Management and outcome after a fall: A 6-month prospective study of 54 older men and women presenting to the emergency department

by

Allison Elizabeth Salter

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Allison Elizabeth Salter	01/08/2004
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Title of Thesis: MANAGEMENT AND OUTCOME AFTER A FALL: A 6-MONTH PROSPECTIVE STUDY OF 54 OLDER MEN AND WOMEN PRESENTING TO THE EMERGENCY DEPARTMENT

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ABSTRACT

Objective: To prospectively compare the care received by 54 older adults after an emergency department (ED) fall presentation with the recommended 'Guideline Care' as published by the American Geriatrics Society (AGS). Secondary objectives include a longitudinal description and change evaluation of this cohort's fall risk profile, functional status, balance confidence, prevalence of depression, physical activity and living arrangements.

Design: 6-month prospective observational study.

Participants and Setting: 54 men and women aged 70 years or older who were discharged back to the community after presenting to the Vancouver General Hospital ED with a fall-related complaint.

Measurements: AGS Guideline care was documented by chart review and questionnaires. Physiological characteristics were measured by Lord's Physiological Profile Assessment (PPA). Functional status, balance confidence, depression, physical activity and other factors were measured by validated questionnaires.

Results: This cohort of fallers who presented to the ED did not receive AGS Guideline Care; only two participants received care consistent with AGS guidelines. Baseline physiological fall-risk scores classified the population at 1.7 SD higher risk than a 65-yr old comparison group and the mean fall-risk score increased (i.e., greater risk of falls) (1.7 ± 1.6 vs. 2.2 ± 1.6, $p < 0.000$) during the 6-month followup period. Also, functional ability (100 (15) vs. 95 (25), $p= 0.002$), balance confidence (82.5 (44.4) vs. 71.3 (58.7), $p < 0.000$) and depression (0 (2) vs. 0 (3), $p < 0.000$) all worsened over 6 months. Within 6 months of the index ED visit, 5 participants had suffered 6 fall-related fractures.

Summary & Conclusion: Medical care of older people who fall and are not admitted to hospital is inconsistent with the AGS Guidelines. This research is the first to prospectively highlight a gap in care of this high-risk group. As fallers who present to the ED constitute a population at high risk of future fracture, this thesis highlights the need for interventions that will address the gap in care that I have identified.

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CHAPTER 1: INTRODUCTION, OUTCOMES, OBJECTIVES & HYPOTHESES

1.1 THE PROBLEM OF FALLS IN THE OLDER POPULATION

Falls in the older population are a major public health concern and an appropriate target for prevention. Reports from the US identified falls as the 5th leading cause of death (1) and the primary reason for 40% of all nursing home admissions (2). Several clinical guidelines have been published to outline components of a comprehensive medical assessment and multi-factorial intervention for older individuals presenting for medical treatment with a fall or fall-related injury (1, 3, 4). The guidelines released as a result of collaborative work by the American Geriatrics Society, the British Geriatrics Society and the American Academy of Orthopaedic Surgeons ('AGS Guidelines') aim to assist health care professionals in fall risk assessment and management of older people who are at risk of falling or who have fallen (1).

The Emergency Department (ED) is a common entry point to the medical system for older people. In Canada, falls account for 86% of older adult injury-related admissions to hospital (5) with the majority of fall-related hip fractures entering the Canadian medical system via the ED. In 2000, 1.6 million older Americans were treated in EDs for fall-related injuries and 353,000 were hospitalized (6). Falls comprise 14-18% of older adult presentations to Australian EDs (7). Commonly, management of older individuals presenting to the ED focuses on injury treatment but fails to provide a systematic evaluation of underlying causative factors and functional consequences of a fall (8).

Approximately 30% of older patients are admitted to hospital following a fall presentation – the remaining 70% are discharged back into the community (9). Whether this discharged population is adequately referred for outpatient and community assessment and intervention has not been examined prospectively. With approximately half of all older individuals who suffer a fall becoming more dependent than before, guidelines suggest that specialist assessment, intervention and followup programs are essential (8, 10). A recent retrospective investigation of community-dwelling older adults presenting with a fall to the Vancouver General Hospital (VGH) ED, however, revealed that the AGS guidelines are rarely followed for patients discharged from the ED setting

(11) indicating that there may be a gap in care between usual practice and 'evidence-based' patient management.

There has, to my knowledge, been no prospective analysis of current medical practice and a detailed description of the community-dwelling older adults who present with a fall to a Canadian ED and are subsequently discharged. Thus, the primary purpose of this thesis was to identify if the evidence-based best practice guidelines (AGS Guidelines) for falls were being followed among patients presenting to the ED with a fall. Second, this study aimed to describe this cohort using variables such as physiological factors related to falling, independence, balance confidence and depression. If the study were to identify gaps in falls guideline care and confirm that the population was at high risk of further falls (and fractures), it would provide future studies with much-needed data to both justify, and develop a successful novel intervention program for those presenting to the ED with a fall.

1.2 OBJECTIVES

This study evaluated a population of community-dwelling men and women who presented to the ED with a fall-related complaint and who were subsequently discharged. This study aimed to address the following research objectives:

1. To determine the proportion of the population that received, some or all components of the AGS evidence-based best practice guidelines for fall prevention within 6-months of the ED presentation.

2. To describe the population on a number of measures of function including standardized physiological fall risk factors, functional ability, living arrangements (i.e. independent, nursing home), balance confidence, physical activity and the prevalence of depression at presentation and at 6-month followup.

3. To investigate the changes this population experienced over the observation period.

1.3 OUTCOMES

1.3.1 Primary Outcome

1. Proportion of participants who received guideline care after attending the ED with a fall-related presentation.

1.3.2 Secondary Variables of Interest

1. Physiological description of the cohort's fall risk factors as measured by the Physiological Profile Assessment (PPA) (12).

2. Changes over a 6-month period in demographic characteristics, physiological fall risk factors, functional ability, physical activity, balance confidence and prevalence of depression.

1.4 HYPOTHESES

The hypotheses outlined in this study's proposal include the following:

1.4.1 Primary Hypothesis

1. Fewer than 30% of participants seeking medical care for a fall by presenting to the ED and subsequent health care providers will receive one or more components of the best practice guidelines for falls specified by the AGS guidelines.

1.4.2 Secondary Hypotheses

1. Participants will have a mean fall risk score indicating a moderate risk of falling.

2. Changes in living arrangements, physiological risk factors, physical activity, functional ability, balance confidence and prevalence of depression will differ between participants receiving AGS guidelines and participants receiving standard care.

1.4.3 Exploratory Analyses

1. At least half of participants who are not provided with AGS guideline care will experience one or more falls during the 6-month observation period (13) (14).

CHAPTER 2: BACKGROUND & SIGNIFICANCE

2.1 EPIDEMIOLOGY OF FALLS

2.1.1 Global Epidemiology

Falls are a major public health problem for societies with aging populations (13, 15, 16). Studies of community-dwelling older adults demonstrate that approximately 30% of the population will fall at least once per year (17, 18). Commonly described as a "sentinel event" in the life of an older person, a fall often marks the beginning of functional decline or is a symptom of a new or worsening medical condition (3). Of older adults who survive fall-related injuries, many never fully recover, and remain with chronic pain, reduced functional abilities, loss of independence, increased risk of falling, and a fear of falling again (19-21).

2.1.2 Canadian Data

The personal, economic, and societal costs of falls among the older Canadian population are enormous. Falls account for 65% of all injuries among older people and were estimated to cost Canadians 3.6 billion dollars in 1995, of which one billion were direct health care costs (22, 23). Hip fractures, a fall-related injury resulting in serious personal costs, also carry a large economic burden. Current Canadian statistics represent the treatment cost of a hip fracture as $30,000 (24). Falls also have a powerful impact on seniors' independence and quality of life. They account for 86% of injury-related admissions to hospital, 40% of admissions to nursing homes and are the leading cause of fatal injury among Canadians over the age of 65 (23). Considering Canada's older population is projected to grow to 5 million by 2011, a 38% increase from the 1998 population of 3.6 million, falls are likely to result in more societal and personal costs unless better management practices are established (23) .

2.1.3 British Columbia Data

Of all the Canadian provinces, British Columbia (BC) has the third highest elderly population (25). Falls are the leading cause of injury resulting in the hospitalization of BC residents aged 65 years and older (26). Considering that 85% of the province's 211

million dollar health care costs for unintentional injuries are attributable to falls, falls are a high priority area of prevention in this province. The release of a comprehensive Fall Prevention Strategy by the Provincial Health Officer in January 2004, confirmed the BC government's concern about falls in BC's older population (27).

2.1.4 Emergency Department Data

Falls among older adults are common ED presenting complaints. Approximately 8% of people aged 70 years or older in the UK present to the ED each year for a fall-related injury (8). Patients who report to the ED with falls have a high rate of injury and often need hospital admission (7). Close et al., (8) has shown that there is a high risk of recurrent falls among those presenting to the emergency department with a fall. It seems logical to provide intervention strategies for fall prevention in the ED as Close et al., did (8) and as current guidelines suggest (1). There are, however, no prospective data as to whether or not this is the current standard of practice.

2.2 FALL PREVENTION GUIDELINES

Several guidelines for fall prevention have been published based on the extensive literature investigating risk factors for falling and various prevention strategies. Such publications include the American Geriatrics Society, British Geriatrics Society, and the American Academy of Orthopaedic Surgeons Panel on Falls Prevention (AGS guidelines) (1), the British Medical Journal Working Group on Falls Prevention (4), the Cochrane Collaboration systematic review (28) and the University of California Los Angeles Emergency Medical Centre Emergency Medicine Guidelines (3). Common themes among these guidelines include the provision of a comprehensive medical assessment and targeted multi-factorial intervention for individuals presenting for medical attention after a fall.

The guidelines investigated in this study are the most recently established AGS guidelines. Created in 2001, these guidelines aimed to "*assist health care professionals in their assessment of fall risk and their management of elderly patients who are at risk of falling and those who have fallen*" (1). Figure 1 outlines the care pathway indicated by the AGS guidelines for an older person who presents to a health care professional for care related to a fall - the care pathway investigated in this study. In addition to a detailed fall assessment, the guidelines include a multi-factorial intervention that should include the following: review and modification of medications (particularly psychotropic medications); strength, balance and gait training; environmental hazard modification; advice on the appropriate use of assistive devices; and, treatment of postural hypotension and cardiovascular diseases (29).

A retrospective investigation of ED fallers presenting to VGH indicated that these guidelines are rarely followed (11). Reports from 226 women aged 70-years or older revealed that 32% were referred to their family physician for followup – only one component of guideline recommendations (11).

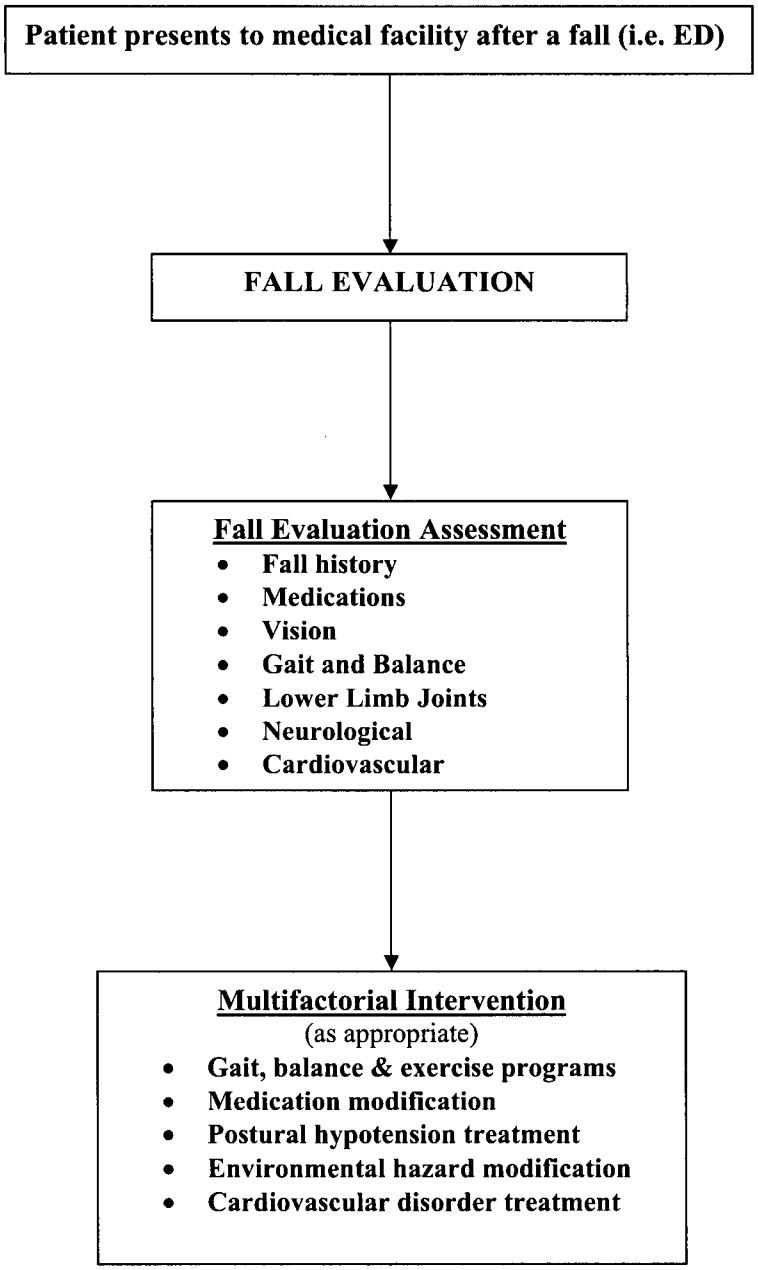

Figure 1: AGS fall assessment and prevention algorithm for patients presenting with a fall

2.3 EMERGENCY DEPARTMENT MANAGEMENT OF FALLS

When individuals fall, particularly if they suspect a more serious injury or are generally frail, they often present to the ED. The ED is a key interface between the hospital, referral services and the community. Traditionally, ED care has been defined as *"care for patients with severe or life-threatening conditions that require immediate medical attention"* (30). While many people who do not have access to a family physician also seek ED medical treatment (8, 9), this use has been shown to be cost-effective (31). Since assessments made in EDs focus on acute care and time physicians spend with patients is often limited, it is readily accepted that there is little opportunity for ED physicians to investigate underlying mechanisms that may lead to a fall or to present fall prevention strategies.

Only recently have researchers from the US, Canada, Australia, and the UK turned their attention towards older people who fall and seek emergency care. Two of these investigations provided an ED intervention. In the first, Baraff and colleagues (3, 32, 33) used a pre-post design to implement a set of guidelines in the ED aimed to prevent subsequent falls and hospitalizations. Although these guidelines are similar to the guidelines subsequently established by the AGS, the implementation process, including staff training and followup, was brief. Furthermore, patients were questioned retrospectively about their emergency care and subsequent falls. Additionally, the burden for recognition of underlying causes and referral to relevant services was placed on already busy emergency nurses and physicians. This intervention did not elicit any changes in number of falls, hospitalizations or injuries.

Close and colleagues conducted a second intervention study (8). This randomized controlled trial assigned the intervention group to a detailed medical and occupational therapy assessment with referral to relevant services as clinically indicated. This interdisciplinary approach to the treatment of elderly fall presentations reduced the risk of falling and risk of recurrent falls in the intervention group (odds ratio 0.39 and 0.33 respectively). Additionally, the odds of hospitalization were lower for the intervention group (0.61) while functional scores (Barthel Index) of the same group were higher than controls.

Although these investigations differ in their interventions, the study by Close and colleagues (8) may have achieved success in part because it did not rely on identification and referral by emergency staff. Older people presenting with a fall were identified by a dedicated researcher who reviewed all patient records while the intervention was carried out by a dedicated geriatrician together with therapy staff who worked outside the ED.

In addition to these intervention trials, Davies and Kenny described the medical profile of older people presenting with falls to the ED (8, 9). Davies and Kenny classified patients according to the description of their index fall and the number of previous falls reported. Eligible participants underwent a detailed history, clinical examination and biochemistry and haematology profile. After applying strict exclusion criteria, they reported that of 26 participants, the three most common fall risk factors were medication (n=10), gait abnormalities (n=9) and carotid sinus hypersensitivity (n=19). Although this study uncovered risk factors characterizing this population, it did not investigate the medical management of these older people or track their outcome over time.

There have also been two retrospective investigations of ED fallers. Bell and colleagues (7) evaluated the characteristics and outcomes of older patients aged 65 years and older presenting to the ED after a fall. Their results illustrated a population with high injury rates, high admission rates and prolonged hospital stays. The most recent study conducted by Donaldson and colleagues (11) demonstrated that 44% of women who presented with a fall to the ED fell again within 18 months.

These previous investigations all identified that the ED is an important access point to a high-risk older group. Although there has been success with an intervention in this setting and with this population in the UK (8), whether or not Vancouver ED fallers receive AGS guideline care has not been examined prospectively. If older people who fall and present to the ED receive guideline care (which includes strength and balance training), then there will be no need to recommend change in medical care. If, however, the results of the present study reveal that participants are not receiving guideline care,

this will provide justification to either change the care delivery system, or study ways of delivering guideline care.

2.4 FALLS

2.4.1 Defining Falls

As falls can result from dizziness, slipping, tripping, fainting, poor balance, leg weakness, seizure, inebriation and significant force (17), it is important to establish a definition that describes the falls under investigation. For the purposes of this study, a fall was defined as inadvertently coming to rest on the ground or other lower level with or without loss of consciousness and other than as the consequence of sudden onset of paralysis, epileptic seizure, excess alcohol intake, or overwhelming external force (8). This is a standard, widely-accepted definition in this field of research (13).

Fall literature often describes older people who have fallen at least once in the past two years as "fallers"(34) and those experienced two or more falls as "multiple-fallers". Those who have not fallen in the past two years are identified as "nonfallers". These terms will be used in this way in the remainder of this literature review.

2.4.2 Who Falls?

Among Canadians aged 65 and older, falls account for 57% and 36% of women's and men's deaths respectively (35). Men are often excluded from studies of falls because women are at a higher risk of fracture from falls as a result osteoporosis (14, 36). Nevertheless, men have a greater death rate then women from fall-related hip fractures (6). To my knowledge, no previous study has described the fall risk characteristics and examined the outcome of male fallers presenting to the ED.

2.4.3 Consequences of Falls

A fall can be a major event in an older person's life. Up to half of all older people who fall without suffering injuries are unable to get up unaided (37). This consequence of falling is termed "long lie" (13). Defined as remaining on the ground for 1 hour or more, long lie is a marker of weakness, illness, social isolation and is associated with high mortality rates among the older population (13). Long lie is also associated with fear of

falling, muscle weakness, pneumonia, dehydration, pressure sores and hypothermia (13, 37). Tinetti and colleagues (37) revealed that 47% of non-injured fallers were unable to get up from the floor without assistance. Investigations of long lie also found that 50% of those who lie on the floor for an hour or longer, die within 6 months of the fall, regardless of the injury sustained (38).

Between 22% and 60% of older people suffer injuries from falls, 10-15% suffer serious injuries, 2-6% suffer fractures and 0.2-1.5% suffer hip fractures (13). The most common self-reported injuries include superficial lacerations and abrasions, bruises and sprains (13). The most common injuries requiring hospitalization include hip fractures, other fractures of the leg, fractures of the radius, ulna and other bones in the arm and fractures of the neck and trunk (13).

The most serious fall-related injury in terms of morbidity and mortality is hip fracture. Older people recover slowly from hip fracture and are vulnerable to postoperative complications (13). In many cases hip fractures result in death. Among those who survive, many never regain complete mobility. In a study of 120 patients who suffered a hip fracture over a 6-year period, Marottoli and colleagues (39) found that before the fractures, 86% could dress independently, 75% could walk independently and 63% could climb a flight of stairs. Six months following their injury, these percentages had fallen to 49%, 15% and 8% respectively.

In addition to injury, depression and fear resulting from a fall can reduce quality of life through disability and loss of independence. A study investigating the consequences of falls to seniors found that the risk of entering a long-term care facility was 2.7 times greater in those who sustained an injurious fall than in those who did not (40). As a result, falls are one of the most common contributing reasons for seniors' admission to nursing homes (13, 37).

2.5 THE TWO FACES OF FALLS: A SYMPTOM & A RISK FACTOR FOR HIP FRACTURE

Just as a heart attack is both a symptom of cardiovascular disease and an independent risk factor for death, a fall can be both a symptom of failure of a physiological system (e.g., postural stability) and an independent risk factor for fracture. Being both a symptom and a risk factor is what I call having "two faces". Each of these faces must be considered in falls-related research. Shortly, I will discuss why falls are a symptom of such things including underlying disease, inappropriate treatment and age-related deficits including macular degeneration and impaired balance. Falls themselves are also a risk factor for a serious complication – hip fracture. Not only are hip fractures costly for the health care system but their occurrence often comes with serious personal costs including loss of independence, depression and even death. Over 90% of hip fractures result from falls (41) and approximately 12-20% of all hip fracture patients die within 12 months of their injury (42). Hip fractures are preventable in populations identified as being at high risk for falls (43).

Loss of bone mineral density (BMD) is a natural process of aging. This natural process, however, can have serious consequences for individuals with low bone density. Osteoporosis and osteopenia represent low bone mass and deterioration of bone tissue. Classification into these groups is based on comparison of a patient's BMD with the mean for a normal young adult population of the same sex and race (44). T-scores are then assigned which indicate the number of standard deviations above or below the mean BMD. Defined by the World Health Organisation (WHO), osteopenic individuals are those with T-scores between -1.0 and -2.5 while osteoporosis is present in people with T-scores lower than -2.5 (44). Osteoporosis puts individuals at a greater risk of fragility fractures, particularly at the wrist, hip and spine. A fragility fracture is identified as a fracture caused by injury that is insufficient to fracture normal bone (44). As a result, fragility fractures are clinically seen as a result of minimal trauma, such as falling from standing height or less, or no identifiable trauma. Approximately 1.5 million Canadians suffer from osteoporosis with 1 in 4 women and 1 in 8 men over the age of 50 having the disease (45).

