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A Qualitative Study Exploring Patients' Perspectives on Pharmacological Management of Osteoporosis Following Upper Extremity Fragility Fractures

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Abstract

Osteoporosis, a significant medical and socioeconomic threat, frequently results in fragility fractures in both men and women. This thesis delves into the various factors that impact how patients with osteoporosis adhere to their medication regimens, as well as the decision-making processes they go through after experiencing upper extremity fragility fractures. Employing qualitative interpretive description methodology, data were collected through semi-structured interviews with fourteen older adult patients at Hand and Upper Limb Centre, St. Joseph's Hospital, through purposeful sampling. Thematic analysis of the transcripts revealed vital factors such as social support, personal health beliefs, side effect management, and treatment accessibility that influence medication adherence. Findings indicate that clear communication, proactive side effect management, and logistical support are critical in enhancing medication adherence. This research underscores the importance of incorporating implementation science principles to develop targeted interventions, ultimately improving patient outcomes and reducing the incidence of osteoporotic fractures. The study's insights contribute to developing comprehensive strategies for better osteoporosis management in older adults.

Keywords:

Osteoporosis, osteopenia, upper extremity, fragility fractures, medication, postmenopausal, distal radius fracture, proximal humerus fracture

Summary for Lay Audience

Osteoporosis is a condition that mostly affects older adults, who have brittle bones and are likely to break certain bones. Because the healing process is time-consuming and difficult, scientists must conduct studies regularly to increase their knowledge and help older adults avoid taking more breaks. We did a study to find out why some older people, who have already broken an arm, take their medicine while other people don't, and what keeps them from continuing to take their medicines. We conducted interviews with 14 patients who were 65 and above, had osteoporosis, and had broken arms before. Our participants indicated that how their doctors communicated with them was very important. This means that patients are more likely to take their medicines when their doctors take the time to explain points and address their concerns. We also realized that people may stop taking their medicine if they feel rushed or ignored. Many stop taking it because they fear side effects, even though it prevents more breaks. Participants of our study also disclosed that their other health problems could affect how they decide about starting their medications. Moreover, having support from family and friends is very beneficial, as it has been observed that participants of our study were more likely to take their medications when their family and friends were actively involved in their treatment. We also came across the fact that it can sometimes be challenging to get medicine, especially in places where it's tough to see a doctor or get to a drugstore. Therefore, if individuals had easier access to their family doctor and drugstore, they would undoubtedly continue to take their medications. People we spoke with favoured simple medications that didn't interfere with their daily routines, such as those that required less frequent administration. As a conclusion, the results of our study helped us understand that people would rather take their medicine as prescribed if their doctors

knew these points, and this can help people with osteoporosis live longer by stopping more bone breaks.

Co-authorship Statement

Dr. Joy MacDermid and Mahtab Jangi developed the study protocol, research questions, methodological considerations and interview guide. The advisory committee members, Dr. Christina Ziebart and Dr. Allison Rushton were included as co-authors in the primary manuscripts based on their contributions. Bansari Patel was a co-author of the primary manuscripts for her contributions through recruitment, data collection, identifying themes, and reviewing the transcripts as a second coder.

Chapter One: Introduction

Mahtab Jangi – responsible for study design, literature review, narrative synthesis and manuscript writing

Joy MacDermid – study design, data analysis and manuscript reviewing

Chapter 2: A qualitative study exploring factors influencing decisional balance to take osteoporosis medications in patients with osteoporosis who have experienced an upper extremity fragility fracture

Mahtab Jangi – primary author, study design, data collection, data analysis and manuscript writing

Joy MacDermid – principal investigator, study design, data analysis, manuscript review

Christina Ziebart – study design, manuscript review

Allison Rushton – study design, manuscript review

Bansari Patel – data extraction, secondary transcript review, secondary coding

Chapter 3: A qualitative study exploring factors influencing patients' adherence to osteoporosis medications in patients with osteoporosis who have experienced upper extremity fragility fractures

Mahtab Jangi – primary author, study design, data collection, data analysis and manuscript writing

Joy MacDermid – principal investigator, study design, data analysis, manuscript review

Christina Ziebart – study design, manuscript review

Allison Rushton – study design, manuscript review

Bansari Patel – data extraction, secondary transcript review, secondary coding

Chapter 4: Grand discussion

Mahtab Jangi – sole author

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Chapter One:

Introduction to Osteoporosis, Current Approaches in Osteoporosis Management and Literature Review

1.1 Introduction to Osteoporosis:

Osteoporosis constitutes an escalating medical and socioeconomic concern, defined by a comprehensive decline in bone density, strength, and microstructural integrity, leading to an elevated risk of fractures (NIH, 2000). The World Health Organization (WHO) diagnostic criteria define osteoporosis as a condition where the bone mineral density (BMD) falls at least 2.5 standard deviations below the mean BMD of a healthy young adult population, indicated by the T-score (Rachner et al., 2011). Moreover, normal BMD is defined as a T-score of -1 or higher and a T-score between -1 and -2.5 is considered osteopenia or low bone mass (Kanis, 2002). The risk of fracture increases gradually as bone mineral density (BMD) decreases (Morin et al., 2023). Systematic reviews and meta-analyses of observational population-based research using absorptiometry methods have shown that there is a two-fold increase in the risk of fracture with every standard deviation (SD) fall in bone mineral density (BMD) (Marshall et al., 1996). The gradient of fracture risk is contingent upon the individual's age, the fracture type, the site and the technique employed (Johnell et al., 2005).

Osteoporosis can be a silent disease, as it can lead to no symptoms until the patient experiences a fracture (LeBoff et al., 2022). Osteoporotic fractures lead to substantial morbidity and mortality (Reid & Billington, 2022). As a result, it is crucial to formulate and implement evidence-based clinical practice guidelines specifically aimed at preventing and managing osteoporosis in postmenopausal women, who represent the most affected group (Levin et al., 2018).

Young individuals' efforts are mainly directed toward lifestyle interventions that enhance and sustain peak bone mass, which include maintaining activity and weight, obtaining a diet with abundant fruits, vegetables and beneficial nutrients, maintaining regular menstrual function, engaging in regular weight-bearing and muscle-strengthening physical activity, and avoiding smoking and excessive alcohol intake (Cosman, 2018). Despite the previous evidence regarding the effect of sufficient calcium and Vitamin D intake on improving outcomes related to fragility fractures, recent systematic reviews and individual studies stated minimal benefits of supplementation in decreasing the prevalence of fractures (Bolland et al., 2018).

Because of the systemic nature of osteoporosis, the associated increase in fracture risk affects virtually all skeletal sites (LeBoff et al., 2022). Hip fractures and vertebral fractures have historically been regarded as major osteoporotic fractures, as they are significantly associated with reductions in hip BMD and spine BMD, respectively (LeBoff et al., 2022). Nevertheless, the incidence of all other fractures (non-hip, non-vertebral) is numerically significantly higher, and collectively, these fractures incur significantly higher economic costs for the population (Compston et al., 2019).

1.2 Epidemiology of osteoporosis:

Osteoporosis is diagnosed in over 2 million individuals in Canada, with an annual incidence of 150 hip fractures per 100,000 (Morin et al., 2023). The Bone Health and Osteoporosis Foundation "BHOF" (Formerly known as National Osteoporosis Foundation "NOF"), estimated that more than 12.3 million people in the United States suffer from osteoporosis, and an additional 43.4 million have bone density that lower than normal (Wright et al., 2014). The yearly fracture incidence is expected to reach 3.2 million by the year 2040, representing a 68% rise over recent years (Lewiecki et al., 2019).

In the United States, it is estimated that 50% of Caucasian women and 20% of Caucasian men aged 50 and older will suffer from an osteoporotic fracture at some stage in their lives (Cosman et al., 2014). Non-Hispanic white and Hispanic American women had the greatest fracture rates when bone mineral density, weight, and other factors were taken into consideration, while Native American, African American, and Asian American women came in second and third, respectively, in terms of frequency of fractures. (Cauley, 2005; Liu et al., 2011). Bone mineral density (BMD), cortical thickness, access to healthcare, comorbidities (like diabetes), and skeletal geometry (like hip axis length) are all thought to have a role in the development of divergent fracture rates (Nelson et al., 2011).

Although there is a correlation between fracture rates and the risk of osteoporosis, this correlation is not universal across different races and ethnicities (Cauley, 2005). For instance, despite the fact

that a smaller percentage of African Americans suffer from osteoporosis, those who have been diagnosed with the condition have fracture rates that are equivalent to those of non-Hispanic whites and have generally recorded poor fracture outcomes (Cauley et al., 2014). The bone mineral density levels of Native Americans are comparable to those of non-Hispanic whites; nevertheless, the proportion of Native Americans who suffer from hip fractures is much greater (Viswanathan et al., 2018). This discrepancy may highlight problems related to screening processes, nutritional intake, lifestyle choices, and follow-up care practices (Viswanathan et al., 2018).

Even though fractures may have potentially fatal effects and anti-fracture therapies are effective, osteoporosis continues to be underdiagnosed and undertreated, particularly in males (Adler, 2018). The risk of mortality in the year after a hip fracture is significantly increased, and hip fractures are strongly predictive of additional fractures within the same year (Colon-Emeric et al., 2003). However, some practice settings discharge up to 80–95% of patients without an anti-fracture treatment or management plan following hip fracture repair (Kim et al., 2015; Roerholt et al., 2009).

Epidemiologic data have convincingly indicated that bone loss, as assessed with testing by DXA, occurs in both women and men as part of the natural aging process (Riggs et al., 2002). Current estimates are that 40% of white women aged 45 years would experience an osteoporosis-related fracture, with this risk rising to nearly 50% if vertebral fractures identified by imaging rather than clinical history are included (Dawson-Hughes et al., 2012). Similarly, it is estimated that 13% of men will experience an osteoporosis-related fracture (Cummings & Melton, 2002). Accordingly, osteoporosis and osteoporosis-related fractures are major public health concerns and impose enormous healthcare costs (Burge et al., 2007). Therefore, identifying and treating persons at the most significant fracture risk is of paramount importance. Evidence supports the cost-effectiveness of pharmacologic intervention for the treatment of patients with prior fragility fractures, low bone mass (osteopenia) and additional clinical risk factors, or osteoporosis as defined by the World Health Organization (DXA T-score –2.5) (Dawson-Hughes et al., 2008a).

1.3 Epidemiology of Upper Extremity Fragility Fractures:

Distal radius fractures (DRF) and proximal humerus fractures (PHF) are the second and third most common fractures in the elderly population, respectively (Baron et al., 1996). A retrospective cohort analysis in Ontario showed that DRFs consisted the largest allocation of upper extremity fractures, while PHF represented the largest number of fractures in the 66-80 subgroup (MacDermid et al., 2021). A DRF may be associated with an increase in mortality because patients older than 65 years with a DRF have been shown to have decreased survival compared with an age-matched population (Rozental et al., 2002). Notably, although 11% of patients with any fragility fracture will suffer a second fragility fracture within 3 years of the initial injury, (Dang et al., 2019), older patients with a DRF have a greater than five times risk of a subsequent hip fracture within one year (Chen et al., 2013).

In another prospective cohort study in 118 patients four years after sustaining a DRF, it was determined that it is crucial to conduct early screening for bone mineral density (BMD) and provide suitable therapy, given that most of the patients with DRF included in this study were in their middle age and had no other health issues (Dewan et al., 2018). This approach may greatly contribute to preventing future fractures in this specific group of patients. Given the known morbidity and mortality associated with secondary fragility fractures, it is essential for orthopedic surgeons to identify these at-risk patients and facilitate the evaluation and treatment of their underlying diminished bone mass and altered microarchitecture (Shoji et al., 2021). Therefore, this evidence has informed the decision to conduct this study to provide a comprehensive understanding of patients' insights through pharmacological management of osteoporosis, specifically those recruited from an orthopedic tertiary care setting in Canada.

1.4 Physiology of Bone remodelling:

Skeletal bone is the primary repository for calcium and phosphorus minerals that are essential to multiple physiologic systems and are critical to locomotion (Ellert et al., 2016). Additionally, it contains a significant portion of the hematopoietic system (Ellert et al., 2016). The bone is directly influenced by a complex system of regulatory hormones, which also indirectly affect other tissues, including the intestine and kidney, to ensure that serum calcium remains constant and that cellular

calcium and phosphorus are sufficient (Ellert et al., 2016). The mineral that is insufficiently present in serum is withdrawn from skeletal stores. The risk of fractures that occur spontaneously or from minimal trauma is increased as a result of the gradual degradation of skeletal microarchitecture by the continuous elimination of bone tissue over time (LeBoff et al., 2022).

In response to hormonal, mechanical, and pharmacologic stimuli, the skeletal system undergoes the processes of bone remodelling or turnover, which involve bone formation or bone resorption (LeBoff et al., 2022). This allows the skeletal system to respond in a dynamic manner. Fractures are repaired by the skeleton via a process known as bone remodeling, which takes place on bone surfaces all across the skeleton after epiphyseal closure (LeBoff et al., 2022). Trabecular bone, which is a strong network of bone largely located in vertebrae, makes up the most considerable portion of the bone's surface area (Ellert et al., 2016). Resorption is the action of osteoclasts which initiate the process of remodelling by degrading and removing damaged bone (Cosman et al., 2014). This process will later be followed by the mechanism of bone formation to replace the bones that have been removed (Manolagas & Jilka, 1995). Complex interactions are involved in the mechanisms that regulate bone formation; however, osteocytes partially mediate these processes (Manolagas & Jilka, 1995). These cells are responsible for inhibiting bone formation and producing a lower quantity of sclerostin in areas that are subjected to a certain mechanical strain, which is the induction of new bone (McClung, 2017).

1.5 Pathogenesis of Osteoporosis:

In order to clarify the pathophysiology of the disease from a molecular perspective, we may then focus on the biochemical processes involved in this matter. Osteoporosis pathophysiology encompasses several elements, including systemic hormones, inflammatory cytokines, the immune system, growth factors, genetics, collagen anomalies, diet, exercise, and lifestyle choices (Nikander et al., 2010). Once peak bone mass is reached, the distribution of bone mineral content follows a normal distribution, and due to this normal distribution, bone density values can be expressed in standard deviations (SD) (Kanis, 2002). Peak bone mass refers to the highest level of skeletal tissue that a person will have throughout their lifetime, reached at the end of skeletal

development (Burrows, 2007). The maximum amount of bone mass is believed to be reached between the ages of 25 and 30, after which it gradually decreases at a rate of 0.5% each year (Zanker & Duque, 2019).

Estrogen insufficiency is a well-researched component that contributes to the development of osteoporosis (Sipos et al., 2009). Osteoblasts and osteoclasts possess estrogen receptors which interact with estrogen, resulting in the increased expression of osteoprotegerin (OPG) and inhibition of the upregulation of receptor activator nuclear factor, KB Ligand, also known as RANKL (Receptor Activator of Nuclear Factor Kappa-B Ligand) (Sipos et al., 2009). OPG is a protein that inhibits bone loss and promotes a balance between bone resorption and formation, whereas RANKL is a protein that stimulates the proliferation of osteoclasts (Iolascon, 2013). The above-mentioned mechanism is a simplified explanation; there are several steps involved in the OPG-RANKL pathway that led to low bone mass and are beyond the scope of this thesis. In postmenopausal women, estrogen deficiency directly decreases the OPG protein and indirectly increases RANKL (Sipos et al., 2009). As a result, this causes an increase in the production of osteoclasts, which eventually leads to the loss of bone tissue (Sipos et al., 2009). Similarly, the age-related decrease in the male hormone testosterone might contribute to the onset of osteoporosis in males (Ellert et al., 2016).

