An Exploration of Current Primary Health Care Practice Regarding Osteoporosis Assessment Following a Low Trauma Wrist Fracture in people aged 50 years and above in Wellington, New Zealand: A Quantitative Survey

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Abstract

Osteoporosis remains a major health issue worldwide. The impact of the condition and the fractures that can occur, can have significant debilitating impact and also incur substantial financial costs to healthcare systems. The burden of osteoporosis and the rate of osteoporotic fractures in New Zealand is comparable to other countries such as Australia, the United States and Europe. There is global literature evidence dating back as far as 1960, indicating that a fracture sustained after a simple trip or fall can be an indicator of osteoporosis. There is a need to ensure that fracture patients with a potential osteoporosis diagnosis, receive follow up care for assessment to treat any underlying bone health issue to prevent future fragility fractures, particularly, hip fractures. Due to limited formal literature sources describing the associated New Zealand context, the aim of this research work was to explore current practice for osteoporosis assessment following a fragility wrist fracture in the general practitioner (GP) primary health care setting in Wellington, New Zealand.

A quantitative cross-sectional descriptive survey of Wellington GPs was undertaken for this purpose. The reporting of study results were guided by the recommendations detailed within the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement on reporting observational studies (Vandenbroucke et al., 2014). 35 out of 297 GPs from 60 practices in the Wellington region responded to the survey. When describing the local context in Wellington, New Zealand, study results showed that almost three quarters of Wellington GP survey respondents follow up patients who have sustained a potential fragility wrist fracture. The discharge summary was also shown to be a vital part of the communication process between the tertiary and primary health care sectors, acting as a prompt to the GP for further investigation. The single biggest barrier inhibiting processes to enable timely osteoporosis treatment as perceived by GP survey respondents, was lack of public funding, in particular to support availability of diagnostic Dual Energy X-ray Absorptiometry (DEXA) scanning.

Other barriers were identified by the GP survey respondents, such as anti-osteoporosis medication side effects, patient compliance to treatment plans and a lack of time within the scheduled consultation to screen patients for osteoporosis. The main educational resources that a large percentage of GP survey respondents independently accessed on a regular basis,

were those that were readily available. These included GP guidelines published by "Osteoporosis New Zealand" and possibly other, and online resources such as "Health Pathways" (a best-practice, condition-specific guideline and information resource for primary health care practitioners - https://3d.healthpathways.org.nz). The results also highlighted that most GP survey respondents preferred to take the lead role in the care for patients needing to undergo osteoporosis investigation and treatment. In addition, the GP survey respondents demonstrated a high level of knowledge regarding osteoporosis risk factors.

In summary, this study has identified features of practice with regards to osteoporosis assessment following a fragility wrist fracture in the Wellington region. In addition, this study has also enabled identification of specific areas that could be better supported and resourced to assist GP's in the prevention of secondary fragility fractures. These include highly visible public health campaigns to raise public awareness of osteoporosis and education to GP's regarding the available screening tools. A significant finding was also that the GP respondents in this study indicated they considered that an important part of their role was responsibility for osteoporosis prevention and treatment. The study results also highlight that despite funding issues, GP survey respondents view osteoporosis prevention and treatment as best placed in the care of the primary health care sector.

This is the first New Zealand study that has identified and described the local context around current practice for fragility wrist fracture care within the Wellington GP community, establishing important reference points which can be used to support further development and research.

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List of Abbreviations

ANZHFR	Australia and New Zealand Hip Fracture Registry
ADL's	Activities of Daily Living
BMD	Bone Mineral Density
BMI	Body Mass Index
BMU	Bone Multi-cellular Unit
BPF	Best Practice Framework
CAD	Canadian Dollars
CCDHB	Capital and Coast District Health Board
CINAHL	Combined Index of Nursing and Allied Health Literature
DAC	Disease Awareness Campaigns
DALY	Disability Adjusted Life Years
DEXA	Dual Energy X-ray Absorptiometry scan
DHB	District Health Boards
DSU	Decision Support Unit
FLN	Fracture Liaison Nurse
FLS	Fracture Liaison Service
FRAX	World Health Organisation Fracture Risk Assessment tool
FTE	Full Time Equivalent
GARVAN	Garvan Institute of Medical Research, Australia - Bone Fracture Risk Calculator tool
GP	General Practitioner
HDEC	Health and Disability Ethics Committee (New Zealand)
HRT	Hormone Replacement Therapy
IOF	International Osteoporosis Foundation
NMDS	National Minimum Data Set
NZD	New Zealand Dollars
ORAI	Osteoporosis Risk Assessment Index tool
OSIRIS	Osteoporosis Index of Risk tool
PHO	Primary Healthcare Organisation
QALY's	Quality Adjusted Life Year
RAGM	Research Advisory Group – Māori
RNZCGP	Royal New Zealand College of General Practitioners
SCORE	Simple Calculated Osteoporosis Risk Estimation tool
SD	Standard Deviation
SFP	Secondary Fracture Prevention
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
US	Ultrasound scan
VUW	Victoria University of Wellington
VUW HEC	Victoria University of Wellington Human Ethics Committee
WHI	Women's Health Initiative study
WHO	World Health Organisation

Introduction

Osteoporosis is defined as a disease "characterised by a decreased bone mass, increased bone fragility and susceptibility to fracture, and is diagnosed by measuring bone mineral density (BMD)" (Dreinhöfer et al., 2005, p. S44). In a clinical standards document, Osteoporosis is also described as a "fragile bone disease that can lead to fragility fractures" (United Kingdom National Osteoporosis Society, 2015, p. 8). These fractures are common, expensive and life changing, and 50% of people who present with a hip fracture will have had a previous fragility (low trauma) fracture United Kingdom National Osteoporosis Society (2015). People at higher risk of developing osteoporosis are identified by the New Zealand Formulary (2017) as post-menopausal women, those with a low Body Mass Index (BMI), and those patients on long term steroid use. A fragility fracture is a low trauma fracture that occurs after a slip, trip or fall from standing height or less (Sanderson et al., 2016). The most common sites for fragility fractures are the wrist (distal radius fracture), hip, vertebrae and humerus (Chen, Hogan, Lyubomirsky, & Sambrook, 2009).

Fragility fractures, in particular hip fractures, place a significant financial burden on the New Zealand healthcare system (Brown, McNeill, Leung, Radwan, & Willingale, 2011; Mithal, 2013) impacting globally as well (Akesson et al., 2013; Cantu & Koval, 2007; Hernlund et al., 2013). There is also the significant personal cost sustained by the injured person (Bertram, Norman, Kemp, & Vos, 2011; Morin et al., 2012; Pasco et al., 2005). The need to address the risk of secondary fractures has been established within the literature (Braatvedt, Wilkinson, Scott, Mitchell, & Harris, 2017; Kimber & Grimmer-Somers, 2011; Mitchell, Cornish, & Milsom, 2012) with a view to reducing the impact on healthcare budgets, and the personal cost to individuals. The challenge moving forward is to facilitate timely assessment and diagnosis of osteoporosis following presentation of an initial fragility fracture, as this serves as an important alert to health professionals that their patient may be at risk of osteoporosis. In a report from the New Zealand Ministry of Health identifying publicly funded hospital discharges from 1 July 2013 to 30 June 2014 (New Zealand Ministry of Health, 2016), 43 patients over the age of 50 years presented to Capital and Coast District Health Board (CCDHB) for surgery for a wrist fracture in that period, and 832 patients presented nationwide. People aged over 50 years old presenting to hospital with injuries due to a trip/fall/stumble in the

same period were 978 in the CCDHB region and 14,188 nationwide (Ministry of Health, 2016). This study aims to explore the current primary health care practice regarding osteoporosis assessment following a low trauma wrist fracture in people aged 50 years and above, in Wellington, New Zealand.

Background

In my practice as an orthopaedic acute nurse coordinator, I see many patients, including women aged over 45 years, who have fractured their wrist after what is a simple trip or fall. From being involved in the implementation of the Fractured Neck of Femur pathway, and also working as the CCDHB study coordinator for the Australian and New Zealand Hip Fracture Registry (ANZHFR), I have learnt that a wrist fracture in people over the age of 50 years can indicate the patient is potentially osteoporotic, and therefore may be at risk of a future hip fracture. In collecting ongoing patient data for the ANZHFR, I have become aware of the devastating impact a hip fracture can have on people personally, with some patients being unable to return to their former level of independence and level of mobility. I have also observed that if a person receives a timely diagnosis and appropriate treatment at the presentation of the first initial potential fragility fracture, this future path can be prevented. We have an ageing population, and the prevalence of hip fractures will increase as the population ages and lives longer. In light of the information currently available regarding fragility fractures, this thesis sought to explore current practice in the primary health care setting associated with identifying and assessing those at risk of secondary fragility fractures.

Current literature sources indicate that while there is an awareness of the need for education, assessment and treatment of osteoporosis to prevent future fragility fractures, this is not always happening in many health care settings globally (Adachi, Josse, & Russell, 2011; Braatvedt, Wilkinson, Scott, Mitchell, & Harris, 2017; Chami, Jeys, Freudmann, Connor, & Siddiqi, 2006; Dreinhöfer et al., 2005; Rozental, Makhni, Day, & Bouxsein, 2008). The aim of this study is to identify if assessment of fragility wrist fractures was occurring within the primary health care community in Wellington, New Zealand. The overall aim of this study was to explore current primary health care practice regarding osteoporosis assessment following a low trauma wrist fracture in people aged 50 years and above, within New Zealand, with a focus on the Wellington Region. The research objectives for this work are to explore the

current processes for patients aged over 50 years with a potential fragility wrist fracture in primary health care within the Capital and Coast District Health Board catchment, and to understand the role of osteoporosis assessment in this context; to understand the role of communication and discharge summaries between secondary and tertiary care centres, and medical centres in the Wellington Region; to identify any perceived barriers by GP's regarding osteoporosis diagnosis and treatment in this context and to identify the educational resources utilised by GPs to further support their osteoporosis knowledge base. A quantitative research approach was used to address the research aim, utilising a cross sectional online survey questionnaire as the data collection method.

Thesis Structure Overview

There are four chapters in this thesis exploring the current primary health care practice regarding osteoporosis assessment following a low trauma wrist fracture in people aged 50 years and above, in Wellington, New Zealand. Chapter 1 presents and explores the literature regarding osteoporosis and wrist fractures within the context of current knowledge. Chapter 2 presents the research methodology and methods utilised for this research, and also outlines the ethical implications and consideration of the research in the context of the Treaty of Waitangi. Chapter 3 presents the results from the online survey questionnaire. The thesis concludes with Chapter 4 where discussion of the survey results is presented in the context of current literature. Following the discussion within Chapter 4 is a summary of the significant findings from this work, in addition to the strengths and limitations of this research work. Chapter 4 will conclude by identifying recommendations for practice and future research opportunities.

Chapter 1   Literature Review

1.1   Introduction

Bone is a dynamic tissue that is continuously removed and replaced (remodelled) to enable the skeleton to adapt to weight-bearing, to enable repair of micro damage (cracks) due to mechanical stresses, as well as allowing mobilisation of calcium from the skeleton for maintenance of serum calcium homeostasis. Bone replacement is initiated by osteoclasts (bone-resorbing cells), which releases growth factors that activate osteoblasts (bone-forming cells). The activities of bone resorption and bone forming are localised within each "bone multicellular unit" or BMU. When skeletal growth is complete, bone size and mineral content has reached its peak, and is then maintained throughout adult life (in the absence of pathophysiological conditions) due to the bone remodelling processes balanced between resorption and formation within each BMU. Osteoporosis is a systemic skeletal disease typified by a bone mineral mass decrease along with bone microstructure alterations, causing cortical bone thinning and increased porosity. These alterations occur as a consequence of increased bone turnover, activated by the decline of oestrogen levels in postmenopausal women. In men, aging and the decline in both testosterone and oestrogen levels also play a role. At the cellular level, due to these endocrine disturbances, a mismatch occurs between osteoclast and osteoblast activity. The loss of bone mineral mass and the microstructural alterations that lead to osteoporosis are the result of complex cellular and molecular mechanisms represented by increased osteoclast numbers and a weaker bone-forming response by osteoblasts (Ferrari, Roux, & SpringerLink, 2019, pp. 1-8).

This chapter summarises information from literature sources from New Zealand and overseas regarding the diagnosis and treatment of osteoporosis. To begin with, descriptions from the literature establishing the link between the first wrist fracture occurring due to a low trauma incident and the subsequent risk of a future hip fracture in a population of adults aged over 50 years will be presented. This includes early seminal research that identified this connection. Descriptions and issues relating to the prevalence of osteoporosis, the personal and economic costs of osteoporosis, and also a discussion on how osteoporosis is diagnosed

will be identified. The treatment options are also discussed, with further identification of possible barriers to osteoporosis diagnosis and treatment, as well as issues around osteoporosis treatment, both from a clinician and patient viewpoint. The chapter will then explore what is currently happening globally in primary and secondary health care to address osteoporosis risk, before concluding with discussion about Fracture Liaison Services.

1.2   Wrist Fractures as an Indicator of Osteoporosis

A wrist fracture sustained after a simple trip or fall has been established as an indicator of osteoporosis in international studies that date back to 1960 (Alffram, 1964; Bauer, 1960; Gay, 1974; Owen, Melton, Ilstrup, Johnson, & Riggs, 1982). Identification of this link emphasises the need for follow up to assess and treat underlying bone health issues. Studies highlighting the link between wrist fractures, and fragility hip fractures are identified and discussed in this section.

A seminal epidemiological study undertaken in Sweden (Bauer, 1960) explored the link between aging and fracture occurrence. A total of 956 neck of femur fracture cases and 1192 lower forearm fracture cases in patients aged over 20 years were examined. The results of this study showed there was a 15–17 year period between an increase in wrist fracture incidence and hip fracture incidence, with the author suggesting a need to investigate bone health 10-20 years before a hip fracture occurs. A subsequent epidemiological study of hip fractures undertaken by Alffram (1964) investigated 1664 Swedish residents who had sustained a hip fracture over a 12-year period and found that women who had sustained a hip fracture were more likely to have had a previous wrist fracture, at more than twice the rate of the general population. Allfram also identified that there was a notable increase in wrist fracture rates for women at around the age of 50 years, but that this did not occur in the male population.

Following on from Allfram's study, a 10-year retrospective study was undertaken in Canada to explore the relationship between an initial wrist fracture and subsequent fractures, as an indicator of underlying osteoporosis. Gay (1974) followed a cohort of patients, 27 men and 109 women, who were aged 18 years and over in 1960 and who had previously sustained a wrist fracture. Since only 2 of the men (7.4%) had sustained a subsequent fracture, the authors concentrated their data analysis on the female participants. Their results showed that

the rate of wrist re-fracture for the female participants was almost 3 times that of the general female population in the study. The authors concluded that a clear pattern of osteoporosis fractures in women was present, suggesting that a wrist fracture could be considered a marker for women at risk of further fractures. A subsequent American study by Owen et al. (1982) explored the presentation of a wrist fracture to predict the potential of hip fracture risk. Their study results indicated that a wrist fracture associated with moderate trauma increased the risk for subsequent hip fracture by 50%. In contrast, a Norwegian epidemiological study by Finsen and Benum (1987) investigating whether the incidence of a previous wrist, or other, fracture indicated the likelihood of sustaining a future hip fracture, showed no demonstrable correlation between a previous wrist fracture and subsequent hip fracture. The study did however detect that there was a higher prevalence of previous wrist fracture in women up to the age of 62 years who had sustained a hip fracture, compared to the general population, leading the authors to conclude that a history of wrist fracture may indicate a higher risk of hip fracture in the older adult.

In a 1992 Swedish population based five year study, Mallmin et al. (1993) sought to identify the risk of hip fracture after a wrist fracture in men and women aged above 40 years, finding that for both men and women, there was an increased risk of a subsequent hip fracture, with a relative hazard of 1.54 for women and 2.27 for men in those who sustained a wrist fracture (Mallmin et al., 1993). The conclusion from this study was that all patients who sustain a wrist fracture should be considered for prophylactic measures in order to prevent further bone loss. Two aspects of the study that contribute to its strength include the lengthy duration of follow up time (23 years) of the participants, in addition to the large cohort of 2676 participants. A similar association between wrist and hip fracture was reported in a 1993 epidemiological study of 1568 Danish women that identified women over the age of 50 years with history of a wrist or upper arm (humerus) fracture had a lifetime risk of sustaining a hip fracture of 5-6% greater than the general population (Lauritzen, Schwarz, McNair, Lund, & Transbol, 1993). In a recent Turkish retrospective evaluation of 142 patients over the age of 60 who had sustained a low trauma hip fracture, Bozkurt, Atik, and Tokgöz (2018) reported that 31.3% (n = 10) of the hip fracture patients had sustained a previous wrist fracture, concluding that physicians should certainly consider osteoporosis in patients who present with a low trauma wrist fracture, with a view to treatment to prevent further fractures.

The American National Osteoporosis Risk Assessment (NORA) three year longitudinal observational study (Siris et al., 2006) identified that the magnitude of increase in both the relative and absolute risk for future fractures, is similar for both younger and older post-menopausal women who have experienced a wrist fracture after menopause. This risk of subsequent fractures was further demonstrated in a 2007 follow up study of 158,940 women from the National Osteoporotic Risk Assessment (NORA) longitudinal observational study undertaken in America by Barrett-Connor et al. (2008). The authors identified that a prior wrist fracture increased the risk of a hip fracture three-fold as well as doubling the risk of sustaining any osteoporotic fracture. The NORA study was the first study to show that post-menopausal women who sustain a wrist fracture after the age of 45 years are at an increased risk for future fractures, regardless of Bone Mineral Density (BMD) and other risk factors. Barrett-Connor et al. (2008) suggest that even young post-menopausal women with a history of prior fractures should be evaluated and managed to prevent future fractures, irrespective of having normal BMD scores, as the initial fragility fracture is a likely sign of poor overall bone quality. The authors concluded that all post-menopausal women who present with a wrist fracture, regardless of what age they are, should be assessed for osteoporosis with a view to reducing future fracture risk.

A 2013 communication report by Cerocchi, Ghera, Gasbarra, Feola, and Tarantino (2013) highlighted that wrist fractures occur at a younger age than vertebral and hip fractures, and suggest that this could be due to higher levels of physical activity, such as walking, in this population group leading to increased fall risk. The authors conclude that fragility wrist fractures are common in peri-menopausal and young post-menopausal women and suggest that the numbers of women sustaining wrist fractures are likely underestimated as they don't always require hospitalisation. When examining the epidemiology of fracture risk associated with aging, Ensrud (2013) reports that wrist fractures are the most common type of fracture in peri-menopausal women with the incidence rising rapidly after menopause before plateauing at the age of 65 years. However, for men, wrist fracture incidence is low and does not increase with age as 80% of wrist fractures occur in women. As also reported by Cerocchi et al. (2013), wrist fractures are more common in healthier older adults, possibly because of increased physical activity such as walking for exercise.

J. C. Crandall et al. (2015) undertook a post-hoc analysis of the American women's health initiative observational and clinical trial, investigating data from 160,930 post-menopausal women aged 50-79 years. This analysis highlighted that of the women who had experienced a wrist fracture, 15.5% subsequently sustained a non-wrist fracture. The hazard ratio was higher in women who had experienced the wrist fracture at a younger age. This analysis indicated that there may be missed opportunities to intervene to prevent future fractures in women who present with an initial wrist fracture. This is also identified by Banefelt et al. (2019) in their prospective observational cohort study of 242,108 women aged 50 years and older that examined the risk of further fractures following an initial fracture (hip, wrist, vertebral, humerus). Banefelt et al. (2019) identified a future fracture risk of 7.1% at 12 months and 12% at 24 months post initial fracture, indicating a need for implementation of healthcare systems that are able to intervene in a timely manner to prevent the second fracture. This is also similar to the result from a population based study by van Geel, van Helden, Geusens, Winkens, and Dinant (2009) identifying an absolute risk of 6.1% for a further fracture in the first year following the initial fracture. This translated to 23% of subsequent fractures occurring in the first year following the initial fracture, again highlighting the need for early action to prevent further fractures.

The research summarised here has highlighted the connection between wrist fracture and subsequent hip fracture in different study cohorts, beginning with a piece of seminal research undertaken in 1960 that indicates a potential diagnosis of osteoporosis within their contexts. This review also highlights the wide range of cohorts (men and women, women only, peri and post-menopausal, history of prior fractures) who are at risk of a subsequent fragility fracture. The literature discussed here supports and reinforces the need to track and follow up at-risk patients to assess bone health.

1.3 Osteoporosis Prevalence, Costs and Diagnosis

A wrist fracture can indicate poor bone density that increases the risk of a subsequent hip fracture. The prevalence of osteoporosis both nationally and globally will be explored in the following section, with a particular focus on hip fractures as this has been established in the previous discussion as a consequence of having developed osteoporosis. A description of the

economic and personal costs of osteoporosis and subsequent injury will also be presented, concluding with information concerning the diagnosis of osteoporosis.

1.3.1 The Prevalence of Osteoporosis

In a 2013 New Zealand Ministry of Health report, Sharpe (2013) identifies osteoporosis as a key fracture risk factor in the older adult, contributing to 82% of fracture related health loss in women and 64% in men, totalling a health loss of 1711 Disability Adjusted Life Years (DALY). It was also reported that 10% of all injury related health loss is estimated as being attributable to osteoporosis in the 50 years and over age group (Sharpe, 2013). In examining hip fracture impact, Sharpe (2013) identifies that the burden of injury related health loss for New Zealand in 2006 was 2386 DALY for femoral fractures, which is two thirds of the total DALY for health loss due to fractures and dislocation (total 3688).

In a survey of Australian women by Eisman, Clapham, and Kehoe (2004) examining the prevalence of osteoporosis and treatment in the primary care setting, the authors concluded that osteoporotic fractures are common among post-menopausal Australian women, with 29% reporting at least one fracture due to low trauma. Despite these statistics, Eisman et al. (2004) identified that very few are on any type of treatment for osteoporosis, highlighting the need for targeted education support for primary health care providers to address the low treatment rate. With a very large sample size of 57,088 participants, this study's results constitute an important contribution to the osteoporosis care context in Australia.

1.3.2 Economic and Personal Costs of Osteoporosis

In a 2011 study quantifying the economic burden of osteoporosis in New Zealand undertaken by Brown et al. (2011), the estimated rate of 672 fractures per 10,000 people aged 50 years and older resulted in a Quality Adjusted Life Year (QALY) loss of 11,250, which was reported to have an estimated total economic cost of $330 million New Zealand dollars (NZD). The estimated cost of treating a hip fracture in 2007 was $23,859 NZD, with this cost including both acute and rehabilitation care, pharmaceuticals and GP visits (Brown et al., 2011). Using information and projections from the National Minimum Data Set (NMDS) and Statistics New Zealand, Brown et al. (2011) estimated the rate of osteoporotic fractures in 2013 to increase to 99,500, with a loss of QALYs of 13,205, and projected economic cost of $391 million NZD. This is set to rise to $459 million NZD in 2020, with osteoporotic fractures estimated to

increase to 115,914, a loss of QALYs of 15,176 (Brown et al., 2011). To ensure the validity of the study results, the authors benchmarked these figures against previous international studies from the UK, USA, Sweden, European Union, Switzerland and France, with the results showing consistency with comparable studies. In a 2013 audit report from the International Osteoporosis Foundation (Mithal, 2013), it is predicted that by 2050 New Zealand's population aged over 50 years will increase by 9% (from 32% in 2013 to 41% in 2050). This report identifies the cost figures for treating osteoporosis in 2007 at $33 million NZD and over $800 million NZD to treat and manage secondary illnesses related to osteoporosis, concluding that the longer that fragility fractures go unrecognised and untreated, the cost burden to the NZD health system will continue to increase (Mithal, 2013).

In an American review of the costs of fragility fractures, Cantu and Koval (2007) report that the worldwide financial burden of fragility fractures is "staggering", and that timely and effective treatment is of major public importance, as osteoporosis and fragility fractures are an international health problem affecting up to 323 million people worldwide, projected to reach up to 1.55 billion people by 2050 (Cantu & Koval, 2007). Although only 30% of hip fractures occur in men, the mortality rate is double that of women with osteoporosis being severely underdiagnosed in the male population (Cantu & Koval, 2007) with a significant economic cost. This issue is also identified and discussed in a subsequent study by Cawthon (2011) which reported that older men have worse outcomes after a hip fracture. However, both Cawthon (2011) and Sanderson et al. (2016) identify that there is a lack of research into osteoporosis and men.