I underscore that although osteoporosis itself is not identified as a risk factor for falls (although some data suggest it may be (14)), it is a risk factor for fracture. The combination of the high prevalence of osteoporosis and its influence on fracture risk makes osteoporosis a particular public health concern. The Osteoporosis Society of Canada predicts that without effective action on osteoporosis prevention and treatment strategies, by 2018, Canada will spend at least $32.5 billion treating osteoporotic fractures.

The ED appears to be an ideal place to identify a population at high risk of falls as well as those patients who have, or should be investigated for; it also appears to be an ideal place to identify osteoporosis. The AGS guidelines include hip protectors and bone strengthening medications as interventions to prevent hip fractures as a result of recurrent falls in older fallers (1). This thesis investigated whether the presence of osteoporosis is diagnosed and managed in this high-risk cohort.

2.6 FALL RISK FACTORS

Many intrinsic (related to the individual) and extrinsic (related to the environment) factors put older people at risk of falling. Some factors pose a greater risk than others and the presence of multiple risk factors can dramatically increase an individual's risk of falling. The risk factors outlined in the following review are all identified for assessment and intervention by the AGS guidelines.

2.6.1 Postural Stability and Falls

Postural stability refers to the ability of an individual to maintain centre of mass within specific boundaries of space (13). These boundaries, or stability limits, define the area in which the body can maintain position without changing the base of support (13). Maintenance of postural stability requires coordination of the musculoskeletal and sensory systems; the former including biomechanical properties of joints and muscle, and the latter including vision, vestibular and somatosensory function (46). Together, these systems combine to coordinate planned and reactive movement. Stability is required in all active movements of the body; loss of stability while standing, or in the process of standing, can result in a fall.

Aging is associated with deterioration in both the musculoskeletal and sensory systems and this change can lead to falls. A normal occurrence during relaxed standing is postural sway that involves small deviations from vertical and their subsequent corrections (47). Numerous studies have demonstrated that age-related declines in these systems lead to increased postural sway in older adults (48-50). Although no clear gender differences for postural sway have been identified, factors known to increase postural sway including reduced lower extremity strength (51-54), reduced peripheral sensation (50, 55), poor near-vision acuity (51) and slowed reaction time (51).

Postural sway is a useful predictor of falls in older people. Lord and colleagues (56-59) found that fallers show greater sway in four test conditions measured by sway-meter: standing on a firm surface with eyes open and closed; and standing on 15cm thick,

medium density foam rubber with eyes open and closed. In each of Lord's studies, an inability to maintain balance on the foam was associated with falling.

2.6.2 Sensory/Neuromuscular Changes and Falls

The process of aging has a profound affect on the body's sensory and neuromuscular systems. Before the age of 55 years, there are few changes in function; however, beyond this age, there exist progressive declines in the sensorimotor system that contribute to stability (13). These changes often affect factors involved in balance control including vision, proprioception, tactile sensitivity, muscular strength, neuromuscular control and reaction time (13).

2.6.2.1 Vision: Visual Acuity, Contrast Sensitivity, Visual Conditions

Several visual functions decline beyond the age of 40 including visual acuity, contrast sensitivity, glare sensitivity, dark adaptation, accommodation and depth perception (13). Visual acuity refers to the eye's ability to see objects clearly including the ability to discriminate fine detail. Results of reading a visual acuity chart are recorded as a pair of numbers where the first number indicates the testing distance while the second number represents the distance from which a normal eye should see the letter clearly. For example, a person with visual acuity of 6/18 can only see at 6m letters that a normal eye can identify at 18 meters. Several studies have investigated the relationship between falls and visual acuity with inconsistent results. Both retrospective and prospective studies have found that impaired visual acuity was associated with a history of falls or a risk factor for recurrent falls (60, 61). Similarly, a large prospective indicated that reduce visual acuity is a risk factor for hip fracture (62). In contrast, studies have shown no relationship between visual acuity and falls in older age-groups (50, 63).

Contrast sensitivity describes the eye's ability to detect large visual stimuli under low-contrast conditions. This visual function is important to perceive edges in the environment that could contribute to trips in the older population. Such edges include steps, pavement cracks, tree roots and gutters. Contrast sensitivity is a better predictor of falls than visual acuity (56, 57, 60).

These age-related deficits can be corrected with glasses but the corrections themselves can exacerbate important fall risk factors. Lord and colleagues (13) found that bifocal lenses impaired depth perception and contrast sensitivity at critical distances required to detect obstacles in the environment. Researchers questioned participants about their last consultation with an eye care specialist and examined the visual aids worn by the participant at the time of the fall.

2.6.2.2 Visual Diseases of Aging - Glaucoma, Cataracts & Age-Related Macular Degeneration (AMD)

The aging eye undergoes numerous physiological changes that impair visual acuity. Older adults are particularly susceptible to eye pathologies including glaucoma, cataracts and macular degeneration. Although research does not yet directly links these pathologies with increased risk of falling, previous diagnosis of these conditions can be used to flag individuals with vision loss, which increases the risk of falls. Similarly, few studies have determined the mechanisms underlying these eye diseases and falls. It is, however, plausible that deficits in visual acuity and contrast sensitivity are further impaired by these conditions and lead to greater fall susceptibility.

Glaucoma refers to a group of diseases characterized by an increase in intraocular pressure that can cause pathological changes damaging the optic nerve. Glaucoma annually affects 1 in every 100 Canadians over the age of 40 years (64). A prospective investigation has associated glaucoma with an increased risk of falling (60).

A cataract is characterized by opacity or loss of transparency of the eye's lens. This opacity leads to cloudy or hazy vision that may be confined to a small area of the lens or capsule, or it may affect the whole structure (65). Significant advances in treatment now mean that 90% of individuals who undergo surgery regain useful vision (65). A small number of studies have found an association between cataracts and an increased risk of falling (13). Felson and colleagues (62) reported that 18% of hip fractures in a 10-year prospective study were associated with visual impairments with cataracts being the most common cause. Similar studies found cataracts to be an independent risk factor for falling (66) while an Australian study reported the presence of cataracts was significantly associated with increased risk of suffering two or more falls in the previous 12 months (60).

AMD is the most common cause of blindness in Canadians over the age of 50 with one in four Canadians experiencing some form of age-related macular degeneration by the age of 75 (67). Macular degeneration is characterized by central vision loss and does not lead to complete blindness as sufferers retain their peripheral vision (68). Few studies have investigated its role as a risk factor for falls. The Blue Mountains eye study in Australia found that the presence of macular degeneration was not a statically significant risk factor for falls in their sample of 3299 older people (60) but this may be due to the small number of subjects in the sample with the condition. Further studies with large samples of older people with macular degeneration are needed to determine its contribution to falls.

2.6.2.3 Peripheral Sensation: Tactile Sensitivity and Proprioception

Peripheral sensation is characterized by many functions including tactile sensitivity and proprioception. Tactile sensitivity decreases significantly with age, especially in the lower limb (13). In both community-and institutionalized people, tactile sensitivity at the lateral malleolus was inferior among fallers than non-fallers (56-58). Awareness of body position is critical to avoid falls and proprioception characterizes the mind's awareness of the body in space. This 'position sense' (13) enables us to accurately place our feet as we walk up steps and to navigate through narrow passageways. Several studies have found significant age-related declines in position sense of the knee joint (13).

2.6.2.4 Muscular Strength

Muscular strength declines with age. In men, muscular strength declines at an accelerated pace beyond the age of 40 such that hand grip strength is reduced by 16% and leg strength by 28% in men aged 60-69 in comparison to men aged 20-29 (13). Women lose muscular strength at an earlier age and at a greater rate to reveal a 20% decline in hand grip strength and 38% in leg strength over the same age range. Beyond the age of 60, both sexes decline significantly in muscular strength.

Muscular strength is important to avoid falling. Age-related lower leg weaknesses can become so dramatic that supporting one's body weight is a problem. Among community-dwelling women aged 75 years and older, 14% of were unable to exert sufficient force from their gastrocnemius muscle to support their body weight (69) and thus, were at serious risk of falling in situations where they would need to place their

body weight on one leg (e.g., walking up stairs). Studies of the ankle plantarflexor muscles have also reflected a difficulty with rising from a chair without the use of hand (18, 61). Inability to accomplish this task is a significant risk factor for falls among community-dwelling individuals (18, 61). Similarly, investigations of ankle dorsiflexion have indicated that the muscles responsible for this action are weaker in fallers than nonfallers (13, 59). Reduced quadriceps strength is also a risk factor for falls and fractures (58, 59).

2.6.2.5 Reaction Time

The ability to recover from a loss of balance is important to avoid falling and reaction time declines with age (13). There is a moderate association between reaction time and body sway indicating that individuals with slow reaction time may be susceptible to falls as a result of the inability to correct postural stability (51, 70).

2.6.3 Medications

People over the age of 65 years ('seniors') consume a disproportionately large amount of prescription medication, accounting for 25-50% of expenditure on medications (13). Among seniors, 85% take at least one medication and 48% take three or more (71). The use of two or more prescription medications by one patient is a common cause of drug-drug interactions in this age group (72). Recently, Canadian researchers conducted a retrospective chart review to document the degree of polypharmacy in a Canadian hospital (73). Of 283 patients, 90.8% were taking 1 or more medications and adverse drug interactions accounted for 10.6% of ED visits. Although the relationship between polypharmacy and falls is well established, the relationship between specific classes of drugs and the risk of falling has not been clearly identified (13). A number of drugs have been implicated in falls including; psychoactive medications (hypnotics, anxiolytics, antidepressants and antipsychotics), cardiovascular medications (antihypertensives, diuretics and vasodilators), as well as analgesics and anti-inflammatory medications (13). Taken together, these data underpin the AGS guideline recommendations for physician review of medication.

2.6.4 Cognitive and Neurological Risk Factors

2.6.4.1 Dementia

Dementia is a well-recognized risk factor for falling. The term "dementia" describes a group of symptoms that are caused by changes in brain function (74). Alzheimer's disease is a common form of dementia. Dementia symptoms may include asking the same questions repeatedly, becoming lost in familiar places, being unable to follow directions, getting disoriented as well as neglecting personal safety, hygiene, and nutrition (74). People with dementia lose their abilities at different rates. Dementia affects approximately 6-10% of community-dwelling older people (75) and has been reported as a strong risk factor for falls by numerous investigators (13). Dementia-related falls are of particular concern in institutionalized older adults (76). With reports of 4 times the risk of suffering a hip fracture as a result of a fall and 3 times the increase in 6 month mortality rates following hip fracture in comparison to those without dementia, its role in falls clearly warrants further investigation (13).

This thesis excluded fallers who presented to the ED with dementia due to the reliance on participant-supplied information about their ED treatment, subsequent medical care and number of recurrent falls. Future investigations may wish to include this population to determine the role of dementia in ED presentations.

2.6.4.2 Depression

Approximately 15% of community-dwelling older adults express significant depressive symptoms with 1-2% expressing major depressive disorders (77). Tinetti and colleagues (78) and Nevitt and colleagues (61) linked depression to an increased risk of falling in community-dwelling older adults. Severe depression was associated with an increased risk of experiencing multiple falls (61). Subsequent observations suggest that depression is associated with an odds ratio of up to 7.5 for experiencing a fall (13). Although the mechanisms underlying depressive symptoms and fall risk have not been determined, it may be that older people suffering from depression are less likely to be involved in physical activity, and are therefore at a greater risk of falls due to reduced muscular strength, coordination and balance (79). Recently, Whooley and colleagues (80) reported that women with depression exhibited significantly poorer self-reported health and functional status and a higher risk of hip fracture than those free of depression. A fall assessment of mental state looking for presence of depression is a

recommended guideline. Similarly, treatment for this condition is a recommended fall prevention strategy (1).

2.6.4.3 Fear of Falling: Balance Confidence

Fear of falling is a prominent feeling described by many older people who have suffered a fall or who suffer from diseases characterized by fragility (e.g., osteoporosis) (21). About 25-55% of community-dwelling older adults who have not fallen nevertheless have a fear of falling (81). Among people with a history of falls, prevalence of fear is even greater (81). A prospective evaluation of older fallers found that one-third of the study group developed a fear of falling after an incident fall (82).

Fear is an important risk factor for falling as it causes many sufferers to curtail exercise and social interactions (83). This inactivity can aggravate the very muscle weakness and gait instability that make falling more likely. Fear of falling has also been associated with balance and gait problems, loss of independence and reduced quality of life (46). On the other hand, inappropriate risk taking (insufficient fear) is a risk factor for falling, and the physiology and psychology of fall risk are not always in concordance with each other (84).

2.6.5 Environmental Risk Factors

Falls are not only a result of physiological factors but, factors of the individual's environment. Environmental fall risk factors include aspects of indoor and outdoor environments, which often contribute to falls when combined with the age-related deficiencies previously discussed. Environmental factors are analysed by assessing the location and cause of the fall. The cause of the fall often reveals the environmental risk factors associated with it. Falls related to trips and slips are more likely to be related to environmental causes. These extrinsic factors are attributed to between 21% (85) and 53% (17) of falls.

Approximately half of all falls in community-dwelling older people occur in the home (13, 17, 85). Campbell and colleagues (85), found that 16% of falls occurred in the individual's garden, 21% in the bedroom, 19% in the kitchen and 27% in the living/dining room. Lord and colleagues found that 6% of participants fell while using the shower or

bath, 3% off a chair or ladder, 6% on stairs and 26% while walking on a level surface (17). These figures indicate that most falls occur while performing common tasks. Fall location tends to vary with increasing age with falls occurring more frequently within the home on level surfaces (17). Men tend to fall more in the garden and are more likely to sustain a hip fracture outdoors (85) while women fall within their homes (85).

Another environmental risk factor to consider is footwear. Although no studies have reported direct relationships with falling, footwear has been found to influence important fall risk factors. Lord and colleagues, (86) found that high-heeled shoes impaired balance while Sherrington and colleagues' (87) evaluation of footwear worn at the time of fall-related hip fractures indicated that slippers were the most common type of footwear worn at the time of the fall. In the present study I requested that participants show me the footwear worn at the time of the fall so I could determine what role they may have played in ED fallers' presentations.

2.6.6 Self- Report of Usual Alcohol Consumption

Alcohol consumption has not been shown to be a falls risk factor as no significant findings have resulted from several large studies (17, 18, 61, 78). Surprisingly, all three of these studies found alcohol use to be protective. Campbell and colleagues (18) speculated that this association may be due to alcohol use being lowest in those with poor physical health or those taking psychoactive drugs or that heavy drinkers underreport their drinking or refuse to participate in studies (13). Although usual alcohol intake has not been shown to be a significant risk factor for falls, it remains an important factor that may be involved in the circumstance of the fall. This study ascertained from ED records if the participant had been drinking alcohol around the time of the ED fall presentation.

2.7 FALL PREVENTION

The first step in fall prevention is identification of fall-specific risk factors. It is then important to identify which risk factors are modifiable by an intervention and then target the specific intervention to the individual or the group to prevent falls or future falls. Several intervention strategies have been studied for a variety of fall risk factors. As a result, these strategies are recommended in the AGS guidelines (1). They are summarized here as I examined whether or not these evidence-based interventions were being offered to the high-risk cohort.

2.7.1 High Risk Case-Finding via the Emergency Department

Not all older people who fall sustain an injury that requires medical attention. Older fallers who present to the ED are an easily identifiable population that appear to be at particularly high risk for a poor outcome. Up to half of the older people discharged from the ED demonstrate an increase in dependency secondary to trauma (88, 89). An investigation that followed geriatric consultation patients two-years after presentation to the ED demonstrated that 34% had died and 52% were in a long-term care facility (90).

2.7.2 Fall Clinic Intervention

Evidence provided by Close and colleagues showed that the ED is a setting that can identify individuals at a high risk of future falls and provide secondary measures to prevent such falls (8). Although successful, this strategy is dependent on staff dedicated to the intervention (e.g., geriatrician and nurse identifying all fallers). Close's work has been used to justify the clinical delivery of several types of 'falls clinics' to which older fallers presenting to the ED can be referred. Models for falls clinics have included: 1) Clinics using a standardized protocol for the medical management of falls; 2) Clinics involving the contribution of pertinent health professionals such as medical specialists, physiotherapists, occupational therapists and podiatrists; and, 3) Clinics using screening tests to identify those at risk for falling and underlying impairments to target deficient areas (13). There is a need for further research to determine which of these services, if any, is the appropriate intervention to marry with the ED.

2.7.3 Exercise

Exercise plays a major role in modifying fall risk factors and preventing falls in the older population (13). Investigations of exercise and falling have included resistance training, endurance training and agility/balance training. Researchers have delivered these training methods through community and home settings and also included popular forms of exercise including Tai Chi. Although several training programs have been investigated, some have demonstrated better results than others.

A number of recent studies examining community-dwelling older adults have provided evidence that many forms of exercise can reduce the incidence of falls (91-93). These studies have proven successful due to large sample sizes and a focus on fall prevention. The FICSIT trials conducted in the USA included seven independent randomized controlled trials where exercise was a component for 10-36 weeks (91). Meta-analysis of these trials included 2328 older adults. The results of this analysis demonstrated a reduction in falls incidence by 10% in those taking part in any exercise intervention and 17% in those receiving a balance-specific intervention. Similarly, Wolf and colleagues, (92) reported a 47.5% reduction in the rate of falls in subjects who participated in a 15-week Tai Chi program. A meta-analysis of 3 randomised controlled trials of home-based exercise programs conducted in New Zealand showed a reduction in falls rate and injury in populations of people aged 65 and older(94). The exercise interventions were delivered by physiotherapists or nurses.

A recent investigation in British Columbia by Liu-Ambrose and colleagues (14), examined the effect of resistance and agility training on a surrogate measure of falls, Lord's physiological profile assessment (PPA). After a 25-week intervention in a group of 75-85 year old women with low bone mass, the PPA fall risk scores were reduced (i.e., less risk of falling) by 57.3% and 47.5% in the resistance and agility training groups, respectively. Although this study did not focus on falls as an outcome, both interventions demonstrated that the reduction in fall risk scores was primarily mediated by improved postural stability. Noting that poor postural stability is a major risk factor for falling, these results are consistent with previous research of resistance and agility training (14). Specific prescription of an exercise program can be made on a group or individual basis. If performances on measures of fall risk are known, an exercise

intervention program can be designed to target those dimensions of exercise that are limited (e.g., reduce strength).

2.7.4 Environmental Modifications

Environmental modification strategies are recommended as a component of a multi-factorial approach to fall prevention. The range of environmental risk factors includes low or excessive lighting, slippery floor surfaces, obstructed walkways, lack of handrails and narrow steps (95). Environmental modifications are an attractive fall prevention strategy as the homes of many older people have a number of environmental hazards and the majority of them are easy to identify and modify (95).

A randomized trial of home assessment and modification was conducted among 530 community-dwelling older adults (96). The intervention group was visited by an occupational therapist who assessed the home for environmental hazards and made modifications where necessary. The results demonstrated a reduction in the rate of falls among those who had fallen in the year prior to the study. The results also showed a reduction in falls outside of the home, which may indicate that the home modifications were not the major factor for the reduction in fall rates. The occupational therapy intervention also included advice on footwear and behaviour, which the authors cite as potentially playing a major role. Other studies have also demonstrated positive results from home modifications (13).

As environmental hazard modification is a key component of the fall prevention guidelines (1), the present study aimed to identify the number of ED fall presentations resulting from environmental hazards and to determine whether this is recognized and led to a referral or treatment pathway after the ED visit. This information provides future studies with evidence to determine an appropriate intervention involving this population.

2.7.5 Assistive Devices

Gait training and proper advice on the use of appropriate assistive devices are components of guideline care for fall prevention. Walking aids are commonly recommended to older people as a means of increasing their walking ability and decreasing their fall risk. Aids may include canes, crutches, wheeled frames and pick-up frames. Prescription of a walking aid can be a time-consuming process as the health care professional must take into account the individual's gait, muscle strength, balance and symptoms (e.g., knee osteoarthritis) (13). Regardless, walking aids can reduce weight-bearing pain, increase base of support and stability and reduce the energy costs of walking (13) .

On the other hand, walking aids have certain disadvantages. Attached to the use of walking aids are social stigmas, adverse effects on the upper limbs, deterioration of motor function and even an increased risk of falling (13) . No study has yet proven that the appropriate use of a walking aid contributes to fall prevention. Several investigations have, however, associated walking aids with an increased risk of falling (78), (18). Some of these falls are a direct result of the assistive device (e.g., tripping over aid). It must be noted that these individuals are at risk of falling because of impaired gait – the reason they are using the walker in the first instance.

CHAPTER 3: METHODS

3.1 STUDY DESIGN

This prospective, observation study followed men and women who presented to an emergency department (ED) with a fall-related complaint for 6-months.

3.1.1 Setting

Vancouver General Hospital (VGH) is a major academic hospital affiliated with UBC that serves the entire Lower Mainland. VGH is the tertiary trauma referral centre for British Columbia and served as the sole recruitment site. The area surrounding VGH has a high proportion of older people. Older people seeking acute care for a fall or fall-related injury often present to VGH.

The interview portion of this study was conducted at the VGH Research Pavilion 5th Floor or the participant's home. Participants had the option of travelling to the Research Pavilion for each assessment or having a researcher (AS) perform the assessment within their own home.