1.6 Diagnostic Tools for Osteoporosis:

The reference tool to assess BMD for the diagnosis of osteoporosis is dual-energy X-ray absorptiometry (DXA), which is approved by WHO, BHOF and Osteoporosis Canada (Marshall et al., 1996). This tool has been approved and widely used because of its accuracy and potential in terms of fracture prevention (Kanis & Glüer, 2000). DXA in FRAX is used to get measurements of the bone mineral density (BMD) in the designated areas (Kendler et al., 2019). The spine is not usually a good location for the diagnosis of osteoporosis because of the high occurrence of degenerative changes, which provide a misleading increase in the bone mineral density (BMD) value (Kendler et al., 2019). In situations where it is not feasible to assess hip bone mineral density (BMD) owing to technological limitations or if the spine is impacted differently, spine BMD

measures may be used to aid in diagnosis (LeBoff et al., 2022). However, the BMD results of the spine can still be considered reliable, especially in individuals who recorded and unexplainable lower BMD compared to that of their hip (Binkley et al., 2014). If it is not possible to accurately measure or interpret the spine or hip, or if a patient exceeds the weight restriction for the DXA, the T-score of the distal forearm (1/3 radius) may be used for diagnosing osteoporosis (Kendler et al., 2019).

Computerized Tomography (CT) is another diagnostic tool for osteoporosis, which utilizes X-rays and computer processing to create detailed cross-sectional images of the skeletal system (Ward et al., 2017). Although CT resolution is lower than that of Dual-energy X-ray Absorptiometry (DXA), it offers significantly greater sensitivity to subtle electron density differences and improved image contrast (Ward et al., 2017). Quantitative CT (QCT) uses a standard clinical scanner for precise tissue density assessment but involves higher radiation exposure than DXA, typically scanning the lumbar spine, hip, and tibia (LeBoff et al., 2022). Peripheral QCT (pQCT) employs similar technology in a compact device specifically targeting the forearm (Ward et al., 2017).

The diagnosis of osteoporosis has historically relied on identifying low bone density without any fractures (Morin et al., 2023). However, the "2016 and 2020 Clinical Practice Guidelines for Diagnosis and Treatment of Postmenopausal Osteoporosis, published by the American Association of Clinical Endocrinologists (AACE) and American College of Endocrinology (ACE)", have provided updated recommendations (Camacho et al., 2020), which agree that it is also possible to identify osteoporosis in people who have osteopenia and an elevated risk of fracture by using FRAX thresholds that are particular to every country (Arceo-Mendoza & Camacho, 2021).

Bone mineral density testing is an effective instrument; nevertheless, the risk of fracture in individual patients is also greatly impacted by clinical risk factors (Lewiecki et al., 2011). The FRAX tool, evaluated by the aforementioned criteria, incorporates a plethora of clinical risk factors that may serve as fracture risk predictors, the majority of which have nothing to do with bone

mineral density (BMD) (Kanis et al., 2011; Lewiecki et al., 2011). Age, gender, body mass index (BMI), smoking, alcohol consumption, prior fracture, parental history of hip fracture, employment of glucocorticoids, rheumatoid arthritis, secondary osteoporosis, and femoral neck bone mineral density (BMD) if it is accessible are the clinical risk factors that are included in the FRAX (Imerci et al., 2018). FRAX is a tool that estimates the likelihood of experiencing a hip fracture or a large osteoporotic fracture (such as fractures in the hip, clinical spine, humerus, or forearm) during the next 10 years (Kanis et al., 2010). Women who are 70 years old or older and have osteopenia (a T-score less than -2.5) should seek treatment for osteoporosis if they have a 10-year probability of at least 15% for a severe osteoporotic fracture in Canada or above the threshold that is specific to their nation (Dawson-Hughes et al., 2008) (Morin et al., 2023). The recent clinical practice guideline in Canada recommends FRAX in addition to the Canadian Association of Radiologists and Osteoporosis Canada (CAROC) tool as well, which acknowledges the results reported by FRAX are in a more accurate fracture risk categorization (Morin et al., 2023).

1.7 Osteoporosis Management:

1.7.1 Pharmacological Management of Osteoporosis

The objective of administering pharmacological therapy for low bone mineral density (BMD) or osteoporosis in postmenopausal women and high-risk males is to reduce the incidence of significant osteoporotic fractures (LeBoff et al., 2022). Pharmacologic therapy is indicated in patients with T-scores in the osteoporotic range and those with a history of fragility fracture; however, it is important to note that most fractures occur in patients with osteopenia or low bone mass (T-score between -1 and -2.5), as these individuals outnumber those with osteoporosis (Eriksen, 2012). In an update to the European Guidelines, patients are stratified into patients into low risk, high-risk, and very high-risk based on clinical factors such as age, sex, body mass index, and prior fractures, with or without BMD (Kanis et al., 2020). In the context of osteoporosis treatment, pharmacologic agents can be classified as either anabolic (which stimulates osteoblasts to produce new bone) or antiresorptive (which targets osteoclast-mediated bone resorption)

(Cosman et al., 2014). Each form of medication has been demonstrated to enhance bone mineral density (BMD) and mitigate the likelihood of fractures (Black & Rosen, 2016).

Bisphosphonates are the first-line pharmaceutical agents for the treatment of osteoporosis and osteopenia (Morin et al., 2023). Alendronate, risedronate, ibandronate (ibandronic acid), and zoledronate (zoledronic acid), the most commonly used bisphosphonates, are all nitrogen-containing bisphosphonates that primarily affect osteoclast survival and activity by inhibiting the mevalonate pathway (Russell, 2011). Denosumab, a human IgG2 antibody that binds to and neutralizes RANKL, is the only RANKL antibody that is presently available for use in the treatment of osteoporosis in patients (Leder et al., 2015). "The effects of treatment with denosumab in women with osteoporosis were investigated in the FREEDOM trial (Bone et al., 2017)". This study demonstrated reductions in bone turnover and increases in bone mineral density that presented a significant difference in comparison with placebo (Bone et al., 2017).

The endogenous Parathyroid is the agent that controls the regulation of homeostasis (Ellert et al., 2016). Bone resorption occurs as a result of continuous and prolonged exposure to PTH, whereas bone formation is promoted by periodic delivery of external recombinant PTH (Saag et al., 2007). There are currently two anabolic medicines that have been authorized by the FDA which are teriparatide and abaloparatide, both of which are generated from synthetic analogs of PTH (LeBoff et al., 2022). Selective estrogen receptor modulators class (including raloxifene, tamoxifen, lasofoxifene, and bazedoxifene) bind to the two estrogen receptors like estrogen, however, the affinity for the receptors is different for selective estrogen receptor modulators and estrogen (LeBoff et al., 2022). Selective estrogen receptor modulators (SERMs) share some protective effects against postmenopausal bone loss and osteoporosis similar to estrogen, while exhibiting other effects contrary to those of estrogen (Langdahl, 2021). The incidence of vertebral fractures is reduced by approximately 30–40% in patients with a prior vertebral fracture and by approximately 55% in patients without a prior vertebral fracture when administered raloxifene (LeBoff et al., 2022). Romosozumab is an anti-sclerostin monoclonal antibody that is FDA-approved for the treatment of osteoporosis in high-risk postmenopausal women (Michael Lewiecki et al., 2018). Romosozumab demonstrates superior efficacy compared to placebo, alendronate, and

teriparatide in reducing fractures and increasing bone mineral density (BMD) in the lumbar spine and whole hip in postmenopausal women with low bone mass (Cosman et al., 2016; Keaveny et al., 2017).

When it comes to osteoporosis in postmenopausal women and men, the most frequent treatment regimens consist of the pharmacological medications that have been discussed above. However, several protocols have been examined in randomized controlled trials and have been shown to be successful in lowering the incidence of new fractures (LeBoff et al., 2022). For instance, it has been proven that the combination and/or sequential use of anabolic (for instance, teriparatide) and powerful antiresorptive (for instance, denosumab) medicines are more successful than monotherapy with any single agent in increasing bone mineral density (BMD) and improving bone microarchitecture and integrity, specifically in the cases of multiple vertebral fractures (Leder et al., 2015). Additional research is required to evaluate the impact of combination therapy on incident fractures. Combining two antiresorptive treatments is not recommended (LeBoff et al., 2022).

1.7.2 Non-Pharmacological Management of Osteoporosis:

BMD can be temporarily increased, and muscle mass can be increased through weight-bearing and resistance exercise (Hinton et al., 2015). Despite lack of randomized trials to demonstrate that weight-bearing physical activity reduces the risk of fractures, longitudinal studies utilizing high-resolution computed tomography have demonstrated beneficial effects on skeletal microarchitecture in conjunction with certain forms of regular physical activity (Kraemer & Nindl, 2012). Fractures are often the result of falls, and both the likelihood of experiencing a fall and the probability that a fall will lead to a fracture increase significantly as individuals grow older (Cosman, 2018). Improved balance and increased muscle tone may be achieved through exercise and balance programs (e.g., tai chi and yoga), which may also serve to mitigate the risk of falls in certain geriatric individuals (National Osteoporosis Foundation, 2019). In addition to exercise, the use of a multidisciplinary program to evaluate risk factors, withdrawal of psychotropic medications (when feasible), and assessment of the home for hazards are prudent strategies for potentially

reducing the risk of falls (National Osteoporosis Foundation, 2019). Other measures that should be implemented include counselling regarding the risks of falls and the reduction of bone mineral density (BMD) associated with cigarette smoking and excessive alcohol consumption (Black & Rosen, 2016)On the other hand, it has always been believed that calcium and vitamin D intake could increase bone mass and reduce fracture risk; however, considering these two elements in treatment regimens remains controversial. (Bauer D, 2014). The Women's Health Initiative (WHI) investigators conducted a large, randomized trial that involved over 36,000 postmenopausal women, in which the trial did not demonstrate a significant effect on fractures even though post-hoc subgroup analyses revealed a benefit among women aged 60 years or older and those who adhered to the assigned regimen (Jackson et al., 2006). While smaller studies have shown that taking vitamin D supplements regularly (but not at intermittent high doses) may slightly decrease the likelihood of falling, their study did not support that vitamin D supplementation alone reduces the incidence of fractures or increases bone mineral density (BMD) (LeBlanc et al., 2015). Health Canada recommends that most postmenopausal women and men over 70 years have 1200 mg of calcium and a daily amount of 1000 mg for males aged between 51-70 years either via food, supplements, or both (Morin et al., 2023). The recommended calcium and vitamin D dosage is often specified within a range to account for variances based on numerous sources (Morin et al., 2023).

1.8 Implementation of health promotion models in osteoporosis management:

Several studies have investigated various health promotion models to promote healthy behaviours among osteoporotic patients or those who are at high risk of osteoporosis. In a cross-sectional study conducted by (Tsamlag et al., 2020), a convenience sampling method was employed in 20 community health service centers in Shanghai, China. An anonymous questionnaire was employed to assess the predictive relationships between self-management behaviours and variables from the Information-Motivation-Behavioral (IMB) model (Tsamlag et al., 2020). It was illustrated in the study that middle-aged and older adult patients with osteoporosis have poor self-management behaviour (Tsamlag et al., 2020). Medical system assistance may facilitate the development of effective self-management practices in patients, and acquiring information about osteoporosis

might alter patients' cognitive abilities, enhance their self-confidence (self-efficacy), and foster the development of effective self-management practices (Tsamlag et al., 2020). Another research was conducted to investigate the effect that educational intervention had on the level of awareness that women had about the prevention of osteoporosis (Pinar & Pinar, 2020). As a result of the study, it was found that Health Belief Model-based health promotion educational intervention provided information on the increase of osteoporosis protection and positive beliefs but did not have the expected effect on altering some osteoporosis preventive behaviours, even though adaptive behaviour change was observed (Pinar & Pinar, 2020). Not only should health care professionals place a greater emphasis on health promotion, but they should also do more research of a higher quality and with a more complete overall design (Pinar & Pinar, 2020). Nevertheless, this approach has the potential to serve as a model for the promotion of a healthy lifestyle in order to safeguard against osteoporosis (Pinar & Pinar, 2020).

The health belief model served as the foundation for a study investigating the influence of a preventative program to prevent osteoporosis in women before and after the intervention (Khani Jeihooni et al., 2015). A number of parameters, including knowledge, perceived susceptibility, perceived severity, perceived advantages, perceived obstacles, self-efficacy and internal signals to action, were shown to have significantly improved in the case group, according to the findings of their research (Khani Jeihooni et al., 2015). This improvement was observed immediately and six months after the intervention compared to the control group (Khani Jeihooni et al., 2015). The intervention group exhibited a significant increase in the BMD T-score of the spine and hip, while the control group experienced a significant decrease in both regions (Khani Jeihooni et al., 2015).

Although many health promotion models or theories could be implemented to increase public awareness regarding osteoporosis, the health belief mode, as has been investigated in the above-mentioned research, there are still additional publications that concentrate on the osteoporosis education intervention that is founded on the Health Belief Model (HBM). In another study, the Health Belief Model (HBM) was employed by the researcher to establish an osteoporosis prevention program that consisted of three elements: educational classes, bone mineral density testing, and individual consultation (Turner et al., 2004). “It was illustrated that Increasing

perceived severity, perceived susceptibility, perceived benefits, and self-efficacy and cues to action while decreasing perceived barriers were actions that promoted participation (Turner et al., 2004).” However, it was stated that more studies are still needed to examine the use of the Health Belief Model as well as other behavioural theories in the design and implementation of osteoporosis prevention programs, which are outlined as educational programs tailored to the aim of osteoporosis prevention (Turner et al., 2004).

1.9 Rationale of the study:

The Ottawa Charter for Health Promotion, a significant document in the field, underscores the role of health promotion in fostering personal and societal growth through the provision of health information, education, and the enhancement of life skills (World Health Organization, 1986). This charter expands the range of choices individuals have to exert more influence on their well-being and surroundings, enabling them to make decisions that promote good health (World Health Organization, 1986). Therefore, it is of paramount importance to build therapeutic programs with the aim of improving osteoporosis knowledge in the high-risk group. Despite extensive research on the diagnosis and management of osteoporosis, concerns about medication adherence in osteoporotic patients persist. These concerns have arisen due to the subclinical nature of the disease, leading to more cessation of treatment by patients. On the other hand, there is a lack of qualitative studies on patients’ insights through their treatment paths and how they incorporate the medications into their routine lives following upper extremity fragility fractures. To achieve this aim, health promotion and knowledge translation strategies could be employed to ensure the successful transfer of knowledge to this group. For instance, if doctors have a greater grasp of the perspectives and behaviours of women about post-menopausal osteoporosis, they will be better able to engage in a relationship with their patients, addressing the patients' genuine worries and expectations (Alami et al., 2016). Concerns and representations made by patients should get a greater amount of attention and time in order to have a better understanding of the priorities they hold (Alami et al., 2016; Meadows et al., 2007).

Research has found that a significant number of patients with fragility fractures, identified as high-risk for additional fractures, struggle with the decision to begin osteoporosis medication (Sale et al., 2011). Whether they found the decision straightforward or challenging, many participants expressed that their choice was not fixed and could be changed in the future (Sale et al., 2011). Adverse effects are among the most prevalent causes of osteoporosis medication discontinuation, and they seem to be linked to a reluctance to resume treatment (Lindsay et al., 2016).

Moreover, research indicates that those diagnosed with osteoporosis tend to view the condition not as a linear progression of their biological health but as a subjective spectrum of health and severity (Rothmann et al., 2018). The impact of an osteoporosis diagnosis varies among individuals, depending on factors such as personal experience, preconceived conceptions or knowledge about the disease, fragility fractures, or discomfort (Rothmann et al., 2018). Consequently, individuals will construct a meaning of the diagnosis that is informed by their self-perceived fracture risk and osteoporosis severity (Rothmann et al., 2018).

A comprehensive review of research on osteoporosis treatment preferences reveals that women equally consider the effectiveness and side effects of medications when making treatment decisions (Barrionuevo et al., 2019). They generally favour medications that require less frequent dosing, finding injectable treatments acceptable if administered at extended intervals (Barrionuevo et al., 2019). However, additional research on patient values and preferences is necessary to guide decision-making in osteoporosis treatments (Barrionuevo et al., 2019). Prior research conducted in the United States, focusing on patients with a high risk of fracture due to osteoporosis, has shown that factors such as efficacy, safety, out-of-pocket costs, and convenience play a significant role in patients' adherence to specific medications (Beaudart et al., 2022). Among these individuals, it was shown that a significant preference existed for daily anabolic therapy as opposed to daily or monthly subcutaneous injections (Beaudart et al., 2022). The presence may enhance the commencement and continuity of osteoanabolic treatment for osteoporosis patients unwilling to undergo injectable therapy (Beaudart et al., 2022).

