Tailored Exercise for Fall and Fracture Prevention In Older Adults: A Family Health Team Approach

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Background: Exercise interventions reduce falls in older adults. Methods for enhancing uptake and adherence to exercise programs in at-risk individuals are needed. **Objectives:** This pilot study evaluated feasibility of recruitment, short-term retention and adherence to PEPTEAM (Prescribe Exercise for Prevention of Falls and Fractures), an exercise plus behaviour change intervention.

Methods: Patients ≥ 65 years old plus ≥ 1 additional risk factor for falls/fractures (≥2 falls in 6 months, age 75+, high CAROC fracture risk, difficulty walking/balance, acute fall, fragility fracture) were identified by nursing staff at the Center for Family Medicine. The intervention was delivered in two visits, with two follow-up calls, and included: a) physician telling the patient they are at risk; b) exercise prescription provided by a physical therapist; c) motivational interviewing, action and coping planning delivered by a kinesiologist. The primary outcome was change in minutes per day of moderate to vigorous physical activity (MVPA) from baseline to six-week follow-up, measured using X2 mini accelerometers. Secondary outcomes included: feasibility of recruitment and retention, an action planning questionnaire, EQ-5D-5L, Short Physical Performance Battery, and the Timed Up and Go. Adherence to exercise was determined using activity logs.

Results: 92 patients were screened, 22 were eligible and 11 were recruited (mean [SD] age 72.64 [6.47] years). All participants returned at 6 weeks. Adherence to exercise was 52%. Mean [SD] minutes of MVPA were 24.7 [22.8] at baseline and 21.6 [15.8] at six weeks (p=0.722). Participant action planning and coping planning abilities were significantly improved (P=0.008), (P=0.012) respectively. Patient-rated health at 6 weeks also significantly improved (P=0.010).

Conclusion: Many but not all patients demonstrated positive changes in intensity-specific

MVPA. The feasibility information collected from this study in addition to practical recommendations identified for future work could be used to inform a future multicenter randomized controlled trial.

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List of Abbreviations

BMD	Bone Mineral Density
WHO	World Health Organization
BMI	Body Mass Index
BP	Bisphosphonate
CAROC	Canadian Association of Radiologists & Osteoporosis Canada
FRAX	Fracture Risk Assessment Tool
RR	Relative risk
OR	Odds ratio
HAPA	Health Action Process Approach Model
OC	Osteoclast
CFFM	Center for Family Medicine (Kitchener, Ontario)
FHT	Family Health Team
PEPTEAM	Prescribe Exercise for Prevention of Falls and Fractures: A Family Health Team Approach
LLPA	Low-Light Physical Activity
HLPA	High-Light Physical Activity
MVPA	Moderate to Vigorous
HRQOL	Health Related Quality of Life
SPPB	Short Physical Performance Battery
TUG	Timed Up and GO

1.0 Chapter 1: Introduction

1.1 Rationale

Falls and fractures together represent one of the leading causes of morbidity and mortality within the older adult population (1-4). Add3itionally, the consequences of falls and fractures contribute substantial costs to the health care system and negatively impact the quality of life of the individual (1). Given that Canada's aging population in increasing at an unprecedented rate, it is imperative that the prevention and management of falls and fractures is made a priority (5,6). One such population particularly vulnerable to falls and fractures are those diagnosed with osteoporosis or low bone mass (1,7).

It has been estimated that approximately 10 million individuals have been diagnosed with osteoporosis and another 34 million are at risk with low bone mass (8). Osteoporosis-related fragility fractures are a common consequence of osteoporosis and result in increased morbidity and mortality (9,10). Approximately 50% of those who suffer a hip fracture do not regain their previous level of mobility and functional independence thus resulting in many of these individuals relying on the use of assistive devices and placement in long-term care (11).

Currently the emphasis of osteoporosis treatment and management is to prevent the occurrence of fragility fractures and the subsequent side effects that accompany them (12). A recent meta-analysis has shown that exercise can assist in the maintenance of bone mass in postmenopausal women (13). Other benefits of exercise such as increases in muscle strength and balance might indirectly prevent fractures through a reduction in fall risk (14). Those who are at a high risk of falls or fracture require patient-specific assessment and individualized prescription that is not typically available at a low cost. Further, it may be difficult to engage these individuals if they have spent most of their life in a sedentary state and experience barriers such

as a lack of transportation, and a lack of knowledge on appropriate types of exercise or how to initiate exercise into their daily living (15,16). Furthermore, the location of the fracture or the person's physical function need to be considered in an exercise prescription. It has been emphasized that the focus should be on an individualized exercise program, which would encompass individual needs while recognizing individual limitations (17).

Family physicians may be in an ideal position to deliver an exercise prescription to a patient, as they are often the first point of contact with the health care system (18). However, there have been a number of problems cited with using family physicians to implement the delivery of an exercise prescription. Among those barriers, a lack of time and a lack of knowledge have been identified as the most problematic (19-24). An interdisciplinary family health team model of care might be important to the treatment of chronic conditions such as osteoporosis (25). Family health teams may provide an ideal form of care where team members work together to deliver the program to the patient and this may help to enhance adherence.

A limitation of many exercise interventions is that they fail to include a behavioural component, which may be an important factor to consider when attempting to facilitate adherence to an exercise program. The Health Action Process Approach is a model of behaviour change that has been widely used in a variety of health contexts including but not limited to physical activity (26-31). The rationale for the selection of this model is that it incorporates key principles of other behaviour change models (32,33). Furthermore, the model has been cited as being a valid and reliable tool for predicting physical activity levels in older adults (34).

The thesis outlines an exercise intervention that is multidisciplinary in nature and tailored to the individual to be employed within an interdisciplinary family health team. Additionally, a behavioral component is built into this intervention with key principles such as action planning

and coping planning that are based on the HAPA model to facilitate the uptake of physical activity in this vulnerable population.

1.2 Study Aims

The project will evaluate the effect of an individualized exercise prescription delivered within a primary care setting on physical activity levels in a population of older adults at risk of falls and fractures. Secondary aims are to evaluate the feasibility of implementing this type of exercise program within a clinical setting, and to evaluate the effects of the exercise program on specific constructs of the Health Action Process Approach (HAPA) model, namely, action planning and coping planning, coping self-efficacy and intentions.

2.0 Chapter 2: Background

2.1 Falls and Fractures

Among those over the age of sixty-five years, falls represent the most common cause of fatal and non-fatal unintentional injuries (35). A fall is defined as "an event which results in a person coming to rest unintentionally on the ground or lower level, not as a result of a major intrinsic event (such as a stroke) or overwhelming hazard." (36). The risk of suffering a fall intensifies with age and fall related injuries and deaths tend to increase exponentially after 80 years (6,37). Approximately 30% of individuals over the age of 65 living within the community fall each year, and this number has been estimated to be even higher in institutions with about one fifth of all falls requiring some form of medical attention (38). The health care costs accrued from falls is significant and impact both direct and indirect costs of care (6). Direct health care costs represent the costs associated with medical visits to address the injuries of falls and the rehabilitation that often accompanies formal treatment (6). The indirect costs of falls are represented by a reduction or absence of regular activities that the individual used to engage in prior to the fall, such as paid work, volunteering or attending community events (6). Additionally indirect costs can encompass the cost of care-giving, as many individuals require aid and assistance from family members following a fall-related incident (6). The occurrence of repeated falls and instability also commonly precede nursing home admission representing another significant cost (39,40). In addition to the significant cost of institutionalization, the substantial loss of independence to the individual that often accompanies nursing home admission can contribute to reduced health related quality of life (41). Aside from the physical impact of falls, a decrease in activity, lost confidence, and feeling depressed may further contribute to the functional decline of the individual (39). The consequences of falls, which are

often fractures, have a greater impact as one becomes older because advancing age is a risk factor for fractures and those with a hip or vertebral fracture are at an increased risk of death (6,9,12). Therefore, the implementation of evidence-based falls prevention programs that may work to decrease the incidence of falls and the health care cost of fall-related injuries in attempts to improve quality of life are certainly warranted (35).

2.1.1 Cause of and Risk Factors for Falls

A number of factors contribute to falls and these include both extrinsic and intrinsic causes. Extrinsic causes represent aspects of the individual's environment such as their living space and obstacles such as steps and or uneven surfaces (42). Intrinsic causes represent things such as potential co-morbidities that the individual may be experiencing (42). An example of this could be medication use to treat another condition, with side effects leading to poor balance and subsequent increased risk of falling. Other potential conditions such as poor eyesight and postural hypotension, which are both commonly seen in the older population can be contributors to falls (42). Risk factors for falls have previously been identified by a number of studies and can be viewed by referring to Table 1 which is adapted from a recent review that presented a pooled analysis of the risk factors for falls and an overview of the associated relative risks (RR).

Table 1. Results of Univariate Analysis of the Most Common Risk Factors for Falls Indentified Across 16 Studies * That Examined Risk Factors

Risk Factor	Significant Total/Total *	Mean RR/OR**	Range
Muscle Weakness	10/11	4.4	1.5-10.3
History of falls	12/13	3	1.7-7.0
Gait deficit	10/12	2.9	1.3-5.6
Balance deficit	8/11	2.9	1.6-5.4
Use assistive device	8/8	2.6	1.2-4.6
Visual deficit	6/12	2.5	1.6-3.5
Arthritis	3/7	2.4	1.9-2.9
Impaired ADL	8/9	2.3	1.5-3.1
Depression	3/6	2.2	1.7-2.5
Cognitive Impairment	4/11	1.8	1.0-2.3
Age >80 yrs	5/8	1.7	1.1-2.5

* Number of studies with significant odds ratio or relative risk ratio in univariate analysis/total number of studies that included each factor

** RR = relative risk ratio; OR = odds ratio. RR calculated for prospective studies; OR calculated for retrospective studies.

From References * (36,43-56)

(Table adapted from (42))

Fractures are the most common type of non-fatal fall-related injuries and carry significant morbidity and mortality risk for the individual(3,57)This risk is evident as those who have suffered a hip fracture have a 20% increased risk of death (58). Falls, co-morbidities, and the use of multiple medications have all been demonstrated to contribute to the risk of fractures (1). Individuals who have been diagnosed with osteoporosis or low bone mass may be more susceptible to falls than older adults without osteoporosis due to a fear of falling and the increased risk of fracturing if they fall (59). Additionally, many in this population are defined as frail and may have a previous history of falls and fractures thus rendering them even more vulnerable (60,61). Currently, there is no formal agreed upon definition of frailty (60-62). Various definitions of frailty do exist and it is common for geriatricians to define frailty as a

"biologic syndrome that is characterized by a reduced reserve capacity and a decreased ability to overcome stressors which might render the individual to become vulnerable to adverse outcomes as a result of a cumulative decline in the physiological systems" (63-65). Use of this definition makes a distinction between frailty and disability (64,66,67). Alternatively, another method used in the attempt to define frailty is the operationalization of a frailty phenoptype that is hypothesized by Fried et al, and describes the presence of frailty as having any three of the following components: shrinking (height loss), weakness in grip strength, poor energy/endurance, slowness, and low levels of physical activity (61). The Canadian Initiative on Frailty and Aging adopts another approach to the definition of frailty. This approach consists of accepting that a variety of different definitions exist and the Canadian Initiative on Frailty and Aging has summarized definitions of frailty to belong to one of four different categories: physiological definitions, those that base the definition of frailty as a complex syndrome, frailty based on a balance model or frailty defined as a geriatric syndrome like falls (68). Despite the lack of a standardized definition, it is evident that those identified as frail tend to be at an increased risk of mortality, falls, and disability (60).

2.2 Osteoporosis

Osteoporosis is a disease that affects the skeletal system and is characterized by a marked deterioration of the bone micro-architecture and low bone mass (58). As a result this renders individuals with osteoporosis to be particularly susceptible to fractures. Osteoporosis affects a significant number of individuals and it has been said that approximately two million Canadians suffer from the disease (58). Further, one in four women and one in eight men who are over the age of 50 have osteoporosis (58). Osteoporosis is estimated to cost the Canadian Health Care system 1.9 billion dollars annually (58). Worldwide, osteoporosis affects over 200 million

individuals, with an osteoporosis-related fracture estimated to occur every 3 seconds and a new vertebral fracture occurring every 22 seconds (69) Osteoporosis also carries with it a substantial personal burden as many with the disease experience decreases in quality of life, increased pain, loss of independence and even suffer emotionally from the disfigurement that can accompany a fracture (10,41,70). A fragility fracture is defined as a fracture that has resulted from a fall from a standing height or less (69). The most common sites for fragility fractures are at the hip, wrist and vertebrae (71). A woman who is over the age of 50 has a 40% chance of developing a hip, vertebral or wrist fracture over the course of her lifetime (72). A loss in height of greater than 1½ inches is often indicative of a vertebral fracture (58). Vertebral fractures also can result in the forward curvature of the spine known as kyphosis, and this can lead to a diminished functional capacity (73,74). It has been estimated that one in four women who experience a new vertebral fracture will fracture again within 1 year as the structural integrity of the spine is affected (75) and hip fractures independently costs the health care system $21,285 in hospitalization costs and another $44,156 if the individual requires institutionalization (58). In one study, it was concluded that approximately 80% of women would prefer death over experiencing reductions to their quality of life as a result of a hip fracture and the losses in independence or subsequent nursing home admission (41). Therefore, the current focus of osteoporosis treatment and management is to prevent fragility fractures to avoid the negative consequences that accompany fracture (12).

2.2.1 Diagnosis of Osteoporosis

Osteoporosis is currently diagnosed according to an individuals' bone mineral density score (76). One is formally diagnosed with osteoporosis when their BMD score is ≤ 2.5 standard deviations below the average bone density of young adults. The average bone density of younger

adults is used as a reference comparison in order to maintain consistency across measures of BMD (58). Bone density scores are generally reported as T-scores and aside from formally classifying osteoporosis, they are used to identify those with lower than normal bone density. Please refer to Table 2 for the World Health Organization Classification of Osteoporosis.

Table 2. WHO Classification of Osteoporosis

World Health Organization Classification of osteoporosis	
T- Score ≤ -2.5 SD	Diagnosis of osteoporosis
T-Score between -) & -2.5 SD	Osteopenia (low bone density)
T-Score ≥ -1 SD	Normal bone density

(Reference (77))

There has been a recent movement away from relying solely on ones' BMD score to determine their risk of fracturing (12). The current emphasis is to use a combination of the BMD results in addition to clinically identified risk factors that are thus able to better predict an individual's 10-year risk of fracture (12). This type of risk assessment is particularly useful as some patients may present with a low bone density score but have relatively low risk of fracturing in the absence of significant risk factors. Alternatively, some individuals may have a very good bone density score but have a high risk of fracturing if they possess a number of clinically significant risk factors. It has been established that women and men who are over the age of 65 should have their bone mineral density assessed (12). Additionally, those over the age of 50 who have established clinical risk factors for fracture such as a fragility fracture after the age of 40, prolonged glucocorticoid use, parental hip fracture, currently smoke, have a high

alcohol intake, low body weight, have rheumatoid arthritis or other disorders known to be associated with osteoporosis should be assessed for fracture risk (12,58). Testing of BMD may also be warranted in those under the age of 50 with special risk factors like having a condition that is associated with losing bone or low bone mass (12,58).

2.2.2 Fracture Risk Assessment Tools (FRAX) and CAROC

Two separate tools were recently developed to provide an estimate of a patient's absolute 10-year risk of suffering a fracture. The Fracture Risk Assessment Tool (FRAX®) released by the World Health Organization is a tool that encompasses various factors known to contribute to fracture risk including BMD, BMI, parental hip fracture, rheumatoid arthritis, secondary conditions that may contribute to bone loss, smoking status and alcohol intake (defined as >3 or more drinks per day) (78). A feature of the FRAX® tool is that it can be used independent of BMD test results. Alternatively, the Canadian Association of Radiologists and Osteoporosis Canada (CAROC) developed the CAROC tool which functions to place individuals over the age of 50 into a low, moderate or high-risk category of suffering a fracture (58). With this assessment tool BMD is used in addition to risk factors such as age, gender, fracture history, and glucocorticoid use to determine the 10-year fracture risk. If an individual presents with a fragility fracture after the age of 40 and has a history of prolonged glucocorticoid use, according to this tool the presence of both of these risk factors puts the individual at high-risk of fracture independent of the BMD score (58,79,80). The CAROC uses fewer risk factors than the FRAX but both tools have been found to demonstrate similar results (81). As a result, it is mainly a physician's personal preference that determines which tool is used and both should provide the same risk assessment result.

2.2.3 Pharmacotherapy for Fracture Prevention

Bisphosphonates are a family of drugs, and are currently the most commonly prescribed class of medications used in the treatment and management of Osteoporosis (82). Currently in Canada there are four types of bisphosphonates that are approved for use and they are; alendronate (Fosamax®), etidronate (Didrocal®), risedronate (Actonel®) and zoledronic acid (Aclasta®). Bisphosphonates are anti-resorptive agents, which work to improve bone density and to prevent fractures (82). Alendronate, risendronate and zoledronic acid are known to prevent both hip and vertebral fractures (58,82). The bisphosphonates function to improve the activity of the osteoblast cells which are responsible for the building of bone tissue. The bisphosphonates bind to the surface of the bone and work to slow bone resorption (82).

2.2.4 Side Effects of Bisphosphonates

Although bisphosphonates are an extremely effective pharmacotherapy, in order to most efficiently work they often are required to be taken at specific times and have a number of directions, which must be followed in order to ensure that they are adequately absorbed and that unwanted side effects are prevented (58). However, despite this there are side effects that can accompany bisphosphonate use and may be experienced by some individuals. The most common types of side effects include abdominal pain, nausea and flu like symptoms, loose stool, risk of ulcers in the stomach and esophagus and pain in the bones and joints (58,82). Further, individuals may need to plan to take the bisphosphonate at a certain time as it cannot be taken with calcium (69,82). Recently there has been an ongoing controversy surrounding long-term bisphosphonate use and their potential association with atypical fractures of the femur raising some concern among users (58,82). However, across three randomized controlled trials the fracture risk associated with bisphosphonates was found to be extremely low and there was no identified significant association found between prolonged BP use and atypical fractures (83).

Although this research area still remains a cause for controversy, Health Canada and Osteoporosis Canada have released position statements on this topic stating that, "the benefits of bisphosphonates at this time outweigh the risks" (25,58). When taken correctly, bisphosphonates may reduce the risk of fracture from 30 to 70%, (84,85) and this kind of effectiveness makes bisphosphonates a cost-effective option for the prevention and treatment of fractures in those >70 yrs (86). However, it is important to keep in mind that these drugs are costly when compared to the cost of other interventions like vitamin D (86). Additionally, maintaining proper adherence to the medication when coupled with potential side effects like nausea and abdominal pain may present difficulty for some seniors (82). Therefore, in addition to pharmacotherapy there is a need for non-pharmacotherapy interventions for patients at risk for falls and fractures.

2.3 Osteoporosis and Exercise

Exercise has been studied in the treatment, prevention and management of osteoporosis (87). Studies have shown that exercise can improve physical functioning, as well as improve psychological symptoms in osteoporotic patients (88,89). Weight-bearing exercises and those that involve resistance training have been shown to prevent bone loss in premenopausal women (90). Further, a recent Cochrane review has found that exercise can assist in the maintenance of bone mass in postmenopausal women, overall effect size was (MD 0.85; 95% CI 0.62 to 1.07) (91). Animal studies have identified that exercises that provide a high magnitude of strain, are applied at a higher frequency, consist of a greater strain rate, dynamically load the bone and have a short frequent duration of loading appear to render the greatest osteogenic adaptation (92). Further, exercise has also been shown to have an impact on bone geometry, with training effects being site-specific and preferentially influence cortical bone over trabecular bone (93).

2.3.1 Physical Activity for Fall Prevention

Prevention of falls is of paramount importance in reducing the risk of fractures, as a history of falls has been shown to be a significant risk factor for experiencing falls in the future and resulting in fractures in vulnerable populations such as individuals with osteoporosis (12,59). Another important consideration is that many individuals who have previously suffered a fall may be less inclined to participate in regular physical activity and render the benefits associated with regular exercise due to an increased fear of falling again (94,95). This is especially true if the individual has already been told that they are in a high-risk category for suffering falls, and subsequently at high risk of fracturing (96).