In a 2005 Australian study that examined the personal cost of fractures for women, the authors (Pasco et al., 2005) identified that hip, wrist and spine fractures are the sites typically associated with osteoporosis and that within this study, these fractures accounted for almost half of the fractures sustained by the study population, with hip fractures having the most severe functional impact. Pasco et al. (2005) indicate that while short term morbidity was usual for all fractures, hip fractures were particularly associated with prolonged morbidity. It was identified that 12 months after a hip fracture, nearly one half of the women were still unable to walk independently, only 10% identified that they had returned to their pre-fracture mobility, and 46-70% of hip fracture participants indicated that they required assistance with

Activities of Daily Living (ADL's) such as dressing, bathing, cooking, gardening and transportation up to 12 months post injury (Pasco et al., 2005).

Bliuc et al. (2009) investigated hip fracture mortality in men and women 60 years and older who had sustained osteoporotic fracture in the years 1989-2007, in an Australian longitudinal population-based study. A total of 452 women and 162 men were included in the study. Non-hip, non-vertebral fractures accounted for 50% of all low trauma fractures and were associated with an increased risk of subsequent fracture. Mortality was higher in the fracture group, compared with the general population, and mortality increased for the first five years after sustaining a fracture, while a further fracture added another five-year mortality risk.

While sustaining a hip fracture can have an ongoing impact on a person's mobility, there is also the effect a hip fracture may have on a patient's ability to return to their own home and therefore, their ability to remain living independently. This impact was examined in a Canadian retrospective study of 70,264 patients over a 20-year period by Morin et al. (2012) where it was identified that the number of patients who required long term care in the year following a low trauma fracture was higher in men and women over the age of 75 years, with the highest rate of patients being those who had sustained a hip fracture. Morin et al. (2012) identified that the number of patients requiring long term care following a low trauma fracture was increasing over time.

With a key assumption that 5% of patients sustaining hip fractures would experience life-long disability, Bertram et al. (2011) undertook a literature review of 25 studies to analyse the rate of long term disability following a hip fracture. This review identified that this assumption of 5% was an underestimation and instead found that 29% of patients over the age of 60 years experienced a life-long disability due to the hip fracture. Bertram et al. (2011) also highlighted that for those who did not experience a life-long disability, achieving full functional recovery could be a prolonged process.

When examining the personal costs of fragility fractures, Bledsoe, Alessi, Toro, Giordano, and Hanypsiak (2018) reported that fragility fractures are not only traumatic but that they are also associated with increased mortality rates. This was further highlighted in an Austrian study by Gosch et al. (2016) examining the impact of an orthogeriatrician service for 256 fragility fracture patients over the age of 70 years old who were admitted to hospital from a long-

term care facility. In their study, Gosch et al. (2016) found that while 29.4% of fragility fracture patients and 33.8% of hip fracture patients died within the first year, this was actually an improvement on a previously reported rate from Neuman et al. (2014) where 47% of hip fracture patients died within a year of injury.

Wang et al. (2015) carried out a four-year multi-centred retrospective cohort study of 1151 female patients over the age of 50 years who had sustained a low trauma hip fracture. Their results showed there was a mortality rate of 13.3% for patients with hip fractures over the period of the study, with a first-year mortality rate of 3.8%. This was a significantly higher rate than the general population in mainland China of 1.6% (a number obtained from the China Health Statistical Yearbook data), although this was an unexpectedly lower mortality rate in comparison to previously published studies where one year mortality rates for patients with hip fracture are reported as ranging from 8.4% to 36% (Abrahamsen, van Staa, Ariely, Olson, & Cooper, 2009; Brozek et al., 2014; Tsuboi, Hasegawa, Suzuki, Wingstrand, & Thorngren, 2007; Wang et al., 2013; Yoon et al., 2011). In addressing the study limitations and the low mortality rate identified within the study, the authors report that as one quarter of eligible participants were non-responders, this could well indicate a higher mortality rate, identifying this as a major limitation of the study.

1.3.3 Osteoporosis Diagnosis

Both in New Zealand and globally, osteoporosis is diagnosed by Dual Energy X-ray Absorptiometry (DEXA) scanning, measured at the femoral neck, which although expensive, is currently considered the gold standard for non-invasive measurement of BMD to enable prediction of osteoporotic fracture risk (Compston et al., 2017; Lems & Raterman, 2017). The DEXA scan provides a measure of BMD expressed as a "T-score" which is a measure of standard deviation (SD) from the normal mean value for a young healthy adult woman, with a T-score of less than -2.5 SD being a diagnosis of osteoporosis (Compston et al., 2017). There are prediction tools available online, such as the World Health Organisation (WHO) Fracture Risk Assessment Tool (FRAX), for general practitioners to utilise to assist in assessing a patients' fracture risk. However, a 2009 Norwegian study (Øyen et al., 2010) of 1794 patients aged 50 years and older, who presented with a low energy wrist fracture concluded that all patients who present with low trauma fractures should be referred for Bone Mineral Density

(BMD) testing because treatment decisions should not be made on the WHO Fracture Risk Assessment tool (FRAX) alone.

In a 2007 study by Milsom et al. (2013), the authors investigated accessibility to DEXA scans in New Zealand, and reported that at eight DEXA machines per one million of general population, New Zealand does not meet the European Union recommendation of 11 DEXA machines per million of population. While in 2007 33,104 DEXA scans were performed in New Zealand, giving a mean of 78.1 DEXA scans per year per 10,000 population, there was a wide regional variation in the number of scans performed by population. The results also indicated that of all the District Health Boards (DHBs), the number of DEXA scans being performed were very low at Capital and Coast District Health Board (CCDHB), with a publicly funded DEXA scan rate 0.8 per 10,000 population, equating to 22 funded scans in 2007 (Milsom et al., 2013). Apart from DHB funding, Milsom et al. (2013) identify that the majority of funding for DEXA scans in 2007 were privately or industry funded. However, in 2011 industry funding was discontinued, which the authors identify has reduced access to DEXA scan even further in New Zealand. As access to medication for osteoporosis treatment for those aged under 75 years is contingent on a DEXA scan result, Milsom et al. (2013) suggest that the lack of funding for DEXA scans risks creating treatment inequities and affects health outcomes. It is also highlighted that if patients who present with the "signal" (first fragility) fracture are not offered the opportunity of a DEXA scan at that time, then the ability to prevent a future hip fracture is lost, therefore it is vital to establish consistent and equitable access to this important diagnostic test (Milsom et al., 2013).

With the cost of a DEXA scan being seen as a potential reason for non-diagnosis of osteoporosis, an Italian study was undertaken by Pisani et al. (2016) to assess the reliability of using an abdominal ultrasound (US) of lumbar vertebrae as a lower cost alternative to the DEXA scan. The results from this study demonstrated that the US scan as an alternative to the DEXA was clinically feasible, as it was slightly more effective in measuring Bone Mineral Density (BMD) than the DEXA scan. This study addresses the issue of costs involved in diagnosing osteoporosis, however one issue noted was the mean Body Mass Index (BMI) of these patients as being 24.33kg/m^2. It would be of interest to know if the same result would be seen in those assessed with a range of BMI measurements.

In a comparison of different osteoporosis diagnostic techniques, Rozental et al. (2013) undertook a study comparing bone microarchitecture in pre-menopausal (<45 year old) women who had sustained a recent wrist fracture, with those women who had not sustained a wrist fracture. The authors compared bone microarchitecture using High Resolution peripheral Quantitative Computed Tomography (HRpQCT) with BMD measurements obtained from DEXA scanning. Rozental et al. (2013) highlight that while DEXA scan and the FRAX tool are considered the current gold standard for diagnosing osteoporosis, BMD does not always accurately reflect fracture risk, as up to 50% of those sustaining a fragility fracture do not have osteoporosis as reflected in the BMD measure. Rozental et al. (2013) identify that although bone loss noticeably occurs after menopause, bone density and microarchitecture actually deteriorate before this and a deterioration in bone microarchitecture has been associated with fragility fractures in post-menopausal women, independent of the BMD measurement. This study also highlighted that HRpQCT can detect differences in bone microarchitecture that DEXA does not measure. The authors concluded that premenopausal women with a recent distal radius fracture have similar BMD measures but their bone microarchitecture was of poorer quality than the control subjects, suggesting that more needs to be done to identify patients who are at risk of osteoporosis, before menopause, to initiate early diagnosis and treatment.

The growing incidence of osteoporosis as an issue in New Zealand and internationally has been identified with the subsequent costs, both individually and on a national and international financial level presented. Diagnosing osteoporosis can be seen as problematic, largely due to the cost of the primary diagnostic tool, however there is hope for new diagnostic tools to address this barrier.

1.4 Osteoporosis Treatment Options

While there are recognised and well-established treatment options for people with osteoporosis, there are barriers, both extrinsic (medication side effects) and intrinsic (patient compliance with treatment), that need to be acknowledged. Treatment options, barriers and issues related to anti-osteoporosis treatment are identified and further discussed.

While calcium supplementation has been shown to be of modest benefit for osteoporosis prevention (when combined with vitamin D), Cano et al. (2018) discuss that there is debate

regarding calcium supplementation for osteoporosis and cardiovascular risk. Cano et al. (2018) identify that a 2010 meta-analyses of RCT's (Bolland et al., 2010) indicated an increased risk, however two subsequent meta-analyses by Wang, Manson, and Sesso (2012) and Lewis et al. (2015) were not able to find an association between calcium supplementation and increased cardiovascular risk.

A review of current available osteoporosis treatments by Ishtiaq, Fogelman, and Hampson (2015) discusses anti-osteoporosis treatment options. Bisphosphonates are "anti-resorptive" treatments, which increase BMD by inhibiting bone resorption leading to reduced fracture risk. They are the first line of treatment, but can cause issues due to gastrointestinal side effects, and are also associated with other (rare) side effects such as osteonecrosis of the jaw. For these reasons, their utility as a primary treatment for osteoporosis can be problematic (Ishtiaq et al., 2015). Anabolic therapy, such as Teriparatide (an endogenous parathyroid hormone) that increases bone mineral density and bone strength by increasing bone formation is another treatment option (New Zealand Formulary, 2017). However, the issue with anabolic therapy is the need for daily subcutaneous injections, with risks associated with prolonged use, as well as risk of osteosarcoma (Ishtiaq et al., 2015).

The New Zealand Formulary (2017) identify the use of the bisphosphonates as well as the use of hormone replacement therapy as effective treatments for post-menopausal osteoporosis. This is reiterated by Osteoporosis New Zealand (Osteoporosis New Zealand, 2017) who highlight that first line treatment of osteoporosis are oral or intravenous bisphosphonates, or oestrogen therapy, with second line treatments including anabolic therapy. Anabolic therapy is available in New Zealand for those patients who sustain further fractures despite having received bisphosphonate treatment for 12 months or more (Health-Pathways, 2016).

Hanley et al. (2017) highlight that the benefit of bisphosphonates is that, unlike other treatments, bone changes that occur with treatment continue even after the treatment has been stopped, which suggest that it is feasible to prescribe "bisphosphonate holidays" for patients who are at low risk of fracture (as evaluated by DEXA scan scores) and have been compliant with treatment for a period of 3-5 years. Currently, however, there is no consensus on how long treatment discontinuation should last, as this can vary from 1-3 years depending on which bisphosphonate is being utilised (Hanley et al., 2017). However, when examining

the impact of cessation of hormone replacement therapy (HRT) treatment, Tremollieres, Pouilles, and Ribot (2001) undertook a retrospective analysis of 50 women attending a menopause clinic to identify the rate of bone loss experienced by postmenopausal women after ceasing HRT. This analysis highlighted that the bone loss experienced by women who discontinued HRT is equal to the bone loss experienced by postmenopausal women who have not had HRT within the first two to five years after menopause, with the bone loss at two years being the most significant. Tremollieres et al. (2001) concluded that this transient acceleration of bone loss post HRT needs to be considered when planning to stop HRT, identifying the need to follow up patients for several years post cessation of HRT to assess fragility fracture risk.

In a further discussion on the use of HRT for osteoporosis treatment, Trémollieres (2019) identified that HRT is efficient, not only to prevent post-menopausal bone loss but also to prevent fragility fractures as there is epidemiological evidence that early preservation of bone mass results in a decreased fracture risk. The use of menopause HRT has declined over the past 10 years due to the results from the Women's Health Initiative Study (WHI) (Writing Group for the Women's Health Initiative Investigators, 2002) which indicated there were safety concerns due to a higher number of reported cardiovascular events, strokes, deep vein thrombosis and pulmonary embolism. However, Trémollieres (2019) urged reconsideration of this decline in use of HRT as the results from the WHI study have been reanalysed and the conclusions have subsequently been updated (Cauley et al., 2003; Jackson et al., 2006) to show that HRT is the only anti-osteoporotic therapy that has a proven efficacy whatever the location of fracture, age of the woman and underlying bone mass levels. Even within the WHI study, the results demonstrated that there was significantly lower rate of fractures when women were treated with menopause HRT. Younger post-menopausal women experience the greatest loss of bone and menopause HRT has been shown to reduce bone turnover, which prevents bone loss and decreases fracture risk. The International Menopause Society consensus statement (De Villiers et al., 2016) proposes that the risks of HRT may be outweighed by the benefits if menopause HRT is initiated either before the age of 60 years or within 10 years after menopause, as well as suggesting that HRT is the only anti-osteoporosis therapy with proven fracture reduction efficacy. Trémollieres (2019) recommended that

menopause HRT be considered as a true primary preventative therapy to maintain bone mass and quality.

Body size is shown to be a major determinant of post-menopausal bone loss, as demonstrated in a random sample of 300 participants in a Finnish population based prospective cohort study of 13,100 women by Saarelainen et al. (2012). The authors demonstrated that there is a positive correlation between high Body Mass Index (BMI kg/m^2) and decreased bone loss in women. Osteopenia may be delayed in women who are overweight, with Saarelainen et al. (2012) proposing that this is due to the higher baseline bone mass at menopause. The authors of the study examined the 10-year time course of bone loss over the period 1989 to 1999, and also predicted the 20-year rate of bone loss. The authors identify that those with a BMI of 30 kg/m^2 have a delayed incidence of bone mass loss (osteopenia) of five years at the spine (compared to two years from those with a BMI 20 kg/m^2), and nine years at the hip (four years for BMI 20 kg/m^2). It is however, unfortunate that the validity of the results is marred as the process of randomising the sample is not described by the authors.

To explore non-pharmacological treatment for osteoporosis prevention, Rong et al. (2016) carried out a meta-analysis of prospective cohort studies (both qualitative and quantitative) to investigate the association between level of physical activity and osteoporosis hip fracture risk in older women. The results from the study indicated that increasing the level of physical activity, within the appropriate range, may reduce the risk of hip fracture, although not wrist fracture. The authors highlight that physical activity is an easy and inexpensive way to improve health, and has the advantage of being a tool that can help prevent post-menopausal bone density loss.

1.4.1 Barriers to Osteoporosis Diagnosis and Treatment

A literature review by Adachi, Josse, and Russell (2011) undertaken to identify barriers to diagnosis and patient adherence to treatment for osteoporosis highlighted that the lack of diagnosis of osteoporosis, both by orthopaedic surgeons and primary care physicians, is a significant barrier to effective fracture prevention. This was also identified by Baek et al. (2009) in a Korean retrospective cohort study, where results indicated that female patients over the age of 50 years sustaining a wrist fracture were less likely to be assessed and treated for osteoporosis than those females who sustain a hip or spine fracture. Baek et al. (2009)

indicated that "despite the ease of identifying high risk patients, and the availability of effective therapies, diagnosis and treatment following fragility fractures remain inadequate" (p.2376).

A narrative review by N. Harvey et al. (2017) identified that public awareness around osteoporosis is too low. There needs to be increasing public awareness of osteoporosis which should lead to people being more active in seeking further assessment and treatment following a fragility fracture. This could support improved patient outcomes as a back-up when the health care professional has not identified any issue. One proposed tool that could be utilised to drive up osteoporosis awareness may be the use of public Disease Awareness Campaigns (DAC) that spell out the risk that "fracture begets fracture" (N. Harvey et al., 2017).

To evaluate the perception of osteoporotic fracture risk and identify possible barriers to diagnosis and treatment, Lewiecki, Leader, Weiss, and Williams (2019) carried out an online survey of 1012 women aged over 50 years of age. The authors reported that due to the lack of public awareness there is a need for more education regarding osteoporosis, in addition to a need to increase awareness that a first low trauma fracture is a sentinel event that requires evaluation and early intervention to prevent further fracture risk. Lewiecki et al. (2019) suggest that increasing patient awareness of osteoporosis risk will enable patients to self-advocate for osteoporosis assessment. Unfortunately, there is no description within this research article that identifies the criteria for selecting participants, and while a response rate of 1012 was obtained there was no identification of how many women were approached to gain this response rate. There was also no identification of where the study participants were located in America, apart from a broad description that participants were American females.

In a 2019 prospective survey of 325 participants by Mora, Blazar, Rogers, and Earp (2019) examining patient's perceived barriers to taking osteoporosis medications, 14% of participants felt they already took too many medications, whereas 10.4% were reluctant due to their fear of the side effects. Unfortunately, the study description did not identify how many patients were approached to complete the survey so there is no clear concept of what type of response rate 325 participants was, and also, the study introduced a bias as it was limited to English speakers only, although there is no identification of the number of non-English speakers who may have fitted the inclusion criteria otherwise.

1.4.2 Osteoporosis Treatment Issues

In a discussion on the risks and benefits of anti-osteoporosis treatment, Hanley et al. (2017) report that long term use of bisphosphonates are associated with an increased risk of subtrochanteric fractures (atypical fractures) and this accounts for 4-10% of all femoral fractures. The authors present the possibility of treatment holidays to help mitigate this risk. Another issue with bisphosphonates is the possibility that they compromise fracture healing rates, leading to clinicians being wary of prescribing them.

Rozental, Vazquez, Chacko, Ayogu, and Bouxsein (2009) undertook a study comparing wrist fracture healing rates for patients who were already on bisphosphonates prior to the injury with those patients who were not treated with bisphosphonates. Rozental et al. (2009) reported results that showed a small difference in fracture healing time, however they noted that this difference of less than a week was not clinically significant. Gong et al. (2012) undertook a randomised controlled study to examine whether early (two weeks) initiation of bisphosphonates post-surgical fixation of a wrist fracture versus medication, commenced at three months post fixation, had an impact on fracture healing. The authors identified that there were no significant differences, either clinically or radiologically to the post-operative outcomes in both groups, with the mean times to radiological union being 6.7 and 6.8 weeks respectively. Gong et al. (2012) did however identify that their study was limited by the small sample size (30 patients in each arm), that only one type of bisphosphonate was utilised, initiation of therapy was post-operative only and the follow up was only for six months. Interestingly, a systematic review by Molvik and Khan (2015) indicated that the results from these studies showed healing rates for wrist fracture patients taking bisphosphonates were significantly longer, which is in contrast to the actual results reported in Gong et al's study. From this, it can be concluded that evidence on the use of bisphosphonates and its association with healing time is mixed, highlighting the need for further research.

In a French 2006-2013 epidemiological, longitudinal retrospective study of 1387 participants exploring osteoporosis treatment initiation and persistence, Belhassen et al. (2017) reported that patient compliance with anti-osteoporotic treatment in France is relatively low, and a high number of patients switch or stop taking the medication. A literature review by Adachi et al. (2011) highlighted that patient non-compliance to taking the prescribed medication is an issue with all chronic diseases and suggest that one reason for non-compliance is a lack of

knowledge around the importance of fracture and osteoporosis prevention. This is further supported in a qualitative study by Sale et al. (2011) that examined the patient experience in regards to deciding to commence and continue with anti-osteoporosis medication, highlighting that health care providers should be aware of the different ways that patients make decisions. Along the same theme as Sale et al's study, Majumdar et al. (2014) undertook a secondary analysis of two previous studies (one controlled pilot study and one randomised controlled trial) to identify modifiable patient related factors in relation to anti-osteoporosis treatment. The authors discuss that the patient perspective is particularly important as the acute fracture event provides the opportunity for a "teachable moment", where patients may be more receptive to osteoporosis education, investigation and treatment. The results of this analysis highlight that patients need to have a good degree of knowledge of osteoporosis, diagnosis, and treatment options to enable clinicians to facilitate ongoing positive treatment behaviours. The authors identified that limitations of their study include the inability to know if there is a cumulative effect of the knowledge that is gained incrementally.

Sale et al. (2012) also undertook another qualitative study to assess why older adult patients who sustain a fragility fracture do not see their fracture as being connected to underlying bone fragility and health. The study results identified that patients saw their injury as a traumatic event, not connecting it to a 'fragility' fracture, which impacts on their willingness to commence or continue anti-osteoporosis medications. Conversely, Baek et al. (2009) suggest that patients who have sustained a wrist fracture may not view this as a serious event, and as such are less willing to pay for a DEXA scan or commence treatment. Sale et al. (2012) suggest that health care workers rephrase how they label fragility fractures. The value of both studies is in highlighting to clinicians of the need to be aware of how patient's perceptions of their injury has an impact on their willingness to commence and continue medications to reduce future fracture risk.

Continuing on from the previously described studies, a grounded theory study of 12 participants who had sustained an upper extremity fracture undertaken by Wozniak et al. (2017) aimed to understand how patients decide to persist with, or stop osteoporosis treatment. The study identified three key themes. The first theme was that patients did not perceive osteoporosis as a serious health condition, especially when compared with cancer. The second theme was that patient's compliance with treatment was due to how they

perceived the balance of risks and benefits of treatment, including fracture risk and side effects. The third theme was that even after a year of treatment, patients re-evaluated their osteoporosis risk versus treatment risks, with treatment being viewed as 'optional' because osteoporosis is not viewed as a life-threatening disease. Wozniak et al. (2017) suggest that healthcare providers could focus on ensuring patients are aware of the risks of untreated osteoporosis, as well as the favourable risk to benefit profile of osteoporosis treatments.

Barrionuevo et al. (2019) undertook a systematic review of 26 studies of postmenopausal women that were both qualitative and quantitative in design, to ascertain what was known about the values and preferences women have in osteoporosis management. Barrionuevo et al. (2019) found that in general women preferred medications that were required to be taken less frequently, even if this meant opting for an injectable route over an oral route. In exploring women's decision making, Barrionuevo et al. (2019) identified that women gave equal consideration to the effectiveness of the treatment and the side effects, while cost and duration of therapy were considered less important. However, convenience, in terms of medication frequency as it impacts on daily life, is given consideration. The authors concluded that there is a need for further studies to be undertaken on patients' values and preferences to help guide decision making in osteoporosis treatment. Although, it is unclear whether it is to guide the patients or the clinician in the decision-making process.

While there are well established treatment options for osteoporosis, there remain barriers to assessment and treatment of osteoporosis such as a lack of public awareness, treatment side effects, as well as patient perceptions of osteoporosis. There also remain issues in patient compliance in commencing or continuing with the anti-osteoporosis medications, as this is a common theme in the published literature.

1.5   The Primary and Secondary Care Context on the Global Stage

It has been established that there is a link between an initial low trauma fracture and subsequent fracture, and the need to ensure these patients are followed up to prevent a subsequent fracture. The following discussion will explore what is currently happening both in New Zealand and globally regarding follow up for fragility fractures.

In a 2012 report from Osteoporosis New Zealand, Mitchell et al. (2012) indicate that people who sustain a fragility fracture will present to medical services, be it the primary or secondary health care system, thus offering an opportunity for health care providers to intervene and prevent any subsequent fractures. Mitchell et al. (2012) propose that as healthcare providers, the priority needs to be to "respond to the first fracture to prevent the second" (p.5).

In a study by Kimber and Grimmer-Somers (2011) the concept of the "fracture cascade phenomena" is presented. This concept recognises that the single biggest predictor of fracture risk in a ten-year period is a previous fragility fracture, and that early detection and management of osteoporosis significantly reduces the likelihood of future fractures. This study investigated the implementation of a comprehensive clinical pathway to identify and manage patients at risk of osteoporosis. Kimber and Grimmer-Somers (2011) conclude that this process requires a multifaceted approach, with the need for repetitive and ongoing strategies to improve practice, as although there were observable improvements in processes and outcomes, some behaviours regressed to pre-implementation baselines once the active implementation phase was complete. This study's key message from this was that at without ongoing focus, positive changes may only be transient.

A multinational survey by Dreinhöfer et al. (2005) explored the current care of osteoporosis fractures in a range of countries with different health care systems. The survey was sent out to professional orthopaedic surgeon organisations in France, Italy, Germany, Spain, the United Kingdom and New Zealand. While most of the respondents held the opinion that orthopaedic surgeons were responsible for identifying and initiating assessment of osteoporosis risk in patients presenting with fragility fractures, only 10% actually ensured that patients who had surgery for a fragility fracture were referred for a BMD test. From this survey it was concluded that up to 95% of patients with fragility fractures are discharged from orthopaedic care without any investigation into the cause of the fracture. Although this study is relatively old, it is one of only three studies (one unpublished) found in the literature search that has a New Zealand component to it. The high survey response rate (response rate of 20-28% from the European countries, and 70% from New Zealand) strengthens the validity of this study, and is one of the key articles in my literature review.