Previous research has brought up several concerns that had shed light as a result of screening administered to a group of women who had not previously sought guidance on their bone health (Salter et al., 2014). Individual variables such as comprehension, choice, perceived danger, and necessity contribute to the difficulty of sticking to osteoporosis preventive medicine, which in turn results in unpredictable patterns of prescription use (Salter et al., 2014). This necessitates that healthcare providers do not assume adherence in older women but instead focus on patients' and providers' beliefs and motivations to establish and maintain acceptable medication regimes. (Salter et al., 2014).

1.10 Project Overview:

The aim of this thesis is to investigate the facilitators and barriers to the pharmacological management of osteoporotic fractures in the Canadian tertiary care setting by understanding patients' perspectives. Interpretive descriptive methodology will be used to co-create understanding by building a patient-centred approach in scrutinizing the current decision-making plans in osteoporosis management (Thorne, 2016).

As we have clarified in the previous sections of this chapter, the ultimate role of osteoporosis diagnostic programs and treatment regimens is the reduction in the incidence of osteoporotic fractures, especially hip and vertebral fractures. Although many trials regarding the educational intervention of osteoporosis have been conducted, fewer studies with a qualitative methodology have focused on the clinical management of osteoporosis and/or the incidence of new upper extremity fractures by further investigating patients' insights and perspectives in decision-making to initiate osteoporosis therapy. Moreover, the student researcher's previous professional experience as a pharmaceutical representative in the osteoporosis division indicated that patients face challenges in their decision to initiate therapy and continue to comply with their treatment plan. This approach enables the identification of critical motivators and barriers to medication-taking, which can vary significantly from those experienced by individuals with hip or vertebral fractures. In contrast, an older adult patient with a hip fracture may be more concerned with long-term mobility and pain management. Moreover, upper extremity fractures often require complex

and prolonged treatment protocols, including surgery, physical therapy, and medication. Understanding the decisional balance in this context is vital for developing tailored interventions that address this patient population's needs and preferences. Qualitative research can contribute to more effective patient education, support, and engagement in treatment plans by focusing on the unique challenges and considerations associated with upper extremity fractures (Brian Haynes et al., 1996). Additionally, exploring the decisional balance in medication-taking for upper extremity fractures can provide insights into broader issues of patient autonomy, shared decision-making, and healthcare communication (Brian Haynes et al., 1996). Patients' experiences and perspectives can inform the development of more responsive and patient-centred healthcare systems that respect individual preferences and promote informed decision-making.

1.11 Thesis composition:

The thesis is divided into four chapters. The first chapter provides an introduction to osteoporosis, osteoporotic fragility fractures, epidemiology, and a literature review that investigates the existing plans for pharmacological and non-pharmacological approaches to osteoporosis therapy.

Chapter 2 addresses the primary research objective and provides a response to the first research question. This chapter has been written as a scholarly article to be submitted for publication. The research question concerns the perceptions of risks and benefits, as well as the factors that influence decisional balance, in relation to the use of osteoporosis medications in individuals who have sustained upper extremity fragility fractures as a result of osteopenia or osteoporosis.

Chapter 3 addresses the secondary research objective and answers the second research question, which concerns the attitudes, priorities, facilitators, and barriers that influence adherence to osteoporosis medication in individuals diagnosed with osteoporosis or osteopenia and who have experienced an upper extremity fragility fracture. This chapter has also been written as a scholarly article to be submitted for publication.

Chapter 4 presents a grand discussion of the thesis.

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Chapter 2:

A qualitative study exploring factors influencing decisional balance to take osteoporosis medications in patients with osteoporosis who have experienced upper extremity fragility fractures

A qualitative study exploring factors influencing decisional balance to take osteoporosis medications in patients with osteoporosis who have experienced an upper extremity fragility fracture

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ABSTRACT:

Introduction: Despite numerous studies on the efficacy and safety of pharmacologic agents for the management of osteoporosis, participants find the decision to start osteoporosis therapy challenging. This study aims to explore the factors influencing decisional balance in osteoporosis pharmacologic therapy among older adult patients with diagnosed osteoporosis who have experienced an upper extremity fragility fracture.

Methods: This qualitative study utilized an interpretive description methodology. Fourteen participants, aged 65 and above, diagnosed with osteopenia or osteoporosis and experiencing distal radius or proximal humerus fractures, were recruited from the Hand and Upper Limb Centre at St. Joseph's Health Centre, London, Ontario. Data were collected through semi-structured interviews and analyzed using a thematic analysis approach.

Results: Four main themes emerged: (1) the role of healthcare interactions in shaping treatment expectations, (2) competing expectations of efficacy vs. fear of side effects, (3) shift from priorities by competing health problems, and (4) perceived inevitability of osteoporosis as inherent to aging.

Conclusion: Effective communication, patient education, and comprehensive care strategies are crucial for enhancing decision-making in the initiation of osteoporosis management. Addressing these factors can improve patient outcomes, especially in the context of multimorbidity, by supporting informed decision-making at the onset of treatment.

Keywords: Osteoporosis, fracture, upper extremity, medication, qualitative study

2.1 Introduction:

Osteoporosis is a growing public health concern that involves systemic impairment of bone mass, strength, and microarchitecture, which increases the risk of fragility fractures (NIH, 2000). It is identified by a bone mineral density (BMD) that is equal to or less than 2.5 standard deviations below the average BMD of a reference sample of young people, as defined by the World Health Organization (WHO) diagnostic classification (T-score) (Rachner et al., 2011). Osteoporosis can be a silent disease, as it develops no symptoms until the patient is experiencing a fracture (LeBoff et al., 2022). Therefore, it is imperative to establish the most updated clinical practice guidelines to prevent and treat osteoporosis, specifically in postmenopausal women, the most significant affected population (Levin et al., 2018).

Osteoporosis can be diagnosed based on the BMD T-score measured at the total hip, femoral neck, or lumbar spine. However, fracture risk prediction is not improved using measurements from multiple sites (Kanis et al., 2006). If it is not possible to accurately measure or interpret the spine or hip, or if a patient exceeds the weight restriction for the DXA, a diagnosis of osteoporosis may be determined by evaluating the T-score of the distal forearm (1/3 radius) (Kendler et al., 2019).

Fractures of the distal radius (DRF) and the proximal humerus (PHF) are the second and third most prevalent types of fractures that occur in the senior population, respectively (Baron et al., 1996). A distal radius fracture may be associated with an increase in mortality because patients older than 65 years with a distal radius fracture have been shown to have decreased survival compared with an age-matched population (Rozental et al., 2002). Notably, although 11% of patients with any fragility fracture will suffer a second fragility fracture within three years of the initial injury, (Dang et al., 2019), older adults with a DRF have a greater than five times risk of a subsequent hip fracture within one year (Chen et al., 2013).

The goal of administrating pharmacologic therapies to treat low BMD or osteoporosis in postmenopausal women is to decrease the burden of major osteoporotic fractures (Shoback et al., 2020). Pharmacologic therapy is indicated in patients with T-scores in the osteoporotic range and

those with a history of fragility fracture; however, it is important to note that most fractures occur in patients with osteopenia or low bone mass (T-score between -1 and -2.5), as these individuals outnumber those with osteoporosis (Shoback et al., 2020). Therefore, major osteoporosis guidelines also recommend the treatment of patients with a history of hip or vertebral fracture or patients with osteopenia and a history of fragility fractures or with greater than or equal to 20% probability of major osteoporotic fracture based on the FRAX tool (Shoback et al., 2020).

In terms of pharmacological management of osteoporosis, the currently available agents for the treatment of osteoporosis can be categorized into antiresorptive (i.e., targeting osteoclast-mediated bone resorption) or anabolic (i.e., targeting osteoblastic activity to induce bone formation) (LeBoff et al., 2022). Drugs of each type have been shown to improve BMD and reduce the risk of fractures (Black & Rosen, 2016).

Research indicates that a majority of patients diagnosed with a fracture, who were considered to have a high likelihood of experiencing another fracture, said that they found the choice to undergo osteoporosis treatment to be “challenging” (J. E. Sale et al., 2011). Irrespective of whether the choice was deemed “simple” or “tough”, several participants expressed that this decision was not permanent (J. E. Sale et al., 2011).

While a systematic review of existing literature on patients' values regarding osteoporosis treatment suggests that women prioritize both effectiveness and side effects equally when deciding whether to take medications for osteoporosis, they tend to prefer medications that are administered less frequently (Barrionuevo et al., 2019). Injectable drugs are also considered acceptable as long as they are given less frequently (Barrionuevo et al., 2019). However, further research is necessary to understand patient values and preferences better to inform decision-making in osteoporosis treatments (Barrionuevo et al., 2019). Moreover, even though there has been extensive research regarding the diagnosis and management of osteoporosis, there is still much concern regarding adherence to medication in osteoporotic patients. These concerns have risen due to the subclinical nature of the disease, leading to more cessation of treatment by patients. On the other hand, there is a lack of qualitative studies on patients’ insights through their treatment paths and how they

incorporated the medications into their routine lives. Therefore, this qualitative study aimed to understand the patient factors contributing to their decisional balance in medication-taking in osteoporosis.

2.1.1 Purpose of the study:

The objective of this qualitative study was to understand the attitudes, priorities, and internal and external factors influencing decisional balance, including perceptions of risks and benefits with respect to taking osteoporosis medication in patients who have been diagnosed with osteopenia or osteoporosis and who have sustained at least one upper extremity fracture (distal radius or proximal humerus fracture).

2.2 Methods:

2.2.1 Study design:

This study was designed according to three main domains introduced by the Consolidated Criteria for Reporting Qualitative Studies (COREQ) to ensure methodological considerations regarding this approach (Tong et al., 2007). This thesis implemented an interpretive description approach to investigate the research question (Thorne, 2016). The strength of this approach is that it provides a nuanced comprehension of clinical phenomena by uncovering and integrating themes and patterns (Teodoro et al., 2018). This methodology enhances the explanation of intricate concepts with a high degree of accuracy and clarity (Teodoro et al., 2018). It must also be noted that interpretive description is a qualitative methodology that is in accordance with the constructivist paradigm of investigation (Hunt, 2009; Thorne et al., 2004). This approach is often employed to draw inferences in the context of clinical sciences (Hunt, 2009; Thorne et al., 2004). Employing this methodology promotes a more profound comprehension of clinical aspects, enabling the development of a clearer vision and a strategic plan for practical implementation. (Teodoro et al., 2018). Moreover, this methodology entitles the researcher to be involved throughout the course of

the research, rendering the knowledge to be co-created by the researcher and respondents (Thorne et al., 2004).

2.2.2 Participants:

To explore the factors influencing decisional balance in patients deciding to initiate pharmacological treatment for osteoporosis or osteopenia, participants who had experienced upper extremity fractures were recruited through purposeful sampling. From December 2023 to April 2024, all participants were enrolled at the Hand and Upper Limb Center (HULC), St. Joseph's Healthcare, London, Ontario. Eligibility criteria for participation included being diagnosed with osteoporosis or osteopenia; being sixty-five years old or older; having sustained a distal radius or proximal humerus fracture; being able to speak, read, and write English; and being capable of providing informed consent.

Study participants were recruited to participate in in-depth, semi-structured interviews, and fourteen people participated in the research. Twelve participants volunteered for telephonic interviews, while the remaining two consented to do an in-person interview at the designated interview room in the clinical research laboratory lab. One participant (p8) did not take any osteoporosis medications, so they were included only in the current study since they contributed to themes related to decisional balance. Each participant gave their consent after being fully informed regarding the study procedures. The eligible potential patients were contacted while attending their wait time for their appointment at the Hand and Upper Limb Centre by the student researcher. In the company of another study team member, the procedures and objectives were explained to them, and they were given enough time to decide whether or not to participate in the study. The content of the Letter of Information (LOI) was clarified thoroughly to the patient, and it was ensured that the participant would provide written informed consent upon their willingness to participate in the study. Table 1 contains a comprehensive breakdown of each participant's demographic information.

2.2.3 Ethical Considerations:

The Western University Research Ethics Board (REB, WREM) and Lawson Health Research Institute (#123925) approved the study protocol in London, Ontario, Canada. The study protocol was developed to guarantee the confidentiality of the information gathered from the participants and to obtain their informed consent before recruiting them for the research. All the individuals who took part in the research were informed that they had the right to withdraw from the study at any time and that they had the opportunity to ask as many questions as they wanted.

2.2.4 Data collection:

The student researcher designed a semi-structured interview guide for data collection following peer consultation with the principal investigator (JM). A pilot interview was conducted with the first participant using the interview guide. As no significant adjustments were necessary, all the participants were interviewed using the same guide. The guide used open-ended inquiries, facilitating the acquisition of specific details using subsequent inquiries and signals. Concerning the following subjects, the interview guide included topics to discuss: 1) fracture background; 2) medication decision-making; 3) understanding and knowledge of osteoporosis; 4) self-declared facilitators and barriers to their continuance of medication; 5) healthcare provider support; 6) lifestyle and self-care; 7) long-term perspectives, which is available in the appendix section of this document. In order to retrieve further information, prompts such as "Would you like to disclose more details on this matter?" and "Can you elaborate on that?" were used. The evolution of the interview questions was iterative, meaning that comparison was constantly made throughout the data collection to ensure that the interview guide was comprehensible to the participants. Data collection was continued until theoretical saturation was secured, and this saturation was interpreted when no new insights were retrieved from the participants in the final three interviews (Morse, 1995).

The student researcher (MJ) conducted all of the interviews. The mean duration of each interview was 44 minutes, with a minimum of 11 and a maximum of 78 minutes of recorded audio interviews. Interviews were recorded using an Olympus DS-3500 encrypted recording device, and the audio files were then kept on a computer secured with a password in an encrypted file on a

server protected by St. Joseph's Hospital. Participants who agreed to participate in the study through phone interviews were placed on speakerphone, and their voices were recorded using the same audio-recording device as the in-person interviews. These participants were assured that their conversations were only audible to the student researcher, who conducted the interviews in a private room within the research lab, in accordance with the ethics approval. The student researcher (MJ) manually transcribed all the interviews verbatim and verified the transcripts in terms of accuracy. The data analysis was conducted word-by-word using an interpretive descriptive approach (Thorne, 2016). Participants who chose telephonic interviews were located in their chosen residences during the interview. In contrast, the in-person interview took place in the designated interview room in the clinical research laboratory at St. Joseph's Hospital.

2.2.5 Data Analysis:

A qualitative thematic analysis was administered to interpret, analyze, and summarize the interview data (Braun & Clarke, 2012). A manual technique was utilized to code the sentences involving the repetitive reading of the interview transcripts and coding the emerging themes from the data. The process was inductive, and data was coded via open coding. Two researchers (MJ and BP) coded the transcribed interview scripts, and the codes were consulted with the principal investigator (JM). Performing intercoder reliability suggests the trustworthiness of the coding process, which necessitates the subsequent analysis (O'Connor & Joffe, 2020). During this stage, the whole set of datasets was read by two researchers, and insights and understandings were written down in memos. According to other studies, employing multiple coders will contribute to the internal validity of the study, thus emphasizing the credibility (Shenton, 2004). Each individually coded script was discussed, and finally, generated codes were finalized and collected into categories. The research team reviewed the coding process until a consensus was reached. In terms of independent scrutiny, one other member of the research team (BP) secondarily reviewed the interpretation and coding process to confirm emerging themes and categories (Thompson Burdine et al., 2021)

As previously mentioned, the methodological management and research governance were developed in adherence to the Consolidated Criteria for Reporting Qualitative Studies (COREQ), which covers the reporting of studies using interviews and focus groups so that the rigour of the analysis and the credibility of the findings can be determined (Tong et al., 2007).