Exercise may indirectly reduce fracture risk by reducing the risk of falls in the elderly, total effect size (0.45; 95% CI 0.25 to 0.80) (97,98). One study, which consisted of individuals participating in a weekly group exercise program, demonstrated that exercise resulted in improvements in balance and a reduced rate of falling (99). Exercise reduces the risk of falling specifically through targeting muscle weakness and impaired balance, which are two of the main risk factors for falls (97). Therefore, effective exercise programs that aim to prevent falls should include aspects of strength, balance training and endurance training (100-102). The Otago exercise program is a program that consists of strength and balance retraining for older adults and has been shown to significantly reduce fall risk and death (98). Another intervention identified that modifying known risk factors for falls may aid in reducing the risk of falling (101). Exercise has also been used to help those who have been identified as being frail. These individuals have an increased risk of falling as a result of their decline in physical function and a diminished capacity to control their balance (103). Interestingly, a recent systematic review on exercise interventions for fall prevention determined that interventions that included challenging balance exercises, provided high doses of exercise and those that did not include a walking

component appeared to be the most effective for fall prevention, effect size (0.84; 95% CI 0.77 to 0.91) (104,105), which is in contrast with previous work recommending endurance activities (100).

2.3.2 Physical Activity, Physical Inactivity and Older Adults

Regular physical activity has been shown to be effective for reducing both chronic disease and disability in older adults (99). The functional benefits of physical activity for older adults include, but are not limited to: improved cognitive function, cardiovascular health, improved muscle strength and balance, physical functioning, fall reduction and positive contributions to health related quality of life (38,106-112). Regular participation in physical activity is key to the maintenance and improvement of independent living in an older adult population (113). Inactivity has been identified as a major public health concern with the prevalence of disease increasing with age and activity levels declining with age (111,114). This is further compounded by the fact that the number of older adults is increasing and the majority of them are not sufficiently active (5,115). The economic burden of physical inactivity has been estimated to cost about $2.1 billion dollars annually, which represents 2.5% of the total direct health care costs in Canada (116). It has also been established that modest reductions in the prevalence of physical inactivity have the potential to reduce health care expenditures by $150 million annually (116). Therefore, interventions aimed at facilitating the uptake and the improvement of physical activity levels in older adults are important.

2.4 Physical Activity Interventions in Primary Care

2.4.1 Role of the Family Physician

For most Canadians the family physician is the first point of contact with the health care system (18,117). Older adults tend to visit their family doctor more frequently than the rest of

the population (118). Patients have reported that they view their family physician to be a credible source of information (118,119). As a result, primary care physicians may have the best ability to motivate patients to become more physically active. Further, current evidence has demonstrated that patients are more likely to initiate as well as maintain physical activity if it has been prescribed from their family doctor (120). This physician advice is also found to be more effective when it is presented to patients in the form of a prescription or detailed plan outlining how one can incorporate more physical activity into their daily lives (120). In addition, physician advice, support in the form of counseling and regular follow-ups with the patient have been identified as important aspects of the individual's social environment that are required to assist in the improvement of one's activity level (121). However, despite the established benefits of physical activity, most physicians do not regularly counsel their patients on becoming more physically active (122,123). Only 28% of patients claim to have received physician advice about increasing their activity levels and from those who did receive advice only 38% of patients received assistance in developing an activity plan (122). One potential explanation for this is a lack of knowledge and expertise in exercise prescription among physicians (24,119). When asked, most physicians state that they feel they have the ability to positively affect their patients through counseling and providing preventative services (124). Additionally, recent work has noted that most physicians are interested in exercise prescription and felt equipped to provide a prescription (125-128). However, in reality only 10% of physicians were actually able to carry out and develop an exercise plan and many have stated that they do not feel confident in their current knowledge of exercise prescription and are not comfortable formally prescribing exercise to their patients, especially the most vulnerable which arguably may have the most to gain from increased physical activity (129). A recent study also noted that a family physician's current

level of exercise counseling is suboptimal and confidence levels of physicians in relation to exercise prescription are not high (117). Further, many physicians report that their medical school training focuses very little on advising patients about physical activity (119,130). This is of particular concern given that the lessons acquired during medical school training and residency has been shown to carry the greatest influence on clinical decision making (18). It is likely that there are many opportunities missed in advising patients about the benefits of exercise to improve their health and quality of life.

Aside from inadequate experience or lack of skills with exercise prescription, a number of other barriers to implementing exercise in primary care have been identified. These barriers include lack of time, and inadequate reimbursement for exercise counseling (117,127,131). A lack of time is an especially salient barrier given that the number of older adults is increasing significantly and the number of physician visits per patient is becoming more frequent (25,118). Additionally, these individuals often present with multiple and complex conditions as the prevalence of chronic disease is on the rise and increases with age (18). As a result of these time constraints and in attempts to manage the additional work loads many physicians are now relying on a one problem per visit policy and are only able to see a patient for an average of 10-15 minutes per visit which is often not adequate time to address or implement a physical activity prescription (18). As a consequence, adherence rates following doctors' recommendations to exercise have been quite low (132).

2.4.2 Interdisciplinary Family Health Team

Family health teams (FHT's) are becoming increasingly prevalent in Ontario, with more and more physicians becoming members of these health teams and delivering care through an interdisciplinary model (18). In this model of care, the team is comprised of a number of

different health care professionals (e.g. physicians, nurses, kinesiologists) who all have a particular area of expertise and work together to provide a patient centered-approach to care. Primary health care teams have the potential to result in cost savings as well as improve patient outcomes (133,134). The idea behind FHT's is that the most appropriate care is provided by the most appropriate provider and this may reduce some of the burden on family physicians (135,136). Further, the integration of team members like a nurse or pharmacist have been shown to improve patient outcomes (133-135,137). One important aspect that has been recently studied has been the incorporation of health professionals who specialize in physical activity prescription and can therefore serve as activity counselors (22,135). These physical activity counselors are generally those with a strong educational background in exercise sciences and as a result are well equipped to provide exercise counseling and design and implement exercise prescription (22). In addition, physical activity counselors are also more likely to have greater time availability in order to provide the intensive counseling that is often required to make the exercise intervention more effective. A strength of the FHT model is that the patient may receive advice from their physician to become more active to address a particular health issue but the activity counselor is then able to apply the necessary skills and time to help the patient carry out the plan. Therefore, these allied health professionals work in tandem with the primary care physician in order to provide the best care possible (136). In fact, a recent review found that exercise interventions which included a health care professional independently or in addition to a physician resulted in the best long-term results defined as greater than six-months of improved physical activity (136).

2.4.3 Physical Activity Interventions in a Primary Care Setting

Given the interest and benefit of increasing physical activity a number of different types of interventions have been implemented within a primary care setting. A review of these interventions found that primary care-based counseling interventions are moderately effective in the short-term however; a substantial amount of variability across the studies included in the review was cited (17). Despite this limitation, the review was able to conclude that there is adequate evidence to recommend that physical activity counseling be incorporated within routine practice (17). Of the studies included in this review, the majority of the physical activity interventions were delivered in primary care but some of the studies delivered the intervention in a group setting or classes that took place outside of primary care (17). Additionally, the studies included a number of different interventionists including the intervention being delivered by a physician only, a nurse, nurse and a physician or students in public health (17). The review was able to conclude that there was no relationship observed between those who performed the intervention or how effective the intervention was (17). Recommendations for effective interventions were those that include: focusing only on physical activity initially, include some type of tailored component that is accompanied with written material and involved a physical activity counselor (17). Likewise, other literature has concluded that the most effective primary care-based interventions are those that focus solely on physical activity and do not attempt to alter multiple health behaviors (138). Interventions that are intensive in promoting physical activity by using multiple health care team members, include interactive training sessions, and the use of an office support system where patient reminders and follow-up information is delivered through a variety of communication channels demonstrated the most effective results (138). To enhance future interventions it has been suggested to have a care provider trained in behavioural counseling techniques emphasizing a collaborative relationship between the patient

and the counselor as well as practicing follow-up counseling to provide a form of encouragement through telephone, in-person or internet meetings (138,139). Taken together, these studies are supportive and warrant further investigation into primary care-based physical activity counseling interventions (140).

2.5 Psychological Mediators in the Adoption of Physical Activity

2.5.1 Physical Activity in Older Adults and the HAPA Model

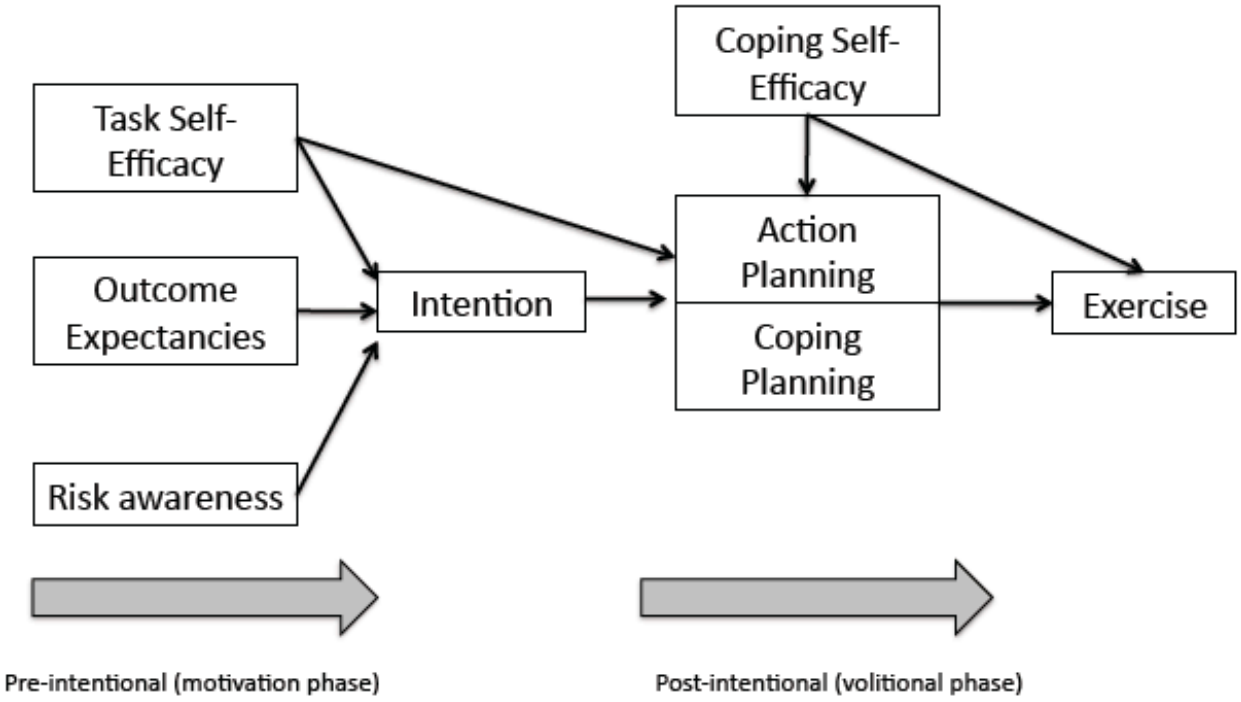
Although the benefits of physical activity have been demonstrated, older adults remain one of the most inactive groups within the population (111,114). Major identified barriers to exercise participation include difficulties in the maintenance and adherence to exercise programs (115). A recent review on the adherence levels of older adults participating in fall prevention programs have identified adherence rates of ~ 52% for individually targeted programs, and rates greater or equal to 75% for multifactorial interventions (141). In attempts to address these key issues, a number of health behavior change models have been utilized to promote positive changes in health behaviour (142). Among these models of behavioural change is the 'Health Action Process Approach' model (see Figure 1), which has been widely used in a variety of health contexts and advocated to be a successful model when trying to change health behaviour (27-31,143). The HAPA model has been utilized in, but not limited to, predicting condom use among young homosexual men, flu vaccine uptake, sunscreen use, and food hygiene (144-147). In addition to the aforementioned health contexts, the Health Action Process Approach has been shown to successfully predict physical activity levels in middle-aged and older adults (34).

The use of the Health Action Process Approach has been advocated over other theoretical models of behaviour change, because it integrates many key aspects of other social cognitive health behaviour change models (32,33). Unlike other theoretical models, a key feature of the

Health Action Process Approach is that a distinction is made between a pre-intentional motivation phase and a post-intentional volitional phase of behaviour (30,32). According to the model, the pre-intentional phase consists of risk perception, outcome expectancies and task self-efficacy and these three variables are believed to precede intention formation (32). Risk perception refers to an individual's belief of the likelihood that a particular health problem will be experienced. It is presumed that the higher the anticipated risk of a given health outcome occurring, the more motivated the individual will be to engage in preventative and precautionary health behaviour changes (32). Outcome expectancies are the result of the individual weighing the pros and cons of certain behavioural outcomes. It is believed that a positive outcome expectation would lead to intentions to adopt the given behavior. Finally, task self-efficacy has been defined as one's belief in their ability to perform a certain task and is one of the strongest predictors of behavioural intentions (32,148). To illustrate this concept, an individual who does not believe in their capacity to perform the desired action may fail to adopt the behavior. The HAPA model then postulates that once an inclination toward a health behavior is made, this intention will then be translated into action (28). At this point the individual is said to have entered the post-intentional volitional stage (33). Key variables of the post-intentional volitional stage are coping self-efficacy and planning which is subdivided into action planning and coping planning (33). Coping self-efficacy refers to one's optimistic beliefs in their ability to deal with barriers that may arise during this stage and enhancing coping self-efficacy can help to maintain the behaviour change (32,33). The planning component of this phase is believed to be the mediator of the intention-behaviour relationship (33). Action planning is defined as a volitional process, which aims to link goal-directed responses to various situational cues (33). Examples of these cues include the when, where and how to act in line with one's goal intention (33).

Alternatively, coping planning is defined as one's ability to anticipate barriers, which might prevent one from implementing their intention (33). Therefore, this construct includes creating detailed plans for overcoming these difficulties. A practical example of this construct would be if it happened to rain or a scheduling conflict developed during the individual's planned time for exercise, they would subsequently plan for alternative days or activities which could be performed in order to ensure that the exercise is completed.

Figure 1. Overview of the Health Action Process Approach Model (HAPA)



(Adapted from Schwarzer, 1992)

2.5.2 Limitations in the use of the HAPA Model as a Guiding Framework

Although the HAPA model has been shown to be a valid and reliable tool at predicting health behaviour change, few studies have specifically looked at the effectiveness of the HAPA model at increasing physical activity levels in older adults. Previous studies have included very heterogeneous samples consisting of rehabilitative populations, and samples consisting of middle-aged and older adults with large age ranges (149,150). To address this limitation it is necessary to test this model in a more homogenous sample of community dwelling older adults who are all over the age of 65. Please refer to Table 3 for a summary of the research methodology of the studies using the HAPA model specifically in a physical activity context. Please also see Table 4 for a summary of outcome definitions for physical activity, measurement and results in this limited number of studies. Note that there is significant variation in defining the outcome of physical activity across these studies. The use of this model is also an ideal fit in a population at high risk of falls and fractures because the model has been demonstrated to be universally applicable and has been used across various ages and cultures (34). Therefore, it is likely that this model will also be applicable to this population, which may consist of individuals from different cultural backgrounds with varying personal characteristics. Finally, a significant limitation to studies using the HAPA model in a physical activity context is the use of a self-report measure of physical activity, which may be particularly susceptible to an overestimation bias. To address this limitation found across these studies previous work has recommended the use of an objective measure of physical activity (149). Previous work using the HAPA model in relation to physical activity have suggested that it is important to create exercise opportunities by specifically generating environments that allow for the targeting of constructs such as self efficacy, risk perception and intentions to best facilitate exercise adherence (149).

Table 3. Summary of the Research Methodologies of Studies Using the HAPA Model in a Variety of Different Health Contexts

Study	Study Design	Sample	Sample Characteristics
Caudroit, 2011	PC	N=120	Older retired adults (53-83yrs), Members of French University Organization
Dohnke, 2010	PC	N=456	Patients of a cardiac rehabilitation program who were enrolled in a previous study (mean age=57.69). significantly > # of males
Hammer, 2011	RCT	N=147 (control n=74) (treatment n=73)	Male and female volunteer firefighters (mean age = 38.61). Male majority (91.4% of participants)
Lippke, 2004	PC	N=509	Orthopedic patients, women (mean age=45) men (mean age=47)
Renner, 2007	PC	N=697	South Korean middle/older adults (16-90yrs)
Scholz, 2009	PC	N=265	First year University Students

PC = Prospective Cohort Study
RCT = Randomized Controlled Trial

From References (34,149,151-154)

Table 4. Summary of Outcome Definition, Measurement and Results of Studies Using the HAPA Model in a Variety of Different Health Contexts

Study	**Outcome Definition: Physical Activity**	**Outcome Measurement**	**Results**
Caudroit, 2011	total frequency of PA/Wk	self-report (Modified Activity Questionnaire, French Version)	PA Intention & coping self efficacy were positive predictors of EX behaviour
Dohnke, 2010	Frequency of physical activity participation/wk or per month	self report questions "How often do you participate in a cardiac rehab program per week or per month"	Intention and self efficacy levels differ for those who dropped out of the program and those who maintained (supports model assumptions)
Hammer, 2011	Post exercise minutes, post exercise sessions converted from hrs to minutes (sessions < 20mins not included)	self-report activity log	Ex behaviour increased in treatment group. (NS)
Lippke, 2004	3 domains of PA: fitness activities, exercise for muscle strength, game sports, min/wk	Self-report of physical activity	Exercise levels increased over time
Renner, 2007	participants asked in line with the EPIC and Norfolk physical activity questionnaire how often engaged in certain activities	Self-report 5 point likert scale	Differences found in motivation as function of age
Scholz, 2009	avg total minutes of exercise/wk (vigorous PA)	Self-report using (IPAQ)	PA positively associated with intentions, self efficacy & action control

PA = Physical Activity, EX = Exercise NS = non-significant
From References (34,149,151-154)

2.5.3 Using key variables of the HAPA Model for Facilitating Adherence to the PEPTEAM Exercise Program

For the purposes of this thesis project, the Health Action Process Approach will be used as a guiding framework for the program as the purpose of this exercise intervention is not to formally test the model but rather to use components of the model to help better facilitate adherence to the tailored exercise program. The following variables of the Health Action Process Approach will be assessed at baseline and at six-week follow-up: action planning, coping planning, coping self-efficacy and intentions. These variables will be targeting extensively during the behavioural intervention components of the program and during follow-up phone calls to participants. These variables have been shown to be important to older adults' decisions to engage in physical activity given that motivational changes tend to occur as a result of age, making these variables of the model more salient than the others when trying to change older adult behaviour (150,155,156). Older adults may be more strongly motivated toward preventative health goals like choosing to engage in physical activity in order to lower their risk of a particular outcome like a fall or fracture prompting them to enter the post-intentional stage of the model (34,157). By arranging to have a family physician refer patients who are at high risk of falls or fractures, this might enhance patient risk perceptions, which have been demonstrated to be especially relevant to older adults (34). Further, the family physician will have the opportunity to influence outcome expectancies by conveying the benefits of exercise to the patients being referred. Task self-efficacy, the third component of the pre-intentional phase will be addressed by having a physiotherapist demonstrate the exercises, enhancing the participants' belief in their ability to complete the task. Therefore, action planning, coping planning, coping self efficacy and intentions have been selected as these variables are likely to

have the greatest ability to influence the physical activity levels of older adults and best help to bridge the intention-behaviour gap once they have entered the post-intentional phase.

2.6 Summary of Background

Falls and fractures carry a substantial individual and economical burden. Exercise is beneficial at reducing the risk of fracture and decreasing the risk of falling through improvements to muscle strength and balance. Individuals at high risk require an individualized exercise program to accommodate individual needs and barriers to exercise. Family physicians may be in an ideal position to recommend exercise. However, a lack of time and specialized knowledge in exercise prescription make it difficult for most physicians to implement into their daily practice. An interdisciplinary family health team where the care is shared across professional disciplines has been recommended as the ideal model to deliver an exercise program. In summary, this study will aim to determine the feasibility of implementing an individualized exercise prescription based on key elements of the Health Action Process Approach model and delivered within a primary care setting to individuals over the age of 65 who are at high risk of falling or fracturing.