In a quantitative survey sent out to Orthopaedic surgeons and General Practitioners (GP's) in hospitals in Northwest England, Chami, Jeys, Freudmann, Connor, and Siddiqi (2006) explored the current practice of orthopaedic surgeons and GP's to ascertain whether patients with a low trauma fracture were being investigated for osteoporosis. There was an excellent response rate with 84% of orthopaedic surgeons, and 81% of GP's responding. As discussed by other authors (Dreinhöfer et al., 2005; Earnshaw, Cawte, Worley, & Hosking, 1998; Kimber & Grimmer-Somers, 2011; Mallmin et al., 1993), a low trauma wrist fracture in a patient's over the age of 50 years indicates a high risk of underlying osteoporosis, and thus a high risk of further fractures. It has been reported that 1 in 3 women, and 1 in 12 men will have an osteoporotic fracture in their lifetime (Chami et al., 2006). A high percentage of respondents (81% and 96% respectively) recognised that low trauma fractures in patients over 50 years of age required investigation for osteoporosis, however neither group regularly investigated these patients. Chami et al. (2006) highlight that GPs needed to be aware of deficiencies in the health system, and be proactive in investigating patients with fragility fractures, also proposing that orthopaedic surgeons need to at least highlight these at-risk patients to the GP's. This study, with its high response rate adds value to the current body of knowledge and has provided a framework for my research question.

In an unpublished retrospective note review (presented at the New Zealand Orthopaedic Association (NZOA) annual scientific meeting in October 2007), Stracey and Bossley (2008) investigated the rates of investigation and treatment of osteoporosis in eight New Zealand in-patient orthopaedic units for patients admitted with fragility fractures. Stracey and Bossley (2008) identified that there were low rates of investigation of osteoporosis, concluding that while osteoporosis is an important disease with a significant impact on the community, the rates and recognition of it by New Zealand orthopaedic surgeons is modest, at best. The units demonstrating the most favourable results were those that had input from the ortho-geriatrician team, although as this service only caters for patients with hip fractures, patients with other fragility fractures are reliant on the orthopaedic surgeon recognising the risk (Stracey & Bossley, 2008).

In an American prospective randomised intervention undertaken by Rozental, Makhni, Day, and Bouxsein (2008), the authors had two aims; to determine the rate of evaluation and treatment of osteoporosis following wrist fracture, and also to compare the difference in

diagnosis and treatment rates when BMD testing is ordered by an orthopaedic surgeon versus a letter sent from the orthopaedic surgeon to a primary care physician. Rozental et al. (2008) concluded that current levels of evaluation and treatment remain unacceptably low although patients who undergo BMD testing are more likely to be treated for osteoporosis. Following on from the previous work, an Irish RCT study undertaken in 2012 (Queally, Kiernan, Shaikh, Rowan, & Bennett, 2013) investigated assessment and treatment rates for osteoporosis in patients who were referred for a BMD test directly from the fracture clinic, compared to patients being referred to their GP for management. As with the study by Rozental et al. (2008), the rates for BMD testing were higher in the intervention group. The result showed that direct referral for DEXA scan was highly effective in increasing the rates of osteoporosis diagnosis and treatment, compared to referring the patient directly to their GP. As in other studies (Mammel, 2011; Rozental et al., 2008), the authors demonstrated how a small cost-effective change in practice could result in a significant improvement in osteoporosis treatment. These studies highlight that while big changes may be needed, small changes could have a positive effect as well.

A New Zealand retrospective review of all patient presentations in 2011 at Auckland City Hospital was undertaken by Braatvedt et al. (2017) and identified that approximately 1 in 18 patients over the age of 50 years presented with a potential fragility fracture. This number reinforces the urgent need for secondary prevention care, such as a fracture liaison service, to be instituted as the review identified that there was insufficient implementation of secondary prevention strategies (Braatvedt et al., 2017).

While awareness of the need for specialised follow up processes for osteoporosis diagnosis and treatment is well established, the research has identified that worldwide, these processes may not be occurring consistently, to the detriment of secondary fracture prevention measures.

1.6   Fracture Liaison Services

The literature described in the preceding section has identified that there are confirmed gaps in assessing patients who are at risk of osteoporotic fractures, which highlights the need for specialist fracture follow up service to address this treatment gap. The effectiveness of

specialised services to follow up patients who sustain a fragility fracture is discussed in the following section.

The International Osteoporosis Foundation (IOF) highlights that less than one third of fragility fracture patients worldwide receive a comprehensive osteoporotic evaluation and subsequent treatment, and identify the need to raise global awareness on secondary fracture prevention (Akesson et al., 2013). This need led to the development of the "Capture the Fracture" position paper, detailing a secondary fracture prevention framework and campaign (Akesson et al., 2013), which is viewed by the IOF as the single most important act to directly improve the care of patients worldwide with fragility fractures, as well as addressing the increasing costs of fracture care. This framework details the need for coordinated, multi-disciplinary Fracture Liaison Services (FLS), as a means to not only identify but also treat fragility fracture patients. To support this need, the framework provides the evidence on international standards of care and practical resources with the aim of closing the secondary prevention care gap. The goal of the Capture the Fracture framework is to enable clinicians to work together to ensure that every preventable fracture is prevented (Akesson et al., 2013).

In a discussion paper by Mitchell (2011) reporting the United Kingdom experience of fracture liaison services (FLS), the author discusses the advent of FLS. The FLS model was first established in the teaching hospitals of Glasgow, Scotland in the late 1990's, with the intention of offering post fracture services to all individuals over 50 years. The model involves a nurse specialist supported by a lead osteoporosis clinician. Mitchell (2011) reports on a 2004 Scottish audit that identified 95% delivery of preventative care for wrist fracture patients from a FLS versus less than 30% for other service structures. Mitchell (2011) also reports on a 2009 independent review of the Glasgow osteoporosis and falls strategy that identified a reduction in hip fractures of 7.3% over the period 1998-2008 while in the same period, hip fracture incidence increased by 17% for the English population. This result is strongly indicative of the effectiveness of Fracture Liaison Services.

When discussing the need for programs to address the prevention of secondary fractures, Ganda (2015) in an Australian and New Zealand Bone Mineral Society Position paper on secondary fracture prevention identifies that up to 50% of those patients presenting with a

fractured hip will have previously sustained a low trauma fragility fracture. Ganda (2015) suggests that if osteoporosis and falls prevention programs are instituted, the risk of these future fractures can be reduced by up to 80%. The mainstay of any secondary fracture prevention programs (SFP) is summarised by Ganda (2015) as the three I's, *Identify*, *Investigate*, and *Initiate*. Central to this is the presence of a coordinator who can oversee all aspects of the SFP (also called Fracture Liaison Service), and multi-disciplinary team involvement. In investigating cities worldwide who have successfully instituted SFP/FLS programs, health care cost savings have been demonstrated, and an increase in the number of patients at risk of fragility fractures have been identified and treated. Despite a New Zealand Ministry of Health directive in 2014 that implementation of a FLS is mandatory for all DHB's, at the time of Ganda's report only 6 FLS's had been established in New Zealand. A subsequent 2018 report released by the Australian and New Zealand Hip Fracture Registry (2018) indicated the number of hospitals across Australia and New Zealand as having a FLS in 2018 was 36% (of 118 hospitals), which, although increased from 33% in 2017 indicates that while these services are being implemented, this is occurring slowly.

Eekman et al. (2014) undertook an observational study investigating the response rate of 2207 fragility fracture patients over 50 years who were invited (either by mail or personally) to attend a FLS at four Dutch hospitals, and also followed up those who did not respond to the invitation. The authors reported that wrist fracture patients were more likely than hip fracture patients to respond to the invitation. In discussing the reasons for non-responses, the authors identify mobility issues as one reason for not attending the clinic, and this was higher for hip fracture patients, highlighting the need for an effective strategy to increase attendance in this patient cohort. The major findings of the study indicated that inviting older adult fracture patients to attend a FLS does lead to a substantially increased response rate as well as extra diligence to taking anti-osteoporosis medication, especially in patients with good mobility and those who had sustained a wrist/ankle fracture.

In 2014, Sarfani, Scrabeck, Kearns, Berger, and Kakar (2014) undertook a pre and post implementation review, first establishing a baseline of osteoporosis screening rates prior to implementing a four month quality initiative for patients over 50 years who present with a wrist fracture. The introduced initiative involved approaching patients with a wrist fracture who met inclusion criteria attending the hand surgery clinic at six weeks post injury, although

the authors do not identify if patients were treated either operatively or non-operatively. The initiative was discussed with the participants and a DEXA bone scan was offered. The screening was undertaken by orthopaedic staff and treatment decisions were made by an endocrinologist. Those patients that declined the specialised follow up and scan were contacted by telephone and given more information. The post implementation results highlighted that an integrated model of care between orthopaedics, endocrinologists and patient educators can increase osteoporosis screening rates for patients presenting with a wrist fracture. Although the authors identify some limitations, given that this an American study, acknowledgment of the funding required for patients to have a DEXA scan, beyond a brief mention that insurance issues led to some patients declining, would have been of benefit.

In a randomised controlled pilot study undertaken by Majumdar et al. (2010), the authors reported that few outpatients with wrist fractures are treated for osteoporosis in the years following the fracture. Majumdar et al. (2010) demonstrated the effectiveness of having a nurse case manager follow up these patients to increase osteoporosis screening and treatment rates. A 2015 audit undertaken by Chan, de Lusignan, Cooper, and Elliott (2015) hypothesised that a Fracture Liaison Nurse (FLN) utilised in secondary care could also improve both the detection of fragility fractures and treatment for people with osteoporosis in primary care. The results of the pre and post implementation audit showed there was a statistically significant improvement in the recording of fractures and fragility fractures (rates nearly doubled) and concluded that presence of a FLN was associated with a period of improved management (Chan et al., 2015).

In a New Zealand analysis of the Fracture Liaison Service (FLS) at Waitemata District Health Board undertaken by Kim, Mackenzie, and Cutfield (2016) it was reported that even a 0.5 FTE (full time equivalent) FLS coordinator results in a positive impact on the population at risk of secondary fragility fractures. The FLS nurse coordinator identified and assessed over 300 patients over a 12-month period, 40% had a DEXA scan, 50% were commenced on bone protection treatment, and 100% had one to one education on their condition and future prevention strategies, although the authors did not identify whether this had an ongoing positive impact. Kim et al. (2016) concluded that nationwide implementation of secondary prevention programmes by individual District Health Boards (DHB's) is possible with the

implementation of a dedicated FLS coordinator. While each DHB may plan and fund their own prevention programme, Kim et al. (2016) proposed that funding and strategic planning support from central government level would allow for a speedier and smoother implementation process.

Results of a 12 month post implementation audit of a best practice framework for FLS worldwide discussed by Javaid et al. (2015) indicate that avoidable secondary fractures are a consequence of the gap between diagnoses and follow up fracture services. This places a burden on patients, families, healthcare services and society. The aim of this study was to identify if it was possible to benchmark FLS's worldwide using the best practice framework standards (BPF) constructed by the International Osteoporosis Foundation (IOF) to ensure that FLS met recognised quality standards. A total of 60 hospitals across six continents completed a questionnaire to evaluate the framework, with the results showing that it was possible to benchmark services internationally using a single tool, despite the variations between different health care systems. The authors identify limitations including that the questionnaire was only available in the English language, and that as the questionnaires were self-reported, the authors were unable to verify the responses. In a subsequent 2018 review of the IOF best practice standards and their applicability to the Asia-Pacific region undertaken by Chan et al. (2018), the authors state that input from experts throughout the Asia-Pacific region indicate that the standards are in general applicable to the Asia-Pacific region. However, it is disappointing to note that there was no identified expert, either invited or unavailable to attend, that represented the specific New Zealand perspective for this review.

In preventing and managing osteoporosis, there are 3 key lifestyle factors that have a positive impact; calcium intake, vitamin D and exercise. Inadequate vitamin D levels have an impact as it can reduce gut absorption of calcium by up to 50% (Daly, 2018). To investigate the impact of a FLS on the rates of vitamin D supplementation for post-menopausal women, Amouzougan et al. (2015) undertook a study comparing vitamin D blood serum levels over an eight year period of 1486 women attending a FLS in France, and reported that vitamin D supplementation in osteoporotic women is now widely integrated into current practice, and extrapolate this to conclude that this demonstrates the positive impact of a FLS. This was demonstrated using measured blood levels of vitamin D over that period, comparing the first four years of the study with the following four years and finding that serum vitamin D levels

had increased. While the authors identify limitations to the study, as this study involved blood tests, discussion regarding the ethics process should have been included as it is unclear whether it is standard to take these tests, and whether the study population was informed that they were being studied.

Axelsson, Jacobsson, Lund, and Lorentzon (2016) investigated the effectiveness of a minimal resource FLS by comparing post implementation patients with patients who were seen prior to implementation, to identify whether this had a positive impact on osteoporosis investigation and treatment rates. The results of the study showed a 51% reduction in the risk of new fractures, by utilising "secretaries" in the emergency department and orthopaedic clinic to identify at-risk fracture patients and ordering the DEXA scan and FRAX assessment. The DEXA scan and FRAX was carried out by an experienced nurse and an endocrinologist evaluated the DEXA scan and FRAX score results and sent recommendations for treatment to the primary care physician. The fracture risk reduction was obtained from comparison of a total of 5329 patients, 2713 from the pre-implementation control group of 2011-2012, and 2616 from the intervention group for the period 2013-2014, and demonstrated that the treated group of patients had a significantly lower fracture rate of 6.6% (as compared to 8.8%) as well as a longer time to fracture of 294 days (compared to 185 days). The authors identify that "secretaries" were responsible for the evaluation; however it is not clear if this is the equivalent of New Zealand non-clinical reception/administration staff. It would therefore have been of value to have included a brief explanation of the standard duties for these roles, to enable a true comparison to the New Zealand context.

In a comparison of the costs for two cohorts of patients with low trauma fracture attending an emergency department (ED) (usual care with no FLS; treatment group with an available FLS) Major et al. (2018) noted that the patients attending the ED with a FLS had 62 fewer fractures per 1000 patients, which lead to a cost saving of (Australian Dollars) $617,275 for the health service. This led the authors to conclude that investing in a FLS can be an effective way to reduce the financial impact of osteoporosis. The importance of working to address the financial impact of the predicted increase in future fragility fractures is vital as Dawson-Hughes, Fuleihan, and Clark (2013) describe the predicted increase as an impending "tsunami", which is positioned to be a substantial threat to health budgets worldwide.

To identify the effectiveness of two different types of FLS in a Canadian Hospital, Majumdar et al. (2018) carried out a pragmatic patient level parallel arm comparative effectiveness trial, comparing a low intensity "Active control" FLS (patients identified and referred to their primary care provider) to a high intensity FLS with a case manager to coordinate care. While the results from the 361 participants showed that both interventions led to improved osteoporosis care, the case manager intervention was significantly better, with a result of 76% of patients identified as having received the appropriate care, compared to 44% of the low intensity FLS. Majumdar et al. (2018) concluded that while the results support the use of a case manager for FLS, there was still value in the use of simpler methods to improve secondary fracture prevention, when resources are firmly limited. This was also the conclusion reached in a further study by Majumdar et al. (2019) assessing the cost effectiveness and health outcomes of the two previously identified models of osteoporosis care compared with usual care (no FLS). The results highlighted that compared to usual care, the case manager led FLS saved $564,000 Canadian Dollars (CAD), patients gained 14 Quality Adjusted life Years (QALY's) and there were 18 less fracture per 1000 patients. Compared to active control, the case manager FLS saved CAD$333,000, patients gained seven QALY's and there were nine less fractures per 1000 patients. Active control compared to usual care showed a cost saving of $231,000 CAD, seven QALY's were gained and nine less fractures per 1000 patients were incurred. Majumdar et al. (2019) concluded that while both interventions were cost effective, reduced fracture incidence and increase quality of life for older patients, the Case manager led FLS was the most cost-effective intervention.

A systematic review evaluating the economic impact of a FLS carried out by Wu et al. (2018) involving 23 studies, demonstrated that FLS is cost effective when compared to usual care or no treatment, regardless of what type of FLS program is instituted or in which country. While there are additional costs for FLS this is offset by the lower costs associated from a reduction in fractures and thus the care required. Wu et al. (2018) conclude that FLS will likely become more cost-effective as the costs for fracture care increase.

The value of an established fragility fracture wrap around service such as a FLS to ensure that patients who are at risk of osteoporosis are identified, assessed and treated has been reinforced by the literature. The challenge now going forward is to ensure broad

[30]

implementation of this service across the relevant health care providers to reduce secondary fragility fracture incidence.

1.7 Conclusion

There is a wide body of evidence available reporting the incidence of fragility fractures and discussing their relationship with osteoporosis and future hip fracture risk. In addition, the individual and economic costs of fragility fractures have also been identified. Prevention of future osteoporotic fractures relies on timely assessment, diagnosis and treatment of at-risk patients. There is clear evidence showing implementation of a FLS, irrespective of the staffing model used, ie case manager versus FLN, has a positive impact on the rates of assessment and treatment of osteoporosis with some studies highlighting that small cost-effective changes can make a big difference in osteoporosis care.

Currently, there is New Zealand specific research content that quantifies the economic burden of osteoporosis in New Zealand (Brown et al., 2011) and identifies the need for secondary fracture prevention in New Zealand (Braatvedt et al., 2017; Ganda, 2015; Mitchell et al., 2012). A literature source from New Zealand also highlights the positive impact of implementing a FLS nurse coordinator (Kim et al., 2016) There is unpublished research (Stracey & Bossley, 2008) that identifies the investigation rates for osteoporosis in New Zealand inpatient orthopaedic units, and a multinational study (Dreinhöfer et al., 2005) with participation from New Zealand orthopaedic surgeons that examined the rate of referral for further osteoporosis investigations. What remains, is a current literature gap relating to New Zealand specific (or based) research that identifies and describes practice within primary health care regarding osteoporosis follow up and assessment following a potential fragility fracture.

Chapter 2   Methodology and Methods

2.1   Introduction

This chapter discusses the methodological elements of the research processes that have been undertaken. The main purpose of this study was to explore current practice processes within the Wellington general practitioner community regarding patients who present with a low trauma wrist fracture, in the context of possible osteoporosis. A quantitative descriptive cross-sectional survey was conducted to achieve this goal. This chapter will highlight the research aim and objectives, then discuss the research methodological approach. This will be followed with further detailing of the methods utilised, including description of the sample population and recruitment process. A summary of the data handling and data analysis processes is also included. Finally, the chapter will conclude by describing the ethics application and approval process followed for this work. Discussion of the core principles of ethical research, and the Treaty of Waitangi principles are discussed in the context of this research work.

2.2   Research Aim and Objectives

The aim of this study was to explore current primary health care practice regarding osteoporosis assessment following a low trauma wrist fracture in people aged 50 years and above, within a New Zealand setting, with a focus on the Wellington Region.

The research objectives for this work were:

- To explore the current processes undertaken when patients aged 50 years and above with a potential fragility wrist fracture are treated in the primary health care setting in the Capital and Coast District Health Board, and to understand the role of osteoporosis assessment in this context.
- To understand the role of communication and discharge summaries between secondary and tertiary care centres, and primary health care centres in the Wellington Region in this context.

- To identify any barriers as perceived by GP's concerning osteoporosis diagnosis and treatment in this context.
- To identify the educational resources used and referred to by GPs to further support their knowledge base with regards to osteoporosis.

2.3 Methodological Approach

A quantitative research approach was used to address the research aim of exploring current primary health care practice regarding osteoporosis assessment in people aged over 50 years in Wellington. In a broad sense, quantitative research involves the use of deductive reasoning to move from a broad theory to a specific research question that leads to clearly defined aims, which can be answered using specific data questions (Rudestam, 2015). This approach utilises numbers as a means to answer the research question (see Claydon, 2015; Liamputtong, 2013). A quantitative research approach is appropriate as a method when some degree of pre-existing knowledge is already present (Bowling, 2014, p. 215). A quantitative research approach for this study is supported by the pre-existing body of knowledge regarding osteoporosis risk and fragility fractures. Specifically, a quantitative descriptive design utilising a cross sectional online survey was employed to identify and understand current practice and follow-up processes applied when patients over 50 years of age present with a wrist fracture within the GP community in the Wellington region.

2.4 Study Method

The following description of the method undertaken for this study is reported using the guidelines of STROBE recommendations for reporting observational studies (Vandenbroucke et al., 2014) (Appendix A).

2.4.1 Survey Method

The method utilised for data collection was a cross sectional online survey questionnaire (Appendix B), to enable data capture at one point in time (Bowling, 2014; Creswell, 2014, p. 157). The advantages of using survey questionnaires such as the data collection method include ease of execution, cost-effectiveness, and enabling access to large numbers of participants, in addition to ensuring participant confidentiality (Bowling, 2014; Youngshin, Youn-Jung, & Doonam, 2015). There are, however, some weaknesses associated with online

questionnaires, as due to specific response options, participants might select an answer that is not precisely how they would have preferred to answer (Bowling, 2014). It is important to ensure the survey will measure what it is intended to measure, as the rigour of any research is directly related to the overarching study design, including questionnaire design (Claydon, 2015; Youngshin et al., 2015). Survey validity is addressed further in Chapter 2.4.4. The survey tool utilised for this study was piloted with 4 medical professionals currently involved in caring for patients with osteoporosis. All the questions included in the survey were based on validated questionnaires. With this project work being a Masters level project, there were attendant limitations in scope for the study, due to the requirements of the degree qualification. The study questionnaire was accessed and completed by participants using a specific link to the Qualtrics online survey website which was provided on the participant invitation letter that was sent electronically. Buchanan and Hvizdak (2009) and Cope (2014) identify online surveys as a convenient, cost-effective and time saving tool for permitting rapid distribution of a survey within a study population. Cope (2014) highlights that electronic surveys also offer the protection of anonymity for participants to answer potentially difficult questions. The advantages described here form the rationale for the survey method selection, although there is a need to acknowledge that there are issues in motivating a potential survey population after invitation to participate in online surveys. In a study examining the willingness of individuals to participate in health research, Glass et al. (2015) demonstrated that participants younger than 60 years of age preferred to complete surveys online, whereas people over 60 years old of age were more inclined to prefer postal surveys. Glass et al. (2015) suggest that participation rates can be improved by offering participants a choice in how to complete a survey. A meta-analysis undertaken by Cho, Johnson, and Vangeest (2013) indicated that survey response rates from health care professionals (physicians, nurses and allied health professionals) are usually limited and continue to decrease over time, demonstrating that postal surveys appear to be more effective in obtaining acceptable response rates when compared to online or web-based surveys. While monetary incentives can help increase response rates, non-monetary incentives make no difference, with the use of follow up reminders to encourage survey completion and deadline reminders supporting increased response rates (Cho et al., 2013; Cope, 2014).

2.4.2 Study Setting

The local setting for this quantitative cross-sectional study was the GP population within the Capital and Coast District Health Board region (CCDHB) in Wellington. This population was selected as Wellington represents an array of GP primary health care centres centrally located within this region, and the location was within the researcher's own domain, enabling support for access to the population to be surveyed. The researcher was also already familiar with the infrastructure required to undertake this work, and had pre-existing working relationships with experts, from both within and outside of the Wellington region.

2.4.3 Study Population

The study population included all currently practising General Practitioners (GP's) working at primary health care centres in the CCDHB region. The inclusion criteria indicated currently practising GP's, including full and part time permanent, and locum staff were eligible to participate. Currently, there are 68 primary health care centres and 313 practising GP's in the CCDHB region (personal communication, Royal New Zealand College of General Practitioners (RNZCGP), October 22nd 2016). The final numbers of primary health care centres invited to participate in this online survey, was 60 practices with 297 general practitioners employed at those practices. The chosen survey sampling method was direct element (also known as census sampling). This sampling method was selected as it is suitable for a set population, such as all Wellington GP's, and enabled every person within that population to participate in the research (DJS Research, 2017, para 1) to maximise recruitment. Discussions with the University statistician connected with this work indicated the anticipated response rate for the study sample would be approximately 20%. Published research also indicated that low response rates may be obtained when surveying GPs (Pit, Vo, & Pyakurel, 2014; VanGeest, Johnson, & Welch, 2007). Within the constraints of this study, there is potential bias due to only those participants interested in osteoporosis taking part in the survey and this is identified in the study limitations (Chapter 4.11).

2.4.4 Survey Tool Validity

In aiming to select an appropriate survey tool, the authors of several research studies which used questionnaires relevant to the planned research were approached via email. Unfortunately, no responses were received despite polite follow up email messages. The

survey tool utilised for this study was therefore, constructed by utilising the answers described in the relevant research studies for retrospective extrapolation of the answers, stemming from questions that were likely asked, see (Blazkova et al., 2010; Chami et al., 2006; Khan, Mallhi, Sarriff, & Khan, 2013; Vytrisalova et al., 2014; Vytrisalova et al., 2017).