3.1.2 Timeline

Participants were assessed within four weeks of their fall to allow time for contact and interview scheduling. Reassessment occurred 6-months after the index presentation. This period of time allowed participants to act on referrals and to demonstrate improvements in fall risk factors if they were provided with a fall prevention strategy. For example, exercise has been shown to successfully modify key risk factors (and fall rates) after 10 weeks participation in a targeted program (14, 93, 97).

3.2 STUDY SAMPLE

3.2.1 Sample Size

Based on preliminary recruitment data, I expected to recruit 50 people within 2 months. From previous work in this ED, I anticipated that less than 30% of older fallers would receive at least one component of guideline care (primary outcome). An anticipated recruitment of 50 patients in 2 months is a sample size to result in a sufficiently narrow confidence interval (i.e. sufficient statistical power) around the proportional estimate

(30%) of the primary outcome (guideline care) to allow meaningful recommendations for interventions or further research to arise from this study (approximately +/- 15%).

3.2.2 Inclusion Criteria

All community-dwelling men and women, aged 70-years or older, who reside in Vancouver or the surrounding Lower Mainland (within 150km) and present to the Vancouver General Hospital ED with a fall-related complaint with subsequent discharge were invited to participate.

3.2.3 Exclusion Criteria

I excluded all residents of nursing homes or extended care facilities, patients with a history of pathology or impairments known to cause falling including Parkinson's Disease, Stroke and Multiple Sclerosis, patients hospitalized as a result of the ED fall presentation, patients who were unable to communicate sufficiently in English, patients who did not reside in Vancouver or the Lower Mainland and patients with significant cognitive impairment (score of less than 24 on the Folstein Mini-Mental State Examination) (98).

Fallers who suffer from specific pathologies such as Parkinson's Disease were excluded because it is difficult to attribute a degree of fall risk to a specific diagnosis where the relative severity of the condition may vary considerably among individuals (12). As a result, this proposed study took a physiological rather than disease oriented approach to describing the cohort.

3.2.4 Exposure

The term "fall" was defined as "unintentionally coming to the ground or some lower level other than as a consequence of sustaining a violent blow, falling from a significant height as a result of mechanical failure or sudden onset of paralysis as in a stroke or epileptic seizure" (13). ED records were reviewed to determine if a fall was implicated in the reason for the ED presentation. The fall was confirmed with contacted participants.

3.2.5 Recruitment

The VGH ED served as the participant recruitment site with some direct participant contact. I reviewed all eligible patient records within 7 days of the ED presentation using the ED census. All older people who fitted the inclusion criteria for this study were contacted to participate in this study regardless of what time in the day they presented to the ED (i.e., 24-hour recruitment). Potential participants were contacted by a researcher by letter within 10 days of the fall presentation. This letter indicated a date and time within two weeks of the fall that I would make contact by telephone. At the time of this call, I confirmed that the participant met the inclusion criteria for the study and set-up an interview date and time. The initial interview took place within four weeks of ED presentation.

3.2.6 Consent

I obtained verbal consent for the interview from the participant during the initial telephone call. I obtained written consent at the beginning of the baseline interview.

3.2.7 Study Profile

Figure 2 outlines the recruitment and interview process for this study. Figure 3 details the flow of participants through the study.

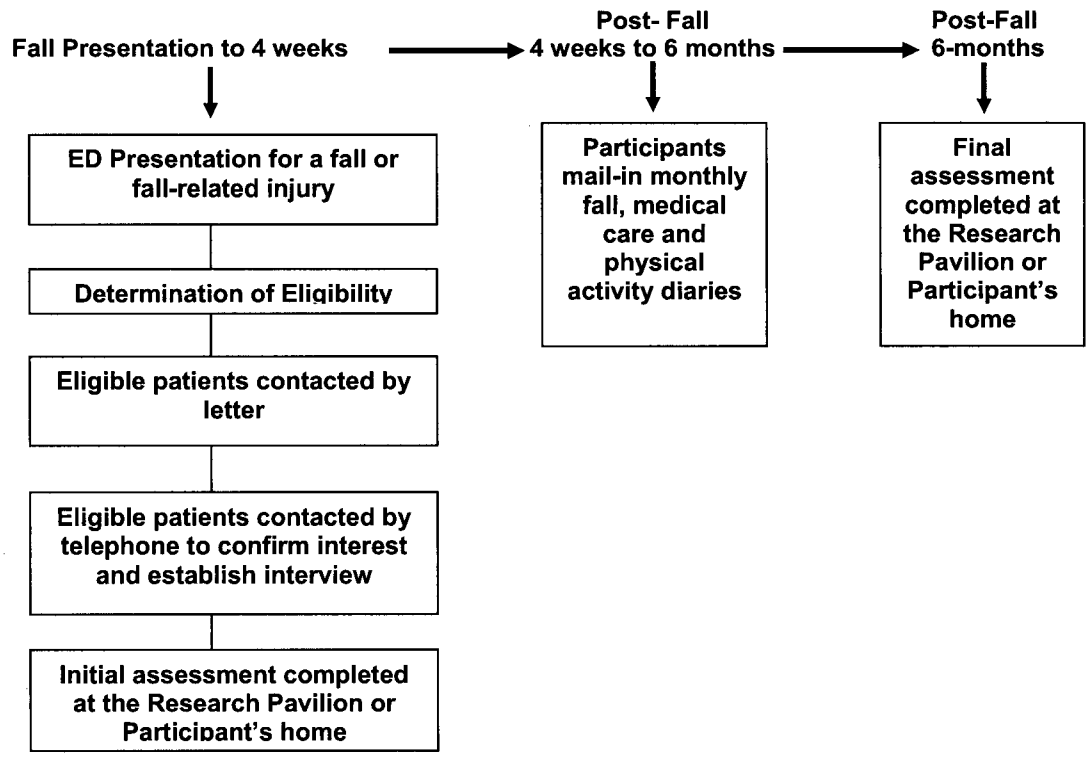

Figure 2: Recruitment and interview process

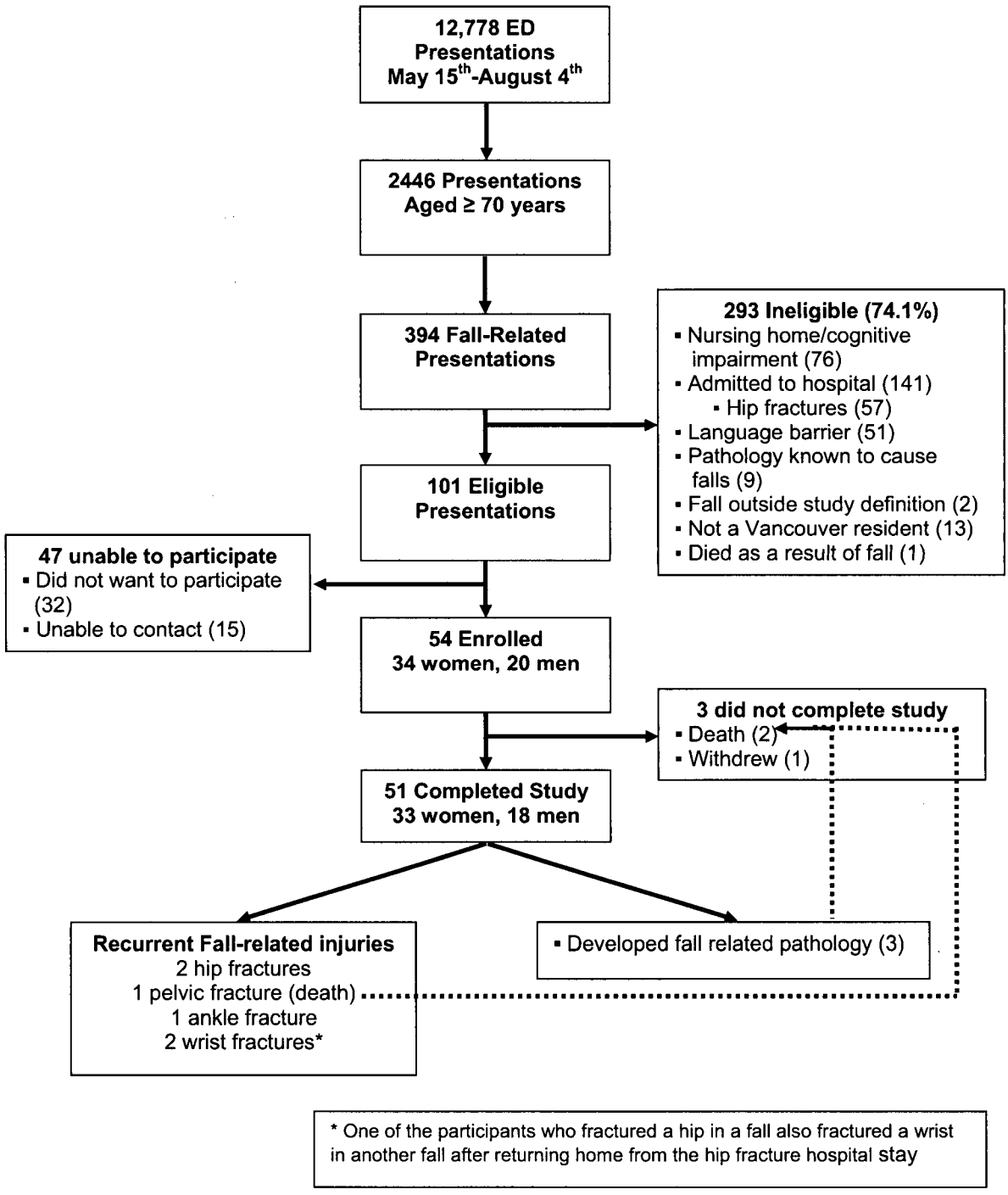

Figure 3: Study profile

3.3 STUDY OUTCOMES

3.3.1 Interviews

Interviews occurred within one month of the ED presentation and at six months post ED presentation. The initial assessment included: 1) Assessment of demographic characteristics; 2) Circumstances surrounding the fall including fall mechanism, location, loss of consciousness, time to standing and method of ED arrival; 3) Emergency physician (EP) management of the fall including examinations and test performed in the ED and recommendations/referrals upon discharge; 4) Health status including living arrangements prior to the fall (did the participant live alone or with a family member or care giver); 5) Subsequent health status within the first month post-fall; 6) Various physiological measurements and related questionnaires including balance confidence and cognitive assessment (Appendix A & B). The initial session took 2-3 hours to complete (Appendix A).

The 6-month followup interview reassessed all baseline measurements and noted medical management from referrals occurring during that period. Any subsequent falls were also noted (Appendix C). I also determined whether medical advice for the fall was sought as the result of a referral or patient-initiated (Appendix C). The 6-month measurement session took 1-2 hours to complete.

3.4 DATA COLLECTION

The following describes the demographic, falls information and measurement tools (Appendix A & B).

3.4.1 General Information

I noted demographic information (Appendix A) including age, specific presenting complaint at triage (e.g., wrist fracture), functional status prior to presentation, circumstances of the fall, co-morbidities as noted, mental state, diagnoses, fall history and disposal for all participants. I also noted management from the participant's chart with particular attention to those factors that provide evidence of fall prevention interventions including: referral to physiotherapy (PT), occupational therapy (OT), and family physician (FP); medication rationalization, assessment of postural hypotension, vision assessment and correction where indicated; and, assessment of environmental

hazards around the home. Given the likelihood of osteoporosis and fall-related fracture in this age group, I examined charts for notes of this previous diagnosis and its management.

I tracked participant's medical care through medical care diaries, and by review of each participant's ED record. In cases where a participant's recollection or records were unclear or discrepant, my physician collaborator contacted the participant's FP to confirm history of medical treatment.

3.4.2 Guideline Care Defined

Guideline care was defined as follows:

Complete Guideline Care: Participant was seen by a Geriatrician or was assessed for fall risk and a health care professional provided a multi-factorial intervention as outlined by the AGS Guidelines.

Partial Guideline Care: Participant was seen in the ED by a special Geriatric Triage team (nurses specially trained in geriatric medicine) or was assessed for fall risk or provided with at least one element of intervention, but not both.

No Guideline Care: Participant may have received some components of a fall risk assessment but was not provided with any intervention.

3.4.3 Modified Canadian Multi-centre Osteoporosis Study (CaMOS) Questionnaire (99)

This questionnaire addressed relevant medical information including medications and medical conditions (99). This questionnaire has been used extensively within the Bone Health Research Group (97, 100).

3.4.4 Activities Specific Balance Confidence (ABC) Questionnaire (101)

Used to assess an individual's fear of falling, this 16-item questionnaire requires the participant to rate their balance confidence (range 0-100%) in several situations. The ABC score differentiates between low and high mobility individuals, correlates with falls-related self-efficacy and balance performance measures. As previously discussed, the

AGS guidelines suggest an evaluation of faller's balance (1). In addition to determining if usual care investigates balance in older fallers, the results of the ABC provided insight into the effect their fall has had on their confidence to perform everyday activities. This insight may assist future investigations of intervention in this group.

3.4.5 Geriatric Depression Scale (GDS) (102)

Developed as a basic screening tool for further diagnostic evaluation of depression in adults 60 years of age and older, this scale has been consistently used in studies of older fallers (8). This study investigated the presence of depression in the population using the Geriatric Depression Scale (GDS) and determined if depression is identified and managed by usual care through review of records and participant interview.

3.4.6 Barthel Index (BI) (103)

This index consists of 10 items that measure a person's daily functioning, specifically the activities of daily living and mobility. The assessment can determine a baseline level of functioning and allow researchers and clinicians to monitor changes in activities of daily living over time; the higher the cumulative score (0-100), the more independent the individual. This tool has been used in previous studies of emergency department fallers (8).

3.4.7 Folstein Mini-Mental State Examination (104)

This tool has been used in numerous fall-related studies to screen for cognitive impairment. It has also been used in previous UBC Bone Health Research Group studies (14, 105).

3.4.8 Falls, Medical Care and Physical Activity Calendar

Several studies have used this technique to prospectively document falls and physical activity during a study period (8, 36, 93, 106). As receiving or not receiving appropriate guideline care is a primary outcome in this study, participants were also asked to record details of their healthcare during the study period. This includes appointments with the individuals' FPs, Optometrist and other health care professionals. The calendar

tracking method has been used previously within the UBC Bone Health Research Group (14, 105).

3.4.9 Physical Activity CORE Questionnaire (58)

Also developed by Stephen Lord, this questionnaire has been used extensively in his fall research and in correspondence to PPA measurements.

3.4.10 Physiological falls Profile Assessment (PPA) Long Form (12)

Developed by International falls authority, Stephen Lord, this tool has been used prospectively to assesses physiological risk factors for falling in older adults (107). The PPA involves a series of simple tests of vision, peripheral sensation, muscle force, reaction time, and postural sway. All 16 tests can be administered within 40 minutes, and all equipment is portable. Table 1 outlines the assessments conducted in this study.

Table 1: PPA components

PPA Task	Description	Measure
Fall Risk Score[AB]	This score is based on the participant's performance in five physiological domains (vision, proprioception, strength, reaction time and balance). The PPA computes this standardized score based on weighting for each of the five components derived from a discriminant function for predicting multiple falls from the Randwick Falls and Fracture Study. These weightings (canonical correlation coefficients) were -0.33 for edge contrast sensitivity, 0.20 for lower limb proprioception, -0.16 for isometric quadriceps strength, 0.47 for hand reaction time and 0.51 for postural sway on a compliant foam rubber surface. Fall risk scores below 0 indicate a low risk of falling, scores between 0 and 1 indicate a mild risk of falling, scores between 1 and 2 indicate a moderate risk of falling and scores above 2 indicate a high risk of falling.	Computed number
Postural Sway	Individuals were asked to stand as still as possible for 30 seconds on 15cm thick medium-density foam rubber mat with their eyes open, wearing the Lord swaymeter 20. The device consists of a 40-cm long rod with a vertically mounted pen at its end. The rod is attached to the participant by a firm belt and extends posteriorly. The pen records sway on a sheet of millimeter graph paper fastened to the top of an adjustable height table. Participants were also asked to perform the same task standing on the floor with their eyes open and closed and on the foam mat with their eyes closed. These tasks were not used to calculate the Fall Risk Score	Total sway path (mm) was determined from the path traced.
Quadriceps Strength	A simple strain gauge was used to assess dominant quadriceps (isometric) strength to the nearest 0.5 kilogram. Participants were seated with the hip and the knee joint at 90 degrees of flexion.	The best of three trials (kg).
Hand Reaction Time	A light was used at the stimulus while the response time was recorded by depression of a switch by the finger.	The average of 10 trials (msec)
Foot Reaction Time	A light was used at the stimulus while the response time was recorded by depression of a pedal by the foot.	The average of 10 trials (msec)
Proprioception	Seated participants with eyes closed were asked to align the lower limbs on either side of a 60 by 60 cm by 1-cm-thick clear acrylic sheet standing on edge and inscribed with a protractor	Difference (deg) matching the great toes.
Edge Contrast Sensitivity	The Melbourne Edge Test was used to assess this aspect of visual function. This test presents 20 circular patterns containing edges with reducing contrast. Correct identification of the orientation of the edge on the patches provides a measure of contrast sensitivity in decibel units (dB), where $dB=-10\log_{10}$ contrast.	Number of the last correctly identified circle (dB).
Dorsiflexion Strength	The participant's foot was strapped into an angled footrest with the knee joint angle at approximately 120-130 degrees. Participants were instructed to forcefully raise the front of their foot. Effort was recorded from a simple strain gauge to the nearest 0.5 kilogram. This score was then converted to Nm.	Newton metres
Visual Acuity	Measured using a chart with high-contrast visual acuity letters (similar to a Snellen scale) and low-contrast (10%) letters. Contrast is the difference between the maximum and minimum luminance divided by their sum. Acuity is assessed binocularly with participants wearing visual aids (if needed) at a test distance of 3m.	Minimum angle resolvable (MAR) in minutes of arc
Tactile Sensitivity	A pressure aesthesiometer was applied to the centre of the lateral malleolus. Participants were seated with their eyes closed and asked to indicate if they felt a fine touch. This instrument contains eight nylon filaments of equal length, but varying diameter. The finest filament detected was recorded.	Logarithms of milligrams pressure

A Italicized components are used to calculate the Fall Risk Score
B Scores are entered into the PPA website form which then calculates the fall risk score

The PPA computes an individual fall risk score based on the participant's performance in five physiological domains: proprioception, vision, strength, reaction time and balance. This standardized score has a 75% predictive accuracy for falls in older people (108). Computed fall risk scores can be interpreted clinically as follows: 1) Less than 0: Low fall risk; 2) 0-1 Standard Deviation (SD) greater risk than 65-year old controls: Mild fall risk; 3) 1-2 SDs: Moderate fall risk; 4) Greater than 2 SDs: High fall risk.

This tool has been used in previous UBC Bone Health Research Group studies (84, 109) and has been used successfully as a portable tool studies of fallers tested in the home (110). It is a reliable (94, 108) and valid (111) measurement tool for assessing fall risk in older people.

The advantages of using the PPA in both the clinical and the research setting as summarized by Lord and colleagues (12) are:

1. Simple to administer: Only minimal training is required for proficiency in test administration.

2. Short administration time: The short version of the PPA takes only 10 to 15 minutes. The comprehensive version takes 45 minutes. Quick administration time aids participation and avoids fatigue in frail older people.

3. Feasible for older people to undertake: The assessments need to be acceptable to older people, in that they need to be non-invasive and not require excessive effort or cause pain or discomfort.

4. Valid and reliable measurements: When combined in a multivariate discriminant analyses, these measurements have been found to predict those at risk of falling with 75 to 79% accuracy in both community and institutional settings (56-58). In a one-year prospective study involving 414 community-dwelling women aged 65 to 99 years, the PPA measurement correctly classified subjects into a multiple falls group or a non-multiple falls group with an accuracy of 75% (58). Reliability

coefficients for the five key discriminatory items of the PPA are reported in Table 2.

Table 2: Reliability coefficients for the 5 key discriminatory items of the PPA (12)

Assessment	ICC*	95% CI
Edge contrast sensitivity	0.81	0.70-0.88
Joint position sense	0.50	0.15-0.74
Quadriceps strength	0.97	0.93-0.98
Hand reaction time	0.69	0.45-0.84
Postural sway on foam rubber mat with eyes open	0.57	0.30-0.76

*ICC = Intraclass correlation coefficients.

5. Quantitative measurements. A fundamental criterion for each test item of the PPA is that they provide continuously scored measurement, that is, quantitative rather than discrete or graded scores. This criterion enables the measurements to be analyzed by parametric statistics. Quantitative measurements also avoid ceiling and floor effects.

6. "Low-tech", robust and portability: If the PPA is to be used successfully in community setting, it needs to be "low-tech", robust, and portable.

7. The major strength of the PPA is that it uses a function-based and quantitative model. It provides a powerful tool for fall risk factor identification and the evaluation of interventions aimed at maximizing physical function (12). To date, studies examining the effects of exercise on fall risk have not used an outcome measure that is comparable to the PPA. Previous studies have typically assessed one or more of the following to evaluate fall risk: 1) postural stability using force platforms, such as centre of pressure analysis; 2) postural stability using a clinical test, such as standing on one leg; 3) performance of a functional task, such as the Timed Up and Go Test; 4) performance on a battery of tasks, such as the Berg Balance Scale 5) gait; and 6) muscle strength. However, these measures have one or more of the following limitations: 1) lack of predictive

validity; 2) no established normative data; 3) does not allow the examination of the individual physiological domains of postural stability; 4) floor and ceiling effects, and 5) non-quantitative measurement (e.g., graded scores of the Berg Balance Scale).

The PPA does not evaluate established fall risk factors such as neuropsychological factors (e.g., cognitive impairment), adverse effects of psychoactive medications, and medical conditions associated with falls (e.g., postural hypotension or carotid sinus hypersensitivity). Lord and colleagues also acknowledge that to refine and enhance the PPA, validated assessments of depth perception, vestibular function, and leaning balance are desirable (12).

