. In other studies, attitudes influencing dental attendance patterns such as anxiety, cost of treatment, value placed on restored teeth, and beliefs regarding the importance of regular dental attendance all acted as significant barriers for patients to receiving appropriate dental care (Abrahamsson et al. 2001; Bagewitz et al. 2002). These factors were discussed in the Focus Groups, but cost was frequently suggested as a common barrier for RCT, and largely because most dental care is privately funded in NZ.

Medical conditions of patients receiving root canal treatment

GDPs in the Focus Groups were proactive in identifying relevant medical conditions that may influence RCT. CVD and DM are increasingly important public health concerns that meet the fundamental criteria for effective screening in dental practice. Since a significant proportion of people are unaware of their chronic disease (Greenberg et al. 2010), it is reassuring that some GDPs are screening for chronic illnesses, despite the cost and time constraints involved for their practice. It was common for the dentists to provide a customised approach to the individual patient and it was considered by the Groups that no particular medical condition seemed to outweigh the influence on RCT of mobility, and the physical limitations of being in a dental chair for a longer procedure.

The GDPs were aware of current recommendations concerning prosthetic joints. Despite the theoretical risk of oral organisms from a dental procedure-induced bacteraemia

infecting a prosthetic joint (LaPorte et al. 1999), the likelihood of bacteraemia from an oral source occurring from normal activities such as eating and performing oral hygiene are probably just as frequent (Uckay et al. 2008), deeming the merits of antibiotic prophylaxis to be questionable. Some GDPs provide antibiotics in certain circumstances, such as for those who have had repeat orthopaedic surgeries due to complications, or where recommendation was given from the orthopaedic surgeon. This is supported by international literature, where global reductions of antibiotic prophylaxis are occurring, there are circumstances in which it is still warranted (American Association of Endodontists 2017; Segura-Egea et al. 2017; Segura-Egea et al. 2018). GDPs in the Focus Group interviews were proactive in contacting relevant medical specialists for advice on how to safely proceed with treating a patient who is medically compromised, and when guidelines did not exist for management, or they were unsure.

Epileptic seizures are the second most common medical incident in dental surgeries in Australia (Chapman 1997). In NZ, more than one quarter of GDPs have encountered a grand mal seizure or status epilepticus in general practice within a 10-year period, so there is a risk when providing RCT to patients with this condition (Broadbent & Thomson 2001). Characterised as a neurological disorder marked by sudden recurrent episodes of sensory disturbance, loss of consciousness, or convulsions, associated with abnormal electrical activity in the brain (Fisher et al. 2005), epileptic patients were reportedly managed with confidence by participating GDPs. Stress is one of the most important factors that provoke epileptic seizures and this can be common in the dental environment (Mehmet 2012). Stress-causing factors should be mitigated before commencing the treatment, and sessions should be kept short. Sudden stimuli such as shimmering bright lights and extreme noise should be also be avoided (Fiske & Boyle 2002). Furthermore, even though patients may be taking regular medication, if more than one seizure is still

occurring per month, their treatment should be postponed unless it is urgent (Mehmet 2012). GDPs in the Focus Group interviews felt that if predisposing factors could be understood, then the likelihood of a seizure could be lessened. Lastly, this may also relate to the theme of practitioner confidence and 'control' of illness through medications, as for CVD and DM.

It has been reported that despite most NZ GDPs believing that the dental setting poses a risk of adrenal crisis for patients taking corticosteroids, there is confusion among dentists in identifying at-risk patients and their ability to manage an event, if it was to occur (Coetzee et al. 2016). This was certainly the case within our Focus Group discussions. There is a need for evidence-based guidelines to be formulated by an expert panel for dissemination amongst the profession (Coetzee et al. 2016).

GDPs managed patients taking bisphosphonate medications using an individualised and risk-based approach. This is supported in the literature, but there is considerable debate as to what risks exist, and what protocols are appropriate (Tanna et al. 2017). GDPs in our Focus Group interviews were aware of the increased likelihood for MRONJ occurring in those on the medication for long periods, with IV doses, and for those with contributory immunocompromisation as supported by literature (Mozzati et al. 2012; Yamazaki et al. 2012; Scoletta et al. 2013). GDPs aimed to retain the natural dentition where possible when patients were taking these medications, with referral to an endodontic specialist often considered for a perceived improved prognosis. This is partly supported by more recent literature (Burry et al. 2016), but is debatable at high levels of evidence (Ng et al. 2008), and may be related to GDPs wanting to shift responsibility to another practitioner in case of adverse outcomes if they provided the primary RCT.

The potential for MRONJ to occur following routine RCT was not discussed by the GDPs in the Focus Group interviews. The role played by the dental dam clamp as a trigger has been questioned in literature and in case reports, even when a patient was on oral bisphosphonates for five years (Nase & Suzuki 2006; Gallego et al. 2011). It therefore appears prudent to avoid any damage to the gingival tissues during tooth isolation and caries excavation. This information needs to be delivered to GDPs in NZ via appropriate CPD.

There was significant discussion around patient awareness and bisphosphonate education amongst dentists, the medical profession, and the public. GDPs stated that patients were now more aware of a potential adverse relationship between dental treatment and taking bisphosphonates but were unsure about what procedures put them at risk. Only 32% of patients that received IV bisphosphonate treatment were aware of the possible risks of developing MRONJ in a European survey (Bauer et al. 2012). In a study of 192 medical GDPs in Seoul (South Korea), 21.9 % had not heard of MRONJ and dental referrals made by medical doctors were implemented in less than 30% of the patients in the survey (Kim et al. 2016).

Conversely, it is important to consider the effects on morbidity and quality of life if a patient with osteoporosis or metastatic bone disease were to have an avoidable skeletal fracture due to low bone-mineral density, as bisphosphonates have been shown to be effective in preventing this (Coleman 2001; Chesnut III et al. 2004). GDPs in the Focus Groups understood that, although there were adverse effects of bisphosphonate treatment, it was vital to consider the wellbeing of the whole patient, and not just their dentition. Despite the impaired bone remodeling caused by these medications, a retrospective study suggested that patients taking long-term oral bisphosphonates can

expect a satisfactory outcome with evidence of periradicular healing after RCT (Hsiao et al. 2009). While NZ data is lacking research in this area, more awareness of the potential detrimental effects of these medications to patients is needed amongst patients and medical professionals.

