Community-Based Physical Activity Following Rehabilitation in Chronic Disease

by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy
Rehabilitation Sciences Institute
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Abstract

The overlap in physical impairments and rehabilitative management for heart failure (HF), chronic obstructive pulmonary disease (COPD), stroke, and diabetes supports the potential for an integrated symptom-directed approach to long-term management and physical activity promotion. The main objective of this thesis was to align the evidence across conditions to allow for comparison of PA levels following rehabilitation and to evaluate whether individuals with HF, COPD, stroke, and diabetes experience similar barriers to PA following discharge from rehabilitation. The first study in this thesis showed that physical activity levels for diabetic adults with a transtibial amputation remain stable following discharge from prosthetic rehabilitation, but fall well below recommended guidelines of 150 minutes/week for adults with diabetes. In the second study, we found similarly low levels of physical activity following rehabilitation for individuals with HF and COPD. In this study, participants also expressed the need for minimally supervised community-based programs tailored to functional ability to support adherence to exercise and prescribed activity following rehabilitation. The third study identified similar perceptions across chronic conditions with respect to barriers to and facilitators of physical activity in the community. However significant differences were found between healthcare professionals and older adults with chronic disease with the respect to their perception of barriers. The findings from the three studies included in this thesis support the need for exercise maintenance programs following rehabilitation and the potential for an integrated approach to management.
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Chapter 1
Introduction

1 Introduction

1.1 Summary of the Problem

Heart disease (HD), stroke, and chronic obstructive pulmonary disease (COPD) inflict substantial financial and social burdens globally. In 2010 alone, these diseases accounted for almost 13 million deaths worldwide\(^1\) and over 245 million life years lost to disability and premature mortality\(^2\). They are the top three causes of global mortality in the category of non-communicable diseases\(^1\), and mortality trends project that these numbers will continue to rise into 2030\(^3\). Cardiovascular diseases, including HD and stroke, accounted for direct Canadian healthcare costs of 7.6 billion dollars in 1998, along with indirect costs of 13 billion dollars from productivity loss\(^4\).

Given the staggering and increasing burden of chronic disease on the healthcare system, there is a strong demand for more effective interventions and secondary prevention strategies. Modifiable risk factors are well established, and are at the heart of many public health efforts. One of the primary factors, physical inactivity was responsible for 5.3 billion dollars of Canadian healthcare costs in 2001\(^5\) and is a predictor of mortality in chronic disease populations\(^6\)-\(^9\). As such, optimizing physical activity (PA) levels is a key component in reducing the economic and human burden of chronic disease.

The type, timing and duration of exercise interventions also play a role in reducing the burden of disease. Short-term interventions have been an effective in addressing symptoms and improving quality of life in chronic disease\(^10\),\(^11\); however, effective long-term strategies to address declining PA levels in chronic disease populations are presently lacking. As PA levels have been shown to positively influence quality of life in community-dwelling older adults\(^12\), benefits of improved activity go beyond improved physical health to achieve a broader impact.
More specifically, the top three chronic diseases (HD, stroke, and COPD) currently affect more than one half of Canadians\textsuperscript{10}, and become more prevalent with age. Although formal rehabilitation fosters benefits in physical performance and quality of life\textsuperscript{11}, access is limited. Furthermore, those who do participate often experience functional decline following program completion\textsuperscript{13}, demonstrating the need for maintenance strategies to promote continued physical activity. Preliminary evidence suggests that community-based models for maintenance exercise may be effective in promoting long-term adherence to exercise\textsuperscript{14}. As non-adherence is a large contributor to functional decline\textsuperscript{14}, identifying factors impacting participation is integral to establishing successful, sustainable strategies for maintaining exercise and physical activity in chronic disease populations.

Given the inherent physiological differences across chronic conditions, this thesis focused on post-rehabilitation populations to minimize heterogeneity among participants. All participants included in this thesis completed a disease-specific, formal rehabilitation program, during which they were exposed to the knowledge and skills required to successfully manage their condition in the community.

The overall objective of this research is to address the issue of long-term sustainability of the functional gains made during rehabilitation for individuals with chronic disease following discharge from formal rehabilitation. Specifically, this thesis explored PA levels in chronic disease populations following discharge from rehabilitation. As chronic disease populations exhibit low levels of PA, this thesis also explored the barriers to and facilitators of engaging in community-based PA from the perspectives of individuals with chronic disease and their healthcare providers.

1.2 Literature Review

As this thesis draws on literature from multiple chronic diseases, the following review is divided into four main sections: 1) Overview of Chronic Disease; 2) Rehabilitation and Chronic Disease; 3) Overlap of Chronic Conditions; 3) Measuring Physical Activity; 4) Physical Activity Levels and Association with Clinical Measures; and 5) Barriers to Physical Activity.
1.2.1 Overview of Chronic Disease

Four chronic disease populations, including heart failure, stroke, diabetes, and COPD, were selected for inclusion in this thesis as they represent four of the top five causes of global mortality in the category of non-communicable diseases\(^1\). Furthermore, these conditions represent the primary diagnosis of participants in each of the major formal rehabilitation programs in Canada, including cardiac, neurological, prosthetic, and pulmonary rehabilitation.