3.0 Chapter 3: Research Methodology

3.1 Research Questions

3.1.1 Primary Research Question

1. Does an individually tailored exercise program that is based on elements of the Health Action Process Approach (HAPA model) and is delivered within a family health team result in increased levels of physical activity after 6 weeks in older adults at high risk of falls and fractures who are over the age of 65?

3.1.2 Secondary Research Questions

3.1.2.1 Secondary Research Questions: Feasibility

1. How many individuals are referred to this program?
2. How many patients agree and are eligible?
3. How many patients refuse to participate in the program?
4. How many participants attend each visit?
5. What is the screening-to-recruitment ratio?
6. What is the short-term adherence to the exercise program?
7. How many individuals are retained at follow-up?
8. How long do the exercise program appointments take?
9. What is the level of patient and physician satisfaction with the exercise program?

3.1.2.2 Secondary Research Questions: Psychological Measures

1. Are there any changes in action planning from baseline to follow-up?
2. Are there any changes in coping planning from baseline to follow-up?
3. Are there any changes in coping self-efficacy from baseline to follow-up?
4. Are there any changes in intentions from baseline to follow-up?

3.1.2.3 Secondary Research Question: Health related quality of life?

1. Are there any improvements to the health related quality of life (HRQOL) of the individual from baseline to follow-up as a result of this exercise program?

3.2 Research Hypotheses

3.2.1 Primary Research Hypothesis

Elements of the Health Action Process Approach Model have been shown to be effective at predicting the uptake of physical activity (34). In addition, health care delivered through an interdisciplinary team that incorporates a physical activity counselor has demonstrated positive patient satisfaction providing support for exercise promotion in this setting (158) . Therefore, it is hypothesized that the tailored exercise program based on the key components of the Health Action Process Approach Model that is implemented in a primary care based setting will result in positive changes in the physical activity levels of the participants, measured by an increase in high-light and moderate-to-vigorous physical activity intensity thresholds at baseline and at the six-week follow-up measured by an activity accelerometer and self-reported activity via an exercise log.

3.2.2 Secondary Research Hypotheses

It is hypothesized that the tailored exercise program will result in favorable levels of exercise adherence defined as 70% of the participants adhering to all exercise visits and prescribed recommendations over the six-week program duration.

The outcomes of the HAPA model are expected to positively change and correspond to improvements in the physical activity levels within this population.

Health related quality of life has been previously shown to positively improve from exercise interventions (112) . Therefore, the health related quality of life of the study participants is expected to improve as a result of this exercise intervention.

3.3 Design and Sample Size

This study is a prospective pilot study with measures taken at baseline and a six-week follow-up. The results of this pilot study will inform the design of a larger future trial implementing this type of tailored exercise prescription delivered within a family health team. This study involves collaboration between the University of Waterloo and the Center for Family Medicine (CFFM), Kitchener, Ontario. A sample of eleven patients from the Center for Family Medicine was recruited for participation in this study.

3.4 Participants

Participants recruited for this study consisted of patients who were over the age of 65, a member of the Kitchener Family Health Team practice and were at high risk of falls or fractures.

Table 5. Inclusion/Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
• ≥ age 65 • member of the CFFM FHT *Have at least one of the following:* • 2 or more falls in the past 12 months • age 75 + • high risk of fracture based on the CAROC • difficulty with walking or balance as determined by attending physician • acute fall • history of a *fragility* fracture after the age of 50	• moderate to severe cognitive impairment • moderate to severe neurologic impairment • not able to communicate in English • contraindications to exercise as determined by physician • uncontrolled hypertension • palliative care, current cancer, on dialysis • participation in similar exercise program including resistance training at least 3 times a week

3.5 Participant Screening and Recruitment

The recruitment for this study was designed so that it complied with clinic privacy policies. The nurses on the family health team completed the screening of patients and the researcher conducted recruitment. All patients over the age of 65 years were screened each day prior to their scheduled appointment. If a potential patient was eligible a referral form for the exercise program was placed in the patient's chart. At this time, the physician was given the opportunity to recommend the exercise program to the individual if they felt that it was safe and that they would benefit. The individual was then asked if they would be interested in participating in an exercise program. Individuals interested in participating were contacted by the researcher with additional information about the study APPENDIX A: Recruitment Script.

Patients not interested in participating in the PEPTEAM program were asked to fill out a refusal questionnaire to enable researchers to determine whether those that chose to participate differed from those that did not. There were two opportunities to complete the refusal questionnaire. The first opportunity was over the phone during the first recruitment phone call. Secondly, the patients were given the option to fill out the refusal questionnaire in their home during visit one if they decided since the first phone call that they were no longer interested or were not interested after learning more about the program. The refusal questionnaire consisted of questions asking about whether individuals already exercised three or more times a week, barriers to participating in exercise, use of a walking aid, health status like a diagnosis of osteoporosis, number of falls in the past year, age and gender. The complete refusal questionnaire can be found by referring to Appendix A: Refusal Questionnaire.

3.6 Consent

During the first scheduled home visit with the researcher participants had the opportunity to read and provide written consent to participate in the study. Following the consent process, participants completed the study questionnaires, which consisted of the medical history, action planning/coping planning questionnaire, and quality of life questionnaire. Participants were also asked to wear an activity monitor for four days. These assessments served as baseline measures for the study.

3.7 Exercise Intervention Overview

The intervention took place at the Center for Family Medicine, Joseph Street site, in Kitchener, Ontario and during in-home visits. The intervention consisted of three stages and began when the patient arrived for their scheduled appointment with the physiotherapist. The physiotherapist on the health team conducted a formal assessment of the patient, incorporating any special care instructions from the individual's family/referring physician. From this assessment an individualized exercise prescription was developed to most appropriately address the health condition and needs of the individual. In addition, all exercises prescribed were modified and tailored to the individual's functional abilities. The functional assessment consisted of the Short Physical Performance Battery (159) and the Timed Up and Go test (160,161). The duration of the assessment and prescription took about one hour. This was followed by a formal demonstration of all exercises by the physiotherapist. The purpose of this was to address any questions that the patients may have and also to ensure the use of proper exercise form and that all exercises were done safely to avoid injury and maximize the benefits of the exercises. This demonstration lasted about 30 minutes. Participants then received written instructions along with photos of the prescribed exercises. Following this appointment, an in-home appointment approximately one week later took place with the kinesiologist. During this appointment the

kinesiologist delivered the behavioural component of this exercise program, which consisted of the implementation of motivational interviewing techniques and the review of action planning and coping planning skills with the participant.

Motivational interviewing is a collaborative counseling style that is strongly patient-centered and emphasizes guiding the individual to strengthen their motivation toward a health behaviour change (162). Motivational interviewing has been used extensively in various health contexts to change behaviour including but not limited to smoking cessation, drug use, and obesity management (163). Unlike other counseling styles, motivational interviewing is not coercive in nature but rather assists the individual in resolving their own ambivalence by focusing on motivational processes that have been shown to best facilitate behaviour change (162,164). For this project the specific therapeutic strategy used to help elicit this behavior change was the use of evocative and powerful questions. Examples of powerful questions include, "what do you want to congratulate yourself for?", "what rule do you need to change for yourself?", "if you knew you would succeed, what would you do?" and "how will you measure success?". Additionally, participants were asked to engage in another therapeutic motivational technique called the 'wheel of life exercise', which coincided with the 'powerful questions'. During this exercise, the participant was presented with a wheel diagram see APPENDIX D: Powerful Questions and the Wheel of Life diagram and was subsequently asked to list in each wedge of the diagram an important aspect of their life. The participant was then asked to rate that aspect out of ten to reflect how satisfied they were with that life component at the present time. An example of this exercise would be to list exercise/health improvement as an important aspect and to then provide a rating out of ten with ten being the most satisfied with no room for improvement and one representing the least satisfied. The powerful questions were then asked to

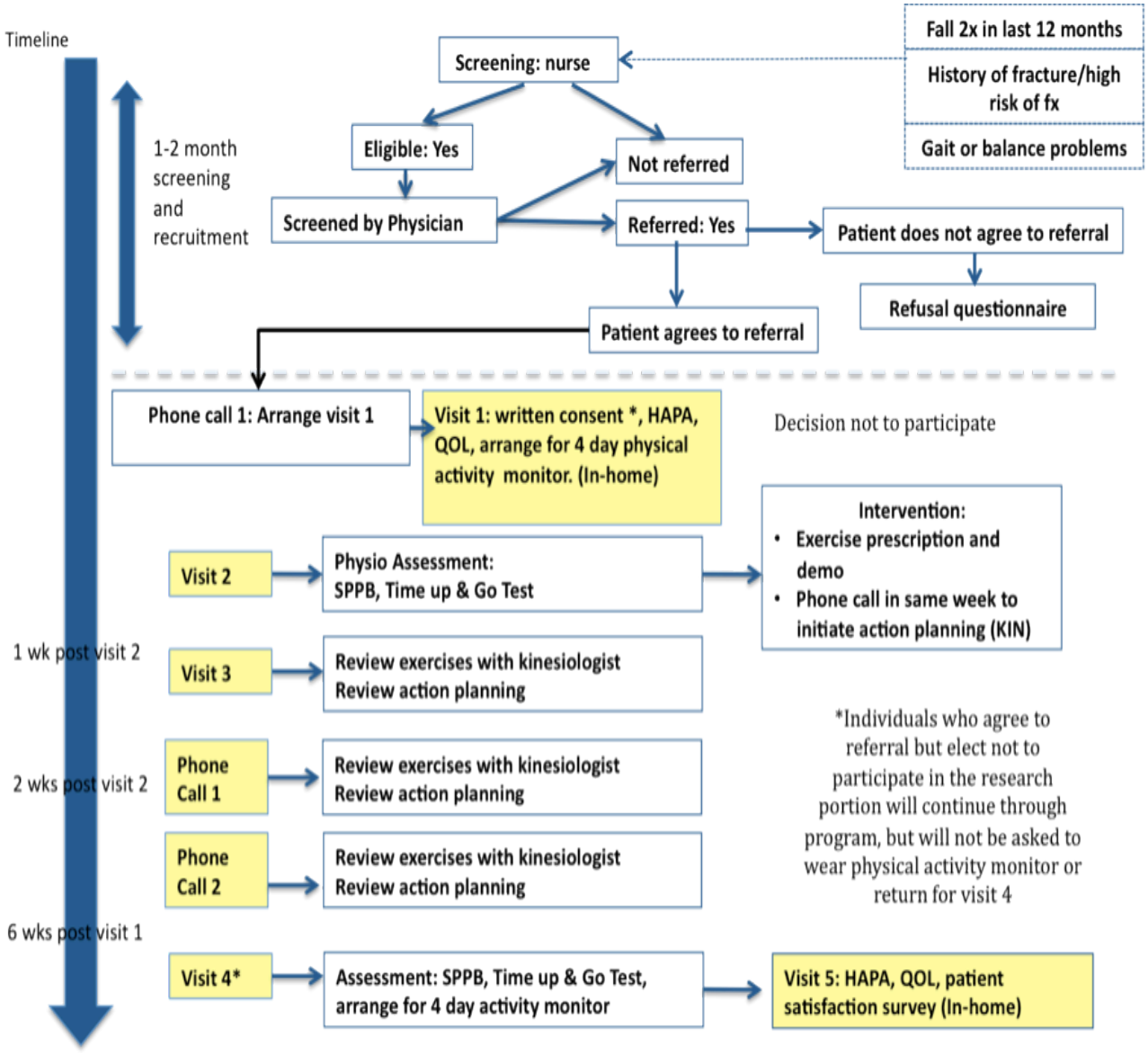
help with an area that needed improvement. For the purpose of this study, physical activity improvement with the addition of one other component was targeted to reflect the primary goal of this program. At this time, the kinesiologist also addressed any questions or concerns that the participant may have had about their prescription and modified the exercises accordingly if required.

During the second half of the in-home visit, the kinesiologist worked with the individual to develop specific action plans (when, where and how) the prescribed exercises would completed. The action plans that were developed were unique to each individual in order to accommodate the tailored exercise prescription. The kinesiologist worked with the patient to identify a specific location to perform certain exercises safely. One example of this was to ensure that the individual completed their prescribed balance exercises near a counter or two walls so that they would have support objects in place for safety. Another example involved identifying a location and use of objects within the home like a chair to perform a sit-to-stand lower extremity strengthening exercise. The other component of action planning like 'when' one would perform the exercises was also addressed through the formal exercise prescription and the kinesiologist working with the individual to modify the prescription to best suit the individual's lifestyle. For example, if a participant was prescribed a certain exercise three times a week, twice a day, the kinesiologist would modify the prescription if a certain day of the week didn't work well and get the participant to plan for a day that did work well (e.g. Are Mondays better for you than Tuesday's). Further, if participants were prescribed more than one exercise for a particular day, the kinesiologist would work with the individual to create a plan for when each type would be completed. For example, for some individuals it worked better for them to plan to complete their balance exercises in the morning and leave their strength training exercises for the evening thus

dividing the time required to complete the prescribed exercises into smaller bouts of time throughout the day. Finally, the kinesiologist reviewed how to properly complete each exercise to remind the participants and to ensure that they were confident in their knowledge of how to perform the activities in their plan. At this time, the kinesiologist also reviewed coping planning, strategies providing practical ways to plan to overcome certain barriers that the individual might encounter when trying to adhere the prescribed program. Two follow-up phones calls in the subsequent weeks followed the visit to review action planning and coping planning skills that were developed with each participant.

A final appointment took place at the end of the program duration (week six) in order to obtain the follow-up functional assessments to compare with baseline measures and drop off the activity monitor to be worn for an additional four days at six-weeks. A final in-home visit served as a time for participants to complete the study questionnaires at follow-up and for the researcher to pick up the activity monitor after the final four days and ask participants to complete the patient feedback survey. Throughout this intervention, study participants were provided with physical activity logs and were asked to record the number of minutes and type of activity performed each day. Please refer to Figure 2 for a complete overview of the study flow.

Figure 2. Study Flow Chart



3.8 Outcome Assessments

3.8.1 Medical History and Screening

Medical history and demographic information such as current health status, lifestyle factors, age, gender, the Short Falls Efficacy Scale – International (FES-I) (165) and bone medication use was collected through a self-reported medical history form that was administered to the patient at visit one. Please refer to APPENDIX C for the complete medical history form. All information related to medical history containing personal information was kept on a password-protected computer and stored in a secure location. Only the primary researcher and research assistants had access to this information. Additionally, all information was de-identified to ensure anonymity. Finally, any adverse events or side effects of the intervention were recorded and are reported with the feasibility results.

3.8.2 Primary Outcome Measures

3.8.2.1 Physical Activity

Physical activity accelerometers were employed as quantitative verification of physical activity levels. The X2-Mini (Gulf Coast Data Concepts., USA) is a three-dimensional sensor that is used to capture the activity levels of an individual. The accelerometer is worn on the hip of the participant for four days. The accelerometer collects minutes of activity throughout the day and provides an estimation of the average number of minutes spent in each exercise intensity category. Four pre-identified accelerometer thresholds have been identified by Freedson et al, and consist of: sedentary; low-light; high-light; and moderate-to-vigorous physical activity (166,167). This intervention aimed to increase the number of minutes spent in the high-light and moderate-to-vigorous threshold categories from baseline to follow-up. Activity monitors have been indicated as the most accurate means of measuring physical activity levels (168-170).

Additionally, participants were asked to fill out a daily physical activity log in order to document their completion of the prescribed exercises and list any additional activities that they may have been engaged in. Minutes of activity per day were reported.

3.8.3. Secondary Outcome Measures

3.8.3.1 Feasibility Information

The following feasibility information was collected to inform a larger future trial. The number of individuals referred to the program, number of patients who agree and were eligible, how many patients refused to participate, the screening to recruitment ratio, the short-term adherence to the exercise program, number of individuals retained at follow-up, length of the program appointments and finally patient and physician satisfaction.

3.8.3.2 Patient and Physician Satisfaction

Two separate questionnaires were developed to assess the quality and satisfaction of the family health team exercise program experience. Through the use of a 5-point likert scale (strongly disagree to strongly agree) the patients had the opportunity to rate a number of different aspects of the program. Aspects of this survey included questions about how enjoyable the program was, if participants learned anything from the program, confidence levels about performing exercise and suggestions for change.

In addition to the patient satisfaction survey, all physicians of the family health team that were involved in referring their patients to the program, were asked to complete an online survey to assess their satisfaction with the program. An email invitation was sent out through the Center for Family Medicine with a link to 'Fluid Surveys', an online survey database for the completion of study questionnaires. The survey was anonymous and took less than five minutes to complete. Using a 7-point likert rating scale (strongly disagree to strongly agree) physicians had the

opportunity to report on how convenient it was to refer patients, how much physicians value the program, confidence levels in exercise prescription, and recommendations for future work.

3.8.3.3 *Psychological Outcomes*

Specific outcomes of the Health Action Process Approach Model were assessed at baseline and follow-up to determine if these outcomes demonstrated a positive change, which according to the model should translate in the uptake of the new health behaviour, physical activity. Psychometric questionnaires assessing action planning, coping planning, coping self-efficacy, and intentions using a 5-point Likert scale were employed (150).

3.8.3.4 Health Related Quality of Life

The EQ-5D-5L questionnaire was used as an assessment of health-related quality of life at baseline and at six-week follow-up. The EQ-5D-5L questionnaire consists of five questions that ask about pain, depression, activities, self-care and mobility, with the addition of a visual analogue scale for patients to self rate their health status (151).

3.8.3.5 Short Physical Performance Battery (SPPB): Functional Assessment

The Short Physical Performance Battery served as a functional assessment to assist in the development of the tailored exercise prescriptions. The SPPB also served as another secondary outcome as measures of the components of the assessment such as: sit to stand, balance test and 8' walk test were recorded at baseline and six weeks follow-up. The summary ordinal score of the SPPB has been shown to be predictive of nursing home admission, disability and mortality (159).

3.8.3.6 Timed Up and GO (TUG): Functional Assessments

The Timed Up and Go test was an additional assessment that was used to inform the development of the exercise prescription by providing a good indication of the participants'

functional ability. The Timed Up and Go test requires the participant to rise from a seated position, walk three meters and return to a seated position (160,161).

3.9 Statistical Analysis

Data was collected and entered into a password-protected spreadsheet as it was collected throughout the duration of the program. Prior to formally analyzing the data using SPSS version 20, all of the data was input into Microsoft Excel to produce means, standard deviations and frequencies. Descriptive statistics mean (SD) were used to summarize and describe the study population using the patient medical history and demographic information collected. Further, mean (SD) were used to describe and characterize the continuous outcomes of the exercise program and count (%) were used to summarize the categorical variables. All data was then entered into the SPSS database and tests of normality were carried out on all outcomes in order to determine if the data were normally distributed. To determine whether or not the data was normally distributed normality tests such as the P-P and Q-Q plot were conducted on the data in addition to viewing the related histograms and performing a Shapiro-Wilk test. The presence of a non-normal distribution was identified and nonparametric statistics were employed to compare the within-group differences between baseline and six-week follow-up. A Wilcoxon signed rank test was used to determine if there were any differences in physical activity levels, psychological variables, health-related quality of life and the functional assessments from baseline to after the intervention. The Wilcoxon signed rank test is an appropriate alternative to the t-test when the data is not normally distributed. Physical activity accelerometer data was processed using a similar protocol previously developed by Freedson et al, and total minutes/day in each intensity threshold were identified (166). Average minutes/day of activity was taken for each intensity threshold to address any missing data in terms of missed days, recording issues or malfunction of

the device. The average self-reported physical activity levels at baseline and six-weeks were obtained for all participants. Adherence was defined as the completion of the prescribed number of sessions and type of exercise. Adherence to exercise recommendations was obtained by identifying each participant's average adherence to their exercise prescription and determining an average adherence to the exercise program for the entire group. In the case of incomplete exercise logs no activity or zero adherence for those weeks was assumed. Patient and Physician feedback data was summarized by frequency counts.

The statistical significance level was set at alpha 0.05. Potential confounders of this study could consist of age, gender, body weight, income level or socioeconomic status, medication use and degree of physical function. Some of these confounders are reported in the participant demographic information.