In the Focus Group interviews, GDPs were eager to commence RCT in pregnant patients for relief of pain and infection, but were generally hesitant around completing the treatment – and would often schedule the obturation and tooth restoration phase after the child was born. However, data shows that women who receive tooth restorations or who undergo extractions or RCT during the second trimester of pregnancy do not experience higher rates of adverse birth outcomes compared with women who do not undergo these dental treatments (Michalowicz et al. 2008).

The use of ionising radiation is required for diagnosis and to check the quality of instrumentation and obturation when performing RCT. It is expected that there is a one-percent increase in congenital abnormalities after an exposure of 100 mSv of foetal dose (Scarfe et al. 2009). Usually, single bitewing or periapical radiography is approximately 0.005 mSv (depending on settings), a panoramic radiograph 0.007 – 0.010 mSv and cone-beam computed tomography scans vary considerably at 2-4 mSv depending on the field of view and machine used (Radiological Society of North America 2020). Since even high single diagnostic doses are always much less than 100 mSv in dentistry, such abnormalities cannot be attributed to usual dental diagnostic doses (Lowe 2004; Razi et al. 2011). However, no radiographic procedure should be carried out on any patient unless necessary, which is the likely justification for GDPs' caution in completing RCT.

Other medications to manage pain and to gain sufficient anaesthesia must be used if RCT is to be performed adequately on a pregnant patient. Few clinical drug trials have

included pregnant women, therefore the best available evidence of these medications is successful long-term clinical use without adverse effects (Steinberg et al. 2013). Traditional, reliable anaesthetics and medications that have a well-documented history of low incidence of adverse effects should be used. Examples include local anaesthetics such as lidocaine/lignocaine 2% with 1:80,000 or 1:100,000 adrenaline and mepivacaine 3% (American Dental Association 2019). Antibiotics (if absolutely necessary) such as penicillin, amoxicillin, and clindamycin; and short-term use of analgesics such as paracetamol are appropriate for the pregnant patient, but non-steroidal anti-inflammatories should be avoided (American Dental Association 2019). When considering prescribing in pregnancy, the dentist must weigh the risk to the foetus versus the benefit to the mother, and the appropriate conclusion should reflect current evidence (Donaldson & Goodchild 2012).

General health and root canal treatment

GDPs displayed a holistic, patient-centric view of 'health' in Focus Group interview discussions relevant to dentistry. Given the current research suggesting a possible relationship between dental health and systemic health (Berlin-Broner et al. 2017), practitioner awareness of this concept was reassuring. In a study of residents of a retirement community, both self-rated general health and self-rated oral health independently explained a significant variance in ratings of self-esteem and life satisfaction (Benyamini et al. 2004), which may imply that as patients age, the value of retention of natural teeth is important.

GDPs did not explicitly discuss any views of chronic disease modulating the effects of endodontic disease but did mention the effects of medications and oral health complications. Particularly, the effects of polypharmacy and an increase in dental caries

is supported in literature and was mentioned in the discussions (Singh & Papas 2014). The recalls in place for patients were not specifically defined for medically compromised patients but based on a personal risk assessment.

It was noteworthy that the GDPs agreed that those at greatest oral disease risk were least likely to be in a position where the improved upkeep of their dentition was possible. Whether this was due to patients' medical conditions limiting their attendance or for financial reasons is also supported in the literature, and the commonality between shared risk factors of general health and oral health is apparent (Sheiham & Watt 2000). Although a direct causal link between systemic health and oral health has not been determined, universal risk factors exist (Sheiham & Watt 2000; Petersen 2003; Sheiham 2005).

Non-scientific information is replete within the general public. Regrettably, some of its sources anecdotally stem from within the dental profession as described in the Focus Group interviews. While the recent Netflix[®] documentary 'Root Cause' may have initiated some resurgence in patients' hesitation for RCT, the GDPs indicated that people with these ideas have always been present. In the interviews, GDPs explained that if approached respectfully, GDPs were confident in reducing patients' fears towards non-scientific facts with individualised discussion. They clarified that often the patients were simply confused about the conflicting information they have heard and wanted to be reassured by a professional.

The use of complementary and alternative medicine treatments in dentistry should be based on evidence of effectiveness and safety as demonstrated in randomised clinical trials. Empirical research should focus on whether alternative medicine and conventional treatments that are demonstrated to be no better than placebo may still have therapeutic

value, provided that their risks are minor (Miller et al. 2004). Dentists should only use treatment procedures that have been established to be effective and with minimal risks involved to patients (Dental Council of New Zealand 2018a).

Continuing professional development and interprofessional communication

The GDPs in the Focus Groups acknowledged that further CPD relating to the management of medical conditions in general dental practice would be valuable. Literature surrounding CPD efficiency suggests that courses can result in widespread new learning and considerable self-reported change in practice. Implementation of continued CPD is an important element of learning during the working life of a dentist, particularly when the demands on professionals change frequently, procedures become increasingly sophisticated, and patients' expectations of standards of service rise (Belfield et al. 2001). However, significant barriers to implementing change in workplace practice were noted and included availability of materials, resources, and support from colleagues (Barnes et al. 2013). Noteworthy was the tendency for CPD courses to be in selected main centres only, with participating GDPs outlining issues with travelling for attendance and lack of available time – an issue not unique to NZ (Nayak et al. 2015). The internet and e-learning are common methods of dental CPD, particularly among younger dentists (Barnes et al. 2013). However, GDPs in the Focus Group interviews reflected that they were unsure of online CPD validity and would prefer information directly from the NZDA or other reputable sources in NZ. CPD is considered important by dental GDPs but needs to be relevant. The value of developing continuing education related to managing medically compromised patients and RCT has been highlighted by this research.

Communication with DHBs varied around NZ, but information was accessible if the dentist had time available to make telephone calls and wait for returned facsimiles or emails. On occasion, GDPs felt that communication back from DHBs could be improved.

Future directions

In future, it may be useful to expand the Focus Groups to include patients and semi-structured group interviews (via Zoom[®] or Skype[®]) with a larger number of dentists to ensure participation of GDPs unable to travel to Dunedin for this research.