3.5 DATA

3.5.1 Entry

Two research staff entered and reviewed all data to minimize recording and transfer errors. The database remains password protected with a backup copy created nightly by VGH IT services.

3.5.2 Confidentiality

All participant information is contained in a locked filing cabinet in the VGH Research Pavilion. All participants are identified by code and the results of this study are presented to ensure participants cannot be identified.

3.6 ETHICS

This study was approved by both VGH and UBC ethics.

3.7 STATISTICAL ANALYSIS

3.7.1 Primary Analyses

Data were analyzed using SPSS (Windows Version 11.5). Data were examined for outliers (greater than 3 SD above or below the mean) with scatter plots. No outliers were excluded as the purpose of this study was to describe a community dwelling, older cohort who presented to the ED with a fall. Outliers were consistently seen in the visual components of the PPA (i.e. Edge Contrast Sensitivity and Visual Acuity). Dependant variables were checked for normality by calculating skewness and kurtosis. If the ratio of each statistic to its standard error was less than 2 or greater than -2, this indicated a normal population distribution (112). Descriptive data are reported for all variables of interest (mean (SD), median (IQR) or number (% of total) where appropriate). Paired t-tests examined the changes in parametric numerical data from baseline to 6-months (PPA Fall Risk Score and components of the PPA including sway conditions on foam, quadriceps strength, reaction time, proprioception, dorsiflexion strength and visual acuity). Non-parametric data (BI, GDS, ABC and components of the PPA including sway conditions on the floor, contrast sensitivity and tactile sensitivity) were evaluated

using Wilcoxon Signed-Rank Test with baseline and 6-month data reported by Median (IQR). The level of significance for both tests was set at $p \leq 0.05$.

The number of recurrent falls as measured by the falls diary and the proportion of fallers and recurrent fallers are reported as descriptive statistics.

3.7.2 Exploratory Analyses

In order to seek trends for future research, exploratory analyses were conducted using logistic regression to model the following associations using the odds ratio as a measure of this association:

1) Baseline PPA and the likelihood of fracture (yes/no)

2) Baseline PPA and the likelihood of a recurrent fall (yes/no)

By fitting these models, a regression coefficient was obtained for each case. Regression estimates show a change in the odds of the dependent variable for 1-unit increase in PPA. Significance of the individual regression estimates is tested by Wald statistics (t-tests).

Descriptive analyses were also conducted to identify exactly where the barriers exist in the care of ED fallers (i.e. level of the physician or patient).

CHAPTER 4: RESULTS

There were 101 eligible emergency department presentations as defined by this study's inclusion criteria between May 15th and August 4th 2003 (Figure 3). A total of 54 eligible patients (53.5%) agreed to participate in the study. During the 6-month followup 3 participants (5.6%; 2 men, 1 woman) dropped out. Of these 3 participants one was too busy to continue participation and two died.

4.1 PARTICIPANT CHARACTERISTICS AT BASELINE

Baseline characteristics of the 54 participants are presented in Table 3. The mean time between the ED fall presentation and the home interview was 13.6 (± 4.8) days. The mean age of participants was 78.5 (± 5.7) years. A total of 27 (50.0%) participants had experienced at least one fall in the previous year and 8 (14.8%) were frequent fallers, defined as having more than one fall in the year leading up to the index fall presentation.

Review of participants' ED records and self-reports revealed many different medical conditions in this cohort. One or more cardiovascular disorders that may have contributed to a fall were present in 31 (57.4%) participants. These conditions included cardiac arrhythmia, coronary artery disease, congestive heart failure, previous heart attack and postural hypotension. Almost all (n=51, 94.4%) participants had some form of visual impairment with 7 (13.0%) confirmed cases of varying degrees of macular degeneration and 19 (35.2%) with cataract formation. Also, 11 (20.4%) experienced peripheral neuropathy and 27 (50.0%) had various degrees of osteoarthritis.

Osteoporosis was diagnosed in 14 (25.9%) participants (all female) with 11 (20.4%) taking a prescribed bisphosphonate therapy. It is noteworthy that 57.4% of participants were taking one or more medications that have been implicated as increasing the risk of falling.

Table 3: Participant characteristics at baseline (N=54)

Characteristic	Number (% of total) or Mean (SD) or Median (IQR)
Demography	
Age (yr) Mean (SD)	78.5 (5.7)
Female	34 (63.0%)
Place of Birth	
North America	31 (57.4%)
Europe	18 (33.3%)
China	3 (5.6%)
Other	2 (3.7%)
MMSE Score (max 30 points) Median (IQR)	29.0 (2.2)
Fall History	
Fall in previous year	27 (50.0%)
Frequent Faller[A]	*8 (14.8%)*
Medical History (%)	
Arrhythmia	16 (29.6%)
Arthritis	31 (57.4%)
Osteoarthritis	*27 (50.0%)*
Rheumatoid Arthritis	*4 (7.4%)*
Cataracts	19 (35.2%)
Cardiovascular Disease	2 (3.7%)
Congestive Heart Failure	1 (1.9%)
Depression	12 (22.2%)
Diabetes (Type II)	6 (11.1%)
Heart Attack	10 (18.5%)
Hypertension	22 (40.7%)
Hypotension	2 (3.7%)
Hypothyroidism	8 (14.8%)
Liver Disease	3 (5.6%)
Macular Degeneration	7 (13.0%)
Peripheral Neuropathy	11(20.4%)
Previous Fracture[B]	**30 (55.5%)**
Total Number of Fractures[C]	*69*
Low Trauma	52
High Trauma	17
Previous Pelvic Fracture	2 (3.7%)
Scoliosis	3 (5.6%)
Surgery	
Hip Replacement	*3 (5.6%)*
Other Hip Surgery	2 (3.7%)
Knee Replacement	*1 (1.9%)*
Other Knee Surgery	1 (1.9%)
Other orthopaedic surgery	*5 (9.3%)*
Hysterectomy	
Oophorectomy	10 (18.5%)
Other	*32 (59.3%)*
Transient Ischemic Attack (TIA)	5 (9.3%)
Visual Impairment[D]	51 (94.4%)
Other Medical History	33 (61.1%)
Osteoporosis/Osteopenia[E] (%)	14 (25.9%)
Female	14 (25.9%)
Bisphosphonate Therapy	11 (20.4%)

Number of Prescribed Medications[F] Mean(SD)	**3.6 (2.6)**
Frequency of Medication Use[G]	
Bone beneficial medications[H]	11 (21.6%)
Medications containing Calcium or vitamin D	16 (28.1%)
Associated with increased risk of low bone density and hip fracture	7 (12.3%)
Cardiovascular medication[I]	18 (31.6%)
Other cardiovascular medication	25 (43.9%)
Benzodiazepine	4 (7.4%)
Other Sedatives/hypnotics (not benzodiazepine)	4 (7.4%)
Antidepressants	5 (8.8%)
Narcotics	6 (10.5%)
Anticonvulsant	2 (3.5%)
Other drugs not associated with fall risk	39 (68.4%)
Unknown	5 (8.8%)
Eye Examination (within 2 years) (%)	48 (88.9%)
Smoking (pack years) Median (IQR)	20.6 (33.1)
Ever smoked	29 (53.7%)
Currently Smoking	5 (9.3%)
Alcohol Intake[J]	
Daily	22 (40.7%)
Weekly	10 (18.5%)
Monthly	6 (11.1%)
Yearly	6 (11.1%)

A Participants experiencing two or more falls in the previous year as identified by ED records and participant report.
B Number of participants who have had a fracture during their lifetime
C Number of fractured bones (e.g., 3 rib fractures in one incident counted as 3 fractures)
D Participant uses some form of prescription lenses
E Diagnosis confirmed by Bone Density Scan (DXA)
F Mean number of prescription medications participants were taking at the time of the index fall
G Number of participants taking each medication. Medications reviewed by a Geriatrician.
H Not directly used to treat osteoporosis, but may have beneficial effects
I Includes digoxin, type 1a antiarrhythmics and diuretics (113)
J Number of participants who consume alcohol on a daily, weekly, monthly or yearly basis

4.2 INDEX FALL PRESENTATION

All participants presented to the ED concerned about their fall or for treatment of an injury suffered during the fall (Table 4). The ambulance service was used for transportation to the hospital in 35.2% of presentations. The median treatment time from ED registration to discharge was 223 minutes with the minimum treatment time being 31 minutes and the maximum being 1278 minutes. The most common fall mechanism was a slip or trip (46.3%) with 76.0% of slips/trips occurring on the sidewalk or street. Outdoor falls represented 51.9% of all falls. Only 3.7% of falls within the home occurred in the bathroom. Alcohol was documented as a factor in 3 of the presentations. Injuries suffered from the index fall were severe in 50.0% of cases (Table 3, note A). An X-ray, MRI, CT scan or combinations of these were ordered in 74.1% presentations. Four female participants required surgery for a broken wrist.

Table 4: Characteristics of the index fall presentation (N=54)

Characteristic	Number (% of total)
Arrived by Ambulance	**19 (35.2)**
Time in the ED (minutes) Median (IQR)	**223 (135.8)**
Fall Mechanism	
Conscious collapse	7 (13.0)
Loss of balance	12 (22.2)
Loss of consciousness	7 (13.0)
Slip/trip	25 (46.3)
Other	1 (1.9)
Unknown	2 (3.7)
Falls related to alcohol consumption	3 (5.6)
Fall Location	
Within the home	19 (35.2)
Bathroom	*2 (3.7)*
Bedroom	*3 (5.6)*
Hallway	*3 (5.6)*
Kitchen	*5 (9.3)*
Balcony/Living Room	*5 (9.3)*
Garage	*1 (1.9)*
Outside	28 (51.9)
Forest Trail/Recreation	*5 (9.3)*
Garden	*4 (7.4)*
Sidewalk/street	*19 (35.2)*
Public Places	7 (13.0)
Restaurant	*3 (5.6)*
Other	*4 (7.4)*
Time spent on floor	
< 5 (min)	38 (70.4)
5-59 (min)	14 (25.9)
> 1 (hr)	2 (3.7)
Ability to get up after fall	
Unaided	35 (64.8)
Loss of Consciousness	
Lost consciousness from fall injury	4 (7.4)
Unknown	9 (16.7)
Injury[A]	
Severe	27 (50.0)
Moderate	20 (37.0)
No injury	7 (13.0)
X-ray/scan (%)	40 (74.1)
Required Surgery (%)	**4 (7.4)**
Wrist	4 (7.4)

A Severe injury falls are falls that result in fracture, loss of consciousness, or any injury requiring sutures. Moderate injury falls include those that result in bruising, sprains, cuts, abrasions, reduction in physical function for at least three days.

4.3 GUIDELINE CARE

Guideline care was not commonly provided by the ED practitioners. Other health care practitioners who later became involved in the participant's care as a result of an ED referral or a participant's personal concern, also rarely provided guideline care. Figure 4 illustrates participants' medical management including ED discharge instructions and referrals. The most common ED referral was to the participant's family physician (FP) (33.3%). The followup rate on the referral to FP was 83.3%.

In total, 8 participants received some form of guideline care. Only 2 (3.7%) participants received complete guideline care, which resulted from an ED referral to an outpatient Geriatrician. Partial guideline care describes the medical management of 6 (11.1%) participants. The Geriatric Triage Team saw these participants in the ED. Partial guideline care was also provided to 2 (3.7%) participants referred from the ED to a cardiologist. These referrals resulted in one participant having the cause of his fall resolved within the 6-month observational period. The second participant is still working with the cardiologist to resolve the syncope, which resulted in the index fall presentation.

Fifteen (27.8%) participants were discharged from the ED without any further instructions. Of these, 3 (20%) returned to the ED within 24 hours of the first ED fall presentation with another fall that required hospital admission. One of these participants experienced the fall while waiting for a ride home after discharge from the ED for the index fall.

Table 5 details the components of the American Geriatrics Society guidelines and how well they were followed in the treatment of participants during both the ED presentation and during subsequent health care visits. Guideline care was not provided by the Family Physician or Orthopaedic Surgeon. All participants referred for physiotherapy received therapy related to the injury that resulted from the index fall. There was no indication that fall prevention therapy (e.g., balance training) was provided. One participant was fitted with a walker by an Occupational Therapist as a result of the referral from the ED for an outpatient Geriatric Assessment.

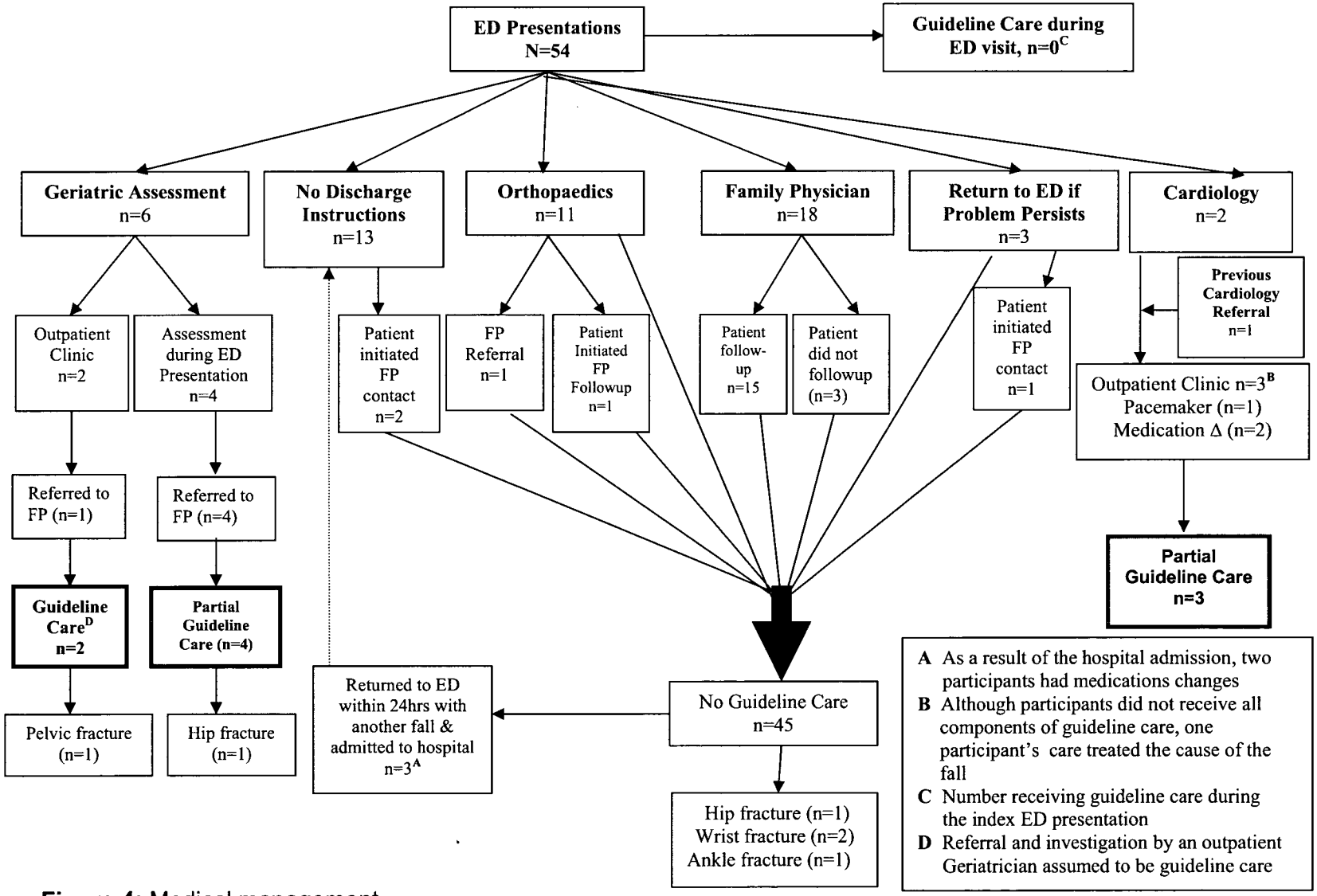

Figure 4: Medical management

Table 5: Guideline management of the index fall (N=54)

Care Provider and Guideline Recommendations	Number (% of total)
Management at Emergency Department Presentation [A]	
Complete Fall Assessment [B]	**0**
Falls history	
Circumstances of the fall	54 (100)
Identification of patient's fall risk factors	0
Identification of any medical comorbidity	54 (100)
Functional status	4 (11.1)
Environmental risks	4 (11.1)
Home hazard assessment	4 (11.1)
Medication assessment	54 (100)
Gait & balance assessment	0
Footwear assessment	0
Lower limb joints assessment	0
Neurological assessment	2 (3.7)
Cardiovascular	6 (11.1)
Interventions to Prevent Falls [C]	
Provision of the Recommended Multifactorial Intervention [D]	***0***
Provision of Recommended Single Interventions	
Exercise	0
Environmental modification	0
Medication modification	5 (9.3)
Assistive devices	0
Behavioural & educational programs	0
Bone strengthening medications	0
Visual intervention	0
Footwear intervention	0
Other Assessments not Outlined by the Guidelines	
Osteoporosis assessment	0
Patient Referrals from the Emergency Department	
Cardiology	2 (3.7)
Fall clinic	0
Family physician (FP)	18 (33.3)
Family physician for fall risk assessment	0(0)
Geriatrician [E]	2 (3.7)
Geriatric Triage Team Assessment [F]	4 (7.4)
Occupational Therapy	1 (1.9)
Orthopaedics	11 (20.4)
Physiotherapy	0(0)
Guideline Care as a Result of ED Referrals	**2 (3.7)** [G]
Partial Guideline Care as a Result of ED Referrals or Treatment	**4 (7.4)**
Cardiologist Management of ED Referred Patients	
Number referred to cardiologist by ED	3 (3.7)
Care provided by the Cardiologist	
Medication change	3 (3.7)
Pacemaker	1 (1.9)
Family Physician Management of ED Referred Patients	
Number referred to FP by ED	18 (35.3)
Referred patients who followed-up with ED referral	*15 (27.8)*
Patients who followed-up with FP without an ED referral	5 (9.3)
Care provided by the Family Physician	
Cardiology referral	0
Fall clinic referral	0
Fall risk assessment	0

Footwear assessment	0
Home hazard assessment	0
Medication rationalization	3 (5.6)
Occupational therapy	0
Osteoporosis assessment	0
Physiotherapy referral	4 (7.4)
Vision assessment	0
Guideline Care	0
Orthopaedic Management of ED Referred Patients	
Number referred to Orthopaedics by ED	11 (20.3%)
Referred patient who attended Orthopaedics	11 (20.3%)
Care provided by Orthopaedics	
Fall clinic	0
Family Physician referral	1 (1.9)
Family Physician referral for fall risk assessment	0
Footwear assessment	0
Home Hazard assessment	0
Medication rationalization	0
Occupational therapy	2 (3.7)
Osteoporosis assessment	0
Physiotherapy referral	4 (7.4)
Vision assessment	0
Occupational Therapy or Physiotherapy Referral[H]	10 (18.5)
Received fall prevention therapy	1 (1.9)

A Identified from participant recall and ED records including paramedic report, nurses' notes, physician notes and specialist reports.
B The guidelines outline that this evaluation "needs to be done to understand and individual's risk factors in order to apply an appropriate intervention".
C Recommendation provided to participant upon discharge from the ED.
D Includes gait, balance & exercise programs, medication and environmental hazard modification, postural hypotension and cardiovascular disorder treatment when indicated.
E Assessment occurs in an outpatient clinic by a Geriatrician within 1-3 weeks of the ED presentation
F Assessment occurs in the ED by a nurse specially trained in geriatrics.
G Participants referred to outpatient Geriatrician.
H All physiotherapy management was directed at rehabilitation of the patient's injury (i.e. broken wrist). No participants received physiotherapy targeting factors that may have caused the fall.

4.4 ADVERSE EVENTS

Five participants (n=5, all female) suffered a fracture as a result of a low trauma fall within 136.7 (± 41.8) days (minimum = 61 days, maximum = 174 days) of the ED fall presentation (2 hip fractures, 1 pelvic fracture, 1 ankle fracture, 2 wrist fractures). One participant fell and fractured her wrist 9 days after returning home from the hospital where she had been treated for a fall-related hip fracture. Consequences of the hip and pelvic fractures were death (n=1), relocation to 24-hr nursing care facility (n=1) and relocation to an assisted living facility (n=1).

4.5 LIVING ARRANGEMENTS

All participants were community-dwelling with 40.7% living alone and 59.3% living with at least one adult at baseline (Table 6). Participants who were living with another adult at baseline tended to move to assisted living facilities more than those living alone.

Table 6: Change in living arrangements from baseline to 6-months (N=54)

	Baseline	Final	Change
Living Arrangements			
Independent (alone)	22 (40.7%)	20 (36.4%)	-4.3%
Independent with another adult	32 (59.3%)	22 (40.7%)	-18.6%
Assisted living	0	5 (9.1%)	+9.1%
24-hour Nursing Care	0	5 (9.1%)	+9.1%
Dead	0	2 (3.6%)	+3.6%

4.6 PARTICIPANT CHARACTERISITICS AT FOLLOWUP

At 6-month followup, 51 (94.4%) of 54 participants remained in the study. Falls were reported by 17 (33.3%) participants and 9 (17.6%) reported more than one fall (Table 7). Of 34 falls, 7 (13.7%) resulted in the participant seeking medical attention with 4 (7.8%) falls requiring hospital admission.