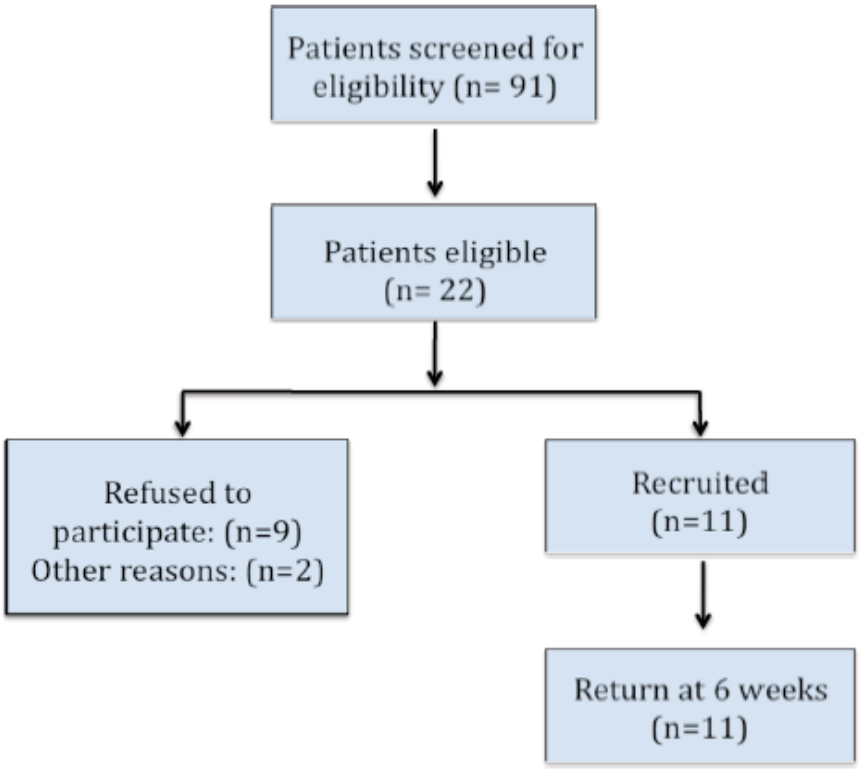
4.0 Chapter 4: Results

4.1 Participant Demographics and Feasibility of Recruitment, Retention and Adherence

4.1.1 Study Flow and Recruitment

A total of 91 patients over the age of 65 were screened for PEPTEAM (Prescribe Exercise for the Prevention of Falls and Fractures: A Family Health Team Approach). Of those 91 patients, 22 of them met the study inclusion/exclusion criteria and were deemed eligible to participate via referral from their family physician. Of those 22, a total of 11 eligible patients from the Centre for Family Medicine were recruited this study (Figure 3). Nine participants refused to participate in the study and 2 were willing to participate but had to refuse because they would be away for the duration of the study. All recruited participants were retained at six-week follow-up.

Figure 3. Study Flow



4.1.2 Participant Demographics

The average age of our sample was 72.6 (6.4) years old and most of our sample consisted of women (n=10, or 90.9%). Only a couple of participants had self-reported osteoporosis (n=2, or 18%) and (n=4, or 36.3%) had experienced one or two falls in the past six months. Participant characteristics are summarized in Table 6.

Table 6. Summary of Participant Characteristics

Characteristic	Mean (SD) or n (%)
Age: mean (SD)	72.64 (6.4)
Female Gender: n (%)	10 (90.9)
High blood pressure: n (%)	5 (45.4)
Chest pain not controlled by medication: n (%)	3 (27.2)
Problems with vision not corrected by glasses/contact lenses: n (%)	1 (9.0)
Problems with sensation or other neurologic conditions: n (%)	4 (36.3)
Self-reported osteoporosis diagnosis: n (%)	2 (18.1)
Diabetes: n (%)	3 (27.2)
Experienced 1-2 falls in the past 6 months: n (%)	4 (36.3)
Experienced > 2 falls in the past 6 months: n (%)	1 (9.0)
Loss of feeling or numbness in the legs or feet: n (%)	5 (45.4)
Dizziness when standing from a seated position: n (%)	6 (54.5)
Short FES-I (7-28)*: mean (SD)	10.82 (5.1)
Broken bone after age 40: n (%)	3 (27.2)
Past or current cancer: n (%)	0 (0)
Hip replacements or any other joint replacements: n (%)	0 (0)
Use of a walking aid: n (%)	2 (18.1)
Vitamin D supplentation: n (%)	8 (72.7)
Avergae dose of vitamin D in those taking it (IU): mean (SD)	983.75 (507.4)
Multivitamin use: n (%)	5 (45.4)
Taking osteoporosis medication: n (%)	4 (36.3)
Parents broke a hip: n (%)	2 (18.1)
Do not smoke: n (%)	11 (100)
Taken oral glucocorticoids for > 3 months: n (%)	1 (9.0)
Rheumatoid arthritis: n (%)	2 (18.1)
Post-secondary education: n (%)	4 (36.3)
Self-rated health to be very good or good: n (%)	8 (72.7)

* the Short Falls Efficacy Scale - International (FES-I), scores range from 7 (no concern about falling) to 28 (severe concern about falling).

4.1.3 Refusal Questionnaire

Of the 9 patients that refused, 6 completed the refusal questionnaire with 5 completing the refusal questionnaire at Time 1 during the initial recruitment call and 1 completed the refusal questionnaire during visit one after hearing more about the program and deciding not to participate. The small sample size did not permit a statistical comparison of those that did and did not agree to participate. Average age of those who refused was 76.8 (5.9) years old, which is slightly older than the average age observed in those who participated 72.6 (6.4) years old. Most of those who agreed to participate were female (n=10, or 90.9%), whereas half of those that refused to participate were female (n=3, or 50%). Therefore, it appears that when comparing the two populations a greater proportion of eligible males refused to participate but the sample is too small to make any definitive conclusions. A higher proportion of patients that agreed to participate experienced 1-2 falls in the past year when compared to those who refused and a slightly higher proportion of those who participated tended to use a walking when compared to those who refused. Characteristics of those who agreed and those who refused are summarized in Table 7.

Table 7. Comparison of Participant Characteristics of Those Who Agreed and Those Who Refused to Participate

Characteristic	Agreed to participate (n=11) mean (SD) or n (%)	Refused to participate (n=6) mean (SD) or n (%)
Age: mean (SD)	72.64 (6.4)	76.83 (5.9)
Female Gender: n (%)	10 (90.9)	3 (50.0)
Osteoporosis: n (%)	5 (45.4)	2 (33.3)
Experienced no falls in the past year: n (%)	6 (54.5)	4 (66.6)
Experienced 1-2 falls in the past year: n (%)	4 (36.3)	1 (16.6)
Experienced > 2 falls in the past year: n (%)	1 (9.0)	1 (16.6)
Broken bone after age 40: n (%)	3 (27.2)	1 (16.6)
Use of a walking aid: n (%)	2 (18.1)	1 (16.6)

4.1.4 Feasibility: Retention and Adherence

One of the primary purposes of this pilot project was to determine if the implementation of this type of interdisciplinary exercise plus behaviour change intervention was feasible to be delivered within a clinical setting, specifically primary care. Two patients were incorrectly referred by not adequately meeting the inclusion criteria and one patient was initially eligible but was later deemed ineligible for the program by the family physician, as there was a change in the health status following a scheduled appointment. One hundred percent (n=11) of participants attended all scheduled visits (2 in-home visits, 2 clinic visits, 2 follow-up phone calls) of the program. Average short-term self-reported adherence to the prescribed exercise program was 52.0% [29.9] and was determined by the physical activity logs. Adherence was defined as the completion of the prescribed number of exercise sessions and type of exercise. If an individual was prescribed strength training 3 times a week and only recorded completing strength training exercises for 1 session of that week, their adherence to their specific recommendations for that week would be 33%. In terms of measuring physical activity levels, 100% of our sample adhered

to wearing the physical activity monitors for four days at baseline and six-weeks but only 63.6% of participants completed the activity logs for the full six-weeks. The average short-term adherence to the exercise program of those who completed the logs for a full six-weeks was 65.7% [23.2]. The time of each visit (2 in-home, 2 in-clinic) lasted approximately 1 ½ hours per participant. Additionally, each follow-up phone call lasted approximately 20 minutes for a total of 40 minutes per participant. Aside from the formally scheduled program visits and phone calls, the reminder calls made to participants while wearing the accelerometers two times a day for four days took a total of about 40 minutes (five minutes per call). Lastly, the final pick up of the monitors from each of the participants' homes lasted approximately 5-10 minutes.

4.1.5 Patient and Physician Feedback

When asked on a five-point Likert-scale how enjoyable the exercise program was with 1 representing not enjoyable to 5 representing very enjoyable, an equal number of participants (n=10) rated the program 3 (n=5) and 4 (n=5) out of 5 with 1 participant rating the program 5/5. Further, when asked why they enjoyed the program, one of the participants stated, "they enjoyed doing new things and that they felt that their balance was improving". Another participant made the statement that, "that it was difficult finding the time to complete the exercises" but most participants said things like they enjoyed having a new regime and the individualized support and scheduled exercise forced them to complete the activity. When asked if they learned anything from the exercise program, all of the participants stated that they either learned new exercises or that they learned that their balance is poor and the prescribed exercises pointed out things that they needed to work on. An important finding to note from the feedback questionnaire was that most (n=7, or 63.64 %) reported that they were very confident in performing exercise

when asked about their confidence in performing exercise following the program. Further, there were no suggestions for change when participants asked what could improve the program.

In total 7 physicians were asked to complete the survey and 4 successfully completed the survey. When asked on a seven-point Likert-scale with 1 representing strongly disagree to 7 representing strongly agree to respond to the following statement 'the program was convenient to refer my patients to', all four physicians replied that it was 'mostly true (6/7)'. When asked to respond to the statement 'I value having the PEPTEAM exercise program to refer my patients to', two out of the four replied that they 'strongly agreed' with this statement (7/7), one 'mostly agreed' with this statement (6/7) and one responded that they 'somewhat agreed' (5/7). When asked to rate how confident they felt in their ability to prescribe exercise recommendations to patients at risk of falls or fractures, two of the physicians 'somewhat agreed' (5/7), one physician 'somewhat disagreed' (3/7) and one physician 'strongly disagreed' (1/7). Finally, when asked about whether the project has increased knowledge or awareness regarding exercise for the prevention of falls or fractures two of the physicians responded that they 'mostly agreed' (6/7), one replied that they 'somewhat disagreed' (3/7) and one 'mostly disagreed' (2/7) with the statement. The final question on the survey asked about any future suggestions for the program. One physician completed this question and stated that, "I liked having the availability of health professionals with expertise looking at my patients, convenient, well received by the patients".

4.2 Intervention Effects

4.2.1 Primary Outcome Intervention Effects: Physical Activity Accelerometer Data

Average minutes per day of physical activity (mean [SD]) in each physical activity threshold category pre-and-post the six–week intervention are reported in Table 8. There were no significant changes in the physical activity levels from baseline to six-week follow-up in any of

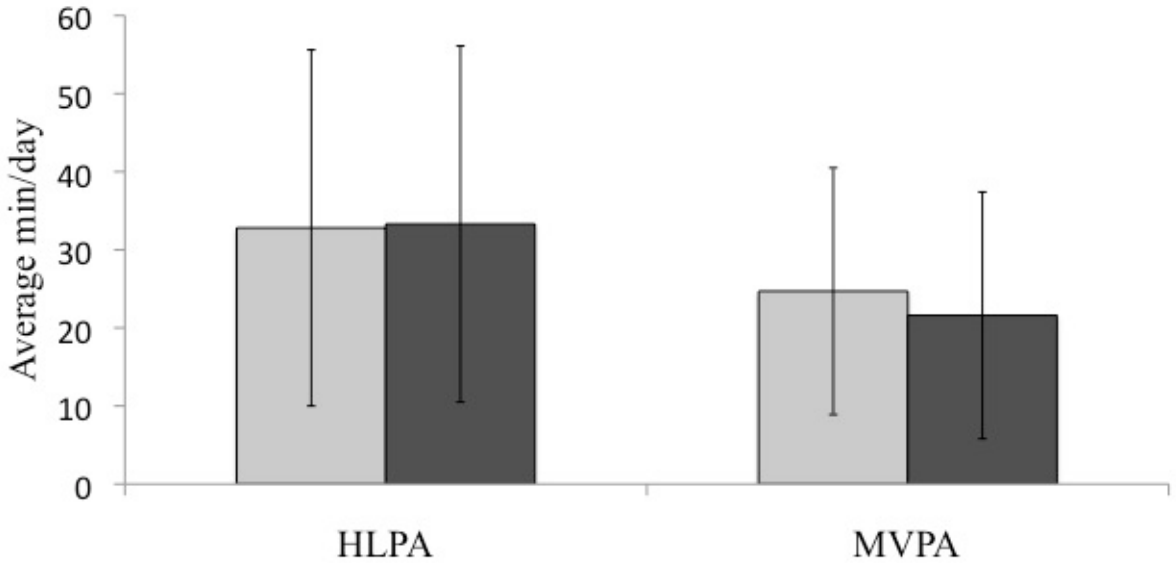
the physical activity thresholds: sedentary, ($z = -7.11$, $p = .477$), low-light, ($z = -1.201$, $p = .230$), high-light, ($z = -.089$, $p = .929$) and moderate-to-vigorous physical activity ($z = -3.56$, $p = .722$). Figure 4 provides a visual representation of the average baseline and six-week follow-up scores for high-light and moderate-to-vigorous physical activity. To inform a future study, we plotted physical activity change scores for each participant in order to see those who increased and those who decreased their moderate-to-vigorous physical activity levels (Figure 5). Please refer to Table 9 for a qualitative analysis that was completed as a way to generate some hypotheses by presenting characteristics of the participants that improved and those that did not improve their physical activity levels.

Table 8. Means and Standard Deviations of Physical Activity Intensity Thresholds at Baseline and Post-Intervention (six-weeks)

Intensity Threshold n=11	Baseline mean (SD)	6 Weeks Follow-up mean (SD)
Sedentary (min/day)	546.2 (274.7)	636.4 (267.1)
Low-Light Physical Activity (min/day)	211.3 (100.0)	190.3 (85.4)
High-Light Physical Activity (min/day)	32.8 (24.4)	33.3 (23.7)
MVPA* (min/day)	24.7 (22.8)	21.6 (15.8)

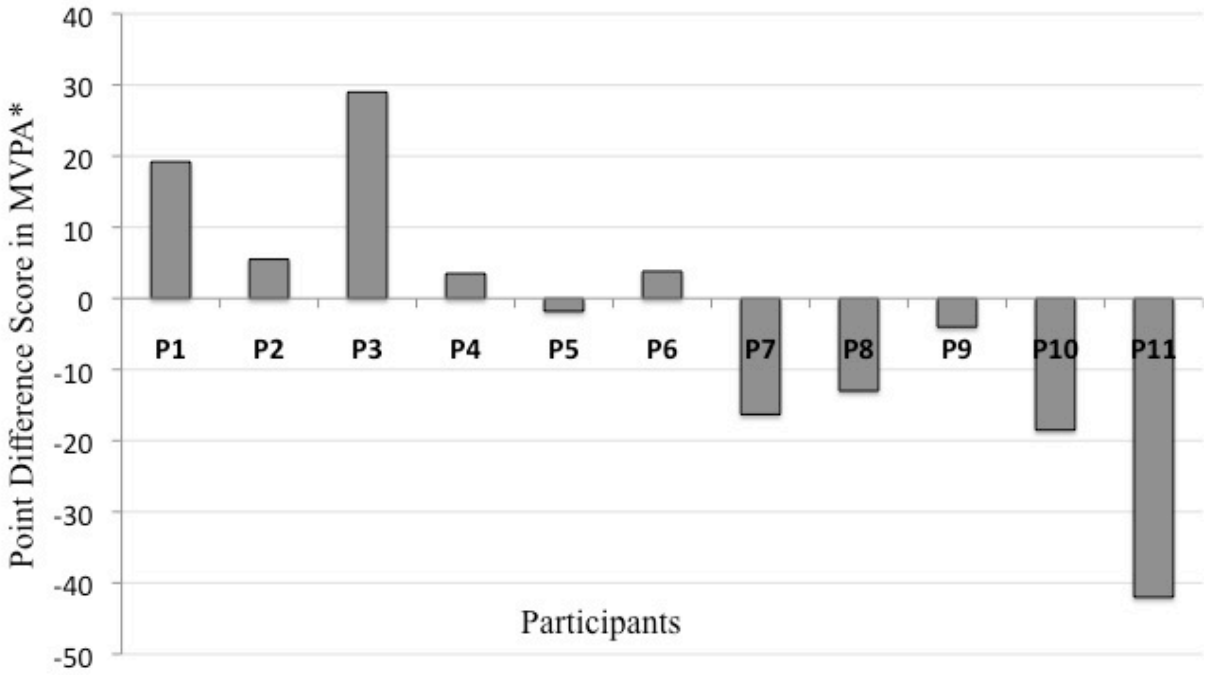
* Moderate-to-vigorous physical activity

Figure 4. Participant Physical Activity Levels (n=11)



Light bars represent baseline measures, dark bars represent post (6 week) measures.
HLPA = High-Light Physical Activity
MVPA = Moderate to vigorous physical activity

Figure 5. Participant Point Difference Change in Moderate-to-Vigorous Physical Activity



*MVPA = Moderate-to-vigorous physical activity

Table 9. Characteristics of participants that increased MVPA* levels and those who decreased MVPA* levels (n=11)

Characteristic	Participants ↑ MVPA* (n=5) Baseline mean (SD) or n (%)	Participants ↓ MVPA* (n=6) Baseline mean (SD) or n (%)
SPPB**: mean (SD)	6.6 (3.2)	9 (2.5)
TUG*** (sec): mean (SD)	16.3 (7.8)	11.9 (3.8)
Intentions: mean (SD)	11 (2.8)	12.3 (1.5)
Coping Self-Efficacy: mean (SD)	32.8 (4.9)	32.3 (8.2)
Action Planning: mean (SD)	18.2 (2.3)	15 (7.9)
Coping Planning: mean (SD)	9.6 (3.6)	11.1 (4.3)
Adherence: mean (SD)	62.4% (32)	43.5% (27.9)
Short FES-I (7-28)ω: mean (SD)	11.6 (6.4)	10.1 (4.2)
Medical Complications (during program): n (%)	2 (40)	5 (83)

* MVPA = moderate to vigorous physical activity
** SPPB = Short Physical Performance Battery (0-12)
*** TUG = Timed Up and Go
◆ The Short Falls Efficacy Scale – International (FES-I), scores range from 7 (no concern about falling) to 28 (severe concern about falling)

4.2.1.1 Primary Outcome Intervention Effects: Self-report Physical Activity

There were no significant changes in the self-reported physical activity levels in the study participants from baseline to six-week follow-up. Mean [SD] of minutes per day was 374.68 [263.34] and 275.18 [257.66] at baseline and six-week follow-up respectively. Mean [SD] of minutes per day for only those participants that filled out a full six-weeks of activity was 332.86 [143.08] at baseline and 432.43 [184.77] at six-week follow-up.

4.2.2 Secondary Outcome Intervention Effects: Psychological Outcomes

4.2.2.1 Action Planning

The Wilcoxon sign rank test was used on all of the behavioural outcomes, as a non-normal distribution was present. A significant within group difference was observed in the participants' ability to engage in action planning when comparing the baseline and follow-up measures ($z = -2.668$, $p = .008$). Nine out of the 11 participants demonstrated an improvement in their action planning score and 2 of the participants demonstrated a tied rank receiving the same score at baseline and follow-up. Mean [SD] action planning scores are presented in Table 10 and this significant difference is illustrated in Figure 6.

Table 10. Secondary Outcome Means and Standard Deviations.