Validity is described as the ability of a methodology or method to accurately measure what requires measuring (Ellis, 2015). Internal validity refers to the need to ensure the appropriate research approach is employed to answer the research question, while external validity is the degree to which the research results can be generalised beyond that research context (Bryman, as cited in Liamputtong, 2013, p. 16). Four of the selected studies utilised to construct the survey had addressed questionnaire validity within the survey tool description of the articles. Khan et al. (2013) reported a Pearson's r product moment correlation of 0.0869, indicating strong questionnaire stability. This measure indicates test-retest reliability, which is the stability related to questionnaires that are designed to measure interest or attitudes that remain steady across time (Tsang, Royse, & Terkawi, 2017). Blazkova et al. (2010); Vytrisalova et al. (2014); Vytrisalova et al. (2017) reported that the questionnaire used for all three surveys had been constructed following structured interviews with GP's and consultations with osteoporosis specialists. Curran et al. (2017) refer to survey reliability as being a measure of consistency, indicating that a survey should be able to reproduce the same results each time it is used under the same conditions. This means that the same instrument should come up with the same answer when used with the same respondent (Muijs, 2011). To investigate generalisability from the survey respondents results respondents to the whole study population, confidence interval calculations were undertaken on the results for who should lead osteoporosis care, importance of GP role in osteoporosis care and the barrier 'lack of public funding' to further identify the applicability of the results to the Wellington GP population as a whole.

To further ensure validity of the constructed survey tool and to apply 'fine-tuning' prior to distribution amongst the survey subjects (Creswell, 2014, p. 161), this survey tool was piloted amongst 4 medical staff members (a GP, an orthopaedic surgeon and 2 geriatricians) who share a special interest in osteoporosis and the health care of the elderly. This pilot survey effort was to ensure that the questions made sense to the target study population and were

clear enough to prevent misinterpretation. The feedback received from this group was that they considered the survey questions of value, that they made sense and flowed well as part of the survey construct. It is interesting to note that "survey flow" is highlighted by Youngshin et al. (2015) as an important aspect of questionnaire design, to ensure that questions are clear and easily comprehended. The survey tool was adjusted accordingly.

2.4.5 Survey Data Collection

A full list of all GP practices in the CCDHB region was provided by the Decision Support Unit at CCDHB following submission of ethics and locality approval documentation needed for this work. A total of 92 listed practices were listed within the CCDHB region and upon first review, 23 practices were immediately excluded; sports medicine, Acquired Brain Injury (ABI) rehab, Rest homes and hospitals, after-hours clinic, youth clinics, family planning and sexual health, and private specialist clinics and a prison health service. This left 68 practices to follow up by phone. Eight further clinics were excluded following phone calls, after identification as not being appropriate for the study due to not being general medical practices (mental health, natural health, sports medicine, youth health, transient population). The final tally was 60 GP practices who agreed to distribute the survey invitation letter via email to all the GP's in their practice. To capture the number of GP's the invitation would be sent to, all practice managers were asked what number of GP's worked at that practice. A total of 49 practice managers engaged directly with these communication efforts, and a further 11 practice manager emails addresses were kindly supplied following discussion of the study with practice nurses or reception staff. Two emails were constructed, one sent to the practice managers who the study had been communicated with directly, and one for the other practice managers who had not been directly contactable. No replies were received by the researcher in response to the emails sent to practice managers who had not been spoken to directly. The email requested that recipients forward the email onto all the GP's at their practice, as it contained an explanation of the study for the GP's and the survey invitation letter (Appendix C) with the online survey link. The date that the survey was open until was also detailed in the email to the GP's as well as the researchers email contact details. Initial computer issues were experienced by some respondents with the Qualtrics website which two GP's highlighted, however this was found to be related to the type of browser the GP opened the survey in.

Following discussion with Qualtrics support, a further email was sent out 4 days after the initial email, to inform GP's of what browsers were recommended to access the survey.

2.5 Data Analysis

The main aim of this research effort was to identify current practice by understanding and exploring the specific actions and processes undertaken by Wellington GP's when a patient presents with a potential fragility wrist fracture. For this purpose, descriptive statistics (measure of frequency - percentages) were used for the data analysis. Utilising descriptive statistics for this study ensured that as well as being able to compare the study results with the key studies identified by the researcher (Blazkova et al., 2010; Chami et al., 2006; Khan et al., 2013; Vytrisalova et al., 2014; Vytrisalova et al., 2017) this study's results should be relatable to future comparable studies. Statistical input and advice were sought regularly throughout this research undertaking. The survey questions were adjusted based on statistical advice to ensure readability and flow in a pre-pilot, and to ensure that respondents would answer the key questions. The planned approach for analysis of the survey results was also identified prior to commencement of the survey.

Data analysis was carried out using the IBM SPSS Version 25 package. The raw data was downloaded directly from the Victoria University of Wellington's Qualtrics website onto the SPSS package installed on the researcher's computer. Prior to analysis using SPSS, all variables were labelled, data screening and cleaning of errors was then undertaken to ensure accurate analysis of the survey responses (Pallant, 2016, p. 44). Three respondents who did not complete the survey beyond the consent question were removed, leaving 32 survey respondents to be included in the analysis. The raw data was then analysed taking into account that participants had answered the question within the multi-response selections, as well as to reflect missing data from non-responses to questions. Additional data that was automatically downloaded from Qualtrics but not relevant to the survey was also removed at this point, this included IP addresses and dates/time of survey completion that could potentially have identified the respondents. Further analysis of the data was then undertaken, with response percentage calculations obtained for all variables. Variables were described using descriptive statistics. Fishers exact test was used to identify the relationship between the dependent variables 'GP risk factor knowledge' and 'Barriers to osteoporosis

treatment and diagnosis' and the independent variable 'Length of Experience'. This analysis was used as the data was categorical and the sample size was small.

2.6 The Ethics Process

An ethics application was submitted to the Victoria University of Wellington Human Ethics Committee (VUW HEC) and was approved on 11th April 2018, approval number 25465 (Appendix D). Following approval and endorsement from both VUW HEC and Research Advisory Group – Māori (RAG-M) (detailed in Chapter 2.8), an application was made to CCDHB for Locality Approval. Locality approval was required as the senior nursing role the researcher carries within the orthopaedic department meant the likelihood was that information would be accessed and utilised that is unavailable for researchers working outside of CCDHB. CCDHB Locality Approval was granted on 26th April 2018 (Appendix E).

2.7 Ethical Considerations

As a research nurse and researcher, my practice across both domains is guided by the Good Clinical Practice (GCP) principles as identified and described in the Declaration of Helsinki, 1964 (Doenges, 2010). Before commencing the proposed research, application for ethical approval from the Victoria University Human Ethics Committee was made. In addressing research, there are core principles that need to be addressed for ensuring research is undertaken ethically, and Beauchamp and Childress (as cited in Liamputtong, 2013, p. 27) and Liamputtong (2013, p. 27) identify five core ethical principles to be considered and addressed when planning to commence research. These principles are identified and discussed, in relation to this research, below.

2.7.1 Respect for Autonomy (Informed Consent)

Sarantakos (as cited in Creswell, 2014, p. 96) identify the elements required for a participant to make an informed decision to participate as being; clear identification of the researcher, sponsoring institution, study purpose, any benefits of participating; what type of involvement is required from the participant; an absolute assurance of confidentiality, and the right to withdraw from the research at any time without consequences (p.96). Also discussed by Creswell (2014, p. 97) is the need to ensure potential participants are not pressured into

consenting, as participation must be voluntary. As this was an anonymous online survey, the steps leading to a participant proceeding to completing the survey questionnaire were voluntary and this was emphasised within the survey invitation letter. Participant consent was also obtained before the participant was able to proceed through the survey questions.

2.7.2 Anonymity

Anonymity is about ensuring that the participant is not known to the researcher, (Liamputtong, 2013, p. 27) and is therefore unknown to anyone else. The researcher was aware that the research question being asked could be viewed as being critical of primary health care centres, thus creating a reluctance to participate. To help mitigate this, the survey responses were anonymous, and this was explained to the participants in the survey invitation letter.

2.7.3 Justice and Beneficence

The principles of beneficence and non-maleficence recognise that there are both risks and benefits to research for the participant (Liamputtong, 2013, pp. 30-31). Beneficence (Beauchamp and Childress, as cited in Liamputtong, 2013, p. 27) recognises that research provides benefits, if not specifically to the participant, but to the greater good. In the context of this study, the benefit is to the community who is at risk of secondary osteoporotic fractures. The process of undertaking research has potential to create harm. One example involves how data is "collected, stored and published" as participants need to be reassured that the data they provide is accessed only by the researcher, and stored securely (Liamputtong, 2013, p. 30). Data security measures were outlined and addressed within the approved VUW HEC application and explicitly detailed in the survey invitation letter sent out to the survey population.

2.7.4 Human Vulnerability and Personal Integrity

The study population surveyed is not considered a vulnerable population as described by Liamputtong (2013, p. 33), in terms of being unable to fully understand and consent. This particular study population comprising of general practitioners can be considered an intelligent and highly educated group. Voluntary participation was obtained only from those who were willing to give their consent and proceed, and as this was an anonymous survey

sent out via practice managers to GP's, there was no risk of the researcher placing undue pressure on those GP's who did not wish to participate.

2.7.5 Cultural Diversity

The Victoria University Human Ethics policy, standard 3.1e states that "researchers have a responsibility to be sensitive to significant social and/or cultural practices of the communities to which individual participants may belong" (Victoria University of Wellington, 2018, p. 1). Awareness of the socio-economic area that a primary health care service is operating within was always at the forefront of the researchers mind in all interactions with practice managers at the primary health care practices that were contacted, as well as when GP's contacted the researcher for clarification. This enabled the researcher to ensure they were respectful of the behaviours, perceptions and beliefs that were culturally appropriate for each medical practice that the researcher contacted, and in doing so, recognising and acknowledging that that medical practices way of doing things was their cultural reality.

Following in-depth examination of the above five core ethical principles requiring focus prior to the ethics application, and subsequent identification of how these principles are to be addressed for this survey, the researcher sought to attend to the requirements needed to ensure Treaty of Waitangi principles for this work were addressed prior to commencing the study.

2.8 Treaty of Waitangi Considerations for Research

It is important to recognise and acknowledge that all research undertaken in New Zealand is of interest to Māori (Hudson, Milne, Reynolds, Russell, & Smith, 2010). Also, as reported by McNeill, Brown, Radwan, and Willingale (2007), although Māori and Pacific peoples living in New Zealand generally have greater bone density than non-Māori and non-Pacific peoples, osteoporotic fractures in Māori people make up 4% of the total number of people sustaining hip fractures. Therefore, the impact and potential benefits of this work for Māori population health, also align with the benefits for the overall Wellington population, in that by identifying potential issues in osteoporosis diagnosis and treatment, the basis for a plan to address these issues can be formulated for all population groups. To ensure alignment with the Treaty of Waitangi principles from the outset, alongside the VUW HEC application, submission was

made to the Wellington Research Advisory Group – Māori (RAG-M) for endorsement. This application was to ensure that the Treaty of Waitangi principles of Partnership, Protection and Participation, in the context of research, were recognised and addressed prior to commencing the study. The application was also intended to invite engagement with external groups to respectfully indicate the intent to undertake this work, ensure processes were appropriate and also ask for support for this work moving forward. The RAG-M application process also ensures Māori are involvement in the research design, as well as guaranteeing collective and individual Māori rights are respected and maintained throughout the research process (Ingham-Broomfield, 2016). The RAG-M application process ensures that as well as addressing the guidelines published by the Health Research Council of New Zealand (2010), the research process also aligns with the Treaty of Waitangi principles of Partnership, Protection and Participation. Endorsement from RAG-M was granted on the 18th April 2018 (Appendix F).

2.9   Funding

This thesis has been fully funded by the CCDHB Professional Development Unit and Health Workforce New Zealand.

2.10 Conclusion

This chapter has presented and discussed the details of the research processes undertaken for this quantitative descriptive cross-sectional survey work. The main purpose of this study is to explore the current practice within the Wellington general practitioner community regarding patients who present with a low trauma wrist fracture, in the context of possible osteoporosis, to establish a reference point of what is presently happening. The chapter discussion commenced by revisiting the research aim and objectives. The research methodology has been discussed and this has been followed by examination of the method that was selected and the processes undertaken, with support from current literature. The rationale for the sample population selection and the recruitment process undertaken has been examined. There has been discussion on the handling of the data and data analysis that the researcher utilised in obtaining the following results. Finally, this chapter has concluded with identification of the process for obtaining ethical approval. This included identifying and

discussing how the core principles of ethical research, as well as the need to ensure Treaty of Waitangi principles were considered and implemented for the undertaking of this research work.

Chapter 3   Results

3.1 Introduction

The overall intent of this work was to understand and explore current primary health care practice regarding osteoporosis assessment following a low trauma wrist fracture in people aged 50 years and above in the Wellington Region. The following data results have been obtained from the online survey completed by the Wellington GP respondents.

3.1.1 Participants

The survey was sent out to GP's in the Wellington region, by email via practice managers at each practice for distribution. The list of Wellington GP's in the Capital and Coast District Health Board region was obtained from the Decision Support Unit (DSU) for CCDHB. Originally there were 92 practices listed in the report obtained from DSU, however following review, the number of practices contacted was reduced to 60 practices as sports medicine centres, rest homes, family planning centres, prison medical care, After Hours medical centres, natural healing and specialist centres were all excluded. In total the survey was sent out to 297 GP's in the Wellington region comprised of those GP's who were currently practising at the 60 medical centres. One GP practice decided to withdraw their participation in this study bringing the final number of GP's associated with the survey distribution to 289 GP's. The survey link was open for 6 weeks, and reminder emails were sent at 2 weeks, 4 weeks and 4 days prior to the survey link closing. The total response rate was 11.7% (n = 32) from a total of 289 GPs that the survey invitation was sent out to.

Of the 4 respondents who did not complete the survey, one respondent did not answer the "estimated practice population size" question (Figure 5) but then continued to answer questions up until the "steps taken by the GP" (Figure 9) and then dropped out of the survey. One respondent did not complete any survey questions beyond the "estimated practice population size" question (Figure 5). Two respondents did not proceed past the question "steps taken by the GP" (Figure 9). Three respondents did not complete the question regarding "whether the GP would routinely investigate the patient for osteoporosis" (Figure 6), however two of those respondents did continue on to complete the survey questions to the end.
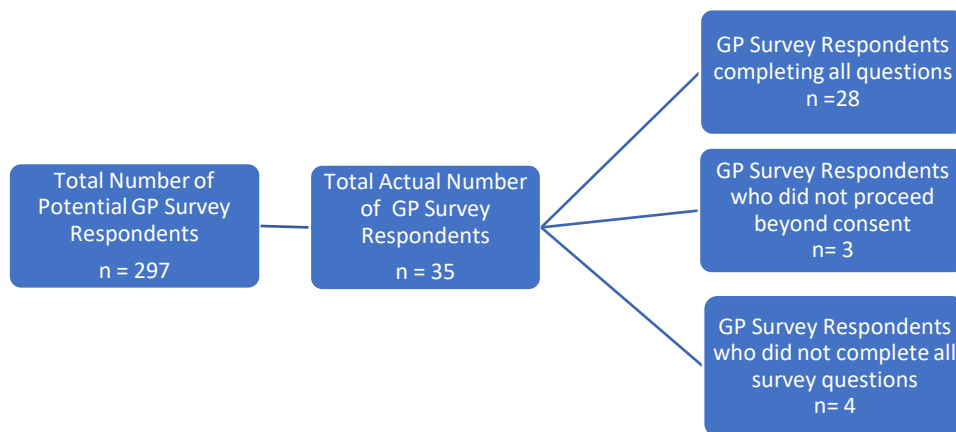
Figure 1: *Flowchart showing numbers of potential and actual GP survey respondents.*

3.2 GP Demographics

To briefly identify the gender composition of the Wellington GP population, survey participants were asked to indicate their gender.

A

B

Gender	N = 32 (%)
Male	12 (37.5)
Female	20 (62.5)
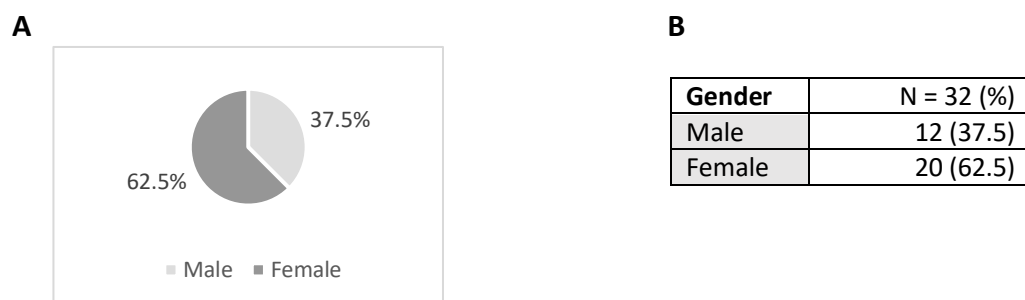
Figure 2: The gender distribution of Wellington region GP survey respondents in 2018. *(A) Pie chart showing the gender distribution of Wellington region GP survey respondents in 2018. (B) Table showing the composition of Wellington region GP survey respondents in 2018 by gender, as indicated by participants.*

The results showed that a higher proportion of respondents were female (n = 20, 62.5%) with male GP's making up the final 37.5% (n = 12) of survey respondents (Figure 2A, 2B).

To understand the breadth and level of experience amongst the GP's, survey respondents were also asked to indicate their length of professional experience in years.

A
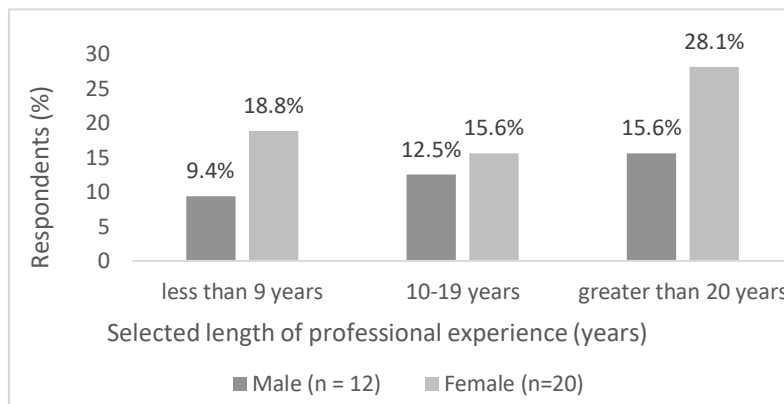
B

Length of Experience (n = 32)	Total n (%)	Male n = 12 (%)	Female n =20 (%)
Less than 9 years	9 (28.2)	3 (9.4)	6 (18.8)
10 – 19 years	9 (28.2)	4 (12.5)	5 (15.6)
Greater than 20 years	14 (43.8)	5 (15.6)	9 (28.1)

Figure 3: Length of professional experience for GP survey respondents in the Wellington region, in number of years and by gender. (A) Bar graph showing GP's professional experience in number of years, by gender. (B) Table showing Length of experience of GP survey respondents in the Wellington region, as reported by participants.

The findings showed that 9 respondents (28.2%) in the survey indicated less than 9 years' experience, which is equal to the group with 10-19 years' experience (n = 9, 28.2%). The highest percentage of respondent's reported length of experience of 20 years or greater (n = 14, 43.8%). Looking at the results by gender, there is an even spread of experience from five to 19 years for male GP's. However, amongst the female respondents, a higher number of GP's have less than 9 years' experience. GP's with 10-19 years' experience is similar for both male and female GP's, while a greater number of female GP's (n = 9, 28.1%) report length of experience great than 20 years.

To further understand the employment situation of the survey respondents to the GP practices, participants were asked to indicate their time commitment to their respective roles.

A

B

Employment Status (n = 32)	Total n (%)
Full time permanent	14 (43.8)
Part time permanent	16 (50.0)
Full time locum	0 (0)
Part time locum	2 (6.3)
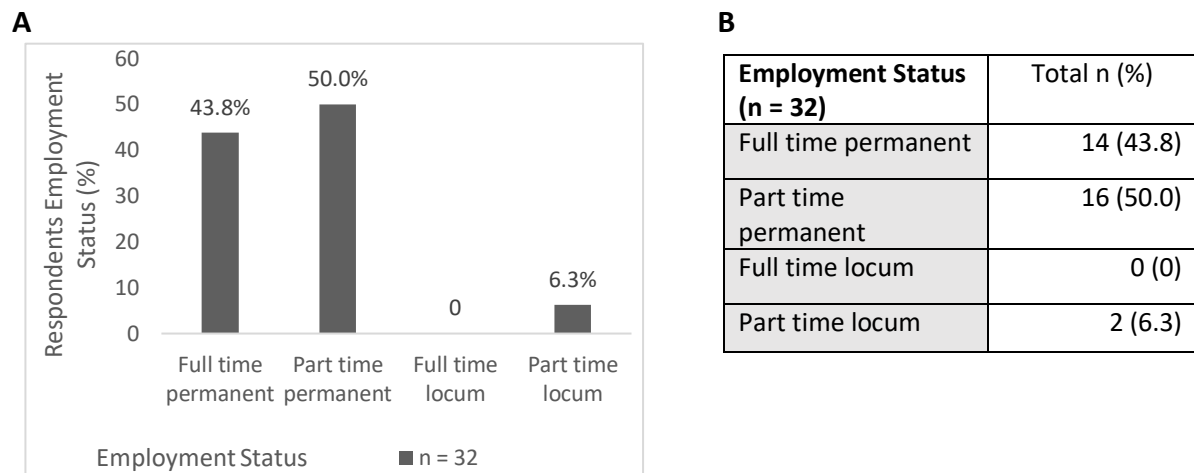
Figure 4: Employment status of Wellington region GP survey respondents in 2018. (A) Bar graph showing the employment status of Wellington region Survey respondents in 2018. (B) Table showing employment status of GP survey respondents in the Wellington region in 2018 by percentage and respondent numbers.

The results indicate that over half of all respondents (n = 18, 56.3%) reported working part time as a GP (including locums) (Figure 4A, 4B). Only 2 respondents were locum GP's.

To describe the local context that GP's operate within, survey respondents were asked to indicate their estimate of the practice population.

A

B

Patient Population of GP practice (n = 31)	Total n (%)
Less than 2,500	3 (9.7)
2,500 – 5,000	6 (19.4)
5,000 – 7,500	9 (29.0)
7,500 – 10,000	9 (29.0)
Greater than 10,000	3 (9.7)
Unknown	1 (3.2)
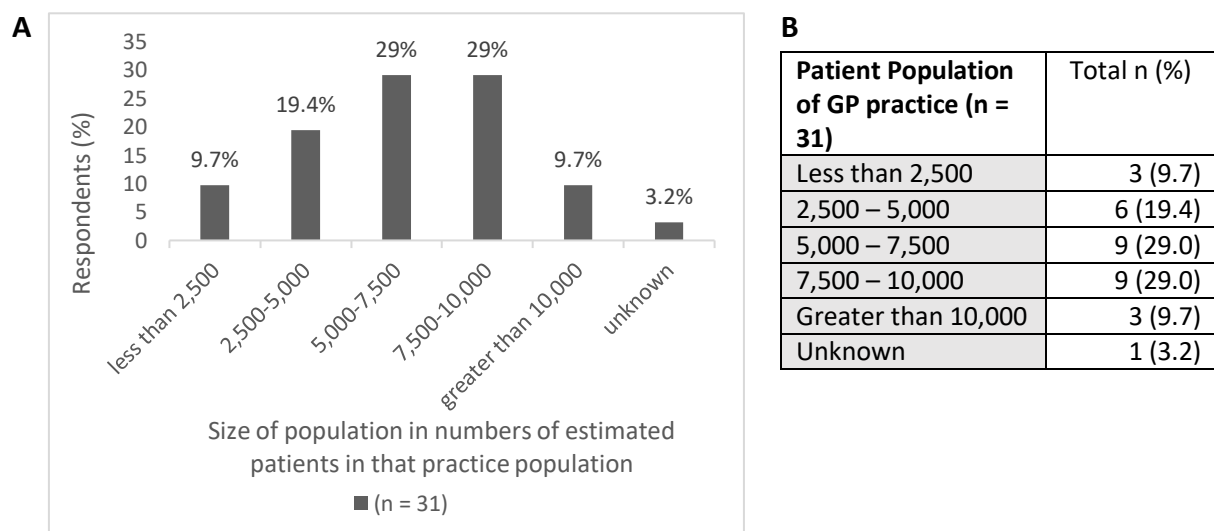
Figure 5: Estimated practice population size, as estimated by GP survey respondents in the Wellington region. (A) Bar graph of practice population size as estimated by GP survey respondents in the Wellington region in 2018. (B) Table showing GP practice population size as reported by GP survey respondents, expressed as percentage and actual numbers.