Table 7: Participant characteristics at 6-month followup (N=51)

Characteristic	6-month Followup Number (% of total) or Mean(SD)
Demography	
Age (yr) Mean (SD)	79.0 (5.7)
Total number of falls	**34**
Frequent Fallers[A] Number (%)	**9 (17.6)**
Recurrent Fallers[B] Number (%)	**17 (33.3)**
Falls requiring medical attention	7 (13.7)
VGH ED	*5 (9.8)*
Other Vancouver Hospital	*2 (3.9)*
Falls resulting in hospital Admission	6 (11.8)

A Number of participants who fell two or more times during the 6-month observation period. Two participants had 4 falls, four participants' had 3 falls.

B Number of participants who fell at least once in the 6-month observation period

4.7 DROPOUT PARTICIPANTS

Two men and 1 woman were not followed up at 6 months. One man withdrew from the study because he was too busy and 2 participants died. Deaths were due to a fall-related pelvic fracture (3 months after the index presentation) and to cancer.

4.8 CHANGES IN SECONDARY OUTCOMES

The Wilcoxon Signed-Rank test suggested significant worsening in the Barthel Index ($p=0.002$), the Geriatric Depression Scale ($p=0.004$) and the Activities-Specific Balance Confidence Scale ($p< 0.001$) scores over the 6-month observational period (Table 8). The participants who fractured their hip (n=2) and pelvis (n=1) had mean ABC scores of 0%, 100% and 100% respectively. The number of participants involved in weekly physical activity increased from 35.3% to 43.1%. The proportion of participants who walked for exercise and the duration for which participant's felt they could walk before needing a rest tended to decrease over the 6-month period.

Table 8: Descriptive statistics for secondary outcome measures at baseline and 6-months (N=51)

Characteristic	Baseline	6-month	% Change or p
Barthel Index Median (IQR)	100 (15)	95 (25)	p=.002[A]
Geriatric Depression Scale Median (IQR)	0 (2)	0 (3)	p=.004[A]
Balance Confidence (ABC) Median (IQR)	82.5 (44.4)	71.3 (58.7)	p=.000[A]
Physical Activity (PA) Number (%)			
Involved in weekly PA[B]	**18 (35.3)**	**22 (43.1)**	+7.8
Weekly PA (number of times/week)[C]			
None	33	29	
Once per week	1	3	
Twice per week	3	3	
Three times per week	3	5	
Four or more times per week	11	11	
Time spent being PA (weekly) Mean (SD)			
None	33	29	
< 30 minutes	6	10	
30-45 minutes	3	4	
> 45 minutes	9	8	
Walking			
Every day	15 (29.4)	13 (25.5)	-3.9
3-6 times/week	7 (3.7)	12 (23.5)	+19.8
Twice/week	4 (7.8)	5 (9.8)	+2.0
Once/week	5 (9.8)	1 (1.9)	-7.9
Never	20 (39.2)	20 (39.2)	0
Duration of Walk			
< 15 minutes	3 (5.9)	6 (11.8)	+5.9
15-30 minutes	12 (23.5)	15 (29.4)	+5.9
30-60 minutes	8 (15.7)	6 (11.8)	-3.9
1-2 hours	4 (7.8)	4 (7.8)	0
2 or more hours	4 (7.8)	1 (1.9)	-5.9
Walking time to rest[D]			
< 5 minutes	8 (15.6)	11 (21.6)	+6.0
5 to < 10 minutes	4 (7.5)	6 (11.3)	+3.8
10 to < 15 minutes	8 (15.1)	6 (11.3)	-3.8
15 to < 30 minutes	11 (20.8)	11 (20.8)	0
30 to < 1 hour	6 (11.3)	4 (7.5)	-3.8
1 hour or more	14 (26.4)	13 (24.5)	-1.9
Home Assistance[E] Number (%)			
Food preparation	5 (9.8)	5 (9.8)	0
Shopping	12 (23.5)	15 (29.4)	+5.9
Household chores	21 (41.2)	26 (50.9)	+9.7
Dressing	5 (9.8)	7 (13.2)	+3.4

A Non-parametric data reported Median (IQR) and evaluated using Wilcoxon Signed-Rank Test
B Baseline activities and 6-month followup activities include golf, swimming, stationary cycling , aerobics, home exercises, weights, curling, personal trainer, yoga, pilates, Health Hearts Cardiac Rehabilitation Program and Tai Chi.
C Weekly PA of participants who are regularly active
D Average time participant can walk before needing a rest
E Participant requires assistance from community services or family members with these tasks

Table 9 shows the baseline and 6-month changes for the fall risk scores, fall risk score components and other components of the PPA not included in the fall risk score calculation. Paired t-test analysis showed a significant increase (i.e., greater fall risk) in the Fall Risk Score (p=0.000). There was statistically significant deterioration for the components of the Fall Risk Score that contribute to the combined score (Postural Sway Eyes Open, Foam; Quadriceps Strength; Hand Reaction Time; Proprioception; and, Edge Contrast Sensitivity).

Table 9: Mean values (SDs) and change for the PPA measures (N=51)

PPA Measure	Baseline (n=51) Mean (SD)	6-month (n=51) Mean (SD)	P
Fall Risk Score [A]	1.73 (1.6)	2.24 (1.6)	.000
Postural Sway (mm)			
Eyes open, no foam [B]	78.3 (48.2)	101.8 (77.7)	.000
Eyes closed, no foam [B]	105.1(59.9)	120.0 (95.2)	.000
Eyes open, foam [C]	370.6 (249.1)	431.4 (268.6)	.001
Eyes closed, foam [C]	710.2 (427.0)	826.9 (430.9)	.000
Quadriceps Strength [C] ***(kg)***	17.3 (8.0)	16.8 (8.6)	.046
Reaction time (msec)			
Hand [C]	289.6 (60.6)	306.7 (75.4)	.000
Foot [C]	340.7 (72.8)	348.0 (88.2)	.098
Proprioception [C] ***(deg)***	1.9 (1.7)	2.6 (2.1)	.000
Edge Contrast Sensitivity [B] ***(dB)***	24 (3)	24 (5)	.003
Dorsiflexion Strength [C] **(Nm)**	9.7 (4.0)	9.1 (4.2)	.004
Visual Acuity			
High contrast [C]	1.5 (0.8)	1.5 (1.2)	.458
Low contrast [C]	2.8 (1.7)	2.4 (1.9)	.950
Tactile Sensitivity [B]	4.3 (0.6)	4.4 (0.6)	.013

A Italicized components are used to calculate the Fall Risk Score
B Non-parametric data reported Median (IQR) and evaluated using Wilcoxon Signed-Rank Test
C Parametric data reported Mean (SD) and evaluated using Paired T-test

Table 10 reports the mean PPA values of participants who reported at least one fall (fallers) and those who did not report a fall (nonfallers) in the year preceding the index fall presentation. Mean values were calculated at baseline including and excluding the 3 dropout participants. Comparison showed no significant difference in PPA fall risk scores between participant at baseline and at 6-months.

Table 10: PPA of previous fallers[A] and nonfallers

	Baseline (N=54)[B] Mean(SD)	Baseline (N=51)[C] Mean(SD)	6-month (N=51)[C] Mean(SD)
Previous Fallers	1.8(1.7)	1.7(1.7)	2.3(1.7)
Previous Nonfallers	1.8(1.6)	1.7(1.5)	2.2(1.6)

A Participants who fell at least once in the year preceding the index fall presentation
B Fallers (n=27) and nonfallers (n=27)
C Fallers (n=25) nonfallers (n=26)

Table 11 reports the mean PPA values of participants who reported at least one fall (fallers) and those who did not report a fall (nonfallers) in the 6-months following the ED presentation. Mean values were calculated at baseline including and excluding the 3 dropout participants. Comparison showed no significant difference in PPA fall risk scores between recurrent fallers and nonfallers at baseline, but was significant at 6-months.

Table 11: PPA of recurrent fallers[A] and nonfallers

	Baseline (N=51)[B] Mean(SD)	6-month (N=51)[B] Mean(SD)
Recurrent Fallers	1.8 (1.9)	2.4 (2.0)
Nonfallers	1.7 (1.5)	2.1 (1.5)

A Participants reporting at least one fall during the 6-month observation period
B Fallers (n=17) and nonfallers (n=34)

4.9 EXPLORATORY ANALYSES

Overall, the proportion of participants who suffered a fracture was 9.3%. No significant association was found between the likelihood of fracture and baseline PPA values (log-likelihood ratio is 31.4, p>.001 for 1 df). Table 12 shows the odds ratio of the outcome associated with baseline PPA values. Fracture was not associated with baseline PPA values as measured by Wald statistics (for every unit of increase in baseline PPA, OR=1.52, [95%CI: 0.8, 2.8]).

Table 12: Exploratory regression analysis of baseline PPA and fracture within 6-month observational period (N=54)

	B	Standard Error	Wald Statistic	df	p	Exponent(B)
Constant	-3.20	0.94	11.58	1	.001	0.04
Baseline PPA	0.42	0.31	1.78	1	.182	1.52

Overall, the proportion of participants who had a recurrent fall was 33.3%. There was a significant association between the likelihood of a recurrent fall and baseline PPA values (log-likelihood ratio is 53.1, p<.001 for 1 df). Table 13 shows the odds ratio of the outcome associated with baseline PPA. Recurrent falls are associated with baseline PPA values, as measured by Wald statistics (for every unit of increase in baseline PPA, OR=2.10, [95%CI: 1.3, 3.4]).

Table 13: Exploratory regression analysis of baseline PPA and recurrent fallers within 6- month observational period (N=51)

	B	Standard Error	Wald Statistic	df	p	Exponent(B)
Constant	-2.16	0.63	11.74	1	.001	0.12
Baseline PPA	0.74	0.25	8.80	1	.003	2.10

CHAPTER 5: DISCUSSION

5.1 Guideline Care of Older Adults Presenting to the ED with a Fall

5.1.1 Guideline Care

To my knowledge, this is the first study to determine whether or not men and women over the age of 70 who presented to the emergency department (ED) for reasons pertaining to a fall received the guideline care outlined by the American Geriatrics Society (AGS) (1). I found that the care of older adults who presented to the ED with a fall does not meet the evidence-based AGS guidelines. During the ED presentation itself, only 4 participants received care that partially fulfilled the AGS guideline recommendations. Within 4 weeks of the index fall presentation to the ED, only 2 participants received care defined by the AGS guidelines - these participants were referred to, and seen by, an outpatient Geriatrician. At 6-month followup, 2 more participants had received partial guideline care as a result of cardiology referrals from the ED. An additional participant also received partial guideline care from a cardiologist, however, the cardiology referral was made by the participant's FP prior to the ED presentation.

The responsibility for providing guideline care does not rest solely with ED staff, but is shared by various health care professionals to whom patients may be referred. Also, the participant her/himself must play a role and adhere to advice. Guideline care was not routinely provided to participants by ED referred health care professionals including orthopaedic surgeons, family physicians and physiotherapists. As was the case in the ED presentations, followup care focused on the injury sustained, not the underlying cause of the fall. For example, all participants referred for an orthopaedic consultation received injury treatment. Of these participants, four were also referred to physiotherapy for the injury. None of the 9 participants referred for physiotherapy received fall prevention therapy (e.g., strength and balance training (94) for the mechanisms of the fall itself, yet physiotherapy prescription of strength and balance training reduces falls by around 30% (93). Two of these 9 participants reported another fall during the 6-month observation period, both resulting in a fracture (1 hip fracture, 1 ankle fracture). I found a similar pattern in the care pathway of older adults referred to and those that sought

further medical care from their family physician. Fall risk assessment or specific prevention therapy was not provided.

ED referrals to followup with a cardiologist and a geriatrician resulted in partial or complete guideline care for four participants. Of the participants' referred to the cardiologist, one participant's cause of the fall was identified and treated while the second participant was having her medications reviewed by the cardiologist to decrease her fall risk at 6-month followup. In both cases, the care provided to the participant did not meet 'complete' (see page 35) AGS guideline care. One participant seen by a geriatrician was referred to an occupational therapist and was provided with a walker; that subject did not experience any falls during the followup period. This study was not powered to assess effectiveness of guideline care on reducing fall risk and preventing falls.

The breakdown in guideline care also occurred at the level of the participants themselves when they did not followup referrals recommended by ED staff. Of the participants referred to their family physician from the ED, three (5.6%) did not attend for followup. Two of these three participants reported multiple falls within the 6-month observation period. The third participant dropped out of the study immediately following the baseline interview. All three participants indicated they felt no need to followup with any further care as their injuries were treated in the ED. All three participants also blamed the fall on their own risk-taking behaviour rather than any physiological deficits. They also felt they could avoid another fall by being more cautious. When the entire cohort was questioned about the care they received during their ED visit, 50 (92.3%) felt they received good or excellent care for their fall. Similarly, all participants who received no discharge instructions from the ED did not feel the need to pursue any further medical care for their fall. Interestingly, throughout discussions with these participants, there was a consistent focus and concern on the result of the fall (i.e., recovering from injury) not the cause of the fall (i.e., poor balance or muscular weaknesses). When the entire cohort was questioned about how they would prevent themselves from falling again, 75% responded by saying they would be more careful.

These data indicate that it may be important to educate the public about falls and falls prevention agreeing with the AGS guidelines that advocate patient education (1). It appears that patients are not aware that most of the factors that cause falls are modifiable. Thus, moving towards better care for older fallers may require a shift in the way society thinks about falls. The danger of falls is not only the outcome of the fall (i.e., injury), but the increased risk for subsequent falls and fall-related injury (e.g., hip fracture or death). Qualitative researchers could help investigate why clinicians and patients fail to address the fall, not the underlying mechanism of the fall. Determining these barriers may lead to better fall care.

Guideline care was provided to 2 of 6 participants in this study who subsequently sustained fall-related fractures. One of these participants was provided with partial guideline care during the ED visit but nevertheless sustained a hip fracture. The second participant received partial care within the ED and then complete guideline care as a result of the ED referral to an outpatient geriatrician. This participant then sustained a pelvic fracture and died as a result of complications. Baseline fall risk scores for these participants were 1.51 and 2.51 indicating a moderate and marked fall risk. The relatively high proportion of 'Guideline Care' among these patients may reflect the ED physicians recognising the severity of medical comorbidity among them and providing a greater level of care and referral to geriatrician. Referral is more likely among participants at greater risk of medical complications.

5.1.2 Is Guideline Care Necessary Treatment for this Population?

The present study indicates that this population of older fallers who presented to the ED is at high risk of further falls (Table 14). While this study was not powered for falls, this cohort of 54 participants experienced 34 falls over 9873 person-days of observation which translates to 126 falls per 100 person years. The control group in the study conducted by Close and colleagues (8) reported a similar rate of 129 falls per 100 person years. Robertson and colleagues' (108) control group of community-dwelling adults aged 80 years and older who did not present to the ED with a fall experienced a fall rate of 93.9 per 100 person years indicating that the population of older adults presenting to the ED with a fall appear to be a high risk group for recurrent falls. In the

absence of intervention studies, observational studies among larger cohorts would allow researchers to examine associations between provision of guideline care and fall rates.

Within 6 months of the index fall presentation, 5 female participants had 6 fall-related fractures. Over 9873 days of observation, this represents a fracture rate of 22.2 fractures per 100 person years. Since all of the fractures in this present study happened to female participants, over 6181 days of observation, this represents a fracture rate of 35.4 per 100 woman years. Two of these fractures were hip fractures (n=2) which represents 44 times the rate of hip fracture reported in a community-dwelling population of women over the age of 60 (114) (overall rate of hip fracture was 0.8 ± .057 per 100 woman years). Since both hip fractures happened to women in the study, this represents a rate of 11.8 hip fractures per 100 woman years. In the EPIDOS study (115) community-dwelling women had a hip fracture rate of 1.8 per 100 woman years. In the study conducted by Close and colleagues (8) where serious injury was defined as suffering a fracture or dislocation, the rate of serious injury was 9.8 fractures per 1000 person years. The increased presentation of the hip fractures by female participants is consistent with the literature that estimates the lifetime risk for hip fracture at 6% in men and 17.5% in women (116). While woman's fracture rate in this present study is quite high, these results should be viewed with caution due to this study's small numbers. Consistent with other studies of fracture rate in community dwelling older women it appears that older, community-dwelling women who experience a fall severe enough to present to the ED for care have a poor outcome (Table 14).

Table 14: Comparison of fall, fracture and hip fracture rate across the literature

Author	Population	Mean Age (years)	Fall Rate (100 person years)	Fracture Rate[A] (per 100 person years)	Hip Fracture Rate (per 100 person years)
Salter et al. (present study)	Community-dwelling men and women aged 70 years and older presenting to the ED with a fall (N=54)	78.5 (5.7)	126	22.2 35.4 [B]	7.4 11.8 [B]
Chang et al.(114)	Dubbo Osteoporosis Study Ongoing longitudinal study of Dubbo, Australia's population of men and women aged 60 years and older. This paper was based on 39,357 person years of observation.	N/R[C]	N/R[C]	2.7 3.4 [B] 1.6 [D]	0.6 0.8 [B] 0.3 [D]
Close et al.(8)	Control Group (n=213) Community-dwelling men and women aged 70 years and older presenting to the ED with a fall	78.9(7.6)	129	9.8	N/R [C]
Dargent-Molina et al.(115)	Women aged 75 years and older with no history of hip fracture (N=7575)	80.5 (3.8)	N/R [C]	N/R [C]	1.8[B]
Robertson et al.(108)	Control group (n=120) community-dwelling men and women aged 80 years or older	83.7(2.9)	93.9	1.8	N/R
Stone et al.(117)	Study of Osteoporotic Fractures (SOF) community-dwelling, non-black women aged 65 years and older (N=9704)	71.7 5.3)	N/R [C]	4.4	0.8

A Represents any fracture
B Rate in 100 woman years
C Not reported
D Rate in 100 man years

5.1.3 Why Guideline Care is not Standard Care in the ED?

Although AGS guideline care was generally not the standard of ED patient care, some assessment and intervention portions of the guidelines were followed. Review of each participant's ED record indicated that all participants received portions of the fall assessment detailed by the guidelines. These portions included detailing fall circumstances, identifying any medical comorbidities, and reviewing current medications. Other components such as fall risk factor identification and gait and balance assessments were absent from the ED assessment. Only five participants received a guideline intervention (medication change) in the ED. These results are consistent with the evaluation attempt by Baraff and colleagues to implement fall

practice guidelines in three busy EDs (33). Their one-time educational intervention targeted emergency physicians, nurses and clerical staff. Coupled with a practice guideline reminder in the form of a checklist, the intervention had a minimal effect on the process of patient care (3, 32). Baraff and colleagues suggested that physician time, resources and awareness may explain why guidelines are not the standard of care for older fallers. Whether these reasons apply in the VGH ED was not investigated in the present study.

During the enrolment period for this study, the ED at VGH treated 12,778 patients of whom 2446 were aged 70 years or older. On average, 140 patients were seen daily in this ED. Furthermore, Vancouver General Hospital is the major teaching hospital for the Faculty of Medicine at the University of British Columbia. In addition to caring for patients, attending ED physicians teach residents and undergraduate medical students. Considering the AGS guidelines outline an assessment and intervention protocol that takes approximately 1 to 1.5 hours to complete, implementing these guidelines within this busy ED is not feasible.

Guidelines are recommendations, not strict rules or regulations. While guidelines exist for virtually every medical condition, not all are routinely practiced (118). In the US alone, over 1000 clinical practice guidelines were approved through the National Guideline Clearinghouse in 2002 (119). Incorporating clinical guidelines into medical practice is a method of practicing evidence-based medicine and is the current gold standard of clinical medicine. The ability to practice evidence-based medicine may vary across health care professionals as a result of training and exposure to evidence-based medicine practice. Family and emergency care can take place in widely varying conditions that can provide challenges to the practice of evidence-based medicine, especially if the physician is not comfortable accessing, evaluating and applying the literature. As both the family physician and emergency physician are often the health care professionals to whom fallers present, they are critical in initiating medical management of this group. Thus, it is important to understand why these guidelines are not being practiced clinically. Although the AGS guidelines were published contemporaneously in several high-impact geriatrics journals, these journals are not likely at the top of an emergency physician's reading list. Baraff and colleagues (32)

demonstrated that an education-based practice guideline formally presented to ED staff did not alter documentation of falls risk factors, causes of falls, consequences of falls or the implementation of the practice guidelines. If guidelines presented formally to EPs in their work environment are not implemented, emergency staff cannot be expected to implement guidelines that are reported in the general geriatric literature.

Although ED health care professionals may not be ideally-placed to provide older fallers with comprehensive guideline care, they have the potential to routinely initiate the medical management pathway to guideline care. A challenge when attempting to change emergency staff's medical management of older fallers is to convince them to recognise that the faller is a "high-risk patient". In the ED, a patient who presents with for example, crushing central chest pain (angina), is automatically identified as being at high-risk for a more serious condition, myocardial infarction. The patient is treated immediately and provided with followup care until the root of the problem has been diagnosed, treated and preventative measures established. This same preventative attitude needs to be applied when assessing and treating the older faller to prevent the complication of hip fracture. In the past, some clinicians have considered that hip fracture is a near-terminal life event that has little impact on longevity. Recent data show that this perception is flawed and that hip fracture is associated with 1.8 year reduction in life years (120).

This example illustrates that both myocardial infarction and hip fracture have parallels in that they can be prevented if symptoms or risk factors are identified and appropriately managed by a team of health care professionals. Just as chest pain alerts ED staff to the possibility of myocardial infarction, a fall by an older person should alert ED staff to the potential risk of hip fracture and thus, lead to the start of management as per the AGS guidelines. One reason falls may not alert ED staff to identify a patient as high risk is because the complication (e.g., hip fracture) is not imminent. A patient with chest pain and electrocardiographic changes of impending infarction appears at much greater risk of a poor outcome than an older person resting comfortably in a treatment bed with a few minor bumps and bruises. During the recruitment period of this study, a female patient who met the criteria for inclusion in this study, presented to the ED complaining of a fall and resulting lacerations. This patient was treated quickly for her wounds,

provided with no guideline care and discharged from hospital. The afternoon of that same day, this patient fell again, this time, fracturing her hip. While this was only one case, it is the most dramatic illustration of the high fracture rate I found during the 6-month followup. Thus, health care professionals who come in contact with older fallers need to recognize the vulnerability of these patients. Additionally, they need to have a place or person to refer these patients. Changing the attitudes of ED staff and establishing appropriate referral destinations is not an easy task (121), but requires further investigation if older fallers are to receive guideline care when presenting to the ED for reasons related to a fall.