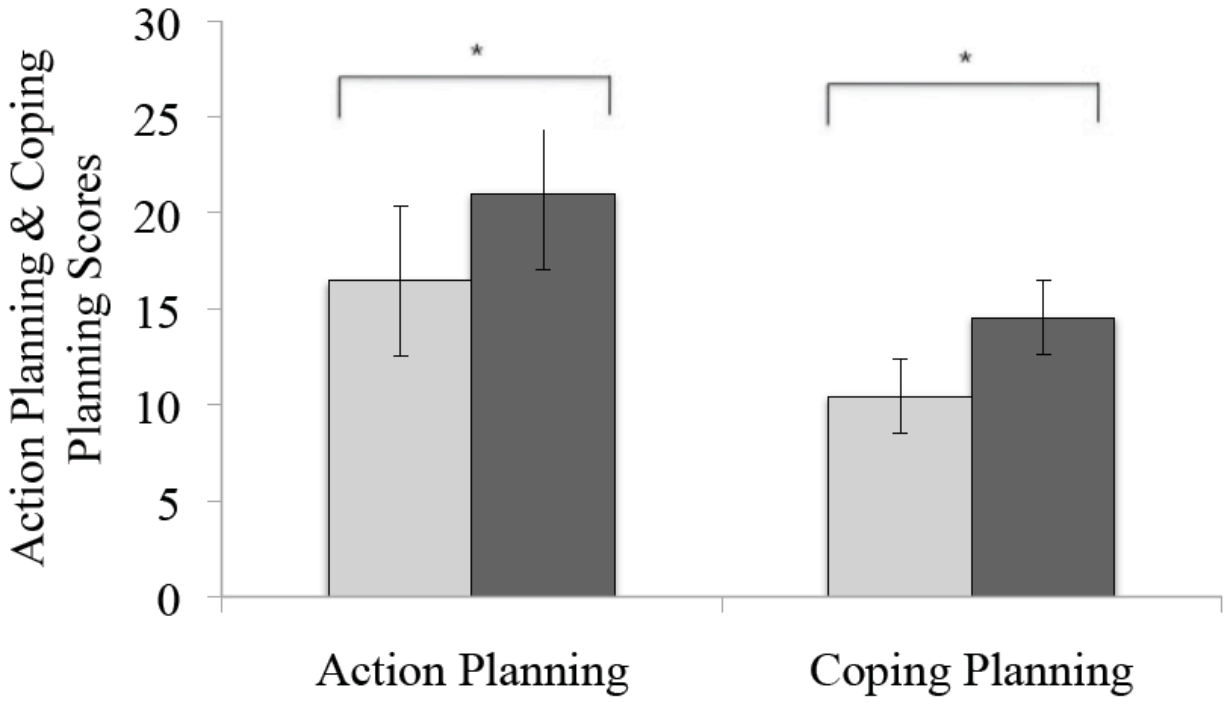
Variable n=11	Baseline mean (SD)	6 Weeks Follow-Up mean (SD)
Action Planning*	16.45 (5.66)	21.00 (1.79)
Coping Planning*	10.45 (3.93)	14.55 (1.92)
Coping Self-efficacy	32.55 (6.59)	34.45 (4.11)
Intentions	11.73 (2.20)	12.0 (1.61)
EQ-5D-5L◆ (HRQOL)	7.05 (1.19)	8.0 (1.00)
SPPB◆◆ (0-12)	7.91 (3.02)	8.73 (2.41)
TUG◆◆◆	13.95 (6.12)	12.33 (4.10)

◆ EQ-5D-5L Health related quality of life, measured by visual analogue scale.
◆◆ Short Physical Performance Battery 0 (worst performance) to 12 (best performance).
◆◆◆ Timed Up and Go
* ≤ 0.05

4.2.2.2 Coping Planning

Participants' coping planning abilities significantly improved over the course of the exercise program from baseline to six-week follow-up ($z = -2.502$, $p = .012$). Therefore, 8 of the 11 participants improved their coping planning score, 2 participants demonstrated a decrease in their coping planning scores and 1 participant tied their score. Mean [SD] coping planning scores are can be found by referring to Table 9 and this significant difference is also illustrated in Figure 6.

Figure 6. Significant Within-Group Differences in Action Planning and Coping Planning Scores



Light bars represent baseline measures and dark bars represent follow-up (six-week) measures. (Significant within-group difference ≤ .05)

4.2.2.3 Coping Self-Efficacy

No significant within-group difference in the participants' coping self-efficacy scores at baseline and six-week follow-up were observed ($z = -1.667$, $p = .095$). Six out of the 11 participants increased their score. Three out of the 11 eleven participants had a decreased score at six-weeks and 2 participants tied their scores. Mean [SD] coping self-efficacy scores can be found by referring to Table 9.

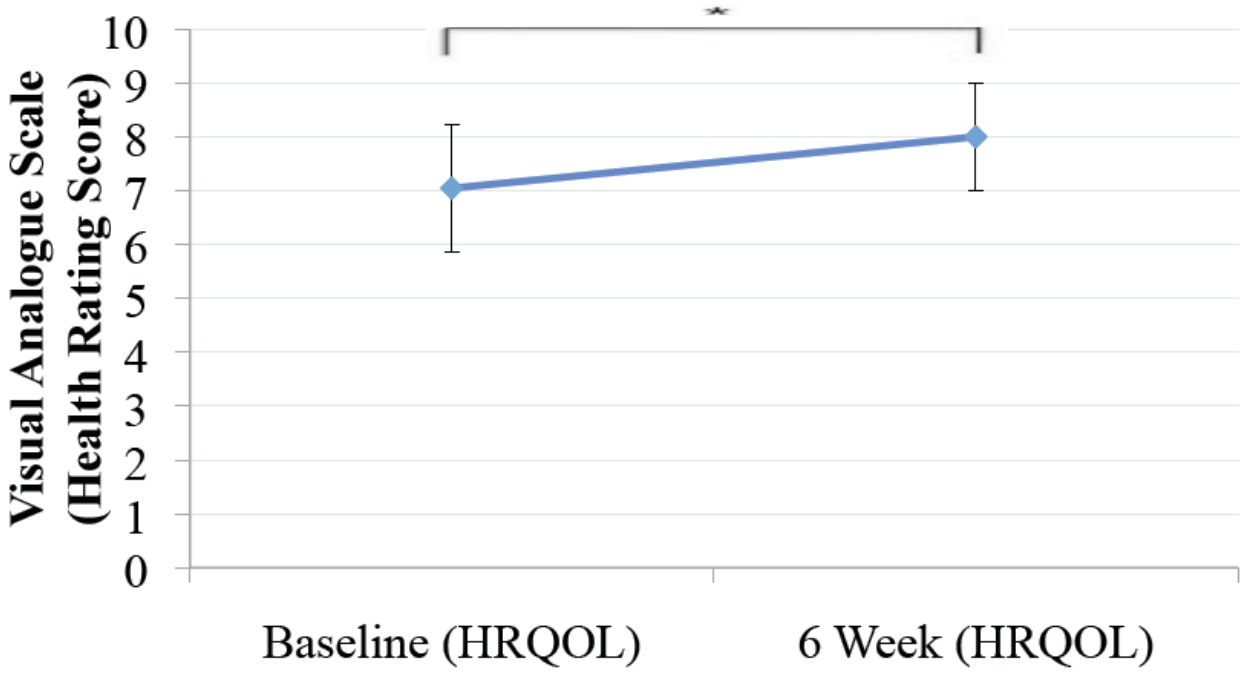
4.2.2.4 Intentions

No significant differences were observed in the participants' intentions to engage in physical activity at baseline and six-week follow-up ($z = -.531$, $p = .595$). Three of the 11 participants increased their intentions score. Three of the participants experienced a reduced exercise intentions score and 5 participants had a tie of their intentions score at six-weeks. Mean [SD] intention scores can be found by referring to Table 9.

4.2.3 Secondary Outcome Intervention Effects: Health Related Quality of Life

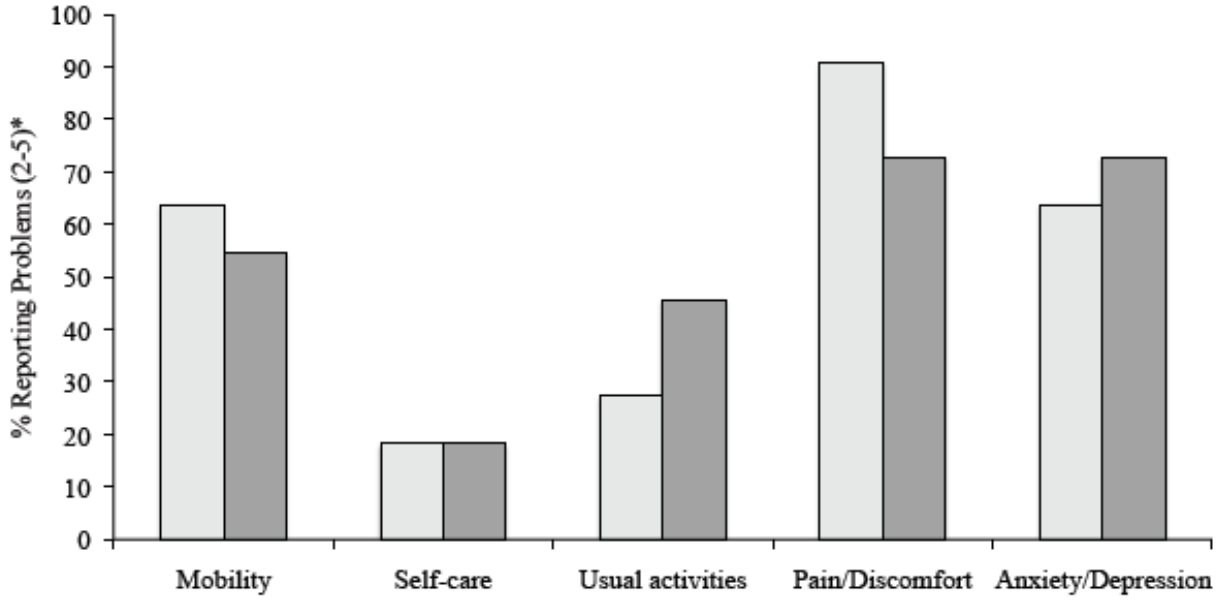
The Wilcoxon sign rank test demonstrated a significant within group change in the participants' health related quality of life assessed by the EQ-5D-5L visual analogue scale (VAS) ($z = -2.565$, $p = .010$). Mean [SD] of the visual analogue health related quality of life scores are reported in Table 8 and this significant within group difference can be observed by referring to Figure 7. The proportion of participants reporting problems (participants that responded with a score between 2-5) in each domain of the EQ-5D-5L can be viewed in Figure 8.

Figure 7. EQ-5D-5L Visual Analogue Scale Score Baseline and Follow-Up (6 weeks)



Significant within-group differences (<0.05)

Figure 8. Proportion of Participants Reporting Problems in Each Domain of the EQ-5D-5L (score of 2-5).



Light bars represent baseline measures and dark bars represent follow-up (6 week) measures

4.2.4 Functional Outcome Measures (Short Physical Performance Battery)

A significant within group difference in the Short Physical Performance Battery (SPPB) scores was observed ($z = -2.041$, $p = .041$).

5.0 Chapter 5: Discussion

5.1 The PEPTEAM (Prescribe Exercise for Prevention of Falls and Fractures) Exercise Program: Summary of Findings

This pilot study examined if a six-week interdisciplinary intervention consisting of an exercise plus a behavioural counseling component would increase the physical activity levels of older adults who are at high risk of falls or fractures. The primary research hypothesis that this six-week tailored exercise program based on key components of the Health Action Process Approach Model and implemented within a primary care setting would result in positive changes in the participants' physical activity levels measures by an increase in high-light and moderate-to-vigorous physical activity intensity thresholds was not supported. Likewise, the secondary research hypothesis that an average adherence level of at least 70% would be obtained from this program was not supported. However, the hypotheses related to the specific psychological variables of the HAPA model were partially supported; there were significant improvements in the action planning and coping planning abilities of the study participants. Although significant changes were not observed in the measured physical activity levels, the ability of our program to positively influence constructs that are theoretically linked to behaviour change is promising for future attempts to alter activity levels in this population. In addition, improvements to health-related quality of life were observed. The results of this study provide support for future work.

5.1.1 Feasibility Discussion of Findings

A major strength of our study is the implementation of an intervention that combines risk assessment and behavior change counseling with exercise instruction targeted to at-risk individuals in a clinical setting. To conduct future work in this area, it is necessary to determine if this novel approach is feasible to be delivered in a busy clinical setting. There has been a lot of previous work conducted in primary care that has incorporated the use of a physical activity

counselor only or provided an exercise prescription but few that use both or that have incorporated the targeting of the specific psychological variables: action planning, coping planning, coping self-efficacy and intentions that we have in this program (17,21,120,135,136,158,171). In the current study we have incorporated a kinesiologist as a physical activity counselor to not only counsel but to attempt to strengthen key behavioural constructs and elicit the use of a tailored exercise prescription in order to observe the influence that these components have together on activity levels. The unique intervention design makes it is difficult to compare with studies that are similar to ours however, components of the current program have been used before and will be used when discussing the feasibility of this program in the following sections.

The PEPTEAM exercise program was able to recruit fifty percent of eligible participants and retained one hundred percent of the sample at six-week follow-up. In a prospective cohort study targeting frail older adults in primary care it was found that 89% of those screened took part in the exercise program (172). Key differences in this study compared to ours was that it was a large multi-center randomized controlled trial that provided an individually tailored progressive exercise program following referral from a family physician but did not incorporate a behavior change component (172). Certainly this is higher than our recruitment of 50% but in line with our findings, the study demonstrated that an exercise program delivered in primary care could successfully recruit frail older adults (172). This is especially important in the context of this larger study demonstrating that it is feasible to recruit in this population. Short-term retention for this study was impressive when compared to that seen in previous work that implemented a randomized controlled trial of physical activity counseling for older adults in primary care (173). In that study, only 83% of participants attended second visits, 78%

attended the third visits. However, it is important to make note that most of the previous studies have been randomized controlled trials with larger sample sizes and longer program durations. Therefore, in that type of design with a large sample of participants it is not likely that one hundred percent of would be retained. The small sample size and relatively short program duration of six-weeks likely resulted in our ability to retain all of our participants. Way of achieving good retention has previously involved encouraging participants to remain in a study for the full duration by developing relationships and maintaining contact (174). In line with those recommendations, this study provided many opportunities for the researcher to develop close relationships and maintain regular contact with study participants. Further, the ability to maintain regular contact with the participants in this study was a direct result of the design of the intervention, which consisted of multiple visits administered by members of the health team. Additionally, the quality and quantity of time spent with each participant was considerable as each visit lasted at least one hour in length and each phone call about twenty minutes each. Therefore, it is likely that the tailored components of our intervention can explain the impressive retention demonstrated here. When making recommendations for future work the issue of maintaining good retention is an especially salient. Maintaining good retention is an especially important concern for randomized controlled trials as poor retention can affect the validity of the study and lead to inconclusive findings (175). It is recommended that future work allow for sufficient opportunities for interaction to occur between the researchers and participants especially if the study is conducted within a clinical setting. Another important aspect of the current program was the use of a nurse to complete the screening of patients for the study. The use of a nurse on the family health team for the recruitment of participants was important, as we were able to screen patients over the age of 65 from participating physicians in a feasible way

prior to their scheduled appointment. This process was feasible in a busy clinical setting as the screening process took limited time prior to each appointment and was able to identify at-risk patients without taking up physician time. This enabled at-risk patients to be identified and also removed some of the burden from physicians who were simply asked to identify if it was safe for the patient to participate in the program. According to the physician and patient feedback surveys, the exercise intervention was well received by the physicians. The physician time commitment was reduced thereby targeting an identified barrier to physicians recommending exercise (20). It is possible that some patients were missed in the screening process. However, to our knowledge the best attempts were made to capture all potential patients who were scheduled for appointments during the recruitment period. The importance of incorporating a nurse has also been identified in a previous clinical trial by McKinney et al, who stated that the involvement of a nurse was responsible for increasing the recruitment and retention rates of their study (176). Therefore, it would be useful for a future trial to also employ the use of a nurse to screen patients if recruiting from a clinical population. Suggested strategies for enhancing retention have included lowering some barriers that participants might face like transportation difficulty, time availability and collecting data in a convenient location (175). In the present study, some of those suggested strategies were used as the participants were only asked to attend the clinic for two visits with the rest being conducted in the home environment, thereby reducing the burden to the patient. Having some of the visits conducted in home was particularly advantageous for participants who had difficulty with transportation or relied heavily on family members to get to appointments. By reducing the barrier of transportation for some of the participants this may have also played a key role in the short-term retention and lends further support to the use of the recommended strategies for improved retention in a future study.

The use of an interdisciplinary team is an evolving strategy for primary care, and may be an effective way to deliver preventative care programs. Referring patients to a physiotherapist to have the exercise prescription administered and a kinesiologist deliver the behavioural components reduced physician burden and addressed physician knowledge gaps in exercise prescription, another identified barrier to physicians recommending exercise (22). A memory clinic based on a similar model of interdisciplinary care and implemented in the same clinical setting as the PEPTEAM program was also well received by physicians (177). Specifically, this study demonstrated that this program could enhance the management of dementia in primary care (177). Only 7.8% of patients were referred to a specialist (177). Therefore, providing interdisciplinary programs like ours for physicians to refer patients to may be feasible and acceptable among clinic staff. In accordance with the HAPA model, implementing the intervention in primary care may have increased the credibility of the program since it was recommended by family physicians. Consequently, this may have contributed to strengthening the patients' risk awareness. Having the physiotherapist provide instruction on how to do the exercises and working with the kinesiologist to form strategies to overcome barriers may have enhanced the participants' task self-efficacy. It is possible that observed improvements in the participants' quality of life may be due to a greater confidence in performing exercise than they had previous to the intervention, but they also may have experienced a greater perceived control over their risk of fall or fractures.

A short-term self-reported adherence of 52% percent to the tailored exercise recommendations was observed. Previous work confirmed that this level of adherence is comparable to that of other multidisciplinary fall prevention programs (178-181). However, it is important to note that there was a lot of variability in the adherence rates of fall prevention

programs which tend to range from 27% to as high as 93% further suggesting that our adherence rate is comparable to some but not as strong as others (178-182). In a review of fall prevention programs Di Monaco et al, attributed the variability seen in adherence rates to be due to the use of different study populations and varying characteristics of interventions (181). It is also difficult to compare our adherence to that of multidisciplinary interventions because of varying study durations and how adherence is measured and defined in previous work. In our study, 100% adherence was defined as the completion of all prescribed exercises each week and was measured using the self-report activity logs. Initially, an adherence rate of seventy percent was stated *a priori* in to define a favourable adherence level for this program based on what had been previously demonstrated (141). Not obtaining this adherence level may partially be explained by the sample characteristics. Many of the participants presented with medical complications or co-morbidities and in theory this may have affected the adherence to the prescribed exercises. Medical complications that arose during the program included the development of gout, fibromyalgia pain in one participant, an ankle sprain, a fall and a minor day surgery requiring a few days recovery time. None of these events were associated with the exercise intervention but likely impacted the participants' ability to maintain their weekly or daily exercises thus influencing the overall adherence to the intervention. One way to compensate for this in future work would be to ensure that sample size calculations account for the fact that medical complications may create problems with attrition or adherence and consequently reduce the ability to observe an effect of the intervention. Given the small sample size used in this study, it was easily observed that the individuals that did not adhere to the program were also the same individuals that experienced health complications requiring time away from their activity. Therefore, a larger sample size would be advantageous, as it could modify the strength of these

events on the overall program adherence. It might also be important to address specific health conditions when targeting coping planning in a future study as these individuals would be presenting with unique barriers to exercise.

An important recommendation for a future trial would be to implement an individualized exercise log. In the current study, a standard activity log was used for all participants APPENDIX C: Physical Activity Log. However, in the context of measuring adherence this design presents some challenges. Part of the reason for the poor adherence may have been that the participants did not understand the logs because they did not understand the categories of exercises, so in future a simple log designed to capture yes/no they did them would be helpful. Further, future work should use a separate, validated tool to capture physical activity levels if this is the desired outcome. Another important consideration is that only 63.6% of participants filled out the activity logs for all six-weeks. It is important to identify strategies for handling missing data *a priori*. If this program was implemented as a large trial, it would be important to ensure that the exercise log contained some way of verifying whether participants did not report any activity because they did not adhere to the exercise and or if they forgot or did not want to complete the log. Some strategies to manage missing data would be to assume no activity or use the last observation carried forward technique (LOCF). Failure to appropriately address missing data could significantly screw the reporting of adherence in a large randomized controlled trial (183).