Thematic analysis was utilized to delve into each participant's experiences, focusing on ensuring the results' trustworthiness by upholding standards of credibility, transferability, dependability and confirmability (Berg & Lune, 2012; Tong et al., 2007). These constructs were implemented to contribute to the study's internal validity, external validity, reliability and objectivity, respectively (Shenton, 2004). Employing multiple reviewers through our study design secured the study's credibility by reducing the risk of researcher bias, while the author's continuous checking and interpretation validation assured confirmability (Shenton, 2004). Although terms like external validity do not apply to the context of qualitative research, strategies to confirm the generalizability of qualitative studies can be implemented (Shenton, 2004). In this case, as studies with a similar methodology have been conducted in different settings, it could be illustrated that the findings of this study are comprehensible by stakeholders, which can acknowledge the transferability (Shenton, 2004). Participants' direct quotes were clarified for each theme, aligning with their demographic information to provide context based on their medical history. These steps ensured the transparency of reporting results (Berg & Lune, 2012). Moreover, Dependability was achieved by employing a rigorous and appropriate research design, implementing the study methodically, and conducting a thorough, reflective appraisal throughout the project (Shenton, 2004). This included consistent monitoring and evaluation of the research processes to ensure reliability and accuracy in the findings (Shenton, 2004). Themes were developed to capture the underlying meaning of codes and categories, accurately reflecting participants' information to ensure confirmability of the study (Graneheim & Lundman, 2004).

2.3 Results:

Table 2.1. Participant demographics and clinical diagnosis.

Participant	**Age**	**Sex**	**Diagnosis**	**Fracture Site**	**Pharmacotherapy Plan**	**Dosing**
P1	72	Male	Osteopenia	DRF	Risedronate	Weekly
P2	66	Female	Osteopenia	DRF	Risedronate	Weekly
P3	94	Female	Osteoporosis	PHF	Denosumab	Biannually
P4	77	Female	Osteoporosis	DRF	Denosumab	Biannually
P5	81	Male	Osteoporosis	PHF	Risedronate	Weekly
P6	67	Female	Osteopenia	DRF	Alendronate	Weekly
P7	67	Male	Osteopenia	PHF	Risedronate	Weekly
P8	77	Female	Osteopenia	PHF	NA	NA
P9	70	Female	Osteoporosis	PHF	Denosumab	Biannually
P10	88	Female	Osteoporosis	PHF	Denosumab	Biannually
P11	75	Female	Osteoporosis	DRF	Denosumab	Biannually
P12	80	Female	Osteoporosis	DRF	Denosumab	Biannually
P13	68	Female	Osteoporosis	PHF	Denosumab	Biannually
P14	77	Female	Osteopenia	DRF	Risedronate	Weekly

Note: DRF=Distal Radius Fracture, PHF=Proximal Humerus Fracture

There were four themes identified from the transcripts (Fig. 2.1)

1. Healthcare interactions shape treatment expectations.
2. Expectations of efficacy compete with fear of side effects.
3. Competing health problems can shift patients' priorities away from osteoporosis.
4. Perceived inevitability of osteoporosis could act as an inherent in aging.

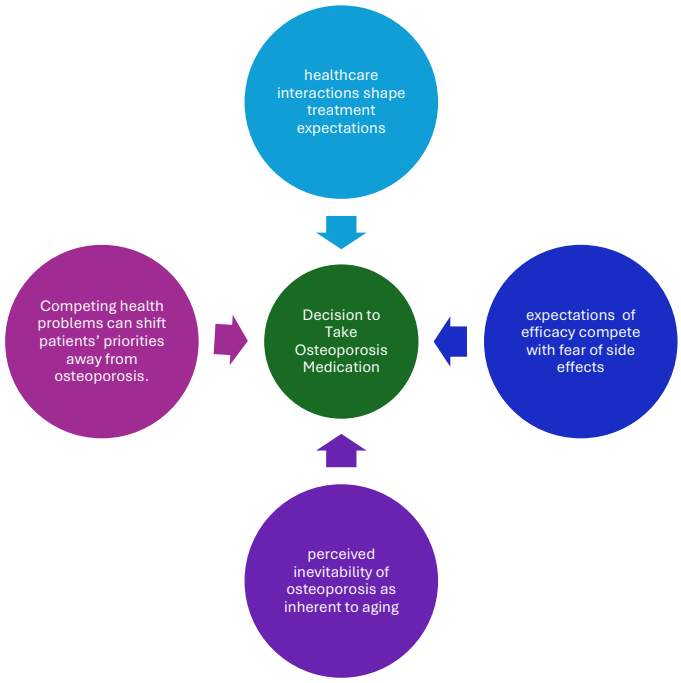

Fig 2.1. Factors influencing decision-making in osteoporosis treatment

Theme 1: Healthcare interactions shape treatment expectations and decisions.

The quality of interactions between healthcare providers and patients plays a crucial role in shaping patients' perceptions and decisions regarding osteoporosis treatment. The trust and clarity provided by healthcare professionals are instrumental in influencing patients' willingness to initiate and adhere to their treatment regimens.

One participant detailed: "*When I first came to the clinic, I felt rushed. I felt they were rushing me, that they really weren't listening to my concerns. No, I was not impressed with the whole… with the initial impression. I felt like they weren't really listening to me. I mean, I had like 3 doctors that were looking. I felt more like a specimen. And personally, it wasn't really an experience, something I'd like to repeat*." *P13, female, 68*

Conversely, when interactions are characterized by transparency in their communication and shared decision-making, they can significantly enhance treatment adherence and patient satisfaction. A different participant recounted how detailed explanations and consideration of patient preferences aided their decision-making process:

" *Well, I think if you trust them, and you know that they listen to your complaints, things will change. I think that is not the first thing when you try to come to medication and maybe being in the health field, she (my doctor) gives me more choices than if I was non-medical because, you know, I have experienced a few more things than other people might have had. So, I think she gives me choices. For that, she has put me on, it is for a reason, and that is why I'm taken up to her decision to start the medication…*" *P12, female, 80*

This highlights the importance of trust in healthcare providers through engaging in conversations about the potential advantages and providing the rationale for initiating therapy. Although this patient was part of the health sector, she had a more critical view of patient-practitioner interaction, which can be considered critical in this matter.

Another participant reflected on the importance of effective communication, particularly when side effects arise, which can often deter patients from continuing treatment:

"*Maybe my family doctor left me on osteoporosis medicine too long, Perhaps, they should have changed it or checked on it or did something else. I'm not a doctor, so I don't understand a lot of medicine, but it seems to me it did have something to do with being on medication too long that*

gave me some side effects and perhaps I wouldn't have forgotten if they decided to change it to something else earlier.." *P4, female, 77*

This narrative underscores the necessity for healthcare providers to discuss potential side effects and manage expectations, ensuring that patients are not only informed but also feel supported throughout their treatment.

Trust in healthcare providers and the clarity of the information they provide significantly influence patients' decisions to initiate and adhere to treatment. Effective communication by healthcare professionals plays a critical role in shaping how patients perceive their treatment options and the likely outcomes of those treatments.

This finding reflects the profound impact that healthcare interactions have on patient engagement with treatment plans. It could be illustrated that patients appreciate the thorough explanation from the healthcare provider, which alleviates their fear and builds trust in the treatment process.

Theme 2: Expectations of efficacy compete with fear of side effects.

This theme encapsulates that patients have the potential benefits of osteoporosis medications and the apprehension about adverse effects, which significantly influence patient decision-making. Effective communication by healthcare providers about disambiguation regarding efficacy and side effects is critical in helping patients navigate these concerns.

One participant discussed their reservations about side effects, which were a major factor in their hesitation to continue their medication:

"*About the PO meds, I had a bad reaction to the PO meds which I tried last year, and I almost got locked jaw. It was like the side effects,… I was experiencing a lot of them, so I just continued taking*

them once weekly. But, it takes a while to get out of your system, and then I was quite reluctant to go to the injection. But, since then, on January 6th I had it. I seem to be OK. I seem to be all right." *P13, 68, female*

This participant clarifies how adverse reactions to previous treatments can significantly impact patients' willingness to try new therapies, despite potential benefits. The fear of experiencing severe side effects again can overshadow the perceived efficacy of the medication, making it critical for providers to discuss these aspects transparently and offer reassurance and alternatives where possible.

Another participant pointed out the importance of understanding both the positive and negative aspects of treatments:

"*They told me about the side effects and how it could help my condition. I had to weigh it because you hear about all these side effects, and you wonder if it's worth it. But they explained how it could prevent more serious fractures which could be more detrimental than the side effects. So, I decided to go ahead*." *P14, female, 77*

These results highlight the critical role that osteoporosis specialists play in assisting patients in weighing the benefits of a medicine against any potential drawbacks, including side effects. Healthcare professionals can assist patients in making more informed decisions that are consistent with their objectives to enhance their quality of life and personal risk tolerance by guaranteeing that patients have a comprehensive understanding of both the risks and benefits. These observations underscore the necessity of a novel approach to patient education and communication. Healthcare providers are required to actively participate in discussions that address patient anxieties and concerns, in addition to providing comprehensive information about the efficacy of treatments and their potential adverse effects. This has the potential to substantially increase patient confidence in their treatment choices, resulting in better adherence and overall health outcomes.

Another participant stated: "*Well it's not just Risedronate. I have issues in taking any medications. I don't take it easily. I think about it. I ask my stepson or Doctor; I ask him all my questions. You know, in the end, it is not easy to get a lot of information. And one issue I have with Prolia is that you can refracture your bone. If you get a bone fracture, you're gonna die, and I'm thinking why do I wanna put a medication in my body that is going to cause fracture in my bone? I don't know. I understand why doctors want you to take it because it helps preventing the fracture of the hip cause they don't like that, and cause when you're at the hospital taking up the bed for too long, they have to do surgery! I understand why my doctor is pushing Prolia and not other meds. I feel they are pushing Prolia because they want the patient out of the hospital taking up the bed.*" *P4, female, 77*

This illustrates the participants' struggles with the side effects and the modifications they need to make in their daily lives, which sometimes lead to refracture, hospitalization and quality of life. This also underscores the significant impact of side effects on patient compliance and satisfaction with treatment regimens which will affect their attitude towards the onset of therapy.

Theme 3: Competing health problems can shift patients' priorities away from osteoporosis.

Several participants declared the presence of other comorbidities as a key factor in influencing their decision to start taking their osteoporosis medication. This negligence will result in osteoporosis being overlooked by more immediate pathologic concerns, often systemic ones.

One participant disclosed:

"*I don't think that they're giving it any more attention than any other condition. No, I don't especially see that. I think there's more attention put on diabetes and other more well-known conditions. Like for cancer, there's more emphasis to the public. And they're focusing on heart, cancer, diabetes. Those seem to be some of the major players, and you know, healthcare is supporting, the politicians are supporting. Osteoporosis? No, I don't think enough is out there for*

people. I mean there are many things. We have an anchor pain. You immediately think you know it's Parkinson's that has those moments. Do you think you're getting Alzheimer's or just aging? So, I don't think that there is any extra emphasis put on it. You have to be your own management or manager of your condition. Know your own body and you gotta know how to push sometimes to your own advocate." *P13, female, 68*

The participant clearly stated that more attention is being drawn to other often systemic geriatric conditions than it is being done to osteoporosis, and this factor will externally affect the patient's adherence and might lead to discontinuation or intermittent cessation of therapy.

Another patient stated that:

"*No, it's not considered as a huge problem. The thing is, our society is getting older. Maybe they will be increasing the information, but I don't think it's nearly as much as say for arthritis. Well, everybody knows a little bit about arthritis, but I don't know whether people are aware of osteoporosis as well or not. The problem I think is with the family doctors that they have to make patients aware that they should be alert. Sometimes I think it's not a problem until you have a fracture and then they say: Why don't we do a bone density? That's a problem.*" *P11, female, 75*

It could be illustrated that patients feel osteoporosis as a serious geriatric condition has been neglected in the presence of other musculoskeletal comorbidities, which is indicative of clinical symptoms.

Patients exhibited greater recall and awareness of their comorbid conditions compared to osteoporosis. This disparity in attention suggests that the clinical manifestations and management of osteoporosis are often overshadowed by other more acute or symptomatic health issues. Consequently, osteoporosis frequently remains underprioritized in the context of overall patient care.

Another participant stated: "*No, I don't believe so. I didn't know I had it and the doctor just told me that I should be tested. I don't know if it had to do with my age or for my health. I mean, I have low iron and low hemoglobin. So, I have to get iron infusions and blood transfusions periodically. So, I have to have blood work done regularly. So, I don't know if it was a combination of that, but he thought that I should have the test anyways. He recommended it and booked it. I went and they found out that I had osteoporosis." P7, female, 70*

Managing multimorbidity in elderly patients requires a more comprehensive approach that includes a stronger focus on osteoporosis. Despite its significant impact on morbidity and quality of life, osteoporosis often remains underdiagnosed and undertreated due to the prioritization of more acute or symptomatic conditions. To enhance patient outcomes, healthcare providers must prioritize proactive screening, education, and integrated care strategies that address osteoporosis alongside other chronic conditions. By doing so, we can ensure that osteoporosis receives the necessary attention and management, ultimately improving the health and well-being of elderly patients with multimorbidity.

Theme 4: Perceived inevitability of osteoporosis could act as an inherent to aging.

Many participants expressed a resignation to osteoporosis as an inevitable part of the aging process, subtly weaving the condition into the fabric of expected senior life challenges. This normalization influenced their receptivity to interventions and colored their interactions with healthcare professionals.

"*I think it's the aging process that's happening that made me think I need to be more careful. Yes. It's a journey and it's not always an easy journey especially when it kinda gets into the end of your options*. "*P2, female, 66*

Patients disclosed their views on their diagnosis with osteoporosis as mostly attributable to their natural process of aging, than any pathologic event that would require specific intervention, as it can be illustrated in these quotes:

"*My body wasn't making new bones properly. I was losing them mostly faster than I was making it. And I would have to go on medication... a lot of people getting that as they get older*." *P10, female, 88*

This theme underscores the participants' acceptance of osteoporosis as part of aging, affecting their health decisions and expectations from treatment outcomes. Other participants also described this feeling as:

"*I suppose only because I noticed other aging people were talking about it and that it was related to aging. I don't think I have anything else to say about it. I think I realized that I must be very very careful when I'm walking, I like to walk*." *P3, female, 94*

This patient also reflected on the asymptomatic nature of the disease in her insights as a simple aging sign, rather than a chronic disorder to be managed specifically:

"*I don't feel like there was any idea that I had osteoporosis. I mean, certainly not in my in my background. I've related aches and pains to getting older. You know, you just get older. You're not as agile as you were. Not related to any physical condition or to any diagnosis, well, I didn't feel like I had symptoms that needed to be looked at. That is part of getting older*." *P6, female, 67*

These quotes illustrate the common thread among participants who often dismiss osteoporosis as merely another facet of aging, rather than a preventable and treatable condition. This perspective could potentially delay the adoption of effective treatment strategies and hinder the management of the disease.

2.4 Discussion:

Our study has unveiled a wealth of insights into the complex factors that influence patient decision-making about initiating medication use for osteoporosis. Despite extensive efforts to improve osteoporosis care and decrease the prevalence of fragility fractures, patients still face significant challenges in considering the decision to start osteoporosis medication. Participants of our study also considered osteoporosis as a natural process of bone degeneration as a result of aging. Previous research also suggested that patients did not associate fractures with bone frailty and expressed concerns about the potential adverse effects of the medicine (J. E. M. Sale et al., 2012). The standard degradation of bones was attributed to aging rather than illness. This belief was strengthened by the fact that osteoporosis often shows no symptoms. Therefore, this belief altered their decisional balance towards neglecting the effectiveness of pharmacotherapy and reaching out to primary care regarding the BMD assessment.

Many individuals provided reasons for their fragility fractures that did not connect the fractures to any bone health concerns (Giangregorio et al., 2008) . This perspective was notably associated with women who have received a diagnosis of postmenopausal osteoporosis and have not encountered any fractures as a result of falling. This has possibly resulted in an alternate inference that fractures may not be exclusively attributed to osteoporosis and bone frailty but rather to an external force (Alami et al., 2016). Perceiving fractures due to an impact caused the women to focus on preventing falls. They considered fractures to be occurrences resulting from impacts, dangerous activities, or risks (Alami et al., 2016). Consequently, these patients expressed doubts about undergoing long-term medication to avoid what they perceived as a rare and unpredictable occurrence. These considerations emphasize the intricacy of patients' decisions to initiate osteoporosis therapy and the need for customized communication and instructional initiatives by healthcare professionals.

Patients frequently encountered a dilemma with the possible advantages of osteoporosis drugs and their apprehension about potential adverse effects. This matter underscores the pivotal role of healthcare practitioners in effectively conveying attainable objectives and managing patient

expectations efficiently. According to the Health Belief Model (HBM), good communication is crucial in managing disagreements. This is because the HBM considers the perceived facilitators and barriers that impact changes in health behaviour (Rosenstock, 1974). This indicates that patient education about the benefits and risks of medications can significantly improve their perceptions toward an informed decision regarding initiating therapy (Horne et al., 2013).