4.6 Conclusion

Rich insights into daily practice were gained from a range of dentists in the Focus Group interviews. Despite participating GDPs displaying a varied consent process for RCT, patient medical information was unanimously collected regularly and there were thorough processes in place for documentation.

GDPs rated the ability for patients to cope with the RCT procedure (such as mobility, ability to recline, and limited mouth opening) more important than associated medical conditions, particularly for patients whose diseases were well controlled. Severely immunocompromised patients were not especially common when providing RCT, but the experience gained was highly individualised and leaves a lasting impression on GDPs' practice. The development of CPD activities addressing the management of medical conditions in dentistry, with an emphasis on updating GDPs' knowledge on ever-changing pharmacology is wanted and warranted.

This qualitative research highlights the value of knowledgeable and attentive GDPs sharing information on their daily practicing strategies and strengthens the information

gained in the PBRN survey of practitioners and patients (Chapter 3). Intuition and thorough communication were paramount to providing a person-centred approach for consent, and management of patients for RCT.

Chapter 5

Final Discussion & Conclusion

5.1 Introduction

Common risk factors confuse an incompletely understood relationship between systemic health and oral health. The dental workforce in NZ is changing, and GDPs are seeing increased numbers of older patients and those with polypharmacy or excessive polypharmacy. In parallel to managing more medically compromised patients, GDPs today must provide technically challenging RCT, on teeth that are frequently heavily restored.

This research aimed to investigate the demographic characteristics of dentists within a PBRN providing RCT in general practice; their self-perceived confidence and competence managing patients presenting with a range of medical conditions when presenting for RCT in general dental practice; their engagement in CPD activities related to endodontics and medical problems in dentistry; the demographic characteristics of their patients receiving RCT from general dentists throughout NZ; and the dental experiences and self-perceived general health status of patients receiving RCT.

It was hypothesised that there are differences in perceptions and endodontic practices of NZ GDPs when managing patients with a range of health status, which are influenced by practitioner demographics, experience, and CPD activities. Additionally, patients requiring RCT were expected to have a range of health conditions, and the decision to proceed with treatment will be influenced by their demographic characteristics and dental awareness.

5.2 Demographic Characteristics of New Zealand Dentists

This research engaged a wide variety of GDPs in clinical research. It delivered rich findings which can contribute to the body of knowledge translating to clinical practice in

NZ. Not unexpectedly, this research has shown that dentists from main centres have support networks from endodontists, other health professionals, and DHBs to support patient care. Useful findings have been uncovered surrounding the management of chronically ill patients where endodontic referral is not an easy option, particularly in rural NZ. In a study from the USA, significantly more rural dentists report lack of appropriate referral options as a barrier to providing successful treatment (Wilder et al. 2014). Additionally, patients from a rural setting report less routine attendance, are less likely to have comprehensive dental insurance, and attend more emergency visits in the USA (Heaton et al. 2004). Patients living in remote locations in Australia incurred significantly higher indirect costs associated with dental treatment and higher mean decayed, missing or filled tooth surfaces (DMFS) scores (Curtis et al. 2007). While it is unlikely that many of the patients who participated in this research have significant distance to travel for general care, some areas of rural NZ such as the West Coast of the South Island have very few dentists. Access to specialist care can be daunting for many patients in NZ and could directly influence treatment selection preferences due to the increased cost of travel and time away from work.

As hypothesised, there were indeed differing perceptions and RCT practices throughout NZ. These especially were related to the practice location, and years of experience. Typically, senior GDPs would treat those similar to their own age more frequently than younger GDPs – and the dentists who had recently entered the workforce typically saw more emergencies and treated fewer routine attenders.

Dentists sampled for the PBRN survey were not strictly representative of NZ's dental workforce. Attempts were made to capture participants who had varied experience and practice knowledge in the purposeful sampling of Focus Groups. This information

provided insight into the daily management for patients having RCT and proved to be informative for identifying ‘gaps’ in currently available CPD activities.

5.3 Confidence and Competence of New Zealand Dentists Managing Patients with Chronic Illness

Dentists in general practice have an important role in the identification and monitoring of chronic diseases. The frequency of dental visits by patients is often much greater than their attendance with their medical doctor, which provides the opportunity for GDPs to promote health and wellbeing. This research has shown that GDPs across the Pilot, PBRN survey and Focus Group interviews were largely confident in managing most chronic medical conditions. Of note, frequently encountered and measurable chronic illnesses such as CVD and DM were not commonly of concern when providing RCT or any dental treatment. Rarer illnesses or medical conditions such as those undergoing oncology treatment, and those with reduced mobility or acceptance of dental treatment were consistently rated as reducing confidence when providing any dental care. Repeatedly, many rated patient-related factors such as the ability to recline, keep the mouth open for longer periods, and tolerate the dental dam as impacting the delivery of RCT. GDPs also reported decreased work satisfaction when treating challenging patients and experienced increased musculoskeletal pain resulting from working in these circumstances, as supported by other literature (Alexopoulos et al. 2004; Morse et al. 2010; Dahlström et al. 2017).

Despite many GDPs reporting less confidence with treating patients with mental illness, it can be extrapolated that GDPs were not concerned by those on regular management for depression. They were however concerned with the inability to give consent, and those with the inability to perform their own oral hygiene who may be in institutionalised

care. This group of patients have higher rates of dental disease and unmet treatment need (Friedlander et al. 2003).

Discussion around bisphosphonate medications were common throughout this research, with GDPs being aware of the increased likelihood for MRONJ if patients were to have extractions. GDPs reported that they would try to avoid extractions wherever possible, even if risk was perceived to be low. Additionally, they were generally conscious of the risk factors for increasing the likelihood of MRONJ, such as those on the medication for long periods, with IV doses, and for those with contributory immunocompromisation (Mozzati et al. 2012; Yamazaki et al. 2012; Scoletta et al. 2013). In general, although GDPs were confident in managing these patients, they preferred specialist referral where possible.