Falls may receive inadequate care in the ED and primary care setting for a variety of reasons. A study by Wenger and colleagues of medical care provided to vulnerable community-dwelling older patients outlined the following likely reasons for inadequate care (122):

1) The skills needed to provide care for falls may not be well taught in medical school and ED residencies;

2) Specific skills such as gait and cognitive evaluation require expertise that may be difficult to acquire and maintain among primary care physicians. For example, performing a mini-mental status examination or gait and balance assessment may be perceived as too time consuming and a task that a clinician is less comfortable performing than a routine electrocardiogram;

3) Conditions such as falls are often poorly identified in clinical practice. This present study noted that while the fall was often noted in the ED report, the bulk of the report referred to the consequence of the fall rather than the reason or mechanisms underlying the fall itself;

4) Unlike other conditions, primary care physicians rarely receive feedback on conditions such as falls. (As this was an American study, the authors indicated that busy clinicians never receive feedback about geriatric conditions, but often receive daily reports from insurers about patients with previous myocardial

infarctions who are not receiving ß-blockers or diabetic patients without a recent glycosylated hemoglobin test. This reason may not apply to the Canadian health care system).

In light of these suggestions, as a teaching hospital, Vancouver General Hospital has the opportunity to integrate these suggestions into the education of medical students to start transforming the care of older fallers.

5.1.4 Bridging the Gap: Who is Responsible for Providing Fall Prevention Care to this Population?

The patient-care pathway from the initial ED presentation to the fall-related assessment often required several steps and varied for different participants in this study. Several investigators have documented that older fallers presenting to the ED are at high risk of recurrent falls and fall-related injuries. The present study has demonstrated that barriers to guideline care exist as a result of the lack of awareness of the guidelines and participants' lack of knowledge that fall risk factors are modifiable. Who then is responsible for the care of this population? Logic would indicate that the primary health care contact should initiate the pathway to guideline care but geriatricians are few and in high demand. The ED at VGH has formed a triage team of nurses to specifically assess older people during their presentation to the ED. While this team does question the individual about their history of falls, this team's main purpose is to asses if the individual is able and has the resources to be discharged home safely. Perhaps the ED should institute a dedicated falls triage nurse who performs a primary falls assessment during treatment in the ED leading to a referral to a geriatrician if needed. This same person could provide older people with information about fall prevention including how to conduct a home hazard assessment and how to access exercise programs existing in the local area. Such an intervention would need to be evaluated for both effectiveness and cost. Regardless of what programs the ED has in place, both emergency physicians and other physicians who provide health care to older patients need to be aware of the danger of falls in this population as there are effective preventions.

5.1.5 Providing this Population with Guideline Care

How can health care practitioners' best provide this high-risk population with guideline care? Results of this and other studies indicate that ED staff are not the ideal health care professionals to provide complete AGS guideline care to patients. Similarly, results of this study indicate that discharge and referral to an outpatient clinic or practitioner does not guarantee guideline care. Of the 54 participants in the study, 3 fell again and required hospital admission within 24 hours of discharge from the ED for the index presentation. The inability of the ED to provide guideline care and the danger of discharging such a high-risk group back to the community argues for consideration of supplementary forms of health care delivery for this high-risk group.

One approach could be to establish a falls clinic or unit directly connected to the ED. In this scenario, an older adult who presents to the ED with a fall would be treated for any acute conditions within the ED and then seen immediately in the falls clinic by a health care professional (i.e. geriatric nurse, physiotherapist, kinesiologist etc.) with special training in geriatrics and falls. The ED could also send other older patients who have not presented with a fall, but who are deemed to be at high risk for falling, to the clinic for investigation and preventative interventions. Another fall clinic scenario is an outpatient fall clinic meaning the patient would be seen in the clinic within a certain time period after the fall (i.e. 2-4 weeks). While the idea of a fall clinic is not new (34), future research needs to determine if referral to a dedicated falls clinic for secondary fall prevention reduces the proportion of fallers and the number of falls during a defined followup period compared to participants who are provided with usual care. Additionally, the time to fracture after a fall needs to be determined within the population to determine if an inpatient falls clinic is necessary. Such a study should consider the time it takes for fall prevention interventions to reduce the risk of falling by modifying fall risk factors. For example, in the study conducted by Liu-Ambrose and colleagues (109), changes in fall risk as a result of improved balance and muscular strength were seen only after 13-weeks of training. Evaluations of the cost effectiveness of a fall clinic compared to usual care are also needed.

The key challenge to improve the standards of patient care is to close the gap between what is known and what happens in clinical practice. This has been referred to as the

knowledge-practice gap (121). The first gap between research and clinical practice was bridged by the creation of the AGS guidelines. An informal survey of the ED staff at VGH upon completion of this present study demonstrated that this group was generally unaware of the AGS guidelines. This indicates that the second gap to bridge is that between clinical protocol and protocol implementation. While it is the responsibility of health care workers to stay informed of new and emerging medical practice, this is very difficult as a result of the large amount of continually emerging evidence. Thus, both public and private agencies must work together to disseminate research results and guidelines to professionals and the public.

The special report from Provincial Health Officer of British Columbia titled "Prevention of Falls and Injuries Among the Elderly" in January 2004 was BC's attempt to disseminate falls research to health care professionals and the public (27). While the report provided specific recommendations for health care professionals, physician recommendations were targeted to the family physician in particular. The present study indicates that older patients presenting to the ED with a fall represent a high-risk group who require targeted assessments and intervention strategies during the ED presentation. These findings need to be incorporated in future reports and recommendations to increase ED health care workers' awareness of older fallers presenting to EDs across the province so as to provide appropriate fall prevention management.

5.1.6 Rewriting the AGS Guidelines

The AGS, British Geriatrics Society and American Academy of Orthopaedic Surgeons have provided the first international falls prevention guidelines. As noted in this present study, however, guidelines are not yet being integrated into routine practice. Specific recommendations for different health care settings and/or prioritizing components of the assessment and interventions may help health care practitioners better implement the guidelines into practice. Alternatively, the large number of guideline elements may need to be broken down into smaller clusters and delivered sequentially in a series of physician visits. In this model a fall could initiate a 3-visit series to the FP where the first visit consists of fall risk assessment and the request for a DXA scan, the second for review of the DXA scan and strength and balance prescription, the third for medication rationalisation, discussion of the home environment with respect to hazards, and

appropriate specialist referral as needed. Such a model would be appropriate for further research in this field and would be strengthened by partnership with a health-economist. In the opinion of a geriatrician conducting falls research, the AGS guidelines for fall assessment (123) could be prioritised as follows:

1. History of the fall(s) circumstances and any previous falls looking for a trend;
2. Past health & medication use (standard component of any medical assessment);
3. Gait & balance evaluation;
4. Neuromuscular examination;
5. Musculoskeletal Exam;
6. Cognition & mood evaluation;
7. Functional level assessment;
8. Cardiovascular evaluation.

With respect to interventions, the same geriatrician agreed that a multi-factorial intervention has advantages over a single intervention as falls can result from multi-factorial syndromes; however, researchers are still unsure which interventions are the best and how they all work together. If aiming to prevent falls at an individual patient level, a detailed assessment is likely most beneficial; however, for fall prevention programs in populations whose fall-risk is unknown, the best evidence for effectiveness is with exercise as an intervention (94, 109, 110, 124). Here is a possible priority list of AGS interventions based on an individual assessment:

=1 Treatment of cardiovascular disorders;
=1 Balance / strength training;
3. Advice on appropriate use of walking aids;
4. Gait training;
5. Medication modification;
6. Visual intervention;
7. Footwear modification;
8. Environmental modification;
9. Behavioural modification;
10. Bone strengthening medications.

Balance and strength retraining and cardiovascular evaluation were weighted equally as no amount of balance and strength training will benefit the patient if the cause of the fall is related to a cardiovascular problem (e.g., loss of consciousness) (125), (34). It is impossible to prioritize the guidelines so that one arrangement fits every clinical situation. While this prioritization may prove useful for larger groups, ultimately, management should be guided by the cause of the fall. Packaging assessment and interventions based on feasibility and timing for implementation in primary care settings may also be another method of presenting the guidelines. Future research should investigate the best combinations of assessments and interventions to provide this population with the best preventative care.

5.1.7 Physical Activity as an Important Intervention to Prevent Falls

Physical activity was not prescribed by any health care practitioner to prevent subsequent falls. Physical activity is strongly associated with reduced risk of major diseases effecting all ages of our population including heart attack, stroke, diabetes and cancer (126). Additionally, falls research has consistently demonstrated that exercise can effectively reduce both fall risk factors and falls in older people by amending physiological impairments. Various meta-analyses (28, 94, 127) and the Cochrane Collaboration (127) showed that strength and balance training reduces falls. The 2003 Cochrane review of interventions for preventing falls in elderly people(127) indicated beneficial interventions including Campbell and colleagues' (93) home program of muscle strengthening and balance retraining and Wolf and colleagues' (92) Tai Chi group exercise intervention. The meta-analysis of four trials conducted by Campbell and colleagues (36, 93, 108) found that the home-based exercise program was most effective in reducing fall-related injuries in those 80 and older and resulted in a higher absolute reduction in injurious falls when offered to those with a history of a previous fall (94). A pre-planned meta-analysis of the FICSIT (Frailty and Injuries: Cooperative Studies of Intervention Techniques) concluded that treatment arms including exercise for elderly adults decreased the risk of falls (91) while activities such as Tai Chi Quan (92) and a home-based strength and balance training program (93) reduced the incidence of falls in community dwelling older adults. Also, Lord et al., (124) demonstrated that a community-based general exercise program improved balance, muscular strength and reaction time in older women. A recent investigation by Liu-

Ambrose and colleagues (14), demonstrated that both resistance and agility training effectively reduced fall risk factors in a cohort of older, community dwelling women with low bone mass. While researchers are still not sure of all of the dimensions (frequency, intensity, type, duration) for exercise prescription various protocols have reduced falls. In light of the evidence for beneficial effects of exercise, why is exercise not commonly prescribed by physicians? Must exercise come in the form of a tablet that a patient picks-up from the pharmacy for it to be prescribed in practice? I found no evidence of investigation of physician's prescribing habits. Future investigations may wish to examine physicians' awareness and prescribing habits of exercise for the older population. Presently, our research group is conducting an investigation of a home-based exercise program in a similar population of ED fallers. Not only do we hope this endeavour will improve ED staff's awareness of older fallers and the options available to reduce the risk of falls, but we hope this intervention will prove cost-effective as an intervention to reduce falls in this high risk population.

5.1.8 Implementing Guideline Care

The AGS guidelines were created to assist health care professionals who care for older fallers but this thesis highlights that guideline care is not reaching patients. Dr. Susan Curry, a researcher in Seattle, Washington, indicated that while it is tempting to focus accountability for the success or failure of guideline implementation on physicians, effective guideline implementation involves multiple levels (118). For example, providers will fail to implement guidelines that they do not find credible, that are too complex, that require clinical systems or other resources that are not accessible and that are radically different from prevailing treatment norms (118). Additionally, patients can undermine their physician's ability to implement the guidelines if they are unable or unwilling to access the necessary treatments. A number of these scenarios were encountered in the present study. Curry (118) indicated that organizational-level strategies can address many of these barriers including building a system for guideline implementation. Sonnad (128) outlined such a model that includes the following challenges to overcome for successful guideline implementation:

1) Motivation for adopting the new guidelines: Are the guidelines to be implemented because of government policy or voluntary adoption?

2) Connection to the strategic plan of the organization: Is the ED's role to provide older people with guideline care or just to treat acute illness and injury?

3) Lack of connection between developers and users of the guidelines: The AGS guidelines were not presented in a journal that is commonly accessed by the majority of the health care professionals involved in the care pathway of these patients (e.g., ED staff, orthopaedic surgeons, family physicians, physiotherapists)

4) Organizations need explicit implementation steps according to their structures and cultures: The ED is primarily an acute care setting meaning guidelines need to be fast and efficient.

5) Organizations need explicit implementation measure to track implementation of the innovation: Many health care professionals come in contact with the older patient in the ED setting and beyond.

Specific recommendations to tackle these challenges include:

1) Making guideline adoption an organizational priority and generating ideas for how to implement it;

2) Bringing the right people and resources to the table to align the guideline with the overall strategic plan of the organization;

3) Defining specific measurable outcomes (goals) for the guideline;

4) Assimilating the guideline through ongoing monitoring that is part of the organization's existing financial and/or quality assurance operations (128).

These recommendations could be adopted for the falls guidelines should the VGH organization commit wholeheartedly to implementing them. The data from this thesis highlight the clinical importance of preventive measures in this particular population.

More than 40% of all medical expenditures are for people over the age or 65, as a result, the quality of care provided to this population has been investigated (121, 122). Quality of care is particularly important to this older population as they prioritize function and comfort over disease treatment and prolongation of life (129). Wenger and colleagues (129), argued that efforts to improve care for vulnerable older adults should focus on the geriatric conditions that profoundly influence functional status. Falls are symptoms of underlying conditions that influence functional status (122) and, they are a very visible marker for directed assessments and management to improve the functional status of older adults. The present study is another step in the research needed to investigate the care of older fallers presenting to the ED. There is a great need for screening and prevention, patient and caregiver education, followup care and co-ordination of services. In order to satisfy this need, Reuben and colleagues (121) recently developed an intervention aimed at improving the care that primary care physicians provide for three geriatric conditions – falls, urinary incontinence and cognitive impairment. This condition-specific intervention employs four methods of changing medical practice: efficient collection of condition-specific clinical data, medical record prompts to encourage performance of essential care processes, patient education materials and activation of the patient's role in followup, and physician decision support and physician education (121). The effectiveness of this intervention in improving the processes of care and clinical outcomes for all three conditions still needs to be evaluated in clinical trials (121). In the near future, 20% of the population will be older than 65 years or age (130). The evidence for fall prevention exists and methods of intervention have been created, but older people are still not receiving guideline care. Researchers and health care professionals need to continue to work towards determining how best to provide this care to older adults in order to ensure quality of life to these patients and minimal government cost. Results of such investigations must not only indicate the deficits, but provide methods to implement and sustain changes to geriatric care.

5.1.9 Screening Patients to Provide Targeted Guideline Care

Falls are not always the result of an underlying physiological or psychological problem -- random events sometimes play a role. Providing guideline care to every person over the age of 70 who presents with a fall is neither economical nor necessary. Therefore, identifying people with modifiable risk factors for future falls is a more rational approach. To target the highest risk group, effective screening tools are important. An evaluation of the 5 participants in this study who suffered a fracture within the 6-month observational period revealed the following commonalities: 1) All five had osteoporosis (four previously diagnosed, one diagnosed shortly after the index fall presentation (14 participants in this cohort had osteoporosis); 2) All five were women (14 participants in this cohort were female and had osteoporosis); and, 3) All five were taking at least 4 prescription medications (7 participants in this cohort had osteoporosis, were female and taking four or more medications). While the numbers in this present study are too small to make any conclusive screening recommendations, if an ED screening procedure that automatically provided guideline care to older adult fall presentations with a confirmed diagnosis of osteoporosis, 14 guideline assessments would have been performed capturing all 5 women who fractured.

5.1.10 Cost-Benefit Analysis

While the AGS guidelines may be the gold standard for care of older fallers (131), its cost-effectiveness as a method of assessment and prevention must be examined and this point is made in the guidelines. Meticulous clinical evaluation and care may be more costly than an effective home exercise intervention program. To provide some preliminary understanding of the health care cost of the AGS guidelines and the health care cost of this study's cohort, a cost-benefit analysis is being undertaken separately.

5.2 Secondary Variables of Interest

5.2.1 Participant Characteristics

The first indication that this population was at higher risk of falls than the average community dwelling population was evident by the number of participants reporting a fall in the previous year. Fifty percent of participants reported at least one fall, which is similar to the results in a similar UK cohort - the PROFET study (8), where 65% of participants reported at least one fall in the year prior to the index fall. Both studies report significantly higher numbers of fallers compared to the commonly quoted figure of 33% for community-dwelling adults of comparable age (132).

Participants who refused to participate in this study or who I was unable to contact were older than those who took part (mean age 81.8 ±5.2 years). Participants who were excluded due to a language barrier exhibited little age difference from the population investigated in this study (mean age 79.8 ± 6.9). Participants who were excluded because of dementia, institutional care or admission to hospital were also older than the participating group (mean age 83.5 ± 7.0). Approximately 55% of excluded participants fell into this latter category indicating that falls are a problem in this population and should be investigated in future studies. Thirty-six percent of excluded participants were admitted to hospital for reasons pertaining to the fall. While admitted patients were excluded from this study because they follow a different care pathway than those discharged from the ED, it is not known if these patients were provided with AGS guideline care. Future studies should evaluate adoption of guideline care and clinical outcomes in this population. The results of this study can only be generalized to the population of community-dwelling older adults presenting to VGH and subsequently discharged.

The purpose of this study was to describe the population of community dwelling older adults presenting to the ED with a fall or related injury. During the course of the 6-month observation period, three participants presented with symptoms and were subsequently diagnosed with diseases implicated in falls including Parkinson's disease, Primary Lateral Sclerosis and cancer (participant died within the 6-month observational period).

These participants' data were not excluded from the analyses as their disease was not diagnosed at baseline. When the analyses were completed with these participants' results removed outcomes did not differ from those of the all-inclusive analysis.

The baseline interview was performed in 87.0% of participants' homes while the 6-month followup interview was performed in 98.0% of participants' homes. I incorporated the home visit into the study protocol after one week of attempting to recruit participants to return to the hospital for the baseline interview. Even though this protocol offered to arrange and cover all transportation costs, only one participant was recruited during this period. The common reason for not wanting to participate was the concern about finding the location for the study within the hospital. VGH is the largest hospital in British Columbia, and its numerous buildings and construction are a challenge for this population. Offering the home visits dramatically improved recruitment and also captured a wider range of the population. Additionally, the portability of the PPA allowed the study to proceed without any protocol changes. As a result, the population described in this study better represents the community-dwelling population presenting to the ED with a fall. Future studies that assess this group may also wish to perform home evaluations.

5.2.2 Characteristics of the Index Fall

Women accounted for 72% of fall-related presentations during the recruitment period which is consistent with findings by Bell et al. (7) and Close et al. (8) where 61% and 67% of presentations were women respectively. These numbers likely reflect the larger proportion of women in this age group and the predisposition of women to suffer a serious injury as a result of a fall due to higher prevalence of osteoporosis (133). Other investigations of community-dwelling populations have also demonstrated higher fall rates in women than men (134),(18). Similar to the results by Bell et al. (7), participants in this study had a high injury rate with 50% of falls resulting in a severe injury and 20% of falls resulting in moderate injury. These data demonstrate that a presentation to the ED for a fall is likely precipitated by the injury sustained in the fall, not necessarily a concern for the reasoning behind the fall. A lower injury (severe) rate (37-38%) was reported by Close and colleagues (8). This result is likely due to Close (8) defining serious injury as fractures and dislocations.

Outdoor falls were more frequent than indoor falls with the sidewalk or street being the most commonly reported fall location. Recent initiatives in Victoria, British Columbia have identified sidewalk cracks and street curbs as potential trip hazards for older adults, especially those with visual impairments (135). As a result, city councils have spent time and money painting street curbs and repairing sidewalk to improve awareness of these hazards. Tripping was the mechanism for 68% of falls occurring on the sidewalk or street in this present study. The remaining participants fell as a result of cardiovascular problems (n=1) and loss of balance (n=5). PPA fall risk scores for those who tripped ranged from -0.30 to 3.68 with a mean value of 1.2 (± 1.1). While these participants exhibited lower fall risk scores (i.e., better health) than the remainder of the cohort, they still possessed a moderate risk of falling. In combination with a targeted strength and balance program (14, 93), repairing hazardous sidewalks or marking curbs and cracks may help to reduce ED presentations resulting from a trip on the sidewalk or street.

Cardiovascular instability has been identified as a mechanism for causing unexplained falls (125). At least one cardiovascular disorder was present in 57.4% of participants in this study with 2 participants being hypotensive and 22 participants, hypertensive.

Three participants were investigated by a cardiologist following the index fall, two as a result of an ED referral while the third participant had a previously booked appointment at the time of the fall. This third participant experienced a syncopal episode which resulted in a fall. This participant was already waiting to have a pacemaker (definitive treatment for syncope) inserted at the time of this fall. Kenny and colleagues (125) in Newcastle, UK, have shown that cardiac pacing (pacemaker) reduced falls in older adults with cardioinhibitory carotid hypersensitivity (CSH). They found a strong association between non-accidental falls and CSH and also noted that patients experiencing nonaccidental falls are not usually referred for a cardiovascular assessment. The present study noted a similar finding as only 18.8% of the participants who reported non-accidental falls (n=16) (conscious collapse, loss of consciousness or unknown) were referred for a cardiovascular assessment by the ED. The results of the study conducted by Kenny and colleagues (125) provided evidence indicating that CSH should be considered in all older adults who present with non-accidental falls but these data post-dated the AGS guideline publication. Future revisions of the AGS guidelines may wish to create categories of guideline care based on the fall mechanism with which the patient presents. Such a revision may lead to targeted, efficient care of fallers presenting to the ED or any other health care professional.