For instance, (J. E. M. Sale et al., 2014) Acknowledged that effectively communicating the potential dangers and advantages of osteoporosis drugs led to an improved desire among patients to start therapy. This is consistent with the findings of individuals who felt more assured about their treatment choices after getting comprehensive explanations from their healthcare professionals. Consequently, improving patient education and addressing concerns regarding potential adverse effects might foster a more favourable inclination toward the conclusive decision to treatment initiation.

The quality of interactions between healthcare professionals and patients substantially impacts how patients perceive their treatment and make decisions. Establishing trust and maintaining effective communication are essential in promoting a favourable healthcare experience and facilitating compliance with treatment regimens. The Theory of Planned Behavior (TBP) is believed to be able to inform public campaigns aimed at bone health using the information from studies to illustrate the salience of attitudes and perceived behavioural control for those with fragility fractures (J. E. M. Sale et al., 2017). Previous exploration through this theory provides evidence that implementing health habits may be significantly impacted by perceived behavioural control, which is shaped by the support and information received from healthcare professionals (Ajzen, 1991) .

It could be illustrated from our study participants that a positive healthcare interaction, characterized by thorough explanations and responsiveness to the patient's personal preferences, can increase the patient's readiness to begin treatment. A patient's pleasure and chance of being satisfied with their treatment increase when they get the desired care, defined as communication that places the patient's preferences at the forefront (Stewart et al., 2024). Conversely, negative

experiences, such as feeling rushed or not being listened to, can undermine trust and discourage patients from continuing necessary treatments (Thorne et al., 2002). In light of this, it is essential for osteoporosis professionals to prioritize knowledgeable and empathic communication in order to cultivate trust and enable informed decision-making in order to initiate the therapy that is advised.

Participants also demonstrated that their previous health experiences, namely those pertaining to the severity of fractures and the healing process, have a significant impact on their present beliefs about the effectiveness and safety of the medication and will influence their inclination to accept and follow therapy recommendations. Condition analysis based on the Self-Regulation Model emphasizes that the cognitive views of an individual's state, which are moulded by prior experiences, affect the individual's responses to potential health risks (Leventhal, 1980).

Participants who had favourable experiences in the past with regard to their health were more receptive to new therapies. In contrast, those who had poor experiences in the past were more hesitant to begin new treatment programs. Patients' decision-making process regarding a new health intervention was considerably impacted by their prior encounters with previous treatment plans. This can be incorporated into healthcare practitioners by explaining treatment alternatives; they must consider these past experiences. This is crucial to addressing patient concerns and establishing a basis for making informed decisions (Horne et al., 2013).

The significance of multimorbidity in osteoporosis management, often leading to the negligence of osteoporosis as a subclinical condition, has been emphasized by participants to be critical in their decision-making process. Multiple health conditions necessitate treatment prioritization, where more immediate and severe conditions typically take precedence over osteoporosis. Despite the increasing interest of researchers in this field, there is still a remarkable gap between the harmful impact of multimorbidity at the individual and societal level and the amount of scientific and clinical research devoted to this topic (Marengoni et al., 2011).

The significant occurrence of multimorbidity and comorbidity in older people has substantial therapeutic implications. The need for intricate clinical treatment to address individual diseases and multimorbidity has immediate social ramifications (Salive, 2013). Specifically, the presence of several chronic conditions requires a significant allocation of social resources and necessitates the creation of innovative systems methods. Two instances that have been acknowledged to demonstrate how multimorbidity makes older adults susceptible to substandard healthcare are polypharmacy and insufficient care recommendations (Salive, 2013). In managing musculoskeletal disorders, osteoporosis is more likely to receive less attention from patients and healthcare providers due to the subclinical type of the disease. The disclosures from our study's participants aligned with these findings, stating that more attention is being drawn to other health conditions or mistakenly considered osteoporosis as another chronic symptomatic musculoskeletal condition that they were receiving long-term treatment.

A high number of individuals perceived osteoporosis as an unavoidable aspect of the aging process, which impacted their willingness to accept therapy. In many cases, the patient refused to have been diagnosed with osteoporosis or osteopenia despite keeping a diagnosis in their records. These findings could be explained by previous findings in the context of chronic health conditions, particularly in women, who were not interested in the context of bone health, even though they had a BMD assessment and were considered eligible to start medication (Alami et al., 2016). The normalization of this disease as an inherent part of the aging process might hinder the implementation of appropriate medication regimens. Health promotion frameworks, such as the Health Belief Model (HBM) and Theory of Planned Behavior (TPB), highlight the significance of altering health beliefs in order to induce behavioural change (Ajzen, 1991; Rosenstock, 1974).

Implementing educational interventions that question the concept of osteoporosis as an inevitable outcome of aging and instead promote it as a controllable condition might effectively alter patient perspectives and motivate proactive treatment. Research has demonstrated that focused educational initiatives may substantially enhance understanding and beliefs about osteoporosis, resulting in more informed decisions regarding treatment, which will secondarily lead to more compliance (Werner, 2005). By addressing these misconceptions, healthcare providers can help

patients understand that osteoporosis is not just a natural part of aging but a condition that can be managed with appropriate interventions by the timely decision to initiate the pharmacotherapy plan.

2.5 Study limitations:

This study acknowledges some limitations. The study sites are located in an orthopedic clinic within a teaching hospital in southwestern Ontario, where patients generally have higher socioeconomic status, advanced education, and better access to primary care. It has been proven that stakeholders from regional, rural, and lower socioeconomic areas might have different experiences. Furthermore, patients who did not speak English or attend follow-up appointments were excluded, potentially skewing the findings, as these individuals may face higher risks of poor healthcare transitions and unique challenges in initiating osteoporosis medication. Additionally, most interviews (12 out of 14) were conducted virtually. As recommended in the literature, this was why a strong connection and rapport between the researcher and participants were not established, as most interviews were conducted over the telephone (Charmaz K, 2006). Lastly, member-checks were not conducted owing to time constraints, which could contribute to the credibility of the completed study (Shenton, 2004).

2.6 Conclusion:

This study emphasizes the intricate interaction of several elements that affect patient decision-making in the treatment of osteoporosis. Participants found healthcare interactions, expectations of efficacy towards fear of side effects, perceived inevitability of osteoporosis as inherent in aging and past health experiences influential in their decision to initiate osteoporosis medications. Healthcare practitioners may enhance patient support and improve health outcomes in osteoporosis management by addressing these aspects, enabling patients to make informed decisions about their treatment programs.

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Chapter 3:

A qualitative study exploring factors influencing patients' adherence to osteoporosis medications in patients with osteoporosis who have experienced upper extremity fragility fractures

A qualitative study exploring factors influencing patients' adherence to osteoporosis medications in patients with osteoporosis who have experienced upper extremity fragility fractures

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ABSTRACT:

Introduction: Osteoporosis poses a threat, particularly among postmenopausal women, leading to increased fracture risk and substantial morbidity. Despite the availability of effective pharmacologic treatments, adherence to osteoporosis medications remains a challenge. This study aims to explore the factors influencing medication adherence in patients with osteopenia or osteoporosis who have sustained upper extremity fractures.

Methods: Utilizing an interpretive description methodology, this qualitative study recruited thirteen participants from the Hand and Upper Limb Centre at St. Joseph's Healthcare, London, Ontario. Data were collected through in-depth semi-structured interviews with eligible participants and analyzed using thematic analysis.

Results: Five themes emerged: (1) the facilitation of adherence by social support, (2) the influence of variable personal health beliefs and perceived necessity of medication (3) the challenge caused by managing medication side effects, (4) the influence of quality of access to primary care and pharmacy and (5) convenience of medication regimens. Participants emphasized the importance of clear communication, effective side effect management, and logistical support in improving adherence.

Conclusion: Addressing the multifaceted barriers to medication adherence requires targeted interventions grounded in implementation science principles. Leveraging social support, patient-co-designed patient education that addresses patient concerns, proactive side effect management, and attending to medication accessibility may be needed to improve adherence to osteoporosis medications.

Keywords: Osteoporosis, medication adherence, upper Extremity fractures, implementation science, qualitative study, patient education

3.1 Introduction:

Osteoporosis is a significant public health concern with medical and socioeconomic dimensions, identified by a systemic reduction in bone density, strength, and microstructural integrity, which increases the risk of fragility fractures (NIH, 2000). The World Health Organization (WHO) classifies osteoporosis by a bone mineral density (BMD) at the hip or lumbar spine that is 2.5 standard deviations or more below the mean BMD of a young adult reference population (T-score) (Rachner et al., 2011). This condition is often asymptomatic until a fracture occurs, resulting in substantial morbidity and mortality (Cummings & Melton, 2002). In light of this, it is of the utmost need to come up with recommendations for the most effective methods of osteoporosis prevention and treatment, particularly for postmenopausal women, who are the most afflicted group (Levin et al., 2018).

Among older adults, distal radius fractures (DRFs) and proximal humerus fractures are the second and third most common fractures, respectively (Baron et al., 1996). Studies have shown that DRFs may be linked to increased mortality rates, as patients over the age of 65 with a DRF exhibit lower survival rates compared to those of the same age group without such fractures (Rozental et al., 2002). Interestingly, while 11% of patients with a fragility fracture will suffer another within three years of the initial fracture, (Dang et al., 2019) individuals who sustain a DRF have a more than fivefold elevated risk of experiencing a hip fracture within one year after the initial one (Chen et al., 2013).

Pharmacologic treatments for low bone mineral density (BMD) or osteoporosis in postmenopausal women focus on lowering the incidence of significant osteoporotic fractures (Shoback et al., 2020). These treatments are recommended for patients with T-scores in the osteoporotic range and for those who have experienced fragility fractures (Shoback et al., 2020). Additionally, major osteoporosis guidelines advocate for the treatment of patients with osteopenia who have a history of fragility fractures or a high risk of major osteoporotic fractures, as determined by the FRAX tool. (Shoback et al., 2020). Despite the efficacy of these treatments, adherence to osteoporosis

medications remains a significant challenge, exacerbated by the subclinical nature of the disease, which often leads to treatment discontinuation.

Implementation science provides a framework for understanding and addressing these adherence challenges by focusing on the factors influencing the implementation of health interventions in real-world settings (Peters et al., 2014). It emphasizes the importance of context, including social, cultural, economic, political, and physical environments, and the roles of various stakeholders in the healthcare system (Peters et al., 2014). Implementation research seeks to understand the factors affecting the adoption, appropriateness, feasibility, and fidelity of interventions (Boaz et al., 2011). This approach is particularly relevant for addressing the multifaceted barriers to adherence to osteoporosis medications.

Previous studies have included multiple factors influential in patients' adherence to osteoporosis medications, including side effects, knowledge about osteoporosis and clarity of instructions about osteoporosis treatment (Iversen et al., 2011). However, there are fewer studies that are more specific on a target population that has incurred upper extremity fragility fractures. By incorporating the constructs of implementation science, which include acceptability, adoption, appropriateness, and sustainability of health interventions, a deeper understanding of the tentative factors on adherence can be illustrated (Proctor et al., 2011).

This research project aims to explore the factors influencing patients' self-reported adherence to osteoporosis medication in patients diagnosed with osteopenia or osteoporosis who have sustained at least one upper extremity fracture. In terms of defining adherence in this study, we chose to rely on self-reported adherence by patients due to the multifaceted nature of this concept, encompassing different aspects in various clinical settings. By applying principles from implementation science, this study seeks to identify attitudes, priorities, facilitators, and barriers to adherence, providing insights that can inform strategies to enhance the implementation of osteoporosis treatments. Understanding these factors will help develop targeted interventions that improve patient adherence, ultimately reducing the incidence of osteoporotic fractures and improving patient outcomes.

3.1.1 Purpose of the study:

The study's objective was to recognize the factors (attitudes, priorities, facilitators, barriers) influencing patients' self-reported adherence to osteoporosis medication in people diagnosed with osteopenia or osteoporosis and who have sustained at least one upper extremity fracture (distal radius or proximal humerus fracture).

3.2 Methods:

3.2.1 Study design:

In adherence to the primary three domains introduced by Consolidated Criteria for Reporting Qualitative Studies (COREQ), interpretive description was employed as the qualitative methodology for this study (Thorne, 2016; Tong et al., 2007). This study has been designed by incorporating the so-called criteria to ensure rigorous methodological standards (Tong et al., 2007). By employing interpretive description, this study aims to develop a nuanced understanding of clinical phenomena, identifying themes that provide deeper conceptual insights with precision (Teodoro et al., 2018). A constructivist paradigm is usually employed within interpretive description methodology (Hunt, 2009; Thorne et al., 2004). This methodology is frequently utilized within clinical research to draw inferences by exploring health science principles (Hunt, 2009; Thorne et al., 2004). This facilitates a more comprehensive understanding of the clinical element, leading to a distinct vision and strategic plan for practice (Teodoro et al., 2018). Furthermore, this methodology allows the researcher to remain actively engaged throughout the research process, resulting in the co-creation of knowledge between the researcher and the participants (Thorne et al., 2004).

3.2.2 Participants:

Between December 2023 and April 2024, participants were recruited for the study at the Hand and Upper Limb Center (HULC), located at St. Joseph's Healthcare in London, Ontario, through purposeful sampling. In order for patients to be eligible for participation, they were required to fulfill the following criteria: a) have been diagnosed with osteoporosis or osteopenia; b) be at least sixty-five years old; c) have had a fracture in the distal radius or proximal humerus; d) be able to speak, read, and write in English; and e) be able to provide informed consent effectively.

Each participant's demographic information is broken out in Table 1. Thirteen individuals participated in the research project to engage in in-depth, semi-structured interviews. The student researcher contacted the eligible individuals in the Hand and Upper Limb Centre while waiting for their appointments. Over the course of the recruiting procedure, a member of the study team followed the student researcher. Following an explanation of the aims and purposes of the study, the student researcher reached out to the participants to ask about their level of interest in participating in the research. A letter of information, a consent form, and sufficient time to evaluate these documents were sent to every individual who participated in the research project. After being provided with comprehensive information on the aforementioned processes, each and every participant granted their informed consent.

3.2.3 Ethical Considerations:

The study protocol received approval from the Western University Research Ethics Board (REB, WREM) and Lawson Health Research Institute (#123925), located in London, Ontario, Canada. The protocol was designed to ensure the confidentiality of the data collected from participants and participants' informed consent to be recruited to the study. Everyone who took part in the study was made aware that they had the right to ask as many questions as they intended and could withdraw from the study at any moment.

3.2.4 Data collection:

The initial author developed a semi-structured interview guide for data collection in collaboration with the principal investigator (JM). After piloting the interview guide with the first participant and finding no need for significant adjustments, the guide was employed consistently in interviews with all remaining participants. This guide featured open-ended questions designed to elicit detailed responses through follow-up and inquired regarding the following sub-categories: 1) fracture history; 2) decision-making regarding medication; 3) awareness and knowledge of osteoporosis; 4) self-identified facilitators and barriers to medication adherence; 5) support from healthcare providers; 6) lifestyle and self-care practices; and 7) long-term outlook. Prompts such as "Can you elaborate further?" and "Could you provide more details on that?" encouraged further elaboration. The interview questions were developed in an iterative manner, which means that comparisons were made consistently throughout the process of data collecting. This was done to guarantee that the interview guide was easily understandable by the individuals who completed the interviews. The data collection process was carried on until theoretical saturation was achieved, and this saturation was considered to have occurred when the participants in the last three interviews did not provide any new insights (Morse, 1995).

The student researcher conducted all interviews and transcribed all audio recordings verbatim, which included eleven by telephone and two in person, based on the participants' preferences. In-person interviews took place in a designated interview room within the clinical research laboratory at St. Joseph’s Hospital. The average interview duration was 38 minutes, with the shortest being 11 minutes and the longest 65 minutes. Recordings were made using Olympus DS-3500 encrypted audio recorder device and securely stored on a password-protected computer in an encrypted file on the secure server of St. Joseph’s Hospital. Participants who consented to participate via phone interviews were put on speaker mode, and the same audio-recording device recorded their voices as the in-person interviews. These participants were also ensured that they were only being heard by the student researcher in the private interview room in the research lab as per the ethics approval. The audio recordings were manually transcribed verbatim, verified by the student

researcher, and analyzed using an interpretive descriptive method (Thorne, 2016) on a sentence-by-sentence basis.