5.1.2 Physical Activity Discussion of Findings

There were no significant changes in the physical activity levels in any of the intensity categories of the eleven participants. There are a few explanations for these findings. Firstly, the small sample size of this study reduced the statistical power to detect any significant intervention

effects. Another explanation for these findings may be related to the heterogeneity of the sample. The participants that demonstrated positive improvements in their activity levels appeared to be those that entered the program with significantly limited functional capacity and more complicated co-morbid conditions when compared to the 'healthier patients' in our sample. It was also evident that those participants that did not improve and in some instances actually had a reduction in activity levels were also many of the same participants that scored high on the Short Physical Performance Battery (Figure 5). It is therefore quite possible that this intervention may not have sufficiently challenged them and may in some instances actually deterred them from their normal activity. Although there was no overall effect on physical activity levels, some participants may have shown a slight improvement. This may be encouraging as previous work by Bumen et al, demonstrated that even modest increases in physical activity specifically in the low-light intensity and high-light intensity thresholds can have a significant positive effect on the health of older adults (168). Interestingly, a recent study by Aoyagi et al, reported that if individuals' physical activity levels could be improved by a single accelerometer rank score, it is likely that there would be a significant reduction seen in medical care costs, and further suggested that this information could be used to justify investment in preventative programs (184). Taken together, these results suggest that although we did not see significant changes in the physical activity levels of all participants, small individual improvements in activity from baseline to follow-up may have had a profound effect on the health of those participants. When planning for a future trial one should aim to further restrict the sample to obtain a less heterogeneous group of participants with respect to baseline activity levels. Specifically, the current exclusion criteria 'participation in a similar exercise program including strength training 3 or more times a week' should be modified to 'participation of any structured exercise 2 or

more times a week'. Many of the active participants may not have engaged in strength training but certainly engaged in other structured activities like bicycling and running 3 or more times a week. Using 2 days a week as a cut off rather than 3 days is also advisable, as it is well known that the majority of older adults are not sufficiently active and therefore using 2 days a week as a cut off would enable the capturing of the least active individuals (115). However, it was observed that some of the individuals that were included in this sample may have engaged in exercise fewer than three times a week but the type, intensity and quality of that activity far exceeded the individuals' activity levels who did not engage any form of activity and whom presented with significant mobility issues and other health complications. Altering this aspect of the exclusion criteria would maintain the representative nature of a clinical population but enable better the targeting of patients who need intervention.

The use of an objective measure of physical activity is one way of overcoming some of the problems with self-report assessments (160). However, there are a few limitations with the use of accelerometers, that need to be acknowledged and may have contributed to our inability to detect changes in activity. The participants in the current study were asked to wear the device for a full day excluding sleeping or showering but some participants reported that the device worn on the hip interfered with some daily activities like napping. The selected site of the accelerometer for this project is an important consideration as previous studies have used locations such as the ankle, hip and elbow with some implementing the use of all three sites (ankle, hip and elbow) for greater precision (185). The hip was selected because of its ease of implementation as it can be hidden in a belt under clothing and is the closest location to the center for mass. Although wearing the accelerometer on the hip provides an objective assessment of physical activity, there are some issues with the hip site that are especially salient to an older

adult population and need to be considered when interpreting why no change in activity was observed in the present study. The specific accelerometers employed for use in this study could not be worn during water activities (115). The inability to capture water activity is an important consideration as two of the older adults in this study participated in aqua-fit classes. Another activity that is not adequately captured by the monitor is bicycling (115). Indeed, one of the participants in this program engaged in fairly heavy bicycling as their primary form of exercise and this activity was also not adequately captured. Other limitations that need to be kept in mind is that the device can malfunction or fall off of the individual (186). In the present study, this was likely the case, as some of the participants presented with data consistent with device malfunction or recording issues. A review by Garatechea et al, on the methodological issues related to accelerometers identified that aging effects in the cognitive and physical health of older participants could affect compliance to accelerometer protocols (185), such as putting the devices on properly, charging them properly or wearing them properly possibly influencing the observed activity levels. Earlier work has demonstrated that when using accelerometers with older adults, there may be a greater likelihood of cognitive difficulties affecting their recall ability to follow protocol directions presenting a skill limitation that needs to be considered in this group (187). Accelerometers are also more costly to buy and implement when compared to self-report assessments especially if funding is a consideration for future work. Most of the cost is related to purchasing them, analyzing the data and the time required to demonstrate how they work to participants. The implementation of the monitors required travelling to the participants' home and requesting that they wear the monitor for four full days (three weekdays and one weekend day). Previous work has suggested that three days is sufficient to capture physical activity levels in older adults but this project utilized four days in order to capture three

weekdays with the additional of one weekend day to get a good approximation of the typical participants' activity level (188). Obtaining four days of activity was especially advantageous for the present study as some recording issues with the monitors were experienced. In some cases only three out of the four days were captured and an average minutes/day was reported in each threshold category over total minutes/day. Consequently, device malfunction or recording issues could have influenced our ability to detect changes by missing activity.

Inherent limitations also exist when measuring physical activity via self-report. The participants may have been especially concerned with over-reporting their activity levels to provide what they might perceive as a more socially desirable level of activity. Due to the numerous study visits and follow-up calls, a relatively close relationship was developed between the researcher and the participants. As a result, the participants may have felt especially accountable to the researcher whom also served as the physical activity counselor and this may have further prompted them to report more desirable activity levels. Another issue with the self-report assessment of physical activity may be the presence of a recall bias. During the program, many of the participants experienced changes in their health status as a result of a new diagnosis, routine day surgeries, or the presence of painful conditions like gout occurring during the duration of the program, which is a typical when working with clinical populations. As a result, some individuals admitted to the researcher that they had gotten behind in their daily recording of activity and this may lend some question to the accuracy of their memory of daily activities. It is clear that the presence of a recall bias is an important consideration for self-report activity as previous work found that the recall of self-report is considered to be a challenging cognitive task (189). Further, it is important to note that individuals with mild cognitive impairment were not

excluded in the study and this may lend further to question to the accuracy of the participants' memory of activity especially if previously identified as a challenging cognitive task.

It is clear that there are inherent limitations associated with both objective and self-report assessments of physical activity. However, each offers unique characteristics and when used together can enable one to attempt to account for some of the limitations of each. For example, although self-report assessments provide no approximation of exercise intensity, participants in this pilot were able to record the type of activities performed in order to assess adherence highlighting the importance of both types of assessments to this program. The difficulty in comparing objective and self-reported physical activity is evident, as self-report measures are only modestly correlated with objective measures like accelerometers (169). Likewise, a study by Prince et al, assessing direct and self-report assessments of activity in adults found that the two types of measures were weakly correlated (190). Therefore, the assessments should be treated as complementary to each other.

5.1.3. Psychological Constructs and the Health Action Process Approach Model

According to the Health Action Process Approach (HAPA) model, action planning, coping planning, coping self-efficacy and intentions should influence a health behavior change and in the context of this program one would expect to see an increase in the physical activity levels of the older adults (191). In a review of several health behavior change models, the HAPA model was found to be the best predictor of intentions and in most of the included studies in the review, intentions themselves in addition to the constructs that predict them were found to be strong predictors of behavior (192). The four specific psychological constructs were targeted as they have been demonstrated to be especially influential to older adult behavior (150,155,156,193). Further, other key components of the HAPA model such as risk perceptions

were targeted by our program via the family physician identifying and conveying to their patients that, “they feel they are at risk of a fall or a fracture” and would recommend that they are referred to the PEPTEAM exercise program. Task self-efficacy was likely targeted through the physiotherapist demonstrating the prescribed exercises and outcome expectancies were likely enhanced as the participants were informed that the program aim was to prevent falls and fractures. As a result, the participants should have entered the post-intentional stage of the HAPA model following referral to our program. Given that there were significant within-group differences in action planning and coping planning abilities, which the model suggests are instrumental in mediating the intention behavior gap, we should have seen a change in activity. The ability of this exercise program to elicit changes in action planning and coping planning abilities provides some support for the strength of this intervention especially when following the model to guide the prediction of behaviour. Even though no significant changes in physical activity levels were observed, the significant improvements in action and coping planning abilities are promising for trying to change activity levels in future work according to the fundamental principles of the model. A number of potential explanations were previously mentioned that may have influenced the ability to detect changes in activity levels. However, if a larger future trial is able to address some of those concerns using the model to guide the prediction of behavior, we may be able to see a change in activity. It is important to keep in mind that the goal of this project was not to test the effectiveness of the HAPA model but rather to use it as a guiding framework to inform the development of an intervention aimed at influencing physical activity behavior in this group of older adults at high risk of falls or fractures. Importantly, a recent Delphi study was able to identify phase-specific determinants of physical activity among older adults, which included the initiation, and setting of goals using things like

implementation intentions (action planning), which is a key component of the HAPA model (155). In our study, we were only able to identify a significant within-group change in action planning and coping planning however, the other psychological variables namely coping self-efficacy and intentions did appear to change in the hypothesized directions. Therefore, one would wonder if a large trial is needed to determine whether the combined intervention is effective for eliciting changes in action planning, coping planning, coping self-efficacy and intentions.

5.1.3.1 Action Planning

Significant within-group differences were observed in the participants' abilities to engage in action planning (when, where and how to engage in exercise) behaviour. This finding is consistent with other work which demonstrated significant changes in action planning, coping planning and increased physical activity levels in a cardiac rehabilitation using a similar method of working with participants to create action plans and coping plans (156). Cardiac rehabilitation patients who received the combined action planning and coping planning increased their physical activity more than individuals who only received the action planning (156). This emphasizes the importance of both of these constructs in eliciting behavior change (30). It has also been suggested that the incorporation of action planning to interventions may help to improve adherence (156,193). In our study, time was spent with the participants to assist them with the location of where they would perform the prescribed exercises, what time of the day they were most likely to perform the exercises and demonstrating how to properly complete the exercises to strengthen action planning. However, due to the poor adherence to the program, it is possible that more time is required to see the positive influence of action planning on adherence that was previously noted. Action planning has been deemed to be an important component in

increasing physical activity levels and predicting action by mediating the intention-behavior relationship (120,194). Further, the effectiveness of planning, as it relates to older adults has been demonstrated by Reuter et al, who suggested that the importance of planning on the intention-behavior gap may increase with age, and using plans to translate goals may be an adaptive strategy adopted by older adults whom may perceive their time to be limited and this provides support for incorporating action planning into interventions targeting older adults (195). Another study by Latimer et al, demonstrated that individuals with spinal cord injury who participated in an eight-week intervention with implementation intentions (action planning) found that those who formed implementation intentions tended to engage in more activity and followed through with their plans (196). However, our study differed in the population used and the study duration of six-weeks compared to eight. Importantly, our study also demonstrated improved action planning suggesting that a six-week duration may be sufficient to target action planning and coping planning but a longer duration may be required for the other psychological variables.

5.1.3.2 Coping Planning

Coping planning refers to the individual's ability to plan ahead in order to overcome certain barriers that one might encounter when engaging in a new behavior (33). Certain barriers like difficulty with transportation lack of money and knowledge of which exercises to do and how to do them properly are especially salient to older adults (115). A key component to this exercise intervention was reviewing coping planning with the participants in addition to the motivational interviewing. Throughout the program, as the participants encountered challenges or difficulties adhering to the prescribed exercises, the review of coping planning during the scheduled visits and phone calls was able to address and target these challenges thus equipping

individuals with practical strategies for overcoming barriers and adhering to their exercise plans. One example of this type of strategy was working with a participant to develop a stair-climbing plan in an apartment complex in the event that the weather was poor. The kinesiologist was also responsible for modifying the exercises if they were too challenging or if the participant was having an exceptionally difficult time completing the exercises. During the in-home visits, the kinesiologist targeted barriers in the home setting. For example, some of participants required modifications and the use of a towel was recommended by the physiotherapist in order to make the postural exercises more accessible for participants presenting with a severe kyphosis. The kinesiologist provided feedback to the participants ensuring that the exercises were being performed correctly after the physiotherapist provided them. As a result, the assistance with exercise equipment better enabled the participants to overcome a common barrier to exercise, which is a lack of knowledge or confidence on how to properly perform the given exercises. Finally, this program was offered at no cost to patients referred and was offered as a clinical service that would not likely be offered at no cost if run through community programs. Therefore, the common barrier of cost for exercise programs was eliminated likely contributing to the improvement in the coping planning skills. The improvements demonstrated in coping planning are in line with other work that has found planning to be an important predictor of behavior (195). Increased physical activity levels attributed to improvements in coping planning have been previously been demonstrated using a similar protocol (156,194).

5.1.3.3 Coping self-efficacy

With regard to the psychological construct of coping self-efficacy no significant within-group changes were observed. This finding is in contrast with previous work, which found that individuals with spinal cord injury who engaged in action, and coping planning had improved

barrier self-efficacy (coping self-efficacy) following the intervention (197). In this case however, it is possible that the sample size affected the strength of these results since we did see the coping self-efficacy abilities change in the hypothesized direction. Another factor may have been that the six-week length of the program was insufficient to adequately alter participant coping self-efficacy. In fact, one study found that barrier self-efficacy (coping self-efficacy) had only a small mediating effect on physical activity at six weeks (198). Consequently, a longer study duration may be required to optimally detect changes in coping self-efficacy in addition to using a more population specific self-efficacy questionnaire.

5.1.3.4 Intentions

We did not see any significant within-group differences in exercise intentions. As with other outcomes, the study was not powered to detect meaningful changes in intentions. Additionally, the program length of six-weeks may not have been long enough to elicit a meaningful change in intentions. According to the HAPA model, intentions have a strong influence on behavior (199). It is possible that the intentions of the participants were already fairly high as they agreed to sign up for the exercise study and therefore it could be difficult to further improve their intentions. However, it is important to keep in mind that the participants of this program were referred to via the family physician, and those that agreed to participate may have had higher than expected intentions because of volunteer bias. Given, that we did not see significant changes in physical activity, the lack of a significant change in exercise intentions may contribute to the explanation for this. Intentions are also closely related to planning and vice versa. Weidemann et al, found that planning was important in mediating the intention behavior relationship but this was only the case when the individual held sufficient intentions (200).

5.1.4 Health Related Quality of Life

Our intervention resulted in a significant increase in health-related quality of life. However, the magnitude of this result is questionable given that this was a secondary outcome and the study lacked power to adequately detect a meaningful change. It is possible that the participants felt more in control of their health condition thus feeling like they were reducing their overall risk of suffering a fall or fracture by completing the prescribed exercises. Further, as a result of the motivational interviewing coupled with the targeting of the key psychological constructs from the HAPA model, there may have been a strengthened sense of empowerment as the participants were provided with tools to help them overcome some of the barriers associated with engaging in regular physical activity. Latimer et al found that those who engaged in an implementation intention (action planning) intervention demonstrated greater confidence in the scheduling of activity and had sustained motivation (196). The benefit of exercise interventions to quality of life has been well documented (201-204). Several studies done on older populations and at risk groups like osteoporotic women have noted improvements in participant quality of life as a result of home based strength and balance training (201-204). Therefore, this significant improvement in health-related quality of life, although a secondary outcome could be especially salient and meaningful to the older adult population.

5.2 Study Limitations

A few limitations of this study need to be acknowledged. The primary limitation of this study is the small sample size of eleven patients. This significantly limits the strength of the study findings specifically, the ability to assess the true effect of the intervention. However, given that this was a pilot study the use of a convenience sample was an initial way to assess the feasibility of this intervention in a cost-effective way before running a large trial composed of many participants. Another limitation of this intervention was the short study duration. As this

was a pilot study the program length was adequate to determine program feasibility. However, the study duration may have contributed to an intervention failure, where we were not able to adequately target all of the psychological constructs in the 6-week duration. It is likely that a longer time period would have allowed for the incorporation of stronger outcomes such as falls or fractures that could better assess the impact of the intervention if we were interested in determining if this type of program prevents falls and fractures in future. These types of outcomes would not have been appropriate to use in a short program, as changes in these outcomes would not likely occur over this duration. The use of accelerometers to objectively capture physical activity is accompanied by certain limitations, which have been previously outlined. Likewise, the self-report physical activity logs were also subject to an information bias, specifically a reporting bias with the participants likely over-reporting the completion of the prescribed exercises and a recall bias where issues with memory may have resulted in the under-reporting of activity for some participants. A recall bias could have also been present due to the repeated measures design of the study with the possible presence of practice effects given that participants completed the same assessments/questionnaires at six-weeks. The influence of information biases could have a tendency to bias the results toward the null hypothesis. Consequently, this would affect the internal validity of the study. Finally, it is possible that the patients who agreed to be in this study were more self-motivated and engaged in their health care than those who declined participation. This may represent a slight volunteer bias, which would have an effect on the external validity of the program.

5.3 Recommendations and Lessons Learned for Future Work

Important recommendations and practical suggestions to improve a future multicenter randomized controlled trial were generating from this pilot. Table 11 summarizes a number of

identified issues and proposed solutions that came out of this work. This study was able to provide important estimates (means and standard deviations) that can be used to guide the implementation of future work.

Table 11. Summary of Identified Issues and Proposed Solutions for Future Work

Issue/Consideration	Proposed Solution
Maintaining good retention	Ensure intervention incorporates multiple visits & points of contact with research staff. Incorporation of a nurse to improve the ability to recruit & retain patients.
Increase the sample size	Ensure that a future power calculation adequately accounts for the variability of patient characterisitcs/current medical conditions. Restriction of the sample by modifying the exclusion criteria to better target at-risk patients.
Lack of detail in activity log	A tailored activity log should be designed during the exercise prescription to reflect the specific intensity, type and time of each exercise in addition to the reporting of min/day. This will improve the assessment of adherence.
If missing data	Standardized protocols should be put in place *a priori* to address missing data. Consent forms should clearly outline how data will be treated if the participant withdrawals from the trial. An indicator should be placed on the activity log to determine if 1) no activity occured 2) the particpant forgot/did not want to complete the daily log. A sensitivity analysis could be performed treating the data as zero (no activity) or employ the LOCF* technique if unsure of participant intention.
Cost of monitors/measure of physical activity	The cost of accelerometers should be considered and weighed against the advantages of their use. Self-report and objective assessments each provide unique information and should be used as complementary to each other to address the limitations associated with each.
Confounders	A future trial should use randomization, restriction or matching to reduce confounders during recruitment. During analysis, stratification, standardization or adjustment in multivariate models could be employed.
Outcomes	Outcomes like bone strength, muscle strength, balance or the incorporation of falls as an outcome or fractures as a primary endpoint could be captured with a longer study duration.
Short study duration	A longer study duration of at least 6 months to a year would allow for adequate assessment of the proposed outcomes.
Design	Use of a multicenter randomized controlled trial would allow for a large sample size, reduce bias and provide the best opportunity to properly assess the effectivness of the intervention and make strong conclusions.

*LOCF (Last observation carried forward)

5.4 Conclusions

The results of this pilot study suggest that it is feasible to recruit and retain older adults for a short-term program implemented in primary care that targets behavior change constructs, motivational interviewing and use of tailored exercise. Although changes in activity levels were not observed, the significant improvements in action planning and coping planning abilities provide some promising support for evaluating whether PEPTEAM can influence activity levels in a future trial. The incorporation of the aforementioned recommendations should enable future work to successfully carry out this kind of intervention on a larger scale. Careful consideration of the limitations and lessons learned from this study will allow for a stronger study of future preventative care interventions delivered in primary care.

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APPENDIX A
Recruitment Materials

Physician Referral Form

Prescribe Exercise for Prevention of Falls and Fractures:
A Family Health Team Approach (PEPTEAM)

Date (mm/dd/yyyy):

__ __/__ __/__ __ __ __

Nurse to insert patient label here only if they are to be referred to the program
(Only if box 1 has been checked off)

Step 2: Completed by physician

Please tell the patient:

1. You are at risk of falls or fractures.
2. I would like to refer you to our PEPTEAM program. The program is free. It includes a visit with our physiotherapist for assessment, a home exercise program tailored for you, and 2 follow-up visits with a kinesiologist.

Ask your patient if they would be willing to have someone contact them to describe the program in more detail. They can choose whether to participate at that time.