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Findings showed that only 9.7% (n = 3) of respondents cover a practice population of less than 2,500 patients, while 19.4% (n = 6) cover a population of 2,500 – 5,000 patients. 58% (n = 18) of GP practice populations fall between 5,000 to 10,000, while a further 9.7% (n = 3) cover a population of greater than 10,000 patients (Figure 5A, 5B). Only 1 respondent (3.2%) did not know the practice population size (Figure 5A, 5B).

3.3 GP Osteoporosis Assessment

To further understand GP's practice regarding osteoporosis assessment, a series of questions were asked to indicate routinely undertaken actions in the response to a scenario.

Scenario (The following information applies to the next two sections 3.3.1 and 3.3.2)

A 50-year-old female has presented to the After-Hours Medical Centre with a left fractured distal radius after tripping over a paving stone. She has been referred to Wellington Hospital Orthopaedic Outpatients for follow up and has had non-operative treatment of her wrist fracture. Treatment has now been completed, the fracture has healed, and she has been discharged back to your care, as her primary health care provider. You have received the discharge letter from Wellington Hospital detailing the mechanism and type of injury, the treatment, and that non-operative treatment has been completed successfully.

3.3.1 Osteoporosis Assessment

To identify whether the discharge summary would serve as a prompt to the GP to follow up this patient to assess osteoporosis risk, survey respondents were asked to indicate how they would respond to the above scenario.

A
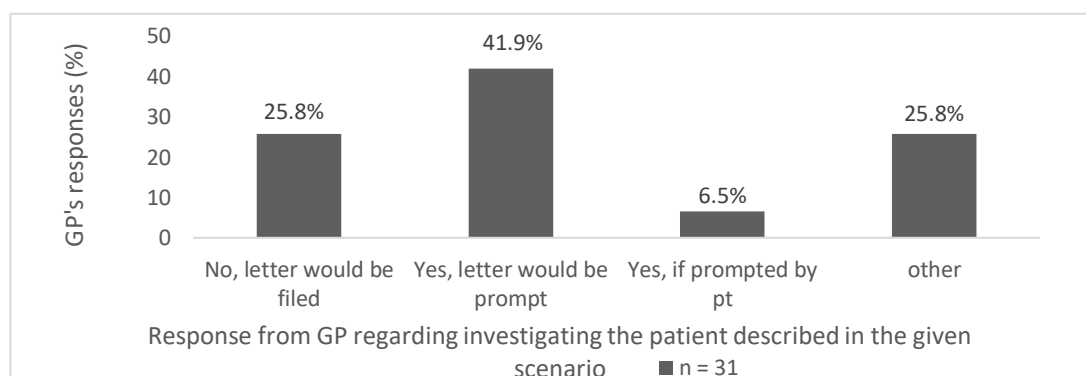
B

GP Response (n = 31)	Total n (%)
No, I would file the discharge letter assuming that the orthopaedic surgeons would follow up if there was a question of osteoporosis	8 (25.8)
Yes, the orthopaedic discharge letter would be a prompt	13 (41.9)
Yes, if prompted by the patient	2 (6.4)
Other	8 (25.8)

Figure 6: GP's responses to scenario 1 regarding whether they would routinely investigate the described patient for osteoporosis. (A) Bar graph showing whether GP respondents would routinely investigate the described patient for osteoporosis. (B) Table showing GP survey responses to stated scenario identifying if they would routinely investigate the described patient for osteoporosis, expressed as percentages and actual numbers.

The findings showed that while 25.8% (n = 8) of respondents would not look at investigating this patient for osteoporosis risk routinely, 41.9% (n = 13) would see the discharge summary as a prompt to follow this patient up to assess for osteoporosis risk (Figure 6A, 6B). Only 6.5% (n = 2) would assess osteoporosis risk if the patient requested it, and a further 25.8% (n = 8) preferred to select 'other', to enable them to add their own comments to the question (Figure 6). In the free text responses, themes centre on further discussion with the patient at the next appointment, one GP stated that discussion of osteoporosis is part of any well woman check. Another comment was that as DEXA is not funded, even following a fracture, the GP would discuss risk factors with the patient.

3.3.2 Osteoporosis Risk Assessment

To identify what options the GP would utilise to commence osteoporosis risk screening, survey respondents were asked to identify how they would investigate the patients in the stated scenario. To ensure GP's could select as all relevant options, multiple responses were enabled.

A
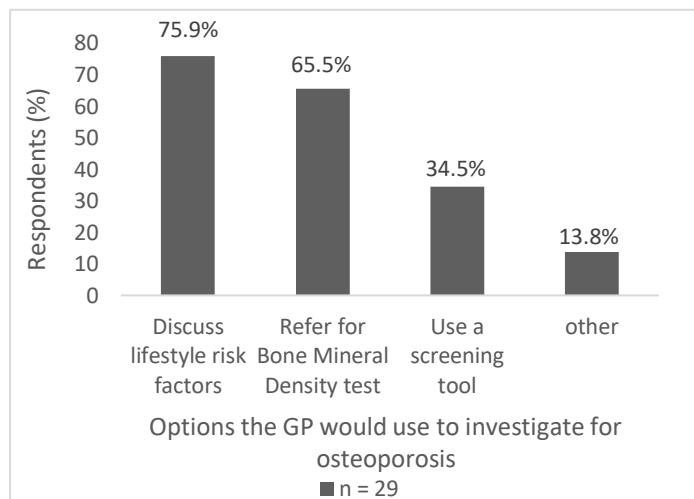
B

How would the GP investigate for osteoporosis (n = 29)	Totals n (%)
Discuss lifestyle risk factors	22 (75.9)
Refer for Bone mineral Density testing	19 (65.5)
Use a screening tool	10 (34.5)
Other	4 (13.8)

Figure 7: GP survey responses regarding osteoporosis investigation preferences for their at-risk patients (multi response – respondents could select more than one response). (A) Bar graph showing GP survey responses regarding osteoporosis investigation preferences for their at-risk patients. (B) Table showing GP survey responses regarding osteoporosis investigation preferences for their at-risk patients, expressed as percentage (Multi response).

The results indicated that 75.9% (n = 22) of GPs would look to discussing lifestyle changes, with 65.5% (n = 19) of GP's referring the patient for bone mineral density testing (Figure 7A, 7B). Results (Figure 7A, 7B) demonstrate that 34.5% (n = 10) of GP's would utilise an osteoporosis risk assessment screening tool, and 13.8% (n = 4) choose to select 'other'. 'Other' themes included discussing referral for BMD testing depending on patient preference and risk profile, the cost of BMD test, and utilising BMD testing as an option, dependent on family history.

3.3.3 Osteoporosis Risk Assessment – Screening Tool

To further identify what screening tools are being utilised by Wellington GP's, respondents who selected that they used a screening tool in question six, were directed to select which osteoporosis risk screening tool they would use.

A
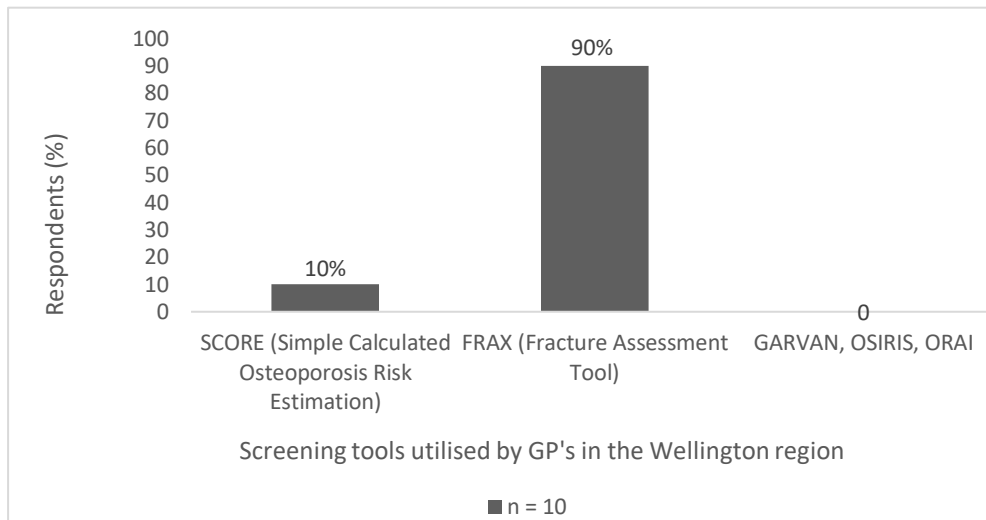
B

Screening tool (n = 10)	Total n (%)
SCORE (Simple Calculated Osteoporosis Risk Estimation)	1 (10.0)
FRAX (Fracture Assessment tool	9 (90.0)
OSIRIS (Osteoporosis Index of Risk) ORAI GARVAN	0 (0)

Figure 8: Percentage responses from the 10 respondents who selected they would use a screening tool, identifying what screening tool they utilise. (A) *Bar graph showing what screening tool would be utilised. (**B**) Table showing of the 10 respondents who selected they would use a screening tool, what screening tool they utilise, expressed as percentages and numbers.*

The results show that of the 10 GP's who indicated that they would use a screening tool, 9 respondents (90%) selected the FRAX online screening tool, and 1 respondent (10%) selected the SCORE screening tool (Figure 8A, 8B). Although respondents were given the option of five screening tools, no other tools were selected.

3.4   GP Patient Management

To identify what tools, treatments and knowledge the GP's would utilise for their patient who had been identified as being at risk of osteoporosis, respondents were asked to select what their next steps would be in addressing osteoporosis risk (multi response – respondents could select more than one response).

A
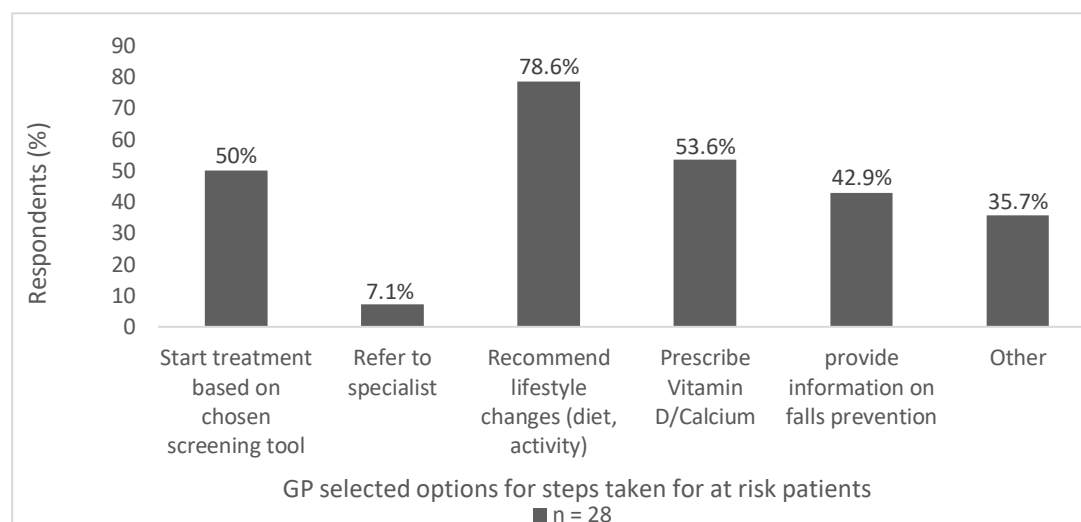
B

Steps Taken (n = 28)	Total n (%)
Start treatment based on screening tool	14 (50.0)
Refer to specialist	2 (7.1)
Recommend lifestyle changes	22 (78.6)
Prescribe Vit D/Calcium	15 (53.6)
Falls prevention	12 (42.9)
Other	10 (35.7)

Figure 9: Actions undertaken by respondents for a patient who has been assessed as at risk of osteoporosis. (Multi responses – respondents could select more than one response). (A) Bar graph showing what actions GP survey respondents would take for a patient who has been assessed as at risk of osteoporosis. (B) Table showing what actions would be undertaken by GP survey respondents for a patient with a fracture that may be due to osteoporosis. Expressed as actual numbers and percentages (Multi response).

The results showed that exactly 50% (n = 14) of respondents chose that they would start treatment based on the screening tool result, while only 7.1% (n = 2) would refer their patient to a specialist (Figure 9A, 9B). The highest percentage of respondents (78.6%, n = 22) would discuss and recommend lifestyle changes with their patient, such as appropriate diet and

physical activity. 53.6% of respondents (n = 15) would look to prescribe Vitamin D and/or calcium and a further 42.9% (n = 12) of respondents would provide information on falls prevention (Figure 9A, 9B). The option of 'other' was selected by 35.7% (n = 10) of respondents describing similar themes to the selected options, focussed around BMD testing, results and cost, prescribing vitamin D but not calcium, prescribing calcium depending on dietary intake, and dietary and lifestyle discussions.

3.4.1 Patient Care

Respondents were asked to select what medical professional they felt should lead the care for patients requiring osteoporosis investigations.

A

B

Lead role (n = 28)	Total n %)	95% CI
Orthopaedic specialist	1 (3.6)	-
General practitioner	25 (89.3)	0.71 – 0.97
Other	2 (7.1)	-
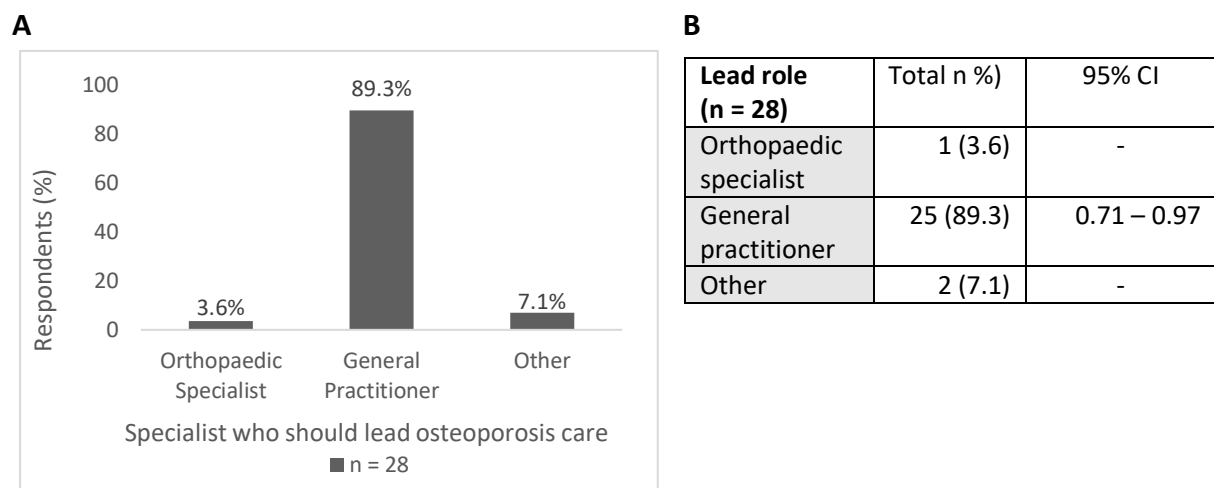
***Figure 10: GP survey respondent's selection for who should take the lead role in initiating osteoporosis investigations. (A)** Bar graph showing who GP survey respondents feel should take the lead role in initiating osteoporosis investigations. **(B)** Table showing GP survey respondents' indication of who should take the lead role in initiating osteoporosis investigations, expressed as percentages and actual numbers.*

The findings indicated that 89.3% (n =25) see that they are best placed to take the lead role in osteoporosis investigations (Figure 10A, 10B). The 95% confidence interval for this result indicates that between 71% and 97% of GP's in the Wellington population would also select that GP's are best placed to lead osteoporosis investigations. Only 1 respondent (3.6%) selected that an orthopaedic specialist should take the lead role (Figure 10A, 10B). For the 2 respondents (7.1%) who selected 'other', one stated that both should be responsible, and the other respondent stated that they felt GP was best placed only if there was funding for the BMD testing.

3.4.2 Patient Care and the Role of the GP

To further explore how GP's view their role, respondents were asked to select an option to indicate how they perceive their value in osteoporosis prevention.

A
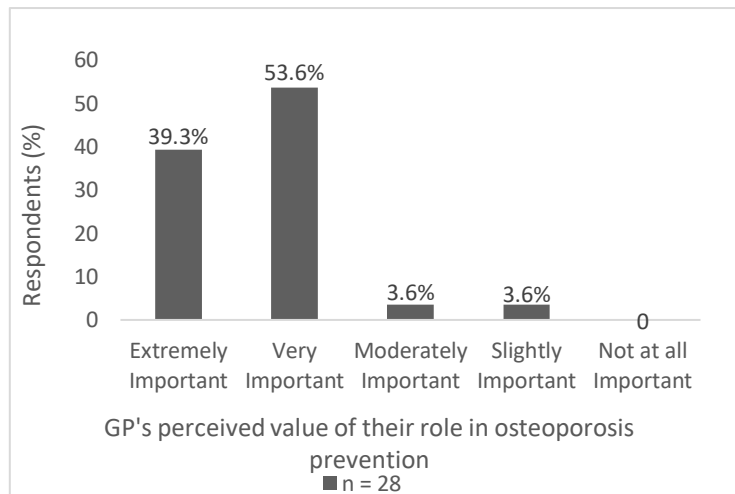
B

Rating of role value (n = 28)	Total n (%)	95% CI
Extremely Important	11 (39.3)	0.21 - 0.59
Very Important	15 (53.6)	0.33 - 0.72
Moderately Important	1 (3.6)	-
Slightly Important	1 (3.6)	-

Figure 11: GP survey respondents perceived role value as primary health care provider in osteoporosis prevention. (A) Bar graph showing how GP survey respondents perceive their role value as primary health care provider in osteoporosis prevention. (B) Table indicating GP's response to the question of how they perceive the value of their role as primary health care provider in osteoporosis prevention, expressed as percentages and actual numbers.

The findings show that most respondents view their value in osteoporosis prevention as high, with 39.3% (n = 11) of respondents selecting their role as being extremely important, and a further 53.6 (n = 15) selecting it is very important. 3.6% (n = 1) of respondents selected respectively, moderately and slightly important, and no respondents selected that their value in osteoporosis prevention was not at all important (Figure 11A, 11B).

3.4.3 Patient Care and Osteoporosis Nurse Specialist Role

As Wellington does not have a dedicated fracture liaison service, and to explore if respondents felt that there could possibly be a role for a nurse specialist in osteoporosis care, respondents were asked to indicate if they felt there would be a benefit in having an osteoporosis nurse specialist available to assist GP's in ensuring all at risk patients are followed up.

A
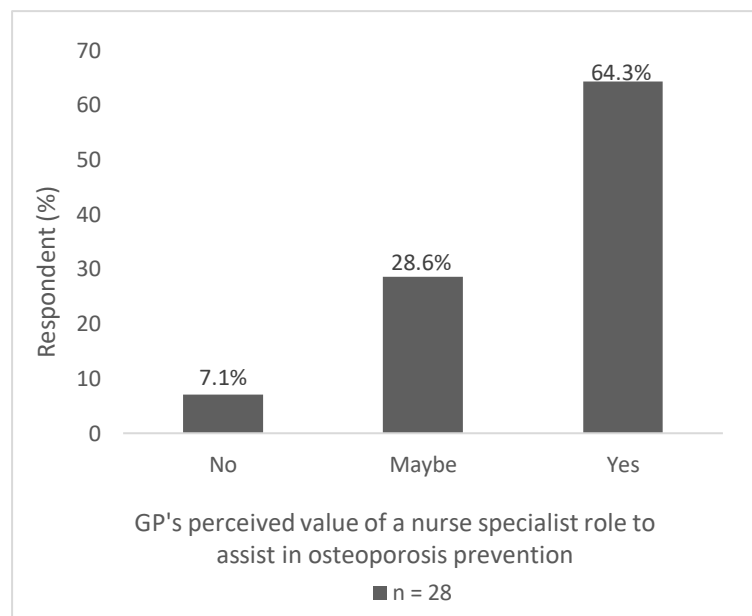
B

Value in a nurse specialist role (n = 28)	Total n (%)
No	2 (7.1)
Maybe	8 (28.6)
Yes	18 (64.3)

Figure 12: GP survey respondents answer whether they think an osteoporosis nurse specialist would be beneficial. (A) Bar graph showing the response from GP's on whether they think an osteoporosis nurse specialist would be beneficial. (B) Table indicating whether GP survey respondents feel an osteoporosis nurse specialist who could be involved in identifying and following up those patients at risk of fragility fractures would be beneficial. Expressed as percentages and actual numbers.

The results showed that 92.9% of respondents (n = 26) selected that a nurse specialist would either definitely be or may be of benefit, with the remainder of respondents (7.1%, n = 2) selecting that they did not think a nurse specialist would be of benefit (Figure 12A, 12B). When providing a rationale for their selection, the "yes" respondents discussed themes such as nurse specialist "being able to help in time pressure environments", nurses being "well placed and having good knowledge base", "providing consistency of care", and "could be a dedicated allocated resource who could educate patients", as well "assisting in gaining DEXA funding".

The respondents who selected 'maybe' or 'no' identified themes such as doctors wanting to "follow up their own patients", and "GP's provide more individualised unfragmented care".

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There were also concerns that a "nurse specialist would add another layer of care", while "doctors can manage", and "seeing GP's is more convenient" as "follow up and management should stay with GPs". The other concerns were around funding with comments that a nurse resource would "add more demand on the underfunded health care funding allocation".

3.5 GP Knowledge and Educational Resources

3.5.1 Risk Factors

To explore the breadth of GP's knowledge regarding osteoporosis risk factors, respondents were given a selection of osteoporosis risk factors and were able to make multiple selections. All of the selections are known risk factors, although some are less known than others.

A

Known Osteoporosis risk factors selected by Wellington GP's   ■ n = 28
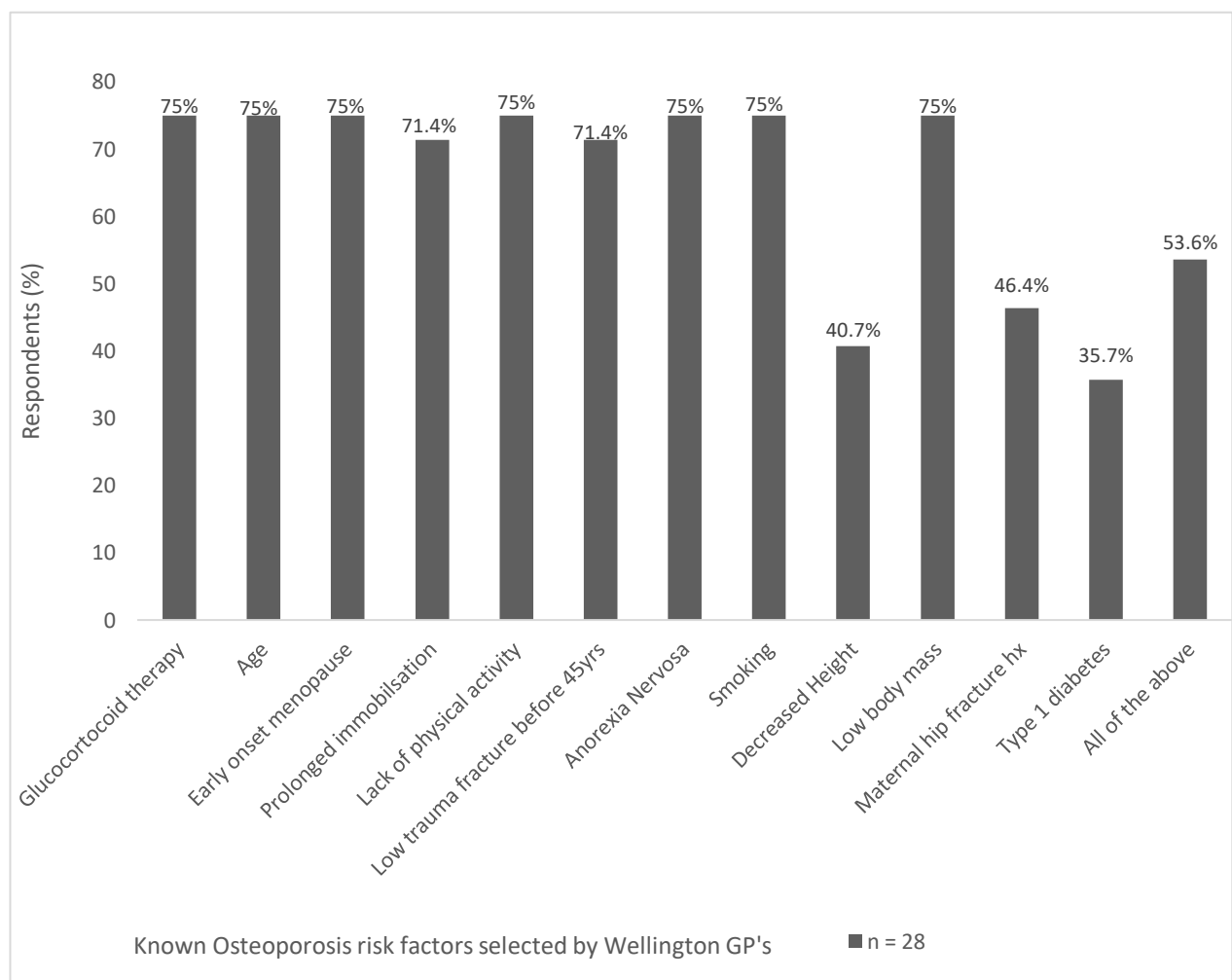
B

Risk factors (n = 28)	Total n (%)
Glucocorticoid therapy	21 (75.0)
Age	21 (75.0)
Early onset menopause	21 (75.0)
Prolonged immobilisation	20 (71.4)
Lack of physical activity	21 (75.0)
Low trauma fracture before 45 yrs	20 (71.4)
Anorexia nervosa	21 (75.0)
Smoking	21 (75.0)
Decreased height	11 (40.7)
Low body mass	21 (75.0)
Maternal hip fracture history	13 (46.4)
Type 1 diabetes	10 (35.7)
All of the above	15 (53.6)

Figure 13: Osteoporosis risk factors selected by Wellington region GP respondents (Multi response). (A) Bar graph showing the osteoporosis risk factors that are known by GP survey respondents in the Wellington region. (B) Table showing known osteoporosis risk factors selected by GP's in the Wellington region, expressed as actual numbers and percentages. (Multi response).