1.2.1.1 Heart Failure

Heart failure (HF) is characterized by the heart’s impaired ability to pump a sufficient amount of blood into the circulatory system. This manifests as symptoms of exertional dyspnea, oedema, reduced exercise tolerance, and fatigue, secondary to underlying cardiac dysfunction\(^15\). Diagnosis is primarily clinical and relies on incorporating individual history, physical examination, and investigative tests\(^16\). As a result, severity is described using a combination of symptoms and exercise capacity according to the New York Heart Association (NYHA) classification\(^17\). The co-morbid nature of the patient population complicates clinical management and often precludes the recommendation of a single management strategy. Arthritis, depression, COPD, anemia, and atrial fibrillation are commonly cited co-morbidities in this patient population\(^18\). Hypertension, diabetes, metabolic syndrome, and atherosclerotic disease are key risk factors\(^18\), and as such are often the target of preventative strategies.

HF is the final stage of progressive heart disease, and prevalence rates of 6-10% have been cited for individuals over the age of 65\(^{19-21}\). Incidence increases with age, with rates significantly higher in men\(^21\) and African Americans\(^22\). The lifetime risk of developing HF is one in five\(^23\), with a 30% risk for individuals aged 55 and older\(^21\). Prognosis centers around a mean survival time of 2 years following diagnosis\(^21\). The global economic cost is an estimated $108 billion per annum\(^24\), with re-admission rates of 29-47% reported within six months of initial discharge from hospital\(^22\).

1.2.1.2 Stroke
Stroke is characterized by a focal loss of cerebral function that is attributed to a compromise in vascular supply\textsuperscript{25}. Dependent on location, severity, and medical management, individuals may experience symptom resolution, incomplete recovery, severe disability, or death\textsuperscript{25}. A common neurological consequence includes unilateral loss or limitation of muscle function, with subsequent deficits in mobility and overall function\textsuperscript{26}. These impairments translate into impairments in walking ability, muscle strength, and balance\textsuperscript{27}, which are often the target of therapeutic intervention. Risk factors are well understood, with hypertension, smoking, abdominal obesity, diet, and physical inactivity accounting for 80\% of global risk\textsuperscript{28}. Physical inactivity, a modifiable risk factor, is the second leading risk factor for stroke, with a population attributable risk of 28.5\%\textsuperscript{28}.

Despite improvements in medical management, stroke has persisted as a major cause of long-term disability, with a global average of over 102,000 life years lost to disability in 2010\textsuperscript{2}. Ischemic stroke represents the majority of etiology at a frequency of 67-81\%, with 68\% of this subtype attributable to large artery disease\textsuperscript{29}. Age-standardized prevalence rates range from 4.6-7.3\% in individuals over the age of 65\textsuperscript{29}. The lifetime risk of stroke is consistent across studies, with one in five individuals over the age of 55 at risk irrespective of gender\textsuperscript{30-32}. The burden lies in the long-term consequences, with a 23\% mortality rates within the first month after onset\textsuperscript{29}. Six-months following the acute stroke event, 33-42\% of stroke survivors require assistance in their daily activities\textsuperscript{33}, with 36\% remaining disabled five years later\textsuperscript{34}. Annual healthcare costs resulting from stroke reach over $2.8 billion in Canada, with disabling ischemic strokes affecting 49\% of the population and demonstrate a two-fold cost increase over non-disabling strokes\textsuperscript{35}.

1.2.1.3 Chronic Obstructive Pulmonary Disease

Chronic obstructive pulmonary disease (COPD) is characterized by the presence of expiratory airflow obstruction due to chronic bronchitis or emphysema\textsuperscript{36}. The natural course of COPD is that of progressive worsening of airflow limitation, repeated exacerbations, respiratory failure, and premature death. In addition to the pulmonary pathology, individuals with COPD develop systemic manifestations of the disease including peripheral muscle dysfunction\textsuperscript{37}, weight loss\textsuperscript{38}, osteoporosis\textsuperscript{39}, and
psychological problems such as anxiety and depression\textsuperscript{40}. These extra-pulmonary effects have a significant impact on the symptoms, quality of life, and mortality in individuals with COPD\textsuperscript{41}. Symptoms of dyspnea, anxiety, exercise intolerance, and fatigue are hallmarks of the disease, and often occur in clusters instead of in isolation\textsuperscript{42}. These individuals also frequently experience additional chronic co-morbidities including cardiovascular disease, cerebrovascular disease, lung cancer, and diabetes which influence long-term prognosis\textsuperscript{43}. Health promotion plays a strong role in prevention, as manageable risk factors for COPD are well-described, including exposure to cigarette smoke, environmental or occupational pollutants, recurrent pulmonary infections, and airway hyper-responsiveness\textsuperscript{44}.