Overall, GDPs in the Pilot, PBRN survey, and Focus Group interviews felt largely well-informed about the effects of chronic systemic illness on oral health and factors relating to RCT. However, they were not confident in therapeutic management and how this affected their dental treatment, which reinforces the need for CPD in this area. Further, not all demonstrated evidence-based understanding. For example, the association between DM and endodontic failure, and understanding the role of glycaemic control was not completely understood. While there may be some prognostic difference prior to treatment commencement, T2 DM is significantly associated with an increased prevalence of periapical radiolucencies (Ng et al. 2008; Segura-Egea et al. 2016). If RCT is performed to a high clinical standard, a successful outcome should be probable, but healing could take an extended time depending on the patient's disease status (Segura-Egea et al. 2016).

5.4 Engagement of New Zealand Dentists in Continuing Professional Development

Life-long learning and engagement with CPD is a core competency for practice in NZ (Dental Council of New Zealand 2016). GDPs in all aspects of the research highlighted the importance of delivery of appropriate and reputable CPD that is directly relevant. GDPs in rural areas outlined how CPD course are becoming increasingly confined to main centres such as Auckland, Wellington, and Christchurch – citing their limitations to travel due to cost and time away from work.

When not confident in managing a patient, it was common for experienced GDPs to request assistance from dental specialists or medical doctors, whereas less experienced dentists would first turn to their senior colleagues for guidance. In USA and Australian dental schools, findings suggested that mentoring was a critical factor in a junior dentist's experience in entering and settling into a career in dentistry (Bartle et al. 2020). At the University of California in San Francisco, having a mentor was associated with greater satisfaction with time allocation at work compared with those without (Feldman et al. 2010).

GDPs called for recent updates on pharmaceutical management of patients with illness, and more guideline documents detailing recommended management strategies in easily digestible formats. It was also acknowledged that with the increasing number of older patients and those with medical complications, the technical difficulty of routine RCT was becoming demanding and more CPD with a focus on improving the endodontic skillset for GDPs would be valuable. Furthermore, most practitioners requested more access to appropriate CPD relating to advances in pharmaceutical management of patients with chronic illness.

5.5 Demographic Characteristics of Patients Receiving RCT

There is some limitation with the translatability of patients who participated in the PBRN survey to general practice in NZ. Due to the purposeful sampling employed in selecting the ages of patients for the Pilot study, many statistics with the PBRN survey are not comparable. Also, due to the considerable numbers of South Island and rural participating practices, it is likely that the ethnic and age details of patients are quite different, especially in main centres across NZ.

Little insight was gained into presenting conditions for all patients attending the dentist in NZ, since participating patients would already have selected RCT as their treatment option of choice. Because of this, more routine attenders, and patients with fewer barriers to dental care participated in the survey than if all dental patients in NZ were surveyed. Patients receiving treatment via DHB centres or in long-term residential care were likely not included since this research took place in GDP's private practices. This could be an interesting area for future research to see how these patients' perspectives on RCT differ.

5.6 Dental Experiences and Self-perceived Health Status of Patients Receiving RCT

Despite some shortcomings with demographic data, this research provides insight into the patient RCT experience, self-reported oral health, and general health of a large group of patients from selected general practices. Patients and dentists shared similar beliefs surrounding the selection of RCT over extraction which may suggest some bias in dentists' participation being related to an interest in endodontics. Retaining teeth has commonly been reported as the primary reason patients opt for RCT, as well as the reason

for their satisfaction with the treatment when compared to extraction and implant therapy (Gatten et al. 2011).

Even though a wide range of pre- and post-operative pain experiences were extensively detailed, this was contextualised by the response of the treating practitioner and the dental team. This revealed that even though significant pain was rarely associated before or after the RCT, educated patients who had received preoperative information about the procedure were able to prepare themselves for this and still rated their treatment experience positively. The role of patient education in dental procedures has shown an increased patient understanding, reduction in post-operative complications, and a reduction in patient anxiety in other literature (Armfield & Heaton 2013).

Typically, patients rated their oral health by referring to their past dental experiences and information provided by their dentist. Conversely, perceptions of general health were frequently attributed to personal habits, diet, exercise, and beliefs – not commonly information provided by the patients' medical doctor. The patient health data collected was self-reported, which may be considered a weakness of the study but was an important first step in adding to the body of knowledge in this area. Research with a modified study design and involving other health professionals may be considered in future.

As hypothesised, patients presenting for RCT had a wide range of health status and this exemplifies the importance of the dentist's understanding of basic general medicine and the impact on care. Patients provided a variety of reasons for choosing RCT over extraction, but predominantly, the retention of natural teeth and the associated effects of this (function and aesthetics) were the main reasons.

5.7 Clinical Recommendations for Managing Patients with Chronic Illness for RCT

Based on the extensive information provided by patients about the RCT experience, a list of recommendations for safe and considerate treatment has been collected. This, and other information from the research can be utilised to inform CPD for general practitioners performing RCT in general practice for all patients, but with emphasis on those with chronic illnesses:

- Proper screening and monitoring of medical conditions is important, especially for conditions which:
 - Limit access to facilities.
 - Reduce mouth opening.
 - Limit the ability of the patient to recline to an ergonomic position for the operator.
 - Limit the ability of the patient to cope for longer appointments with a dental dam in place.
- Chronic disease should be identified, investigated, and levels of control should be well documented:
 - Patients tend to under report, and practitioners may dismiss diseases due to their commonness (such as CVD, DM, and mental health conditions).
- Use of visual aids while explaining treatment options and processes are important:

- Allow patients to take away an information sheet prior to RCT commencement and give them time to ask questions.
- GDPs should spend some time discussing the details of the procedure using photographs and radiographs after the treatment session.
 - It is important for patients to feel as though they are not being rushed to leave.
- Careful explanations of the RCT procedure should be performed, including endodontic and restorative factors that may affect the long-term prognosis:
 - The prognosis can change throughout the treatment particularly from procedural factors (inability to locate canals, working length deficiencies, canal transportations, tooth fracture, encountering cracks or damage following initial access and caries removal).
 - Written consent should be considered for complex RCT or where the roots are near other anatomical structures such as the maxillary sinuses or inferior alveolar nerve canal.
 - Updates should be provided to patients at the beginning and end of each visit, and dialogue between the dentist and patient should continue throughout the treatment sessions.
- GDPs should set clear expectations regarding likelihood of some post-operative pain and muscle soreness:
 - Consider prescribing pain relief post operatively if medically appropriate.
 - Include the use of a well-fitting bite-block where tolerable by patients.