Over the 6-month observation period, 33.3% of participants fell (34 falls) with 17.6% of participants falling more than once and 13.7% reporting a fall requiring medical attention. When adjusted for length of followup, these numbers are very similar to those reported in the PROFET study where after one year of followup, 52% of the control group reported a subsequent fall with 26% reporting three or more falls (8). Among these fallers, 8% reported a serious injury. Campbell and colleagues' (93) study of a home-based exercise intervention to prevent falls in women aged 80 years and older demonstrated that 40.8% of the control group fell again within 11.3 months of followup. While followup in the present study only spanned 6-months, 33.3% had already experienced a subsequent fall. Additionally, the cohort of this study was younger than Campbell's cohort with a mean age of 78.5 (± 5.7) years compared to 84.1 (±3.4) years. Thus, individuals presenting to the ED secondary to a fall appear to be at a greater risk for subsequent falls than 'normal' community-dwelling older adults. Put another way, ED fallers have a fall rate like a much older group of community-dwelling older people.

Polypharmacy and the use of certain medications increase risk of falls (136). Participants in this study who experienced another fall within the 6-month observation period were taking an average of 4.9 (±3.0) prescription medications at baseline. Comparatively, participants who did not experience another fall within the 6-month period were taking an average of 2.6 (±2.1) prescription medications at baseline. As previously indicated, all five participants in this study who suffered a fracture as a result of another fall were taking at least four prescription medications. Leipzig and colleagues (113, 137) reported that older adults taking more than three or four medications were at increased risk of recurrent falls. The present study results are consistent with larger studies that suggest patients' prescribed numerous medications warrant attention for falls prevention.

Medications implicated in elderly falls include psychotics (benzodiazepines, antidepressants, neuroleptics, non-benzodiazepines sedatives), anticonvulsants and cardiovascular medications (diuretics, digoxin, Type 1A antiarrhythmics) (113, 136, 137). Thirty-one (57.4%) of participants in this present study were taking at least one of these medications upon presenting to the ED. In total, 10 participants had their medications changed, 5 during the index fall presentation to the ED, 3 by their FP and 2 by their cardiologist. All of the medications changed were those implicated in falls. Kelly and colleagues (136) demonstrated that the taking of certain medications was an independent predictor of sustaining an injurious fall in an older community-dwelling population. The combination of medication and physiological deficits resulting from disease or natural ageing are intrinsic factors that need to be identified in this high-risk population of older emergency department fallers. All three participants who were discharged from the ED and who returned to the ED within 24 hours of their initial fall had medication implicated in their fall. All three of these participants did not have their medications changed during the index ED visit, but required a further ED attendance before the medications were identified and changed. This result suggests medication should be carefully scrutinized during a fall-related ED visit.

5.2.3 Physiological Profile Assessment: Fall Risk

The standard of care provided by the routine medical management pathway initiated by a fall presentation to the ED did not reduce fall risk. Participants in this study showed a significant increase in fall risk from 1.73 to 2.24 standard deviations over the 6-month observation period. This increase represents a change from a moderate risk of falling to a marked risk of falling (12). There are several possible reasons for this significant increase as aging alone does not explain such a large change. The major contributing factor may be the index fall itself. The fall experienced by participants in this study was severe enough to cause each participant to seek emergency medical attention and may affect patients' mobility (e.g., strength and balance). While this is the first study to use the PPA to investigate participants' physiological changes after presenting to the ED with a fall, the control group of Close's investigation (8) also demonstrated declines in certain physiological measures (8). Future investigations of guideline care should investigate if fall risk is modified by guideline care.

5.2.4 Functional Ability, Balance Confidence & Depression

A similar pattern of deterioration was seen in functional ability as measured by the Barthel Index, fear of falling as measured by the Activities Specific Balance Confidence Scale and depression as measured by the Geriatric Depression Scale. In the study conducted by Close and colleagues (8), participants in the intervention group were provided with a detailed medical assessment followed by an occupational therapy assessment and referral to relevant services. After a one year followup, participants in both the control and intervention groups demonstrated significant decreases (worsening) in Barthel scores with the control group demonstrating a significantly greater decrease compared with the intervention group. Age clearly influences this variable in my observational study but does not explain the greater control versus intervention differences in Close's study (8).

Fear of falling is a common psychological consequence of falling and a common fear among older adults who have not experienced a fall. Three participants in this study who were determined to be at risk of falling as measured by PPA and who subsequently fractured (2 hip, 1 pelvic) demonstrated interesting ABC scores. One participant

reported 0% confidence for all 16-items while the other two participants reported 100% confidence for the same items. While low balance confidence has been associated with falling, I cannot explain the relationship between the overly confident participants and their subsequent fall and fracture. While the discordance between poor baseline fall risk score and high balance confidence may indicate that the participants did not understand the questionnaire or that they both had some cognitive impairment, neither was evident at the time of the baseline interviews. Additionally, this discordance might suggest that the participants tended to engage in risky behaviour which would have been captured in the fall mechanism itself. Again, review of medical records indicates that both fractures resulted from a low trauma fall not indicative of risky behaviour. Liu-Ambrose and colleagues (109) also noted that some participants exhibited discordance between change in ABC score and change in fall risk as measured by PPA. One participant had, however, recently lost her spouse and demonstrated severe depression as measured by the geriatric depression scale at the time of the baseline interview. Research has implicated depression as a falls risk factor (78), (61). Whooley and colleagues' (80) prospective study of 7414 community-dwelling women reported that those with depression exhibited a higher risk of hip fracture. While the mechanism underlying depressive symptoms and fall risk have not been fully assessed(34), it has been suggested that older people who suffer from depression are less likely to be involved in physical activity, and are therefore, at greater risk of falls due to reduced muscular strength, coordination and balance (79). Further investigation to determine the mechanism underlying falls in people with depression may help to provide this population with targeted

This population demonstrated a significant increase in fear of falling over the 6-month observation period suggesting that the decline in functional ability is accompanied by a corresponding decline in balance confidence. Had both parameters not changed, participants would be considered at greater risk of falling as their confidence would not match their physical abilities, thus, placing them at a greater chance of participating in risky behaviour that may cause a fall. Resistance and agility training can improve an individual's fall risk score and corresponding balance confidence (109) and such an intervention may be appropriate in this population to prevent future falls.

Participants demonstrated a significant decrease in balance confidence over the 6-month period. The median ABC score for this group at baseline was 82.5. According to Myers and colleagues (138), ABC scores of 80 or above are indicative of highly functioning, physically active older adults. While these scores are high, considering the population just experienced a fall, this is likely reflective of the functional level of this population. Despite the fall, they are still community-dwelling and were considered well enough to be discharged from the ED after the presentation. Over the 6-month observation period, this score dropped to 71.3. This indicates a decrease in the level of function and physical activity (139). While the significant decrease in functional ability was noted (Barthel Index, assistance required for activities of daily living), similar changes in physical activity were not as evident. This may be in part a reflection of the measure used to determine PA in this population. The PA questionnaire used allowed us to compare results against a large international fall study where a similar level of activity was noted in the group of fallers (17). This questionnaire provides a descriptive account of participants' PA. While I chose to describe participants' changes in physical activity, chi-square analysis could be used to examine changes in physical activity.

To my knowledge, this is the first study to describe the depressive state of older people presenting to the ED with a fall-related concern. Participants demonstrated a significant worsening of their depressive symptoms as measured by the Geriatric Depression Scale; however, the majority of participants' scores did not result in a positive screening result (i.e. score of 5 or above). At baseline, 7 of the 51 participants who remained at 6-months recorded scores greater than 4 while more than 50% of participants (n=33) reported scores of zero (a score greater than 4 indicated some level of depression). These 7 participants were either housebound, had a more than 3 co-morbidities, had experienced a significant life event in the past year or some combination of these. Four of these participants experienced another fall within the 6-month observational period with one fall resulting in a hip fracture. At the 6-month interview, similar results were noted with the only differences being participants who showed previous signs of depression elevated their scores, participants who moved to an assisted living facility or nursing home increased their scores and the loss of a spouse dramatically increased a participant's score. Additionally, the participant who sustained a fractured pelvis and died had a score indicating depression at baseline. Depression has been implicated as

a risk factor for falling (34). The GDS is a fast, simple tool that could be used in a fall clinic or ED setting as a screening tool for depression.

5.2.5 Physical Activity

To my knowledge, the physical activity level of community dwelling older adults presenting to the ED with a fall has never been documented. The baseline interview took place on average 13.6 (± 4.8) days after the index fall presentation. At this time, a number of participants were still nursing injuries that resulted from the index fall. This may account for the increase in the number of participants involved in at least one weekly organized physical activity over the 6-month observational period. Participants who were physically inactive, meaning they did not participate in weekly organized physical activity and did not walk for exercise (n=14) had a mean baseline fall risk score of 1.9 (± 1.6) with 8 reporting another fall within the 6-month observational period. This sub-group of physically inactive seniors reported a higher mean fall risk score than the rest of the cohort. While I did not test statistical significance, participants in this study who were more physically active had a lower mean fall risk score and had a lower ratio of falls to number of people.

5.2.6 Living Arrangements & Assistance Required Within the Home

Living arrangements and assistance required within the home changed for a number of participants over the 6-month observation period. In general, participants sought more assistance from sources outside the home (i.e., home care, meals on wheels, cleaning service) to assist with household tasks (i.e., shopping, cleaning) and activities of daily living (i.e., bathing, dressing). This increased demand in outside services was reflected in the functional decline by the Barthel Index. In terms of living arrangements, three participants living independently at baseline fell and sustained a fracture within 6-months. One of these participants moved to a nursing care facility (hip fracture), one moved to an assisted living facility (wrist fracture) and one died. At the time of the 6-month interview, the second participant who sustained a fall-related hip fracture and wrist fracture within the 6-month period was in the process of making the arrangements to move to an assisted living facility. The participants who moved to an assisted living facility or nursing home over the 6-month observational period did not exhibit lower

functional ability than those who remained living independently. However, at the 6-month interview, this group included two of three participants who had the highest depression scores (indicating severe depression) and had a mean functional score of 59.5 (±13.0). A major societal challenge is to keep the older population living safely in independent dwellings for as long as possible. The present study and other studies (8), (125), (9) have already demonstrated that the ED is an ideal place to identify a group of high-risk older adults. Falls experienced by older adults have already been identified as a sentinel event leading to a cascade of events including decreased mobility, decrease functional ability and increased susceptibility to disease (3). Since 19.6% (n=10) of this cohort moved to a care facility within 6 months of the fall but only one received partial guideline care for the index fall, future investigations of guideline care and other preventative falls interventions should investigate the effect these programs have on older peoples' ability to remain living independently. A positive effect on this factor would contribute evidence for government funding agencies to provide the resources to institute province-wide fall clinics or other preventative programs.

5.2.7 Significant Life Events

A number of participants experienced a significant life event in the time leading up to the index fall and during the 6-month observation period. For the purposes of this study, a significant life event is any stressful or emotional event. Such events can lead to increased depression and a resulting increased risk of falls(34). With aging, negative significant life events become more frequent as deaths of friends and family and changes in living arrangements are more likely to occur. In the year prior to the ED fall presentation, 11 participants experienced a significant life event including the death of a spouse (n=3). Additionally, 12 participants experienced a significant life event during the 6-month observational period. A fall that is serious enough to require a visit to the ED has been identified as a significant life event for older people (3). The combination of a fall and another event can have a major impact on the lives of older people. In this present study, 7 participants who reported a significant life event prior to the ED presentation or during the 6-month observation period had a subsequent fall within the observation period. This captures 41% of the cohort who had a fall in the 6-month observation period. While the population of older fallers itself is a high-risk population, a subpopulation of ED fallers who have experienced an additional significant life event

may have greater risk of another fall. This will need to be tested in an appropriately designed cohort study.

A number of factors may have precipitated the changes previously discussed in this study's cohort from baseline to 6-months. While I hypothesize that the index fall (and its underlying causes) was major contributor to the changes noted in this cohort, there are other possible contributing factors. A number of these contributors have already been discussed including changes in living arrangements and experiencing a significant life event. In terms of the index fall, however, it may be the severity of the fall that contributed to the changes. All participants in this study experienced a fall that caused enough concern or resulted in a serious enough injury to cause them to seek medical attention in the emergency department. As a result of these injuries and concerns, participant may have reduced their activity immediately following the fall to result in the noted physiological changes. Similarly, the seriousness of the fall and concerns about another fall may have precipitated the noted psychological changes (i.e. decreased balance confidence as a consequence of falls). Future investigations of this population should include a control group to investigate the effects of the fall on these physiological and psychological changes.

As previously indicated, other significant events experienced by participants including the death of a spouse or having a serious illness may have also caused these functional declines. Ageing itself may have also played a role. The impact of ageing on the physiological measures taken in this study is described earlier in this thesis. The impact of ageing on the physiological measures noted in this study cannot be determined since no control group was recruited. If determining the effect of ageing was a primary concern in this cohort, this study should have recruited an age-matched control group of healthy, community-dwelling men and women who presented to the ED at VGH for reason other than a fall. Since ageing is confounded by diseases which are more prevalent with age and which cause falls, such a control group needs to be truly healthy. Future investigations wishing to rule out the effects of ageing alone in this population should recruit a healthy control population.

5.3 Exploratory Analyses

The analyses discussed in this section were conducted purely out of interest and to provide possible directions for future investigations of older fallers. Exploratory analysis showed no statistically significant association between the baseline PPA scores and fracture within 6 months. Nevertheless, the rate of hip fracture in the present cohort is well above the rate seen among the normal community-dwelling population (Table 14). The results of this study indicate that this population is a high risk group by both PPA and fall risk scores. While little difference was noted between baseline fall risk scores of participants who fell again within the 6-month period (mean 1.8 (±1.9)) and those who did not fall (mean 1.7 (±1.5), future investigations powered for falls should examine this relationship to determine if the PPA measure of fall risk (short form) is a tool that could prove to be a useful screening technique to identify patients who are likely to experience another fall in order to provide targeted fall prevention strategies aimed at the deficits demonstrated by the components of the PPA.

5.4 Strengths and Limitations of the Study

To my knowledge, this study is the first to prospectively evaluate the ED management of older fallers and relate this management to guideline care. While two intervention studies have studied an ED population, only one attempted to implement guidelines in the immediate ED setting and it met with little success. By detailing current management practices in the ED, this study provides basic information as to whether or not high-risk patients are receiving guideline care (including exercise prescription).

Studies of older adults are often unable to sample the entire continuum of health in that population. Older people who are sick or afraid to leave their home for fear of falling do not participate in research initiatives that require them to travel, often to busy hospitals in unfamiliar places. This proposal is unique in that it captures a wider range of the older population by offering participants the option of participating in the study at the VGH Research Pavilion or within their own home. Thus, results will be more applicable to the population investigated in this study.

Only one study has investigated the health of ED fallers, but it profiled only the immediate post-fall period (9). This study described the immediate post-fall risk profile of ED fallers in more detail than previous studies. In addition, this study investigated changes in these factors over a 6-month period.

Finally, followup of this cohort was nearly 100% complete with over 50% of eligible participants recruited to the study. This was in large part a result of providing participants with the option of having the interview at their own home.

Limitations of this study include:

1) *Missed Exclusion Criteria*: I attempted to exclude ED fallers with major underlying diseases that are known to result in falls in order to examine normal age-related declines in function known to increase the risk of falls; however, it is often difficult to differentiate between the effects of normal aging and the effects of pathology. As a result, three participants possessed deficits related to pathology that had not yet been expressed clinically.

2) *Exclusion of Non-English Speaking Patients*: Vancouver has the highest proportion of Asian people in all of Canada (130). Unfortunately, the limited budget of this study and time required to translate materials into a variety of languages required the exclusion of all participants who were not able to communicate in English. Future investigations may wish to access groups like United Chinese Community Enrichment Services Society (SUCCESS) for volunteers to assist with recruitment and translation.

3) *Exclusion of Hospitalized Fallers and Assisted Living Residents*: This investigation described the management and outcome of community-dwelling older people who presented to the ED with a fall and were subsequently discharged. I did not investigate fallers who were residents of a nursing facility or assisted living facilities. Similarly, I did not follow those ED presentations that required hospitalisation. These groups were excluded because they followed a different care pathway than

discharged patients. For example, hospitalized fallers receive daily physiotherapy during their hospital stay. Similarly, nursing care residents have 24-hour nursing care. Therefore, the results of this study cannot be applied to the entire older population.

4) *Exclusion of Community-Dwelling Fallers Not Presenting to the ED*: Although this study provides a description of fallers who sought medical attention at the ED, this study did not capture community-dwelling older adults who fall and do not present to the ED.

5) *Not Powered for Falls*: The primary outcome of this study was to determine the proportion of participants who received guideline care after attending the ED with a fall-related presentation. As a result, this study was not powered for falls and, therefore, cannot evaluate the relationship between fall-related risk factors and recurrent falls in this group. This study does, however, describe the guideline care, fall-related risk factors and subsequent falls in this group which is useful information for future investigations powered for falls in this ED setting.

6) *Documentation of Guideline Care:* While every effort was taken to accurately document each participant's care pathway beginning with the ED presentation, it was difficult to determine all portions of care. For example, not all physicians and nurses write down every examination or assessment performed on each patient. Some may rely on mental checklists. These examinations and assessments were not captured in this study. If a more detailed analysis of the treatment pathway for older fallers is required, interviews with health care workers caring for that patient after an assessment is complete may provide better information. This investigation could tend to cause health care workers to change the way they care for patients and thus, skew the results.

Additionally, while I made every effort to verify medical care by another source other than the medical care diaries and participant recollection of treatment, participants may have under-reported the true care received. In the case of this present study, however, this possible under-reporting highlights the need to involve the patient in

the care process (121). For example, if participants were frequently provided with a preventative intervention, an absence of reported interventions likely indicates that participants are not following or using the interventions provided by their health care professional.

CHAPTER 6: CONCLUSIONS, RECOMMENDATIONS & FUTURE RESEARCH DIRECTIONS

6.1 Primary Objective: Guideline Care

6.1.1 Conclusions

1) The population of older men and women presenting to the ED for fall-related medical care represent a population at high risk of further falls compared with data that represent community-dwelling norms.

2) Guideline care is not the standard of care provided to older people during the ED visit after a fall-related presentation.

3) Guideline care does not appear to be the standard of care provided to older people presenting to medical services subsequent to their fall-related ED presentation. This requires further investigation.

6.1.2 Recommendations

1) Fall assessment and prevention protocols need to be initiated within the ED setting.

2) Different methods of providing guideline care to older patients who present to the ED with a fall need to be investigated to determine which assessment and intervention combination works best with the ED setting while being cost-effective.

3) Further investigation is needed to determine the resources available to care for this population outside of the ED setting.

4) At numerous levels including government, health care workers and patients, there is a need for greater emphasis on improving awareness that fallers who present to the ED are not well managed.

6.2 Secondary Variables

6.2.1 Conclusions

1) The physiological profile of this group of older people presenting to the ED with a fall related complaint revealed a group at high risk for another fall.

2) Physiological deficits are not the only factors contributing to this group's high risk of falling. Functional ability, balance confidence and depression also worsened in this group over the observation period.

6.2.2 Recommendations

1) The PPA assessment tool should be further investigated in the ED setting to determine if it is an appropriate screening tool for use in this health care setting.

2) Interventions to prevent falls in this high-risk group should be multi-factorial to address all risk factors in this population.

6.3 Future Research Directions

In the process of conducting this study and writing this paper, the following issues were identified and should be researched to ensure this specific clinical population and the older population in general receives appropriate care for their fall upon presentation to any health care provider:

1) Is a home-based exercise intervention provided to this population an effective method of care to reduce falls? Is this method also cost effective? (i.e., effective in reducing falls and cost effective)

2) Why is exercise not commonly prescribed to older patients?

3) What is the best method, or is there a better method, of getting new and emerging evidence to health care professionals to further the practice of evidence based medicine?

4) What does the care pathway look like for patients who are admitted to hospital?

5) What is the relationship between age-related macular degeneration and falls in older people?

6) Can the AGS guidelines be tailored to specific health care professionals (i.e. emergency physician, cardiologist etc.) to provide specific evaluation protocols for their older patients to assess falls quickly and efficiently?

7) What is an effective screening method for older patients presenting to the ED with a fall-related complaint?

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APPENDICES

APPENDIX A: Letter of Invitation & Letter of Consent

APPENDIX B: Baseline Data Collection Forms & Measurement Tools

Baseline Interview
Emergency Department Data Collection Form
Modified CaMOS Questionnaire
Mini-Mental State Exam
Barthel Index (BI)
Geriatric Depression Scale (GDS)
Activities Specific Balance Confidence Scale (ABC)
Physical Activity Questionnaire
Physiological Profile Assessment (PPA) Data Recording Sheet
Fall, Medical Care & Physical Activity Calendar Title Page and Information Letter

Baseline Interview

To be administered in addition to fall screening measurements within 4-weeks of ED presentation.

Participant ID:_____Date:_____

Time Between Fall Presentation and Interview (days):_____

Mental Status (Mini-Mental) Score:_____ Interpretation:_____

Baseline Functional Status (Barthel) Score:_____ Interpretation:_____

Baseline Depression Status (GDS) Score:_____ Interpretation:_____

Baseline Balance Confidence (ABC): □ Complete

Baseline Physical Activity Questionnaire: □ Complete

Baseline PPA Fall Risk Score:_____ Interpretation:_____

CaMOS Questionnaire: □ Complete Baseline Interview & ED Record: □ Complete

Baseline Medical History

Have you had any falls since you came to the ED on _____(date)? □ Yes □ No If yes
Number_____
Did you seek medical attention (MA)? □ Yes □ No
If yes, form of MA_____

Have you been told you have osteopenia/osteoporosis? □ Yes □ No
If yes When?_____

Who?_____

Medical Care

10) Will you make any changes to prevent yourself from falling again? Please explain:

_____
_____
_____
_____

11) Why did you seek medical treatment in the ED for your fall?