3.2.5 Data Analysis:

A qualitative thematic analysis was conducted to evaluate, analyze, and synthesize the data obtained from the interviews (Braun & Clarke, 2012). The design and analysis of the study were implemented to secure the trustworthiness by adhering to constructs of qualitative research, including credibility, transferability, dependability and confirmability (Tong et al., 2007). Each of these constructs focuses on internal validity, external validity, reliability and objectivity, respectively (Tong et al., 2007). The sentences were coded manually, which involved repetitively reviewing the interview transcripts and identifying the emergent themes from the data. The procedure followed an inductive approach, and the data was coded using open-coding techniques (Braun & Clarke, 2012). Two researchers (MJ and BP) coded the transcribed interview scripts. Conducting an intercoder reliability assessment demonstrates the dependability of the coding process, which is the basis for future analysis (O'Connor & Joffe, 2020). At this point, two researchers thoroughly examined the whole collection of datasets and recorded their observations and understandings as memoranda. Additional research suggests that employing several coders enables a more non-biased viewpoint when analyzing the data (Shenton, 2004). Each script, which had been created independently, was thoroughly analyzed. Eventually, the generated codes were carefully reviewed and organized into several categories. The study team underwent scrutiny of the coding method until a unanimous agreement was achieved. Regarding independent examination, an additional member of the research team (BP) conducted a secondary evaluation of the interpretation and coding procedure to validate the emergent themes and categories (Thompson Burdine et al., 2021)

As mentioned, the methodological framework and research governance were established following the Consolidated Criteria for Reporting Qualitative Studies (COREQ). This framework ensures comprehensive reporting of studies involving interviews and focus groups, allowing for the assessment of the analysis's rigour and the credibility of the findings (Tong et al., 2007).

To explore participants' experiences, a thematic analysis was conducted, focusing on ensuring the study's credibility, confirmability, and dependability (Berg & Lune, 2012). Credibility was strengthened through legitimate research design by ensuring peer reviews, while the author's continuous data validation and interpretation ensured confirmability (Shenton, 2004). Although external validity is not applicable in qualitative research, strategies can be employed to enhance the generalizability of qualitative findings (Shenton, 2004). For instance, demonstrating that similar studies using the same methodology have been conducted in various settings can show that the findings of this study are understandable and relevant to stakeholders, thereby supporting their transferability (Shenton, 2004). Direct quotes from participants were clarified regarding each of the themes. Moreover, the quotes directly corresponded with the demographic information provided to help understand their insights based on their medical history. These measures helped ensure the transparency of the study (Berg & Lune, 2012). Dependability was established by adopting a rigorous and appropriate research design, executing the study methodically, and conducting a comprehensive reflective appraisal throughout the research process (Shenton, 2004). This approach involved consistent monitoring and assessment of the research procedures to ensure the reliability and accuracy of the findings (Shenton, 2004). Moreover, Themes were developed to encapsulate the essential meanings of codes and categories, accurately representing the participants' perspectives (Graneheim & Lundman, 2004).

3.3 Results:

Table 3.1. Participant demographics and clinical diagnosis.

Participant	Age	Sex	Diagnosis	Type of Fracture	Pharmacotherapy Plan	Dosing
P1	72	Male	Osteopenia	DRF	Risedronate	Weekly
P2	66	Female	Osteopenia	DRF	Risedronate	Weekly
P3	94	Female	Osteoporosis	PHF	Denosumab	Biannually
P4	77	Female	Osteoporosis	DRF	Denosumab	Biannually
P5	81	Male	Osteoporosis	PHF	Risedronate	Weekly
P6	67	Female	Osteopenia	DRF	Alendronate	Weekly
P7	67	Male	Osteopenia	PHF	Risedronate	Weekly
P8	70	Female	Osteoporosis	PHF	Denosumab	Biannually
P9	88	Female	Osteoporosis	PHF	Denosumab	Biannually
P10	75	Female	Osteoporosis	DRF	Denosumab	Biannually
P11	80	Female	Osteoporosis	DRF	Denosumab	Biannually
P12	68	Female	Osteoporosis	PHF	Denosumab	Biannually
P13	77	Female	Osteopenia	DRF	Risedronate	Weekly

Note: DRF=Distal Radius Fracture, PHF=Proximal Humerus Fracture

There were five themes identified from the transcripts: (Fig. 3.1)

1. Social support facilitates adherence.
2. Variable Personal health beliefs and the perceived necessity of medication influence adherence.
3. Managing medication side effects can challenge adherence.
4. Access to primary care and pharmacy and quality of healthcare services influences accessibility and awareness.
5. Convenience of medication regimens affects choice.

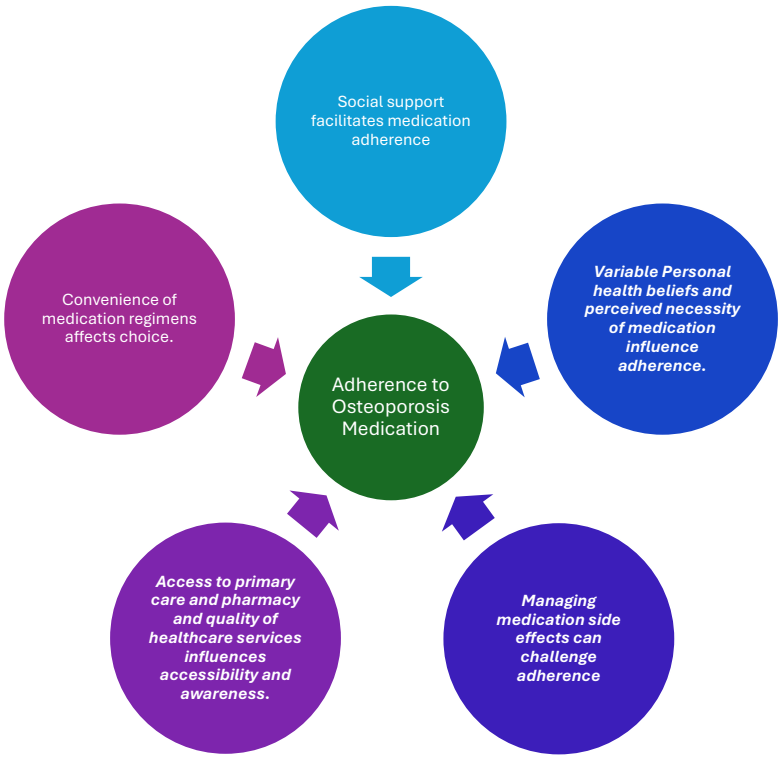

Fig. 3.1: Critical Factors in Adherence to Osteoporosis Medications

Theme 1: Social Support facilitates medication adherence.

Social support and family involvement emerged as considerable factors influencing patients' adherence to osteoporosis medication regimens. Many participants emphasized the role of family members in managing their medication schedules and providing necessary assistance with their pharmacotherapy program.

One participant shared: "*Yes, she did. She too, was on the drug. It wasn't PROLIA. It was another drug, and I can't think of the name. And she took it not by injection. I think she took it orally. This made me accept my doctor's offer more easily. I had a fair knowledge about it*" *P3, female, 94*

This participant evaluated her communication with fellows who were on osteoporosis pharmacotherapy positively in gaining more information and insights about the disease and the treatment plans, which further assisted her through complying with her treatment more smoothly.

Another participant stated*: "Ah, Well it's not just Risedronate. I have issues in taking any medications. I don't take it easily. I think about it. I asked my stepson if I couldn't reach my doctor; I asked him all my questions. You know in the end, not easy to get a lot of information" P4, female, 77*

The involvement of this participant's family through her osteoporosis therapy provided her comfort in receiving support in the course of her treatment and positively improved her adherence.

Another participant also reflected on the positive influence of family support on her treatment plan:" *I think I'm getting all the property here that I need to. I mean my family my daughter… she's up on this and make sure that I'm getting all that I'm supposed to have*." *P8, female, 70*

Another participant stated: "*The doctor gave it to me. Since then, I have friends that I know who are also on Prolia. Actually, they were my classmates. I got to learn from them.*" *P11, female, 80*

These quotes illustrate how the presence of supportive friends and family and attentive healthcare providers can significantly enhance a patient's ability to adhere to their prescribed osteoporosis

treatments. Most of the participants disclosed similar insights on the direct positive influence of their family and friends on the course of osteoporosis management. However, they also clearly indicated that their insights have helped them gain a more accurate perception of osteoporosis as a geriatric condition and subsequently adhere to the treatment.

One Participant disclosed: "*My friends are quite helpful. I'm very lucky and very fortunate. I have a good support system. I don't know where I'd be without them.*" *P12, female, 68*

It could be illustrated from their perspectives that the involvement of family members in medication management and daily activities helps mitigate the challenges posed by the condition and improves overall treatment adherence.

Theme 2: Variable Personal health beliefs and the perceived necessity of medication influence adherence.

Patients' beliefs about the necessity of osteoporosis medications and their personal health beliefs significantly impact their adherence to treatment. Many participants discussed how their understanding of the condition and the perceived benefits of the medication influenced their decision to start and continue with the treatment.

One participant described their experience: "*Well I think I have a fair knowledge. I know that the bones thin as you age, and it happens to a lot of people. I know a lot of friends who have osteoporosis and I think that one person I spoke to who was on Prolia shot said that they had sort of side effects and the doctor put her on something else that she tolerated more easily*." *P3, female, 94*

Another participant stated:" *I heard it from my family doctor, she went over the side effects. I did look up what she mentioned. I usually look up what the clinicians have to say about this, and it was there that it's possible that you might die if you get a fracture and that's made me not want it*

for a while, but I think I am at that point where I don't have any choice because I believe, I went through the bone density test a week ago and the technician said I lost two inches of the last 29 digits before a year ago. My body bones…… kinda making me do this." *P6, female, 67*

These narratives highlight the importance of patient education and clear communication about the benefits and the accurate indication of osteoporosis medications. When patients understand the necessity of the medication and believe in its efficacy, they are more likely to adhere to their treatment regimens. Moreover, personal health beliefs and prior experiences with medication play a crucial role in shaping adherence behaviors. Patients who have previously experienced adverse effects or who have observed others dealing with side effects may be more hesitant to commence or continue their medication. Conversely, those who perceive a direct benefit, such as improved bone density or reduced fracture risk, are likely to remain committed to their treatment. Therefore, addressing individual health beliefs and providing tailored information that resonates with each patient's experiences and expectations can significantly enhance adherence to osteoporosis medications.

Theme 3: Managing medication side effects can challenge adherence.

Managing the side effects of osteoporosis medications was a recurring theme among participants. Many reported experiencing adverse effects that impacted their daily lives and this influenced their willingness to continue with the medication.

One participant recounted: "*Well on the day you take them you have to take them on an empty stomach and you can't feed up and you can't lay down for at least half an hour when you take that medication. Though for me, I get up really early to take that medication so I still can have breakfast at a reasonable time and get on with my routine in the morning. In the next couple of days, I usually didn't feel like doing a whole lot because I didn't feel comfortable, you know, with the pain in my bone. So, I would plan it on a weekend like maybe I could take it on a Friday and Saturday. And on Sunday, I wasn't working and was home and I had to not put so many plans for weekends (laughs). So, it does affect you in some ways*. "*P4, female, 77*

This patient described the medication side effects directly influencing their choice for the timing of the medication and weekly planning and how they organized personal schedules to accommodate these common side effects. These adjustments could impact overall patient adherence.

She then added: "*It was like the side effects I was experiencing a lot of them, so I just continued taking them once weekly. But it takes a while to get out of your system. Then I was quite reluctant to go to the injection. But since then, I had it, I seem to be OK. I seem to be alright*. "*P4, female, 77*

Therefore, this patient had to switch her regimen to an anti-resorptive injection, which seemed more tolerable than the injection given the diminishing effects of long-term adverse events they were experiencing, leading her to adhere to her osteoporosis therapy. In some cases, patients encountered departure in the information they were receiving from different healthcare sectors, which drove their course of coping with side effects challenging.

A patient disclosed in this regard: "*They (the instructions) were conflicting. On the package instructions, it said with food. The pharmacist said without food. So, I got both. I had a friend who was already taking it, and their instructions were with food. My instruction was without food. And then you have to sit for half an hour, sit straight. So, the instructions were very…, I mean, I googled it and I kept getting mixed. So, I didn't know whether it was with food or without food. So yeah, I found them very confusing.* "*P12, female, 68*

This participant reported receiving conflicting information regarding the administration of her osteoporosis medication, which led to considerable confusion and uncertainty about continuing the treatment due to concerns regarding the side effects. This inconsistency in communication highlights the critical need for clear, accurate, and consistent information from healthcare providers. Communication aids that can shared can facilitate a shared understanding and better communication. The confusion about potential side effects can significantly impact a patient's adherence to medication regimens, as fear and uncertainty may lead to non-compliance or

discontinuation of therapy. Ensuring that patients receive uniform and comprehensible information about their treatment is essential to improving adherence and optimizing health outcomes.

These experiences underscore the need for healthcare providers to address side effects proactively and offer strategies to manage them effectively. By doing so, they can help patients remain committed to their medication regimens despite the challenges posed by side effects.

Theme 4: Access to primary care and pharmacy and quality of healthcare services influences accessibility and awareness.

The proper access to primary care and pharmacy to conveniently obtain and administer osteoporosis medications was a critical factor influencing adherence and completing the treatment plan. Participants discussed the logistical challenges they faced in accessing the primary care and medications and the impact of these challenges on their treatment adherence.

One participant explained the challenges faced due to the unavailability of a consistent primary care provider after their previous doctor retired:

One participant disclosed: "Well*, when I was in Chatham and that's when they diagnosed osteoporosis, we had a doctor in Ridgetown and he retired, and when he retired, I didn't have a doctor. I wanted to talk to the pharmacist. And then, occasionally, from time to time, they would have a walk-in clinic. I had issues until then, but we never had a walk-in clinic lasting for a time because we were kinda in the country. Yeah, I guess, not busy enough for a fair walk-in, but I think now that there are more people in Chatham and Blenheim, both have their own clinics. So, I was just there at a rough time.*" *P4, female, 77*

Another participant shared: "*Well, yes, I think that. It would be. Well, you know, in the will of what's happening with the healthcare scheme, I can quite understand that they put the onus on the patient rather than the doctor to have this done every six months and not to have a supply of Prolia*

in his office, for example, in the doctor's office, rather than I have to order it, fetch it from the drugstore, take it to the doctor." *P3, female, 94*

This participant also mentioned the frequency of BMD tests due to financial constraints within the healthcare system, which affected their perception of their progress through osteoporosis treatment:

She also shared: "*It's always been a problem. The main problem seemed to me as, I had more frequent bone densities when I was a little younger, like 20 years ago. Now they're not doing this many, but I am also fully aware that they health service generally is strapped for cash and doctors try to avoid doing tests that they feel are not warranted. Probably years ago, they wouldn't hesitate to offer bone density test, for example, more frequently, now they are more careful about doling out those goodies because of the healthcare crisis*" *P3, female, 94*

One participant highlighted the insufficient attention to detail and subsequent lack of follow-up in specialty care, resulting in a sense of being regarded as a mere number rather than a unique person with distinct health requirements:

"*No. I've found that even when I went to the specialist and he gave the PO, no, he wasn't helpful at all. I felt like I was a statistic. You go to see a specialist and you think they have your bone density results from 2017! No, he didn't even have the results of that! So, what was he basing his opinion on? I question that, what are you basing? I mean, you haven't seen how it's progressed because you haven't looked at my last bone density test over the years. So how do you know they are deteriorating?* "*P13, female, 77*

The crucial need for maintaining consistent and easily available primary care, implementing effective drug delivery mechanisms, and providing extensive follow-up in different levels of health sectors will directly influence patients' adherence to osteoporosis therapy. By tackling these

obstacles in healthcare services, there is a potential for substantial improvement in patient outcomes and compliance with recommended prescription regimens.

Theme 5: Convenience of medication regimens affects choice.