Results showed that of all the known risk factors listed, glucocorticoid therapy, age, early onset menopause, lack of physical activity, anorexia, smoking and low body mass were selected by 75% (n = 21) of respondents as being risk factors (Figure 13A, 13B). Prolonged immobilisation and history of low trauma fracture before 45 years were selected by 71.4% (n = 20) of respondents. Just over half of all respondents (53.6%, n = 15) selected 'all of the above', and there were lower response rates for decreased height (40.7%, n = 11), maternal hip fracture history (46.4%, n = 13) and type 1 diabetes (35.7, n = 10) (Figure 13A, 13B). When revisiting the raw data and those who selected 'all of the above', glucocorticoid therapy, age, early onset menopause, lack of physical activity, anorexia nervosa, smoking and low body mass were identified as risk factors by most respondents, with slightly less selecting prolonged immobilisation and low trauma fracture history before 45 years as risk factors.

3.5.2 Relationship between GP's Length of Experience and Risk Factor Identification

Chi square testing was applied to the variable 'Length of Experience' and selection of each risk factor, with Fishers exact test determining that there is no statistically significant relationship between Length of Experience (p = 0.191 to p = 1.000) and osteoporosis risk factor knowledge. However, Cramer's V is 0.274 for the risk factors Glucocorticoid therapy,

early onset menopause, lack of physical activity, Anorexia nervosa, smoking and low body mass index which indicates there is a moderately strong relationship between length of experience and selecting these as a risk factor. Cramer's V is 0.316 for Type 1 diabetes indicating a strong relationship between length of experience and selecting this as a risk factor while Cramer's V of 0.358 for history of maternal hip fracture and 0.380 for decreased height indicates a very strong relationship between length of experience and the selection of these two risk factors. It is likely that determining the statistical significance is problematic due to the small sample size, however Cramer's V results indicate there is a relationship between length of experience and risk factor knowledge.

3.5.3 Educational Resources

To identify the type of resources that GP's access and utilise to assist them with osteoporosis knowledge, respondents were given a variety of educational resources to select from and were also further asked to indicate the frequency with which these resources were accessed or utilised.

A
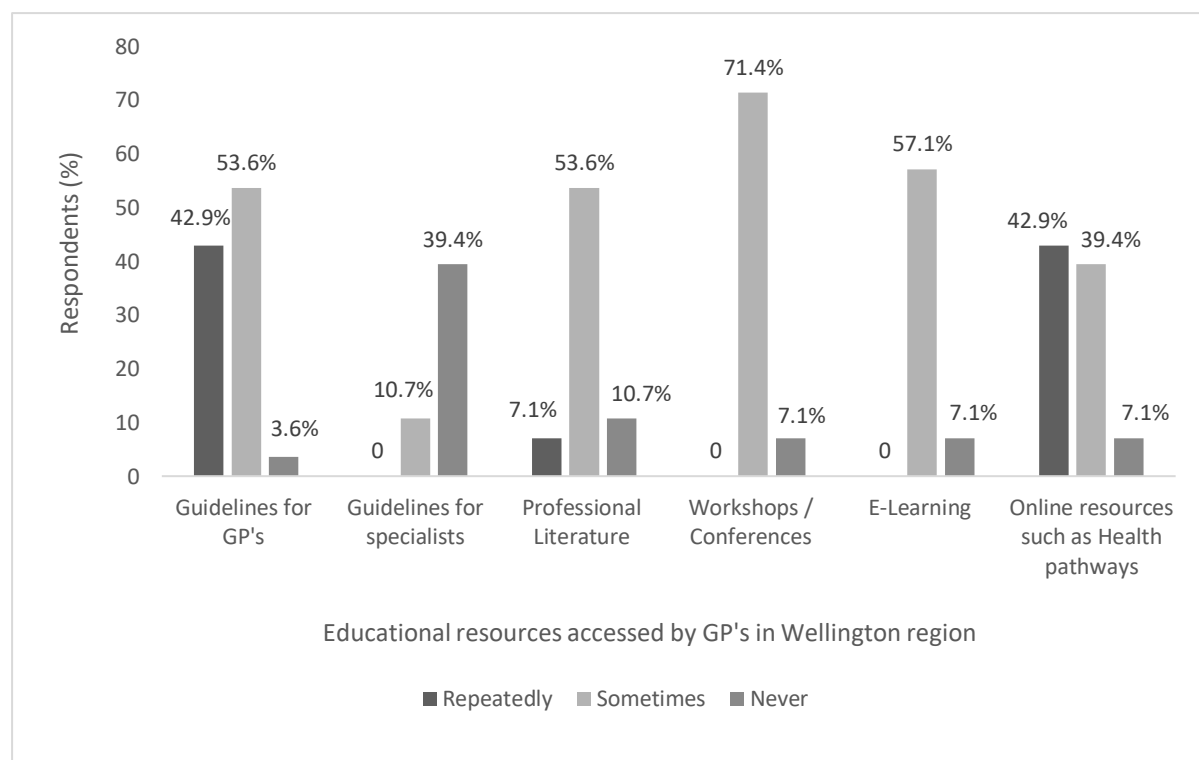
B

Educational resources (n = 28)	Repeatedly Total n (%)	Sometimes Total n (%)	Never Total n (%)
Guidelines for GP's	12 (42.9)	15 (53.6)	1 (3.6)
Guidelines for specialists	0 (0)	3 (10.7)	11 (39.4)
Professional Literature	2 (7.1)	15 (53.6)	3 (10.7)
Workshops / Conferences	0 (0)	20 (71.4)	2 (7.1)
E-Learning	0 (0)	16 (57.1)	2 (7.1)
Online resources such as Health pathways	12 (42.9)	11 (39.4)	2 (7.1)

Figure 14: Educational resources utilised by GP's in the Wellington region (Multi response). (A) Bar graph indicating the educational resources that are utilised by GP survey respondents, and the frequency that these resources are utilised. (B) Table showing the educational resources utilised by the GP survey respondents, and the frequency that these resources are utilised, expressed as percentages and actual numbers. (Multi response).

The results show that for resources that Guidelines for GP's and the online Health Pathways resources are accessed repeatedly by 42.9% (n = 12) of respondents. Professional literature is also used repeatedly by 7.1% (n = 2) (Figure 14A, 14B). The resources that are utilised sometimes are workshops and conferences (71.4%, n = 20), guidelines for GP's (53.6%, n = 15), professional literature (53.6%, n = 15) and e-learning (57.1%, n = 16), with a smaller percentage selecting Health Pathways as a resource they use sometimes (39.3%, n = 11) (Figure 14A, 14B). Only 10.7% (n = 3) of GP's access specialist guidelines sometimes (Figure 14A, 14B). In identifying the resources that are never utilised, 39.3% (n = 11) of respondents selected that they never use guidelines for specialists (Figure 14A, 14B). One GP (3.6%) never uses GP guidelines, 7.1% (n = 2) of GP's selected that they never go to workshops or conferences, participate in e-learning or utilise online resources such as Health Pathways for osteoporosis information, and 10.7% (n = 3) never utilise professional literature.

3.6 Barriers to Diagnosis and Management of Osteoporosis

To identify what GPs perceive as the barriers to osteoporosis diagnosis and management, respondents were given a range of barriers to select from, of which they were able to make multiple selections.

A
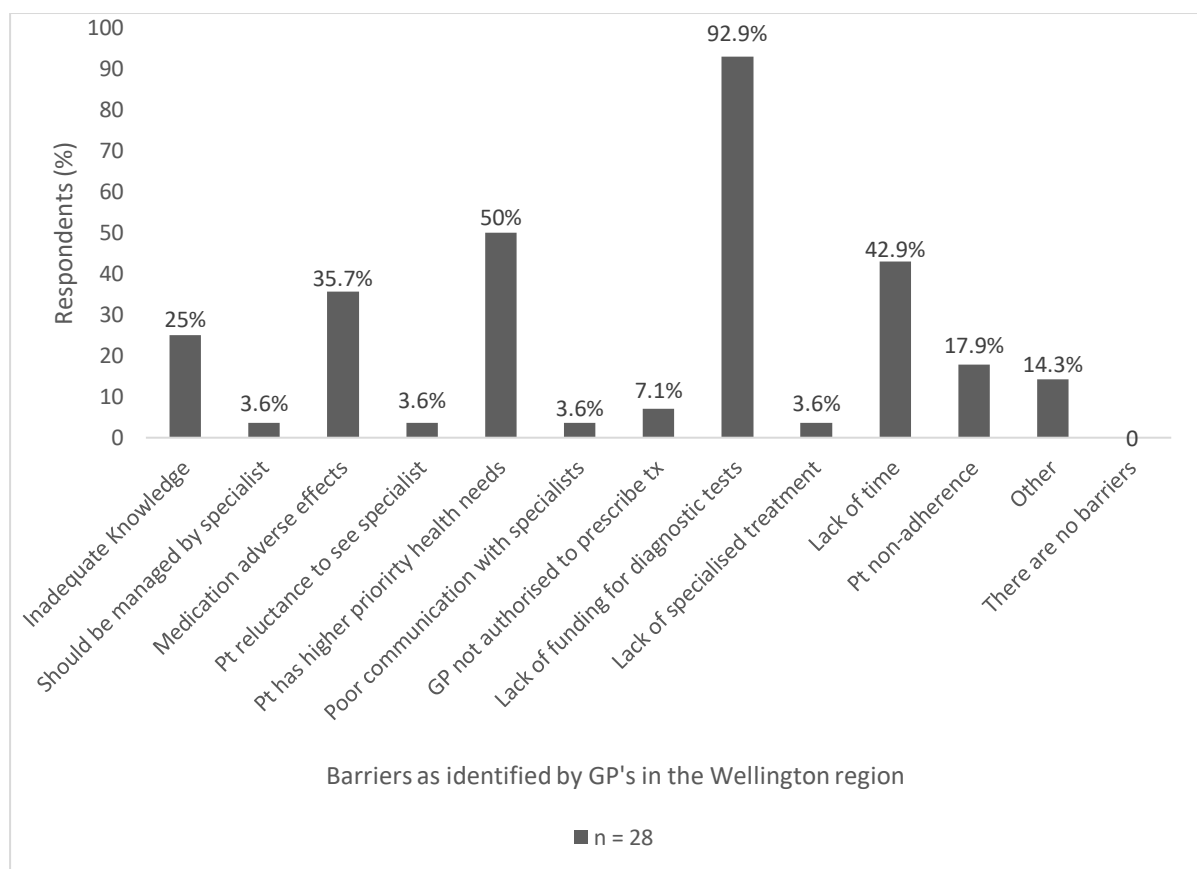
B

Barriers (n = 28)	Total n (%)	95% CI
Inadequate Knowledge of osteoporosis	7 (25.0)	-
Osteoporosis should be managed by specialist	1 (3.6)	-
Osteoporosis medication adverse effects	10 (35.7)	-
Patient reluctance to see a specialist	1 (3.6)	-
Pt has higher priority health needs (perceived as more serious)	14 (50.0)	-
Communication with specialists inadequate (i.e. delayed or no reports)	1 (3.6)	-
GP not authorised to prescribe selected medications	2 (7.1)	-
Unavailability of public health funding for diagnostic tests	26 (92.9)	(0.76-0.99)
Unavailability of specialised treatment	1 (3.6)	-
Lack of time	12 (42.9)	-
Pt non-adherence	5 (17.9)	-
Other	4 (14.3)	-
There are no barriers	0 (0)	-

Figure 15: Barriers to osteoporosis diagnosis and management in the Wellington region, as perceived by Wellington region GP's (Multi response). (A) Bar graph showing GP survey respondents perceived barriers to osteoporosis diagnosis and management in Wellington. (B) Table showing the perceived barriers to osteoporosis diagnosis and management in the Wellington region, as reported by Wellington region GP's, expressed as percentages and actual numbers (Multi response).

[60]

The results show that 92.9% (n = 26) of respondents identify lack of public funding for diagnostic tests as a barrier, while 50% (n = 14) see that these specific patients often have more serious health care needs and this presents a barrier (Figure 15A, 15B). 42.9% (n = 12) feel that lack of time is a barrier, and 35.7% (n = 10) find that the adverse effects from the medication are a barrier. 25% (n = 7) feel that they have an inadequate level of knowledge of osteoporosis, and a further 17.9% (n = 5) find that patient non-adherence to treatment creates a treatment barrier (Figure 15A, 15B). Issues with GP's being able to prescribe medication is only seen as a barrier by 7.1% (n = 2), and only one respondent each (3.6%) respectively selected issues around unavailability of specialised treatment, referring the patient to, and specialist input/communication. For the selection option 'other', 14.3% (n = 4) of respondents discuss lack of access to DEXA, "lack of process and organisational structure", "dental issues around bisphosphonates and a knowledge gap in dentistry regarding this". Further comments are that "the scoring tool does help" and "patient education and motivation is important". Specialist involvement is potentially a barrier, but this is not further defined in what way it could be a barrier.

3.6.1 Relationship between Length of Experience and Barriers

Chi square testing was applied to the variable 'Length of Experience' and those barriers that were selected by 5 respondents or more. This number was selected as the smaller numbers would not have any significant value. Fishers exact test demonstrated no statistically significant relationship (p = 0.323 to p = 0.864) between the length of GP experience and selection of barriers to osteoporosis diagnosis and management. However, Cramer's V of 0.339 for the barrier lack of time and 0.309 for patient non-adherence is indicative of a strong relationship between this being selected and length of experience. For the remaining barriers selected by 5 or more respondents, Cramer's V results for inadequate knowledge of osteoporosis (0.143), medication adverse effects (0.105) and higher priority health needs (0.101) indicate a very weak relationship to length of experience, while unavailability of funding (0.196) indicates a weak relationship between length of experience and this barrier. A 95% Confidence interval calculation was undertaken on the barrier 'lack of public funding' with a resulting 95% CI of 0.76 - 0.99, indicating that this is likely perceived as a significant barrier to the Wellington GP population.

3.7 GP and Healthcare Provider Communication

As it is vital that there are clear and reliable lines of communication between primary and secondary health care and to identify whether GP's do receive discharge summaries from the After-hours medical centre, secondary or tertiary care centre following completion of treatment, respondents were asked to indicate by frequency whether they received a discharge summary as standard practice.

A

Total by respondents (%)
n = 28

42.9%

57.1%

☐ Always   ■ Most of the time
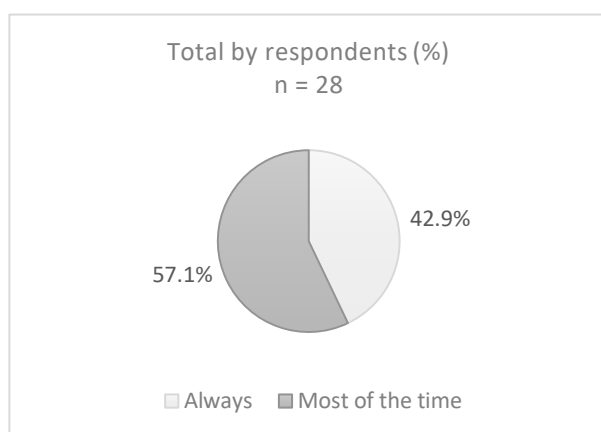
B

Frequency (n = 28)	Total n (%)
Always	12 (42.9)
Most of the time	16 (57.1)

Figure 16: Does the GP receive a discharge summary from after-hours medical centre, secondary or tertiary healthcare provider on their patients, as standard procedure. *(**A**) Bar graph indicating whether GP survey respondents receive a discharge summary from the After-hours medical centre, secondary or tertiary healthcare provider on their patients. (**B**) Table showing GP survey response regarding whether they receive a discharge summary from the After-hours secondary or tertiary healthcare provider on their patients, expressed as percentages and actual numbers.*

The findings show that while 57.1% (n = 16) state that most of the time they receive the discharge summary, 42.9% (n = 12) identify that they always receive it (Figure 16A, 16B).

3.7.1 Discharge Summary Communication

To identify what the 'normal' mode of delivery for the discharge summary is, respondents were asked to indicate what form they receive the discharge summary in.

A

B

Discharge summary form (n = 28)	Total n (%)
Electronic, via email	27 (96.4)
Postal mail	1 (3.6)
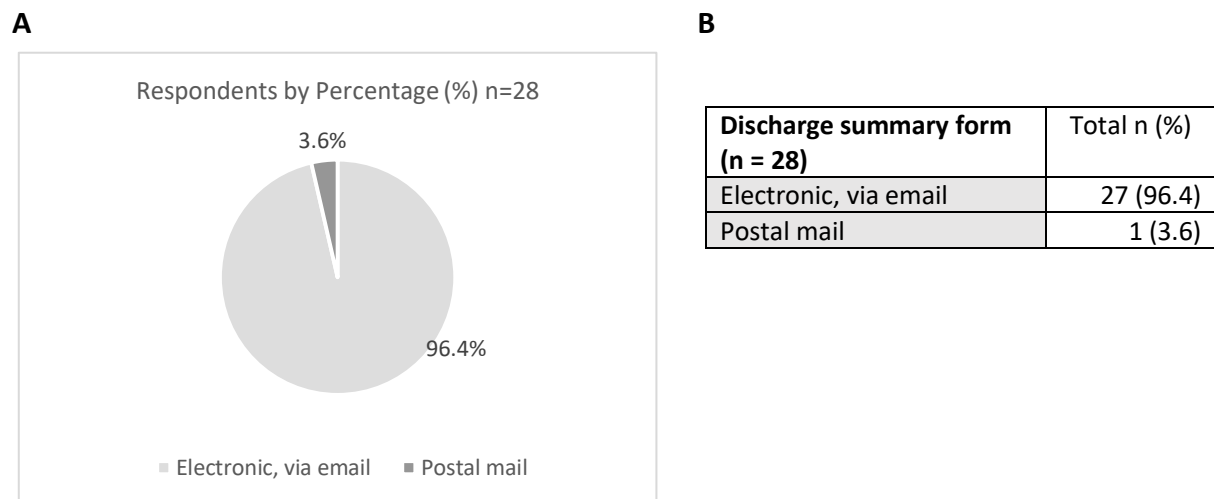
Figure 17: What form is the discharge summary received in. (A) Pie chart indicating what form the GP survey respondents receive the discharge summary in. (B) Table showing what form the discharge summary is sent in, expressed as percentage and actual numbers.

The findings show that 96.4% (n = 27) report that the discharge summary is sent via email, with only one respondent (3.6%) selecting that they receive the discharge summary via postal mail (Figure 17A, 17B).

3.8 Summary of Key Findings

The results from the survey highlight several key findings that will be discussed in the following chapter;

- Almost three quarters of GP survey respondents were aware of the need to follow up patients after a potential fragility wrist fracture.
- All GP survey respondents receive a discharge summary from the After-hours, secondary or tertiary level provider. The discharge summary is a vital part of communication between the tertiary and primary health care sectors as this acts as a prompt to the GP for further investigation.
- Lack of funding for the DEXA scan was seen as a significant barrier to osteoporosis diagnosis and treatment in Wellington by the GP survey respondents, and is a consistent theme throughout the survey, although there are other identified barriers.

- The most utilised resources for GP survey respondents to further their knowledge on osteoporosis are GP guidelines, workshops and conferences, and online resources such as Health Pathways.

- GP survey respondents see their role as central to and highly valued in leading osteoporosis prevention.

- There is a high level of knowledge regarding osteoporosis risk factors, and therefore awareness among the Wellington GP survey respondents.

Chapter 4   Discussion

4.1   Introduction

The overarching purpose of this work was to identify current practice for fragility fracture follow-up in the Wellington general practice setting. The specific objectives were to firstly identify follow-up practice for potential fragility wrist fracture, for osteoporosis assessment in general practice in the Capital and Coast District Health Board region. Secondly, was to explore the role of communication and discharge summaries from the After-hours, secondary or tertiary care centre where their patient was initially treated for fracture injury. Thirdly, the perceived barriers to osteoporosis diagnosis and treatment in Wellington general practice were identified and explored. The final objective was to also identify the tools used by general practitioners to further their knowledge on osteoporosis. A quantitative cross-sectional survey design was employed for use in this study to support achievement of these objectives.

Relevant New Zealand and global studies were sought from formal literature sources to explore and improve understanding of the local and international contexts. The response rate of 11.7% (n = 32) from the 289 GPs that the survey was sent out to was low but also not unexpected in this particular study population, based on statistical advice and also as indicated by previous findings from others (Parkinson et al., 2015; Pit et al., 2014; VanGeest et al., 2007).

Results from the 32 GP participants currently practising in the Wellington region indicated that most GP survey respondent's follow-up patients aged 50 years and above with a potential fragility wrist fracture for osteoporosis assessment. For the purposes of this work, the term 'follow-up' refers to patients who are contacted by their GP to attend a consultation to discuss and assess osteoporosis risk. Almost all medical practices in Wellington receive a discharge summary from the After-hours, secondary or tertiary care centre where their patient was initially treated for fracture injury. This is important as the discharge summary is a vital part of communication between the tertiary, secondary and After-hours general practice sectors and can act as a prompt to the GP for further investigation. In addition, the survey responses highlighted that while the biggest barrier to osteoporosis diagnosis and treatment was lack of funding, there were other barriers identified by GP survey respondents such as more serious

health needs taking precedence, lack of time and the side effects of anti-osteoporosis medications. This finding is important as it highlights that there are barriers to osteoporosis diagnosis and treatment experienced by GP survey respondents that can impact upon their patients. To further their knowledge concerning osteoporosis, the educational resources that GPs access most consistently were GP Guidelines, online resources such as "Health Pathways", in addition to relevant workshops and conferences. The results highlight that the GP survey respondents clearly wanted to lead the care for their patients for osteoporosis investigation and treatment. In support of the GP survey respondents wish to lead care, the results also identify a high level of knowledge of osteoporosis risk factors among the respondents of the survey.

4.2 Demographic Overview

The first part of the survey consisted of questions designed to understand the demographic makeup of the Wellington GP community. It was shown that females comprise the greater proportion of GP survey respondents in the Wellington region, as almost two thirds of respondents (62.5%, n = 20) were female. This result may reflect a female dominated GP workforce in the Wellington region or it may be reflective of the willingness of female GP survey respondents to complete the survey for this particular study. The results also indicate that there is a wealth of medical experience among GP survey respondents, with 62.6% (n = 20) of respondents identifying that they have greater than 15 years professional experience. Across genders, length of experience is similar with 41.7% (n = 5) of male GP survey respondents and 45% (n = 9) of female GP survey respondents reporting practice experience of greater than 20 years. In examining the practice population size, 58% (n = 21) of GP survey respondents reported a practice population of 5,000-10,000 patients, indicating that this may be the most common population size associated with any one GP practice in the Wellington region. Together these characteristics offer a picture of a Wellington GP survey respondent population that is largely female, highly experienced and covering a large practice population. It is highly likely that this GP population cohort may differ to others in characteristics when compared with other areas around New Zealand. It was important for the purposes of this work, to briefly describe the GP context in Wellington. Following on from the demographic characteristics of the study population, the key study findings are discussed in further detail.