Please complete the following:

			Comments/Reasons for Not Referring
1.	The patient **is** interested in learning more about PEPTEAM & agreed verbally to us passing on their contact information to the researcher.	☐	
2.	The patient **is not** interested in learning more about PEPTEAM.	☐	
3.	I have chosen not to refer the patient to the exercise program (PEPTEAM).	☐	
4.	I did not have time or forgot to ask the patient about PEPTEAM.	☐	
5.	The patient is not eligible for PEPTEAM.	☐	

_____
Signature of Physician

Patient age _____; Patient gender _____ (to characterize those that do and do not participate)

Physician or Nurse Comments:

Questions? Contact Lora Giangregorio at lora.giangregorio@uwaterloo.ca, 519 888 4567 x 36357

Prescribe Exercise for Prevention of Falls and Fractures:
A Family Health Team Approach (PEPTEAM)

Step 1:

PATIENT SCREENING TO BE COMPLETED BY NURSE:

The patient is eligible if they:

- ☐ are 65 years or older: *insert patient age and gender on the referral form.*

Patients between 65-74 need to have at least one of the following:

- ☐ 2 or more falls in the past 12 months
- ☐ high risk of fracture (CAROC or FRAX)
- ☐ difficulty with walking or balance
- ☐ present with acute fall
- ☐ history of a fragility fracture after age 50

- ☐ Patients 75+ do not require any other eligibility criteria.

The patient will be excluded if they have any one of the following:

- ☐ moderate to severe cognitive impairment (cannot understand/remember instructions)
- ☐ moderate to severe neurologic impairment
- ☐ are not able to communicate in English
- ☐ exercise contraindications (e.g., uncontrolled hypertension)
- ☐ are palliative, current cancer or are on dialysis
- ☐ participate in resistance training at least 3 times a week

ACSM Contraindications to Exercise Testing

Absolute contraindications	Relative Contraindications
1. Recent significant change in the resting ECG suggesting infarction or other acute cardiac event. 2. Recent complicated myocardial infarction (unless patient is stable and pain-free) 3. Unstable angina 4. Unstable ventricular arrhythmia 5. Uncontrolled atrial arrhythmia that compromises cardiac function 6. Third degree AV heart block without pacemaker 7. Acute congestive heart failure 8. Severe aortic stenosis 9. Suspected or known dissecting aneurysm 10. Active or suspected myocarditis or pericarditis 11. Thrombophlebitis or intracardiac thrombi 12. Recent systematic or pulmonary embolus 13. Acute injections 14. Significant emotional stress	1. Resting diastolic blood pressure >115 mm Hg or resting systolic blood pressure >200 mm Hg 2. Moderate valvular heart disease 3. Known electrolyte abnormalities (hypokalemia, hypomagnesemia) 4. Fixed-rate pacemaker (rarely used) 5. Frequent or complex ventricular ectopy 6. Ventricular aneurysm 7. Uncontrolled metabolic disease (e.g., Diabetes, thyrotoxicosis, or myxedema) 8. Chronic infectious disease (e.g., Mononucleosis, hepatitis, AIDS) 9. Neuromuscular, musculoskeletal, or rheumatoid disorders that are exacerbated by exercise. 10. Advanced or complicated pregnancy

Questions? Contact Lora Giangregorio at lora.giangregorio@uwaterloo.ca, 519 888 4567 x 36357

Recruitment Script

Primary Investigators:
Dr. Lora Giangregorio
Carly Skidmore
Symron Bansal

Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach

University of Waterloo

[insert DATE]

Dear _____, (patient name inserted)

My name is Carly Skidmore, I am a kinesiologist and I am calling from the University of Waterloo. Recently, you were referred to an exercise program by your family physician and you indicated that you were interested in participating. We are conducting a pilot study on the exercise program that will take place at the Center for Family Medicine, Victoria Street site. The research will examine if this type of exercise program delivered in a primary care setting is effective at influencing physical activity levels. We are also interested in gathering information about the timing and acceptability of our assessments by a physiotherapist and the feasibility of delivering this exercise program in a clinical setting. We will use the results of the study to inform future research and the development of an exercise program for persons at risk of falls or fractures and with other health conditions like osteoporosis.

This study will consist of a six week individualized exercise program that will be specifically tailored and designed to meet individual needs. The exercise program will be designed by a physiotherapist and will be implemented through a health care team consisting of your family physician, a physiotherapist, Alexandra Ilich and a kinesiologist, Carly Skidmore. You will receive an assessment from the physiotherapist and this will be used in the design of your exercise program. We will provide you with full instructions and demonstrate how to safely perform your prescribed exercises at home. We will measure your level of physical activity and responses to the study questionnaires at the beginning of the study and during the final assessment at week six. We can provide you with all of your results if you wish. This exercise program will also allow a university graduate student to complete a research project. If you are interested in participating, you will be asked if you wish to participate in any of the following assessments. If you decide to participate, you can choose if you agree to have your results used for research. The assessments include:

- the completion of questionnaires about planning, exercise intentions, and quality of life. Additionally, you will be asked to fill out a short questionnaire pertaining to your medical history. These questionnaires will be completed during your first in-home visit. You will also be asked to record your daily activity in an activity log book.

- You will be asked to wear an activity monitor on your hip for four days at home at the beginning of the study and for four days at the end of the study.
- You will be asked to attend a 1 hour session with a physiotherapist to have an assessment and receive your tailored exercise program. You will also receive a demonstration and safety instructions for each exercise. The assessment will consist of a test for lower body strength, a balance test and walking tests. You will also visit the physiotherapist during the final week of the study and complete the previous assessment in order to provide follow-up measures.
- One week after your session with the physiotherapist you will receive a phone call from a kinesiologist who will address any questions/concerns you may have about your new exercise routine. The kinesiologist will also address aspects of action planning, and work with you to manage barriers and help you to create a plan for your exercise routine. You will also book an appointment with the kinesiologist at the clinic which will serve to review the exercises and modify them to you accordingly.

To participate, you must be over the age of 65 years, be a patient from the Center for Family Medicine, able to understand English, experienced 2 or more falls in the past 12 months, and have difficulty with walking or balance as determined by your attending physician.

All measurements will be obtained by trained researchers under the supervision of Dr. Lora Giangregorio. No financial remuneration can be provided for your participation. All information you provide will be confidential. Your name will be replaced by an identification code. You can stop participating at any time without having to give a reason. A decision not to volunteer or to withdraw from the study after you have enrolled will not have any impact on how you are treated or the care you receive at the Center for Family Medicine. If you decide that you do not want to have any of your data collected for research purposes but would still like to be offered the exercise program, you will receive all of the same services but will not be asked to complete the study questionnaires, wear the activity monitor or record your daily activity. If you have any questions about the study or the assessments you can contact Lora Giangregorio at 519 888 4567 x 36357.

Your participation in the research will help us design better research studies and exercise programs for individuals with the aim to prevent falls and fractures. Thank you for your consideration.

Sincerely,

Lora Giangregorio

This study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. If you have any questions regarding your rights as a research participant, you may contact: Dr. Susan Sykes University of Waterloo Research Ethics Board at 519-888-4567, x 36005, ssykes@uwaterloo.ca.

Refusal Questionnaire

Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach

REFUSAL QUESTIONNAIRE

Script:

"We appreciate you considering the opportunity to participate in our research project. We understand that you prefer not to participate however, it is important for us to know whether the people who are interested in our exercise program as well as those who choose to participate in our study differ from the people who don't. We are wondering if you would mind answering 9 brief questions about your age, gender and medical history. Your name or any identifying information will not be used with this information. You can skip questions you do not wish to answer. Refusing to answer these questions will not have an impact on the care you receive at the Center for Family Medicine. Would you be willing to let me ask the questions?"

1. Do you currently exercise 3 or more times per week?

❑ yes
❑ no

2. What for you is the biggest barrier to participating in exercise?

❑ I don't know what exercises I should do or how to do them properly
❑ I don't have space or equipment for exercise.
❑ I am fearful of doing exercise.
❑ I don't have time to exercise.
❑ I don't like exercise.
❑ I can't afford to pay for classes or instruction.
❑ I do not have access to transportation.
❑ Other: _____
❑ I do not face any barriers in participating in regular exercise.

3. Do you use a walking aid?

❑ Never
❑ Sometimes
❑ All the time

4. Have you been diagnosed with osteoporosis?

❑ Yes
❑ No
❑ I don't know

5. After age 40, have you ever fractured your hip, spine, wrist, or upper arm?
❑ Yes
❑ No
❑ I don't know

6. If yes, do you experience pain?
❑ yes
❑ no

If yes, would you say your pain is?
❑ Chronic, or always present
❑ Acute, only arising on rare occasions
❑ Sometimes present

7. How many falls have you had in the last year?
❑ One
❑ Two
❑ More than Two

8. What is your year of birth? ☐☐☐☐
Y Y Y Y

9. What is your gender? ☐ Male ☐ Female

Thank you for your help.

Participant Feedback Form

March 01, 2012

Dear participant,

I would like to thank you for your participation in this pilot study. As a reminder, the purpose of this pilot study is to evaluate whether an individualized exercise prescription that is delivered within a primary care setting is effective at increasing physical activity levels in those who are at a high risk of falling or fracturing. Secondly this study is being conducted to determine the feasibility of implementing this tailored program within an interdisciplinary health care team and delivered in primary care.

The data collected during this study will contribute to a better understanding of the appropriate direction for the future development of an inexpensive and effective exercise program specifically for persons at risk of falling or those who have other conditions such as osteoporosis where an exercise program would be of benefit.

Please remember that any data pertaining to you, as an individual participant will be kept confidential. Once all the data are collected and analyzed for this project, I plan on sharing this information with the research community through seminars, conferences, presentations, and journal articles. If you are interested in receiving more information regarding the results of this study, or if you have any questions or concerns, please contact me at either the phone number or email address listed at the bottom of the page. If you would like a summary of the results, please let me know now by providing me with your email address. You will receive an email outlining any changes or improvements in your physical activity levels, questionnaires and assessments completed by the physiotherapist. When the study is completed, you will be provided with the information. The study is expected to be completed by August 1st 2012.

As with all University of Waterloo projects involving human participants, this project was reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. Should you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes in the Office of Research Ethics at 519-888-4567, Ext., 36005 or ssykes@uwaterloo.

Sincerely,

Lora Giangregorio

Department of Kinesiology
Faculty of Applied Health Science
University of Waterloo
200 University Ave, West
Waterloo, Ontario
Canada N2L 3G1
Tel: 519-888-4567 x 36357
Email: lora.giangregorio@uwaterloo.ca

APPENDIX B
Participant Consent Form

Participant Information Sheet and Consent Form

Title of project:
Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach

Primary Investigator: Lora Giangregorio
Assistant Professor
University of Waterloo, Department of Kinesiology
Tel: (519) 888-4567 Ext. 36357
Email: lmgiangr@uwaterloo.ca

Student Investigator: Carly Skidmore, Symron Bansal

You are being invited to participate in a research pilot study that is being conducted on the exercise program you were referred to. It is important for the researchers to be able to determine how many individuals are interested in the exercise program and how many individuals consent to their data being collected during the program for research purposes. This information and consent form provides detailed information about the study. Should you decide to participate, you will be asked to sign this form. By signing the information and consent form you are confirming that you are consenting to your data being collected and used for research throughout the study, understand the purpose of this study and have had all your questions answered by the study investigators. Please take your time to make your decision.

Why is this research being done?

Falls and fractures together represent one of the leading causes of disability in the older adult population. Falls and fractures also contribute significant costs to the health care system and can have a negative impact on the individual's quality of life. Fractures, a common consequence of falls can cause pain, reduced function and an increased risk of death. There is research to suggest that exercise may be beneficial for individuals at risk of falling through improvements to balance and muscle strength. To conduct well-designed research studies of exercise, it is important to design feasible research protocols. To provide a tailored exercise program to individuals at high risk of falling, it is important to understand what

aspects of the program are important to changing activity levels and how feasible it is to deliver a tailored exercise program within primary care.

What is the purpose of the study?

The purpose of this pilot study is to evaluate the ability of an individualized exercise prescription delivered to older adults over the age of 65 to increase physical activity levels within a primary care setting. Secondary purposes are to determine how easy it is to recruit participants and to perform our assessments, to help the development of future research studies. We may use the information obtained from this study to inform the development of a large community exercise program offered to individuals through their primary care provider.

What will your responsibilities be if you decide to take part in the study?

If you volunteer to participate in the study, you will be asked to participate in a six-week exercise program. This program will consist of brief questionnaires that will take 15-20 minutes to complete, wearing a physical activity monitor for 4 days at the beginning and end of the study, and an appointment with a physiotherapist that will last approximately one hour. You will also be contacted by telephone throughout the study by a kinesiologist who will deliver an action planning component and whom you will meet with regularly to review and modify your exercises accordingly. The details of the questionnaires and assessments are outlined below:

1. We will measure your physical activity level using a physical activity monitor that will be worn for 4 days on your hip during waking hours at the beginning and at the end of the study. Additionally, you will be asked to record your activities each day in an exercise log.
2. You will be asked to complete a questionnaire known as the EQ-5D. This is a very short questionnaire consisting of 5 questions. It will ask you about pain, depression, mobility, self-care and your activities.
3. We will ask you to complete questionnaires which will ask you about your intentions to engage in physical activity and any plans that you might have to engage in physical activity. They will also ask you about how confident you are in your ability to engage in an exercise program.
4. We will measure your lower leg strength and balance using the repeated sit-to-stand test. You will be asked to stand up from a chair and sit back down 5 times as quickly as you can without using your arms to assist. We will time how long it takes for you to do this.

5. We will measure your balance by 1) asking you to stand with your side heel of one foot touching the big toe of the other; 2) standing with both feet together; 3) standing with the heel of one foot in front of the toes of the other foot. You will be asked to stand still for 10 seconds for each condition.
6. We will ask you to complete a walking test where we will ask you to stand up from a chair and walk a distance of 8 feet. We will time how long it takes for you to do this.
7. You will be asked to complete another walking test. This walking test will involve sitting in a chair, stand, walk for 3 meters and return to your chair. We will time how long it takes for you to do this.
8. As part of the research component of the study, and with your agreement we will document your medical history. We will collect information such as health problems, medications, and history of falls or fractures. All medical history will be collected through self-report. This will help us describe the group of people we are studying. We will use a brief medical history questionnaire to document this information. We will also ask if you consent to the researchers verifying your medical history with your physician.

Your progress during this exercise program including the results of your questionnaires, and physical assessments will be included in your medical chart to allow your family physician to review your progress.

You will have the opportunity to complete a patient feedback form on the exercise program following study completion. The information provided on this feedback will remain confidential and will be viewed only by the researcher.

Who is collecting the data?

Researchers at the University of Waterloo are collecting information about physical activity levels and the timing and acceptability of the assessments to help in planning future studies of exercise. This research project will be used as a graduate student's master's thesis.

What are the possible benefits of the study for me and/or society?

We cannot promise any personal benefits to you from your participation in the study. However, you will be provided with an exercise program designed specifically to meet your individual needs and hopefully reduce your risk of falling and improve your physical function. This study will provide valuable information that will be used to inform the development of an inexpensive and effective exercise program that can be delivered in primary care.

What are the possible risks and discomforts?

All tests that are part of this study do not require you to perform any activity that you would not normally conduct during your normal day-to-day activities. The exception is the balance test where we are asking you to stand with your feet beside and in front of each other. This may increase your risk of falling more than you would encounter in your daily life however, there will be at least two health professionals present to assist if you are losing your balance. It is also possible that you may experience mild muscle soreness and other exercise-related outcomes, such as minor changes in blood pressure and heart rate.

How many people will be in this study?

We aim to recruit between 10-20 individuals who are patients from the Center for Family Medicine.

What information will be kept private and confidential?

Information gathered from your testing and health records will only be shared with others with your consent or if required by law. All identifying information will be removed from the data and will be replaced with an identifier (ID code). A key file linking the ID code with your name will be separate from the data and will be stored on a password protected computer. A hard copy of the key file and all forms and study materials will be stored in Dr. Giangregorio's locked office in Burton Matthews Hall Room 1109 at the University of Waterloo. Paper and electronic records will be retained indefinitely. Only the research team will have access to the data. The data will be used for student research projects, but your name or other identifying information will not appear with the data.

If I do not want to take part in the study, are there other choices?

It is important for you to know that you can choose not to participate in the study. Choosing not to participate will in no way affect the regular treatment or health care that you receive at the Center for Family Medicine. You are reminded that if you do not wish to sign this consent form to have your data collected for research but would still like to participate in the exercise program you will receive all of the same services but will not be asked to complete the study questionnaires, wear the activity monitor or record your daily activity.

Can I end my participation early?

If you volunteer to be in this study, you may withdraw at any time. You have the option of removing your data from the study. The investigators may withdraw you from this research if circumstances arise which warrant doing so. You may also elect to only participate in certain aspects of the study.

Will I be paid to participate in this study?

There is no remuneration for participation in this study.

Are there any costs to me for my participation?

Your participation in this research project will not involve any additional costs to you or your health care insurer.

What happens if I have a research-related injury?

If you sign this consent form it does not mean that you waive any legal rights you may have under the law, nor does it mean that you are releasing the investigators, institutions and/or sponsors from their legal and professional responsibilities. Financial compensation for such things as lost wages, disability or discomfort due to injury is not routinely available.

Consent of Participant

I have read the information presented in the information letter about a study being conducted by Dr. Giangregorio and colleagues at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I requested. I am aware that I may withdraw from the study without penalty at any time by advising the researchers of this decision.
This project has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact Dr. Susan Sykes, Director, Office of Research Ethics at 519-888-4567 ext. 36005 or by email at ssykes@uwaterloo.ca.
With full knowledge of all foregoing, I agree, of my own free will to participate in this study. I have been advised that I will receive a signed copy of this form

Name of Participant

_____

Signature of Participant Date

_____ _____

Name of Witness

_____

Signature of Witness Date

_____ _____

APPENDIX C
Study Questionnaires

Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach

Medical History

Participant ID #:_____

Please answer the following questions:

1) Have you been told you that you have high blood pressure or are you currently being treated for high blood pressure?

   Yes ☐ No ☐ I don't know ☐

2) Do you ever have chest pain that is not controlled by medication?

   Yes ☐ No ☐

3) Do you have any problems with your vision that are not corrected with glasses or contact lenses?

   Yes ☐ No ☐

4) Do you have problems with sensation or any neurologic condition (eg. history of stroke or Parkinson's Disease) ?

   Yes ☐ No ☐

5) Have you been diagnosed with osteoporosis ?

   Yes ☐ No ☐ I don't know ☐

6) Have you been diagnosed with diabetes?

   Yes ☐ No ☐ I don't know ☐

7) How many times have you experienced a fall in the past 6 months?

No falls ☐ Yes, 1-2 times ☐ Yes, more than 2 times ☐

8) Do you ever experience loss of feeling or numbness in your legs or feet?

Yes ☐ No ☐

9) Do you ever experience dizziness when standing up from a seated position ?

Yes ☐ No ☐

Short Falls Efficacy Scale (FES-I)
Now we would like to ask some questions about how concerned you are about the possibility of falling. Please reply thinking about how you usually do the activity. If you currently do not do the activity, please answer to show whether you think you would be concerned about falling IF you did the activity. For each of the following activities, please circle the number which is closest to your own opinion to show how concerned you are that you might fall if you did this activity.

Activity	Not at all concerned	Somewhat Concerned	Fairly Concerned	Very Concerned
1) Getting dressed or undressed	1	2	3	4
2) Taking a bath or shower	1	2	3	4
3) Getting in or out of a chair	1	2	3	4
4) Going up or down stairs	1	2	3	4
5) Reaching for something above your head or on the ground	1	2	3	4
6) Walking up or down a slope	1	2	3	4
7) Going out to a social event (eg. religious service, family gathering, or club meeting)	1	2	3	4

Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach

Medical History

PATIENT DEMOGRAPHICS

PLEASE SELECT YOUR GENDER: F ☐ M ☐

DATE OF BIRTH: ☐☐☐☐ / ☐☐ / ☐☐
Y Y Y Y M M D D

FRACTURES

HAVE YOU EVER BROKEN A BONE AFTER THE AGE OF 40?

☐ YES ☐ NO

IF **YES**, WHICH BONE DID YOU BREAK?