Many of the participants regarded the practical aspect of the treatment plan as pivotal in their compliance towards the regimen. These participants noted that the simplicity of the process of incorporating the pharmacotherapy plan into their routine had a great influence on their choices to continue the medication.

In one case, although there were minor inconveniences in the regimen, it was considered manageable according to the participant: "*Oh I'd Simply put it in my daybook, and I would put in a notice about a week ahead of the due date to order Prolia so that the drug store would have it on hand. They don't keep them on hand. That was an inconvenience, but a minor one*." *P3, female, 94*

Another participant deliberated on their preferences for various routes of administration: "*Well, the easiest is PO. And then injection and then IV. So those were my options, so I started with the easiest. But now, injection seems to be working.*" *P11, female, 80*

The other participant also elaborated on the route of administration: "*They give you a choice where you can go and see if you can take Prolia or you can take IV infusion. Originally, I wanted the IV infusion because it was probably a better route because you have to do it once a year, I think it is. But when I kept thinking about it, I thought it could be harder because you have to take blocks of water. So, I thought Prolia was better.*" *P9, female, 88*

These narratives illustrate that the simplicity of integrating the medication routine into daily life, the frequency of administration, and the logistical aspects of obtaining and managing medications are critical factors influencing patients' choices. It must be noted that many of the participants were

being treated with oral antiresorptive agents, which had an important role in declaring their satisfaction through their ongoing treatment; on the contrary, many of the participants were offered intra-venous and subcutaneous injections. Given the intervals of the so-called regimens being yearly and biannual, respectively, patients will confirm more adherence to these treatment plans. Although many of them refused to take the annual IV infusions (ACLASTA), they described the coordination between stakeholders in getting the subcutaneous injections (PROLIA) effective in their decision to continue the injections.

3.4 Discussion:

This study describes how social, health care and medication characteristics influence adherence to osteoporosis medication in people diagnosed with osteopenia or osteoporosis who have sustained upper extremity fractures. Thematic analysis of the participant transcripts revealed five key themes: the impact of social support, the perceived necessity of medication and personal health beliefs, managing medication side effects, the role of access to pharmacy and healthcare services and the convenience of medication regimens. These findings can help future health policy implementation in creating a comprehensive understanding of the barriers, facilitators, and factors to medication adherence and offer insights for improving patient outcomes through targeted interventions grounded in implementation science.

Social support and family involvement were the first emerging themes in this study, which are critical determinants of medication adherence among osteoporosis patients. The involvement of friends and family members in ongoing health interventions, specifically managing medication schedules and assisting with the treatment plan, was found capable of mitigating the challenges posed by bone frailty and osteoporosis and improving adherence to prescribed treatments. Participants in this study highlighted the indispensable role of family support in their process of anti-osteoporosis therapy.

Our study participants considered friends and family members helpful in managing their ongoing medication prescriptions. Patients were better able to handle the complications of their treatment plans with this assistance, which increased the likelihood that they would take their prescriptions as prescribed despite obstacles such as mobility issues. Friends and family members helped participants in our study connect to osteoporosis awareness programs, make medication schedules, arrange transportation to medical appointments and share their experiences regarding side effects and instructions with the participants. This created a supportive environment that aided in compliance with osteoporosis treatment. Consistent with previous research, this highlights the beneficial effect of social support on health outcomes for those dealing with chronic diseases (Gallant, 2003).

The beliefs that patients have on the significance of osteoporosis therapy, as well as their own health attitudes, have a significant role in shaping the adherence habits that they have. There is a significant relationship between the relevance of human characteristics, such as beliefs, knowledge, and attitudes, and the effectiveness of health interventions (Damschroder et al., 2009). It is of the utmost significance to build patient education in an effective manner and convey the inherent challenges and advantages of medications in a clear and concise manner. This is implemented through promoting healthy attitudes and improving medication adherence. The fact that many individuals are still taking their medicine in addition to other treatment regimens for other illnesses or comorbidities lends credence to this idea. Moreover, participants of our study reflected on the fact that the perceived advantages of medications and their familiarity with osteoporosis had a major role in their choice to comply with therapy. Based on these results, it is clear that patients need individualized educational programs to fill in the gaps in their understanding of osteoporosis and its therapies. A patient's conviction in the severity of their osteoporosis condition and the effectiveness of their medicine is a key factor in determining how well they will respond to therapy. Individuals are more likely to comply with their recommended treatments when they have faith in the significance of their medicine and are aware of the advantages it offers (Horne et al., 2013).

The findings of our study regarding this theme enlightened that osteoporosis professionals could communicate openly and empathetically with patients, addressing their concerns and providing comprehensive information about the nature of the disease and the multifaceted strategies for pharmacological and non-pharmacological management. This approach can help patients develop a more accurate understanding of their condition and the efficacy of pharmacological interventions, ultimately leading to improved adherence and musculoskeletal health outcomes.

Managing the side effects of osteoporosis medications emerged as another theme in this study. Research emphasizes the significance of addressing intervention features, such as complications and side effects, in order to enhance the effectiveness of the implementation process (Damschroder et al., 2009). Participants said that they had experienced side effects that contributed to their overall quality of life and affected their desire to continue taking the medicine. As a result, the disclosures made by our participants indicate that healthcare professionals should consider taking preventative measures to control adverse effects.

Healthcare providers must address the challenges by offering practical solutions, such as sticking to novel regimens, i.e. combination therapies, considering drug holidays regarding the eligible medications as per the suggestion of the clinical practice guidelines, switching to alternative treatments, or contemplating regimens to address long-term side effects, specifically associated with anti-resorptive therapies. Regular follow-ups and open communication about these side effects can help patients feel supported and more likely to continue their medications despite challenges. Although it is obviously confirmed by previous research that addressing side effects proactively can significantly reduce discontinuation rates and improve patient outcomes (DiMatteo et al., 2007), osteoporosis health professionals need to take the long-term side effects of anti-resorptive agents into account, given the higher probability of these agents being initiated for potential candidates.

The incorporation of side effect management into patient education programs is another method that may be used to empower patients to better control their side effects and maintain adherence to their treatment regimens. However, the majority of the participants did not provide any

information on this topic, despite the fact that some of them admitted that they were informed about the long-term negative effects. When patients are given information about what to expect in the future on rare side effects and how to manage common side effects, it can help reduce anxiety and improve their ability to cope with treatment-related challenges. This is especially important when considering the higher rate of refracture that occurs after bisphosphonate therapy in osteoporotic patients (Brozek et al., 2016). Research also suggests that fractures that occur while a patient is on denosumab may not always reflect an unsatisfactory therapeutic response (Kendler et al., 2019). In spite of this, it is nevertheless recommended that medical professionals use a diverse approach in the therapy of osteoporotic fractures and rehabilitation, taking into account medicines that have distinct modes of action. It is essential to take a comprehensive approach to the management of side effects in order to ensure patient adherence and achieve the best possible treatment results (Kendler et al., 2019).

The quality and accessibility of primary care services, as well as pharmaceutical services, were found to be critical in logistical challenges that could impact patients' completion of their treatment plans. This finding was aligned with previously published literature emphasizing the role of healthcare services in the management of chronic geriatric conditions (Gulliford et al., 2002). There were self-reported barriers to adherence in this study, such as lack of access to family doctors due to retirement in rural areas, lack of consistent access to clinics and the burden of coordinating the appointments to receive the dosage on patients. Therefore, ensuring accessible care and overcoming the logistical barriers will improve health outcomes in the pharmacological management of osteoporosis (Russell et al., 2009).

The convenience of treatment regimens was also found to be another factor influencing adherence. Participants clearly detailed the processes involved in obtaining their prescriptions and how these obstacles affected their ability to stick to their treatment plans. Their emphasis on the process, and for some patients refusing specific plans e.g. intravenous infusions, enlightens the necessity for patients to have the resources they need to successfully manage their osteoporosis drug regimens, as well as for prescriptions to be conveniently available to them. All the participants in this study were prescribed parenteral or injection anti-resorptive agents, which contain longer intervals

between each dosage. This will indirectly increase patients' adherence to their osteoporosis medication; however, could address probable discontinuation of patients on more long-term therapy through their perceived necessity of medication

Streamlining medication availability and offering supporting tools might boost adherence and increase health outcomes (Nieuwlaat et al., 2014). Simplification of medication regimes and boosting pharmaceutical accessibility are vital measures in promoting adherence. This may include decreasing the frequency of medicine dispensation, offering home delivery services, and guaranteeing convenient access to recommended patient therapies. By overcoming practical obstacles and optimizing the administration process, achieving higher adherence rates and better treatment results is possible.

Collaborative efforts between policymakers and healthcare providers are required to establish policies that might effectively handle these logistical problems. Among them include creating reminder systems and coordinating with pharmacists to ensure that patients get their medications and appointments on time. If healthcare systems remove the logistical constraints that are now in place, they could establish a more supportive atmosphere that encourages adherence and improves patient outcomes.

3.5 Study limitations:

This study indicates some limitations. Due to time constraints and ethical considerations of the study, member checks were not performed, which is acknowledged as an important element of credibility (Shenton, 2004). The student researcher (interviewer) and the participant did not build a strong rapport, as suggested in the literature since the majority of the interviews were performed remotely (Charmaz K, 2006). Furthermore, the dosing schedules for patients were different as they were receiving various pharmacologic agents with various routes of administration. These variations could have influenced the patterns of adherence reported by participants. Moreover, the study sites operate from an orthopedic clinic in a teaching hospital in southwestern Ontario, with patients being admitted with relatively higher socioeconomic status, high educational background,

and primary care accessibility. Regional, rural, and lower socioeconomic stakeholders will likely have different experiences. Lastly, patients who did not speak English were excluded from the study. Such patients may be at high risk for poor-quality healthcare transition, and their exclusion may result in biased findings.

3.6 Conclusion:

Participants of our study found the multifaceted nature of medication adherence in osteoporosis patients challenging. They highlighted the critical role of social support, personal health beliefs, side effect management, and medication accessibility in influencing adherence behaviours. Based on implementation science, interventions should be designed to leverage social support systems, enhance patient education, manage side effects proactively, and simplify medication access. Integrating implementation science into the development and evaluation of adherence interventions provides a robust framework for understanding and addressing the complex factors influencing medication adherence in osteoporosis patients.

3.7 Disclosure statement:

The authors reported no potential conflict of interest.

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Chapter 4:

Grand Discussion

The purpose of this thesis was to investigate patients' views on how they see the progression of the pharmacotherapy procedure for osteoporosis long-term therapy challenges. More specifically, we were interested in patients who had been diagnosed with osteoporosis or osteopenia and had sustained at least one fragility fracture in their upper extremities. The population with vertebral or hip fractures has been the focus of previous research; however, our study aimed to delve into new, unstudied areas in patients who have sustained upper extremity fragility fractures and have been recruited from an orthopedic tertiary care setting. Our research aimed to investigate the personal, physical, emotional, occupational, economic, and environmental impacts of treating these patients.

Furthermore, we have found factors that are distinct in terms of the decision-making to initiate the therapy and adherence of patients with osteoporosis to their prescription. The distinction between the initiation of pharmacotherapy and the implementation of the treatment needs to be conducted for further research to comprehend the consequences of these factors on the long-term effectiveness of therapy. The findings of our study emphasized the significance of patient-centred treatment by training healthcare workers on efficiently addressing the varied requirements of persons treating osteoporosis after upper extremity fractures. This significance was the critical role of supportive social environments, clear communication, and individualized treatment plans in improving adherence to osteoporosis medication.

The primary objective of this thesis, which was addressed as the first research question in Manuscript 1, was to explore patients’ views and insights regarding the decision to start osteoporosis pharmacological management while they have sustained at least one upper extremity fragility fracture (distal radius or proximal humerus fracture). We aimed to identify the perceptions of risks, benefits, and factors, including attitudes, priorities, and internal and external factors influencing decisional balance in therapy in the so-called population. To achieve this, we conducted semi-structured qualitative interviews with an interpretive descriptive approach with patients recruited from an orthopedic tertiary care setting in London, Ontario (Thorne, 2016). Using a thematic analysis approach, we were able to address our research question by delving into patients' subjective views and understandings of their disease, considerations such as perceived efficacy vs fear of side effects, the influence of healthcare interactions on treatment perceptions,

the weight of past health experiences on treatment decisions, and the fact that aging is a natural trigger for osteoporosis were all brought to light by the results (Braun & Clarke, 2012).

The secondary objective of this study was examined by the second research question in Manuscript 2. This manuscript also employed an interpretive descriptive methodology that explored the ongoing adherence to osteoporosis medication and the factors influencing long-term pharmacotherapy management (Thorne, 2016). We examined the same target population that we did in the first manuscript, providing a comprehensive understanding of the barriers and facilitators in maintaining compliance after exploring their decisional balance. The themes that were identified in the study were of great assistance in having a thorough understanding of the complexities of long-term osteoporosis pharmacotherapy. These themes included the following: the impact of social support, the variable perceived necessity of medication and personal health beliefs, managing medication side effects, quality of access to primary care services and pharmacy, and convenience of medication regimens.

This study emphasizes the essential need for patient communication to maximize the effectiveness of medication treatment. Social support and the quality of contact with healthcare professionals substantially influence patients' adherence to their recommended treatment programs. Hence, qualitative research may be used to thoroughly comprehend the necessary services based on people's unique health experiences.

Assessing the acceptability, implementation, and sustainability of therapies that improve adherence in real clinical settings may be done systematically utilizing frameworks from the field of implementation sciencethat could highlight the importance of both internal and external factors, the adaptability of interventions, and the involvement of stakeholders throughout the implementation process (Damschroder et al., 2009; Glasgow et al., 1999).

Medical professionals may use the existing frameworks to develop and deliver therapies tailored to meet the specific needs of people who are experiencing bone frailty and require pharmacological management. Consequently, this will guarantee that the therapies are practical and long-lasting.

The use of this technique has the potential to ultimately enhance the results for patients and increase the quality of treatment for those who suffer from osteoporosis. To do this, it bridges the knowledge gap that exists between research and the clinical practice that is currently being used.

4.1 Implications of findings:

The findings of this thesis have some implications, including the following: 1) the challenges that patients face when attempting to adhere to their osteoporosis medication regimens; 2) the ways in which social support and interactions with healthcare providers influence adherence; 3) the various ways in which individuals can cope with the adverse effects of medication and make it easier for themselves to take their medication as prescribed; 4) the significance of patient-centred care; and 5) the influence that patients' own health beliefs and the perceived need of medication have on their decision making and adherence to their medication regimens. These results contribute to future research, eventually leading to enhanced clinical practice standards. This will be accomplished by increased individualization of care, more concrete means for assuring treatment completion, and more excellent public knowledge of the different needs of the population.

4.2 Clinical Implications:

Prior research has indicated that the adverse events associated with anti-osteoporosis medicines have emerged as a significant concern. Despite their rarity, the undeniable influence they had may primarily be attributed to the unfavourable coverage they received in the news and media (Peeters et al., 2014). The current study portrayed the necessity of a broader personal and social context of patients' lives to develop a comprehensive care plan to explore the dynamic nature of knowledge translation strategies to provide a holistic understanding of compliance needs.

Healthcare professionals must be equipped with the knowledge and skills to support patients in managing their medication regimens and self-care practices. As part of this, it is necessary to provide clear and thorough information on the advantages, adverse effects, and techniques for

managing issues associated with medicine. Family physicians, in conjunction with other medical professionals who are part of secondary and tertiary care, have the potential to play a significant part in ensuring that patients adhere to their treatment plans. This can be accomplished by providing individualized interventions that encourage patients to participate in daily activities, improve their overall quality of life, and reduce the number of patients who stop receiving medications over the course of their treatment. Taking this approach is consistent with the concepts of patient-centred care, which ensures that treatment programs are tailored to meet each patient's specific requirements and preferences.