4.3 Wellington General Practitioner Osteoporosis Follow-Up and Assessment

There is a large body of literature identifying the need to follow-up patients who have sustained a potential fragility wrist fracture to assess osteoporosis risk (Barrett-Connor et al., 2008; Braatvedt et al., 2017; Chami et al., 2006; C. J. Crandall et al., 2015; Javaid et al., 2015; Kimber & Grimmer-Somers, 2011; Mallmin et al., 1993; Mitchell et al., 2012). The study results from this work indicate that almost three quarters (74.2%, n = 23) of Wellington GP respondents perceive the discharge letter or patient request, as a form of prompt to investigate further. Within the free text option accompanying some of the survey questions, GP survey respondents acknowledged the need to discuss osteoporosis risk with the patient at the next appointment. These results also indicate that 6.5% (n = 2) would initiate investigations at the patient's request, which is a similar finding to the study undertaken by Chami et al. (2006) where 3% of GP survey respondents indicated they would investigate at the patients prompting. GP survey respondents carrying out investigations in response to patient prompting lends support to the need for public health initiatives to increase the public's awareness of osteoporosis risk. Increasing public awareness of osteoporosis and risk factors can encourage people to be proactive about their bone health, directing and guiding patient-initiated osteoporosis discussions with their GP's (Alami, Hervouet, Poiraudeau, Briot, & Roux, 2016; N. Harvey et al., 2017).

Discussion of osteoporosis risk with the patient is paramount and the patient needs to be engaged in the process. However, as osteoporosis often only becomes apparent when a fracture occurs, this places the responsibility on health care practitioners to initiate secondary prevention strategies (Curtis, Moon, Harvey, & Cooper, 2017). Curtis et al. (2017) go on to suggest that "greater efforts are … required from healthcare funders and providers to shift attention towards the identification and treatment of those at the highest fracture risk with the aim of closing the osteoporosis treatment gap" (Curtis et al., 2017, p. 12).

The findings from this work indicate that most GP survey respondents are aware of the need to follow up patients at risk of osteoporosis, following discharge summary or in response to patient prompting. Together the study results and the literature highlight the need for GP's to follow up patients at risk of fragility fractures, so that they can be further assessed for

osteoporosis and, if indicated, commence treatment to prevent future fragility fractures. To further support GP respondents' awareness of the need to follow up patients sustaining a fragility wrist fracture, the following discussion identifies the tools GP's utilise to assess, manage and treat osteoporosis risk.

4.3.1 Wellington GP Osteoporosis Assessment - Screening Tools

Osteoporosis New Zealand and Health Pathways 3D guidelines recommend the use of the FRAX or GARVAN osteoporosis risk screening tools (HealthPathways 3D, 2019; Osteoporosis New Zealand, 2017), both of which can be used without having a Bone Mineral Density (BMD) test result and are easily accessible on-line. In this study, it was shown that while osteoporosis risk prediction tools are available online, 65.5% (n = 19) of GP survey respondents would not utilise this in the first instance. The effectiveness of both the FRAX and GARVAN tools have been examined and validated by Compston et al. (2017) and Curtis et al. (2017) although both authors identified limitations to these tools. Of the 10 GP survey respondents who reported using a screening tool, the FRAX was the most utilised screening tool, with 90% (n = 9) of GP survey respondents selecting this tool. This finding was similar to that seen in a study by Khan et al. (2013) where FRAX was the most widely known screening tool among Malaysian GP survey respondents and pharmacists. However, it is important to note that the FRAX tool does not incorporate the number of fractures beyond one fracture, and the ability to add in all fractures would increase the risk profile (Compston et al., 2017). GARVAN also has its limitations as it has been generated from a small cohort of 2000 Australian people (Curtis et al., 2017). A 2011 study (Bolland et al., 2011) demonstrated both the FRAX (with and without BMD) and the GARVAN (with BMD) had limitations in their ability to accurately predict the risk of hip and osteoporotic fractures, while a further study (Ahmed et al., 2014) demonstrated that the GARVAN risk assessment tool is most effective when BMD was utilised in the tool. In this study, GARVAN screening tool was not selected by any GP survey respondents.

Study results such as these may undermine GP confidence in the validity of these tools, although subsequent studies (Compston et al., 2017; Shepstone et al., 2018; Turner et al., 2018) demonstrated the positive effects of utilising screening tools for osteoporosis risk assessment.

4.3.2 Wellington GP Osteoporosis Assessment - Diagnostic Testing

This work showed that 65.5% (n = 19) of GP survey respondents would refer the patient for BMD testing (obtained from the DEXA scan), however the cost of DEXA is highlighted as an issue throughout the online survey. Although it is ideal to have the BMD test to enter into the screening tool, the BMD result is not required to obtain a risk factor prediction from the tools, although a more accurate risk prediction can be gained when there is a BMD result to add into the screening tools (Ahmed et al., 2014; Bolland et al., 2011; Compston et al., 2017; Curtis et al., 2017). Upon examination of the literature, it is interesting to note that while blood testing was not included as a question this time in the survey, further work could be undertaken to explore this. Compston et al. (2017) highlight blood results (i.e. full blood count, C-reactive protein, thyroid function, serum calcium / albumin / creatinine / phosphate) as forming a key facet of osteoporosis assessment. Even though there was opportunity to provide additional feedback and comments within this section of the online survey, blood tests were not mentioned by any of the respondents at any part of the survey.

Identification of osteoporosis risk by utilising the screening tools, DEXA scan and blood tests have been briefly discussed. Alongside screening tools and diagnostic tests to identify osteoporosis risk, another tool for GP's to utilise for osteoporosis risk assessment is identifying modifiable lifestyle factors to reduce osteoporosis risk. These adjunct discussion tools are now examined.

4.3.3 Wellington GP Osteoporosis Assessment – Lifestyle Discussion

This work also showed that the majority of respondents (78.6%, n = 22) would normally discuss lifestyle changes with their patients, which is similar to the study by Vytrisalova et al. (2017) where 76% of respondents would initiate lifestyle change discussion. Lifestyle change discussion involves factors such as reducing alcohol intake, maintaining a healthy BMI, stopping smoking and instituting or maintaining regular daily weight bearing exercise (Osteoporosis New Zealand, 2017). Our findings also show that 42.9% (n = 12) of GP respondents view it as part of their role to explore and discuss falls prevention strategies, similar to the Vytrisalova et al. (2017) study where 49% of respondents would discuss fall prevention strategies. The need for a Falls Risk Assessment is identified in the Osteoporosis Clinical Guidance for Health Practitioners published by Osteoporosis New Zealand (2017)

which details the Health Quality Safety Commission (HQSC) initiative that consists of the "Ask, Assess, Act" three screening questions, which enables the health care provider to ascertain the need to address falls prevention for their patients. Health Pathways 3D also has falls risk assessment guidance available online for health professionals. Falls prevention efforts require a multi-faceted approach by the health care provider, involving patient education, medication review, exercise based programmes as well as addressing underlying health issues that impact on mobility and balance (Osteoporosis New Zealand, 2017).

An ongoing focus on falls and fracture prevention is highlighted and addressed as part of the New Zealand Ministry of Health's Healthy Ageing Strategy (Associate Minister of Health, 2016). This strategy outlines the goals of care to enable older New Zealanders to "live well, age well and have a respectful end of life in age friendly communities" (Associate Minister of Health, 2016). Another nationwide New Zealand initiative called 'Live Stronger for Longer' has the primary focus of reducing falls and fractures in those aged 65 years and over, with the goal to reduce the incidence and severity of falls and fractures, and enable people to remain in their own home for as long as possible. This is a multi-agency initiative between the Ministry of Health (MOH), Accident Compensation Corporation (ACC), HQSC and all DHB's. This initiative aims to develop innovative and improved health system services by providing new models of care, identifying people at risk of falls and fractures and supporting targeted interventions to reduce future risk.

As well as advising patients on lifestyle changes to reduce osteoporosis risk, GP survey respondents also have access to available tools to assess falls risk, to enable prevention strategies to be established. The need for falls and fracture prevention strategies is supported by the New Zealand Ministry of Health strategic planning papers and initiatives, to enable a healthy old age for all New Zealanders. Following on is discussion on treatments the GP can institute as a prevention measure for osteoporosis risk.

4.3.4 Wellington GP Osteoporosis Treatment – Vitamin D and Calcium

While 53.6% (n = 15) of GP survey respondents would seek to prescribe calcium or vitamin D supplements, it is not unexpected that more GP survey respondents did not indicate this to be part of their practice, as the evidence for calcium and vitamin D supplementation effectiveness is varied. There is ongoing debate regarding cardiovascular risk and calcium

supplementation (Bolland et al., 2010; Cano et al., 2018; Lewis et al., 2015; Wang et al., 2012). There also appears to be no clear consensus about what is best practice in prescribing calcium and vitamin D for osteoporosis prevention and treatment. The contrasting information on calcium and vitamin D prescribing is explored further.

Vitamin D

Reid (2015) further discusses that while vitamin D can help prevent osteomalacia (bone softening) in patients with low vitamin D levels, higher doses have not been shown to increase bone density. Two studies (Sanders et al., 2010; Smith et al., 2007) demonstrated an increase in fracture risk for higher doses and two further studies (Bischoff-Ferrari et al., 2012; Sanders et al., 2010) demonstrated an increased falls risk. A subsequent publication (Reid, 2016) indicated that treatment of mild vitamin D deficiency does not improve BMD or fracture risk reduction. However, in a review and update to the UK national osteoporosis guidelines, Compston et al. (2017) report that meta-analysis has shown vitamin D may confer a protective effect from fractures and reduce falls, and therefore recommend doses of 800 IU Vitamin D3 (cholecalciferol) daily for patients who are at increased risk of fracture (normal daily recommended dose is 400 IU for adults).

Calcium

A key symposium article (Reid, 2015) reported that there was likely no benefit from calcium supplementation, and with the cardiovascular, gastrointestinal and renal calculi risks, the author suggests abandoning routine use of calcium supplementation for osteoporosis prevention. N. C. Harvey et al. (2017) carried out a review of the evidence for calcium +/- vitamin D supplementation and recommended that patients at risk of calcium and vitamin D deficiencies, and those taking anti-osteoporotic therapy are prescribed calcium +/- vitamin D supplementation as an adjunct. Chiodini and Bolland (2018) examined the evidence for the merits and risks of prescribing calcium, and calcium/vitamin D supplements for patients at risk of fragility fractures. The authors concluded that based on results of large RCT's, the minor fracture risk reduction gained from using calcium, and calcium/vitamin D supplements are outweighed by the slight risk of adverse effects, recommending that clinicians should not routinely prescribe supplementation (Chiodini & Bolland, 2018). However, other researchers (Compston et al., 2017; N. C. Harvey et al., 2017) identify that calcium and vitamin D

supplementation should be prescribed alongside anti-osteoporotic treatments for those who are deficient. As clinical trials of anti-osteoporosis treatment are undertaken on populations that are not deficient in these nutrients (Compston et al., 2017; N. Harvey et al., 2017), the implication could be made that that anti-osteoporosis treatment effectiveness is linked to adequate calcium and vitamin D supplementation.

The results from formal literature sources highlight the contrasting nature of the evidence of calcium and vitamin D effectiveness, which may help explain why a higher number of GP survey respondents do not prescribe calcium and vitamin D routinely as a preventative measure.

In this work, almost two thirds of GP respondents indicated they would follow up the patient at risk of osteoporosis. This is supported by the literature that highlights the need for GP survey respondents to follow up patients at risk of fragility fractures, assess for osteoporosis and if indicated, commence treatment to prevent future fragility fractures. In addition to identifying the number of survey respondents who would follow up their patients, this discussion has examined the study results to identify the tools GP survey respondents could utilise to assess, manage and treat osteoporosis risk. Identification of osteoporosis risk by utilising the screening tools, DEXA scan and blood tests have been briefly discussed. Alongside screening tools and diagnostic tests, there are other tools such as falls risk assessment and lifestyle risk factor identification available for GP's to assess lifestyle factors and advise modifications for osteoporosis and falls and fracture prevention (HealthPathways 3D, 2019; Osteoporosis New Zealand, 2017). Results from formal literature sources highlight the contrasting nature of the evidence of calcium and vitamin D effectiveness, which may help explain why a higher number of GP survey respondents do not prescribe calcium and vitamin D routinely as a preventative measure. To ensure the need for follow up is highlighted to the GP, the importance of reliable discharge summary communication is now discussed further.

4.4   Discharge Summary is an Essential Communication Tool

One of the key findings of this study showed that communication via discharge summary is vital to ensure that patients at risk of osteoporosis following a low trauma wrist fracture are

identified by their GP. The discharge summary acts as a prompt for the GP to follow up and assess the patient's osteoporosis risk. While 41.9% (n = 13) of the GP survey respondents clearly stated that they would regard the discharge summary as a prompt, a further 25.8% (n = 8) of GP respondents indicated that for them, the discharge summary was an indicator to incorporate some form of risk assessment for their patients during a consultation appointment. Overall, our results indicate that all respondents receive the discharge summary either most of the time (57.1%, n = 16) or always (42.9%, n = 12).

In summary, GP survey respondents usually receive the discharge summary and this acts as a prompt for the GP, highlighting the significance of the discharge summary communication. To ensure that the injury is possibly a fragility fracture is emphasised, a clear description of the mechanism of injury is needed. If a discharge summary does not state the mechanism of injury, or if this information is not clear, the GP may not be prompted to follow up with the patient. This risks a missed opportunity to assess and treat osteoporosis, and reduce the possibility of further fragility fracture prevention.

In recognition of the need to emphasise a possible fragility fracture injury to a patient's primary health care provider, the CCDHB orthopaedic service has recently instituted a new process. The medical team is encouraged to state within the discharge summary that the patient has sustained a fragility fracture and requires follow up from the GP for osteoporosis assessment (Julia Catsburg, Orthopaedic Service Manager, personal communication, 11th February, 2019). The effectiveness of this simple intervention in increasing treatment rates has been identified in a study by Rinat, Rubin, Orbach, Giwnewer, and Rozen (2016). Previous studies confirm that to reduce the risk of poor patient outcomes, a discharge summary needs to contain clear and accurate information. Discharge summaries sent from After-hours, secondary and tertiary level care to primary health care centres need to be accurate and comprehensive, as poor healthcare communication has been linked to negative patient outcomes within multiple studies (Briggs, Lee, Sim, Leys, & Yates, 2012; Kripalani et al., 2007; Scotten, Manos, Malicoat, & Paolo, 2015; Sorita et al., 2017; Sutcliffe, Lewton, & Rosenthal, 2004; van Walraven & Rokosh, 1999). This is further highlighted in studies identifying that inaccurate or missing information in a discharge summary places the patient at risk of sustaining an avoidable adverse event (Belleli, Naccarella, & Pirotta, 2013; Kripalani et al., 2007; Sutcliffe et al., 2004), which in this context can be another fragility fracture. Further

literature sources highlight that discharge summaries are a vital part of the healthcare process to ensure a patient receives timely and effective continuity of care, which is also associated with better outcomes for the patient (Salisbury, Sampson, Ridd, & Montgomery, 2009; Shin et al., 2014).

To ensure the discharge summary is received, there is value in considering effective communication delivery methods. This work showed that 96.4% (n = 27) of survey respondents receive the discharge summary via email. Information technology should support efficient discharge summary delivery to the primary health care provider. It is possible that the survey response of GPs receiving the discharge summary "always" or "mostly" could be directly linked to the summary being sent via electronic mail, however this was not a specific question within the survey. Previous studies examining current methods of discharge summary delivery to the primary health care provider highlight that there can be significant issues when there is a breakdown in the process of information sharing (Wilson, Ruscoe, Chapman, & Miller, 2001). Indeed, within the context of postal mail there is the risk that mail is lost or delayed. To address the risk of delayed or non-delivery of discharge summaries, studies have highlighted the efficiency gained from transmitting information via the multiple computer platform options available (Chen, Brennan, & Magrabi, 2010; Newnham et al., 2017; Scotten et al., 2015).

This literature, together with the findings from this study indicate that timely, accurate and clear discharge summary communication between secondary and tertiary care providers to primary health care is associated with better patient outcomes. This need for clear inter-health care provider communication supports and enables GP survey respondents to provide ongoing and appropriate care to their patients. Despite clear and consistent communication in the GP survey respondents' community, there are barriers that GP survey respondents identify as impacting on osteoporosis identification and management.

4.5 Barriers to Osteoporosis Diagnosis and Treatment in Wellington

The single largest barrier identified by Wellington GP survey respondents is the lack of funding for diagnostic tests, primarily the DEXA scan, as indicated by 92.9% (n = 26) of GP respondents.

The DEXA scan funding issue was clearly communicated in the comments section within the survey, with GP respondents stating this is a "glaring obstacle", leading to "under-diagnosis". Access to DEXA scanning as a barrier was also identified in the survey by Chami et al. (2006), although it is not clear if this was due to funding or availability. Correspondingly, 44% of respondents in the Czech survey (Vytrisalova et al., 2017) identified financial limits set by the health insurance company as a barrier. Financial restraints, specifically for the DEXA scan and medication, were identified by Otmar, Reventlow, Nicholson, Kotowicz, and Pasco (2012) as having a possible influence on why some Australian physicians indicated a lack of concern regarding osteoporosis when surveyed in this study. In a review article introducing the implementation of Fracture Liaison Services (FLS) in Taiwan, Chang et al. (2018) also identify that lack of funding is considered one of the biggest impediments for initiation and maintenance of FLS programs within Taiwan.

While 35.7% (n = 10) of the surveyed GP respondents view anti-osteoporosis medication side effects as a barrier to osteoporosis diagnosis and treatment in Wellington, only 9.8% of Czech respondents (Vytrisalova et al., 2017) view anti-osteoporosis medication side effects as a barrier, while a US study (Neuner & Schapira, 2012) identifies anti-osteoporosis medication side effects as a barrier to osteoporosis treatment. In an editorial by Rhee (2018), it is highlighted that well documented side effects of anti-osteoporosis medication have a negative impact on treatment decisions by both physicians and patients. This opinion is shared by Adachi et al. (2011); Jaleel, Saag, and Danila (2018) and Belhassen et al. (2017) who identify that there continue to be issues with patients' reluctance to commence or continue with treatment, requiring multi-faceted solutions. There are also well documented adverse effects of anti-osteoporosis medications. Multiple studies both qualitative and quantitative identify the impact of this on whether GP survey respondents are willing to prescribe the medication, and whether patients will commence or continue to take their medication (Alami et al., 2016; Barrionuevo et al., 2019; Belhassen et al., 2017; Modi et al., 2017; Mora et al., 2019; Sale et al., 2011; Swart et al., 2018). The adverse effects of osteoporosis medications have been highlighted as part of collecting Australian and New Zealand Hip Fracture Registry (ANZHFR) data for CCDHB, where local participants describe anti-osteoporosis medication side effects experienced by friends and family as a reason for reluctance to take it themselves. This is supported by work undertaken by Alami et al. (2016) identifying that anti-osteoporosis

treatments generate fear, and that positive benefits can be outweighed by the perceived negative outcomes associated with treatment.

Medication side effect concerns can also be seen to work hand-in-hand with patient non-compliance, although this as a barrier was only identified by 17.9% (n = 5) of Wellington GP survey respondents. However, in the study by Fogelman, Goldshtein, Segal, and Ish-Shalom (2016) this was an issue for 26% of Israeli GP respondents. The results in this work indicate that 50% (n = 14) of GP survey respondents viewed other more serious health needs as a barrier, which was also an issue in an Australian survey (Otmar et al., 2012) where physicians ranked other serious health conditions as requiring prioritisation over osteoporosis. However, only 27.8% of respondents in the Czech survey (Vytrisalova et al., 2017) reported this as a barrier. Lack of time was perceived as a barrier for 42.9% (n = 12) of GP survey respondents, whereas only 17.2% of the Czech respondents (Vytrisalova et al., 2017) viewed time as a barrier for them, and 20% of Israeli physicians (Fogelman et al., 2016) identified this as an issue.

In the context of current literature sources referred to as part of this work, a consistent theme described across different health care systems indicate that a lack of funding is a theme throughout the world. This was also identified within this New Zealand based work. The results, both from this study and globally, identify that there are other perceived barriers experienced by primary health care providers such as medication side effects, other health conditions and physician time. It is interesting to note the disparities and contrasts between study results from Israel (Fogelman et al., 2016), Czech (Vytrisalova et al., 2017), Australia (Otmar et al., 2012) and these New Zealand based survey results, although this may be due to differences in primary health care systems.

While identifying barriers to osteoporosis diagnosis and treatment is important, it is also useful to know what resources GP survey respondents' access to further their knowledge of osteoporosis, which is now discussed in the following key study finding.

4.6 Educational Resources Accessed by Wellington GPs

The educational resources GP survey respondents access most consistently to further their knowledge on osteoporosis are Guidelines for GP survey respondents, online resources such

as "Health Pathways", and relevant workshops and conferences. The results show that Guidelines for GP's is accessed as a resource by 96.5% (n = 27) of GP survey respondents either sometimes or repeatedly. While respondents do not utilise professional literature (journal publications) repeatedly (7.1%, n = 2), the results indicate that 53.6% (n = 15) of respondents do access this resource sometimes, with 10.7% (n = 3) of GP survey respondents not utilising professional literature as a resource at all. It is foreseeable that resources such as workshops/conferences are not utilised repeatedly, likely due to availability, funding and time constraints, however 71.4% (n = 20) of GP survey respondents do utilise this resource sometimes. E-learning was occasionally used by a high proportion of respondents (57.1%, n = 16). The prospect that a high percentage of respondents use online resources such as Health Pathways was confirmed by the results that showed online resources are used repeatedly and sometimes by 82.3% (n = 23) of GP survey respondents. The results from Wellington GP survey respondents are comparable to the study by Vytrisalova et al. (2017) where GP guidelines, professional literature, and workshops and conferences were utilised most frequently, and a study by Fogelman et al. (2016) that identified conferences and lectures as valued sources of knowledge acquisition by the study participants.

The best resources to focus on to ensure GP survey respondents continue to be supported in gaining and maintaining osteoporosis knowledge, are identified within the study results as GP guidelines, relevant workshops and conferences and online tools such as "Health Pathways".

Following on from identifying how general practitioners acquire ongoing osteoporosis knowledge, there is value in ascertaining who GP survey respondents feel should take the lead and responsibility for osteoporosis care for their patients.

4.7   GP's Lead Care for Osteoporosis Investigation and Treatment

When asked about the responsibility for leading care for osteoporosis investigation and treatment, it was shown that 89.3% (n = 25; 95% CI 0.71- 0.97) of GP respondents felt they should lead these investigations for their patients. Further responses also indicated that 92.9% (n = 26) (95% CI 0.76-0.99) of GP survey respondents see their role as significant (very/extremely important) in preventing osteoporosis within their community. These results

indicate that a high proportion of the Wellington GP survey respondents perceive their role as fundamental to initiating osteoporosis investigations, and as significant to osteoporosis prevention in the community. Vytrisalova et al. (2017) identified that only 33% of Czech GP survey respondents viewed their role in the fight against osteoporosis as essential, with a further 61% seeing their role as of medium importance, which can be seen as a response that the respondents neither feel strongly or mildly that their role is of importance.

It is interesting to note the contrast of results between Vytrisalova et al. (2017) and this study, as the specialist is identified as being central to osteoporosis prevention in Czech, whereas the GP role is identified by the survey respondents as central to osteoporosis prevention in Wellington. This contrast could very well be due to the different health care systems and how they are structured and funded. There is a dearth of literature concerning GP preferences and perceptions regarding lead care for osteoporosis. While the question was asked by Chami et al. (2006) in their survey to GP survey respondents and orthopaedic surgeons, the results were not reported in the published outputs. Multiple research looks at how GP survey respondents carry out their role in osteoporosis assessment and treatment (Alami et al., 2016; Blazkova et al., 2010; Fogelman et al., 2016; Modi et al., 2017; Neuner & Schapira, 2012; Otmar et al., 2012; Swart et al., 2018), and the care gaps within these roles. However, the presumption within the available research is that GP survey respondents are already leading the care for osteoporosis assessment and treatment.

While the key study finding is of the GP respondents' perceived role value, a further question was asked to explore whether the GP's saw any benefit in an osteoporosis nurse specialist role.

4.7.1 Osteoporosis Nurse Specialist Role

These results show that almost all of the respondents (92.9%, n = 26) (95% CI 0.76 – 0.99) indicated that there would be benefit in having an osteoporosis nurse specialist. This aligns closely with Chami et al. (2006) where 94% of GPs selected that a nurse specialist may provide a beneficial service. The benefits of a nurse specialist have been demonstrated in studies by Chan et al. (2015); Majumdar et al. (2011); Majumdar et al. (2010) and Merle et al. (2017), identifying that an osteoporosis nurse specialist can notably improve post fracture care follow up rates.