- Checking on patients later, or on the following day with a telephone call is highly appreciated.

5.8 Conclusion

This research demonstrated the advantages of utilising a mixed methods approach for research that can translate into the NZ general practice environment. A national PBRN survey and Focus Group interviews have identified that patients present with a range of health conditions; as well as understanding the significance of these conditions when treatment planning, GDPs must work through the consent process and perform challenging technical procedures to the highest standard.

The importance of empathetic communication and patient education concerning the RCT procedure and prognosis is vital to a good experience for the patient. In addition to improving patients' oral health, the dental practitioner has a vital role in supporting their general health, management of risk factors for chronic disease, and to initiate referral to medical colleagues.

Targeted CPD that can support GDPs to competently provide safe and holistic care of patients directly relating to clinical practice is essential and must be relevant to GDPs in both main centre and rural

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Appendices

Appendix 1 Ethical Approval



H18/091

Academic Services
Manager, Academic Committees, Mr Gary Witte

20 August 2018

Dr L Friedlander
Department of Oral Rehabilitation
Faculty of Dentistry

Dear Dr Friedlander,

I am writing to let you know that, at its recent meeting, the Ethics Committee considered your proposal entitled "**Health status of patients receiving root canal treatment in New Zealand general dental practice - A Practice Based Research Study**".

As a result of that consideration, the current status of your proposal is:- **Approved**

For your future reference, the Ethics Committee's reference code for this project is:- **H18/091**.

The comments and views expressed by the Ethics Committee concerning your proposal are as follows:-

While approving the application, the Committee would be grateful if you would respond to the following:

Methodology

The Committee asks whether you have considered other forms of obtaining health information from patients, such as accessing e-Health to support the information collected from patients?

The Committee noted that the pilot study will test and validate the survey instrument. The Committee asks, where any changes are made to the survey following the pilot, that you submit an amendment for approval to the Committee.

Information Sheet and Consent Form

The Committee suggests that you develop 2 separate Information Sheets and Consent Forms for the 2 groups of participants, one of the clinicians and one for the patients.

Please provide the Committee with copies of the updated documents, if changes have been necessary.

The standard conditions of approval for all human research projects reviewed and approved by the Committee are the following:

Conduct the research project strictly in accordance with the research proposal submitted and granted ethics approval, including any amendments required to be made to the proposal by the Human Research Ethics Committee.

Inform the Human Research Ethics Committee immediately of anything which may warrant review of ethics approval of the research project, including: serious or unexpected adverse effects on participants; unforeseen events that might affect continued ethical acceptability of the project; and a written report about these matters must be submitted to the Academic Committees Office by no later than the next working day after recognition of an adverse occurrence/event. Please note that in cases of adverse events an incident report should also be made to the Health and Safety Office:

<http://www.otago.ac.nz/healthandsafety/index.html>

Advise the Committee in writing as soon as practicable if the research project is discontinued.

Make no change to the project as approved in its entirety by the Committee, including any wording in any document approved as part of the project, without prior written approval of the Committee for any change. If you are applying for an amendment to your approved research, please email your request to the Academic Committees Office:

gary.witte@otago.ac.nz

jo.farronediaz@otago.ac.nz

Approval is for up to three years from the date of this letter. If this project has not been completed within three years from the date of this letter, re-approval or an extension of approval must be requested. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing.

The Human Ethics Committee (Health) asks for a Final Report to be provided upon completion of the study. The Final Report template can be found on the Human Ethics Web Page <http://www.otago.ac.nz/council/committees/committees/HumanEthicsCommittees.html>

Yours sincerely,



Mr Gary Witte
Manager, Academic Committees
Tel: 479 8256
Email: gary.witte@otago.ac.nz

c.c. Professor K M Lyons Department of Oral Rehabilitation

Appendix 2 Māori Consultation

NGĀI TAHU RESEARCH CONSULTATION COMMITTEE *TE KOMITI RAKAHAU KI KĀI TAHU*

Wednesday, 11 April 2018.

Dr Lara Friedlander,
Faculty of Dentistry - Sir John Walsh Research Institute.

Tēnā Koe Dr Lara Friedlander,

Health status of patients receiving root canal treatment in New Zealand general dental practice – A Practice Based Research Study

The Ngāi Tahu Research Consultation Committee (the committee) met on Tuesday, 10 April 2018 to discuss your research proposition.

By way of introduction, this response from The Committee is provided as part of the Memorandum of Understanding between Te Rūnanga o Ngāi Tahu and the University. In the statement of principles of the memorandum it states "Ngāi Tahu acknowledges that the consultation process outline in this policy provides no power of veto by Ngāi Tahu to research undertaken at the University of Otago". As such, this response is not "approval" or "mandate" for the research, rather it is a mandated response from a Ngāi Tahu appointed committee. This process is part of a number of requirements for researchers to undertake and does not cover other issues relating to ethics, including methodology they are separate requirements with other committees, for example the Human Ethics Committee, etc.

Within the context of the Policy for Research Consultation with Māori, the Committee base consultation on that defined by Justice McGechan:

"Consultation does not mean negotiation or agreement. It means: setting out a proposal not fully decided upon; adequately informing a party about relevant information upon which the proposal is based; listening to what the others have to say with an open mind (in that there is room to be persuaded against the proposal); undertaking that task in a genuine and not cosmetic manner. Reaching a decision that may or may not alter the original proposal."

The Committee considers the research to be of importance to Māori health.

As this study involves human participants, the Committee strongly encourage that ethnicity data be collected as part of the research project. That is the questions on self-identified ethnicity and descent, these questions are contained in the latest census.

The Committee suggests dissemination of the findings to relevant Māori health organisations, for example the National Māori Organisation for Dental Health, Oranga Niho and to Professor John Broughton and Malcolm Dacker, who are involved in Māori Dental Health, University of Otago.

The Ngāi Tahu Research Consultation Committee has membership from:

*Te Rūnanga o Ōtākou Incorporated
Kāi Huirapa Rūnaka ki Puketeraki
Te Rūnanga o Moeraki*

NGĀI TAHU RESEARCH CONSULTATION COMMITTEE
TE KOMITI RAKAHAU KI KAI TAHU

We wish you every success in your research and the committee also requests a copy of the research findings.