1. HIP OR FEMUR: ☐
2. UPPER ARM OR ELBOW: ☐
3. WRIST OR FOREARM: ☐
4. OTHER: ☐

(please describe)_____

Has anyone ever diagnosed you with cancer? yes ☐ no ☐

Do you have a hip replacement or any other joint replacements?

yes ☐ no ☐

If yes, where? _____

Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach

Medical History

Mobility:

Do you use a walking aid? yes ☐ no ☐

If yes, which type of walking aid do you use?

walker: ☐ ( ) 4-wheeled ( ) 2-wheeled ( ) standard

cane: ☐ ( ) quad ( ) straight

other:_____

SUPPLEMENTS

DO YOU TAKE VITAMIN D SUPPLEMENTS?

Vitamin D	☐ Yes	☐ No	☐ Unknown
If Yes, (dose) per day: ☐☐☐☐ IU			

Multivitamin	☐ Yes	☐ No	☐ Unknown

Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach

Medical History

ARE YOU CURRENTLY TAKING ANY MEDICATION FOR YOUR BONES?

☐ Yes ☐ No

If yes, which one?

Didrocal (Etidronate)	☐
Fosamax (Alendronate)	☐
Actonel (Risedronate)	☐
Aredia (Zolendronate)	☐
Bonefos/Clasteon/Ostac (Clodronate)	☐
Skelid (Tiludronate)	☐
Other: (*Specify*) _____	☐
Other: (*Specify*) _____	☐

Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach

Medical History

FRAX risk factors :

(Please check all of the following that apply to you)

Have you had a previous fracture? ☐ Yes ☐ No

Did either of your parents break a hip? ☐ Yes ☐ No

Do you currently smoke? ☐ Yes ☐ No

Have you ever taken oral glucocorticoids (eg. prednisone) for 3 months or longer? ☐ Yes ☐ No

Do you have Rheumatoid Arthritis? ☐ Yes ☐ No

Do you have any of the following conditions:

osteogenesis imperfecta: ☐ Yes ☐ No

hyperactive thyroid: ☐ Yes ☐ No

premature menopause (before age 45 years): ☐ Yes ☐ No

chronic liver disease: ☐ Yes ☐ No

Education:

Please select the highest level of education achieved.

elementary school: ☐ high school: ☐

Post secondary: ☐ > post secondary: ☐

Overall would you say that your health is:

excellent: ☐ very good: ☐ good: ☐ fair: ☐ poor: ☐

Psychological Constructs Questionnaire

Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach

Participant Id #:_____

Action Planning: Exercise

Do you already have concrete plans with regards to exercising?
I already have concrete plans…

	Not at all true	Barely true	Unsure	Mostly true	Exactly true
…when to exercise.	☐ 1	☐ 2	☐ 3	☐ 4	☐5
… where to exercise.	☐ 1	☐ 2	☐ 3	☐ 4	☐5
… how to exercise.	☐ 1	☐ 2	☐ 3	☐ 4	☐5
… how often to exercise.	☐ 1	☐ 2	☐ 3	☐ 4	☐5
… with whom to exercise.	☐ 1	☐ 2	☐ 3	☐ 4	☐5

Coping Planning: Exercise

Do you already have concrete plans for your new exercise schedule (Habits)?
I already have concrete plans…

	Not at all true	Barely true	Unsure	Mostly true	Exactly true
… what to do if something intervenes.	☐ 1	☐ 2	☐ 3	☐ 4	☐5
… what to do if I miss an exercise session.	☐ 1	☐ 2	☐ 3	☐ 4	☐5
… what to do in difficult situations in order to stick to my intentions.	☐ 1	☐ 2	☐ 3	☐ 4	☐5

Participant Id #:_____

… when to especially watch out in order to stay committed.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Coping Self-Efficacy: Exercise

It is important to stay physically active. Are you confident that you can manage that?
I am sure I can keep being physically active regularly, even if…

	Not at all true	Barely true	Unsure	Mostly true	Exactly true
… It takes me a long time to make a habit.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
… I am worried and troubled.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
… I don't see success at once.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
… I am tired.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
… I am stressed out.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
… I feel tense.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
… I won't get social support for my first attempts.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
… I have to start all over again several times until I succeed.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

… My partner/family isn't physically active.	☐ 1	☐ 2	☐ 3	☐ 4	☐5

Intentions: Exercise

What are your intentions for engaging in exercise over the next 6 weeks?
Do you intend to engage in balance and resistance training exercises 3 times a week for 30 minutes a day over the next 6 weeks?…

	Not at all true	Barely true	Unsure	Mostly true	Exactly true
… I intend to engage in balance and resistance training exercises 3 times a week for 30 minutes a day over the next 6 weeks.	☐ 1	☐ 2	☐ 3	☐ 4	☐5
… I plan to engage in balance and resistance training exercises 3 times a week for 30 minutes a day over the next 6 weeks.	☐ 1	☐ 2	☐ 3	☐ 4	☐5
… I will engage in balance and resistance training exercises 3 times a week for 30 minutes a day over the next 6 weeks.	☐ 1	☐ 2	☐ 3	☐ 4	☐5

(English version for the UK)

Under each heading, please tick the ONE box that best describes your health TODAY

MOBILITY

I have no problems in walking about ❑
I have slight problems in walking about ❑
I have moderate problems in walking about ❑
I have severe problems in walking about ❑
I am unable to walk about ❑

SELF-CARE

I have no problems washing or dressing myself ❑
I have slight problems washing or dressing myself ❑
I have moderate problems washing or dressing myself ❑
I have severe problems washing or dressing myself ❑
I am unable to wash or dress myself ❑

USUAL ACTIVITIES *(e.g. work, study, housework, family or leisure activities)*

I have no problems doing my usual activities ❑
I have slight problems doing my usual activities ❑
I have moderate problems doing my usual activities ❑
I have severe problems doing my usual activities ❑
I am unable to do my usual activities ❑

PAIN / DISCOMFORT

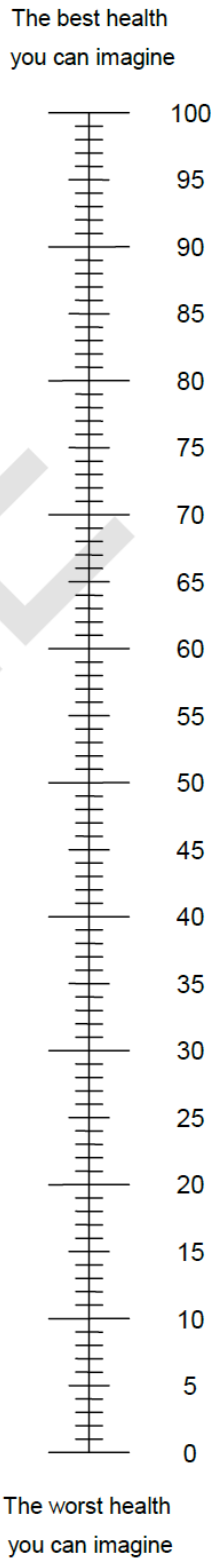
I have no pain or discomfort ❑
I have slight pain or discomfort ❑
I have moderate pain or discomfort ❑
I have severe pain or discomfort ❑
I have extreme pain or discomfort ❑

ANXIETY / DEPRESSION

I am not anxious or depressed ❑
I am slightly anxious or depressed ❑
I am moderately anxious or depressed ❑
I am severely anxious or depressed ❑
I am extremely anxious or depressed ❑

- We would like to know how good or bad your health is TODAY.
- This scale is numbered from 0 to 100.
- 100 means the best health you can imagine.
  0 means the worst health you can imagine.
- Mark an X on the scale to indicate how your health is TODAY.
- Now, please write the number you marked on the scale in the box below.

YOUR HEALTH TODAY = ☐



SPPB (Short Physical Performance Battery)

Short Physical Performance Battery

1. Repeated Chair Stands

Instructions: Do you think it is safe for you to try and stand up from a chair five times without using your arms? Please stand up straight as quickly as you can five times, without stopping in between. After standing up each time, sit down and then stand up again. Keep your arms folded across your chest. Please watch while I demonstrate. I'll be timing you with a stopwatch. Are you ready? Begin

Grading: Begin stop watch when subject begins to stand up. Count aloud each time subject arises. Stop the stopwatch when subject has straightened up completely for the fifth time. Also stop if the subject uses arms, or after 1 minute, if subject has not completed rises, and if concerned about the subject's safety.. Record the number of seconds and the presence of imbalance.. Then complete ordinal scoring.

Time: _____sec (if five stands are completed)
Number of Stands Completed: 1 2 3 4 5

Chair Stand Ordinal Score: _____

0 = unable
1 = > 16.7 sec
2 = 16.6-13.7 sec
3 = 13.6-11.2 sec
4 = < 11.1 sec

2. Balance Testing

Begin with a semitandem stand (heel of one foot placed by the big toe of the other foot). Individuals unable to hold this position should try the side-by-side position. Those able to stand in the semitandem position should be tested in the full tandem position. Once you have completed time measures, complete ordinal scoring.

a. Semitandem Stand

Instructions: Now I want you to try to stand with the side of the heel of one foot touching the big toe of the other foot for about 10 seconds. You may put either foot in front, whichever is more comfortable for you. Please watch while I demonstrate.

Grading: Stand next to the participant to help him or her into semitandem position. Allow participant to hold onto your arms to get balance. Begin timing when participant has the feet in

position and lets go.

Circle one number

2. Held for 10 sec
1. Held for less than 10 sec; number of seconds held _____
0. Not attempted

b. Side-by-Side stand

Instructions: I want you to try to stand with your feet together, side by side, for about 10 sec. Please watch while I demonstrate. You may use your arms, bend your knees, or move your body to maintain your balance, but try not to move your feet. Try to hold this position until I tell you to stop.

Grading: Stand next to the participant to help him or her into the side-by-side position. Allow participant to hold onto your arms to get balance. Begin timing when participant has feet together and lets go.

Grading

2. Held of 10 sec
1. Held for less than 10 sec; number of seconds held_____
0. Not attempted

c. Tandem Stand

Instructions: Now I want you to try to stand with the heel of one foot in front of and touching the toes of the other foot for 10 sec. You may put either foot in front, whichever is more comfortable for you. Please watch while I demonstrate.

Grading: Stand next to the participant to help him or her into the side-by-side position. Allow participant to hold onto your arms to get balance. Begin timing when participant has feet together and lets go.

Grading

2. Held of 10 sec
1. Held for less than 10 sec; number of seconds held_____
0. Not attempted

Balance Ordinal Score: _____

0 = side by side 0-9 sec or unable

1 = side by side 10, <10 sec semitandem

2 = semitandem 10 sec, tandem 0-2 sec

3 = semitandem 10 sec, tandem 3-9 sec

4 = tandem 10 sec

3. 8' Walk (2.44 meters)

Instructions: This is our walking course. If you use a cane or other walking aid when walking outside your home, please use it for this test. I want you to walk at your usual pace to the other end of this course (a distance of 8'). Walk all the way past the other end of the tape before you stop. I will walk with you. Are you ready?

Grading: Press the start button to start the stopwatch as the participant begins walking. Measure the time take to walk 8'. Then complete ordinal scoring.

Time: _____ sec

Gait Ordinal Score: _____

0 = could not do

1 = >5.7 sec (<0.43 m/sec)

2 = 4.1-6.5 sec (0.44-0.60 m/sec)

3 = 3.2-4.0 (0.61-0.77 m/sec)

4 = <3.1 sec (>0.78 m/sec)

Summary Ordinal Score: _____

Range: 0 (worst performance) to 12 (best performance). Shown to have predictive validity showing a gradient of risk for mortality, nursing home admission, and disability.

Reprinted from Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, Scherr PA, Wallace RB. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol Med Sci 1994; 49(2):M85-M94

Timed Up and Go (TUG) Test[1,2]

Participant Id #:_____

1. Equipment: arm chair, tape measure, tape, stop watch.

2. Begin the test with the subject sitting correctly in a chair with arms, the subject's back should resting on the back of the chair. The chair should be stableand positioned such that it will not move when the subject moves from sitting to standing.

3. Place a piece of tape or other marker on the floor 3 meters away from the chair so that it is easily seen by the subject.

4. Instructions : "On the word *GO* you will stand up, walk to the line on the floor, turn around and walk back to the chair and sit down. Walk at your regular pace.

5. Start timing on the word "*GO*" and stop timing when the subject is seated again correctly in the chair with their back resting on the back of the chair.

6. The subject wears their regular footwear, may use any gait aid that they normally use during ambulation, but may not be assisted by another person. There is no time limit. They may stop and rest (but not sit down) if they need to.

7. Normal healthy elderly usually complete the task in ten seconds or less. Very frail or weak elderly with poor mobility may take 2 minutes or more.

8. The subject should be given a practice trial that is not timed before testing.

9. Results correlate with gait speed, balance, functional level,the ability to go out, and can follow change over time.

10. Interpretation ≤ 10 seconds = normal

≤ 20 seconds = good mobility, can go out alone, mobile without a gait aid.

< 30 seconds = problems, cannot go outside alone, requires a gait aid.

A score of more than or equal to fourteen seconds has been shown to indicate high risk of falls.

Participant Time:_____ (sec)

1. Podsiadlo D, Richardson S. *The Time "Up & Go": A Test of Basic Functional Mobility for Frail Elderly Persons.* Journal of the American Geriatrics Society 1991; 39(2): 142-148
2. Shumway - Cook A, Brauer S, Woollacott M. *Predicting the Probability for Falls in Community-Dwelling Older Adults Using the Timed Up & Go Test.* *Physical Therapy 2000 Vol 80(9): 896-903.*
Saskatoon Falls Prevention Consortium, Falls Screening and Referral Algorithm, TUG, Saskatoon Falls Prevention consortium, June, 2005

Physical Activity Log

Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach
Physical Activity Log

Participant Id #:----------

Activity	**Date:_____**	**Date:_____**	**Date:_____**	**Date:_____**	**Date:_____**	**Date:_____**	**Date:_____**
Strength Training	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____
Walking	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____
Aerobic Activity	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____
Balance Exercises	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____
Flexibility	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____
Other:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____

Activity	**Date:_____**	**Date:_____**	**Date:_____**	**Date:_____**	**Date:_____**	**Date:_____**	**Date:_____**
Strength Training	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____
Walking	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____
Aerobic Activity	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____
Balance Exercises	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____
Flexibility	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____
Other:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____	Min:_____

1 of 2

Patient Feedback Survey

Prescribe Exercise for Prevention of Falls and Fractures:
A Family Health Team Approach (PEPTEAM)

Patient Feedback Survey

1. How enjoyable is this exercise program?

(not enjoyable) ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 (very enjoyable)

Why? _____

2. What have you learned from the exercise program?

_____

3. How confident do you feel in performing exercise?

(not at all confident) ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 (very confident)

4. What have you learned about the exercise resources available within the community?

_____

5. What would you change about the exercise program?

_____

Physician Feedback Survey

Prescribe Exercise for Prevention of Falls and Fractures:
A Family Health Team Approach (PEPTEAM)

Dear Physicians,

We have completed our pilot study of the PEPTEAM exercise program. We would like your feedback regarding the feasibility and acceptability of the PEPTEAM exercise program. Participation in this survey is voluntary and a decision not to take part will have no impact on your relationship with the Centre for Family Medicine or the University of Waterloo. We are asking you to take less than five minutes of your time to complete the online survey (see link below). Your responses will remain anonymous.

(Survey link/through FluidSurveys)

Thank you kindly for your feedback,

Carly Skidmore, H.BKin, CK

MSc Candidate

Contact: Lora Giangregorio at lora.giangregorio@uwaterloo.ca, 519 888 4567 x 36357

This project has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact Dr. Susan Sykes, Director, Office of Research Ethics at 519-888-4567 ext. 36005 or by email at ssykes@uwaterloo.ca.

Tailored Exercise for Fall and Fracture Prevention in Older Adults: A Family Health Team Approach

Physician Feedback Survey
(To be uploaded to FluidSurveys)

You have been identified as someone who referred one or more patients to the PEPTEAM exercise program, which is a program that provides individualized exercise prescription and motivational counseling to patients at risk of falls or fractures. We would like some feedback on your experience. Please indicate your level of agreement with each of the following statements.

1. It was convenient to refer my patient(s) at risk of falls or fractures to the PEPTEAM exercise program.

Strongly disagree	Mostly disagree	Somewhat disagree	Neutral	Somewhat agree	Mostly agree	Strongly agree
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7

2. I value having a program like the PEPTEAM exercise program to refer my patient(s) to.

Strongly disagree	Mostly disagree	Somewhat disagree	Neutral	Somewhat agree	Mostly agree	Strongly agree
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7

3. I feel confident in my ability to provide exercise recommendations to patients at risk of falls or fractures.

Strongly disagree	Mostly disagree	Somewhat disagree	Neutral	Somewhat agree	Mostly agree	Strongly agree
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7

4. Participating in the PEPTEAM pilot project has increased my knowledge or awareness regarding exercise for the prevention of falls or fractures.

Strongly disagree	Mostly disagree	Somewhat disagree	Neutral	Somewhat agree	Mostly agree	Strongly agree
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7

5. Is there anything that you liked or didn't like about the implementation of the PEPTEAM pilot project? Do you have any suggestions for future work in this area?

_____

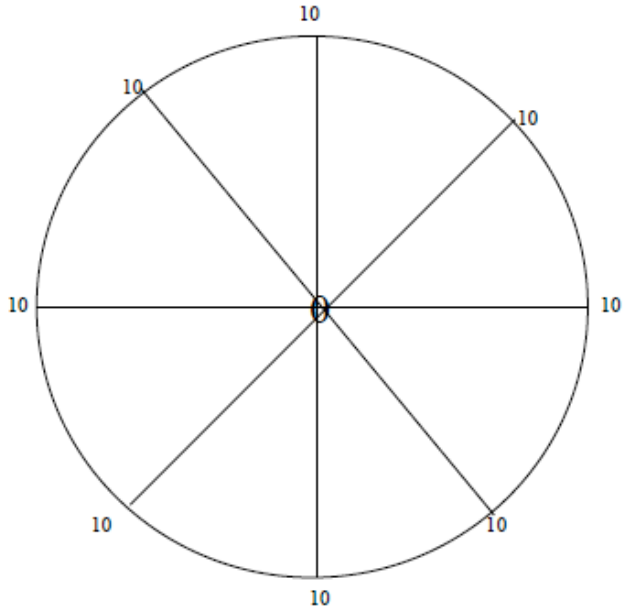
APPENDIX D

Motivational Interviewing Materials/Exercise Prescription Materials

Powerful Questions for Motivational Interviewing & Coaching

What are you afraid of?	What are you assumptions about?	What are you passionate about?
What do you want?	Where do you hold back?	What do you need to give yourself permission for?
What do you need to admit?	What do you want to congratulate yourself for?	What is important about _____?
What will you do? When? How will I know?	What's your first step?	What's another way to look at it?
Who do you need to be to _____?	What would be a metaphor for this?	What's the bigger game for you?
What's the impact you want?	What rule have you created about _____?	What rule do you need to change for yourself?
What are you saying "yes" to?	What are you saying "no" to?	What are some other choices?
What do you know about it now?	What's exciting about it?	What's fun about it? What makes your heart sing?
What's hard about it?	What's scary about it?	If you knew you'd succeed, what would you do?
What are you avoiding?	What lie are you telling yourself?	How do you want it to be?
What else? Is there more?	What are the possibilities?	What would _____ give you?
What does this cost you? How does this serve you?	What will you commit to?	How will you measure your success?
What aren't you saying?	What do you value about _____?	What is calling to you?
What are you tolerating?	What is the gift in this?	What's neat about this?

MotivationaI Interviewing for Health Behaviour Change …the Wheel



the Monarch System
Transforming health behaviour...

Sample Exercise Prescription Sheets

Sample Exercise Prescription Form

Patient Name: _____

Exercises To Do Daily					
Name of Exercise	**Number of Sessions**				
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
Exercises To Do As Prescribed					
Name of Exercise					
	Mon	Tues	Wed	Thurs	Fri
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

Sample Exercises

Sample of Prescribed Exercises

- Providing cues to improve posture
- shoulder press
- head press
- chair sit to stand
- stair climbing
- walking
- toe walking (forward/backwards)
- heel walking
- one-leg stand
- unsupported/supported hip extension
- step-ups
- active hamstring curls
- semi-tandem/full tandem stance (with and without support)
- unsupported/supported hip abduction