When viewed together, the results from this study alongside formal literature sources indicate that GP perception of who should lead care and the value of the role GP's perform with osteoporosis care is likely influenced by the different health care systems the GP engages with and operates within (Chami et al., 2006; Vytrisalova et al., 2017). A further study result identified that the GP survey respondents view a likely benefit in an osteoporosis nurse specialist role, and this is supported by literature (Chan et al., 2015; Majumdar et al., 2011).

As the GP survey respondents perceive themselves as key providers in osteoporosis care, it is of value to identify the level of knowledge within the Wellington GP survey respondent's community.

4.8 Wellington General Practitioners Osteoporosis Risk Factor Knowledge

These results showed that glucocorticoid therapy, age, early onset menopause, lack of physical activity, anorexia, smoking, low body mass, prolonged immobilisation and history of low trauma fracture before 45 years of age are correctly identified as osteoporosis risk factors by 71.4 -75% (n = 20-21) of respondents. This result indicates that these risk factors are clear and well defined and that the GP respondents have a high level of awareness with regards to osteoporosis risk factors. The three risk factors that were least identified by respondents; history of maternal hip fracture (46.4%, n = 13), decreased height (40.7%, n = 11) and type 1 diabetes (35.7%, n = 10) are not currently identified in the Osteoporosis New Zealand guidelines as risk factors, therefore it is foreseeable that they were not selected by a greater number of GP survey respondents, although maternal hip fracture history is identified in 3D "Health Pathways" osteoporosis algorithm. Decreased height as a risk factor was included in the question on the basis of the Vytrisalova et al. (2017) survey questions. While further investigation does not have this clearly identified as a risk factor, Compston et al. (2017) discuss the need for vertebral fracture assessment if there is a reported history of loss of height of more than 4cm in postmenopausal women and older men. It is proposed that this may be the reason why decreased height is identified as a risk factor, as in, a significant loss of height as an older person. Furthermore, although diabetes is a known risk factor, the reasons for this remain unclear within the literature sources (Hough, Pierroz, Cooper, & Ferrari, 2016; Sellmeyer et al., 2016).

Globally, osteoporosis risk factor knowledge is variable. In a survey of physicians working in Israel (Fogelman et al., 2016) only 19% of physicians correctly identified all five main osteoporosis risk factors, and while physicians working in France (Alami et al., 2016), correctly identified eight risk factors, some of the physicians did not view osteoporosis as a disease, more as a normal part of the aging process. In a survey undertaken by Mahdaviazad, Keshtkar, and Emami (2018), physicians working in Iran demonstrated an adequate level of osteoporosis risk factor knowledge, although overall osteoporosis knowledge appeared limited. In contrast, a study of Saudi employed physicians and nurses by Alghamdi and Mohammed (2018) identified 90.1% of practitioners demonstrated a good level of osteoporosis knowledge with 63% to 96.5% of respondents correctly identifying five osteoporosis risk factors. To assess the level of knowledge in future healthcare providers, Elnaem et al. (2017) studied osteoporosis knowledge levels amongst Malaysian health care students (medicine, allied health and pharmacy students), identifying a gap in knowledge levels concerning osteoporosis across all undergraduate healthcare programs.

These reported findings in combination with our study results, indicate there are varying levels of osteoporosis knowledge globally. While there appear to be osteoporosis knowledge gaps present in future health care providers, identification of the gaps provides educators with the opportunity to address this. The findings of this work indicated that the Wellington GP survey respondents demonstrate a good level of osteoporosis risk factor knowledge when viewed alongside global knowledge levels.

4.9 Key Study Findings Summary

There were six main study findings identified and discussed as part of this work, with support from current worldwide literature sources. A substantial percentage of Wellington GP survey respondents indicated they would follow up patients aged 50 years and above presenting with a potential fragility wrist fracture, for osteoporosis assessment. The need for follow up in this context has been supported by the literature. Further discussion was undertaken on results that identified tools available to assist GP's with osteoporosis assessment and prevention efforts. In addition, almost all GP survey respondents in Wellington receive a discharge summary from the After-hours, secondary or tertiary care centre where their patient was initially treated for fracture injury. The discharge summary was identified as a

vital part of communication between the tertiary and primary health care sectors, acting as a prompt to the GP for further investigation. Furthermore, while the single largest barrier to osteoporosis diagnosis and treatment identified by the GP survey respondents is lack of funding, there remain other barriers recognised, such as lack of time, other more serious health issues and medication side effects. These reported barriers also appear to be relevant to different healthcare systems globally. The educational resources GP survey respondents access most consistently to further their knowledge on osteoporosis are Guidelines for GPs, online resources such as "Health Pathways", and attendance at relevant workshops and conferences. Utilisation of these educational resources are comparable to the actions reported in the Israeli and Czech study results (Fogelman et al., 2016; Vytrisalova et al., 2017). The study results have clearly indicated that Wellington GP survey respondents want to lead the care for patients in osteoporosis investigation and treatment, and view their role as important. An additional result showed that survey respondents are positive in identifying that there may be a benefit to having an osteoporosis nurse specialist role, and this is supported by literature (Chan et al., 2015; Majumdar et al., 2011; Merle et al., 2017). In support of the desire of GP survey respondents to lead osteoporosis care for their patients, the study results highlight that there is a high level of knowledge of osteoporosis risk factors amongst the Wellington GP survey respondents. The literature results identify osteoporosis knowledge as variable among different health care systems.

As identified in Chapter 2.8, while Māori and Pacific peoples living in New Zealand have greater bone density than non-Māori and non-Pacific peoples, and a lower rate of hip fractures per population, it is probable that the impact of hip fractures is similar to non-Māori and non-Pacific peoples. The possible benefits of this work for Māori and Pacific populations in Wellington align with the benefits for the overall Wellington population, in highlighting potential issues in osteoporosis diagnosis and treatment in Wellington, to enable the basis for a plan to address these issues to be formulated for all population groups. Further work to explore whether Māori and Pacific peoples in New Zealand experience the same impact due to hip fractures than non-Māori and non-Pacific peoples, would be beneficial. Identification and a brief discussion of the strengths of this study are now undertaken.

4.10 Study Strengths

The strengths of this study lay in establishing a reference point of current practice in the Wellington GP community. Because there was no published research found describing current practice concerning osteoporosis assessment and prevention following a fragility wrist fracture within primary health care in New Zealand, this research work that was undertaken was timely and useful, by providing a snapshot of the New Zealand context. In addition, prior to this survey, Wellington primary health care services did not have a specific focussed service such as a formal fracture liaison to screen patients for secondary fragility fractures. In the absence of this type of service, and due to the dearth of knowledge that currently exists in the research literature, it was important to investigate the current practice in osteoporosis assessment, prevention and management amongst the New Zealand GP population. Currently, the existing New Zealand-specific research focuses on current practice for osteoporosis secondary fracture prevention within the inpatient hospital setting. It is possible that following up wrist fracture patients for osteoporosis assessment was already occurring within primary health care settings in New Zealand, but there was a need for this to be identified and confirmed.

4.11 Study Limitations

The findings in this study represent the experiences and views of the Wellington based GP respondents alone and may have limited generalisability to the wider Wellington regional and New Zealand GP national setting. The survey obtained a response rate of 11.7%. It was not possible to describe the characteristics of the non-responders. It should also be noted that not all respondents attended to all the survey questions. There are limitations to this study, firstly from the wording of some of the survey questions. For the screening tool question, it may have been better to ask what screening tools the GP was aware of, instead of what screening tool they used, as this may have identified a broader range of screening tools in use by the Wellington survey respondents. Asking for further information from the respondents regarding what specific guidelines GPs use and also what treatments the GPs initiate, based on guidelines, would have gained more in-depth information for this study. Potentially, only GP respondents with an interest in osteoporosis were motivated to complete the survey, thus introducing the possibility of a non-response bias within the survey results. As there was no

email response from the 11 practice managers who the researcher had not spoken to directly, there is no way to be sure that the survey invitation letter with the survey link was disseminated to the GP's within those practices. This could have potentially altered the final response rate percentage. A response rate of greater than 11.7% may have been obtained if the survey closing date was extended beyond the planned six weeks the survey was opened to respondents. Extending the closing date for the survey may have improved the response rate as five participants had commenced the survey in the last three to four days it was open but did not proceed past the consent and demographic questions. It could be ventured that the respondents intended to return to complete the survey. However, within the scope of this Masters Research work, there were time constraints requiring clear adherence to time limits for the survey to be open to the survey population. The study strengths and limitations have been identified here and briefly discussed. The significant results from this study are now summarised.

4.12 Significant Results

- Almost three quarters of GP survey respondents were aware of the need to follow up patients after a potential fragility wrist fracture.
- All GP survey respondents receive a discharge summary from the After-hours, secondary or tertiary level provider. The discharge summary is a vital part of communication between the tertiary and primary health care sectors as this acts as a prompt to the GP for further investigation.
- Lack of funding for the DEXA scan was seen as a significant barrier to osteoporosis diagnosis and treatment in Wellington by the GP survey respondents, and is a consistent theme throughout the survey, although there are other identified barriers.
- The most utilised resources for GP survey respondents to further their knowledge on osteoporosis are GP guidelines, workshops and conferences, and online resources such as Health Pathways.
- GP survey respondents see their role as central to and highly valued in leading osteoporosis prevention.

- There is a high level of knowledge regarding osteoporosis risk factors, and therefore awareness of the significance of fragility fractures among the Wellington GP survey respondents.

The significant study findings have been identified and detailed above. Following on, there will now be discussion on the recommendations and implications for practice from these study results.

4.13 Recommendations for Practice

The following opportunities and implications for practice from the study results are now identified and discussed.

- While almost three quarters of GP respondents would carry out an osteoporosis risk assessment on their patient who sustained a potential fragility wrist fracture, the aim would be to increase this number. This study has demonstrated that funding is a substantial barrier to carrying out an osteoporosis risk assessment. Further research exploring this issue using a nationally representative sample is recommended.

- Osteoporosis risk assessment could be increased by conducting highly visible public health campaigns. The aim would be to educate the public to think about their bone health, and to prompt discussion with their GP's. There also needs to be focus on ensuring that people are well informed regarding the risks of untreated osteoporosis.

- Concurrently, education could be targeted to GP's to increase their awareness of osteoporosis risk assessment following patient prompt. It would also be of worth to highlight the use of screening tools as an effective assessment tool.

- In a bid to reduce costs and increase accessibility, consideration of the use of ultrasound scan as an alternative to the DEXA could be of value.

- Clinicians need to remain aware of how they describe fragility fractures and osteoporotic treatment to patients, as this can impact on people's willingness to commence and continue anti-osteoporosis medications.

The following section identifies further research opportunities generated from this study.

4.14 Further Research Opportunities

The research opportunities discussed focus on further exploration of the survey results to gain greater understanding of current practice in the GP community. It would be of interest to research whether there is a correlation between practice size and osteoporosis knowledge among GP's, as well as exploring whether there are other factors (i.e. resourcing by practice size, rural vs urban practices) that may impact on osteoporosis knowledge within practice communities. To increase the rate of screening tool use, further exploration of the guidelines used by GPs to discover the reason for the moderate use of screening tools among the respondents would be of value, i.e. is this due to lack of knowledge of the other screening tools, lack of accessibility to the tool online, the need for a BMD result or validity perceptions. In view of the new process for discharge summary communication within CCDHB orthopaedics, auditing of discharge summaries to identify if a low trauma fracture was clearly stated in the mechanism could be of value. Further in-depth exploration of the effects of funding constraints for DEXA scan on the population that is vulnerable to osteoporosis may provide benefits in highlighting where limited funding can be further targeted. Importantly, further work should also explore understanding as to whether Māori and Pacific peoples living in New Zealand experience the same impact of hip fractures as for non-Māori and non-Pacific peoples. Further studies that identify how patients' values and preferences guide their decision making in osteoporosis treatment would be of value in the aim to increase medication compliance rates, in particular specifically exploring the New Zealand public's experiences of osteoporosis and osteoporosis treatments.

4.15 Conclusion

This online survey has provided information regarding current practice for wrist fragility fracture follow up in the Wellington general practitioner population. This study establishes a reference point for research on what was happening within the primary health care community in Wellington, New Zealand, in regards to osteoporosis prevention and treatment. The aim and specific objectives of this survey have been addressed as the study has identified that patients aged 50 years and above with a potential fragility wrist fracture are followed up for osteoporosis assessment by almost two thirds of GP respondents in the Capital and Coast District Health Board region. It has also been established that all GP respondents receive a

discharge summary from the After-hours, secondary or tertiary care centre where their patient was initially treated for fracture injury. The perceived barriers to osteoporosis diagnosis and treatment in the Wellington GP survey respondents' community have been identified, as well as the tools that the GP survey respondents access to gain and further their knowledge on osteoporosis. The study has also identified that Wellington GP survey respondents want to lead osteoporosis assessment and prevention care, seeing their role as of high importance, and has established that there is a high level of osteoporosis knowledge within the Wellington GP survey respondent's community.

This chapter has briefly discussed the demographic characteristics of the survey population, following on with identification of the key study findings and discussion of each key finding with support from the literature. The strengths and limitations of the study have been identified, and these have been followed by a summary of the significant study results. From the study results, recommendations for practice have been made, and this chapter has concluded with a brief discussion on potential opportunities for further research.

Appendices

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Appendix A -STROBE—checklist of items to be included in observational study reports

(Von Elm et al., 2007)

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	**i**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	**i**
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	**1**
Objectives	3	State specific objectives, including any prespecified hypotheses	**30**
Methods			
Study design	4	Present key elements of study design early in the paper	**31**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	**33-35, 41**
Participants	6	*Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	**33**
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	**33, 79**
Data sources/ measurement	8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	**42**
Bias	9	Describe any efforts to address potential sources of bias	**79**
Study size	10	Explain how the study size was arrived at	**33**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	**36**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	**36**
		(*b*) Describe any methods used to examine subgroups and interactions	**36**
		(*c*) Explain how missing data were addressed	**36**
		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	**N/A**
Results			
Participants	13	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	**42**
Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	**43-45**

	Item No	Recommendation	Page No
	14	(b) Indicate number of participants with missing data for each variable of interest	**43-60**
Outcome data	15	*Cross-sectional study*—Report numbers of outcome events or summary measures	**43-60**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	**50-51**
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	**54,58**
Discussion			
Key results	18	Summarise key results with reference to study objectives	**60. 78**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	**79**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	**80**
Generalisability	21	Discuss the generalisability (external validity) of the study results	**79**
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	**iii, 40**

Appendix B: Participant Survey

Q2 I have read the participant information provided and consent to participate in this survey

○   Yes, I give my consent (1)

Q3 Please select your gender: Male / Female

Q4 Length of professional experience as a general practitioner

less than 5 years / 5-9 years / 10-14 years / 15-19 years / greater than 20 years

Q5 Please select the employment status that applies

Full time permanent / Part Time permanent / Full time Locum / Part time Locum

Q6 Please select the answer that best describes the population size of your practice

less than 2,500 / 2,500 - 5,000 / 5,000 - 7,500 / 7,500 - 10,000 / greater than 10,000
Unknown

Q7 The following two questions relate directly to this scenario:

A 50-year-old lady has presented to the After-Hours Medical Centre with a left fractured distal radius after tripping over a paving stone. She has been referred to Wellington Hospital Orthopaedic Outpatients for follow up and has had non-operative treatment of her wrist fracture. Treatment has now been completed, the fracture has healed and she has been discharged back to your care, as her primary health care provider. You have received the discharge letter from Wellington Hospital detailing the mechanism and type of injury, the treatment, and that non-operative treatment has been completed successfully.

Q8 Would you routinely investigate this patient for osteoporosis?

- No, I would file the discharge letter assuming that the orthopaedic surgeons would follow up if there was a question of osteoporosis
- Yes, the orthopaedic discharge letter would be a prompt
- Yes, if prompted by the patient
- Other, please state

Q9 If you were to investigate this patient, how would you investigate?
(please select all that apply)

- Discuss lifestyle risk factors
- Refer for Bone Mineral Density testing
- I would carry out screening using an osteoporosis screening tool
- Other

Q10 I would usually carry out screening using ONE of the following tools

SCORE (Simple Calculated Osteoporosis Risk Estimation) / OSIRIS (Osteoporosis Index of Risk) / ORAI (Osteoporosis Risk Assessment instrument) / FRAX (Fracture Assessment tool) / GARVAN / Other, please state

---

Q11 What steps would you take when seeing a patient with a fracture that may be due to osteoporosis?
(Please choose as many as appropriate)

- I would start treatment based on the previously selected screening tool
- I would refer the patient to a specialist
- I would recommend lifestyle changes (such as appropriate diet, physical activity)
- I would prescribe calcium/vitamin D supplements
- I would provide information on falls prevention
- Other

Q12 Who do you think is best placed to take the leading role in initiating investigations for osteoporosis?
Orthopaedic specialist / General / Other

Q13 How do you view the value of your role as a primary health care provider in osteoporosis prevention?
Extremely / Very important / Moderately important / Slightly important / Not at all important

Q14 Do you think that an osteoporosis nurse specialist who could be involved in identifying, and following up those patients at risk of fragility fracture would provide a beneficial service?
No / Maybe / Yes

Q15 please explain your answer to the above question

Q16 Please select any of the following that are known osteoporosis risk factors

Glucocorticoid therapy / Age / early onset menopause / prolonged immobilisation / lack of physical activity / history of low trauma fracture after age 45 years / Anorexia Nervosa / smoking / decreased height / low body mass index / history of maternal hip fracture / type 1 diabetes / all of the above

---

Q17 What resources do you access for osteoporosis information?

	Repeatedly (1)	Sometimes (2)	Never (3)
Guidelines for GP's	☐	☐	☐
Guidelines for Specialists	☐	☐	☐
Professional literature	☐	☐	☐
Workshops/conferences	☐	☐	☐
E-Learning	☐	☐	☐
Online resources such as Health Pathways, Osteoporosis NEW ZEALAND	☐	☐	☐
Other, please state	☐	☐	☐

Q18 What do you see as the barriers to the diagnosis and management of osteoporosis in Wellington (please select as many as appropriate)

- Inadequate knowledge of osteoporosis
- Osteoporosis should be managed by a specialist
- Adverse effects of osteoporosis medication
- Patient reluctance to see a specialist
- Patient with higher prioritised health needs (perceived as more serious)
- Communication with specialists (ie delayed or no reports)
- GP is not authorised to prescribe selected medications
- Unavailability of public health funding for diagnostic examinations
- Unavailability of specialised treatment
- Lack of time
- Patient non-adherence
- Other, please state
- There are no barriers

Q19 Do you, as the primary health care provider, receive a discharge summary on your patient who has presented at either the After-Hours Medical Centre, or Wellington Hospital Emergency Department/Orthopaedic Outpatients as standard procedure

- Always
- Most of the time
- About half the time
- Sometimes
- Never

Q20 If you receive the discharge summary, what form is it sent in?

- Electronic, via email
- Postal mail

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

VICTORIA
UNIVERSITY OF WELLINGTON

Current practice in management of patients presenting with a low trauma wrist fracture to primary health care settings in the Wellington region.

INVITATION LETTER FOR PARTICIPANTS

Thank you for taking the time to read this information. Please read this information before deciding whether or not you want to take part. If you decide to participate, thank you. If you decide not to participate, thank you for considering my request.

Who am I?

My name is Nik Florance and I am a Masters candidate in the Master of Health Care programme at the Graduate School of Nursing, Midwifery and Faculty of Health, Victoria University of Wellington. This research project is work towards my thesis at Victoria University of Wellington.

What is the aim of this project?

The project aims to explore current primary care practice regarding osteoporosis assessment following a low trauma wrist fracture in patients over 50 years old.

What are the objectives of this project?

The objective of this project is to enable the researcher to be able to identify if, and where any gaps in care may exist. It is anticipated that this research will provide a resource for CCDHB and the PHOs to enable construction of a plan to provide support where necessary.

This research has been approved by the Victoria University of Wellington Human Ethics Committee; approval number 25465.

How can you help?

If you are happy to take part in this study, please **copy and paste** the following link: http://vuw.qualtrics.com/jfe/form/SV_a5FOEdNECLwXvyl to complete the anonymous

online survey on the Victoria University of Wellington Qualtrics website. The survey consists of 20 questions and will take five to seven minutes to complete.

What will happen to the information you give?

This research is anonymous. As the survey responses are anonymous, the responses given are not linked to any individual, or primary health care practice. All information from the survey will be reported as either percentages or general comments, there will be no individual responses or identifying data reported. If you wish to receive a summary of findings on completion of the study, you will be given the opportunity to enter your email address at the end of the survey, and this will not be linked to your responses in any way.

Only myself as the principal investigator, and my academic supervisors will read the information collected in the responses. At the completion of the survey, the responses collected will be stored securely on the Qualtrics website under password protection only known by the principal investigator. The collected information will be stored for a period of up to two years following completion of the research project and will then be permanently deleted.

What will the study produce?

The information from this research will be used in my Master thesis report. It is possible that information from this research will be published in academic or professional journals, and/or be disseminated at academic and professional conferences.

If you accept this invitation, what are your rights as a research participant?

There is no obligation to complete the survey. If you do decide to proceed to complete the survey you have the right to ask any questions about the study at any time, and receive a summary of the results of this research by emailing the researcher to request a copy.

If you have any questions or problems, who can you contact?

If you have any questions, either now or in the future, please feel free to contact:

Student / Principal Investigator: **Supervisor:**

Name: Nik Florance   Name: Dr Priya Saravanakumar

University email address: Role: Lecturer

██████████████████   School: Graduate school of Nursing, Midwifery and Faculty of Health

                                                               Email: ████████████████

You can also contact the HEC convener that approved this study:

AProf Susan Corbett, email ████████████. New Zealand, telephone █████████

Appendix D: Ethics Approval VUW HEC

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

VICTORIA
UNIVERSITY OF WELLINGTON

Phone ████████
Email ████████

MEMORANDUM

TO	Nikola Florance
FROM	AProf Susan Corbett, Convener, Human Ethics Committee
DATE	11 April 2018
PAGES	1
SUBJECT	**Ethics Approval: 25465** Current practice in management of patients presenting with a low trauma wrist fracture to primary health care settings in Wellington region: A quantitative survey

Thank you for your application for ethical approval, which has now been considered by the Standing Committee of the Human Ethics Committee.

Your application has been approved from the above date and this approval continues until 11 April 2021. If your data collection is not completed by this date you should apply to the Human Ethics Committee for an extension to this approval.

Best wishes with the research.

Kind regards

Susan Corbett
Convener, Victoria University Human Ethics Committee

Appendix E: CCDHB Locality Approval

Capital & Coast District Health Board
ÜPOKO KI TE URU HAUORA

Locality sign off for Hospital/Ethical Approval

Full project title:	Current practice in management of patients presenting with a low trauma wrist fracture to primary health care settings in the Wellington region
Short project title:	n/a

1. Declaration by principal investigator

The information supplied in this application is, to the best of my knowledge and belief, accurate. I have considered the ethical issues involved in this research and believe that I have adequately addressed them in this application. I understand that if the protocol for this research changes in any way, I must inform the ethics committee.

Name of Principal Investigator (please print):	Nik Florance
Signature of Principal Investigator:	*[signature]*
Date:	23 / 4 / 2018

2. Declaration by Clinical Leader in which the Principal Investigator is located

I have read the application, and it is appropriate for this research to be conducted in this department. I give my consent for the application to be forwarded to the ethics committee.

Name (please print):	Mr Peter Devane		
Signature:	*[signature]*	Institution:	CCDHB
Date:	26 / 4 / 18	Designation:	Clinical Leader -Orthopaedics

- Where the Clinical Leader is also one of the investigators, the Clinical Leader declaration must be signed by the Clinical Executive Director.

3. If the application is for a student project, the supervisor should sign the declaration.

I have read the application, and it is appropriate for this research to be conducted under my supervision. I give my consent for the application to be forwarded to the ethics committee.

Name (please print):	Dr Priya Saravanakumar		
Signature:	*[signature]*	Institution:	Victoria University of Wellington
Date:	26 / 4 / 2018	Designation:	Supervisor

4. Declaration by Operations Manager/ED in which the Principal Investigator is located

I have read the application, and it is appropriate for this research to be conducted in this department. I give my consent for the application to be forwarded to the ethics committee.

Name (please print):	Mr Grant Kiddle		
Signature:		Institution:	CCDHB
Date:	26 . 4 . 18 .	Designation:	Executive Director - Clinical

Appendix F: RAG-M Endorsement

Māori Partnership Board, Capital & Coast DHB

RESEARCH ADVISORY GROUP MĀORI (RAG-M)

17 April 2018

Nik Florance

Tēnā Koe

Re: RAG-M #571 - Current practice in management of patients presenting with a low trauma wrist fracture to primary health care settings in the Wellington region

☑ Your application has been endorsed

Please note that the committee request a summary of the research results on completion of your research.

RAG-M wishes you all the very best with your study.

Ngā mihi nui,

Jack Rikihana
Chairperson

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