This letter of suggestion, recommendation and advice is current for an 18 month period from Tuesday, 10 April 2018 to 10 October 2019.

Nāhaku noa, nā



PR NTRCC

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Kaiwhakahaere Rangahau Māori
Research Manager Māori
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The Ngāi Tahu Research Consultation Committee has membership from:

*Te Rūnanga o Ōtākou Incorporated
Kāti Huirapa Rūnaka ki Puketeraki
Te Rūnanga o Moeraki*

Appendix 3 Pilot Survey of Practitioners

1. What area of NZ do you practice?

- North Island Main Centre
- North Island Regional
- South Island Main Centre
- South Island Regional

2. Age range

- Under 25 years
- 26-30 years
- 31-40 years
- 41-50 years
- 50-65 years
- Over 65 years

3. Where did you gain your undergraduate degree from?

- University of Otago
- Australian University
- United Kingdom University
- American University
- Canadian University
- South Africa
- Other Country _____

4. What age of patients do you mostly manage that require endodontic treatment?

- < 18 years
- 18-40 years
- 41-65 years
- Over 65 years
- All ages

5. For which teeth do you perform root canal treatment? (Tick those that apply)

- Maxillary incisors and canines
- Maxillary premolars
- Maxillary molars
- Mandibular Incisors and canines
- Mandibular premolar
- Mandibular molars

6. How do you rate your confidence in managing patients for root canal therapy with the listed medical conditions? (Tick the appropriate box)

Patient Medical condition	Very Unconfident	Unconfident	Neutral	Confident	Very Confident
Bleeding disorders					
Diabetes					
Respiratory conditions					
Prosthetic joints					
Epilepsy – controlled					

Previous stroke					
Polypharmacy					
Oral bisphosphonates					
immunosuppressants eg high dose steroids, cyclosporin					
Aspirin or other anticoagulants					
Multimorbidity (several chronic diseases)					
Organ transplant patients					
Oncology patients					

If anything else influences your confidence please comment

7. If you are not confident in performing root canal treatment on a patient with a medical condition, what do you do?

8. How would you describe your knowledge of medical problems relevant to dentistry?

- Very good
- Good
- Neutral
- Poor
- Very poor

9. The last time I engaged in a CPD activity related to medical problems in dentistry was (excluding life support courses):

- 5 years
- 2 years
- 1 year
- 6 months
- Can't remember

10. Which medical problems are you most comfortable managing?

Appendix 4 Pilot Survey of Patients

Part A

1. What is your gender?

- Male
- Female
- Other

2. What is your age?

_____ years

3. Which ethnic group(s) do you belong to? (tick all that apply)

- NZ European
- New Zealand Māori
- Samoan
- Cook Island Māori
- Tongan
- Niuean
- Chinese
- Indian
- Other (please state) _____

4. Which of the following *best* describes your employment status?

- Full-time (30 or more hours per week)
- Part-time
- Contract, freelance or casual employee
- Self-employed
- Retired
- Stay-at-home parent
- Full-time student
- Part-time student
- Unemployed

5. What is your highest qualification?

- Level 1 School Certificate (year 11; 5th form)
- Level 2 School Certificate (year 12; 6th form)
- Level 3 School Certificate (year 13; 7th form)
- Level 4 Certificate
- Level 5 Diploma
- Level 6 Diploma
- Trade Certificate
- Bachelor's Degree or Level 7 Qualification
- Bachelor (Honours) Degree or Postgraduate Certificate/Diploma
- Master's Degree
- PhD (Doctorate – not medical doctor)
- Other qualification _____

Part B – Dental History

6. What is your *usual* reason for visiting the dentist?

- Routine check up
- For cleaning my teeth / gums
- When I have a problem

7. When did you last visit a dentist?

8. How often do you have a check-up appointment with X-rays?

- 5 yearly
- 2 yearly
- Once a year
- I don't remember when I last had a check-up with X-rays

9. How long have you been attending this practice

- More than 10 years
- 5-10 years
- 2-5 years
- Less than 2 years
- This is my first visit to this practice

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

- Very good
- Good
- Fair
- Poor

Why do you give this response?

11. Have you ever been told you have gum disease (periodontal disease or gingivitis)?

- Yes
- No

12. Do you wear/have a _____? (tick as many that apply)

- Denture (plate)
- Bridge
- Implant

Part C – Your root canal treatment

13. Is this your first root canal treatment?

- Yes (go to question 15)
- No

14. How would you describe your previous root canal experience?

- Very good
- Good
- Neutral
- Poor
- Very poor

Why do you give this response?

15. Which best describes the tooth requiring root canal treatment (tick 2 boxes):

- A front tooth
- A back tooth

- An upper tooth
- A lower tooth

16. Why are you having your tooth root canal treated?

- Dental decay
- Periodontal (gum) disease
- I have a big filling and the nerve has died
- An accident or injury (trauma)
- Because I need other treatment (e.g. before a crown or denture is placed)
- Don't know
- Other reason (please state) _____

16. What is the main reason you chose to have root canal treatment instead of extraction of the tooth?

- Aesthetics (to avoid the appearance of missing teeth)
- To avoid difficulty eating
- Concern that my denture (plate) will no longer fit or be loose
- The cost of replacing a missing tooth may be greater than root canal treatment
- I don't like losing teeth
- Other reason (please state)

17. Was the tooth giving you pain before root canal treatment?

- Yes
- No (Go to question 19)

Please describe the pain (where it is, how long it has been painful for, what brings the pain on, what makes it better, what it feels like):

18. Approximately how long has the tooth been painful for?

- 1 day
- 2 - 3 days
- 1 - 2 weeks
- About a month
- 1 - 3 months
- More than 3 months

19. On a scale of 1-10 how bad is the pain (Circle the number)

(No pain) 1 2 3 4 5 6 7 8 9 10 (Severe pain)

20. Did pain influence your decision to have root canal treatment

- Yes
- No

Why did you choose this answer?