□ To determine why I am falling and how to prevent it
□ For treatment of an injury I sustained in the fall
□ Other

Were you satisfied with your experience in the ED when you presented with the fall on (date of fall)? □ Yes □ No
Explain:_____
_____

Emergency Department Data Collection Form

Date ED	**Age DOB**	**MRN**
Date of Fall	**City**	**Ethnicity**
Time in ED	**Arrival ED ❑ W ❑ E**	**Admitted ❑ Yes ❑ No ❑ Died** **Discharge Location:**
❑INDPNT ❑INDPNT spouse/family ❑INDPNT with home care ❑Retire Home ❑Nursing Home ❑Unknown		
Chief Complaint	**Fall Location**	
Fall Mechanism		
Length of Lie **❑ None ❑ < 5 minutes ❑5mins to 1 hour** **❑ > 1 hour**	**Did patient get up unaided? ❑Yes ❑No ❑Unknown** **LOC ❑Yes ❑No ❑Unwitnessed ❑Unknown**	
Injury ❑Yes ❑No		
X-Rays ❑ Yes ❑ No		
Surgery ❑ Yes ❑ No		
Final Diagnosis ❑ None recorded		
Supine BP	**Sitting BP**	**Standing BP** **HR** **Mental State**
❑Arrhythmia ❑Depression ❑Diabetes ❑CVD ❑CHF ❑Hypertension ❑Hypotension ❑Osteoarthritis ❑Osteoporosis ❑Previous Fall ❑Any Previous Fracture (○Low Trauma ○High Trauma) ❑Previous Hip Fracture ❑Hip Replacement ❑ Stroke ❑ TIA ❑Visual Impairment ❑ Cataracts **❑ Macular Degeneration ❑Other_____**		

Current Medications		Meds Prescribed by EP	
Drugs	**Dose**	**Drug**	**Dose**

Discharge Plan
GP Referral ❑
Falls Clinic Referral ❑
Fall Risk Assessment ❑
Foot wear Assessment ❑
Home Hazard Assessment ❑
Medication Review ❑
Medication Change ❑
Mental State Assessment ❑
Occupational Assessment ❑
Orthopaedics Referral ❑
Osteoporosis Assessment ❑
Physio Referral ❑
Vision Assessment ❑
Other _____

No Plan Reported ❑

FALL HISTORY: Has this patient presented with a fall at VGH ED in the past? ❑ Yes ❑ No
Has this patient re-fallen since the above-recorded fall? ❑ Yes ❑ No

Previous Falls, Recurrent Falls or Return Visit for Previous Fall Complication

Previous Fall ❑ **Recurrent Fall ❑** **P. Fall Complication ❑**	**Previous Fall ❑** **Recurrent Fall ❑** **P. Fall Complication ❑**	**Previous Fall ❑** **Recurrent Fall ❑** **P. Fall Complication ❑**
ED Date	**ED Date**	**ED Date**
Fall Date	**Fall Date**	**Fall Date**
Chief Complaint	**Chief Complaint**	**Chief Complaint**
Fall Location	**Fall Location**	**Fall Location**
Fall Mechanism	**Fall Mechanism**	**Fall Mechanism**
Injury ❑ Yes ❑ No	**Injury ❑ Yes ❑ No**	**Injury ❑ Yes ❑ No**
Fracture ❑ Yes ❑ No	**Fracture ❑ Yes ❑ No**	**Fracture ❑ Yes ❑ No**
Surgery ❑ Yes ❑ No	**Surgery ❑ Yes ❑ No**	**Surgery ❑ Yes ❑ No**
Diagnosis	**Diagnosis**	**Diagnosis**

MODIFIED CaMOS QUESTIONNAIRE

To begin the interview, I would like to ask you general questions about yourself.

A. SOCIO-DEMOGRAPHIC INFORMATION

1.1 Date of Birth: _____/_____/_____ (Present age_____)
Day Month Year

1.2 In what country were you born? _____

1.3 How many years of school have you finished? (Mark the highest grade completed)

- □ Less than grade 9
- □ Grades 9-13, without certificate or diploma
- □ High school certificate or diploma
- □ Trades or professional certificate or diploma (CEGEP in Quebec)
- □ Some university certificate or diploma
- □ University degree

1.4 What is your current employment status?

- □ Employed full time
- □ Homemaker (full time)
- □ Employed
- □ Disability
- □ Retired → How old were you? _____years
- □ Other (specify_____)

1.5 Do you live alone? □ Yes □ No

If no, do you live with another adult?
□ Yes □ No

1.6 Do you have a particular doctor or clinic that you would call your regular doctor or clinic? □ Yes □ No

Physician/Clinic Name:_____

B. MEDICAL HISTORY

Now we'll review your medical history

2.1 Has a doctor ever told you that you have any of the following conditions?

Condition	Diagnosis			Treatment			
	Yes	No	DK	Yes	No	DK	N/A
Osteoporosis							
Rheumatoid arthritis							
Thyroid Disease: 1 = Hyperthyroidism 2 = Hypothyroidism							
Liver Disease							
Scoliosis							
Hypertension							
Heart attack							
Stroke							
TIA (Transient Ischemic attack)							
Macular Degeneration							
Glaucoma							
Neuromuscular Disease 1 = Parkinson's Disease 2 = Multiple Sclerosis 3 = Other							
Diabetes: Age_____ 1 = Insulin Dependent 2 = Non Insulin Dependent							
Peripheral Neuropathy (numbness)							

2.2 Which of the following surgeries have you had in the past? How old were you?

Surgery	Yes	No	Details
Joint replacement			
Other orthopaedic			
Other (list)			

2.3 Have you fallen in the past week? □ Yes □ No
If yes, how many times?_____

2.4 Have you fallen in the past month? □ Yes □ No
If yes, how many times?_____

2.5 Do you consume alcohol? □ Yes □ No
If yes (# drinks/time): ____/day ____/week ____/month ____/year

2.6 Have you ever had a Bone Density Scan? □ Yes □ No
If yes: Scan Date_____ Scan Results_____

2.7 When was your last eye exam?

2.8 Do you wear prescription lenses or contact lenses? □ Yes □ No

2.9 When was the last time you had an eye exam?
❑ Within the past year ❑ 1 ≥ 2 years ❑ 2 ≥ 5 years ❑ > 5 years ago ❑ Never

2.11 Have you ever had problems with your cataracts? □ Yes □ No
If yes, are you experiencing problems right now? □ Yes □ No

C. DRUGS AND MEDICATIONS

Now I will ask you about the medications you are taking

3.1 List the current medications or self-administered supplements you are taking on a regular basis.

Name	Dose	Frequency

D. FRACTURES

4.1 Have you ever fractured any bones? □ Yes □ No (if no, continue to part E)

If yes, complete the following table

Refer to picture of body skeleton if necessary)

Use the following trauma codes to indicate how it happened

1 = severe trauma – falling from greater than standing height, motor vehicle accident, skiing accident or hit by a moving object.
2 = minimal trauma – falling from a standing height or broke bone without injury or fall
3 = other disease

Incident(s	Trauma Code	Age (years)	BONE SITE										OTHER			
			BACK		RIBS		PELVIS		FOREARM/ WRIST		HIP		BONE SITE		BONE SITE	
			#	X	#	X	#	X	#	X	#	X	#	x	#	x

# = fracture
X = X-ray

E. TOBACCO

5.1 Have you ever used any of the following tobacco products daily for at leas6 months?

Cigarettes	□ Yes	□ No
Pipes	□ Yes	□ No
Cigars	□ Yes	□ No
Chewing tobacco	□ Yes	□ No

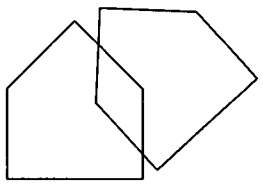
5.2 Complete the following table for each product used:

Product	Age Started	Currently Smoking	Age Stopped	Amount per Day	Temporarily Stopped (years)
Cigarettes					
Pipe					
Cigar					
Chewing Tobacco					

MINI-MENTAL STATE EXAMINIATION (MMSE)

Participant ID:_____ Date:_____

Max Score	Score	
		ORIENTATION
5	_____	What is the (year) (season) (date) (day) (month)?
5	_____	Where are we: (province) (country) (town or city) (hospital) (floor)?
		REGISTRATION
3	_____	Name 3 common objects (i.e., "apple" "table" "penny") Take 1 second to say each. Then ask the patient to repeat all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until he/she learns all 3. Make a maximum of 6 trials. Count trials and record. Trials_____
		ATTENTION AND CALCULATION
5	_____	Spell "world" backwards. The score is the number of letters in correct order (D_L_R_O_W)
		RECALL
3	_____	Ask for the 3 objects repeated above. Give 1 point for each correct answer.
		LANGUAGE
2	_____	Name a pencil and a watch.
1	_____	Repeat the following: "No ifs, ands, or buts."
3	_____	Follow a 3 stage command: "Take a paper in your right hand, fold it in half and put it on the floor."
		READ AND OBEY THE FOLLOWING
1	_____	Close your eyes
1	_____	Write a sentence
1	_____	Copy the following design



Total Score _____

THE BARTHEL INDEX

Patient Name: _____

Rater Name: _____

Date: _____

Activity	Score
FEEDING 0 = unable 5 = needs help cutting, spreading butter, etc., or requires modified diet 10 = independent	_____
BATHING 0 = dependent 5 = independent (or in shower)	_____
GROOMING 0 = needs to help with personal care 5 = independent face/hair/teeth/shaving (implements provided)	_____
DRESSING 0 = dependent 5 = needs help but can do about half unaided 10 = independent (including buttons, zips, laces, etc.)	_____
BOWELS 0 = incontinent (or needs to be given enemas) 5 = occasional accident 10 = continent	_____
BLADDER 0 = incontinent, or catheterized and unable to manage alone 5 = occasional accident 10 = continent	_____
TOILET USE 0 = dependent 5 = needs some help, but can do something alone 10 = independent (on and off, dressing, wiping)	_____
TRANSFERS (BED TO CHAIR AND BACK) 0 = unable, no sitting balance 5 = major help (one or two people, physical), can sit 10 = minor help (verbal or physical) 15 = independent	_____
MOBILITY (ON LEVEL SURFACES) 0 = immobile or < 50 yards 5 = wheelchair independent, including corners, > 50 yards 10 = walks with help of one person (verbal or physical) > 50 yards 15 = independent (but may use any aid; for example, stick) > 50 yards	_____
STAIRS 0 = unable 5 = needs help (verbal, physical, carrying aid) 10 = independent	_____
TOTAL (0–100):	_____

Geriatric Depression Scale Shortened Version

Participant ID:_____ **Date:**_____

INSTRUCTIONS
Undertake the test orally. Obtain a clear yes or no answer. If necessary, repeat the question. Cross off either yes or no for each question (depressive answers are bold/italicized). Count up 1 for each depressive answer.

Scoring Intervals 0-4 No depression 5-10 Mild depression 11+ Severe depression

1. Are you basically satisfied with your life? Yes ***No***

2. Have you dropped many of your activities and interests? ***Yes*** No

3. Do you feel happy most of the time? Yes ***No***

4. Do you prefer to stay at home rather than going out and doing new things? ***Yes*** No

If none of the above responses suggests depression, STOP HERE. If any of the above responses suggests depression ask questions 5-15.

5. Do you feel that life is empty? ***Yes*** No

6. Do you often get bored? ***Yes*** No

7. Are you in good spirits most of the time? Yes ***No***

8. Are you afraid that something bad is going to happen to you? ***Yes*** No

9. Do you feel helpless? ***Yes*** No

10. Do you feel that you have more problems with memory than most? ***Yes*** No

11. Do you think it is wonderful to be alive? Yes ***No***

12. Do you feel pretty worthless the way you are now? ***Yes*** No

13. Do you feel full of energy? Yes ***No***

14. Do you feel that your situation is hopeless? ***Yes*** No

15. Do you think that most people are better off than you are? ***Yes*** No

6-month Follow-up
Activity-specific Balance Confidence (ABC) Scale

Participant ID:_____ **Date:**_____
For **each** of the following activities, please indicate your level of self-confidence by choosing a corresponding number from the following rating scale. Answer all items even if there are activities you would not do or are unsure about.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Not Confident										Completely Confident

How confident are you that you will not lose your balance or become unsteady when you...

A)... walk around the house?_____ %

B)... walk up and down stairs?_____ %

C)... pick up a slipper from the floor?_____ %

D)... reach at eye level?_____ %

E)... reach while standing on your tiptoes?____ %

F)... stand on a chair to reach?_____ %

G)... sweep the floor?_____ %

H)... walk outside to nearby car?_____ %

I)... get in and out of a car?_____ %

J)... walk across a parking lot?_____ %

K)... walk up and down a ramp?_____%

L)... walk in a crowded mall?_____ %

M)... walk in a crowd or get bumped? _____ %

N)... ride an escalator holding the rail?_____ %

O)... ride an escalator not holding the rail?_____ %

P)... walk on icy sidewalks?_____ %

PHYSICAL ACTIVITY Questionnaire

Participant ID:_____ **Date:**_____

1. How much time do you spend in the following activities in an average week?

	NUMBER OF TIMES PER WEEK				
	NONE	1	2	3	4+
BOWLING	[ ]	[ ]	[ ]	[ ]	[ ]
GOLF	[ ]	[ ]	[ ]	[ ]	[ ]
TENNIS	[ ]	[ ]	[ ]	[ ]	[ ]
SWIMMING	[ ]	[ ]	[ ]	[ ]	[ ]
DANCING	[ ]	[ ]	[ ]	[ ]	[ ]
JOGGING	[ ]	[ ]	[ ]	[ ]	[ ]
BICYCLING	[ ]	[ ]	[ ]	[ ]	[ ]
AEROBICS	[ ]	[ ]	[ ]	[ ]	[ ]
OTHER _____	[ ]	[ ]	[ ]	[ ]	[ ]

	NUMBER OF MINUTES PER SESSION		
	LESS THAN 30	30-45	45+
BOWLING	[ ]	[ ]	[ ]
GOLF	[ ]	[ ]	[ ]
TENNIS	[ ]	[ ]	[ ]
SWIMMING	[ ]	[ ]	[ ]
DANCING	[ ]	[ ]	[ ]
JOGGING	[ ]	[ ]	[ ]
BICYCLING	[ ]	[ ]	[ ]
AEROBICS	[ ]	[ ]	[ ]
OTHER _____	[ ]	[ ]	[ ]

2. How often do you go on <u>planned</u> walks for exercise? (i.e. walking in the park, along the beach, in the streets, bushwalking, walking the dog etc)

Every day	[ ]
3-6 times/week	[ ]
Twice/week	[ ]
Once/week	[ ]
Never	[ ]

3. In these planned walks, how long do you walk for?

Less than 15mins/day	[ ]
15mins to less than 30mins/day	[ ]
30mins to less than 1 hour/day	[ ]
1 hour to less than 2 hours/day	[ ]
2 or more hours/day	[ ]

PHYSICAL ACTIVITY (Continued)

4. In addition to the exercise you mentioned above, how much time do you spend each day doing other physical activity such as climbing stairs, shopping and gardening? (Excludes housework and walking inside the house)

Less than 15mins/day	[ ]
15mins to less than 30mins/day	[ ]
30mins to less than 60mins/day	[ ]
1 hour to less than 2 hours/day	[ ]
2 or more hours/day	[ ]

5. How many hours would you spend on your feet each day doing tasks like housework, walking around the house and self care?

Less than 15mins/day	[ ]
15mins to less than 30mins/day	[ ]
30mins to less than 60mins/day	[ ]
1 hour to less than 2 hours/day	[ ]
2 hours to less than 4 hours/day	[ ]
4 or more hours/day	[ ]

6. On an average day, how long can you walk for before you need a rest?

Less than 5mins	[ ]
5mins to less than 10mins	[ ]
10mins to less than 15mins	[ ]
15 mins to less than 30mins	[ ]
30 mins to less than 1 hour	[ ]
1 hour or more	[ ]

DISABILTIY

1. Do you receive any help from the following community services?

Meals on wheels	Yes	[ ]	No	[ ]
Home help	Yes	[ ]	No	[ ]
Community nurse	Yes	[ ]	No	[ ]
Shopping service	Yes	[ ]	No	[ ]
Canadian Institute for the Blind	Yes	[ ]	No	[ ]
Other _____	Yes	[ ]	No	[ ]

2. Do you need help to carry out any of the following activities because of a disability?

Shopping?	Yes	[ ]	No	[ ]
Clothes washing and house cleaning?	Yes	[ ]	No	[ ]
Cooking?	Yes	[ ]	No	[ ]
Dressing?	Yes	[ ]	No	[ ]

PPA Data Recording Sheet

Participant ID:_____ **Date**_____

Melbourne Edge Test: _____

Proprioception: 1)_____ **2)** _____ **3)**_____

Touch Sensation: 1)_____ **2)** _____ **3)**_____

Reaction Time:

HAND	FOOT
T1	
T2	
T3	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Quadriceps Strength	Ankle Strength
1	
2	
3	

Eyesight:
High Contrast Chart: _____
Low Contrast Chart: _____

Sway

EONF	AP:	L:
ECNF	AP:	L:
EOF	AP:	L:
ECF	AP:	L:

Co-ordinated Stability: Corners_____ **Sides**_____

Maximal Balance Range:_____

APPENDIX C: 6 month Data Collection Forms

6-MONTH INTERVIEW

Participant ID:_____ Date:_____

1) Have you had another fall since in the past 6-months? YES NO

If Yes, acquire details for each fall on the fall history recording sheet (verify with calendar)

MEDICAL CARE SINCE THE INDEX FALL:
(If participant was referred to his/her FP by the ED during the baseline presentation)

2) My records indicate you were referred to your FP by the EP. Did you follow-up on this referral and make an appointment with your FP regarding the index fall? YES NO

If YES, did your FP do any of the following relating to the fall:

Refer you to a Fall Clinic Referral	YES NO
Perform a Fall Risk Assessment	YES NO
Perform a Footwear Assessment	YES NO
Perform a Home Hazard Assessment	YES NO
Review your Medications	YES NO
Change your Medications	YES NO
Refer you to physiotherapy	YES NO
Request a Bone Density Scan	YES NO
Perform or refer you for a Vision Assessment	YES NO
Other	YES NO

If any of the above were performed or recommended – Did you follow-up on the FP advice? YES NO
Explain

3) If NO, did you make an appointment with your FP without recommendation from the EP regarding the index fall? (verify with calendar) YES NO

If YES, did your FP do any of the following relating to the fall:

Refer you to a Fall Clinic Referral	YES NO
Perform a Fall Risk Assessment	YES NO
Perform a Footwear Assessment	YES NO
Perform a Home Hazard Assessment	YES NO
Review your Medications	YES NO
Change your Medications	YES NO
Refer you to physiotherapy	YES NO
Request a Bone Density Scan	YES NO
Perform or refer you for a Vision Assessment	YES NO

4) If NO, why did you not seek any additional care after your visit to the ED for the index fall?

_____

_____

_____

_____

OTHER:

5) Have your living arrangements changed in the past 6-months? YES NO
If YES, what are your new living arrangements?

6) Have you had any medication changes in the past 6-months? YES NO
If YES, record medication changes:

7) Have you suffered from any new ailments or had any medical procedures in the past 6-months (circle all that apply):

Arrhythmia Depression Diabetes CVD Hypertension
Hypotension Osteoarthritis Osteoporosis Fall CHF Fracture
(Low Trauma High Trauma) Surgery Stroke Cataracts
TIA Macular Degeneration Visual Impairment Other:_____

8) Have you had your vision checked in the past 6-months? YES NO
If YES, were any changes made to your prescription? YES NO
Describe:_____

9) Have you had a bone density scan in the past 6-months? YES NO
If YES, what were the
results?_____

10) Will you make any changes to prevent yourself from falling again? Please explain:
_____
_____
_____
_____

11) Why did you seek medical treatment in the ED for your fall?

□ To determine why I am falling and how to prevent it
□ For treatment of an injury I sustained in the fall
□ Other

Administer and record the results of the following questionnaires/test:

6-month Functional Status Score (Barthel): Score_____ Interpretation_____

6-month Depression Score (GDS): Score_____ Interpretation_____

6-month ABC Score: □ Complete

6-month PPA Fall Risk Assessment: Score_____Interpretation_____

6-month Physical Activity Assessment: □ Complete

6-month Follow-up Fall History

Participant ID:_____ **Date:**_____

How many falls have you had in the past 6-months?_____
(verify with calendar)

FALL #____ (use additional forms if more than 1 fall)

Fall Date:	Number of days since index fall:
Did you seek medical attention for the fall? YES NO If YES, where did you receive medical treatment? VGH ED GP Walk-in clinic Other Vancouver Hospital:_____ Other: If HOSPTIAL VISIT, were you admitted? YES NO Duration:_____ Did the medical professional you received treatment from do any of the following: Refer you to a Fall Clinic Referral YES NO Perform a Fall Risk Assessment YES NO Perform a Foot wear Assessment YES NO Perform a Home Hazard Assessment YES NO Review your Medications YES NO Change your Medications YES NO Refer you to physiotherapy YES NO Request a Bone Density Scan YES NO Perform or refer you for a Vision Assessment YES NO	
Fall Location:	
Length of Lie: None < 5 minutes 5mins to 1 hour > 1 hour	
Require assistance to get up? YES NO No Witness	Loss of Consciousness: Yes No Unknown
Fall Mechanism:	
Injury(s): YES NO	Fracture: YES NO
Surgery: YES NO	