Qualitative research has been recommended in order to investigate individuals' beliefs and perspectives on medication taking (Brian Haynes et al., 1996). Future qualitative investigations, including family physicians, orthopedic surgeons, FLS practitioners and endocrinologists, hold the potential to provide more accurate insights into the compliance of individuals more reliant on early-bird information regarding the initiation of preventive care regarding osteoporosis. Similarly, a longitudinal study examined the continuity of primary care after attending an orthopedic fracture clinic (Meadows et al., 2007). The study revealed that deficiencies in interprofessional communication had a negative impact on the follow-up treatment provided by general practitioners (Meadows et al., 2007). The presence of strong practitioner-patient connections and a perceived need to consult with a practitioner are crucial factors that promote primary care follow-up for patients. The establishment and maintenance of robust doctor-patient relationships have been seen to occur via the practice of longitudinal care and the accumulation of consultation experience (Ridd et al., 2009). Therefore, incorporating patients' perspectives on building a rapport with the responsible practitioner can offer a comprehensive view of genuine patient needs while validating participants' statements regarding the knowledge to be transferred. However, there is still room for improvement in the research on patients' perspectives on their disease and the disambiguation between healthy aging and pathologic frailty.

4.3 Future research:

In the future, research should include a broad variety of healthcare professionals knowledgeable about osteoporosis management protocols and many levels of healthcare. The current study can be conducted with surgeons specialized in upper extremity care, fracture liaison services practitioners, and other stakeholders; this will allow for a better understanding of health professionals' experiences and provide a thorough understanding of the situation. The qualitative inquiries aiming at the outcomes that affect patients' adherence to complete long-term geriatric therapy could ameliorate patients' willingness to recognize the medication as the only leverage to prevent future fractures by furnishing supplementary early knowledge about the onset of the disease through effective communication and a patient-centred approach.

More research needs to be done regarding mapping service processes and integration factors influencing long-term post-clinic care following upper extremity fragility fractures. Interprofessional communication and role ambiguity can affect patients' engagement with healthcare providers, along with the inaccurate perception of osteoporosis as a sign of the normal process of aging (Bennett et al., 2023). Therefore, a multi-faceted knowledge translation strategy must be examined to consider public health promotion and policy prioritization of osteoporosis to contribute to the gap between the primary and tertiary care landscape. These strategies need to be tailored to the needs of geriatric care, considering that reasons for medication non-adherence are multifactorial and individual-specific (Hiligsmann et al., 2019). Successful interventions may be condition-specific (Torres-Robles et al., 2018).

4.4 Study strengths and limitations:

The current two studies investigated in this thesis held novelties in different aspects. Eleven participants out of the total fourteen patients recruited for this study were females, i.e. only three males consented to participate. Considering the reported prevalence of Distal radial fractures (DRF), with 6% in males and 33% in females (Vincent et al., 2023), our demographic population distribution is somewhat consistent with the ongoing incidence of the disease among the target population, which could be acknowledged in terms of the generalizability of the findings. Moreover, previous research examining adherence in osteoporosis indicated that patients who

consent to participate in research studies are more likely to adhere to their doctor's treatment recommendations (Marinker et al., 1997). We focused on ensuring that our sample was as diverse as possible, recruiting patients with various treatment durations under various treatment regimens through purposeful sampling. However, all the patients were under antiresorptive agents, which could shape the population of interest highly adherent to osteoporosis medications.

This study indicates some limitations. Firstly, member-checking was not implemented for the participants, given the eligibility criteria of participants having sustained upper extremity fractures. Therefore, further engagement of the participants was not feasible, though it could contribute to the credibility of the research (Shenton, 2004). The researcher and the participant did not build a meaningful connection, as advised in the literature (Charmaz K, 2006). This was primarily because most interviews were performed over the telephone. The study sites operate from an orthopedic clinic in a teaching hospital located in southwestern Ontario, with patients being admitted with relatively higher socioeconomic status, high educational background, and primary care accessibility. It is anticipated that stakeholders from lower socioeconomic backgrounds and rural areas would have different experiences. Moreover, the second study relied on self-reported adherence from patients. Given that patients received agents with different dosing, they reported their perspectives regarding adherence, and the second chapter reflected these insights rather than a specific framework. The research excluded patients who were non-English speakers or did not attend a follow-up consultation. Patients with such characteristics may have a significant risk of receiving substandard treatment, and their removal from the study may have influenced the results in a biased manner.

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Appendices:

Interview Guide:

Preamble:

I am grateful for your willingness to participate in this research project. I am Mahtab Jangi, pursuing a master's degree in the Health and Rehabilitation Sciences program at Western University. I am currently enrolled in the Health Promotion stream and working under Dr. Joy MacDermid's direction. Within the scope of this research, I am interested in hearing the perspectives of patients who have suffered a fracture of the wrist or arm and are now on osteoporosis medication. The purpose of this research is to fulfill the requirements for my master's thesis. I am curious to learn about the difficulties you had once you began taking osteoporosis drugs, as well as how your fracture(s) affected this journey. I will be asking questions about each of these topics, but there is no correct or incorrect response. We will gather and discuss topics to assist the team in comprehending how we may enhance the circumstances for patients in the future.

"At this point, I will start engaging in questioning. If at any time you decide that you do not desire to respond to a question and instead go to the next one, you are free to do so. Additionally, if you would want to terminate the interview at any point in time, let me know as soon as possible.

"Do you have any questions before we start?"

If you don't mind, we will start by talking about your experience after the initiation of osteoporosis treatment. Now, before we start, I want to ask your permission to press the audio-recording button. (start recording after she verbally consents)

1. Introduction and Background:

   a. Tell me about your experiences with the wrist/arm fracture (and how it's impacted your life.)

   b. When you were diagnosed with osteoporosis,

      what did you think when you heard that?

      What does osteoporosis mean to you?

c. What's your history of getting diagnosed with osteoporosis? Describe your experience with your osteoporosis diagnosis, please.

d. Have you had any family history regarding osteoporosis?

3. Medication Decision-making:

a. Are you currently taking any medications for your osteoporosis? How did you decide to start taking osteoporosis meds?

b. What influenced your choice to take these meds? Why did you take those medications?

c. What did your doctor say about treatment options and how they'd help?

d. How did your personal beliefs and values fit into starting the meds?

e. Were there any moments when you were unsure?

4. Understanding and Knowledge:
   a. Can you describe to me what you were told related to how the osteoporosis medication works?
   b. Do you think you have a good understanding of how the medication works?

c. Where did you learn about these meds and how they'd help?

d. Were you told about any warnings or side effects?

e. How has your understanding of osteoporosis changed as you went along?

5. Facilitators for Medication Adherence:

a. What has made it hard or easy to stick with your medication routine?

b. How did the meds affect your daily life and well-being?

c. What strategies have you used to stick to your medication routine?

d. Did you use any tricks to help you remember? Describe them.

6. Barriers to Medication Adherence:

a. Did you face any problems sticking to your med schedule?

b. What led to missing doses or changing the plan?

c. How did you handle side effects or challenges?

7. Healthcare Provider Support:

a. How did your doctor help you with your wrist/arm fracture and meds?

b. How did your doc support your decisions and adherence?

c. How important was it to talk openly with your healthcare provider?

8. Lifestyle and Self-care:

a. What changes, if any, have you had to make to your lifestyle because of osteoporosis medication?

b. Have you made any lifestyle changes for your bone health? Describe them.

c. What's your view on self-care in managing osteoporosis?

9. Long-term Perspectives:

a. How do you see the future with osteoporosis meds? What do you think you will do for osteoporosis?

b. Any thoughts on sticking with the meds and how it'll impact your health? Something motivating you to take it consistently?

c. (Tell me about) How do you feel about making changes to your treatment?

10. Overall Experience:

a. Looking back, what's your take on dealing with osteoporosis meds and the condition? b. If you could change one thing about your journey, what would it be? (journey about meds) How did you cope with it? How they changed your life?

c. What's the bigger picture of your experience with the wrist/arm fracture, meds, and how it's affected your view of health? If you have a friend who has osteoporosis, what would your advice be to them?

References:

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LAWSON FINAL APPROVAL NOTICE

LAWSON APPROVAL NUMBER: R-23-527

PROJECT TITLE: Facilitators and barriers to pharmacological management of osteoporotic upper extremity fractures: an interpretive descriptive analysis

PRINCIPAL INVESTIGATOR: Dr. Joy MacDermid

LAWSON APPROVAL DATE: 28/11/2023

ReDA ID: 14017

Overall Study Status: Active

Please be advised that the above project was reviewed by Lawson Administration and the project was **approved**.

All research must follow applicable laws, regulations, policies, procedures and guidance, including hospital and Lawson policies, and Lawson Standard Operating Procedures.

Please provide your Lawson Approval Number (R# above) to the appropriate contact(s) in supporting departments (eg. Lab Services, Diagnostic Imaging, etc.) to inform them that your study is starting. The Lawson Approval Number must be provided each time services are requested.

Dr. David Hill
Scientific Director and Integrated V.P. Research
Lawson Health Research Institute

Letter of Information and Consent

Project Title: facilitators and barriers to pharmacological management of osteoporotic upper extremity fractures: an interpretive descriptive analysis

Investigators

Dr. Joy MacDermid, PT Ph.D. (Principal Investigator)
Department of Physical Therapy, Western University
Email: *****

Mahtab Jangi, DVM, MSc. Candidate (Student Investigator)
Department of Health and Rehabilitation Sciences, Western University
Email: *****

What is the purpose of this study?
The following study is a graduate student project studying at Western University. The purpose of this study is to understand decisions, considerations, and facilitators for adherence to osteoporosis medications in patients who have a diagnosis of osteoporosis and have incurred an upper extremity fracture. This knowledge is potentially expected to benefit future patients, clinicians as well as hospital authorities in getting better prepared for the forthcoming medication prescription for osteoporotic patients. You are being invited to participate in this study because you are a patient at the Hand and Upper Limb Centre of St. Joseph's Hospital and this interview may help us gain insights into the immediate hurdles and adaptations that you came across and what helped you overcome or deal with it. The interview will be semi-structured, meaning we have a guide we will follow but certain questions and prompts may come up that are not anticipated.

Recruitment
Approximately 20 patients, who have been diagnosed with osteoporosis/osteopenia and have experienced distal radius and/or proximal humerus fractures at the St. Joseph Hospital, can speak, read/write in English, and have given informed consent will be recruited from the Hand and Upper Limb Centre (HULC).

Study Procedures
This study is an interview. You have been approached by your clinician introducing the study to you and followed up by research support staff, Katrina Munro, asking whether you are interested in participating in this interview. Please read through this letter of information and if you have any questions, you may ask the research support staff. If you are willing to participate you will be asked to sign a consent form and provide your contact information (contact number and E-mail address) if you feel comfortable. You will then be contacted by phone or in-person to set up a date and time for the interview, and at this point, you can ask any additional questions you might have about participation. The interview will take place at St. Joseph's Hospital in the Hand and Upper Limb Clinical Research Lab (D0 139); however, there is also an availability

of a virtual interview through telephone or Microsoft Teams. Your e-mail addresses and telephone numbers will be collected if you opt for the virtual interview session. When you arrive, we will ask if you are still willing to participate in this study. We will then get you to fill out the informed consent form and lastly, conduct your interview. You will be asked to respond to the interview questions honestly. The interview should take approximately 30 to 150 minutes. Furthermore, if you opt for a virtual interview session on Microsoft Teams, you will have the flexibility of keeping the camera on/off as per your wish and choice. You will be informed about this at the beginning of the virtual interview session as well as at the start of the recording (audio recording). Any information regarding your name or demographics will be kept separate from the interview and accessed only by members of the research team. The interview will be recorded using an encrypted recording device and stored on a password-protected computer in an encrypted file. The in-person and virtual interviews will be audio-recorded using an Olympus DS-3500 Encrypted voice recorder. Furthermore, the interviews will be transcribed by the student investigator, Mahtab Jangi.

Participation in the Study:
Participating in this study is voluntary. You will receive a copy of the letter of information and consent form for your records. You do not waive any of your legal rights by signing the consent form. You may refuse to participate, refuse to answer any questions, or withdraw from the study at any time with no effect on your future care. You will continue to receive standard care, i.e., routine checkups with your doctor.
If you decide to withdraw your participation in our study, your data will not be utilized in the study and will be managed as per Western Research Ethics Board and Lawson's data retention policy. If you have concerns or would like to withdraw you can contact the principal investigator, Dr. Joy MacDermid, or research co-ordinator, Katrina Munro.

What are the benefits of this study?
There are no direct benefits to you associated with your participation in this study, but your study participation will have societal benefits. The study is expected to benefit the clinicians (physicians, surgeons, internists, physiotherapists, and occupational therapists) in developing an impactful pharmacological management strategy which will better prepare the patients to adhere to their prescribed medication. Moreover, as the literature lacks a qualitative aspect on the topic of osteoporotic upper extremity pharmacological management, the study will also contribute to the literature and accelerate the process of more studies being conducted on the topic. Thus, the study will surely benefit future patients in tackling and coping well alongside the already-mentioned advantages to clinicians, hospital staff, and academicians.

Are there any risks or discomfort associated with this study?
There is a potential for a privacy breach, as identifying information is being collected. However, identifying information will be kept separate from the data. Instead, the data will be de-identified.

How many people are in this study?
There will be approximately 20 people in this study, however, for qualitative research, data collection will stop when we reach theoretical saturation, meaning we are not learning any new information from the participants.

Is there any compensation if I participate?
There is no monetary reimbursement for participation in this study.

Will my results be kept confidential?
Your results will be held in strict confidence. No person, other than the study team and treating clinician will have access to the study data.

Upon study recruitment, participants will be given a unique numerical identifier (Participant ID) that will be entered on all data collection forms containing personal information in lieu of their name. This identifier will be randomly generated and will not include any personally identifying information (such as name or hospital ID). The study investigators will keep a master copy of the unique identifier assigned to each participant. This list will be stored on the SJHC secure G drive. Participants' contact information and consent forms will also be collected and stored separately from the master list of unique identifiers. All paper files will be stored in a locked file cabinet in the HULC clinical research lab, and all electronic files will be stored on a password-protected computer on the secure hospital network. A summary of this study might be put on our lab website for public viewing; however, this would not identify you in any way. It must also be noted that direct quotes may be used in a publication and the media, but again no identifiers will be linked to the quotes. Representatives of the University of Western Ontario Health Sciences Research Ethics Board and Lawson Quality Assurance and Education Program may contact you or require access to your study-related records to monitor the conduct of research and to ensure that proper policies and guidelines are being followed. Under the Lawson data retention policy, the study investigators will retain your information and study data for 15 years.

Publication
If the results of the study are published, your name will not be used. There may be direct quotes, but they will not be associated with your name. If you would like to receive a copy of any potential study results, please provide your name and contact number on a piece of paper separate from the Consent Form.

Whom may you contact to find out more about this study?
You will be given a copy of this letter. If you have questions about taking part in this study, you can directly contact:

Dr. Joy MacDermid, Principal Investigator, can be contacted at ***** ext *****.
Katrina Munro, Study Research Assistant, can be contacted at ***** ext *****.
Mahtab Jangi, Student Investigator, can be contacted at ***** ext *****.

If you have any other questions about your rights as a research participant or about the conduct of the study, you may contact: St Joseph's Health Care London Patient Relations Consultant at *** ext. *****.**

Consent to Participate In: facilitators and barriers to pharmacological management of osteoporotic upper extremity fractures: an interpretive descriptive analysis

Dr. Joy MacDermid, PT Ph.D. (Principal Investigator)
Department of Physical Therapy, Western University
Email: *****

Mahtab Jangi, DVM, MSc. Candidate (Student investigator)
Department of Health and Rehabilitation Sciences, Western University
Email: *****

- I have read the letter of the information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

_____	_____	_____
Signature of Participant	Print Name of Participant	Date

- My signature means that I have explained the study to the participant named above and answered all the questions.

_____	_____	_____
Signature of the person obtaining consent	Print name of person obtaining consent	Date

Curriculum Vitae

Name: Mahtab Jangi

Post-secondary Education and Degrees:
Ferdowsi University of Mashhad
Mashhad, Razavi Khorasan, Iran
DVM Doctor of Veterinary Medicine
2011 – 2018

The University of Western Ontario
London, Ontario, Canada
MSc Health and Rehabilitation Sciences (Health Promotion)
2022 - 2024

Honours and Awards:
Graduate Fellowship
The University of Western Ontario
2023

Related Work Experience
Graduate Teaching Assistant
The University of Western Ontario
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Publications:

Jangi, M., EIDI, S., & GHODRATI, A. H. (2019). Effects of Iranian Spirulina platensis extract on Microsporum canis isolates.