21. What do you know about root canal treatment? (e.g. discomfort during or after the appointment, what is involved in the procedure, risks, benefits, how many visits will be needed, cost)

Part C General Health

22. How often do you visit your general medical doctor (GP)?

- More than once every 2 weeks
- Once per month
- Every 3 months
- 3 - 6 months for a check up
- Yearly or when I am unwell
- Rarely and only when I am unwell

23. How would you rate your general health at present?

- Excellent
- Very good
- Good
- Fair
- Poor

Why did you choose this answer?

24. Please describe your smoking status:

- Never smoked
- Ex-smoker (Gave up more than 5 years ago)
- Ex-smoker (Gave up over 1 year ago)
- Ex-smoker (Gave up less than 1 year ago)
- Current smoker (less than 10 cigarettes per day)
- Current smoker (more than 10 cigarettes per day)

25. How often do you drink alcohol?

- Don't drink alcohol
- On special occasions
- Only on weekends
- Once per week
- 3-5 times per week
- Every day

26. Do you take any medications or supplements? (including supermarket and pharmacy medicines or pain relief)

- Yes
- No

Please list these medications on the next page.

28. Please indicate if you have any of the following medical conditions and/or see a specialist:

Medical condition	I have this condition	I see a specialist for this condition
Diabetes – Type 1 (insulin dependent)	<input type="checkbox"/>	<input type="checkbox"/>
Diabetes – Type 2	<input type="checkbox"/>	<input type="checkbox"/>
Osteoporosis	<input type="checkbox"/>	<input type="checkbox"/>
Current or previous cancer treatment	<input type="checkbox"/>	<input type="checkbox"/>
Bleeding disorder (e.g. haemophilia)	<input type="checkbox"/>	<input type="checkbox"/>
Lung disease (e.g. asthma, COPD)	<input type="checkbox"/>	<input type="checkbox"/>
High blood pressure	<input type="checkbox"/>	<input type="checkbox"/>
Angina	<input type="checkbox"/>	<input type="checkbox"/>
Previous heart attack	<input type="checkbox"/>	<input type="checkbox"/>
Liver disease (e.g. cirrhosis, hepatitis)	<input type="checkbox"/>	<input type="checkbox"/>
Kidney disease	<input type="checkbox"/>	<input type="checkbox"/>
Gastro-intestinal disease (e.g. IBS, Crohn's)	<input type="checkbox"/>	<input type="checkbox"/>
Skin disease	<input type="checkbox"/>	<input type="checkbox"/>
Previous stroke	<input type="checkbox"/>	<input type="checkbox"/>
Arthritis or disease affecting mobility	<input type="checkbox"/>	<input type="checkbox"/>
Joint replacement (e.g. hip, knee, shoulder)	<input type="checkbox"/>	<input type="checkbox"/>
Organ transplant e.g. kidney, heart, lung	<input type="checkbox"/>	<input type="checkbox"/>
Mental health conditions	<input type="checkbox"/>	<input type="checkbox"/>

Health and Exercise

29. The following questions are about activities you might do during a typical day. Does your health limit you in these activities? If so, how much?

Activity	Yes, limited a lot	Yes, limited a little	No, not limited
Moderate activities, such as moving a table, pushing a vacuum cleaner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Climbing two flights of stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

30. In a typical week, how many days would you exercise?

- I don't regularly exercise
- Once a week
- 2 to 4 days a week
- 5 to 7 days a week

Do you have any other comments regarding the survey or root canal treatment?

Thank you for your participation in the survey

Appendix 5 PBRN Survey of Practitioners

P

Practitioner Questionnaire

Thank you for participating in our study. We would appreciate each dentist in your practice providing root canal treatment to contribute to our survey by completing this form. All responses are anonymized.

1. What is your age?

- Under 25 years
- 26-30 years
- 31-40 years
- 41-50 years
- 50-65 years
- Over 65 years

2. Gender

- Male
- Female

3. When did you graduate as a general dentist?

- Before 1970
- 1971-1985
- 1986-1999
- 2000-2012
- After 2013

4. Where did you gain your dental degree from?

- New Zealand
- Australia
- United Kingdom
- America
- Canada
- South Africa
- India
- Other Country _____

5. Where do you mainly practice?

- North Island main centre (Auckland, Hamilton, Tauranga, Wellington)
- North Island regional
- South Island main centre (Christchurch, Dunedin)
- South Island regional

6. What age of patients do you mostly manage for root canal treatment?

- < 18 years
- 18-40 years
- 41-65 years
- Over 65 years
- All ages

7. Which teeth do you perform root canal treatment? (Tick those that apply)

- Maxillary incisors and canines
- Maxillary premolars
- Maxillary molars
- Mandibular Incisors and canines
- Mandibular premolar
- Mandibular molars

8. What do you think influences patients' decision making the most when deciding between root canal treatment and extraction?

- Pain
- Fear of dentists
- Financial cost
- Medical risks relating to extraction (e.g. bisphosphonate therapy)
- Patients' don't like losing their teeth
- Time off work/multiple visits

Do you have any other views or comments?

9. How do you rate your confidence in managing patients for root canal treatment with these medical conditions? (Tick one box per condition)

Patient's Medical condition	Very Unconfident	Unconfident	Neutral	Confident	Very Confident
Diabetes – Type 1 insulin dependent					
Diabetes – Type 2 non-insulin dependent					
Osteoporosis					
Previous or current cancer treatment					
Bleeding disorder e.g. haemophilia					
Lung disease e.g. asthma, emphysema					
High blood pressure					
Previous heart attack					

P

Practitioner Questionnaire

Patient's Medical condition	Very Unconfident	Unconfident	Neutral	Confident	Very Confident
Liver disease e.g. hepatitis, cirrhosis					
Kidney disease					
Gastro- intestinal disease e.g. Coeliac disease					
Skin disorder					
Previous Stroke					
Arthritis or disorder affecting mobility					
Joint replacement e.g. hip, knee, shoulder					
Organ transplant					

P

Practitioner Questionnaire

Patient's Medical condition	Very Unconfident	Unconfident	Neutral	Confident	Very Confident
Mental health condition					
Epilepsy					
Bisphosphate therapy					
Polypharmacy					

10. If you are not confident in performing root canal treatment on a patient with a medical condition, what do you do?

11. Which medical problems are you most comfortable managing?

12. Which medical problems are you most uncomfortable managing?

13. How would you describe your knowledge of medical problems relevant to dentistry?

- Very good
- Good
- Neutral
- Poor
- Very poor

14. When was the last time you attended/ engaged in a CPD activity (course or journal article CPD) related to medical problems in dentistry (excluding life support/CPR courses)?

- 5 years ago
- 2 years ago
- 1 year ago
- 6 months ago
- Can't remember

15. Are there any areas of CPD that you think would be helpful for general dentists related to managing patients with medical problems?

Do you have any further comments?

Thank you for completing the survey

Appendix 6 PBRN Survey of Patients

P

Patient Questionnaire

#__

Thank you for participating in this study. Your anonymous responses will be very helpful in providing information about the health of patients receiving root canal treatment in New Zealand.

Part A – Participant Information

1. What is your gender?

- Male
 Female

2. What is your age?

- 25 years or under
 26-30 years
 31-40 years
 41-50 years
 50-65 years
 Over 65 years

3. Which ethnic group(s) do you belong to? (tick all that apply)

- New Zealand European
 New Zealand Māori
 Samoan
 Cook Island Māori
 Tongan
 Niuean
 Chinese
 Indian
 Other (please state) _____

4. Which of the following *best* describes your employment status?

- Full-time (work 30 or more hours per week)
- Part-time
- Contract, freelance or casual employee
- Self-employed
- Retired
- Stay-at-home parent
- Full-time student
- Part-time student
- Unemployed

Part B – Dental History & Root Canal Treatment**5. What is your *usual* reason for visiting the dentist?**

- Routine check up
- For cleaning of my teeth / gums
- When I have a problem

6. When did you last visit a dentist (for check-up or pain)?

7. How often do you have a check-up appointment?

- About every 5 years
- About every 2 years
- Once a year
- I don't remember when I last had a check-up

8. How long have you been attending this practice?

- More than 10 years
- 5-10 years
- 2-5 years
- Less than 2 years
- This is my first visit to this practice

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

- Excellent
- Very good
- Good
- Fair
- Poor

Why do you give this response?

10. Have you ever been told you have gum disease (periodontal disease or gingivitis)?

- Yes
- No

11. Do you have a: (tick all that apply)

- Denture (plate)
- Bridge
- Implant

12. Is this your first root canal treatment?

- Yes (go to question 14)
- No

13. How would you describe your previous root canal experience?

- Very good
- Good
- Neutral
- Poor
- Very poor

Why do you give this response?

14. Which tooth/teeth require root canal treatment? (tick all that apply)

- An upper front tooth
- An upper back tooth
- A lower front tooth
- A lower back tooth

15. Do you know why you are having root canal treatment? (tick all that apply)

- Dental decay
- Periodontal (gum) disease
- I have a big filling and the nerve has died
- My tooth has cracked or split
- An accident or injury (trauma)
- Because I need other treatment (e.g. before a crown or denture is placed)
- I don't know
- Other reason (please state) _____

16. What is the main reason you chose to have root canal treatment instead of tooth extraction?

- Aesthetics (to avoid the appearance of missing teeth)
- To avoid difficulty eating
- Concern that my denture (plate) will no longer fit or be loose
- The cost of replacing a missing tooth may be greater than root canal treatment
- I don't like losing teeth
- Other reason (please state)

17. Approximately how long has the tooth/teeth been painful?

- The tooth/teeth has never given me pain
- Less than 1 week
- Less than 1 month
- 1 - 3 months
- More than 3 months

18. On a scale of 1-10 how bad was the pain at its worst? (Circle the number)

(No pain) 1 2 3 4 5 6 7 8 9 10 (Severe pain)

19. Have you needed to take taking pain relief eg panadol, ibuprofen?

- Yes
- No

Do you have any other comments about pain before, during or following your root canal treatment?

20. What did you know about root canal treatment before you visited your dentist?

Part C - General Health**21. How often do you visit your general medical doctor (GP)?**

- More than once per month
- Once per month
- Every 3 months
- Every 6 months
- Yearly
- I only see my GP when I am unwell

22. How would you rate your general health?

- Excellent
- Very good
- Good
- Fair
- Poor

Why did you choose this answer?

23. Please describe your smoking status:

- Never smoked
- Ex-smoker (Gave up more than 5 years ago)
- Ex-smoker (Gave up over 1 year ago)
- Ex-smoker (Gave up less than 1 year ago)
- Current smoker (less than 10 cigarettes per day)
- Current smoker (more than 10 cigarettes per day)

24. How often do you drink alcohol?

- I don't drink alcohol
- On special occasions
- Only on weekends
- Once per week
- 3-5 times per week
- Every day

25. Do you take any medications or supplements prescribed by your doctor?

- Yes
- No

26. Do you take any other medications or supplements bought over the counter from a pharmacy or supermarket?

- Yes
- No

28. Please indicate with a tick in the box if you have any of the following medical conditions and/or see a specialist other than your GP doctor (if you do not have the condition please leave it blank)

Medical Condition	I have this medical condition	I see a specialist for this medical condition
Diabetes – Type 1 insulin dependent		
Diabetes – Type 2 non-insulin dependent		
Osteoporosis		
Previous or current cancer treatment		
Bleeding disorder e.g. haemophilia		
Lung disease e.g. asthma, emphysema		
High blood pressure		
Angina		
Previous heart attack		
Liver disease e.g. hepatitis, cirrhosis		
Kidney disease		
Gastro-intestinal disease e.g. Coeliac disease, Irritable bowel syndrome, Crohn's disease		
Skin disorder		
Previous stroke		
Arthritis or disorder affecting mobility		
Joint replacement e.g. hip, knee, shoulder		
Organ transplant e.g. kidney, heart, lung		
Mental health condition		
Epilepsy		

Part C - Health and Exercise

29. How do you rate your personal fitness?

- Excellent
- Very good
- Good
- Fair
- Poor

30. In a typical week, how many days would you exercise?

- I don't regularly exercise
- Once a week
- 2 to 4 days a week
- 5 to 7 days a week

Do you have any other comments regarding your root canal treatment?

Thank you for your participation in the survey