Increasing with age, COPD prevalence is highest in individuals aged 65 years and over \textsuperscript{44}, with a current prevalence of 22\% in this age group\textsuperscript{45}. Lifetime risk is estimated at 28\%, with males and individuals living in rural areas demonstrating a higher risk\textsuperscript{45}. The course of the disease involves a rapid decline in health status, with mortality rates of 50\% within the first four years following initial hospitalization\textsuperscript{46}. Following a second exacerbation, the risk of future exacerbations increases threefold, with an average cost to the Canadian healthcare system of $646-736 million per year\textsuperscript{47}. COPD accounts for the highest rate of hospital admissions among the major chronic illnesses in Canada\textsuperscript{48}, with a conservatively estimated total hospitalization cost of $1.5 billion a year\textsuperscript{47}.

1.2.1.4 Diabetes & Dysvascular Amputees

Diabetes is metabolic disorder characterized by hyperglycemia secondary to deficiencies in insulin secretion, insulin action, or both\textsuperscript{49}. Physical inactivity, smoking, obesity, alcohol consumption, and poor dietary habits have been identified as risk factors that significantly increase individual risk of developing type 2 diabetes\textsuperscript{50}. Long-term complications involve retinopathy, nephropathy, autonomic neuropathy leading to cardiovascular symptoms, and peripheral neuropathy with a risk of foot ulcers and amputations\textsuperscript{49}. Amputation is a common secondary consequence, leading to symptoms of exercise intolerance\textsuperscript{51,52}, fatigue\textsuperscript{53}, and pain\textsuperscript{51}.

Diabetes was responsible for 1.3 million global deaths in 2010, doubling the numbers seen in 1990 and representing the highest percentage change across all causes of
mortality\(^1\). This trend is reflected in prevalence rates, with the current estimate of 366 million individuals worldwide expected to increase by 60\% by 2030\(^54\). The lifetime risk of developing diabetes at the age of 45 is 16\% and declines with age\(^50\), however the presence of individual risk factors increases the risk exponentially with each additional factor\(^50\). The true impact of diabetes manifests itself in subsequent complications, with diabetes well-established as the leading cause of both end-stage renal disease and non-traumatic lower extremity amputations in Canada\(^55\). Individuals with diabetes who undergo a lower extremity amputation are younger than their non-diabetic counterparts, have a greater number of comorbidities, and are more likely to experience progression to a higher amputation level\(^56\). Healthcare costs for diabetic dysvascular amputees are in excess of $4.3 billion annually\(^56\), with population prevalence projected to increase by over 50\% over the next thirty years\(^57\). The increase in prevalence stems from an aging population and high rates of dysvascular conditions among older adults\(^57\). Healthcare costs for individuals with diabetes are an estimated $245 billion annually in the United States\(^58\), with individual expenditures being 2.3 times higher than those without a diagnosis of diabetes.

1.2.2 Rehabilitation and Chronic Disease

1.2.2.1 Heart Failure

Formal rehabilitation programs improve quality of life in individuals with HF, in addition to reducing mortality rates and all-cause hospital admissions\(^16\). Comprehensive programs include a component of exercise training, risk factor and lifestyle education, and psychological support\(^16\). Home based programs may be equally efficacious\(^59\), with proven gains in exercise capacity, quality of life, and maximal aerobic capacity\(^60\). Irrespective of delivery, individuals demonstrate diminution of benefits following completion of an exercise training program\(^61\), highlighting the need for effective long-term strategies.

National guidelines recommend that all individuals in NYHA Class I-III be considered for supervised exercise programs\(^62\). The current HF population is underserviced, with
reports in the United Kingdom uncovering only 57% of cardiac rehabilitation (CR) programs accept HF patients and only 14% of CR institutions offering a dedicated HF program\textsuperscript{63}. Furthermore, having a diagnosis of HF has been shown to negatively influence referral to CR\textsuperscript{64}. This is especially concerning in a population where 79% of patients report 2 or more comorbidities, with multiple comorbid conditions decreasing self-efficacy\textsuperscript{65}. As self-efficacy is the most important factor in predicting PA\textsuperscript{66}, alternative delivery models for exercise programs are required in order to improve access for individuals living with HF.

1.2.2.2 Stroke

Formal rehabilitation following stroke improves gait speed, balance, and walking capacity, with benefits extending into the chronic phase\textsuperscript{67,68}. A combination of repetitive, intense motor training, functional tasks, and walking training are utilized, in addition to a multidisciplinary approach involving speech, cognitive, and occupational therapy as indicated\textsuperscript{69}. Stroke rehabilitation confers benefits in balance and mobility, measured by both physiological and functional outcomes\textsuperscript{70}, with similar improvements noted in home-based programs\textsuperscript{71}. Benefits in exercise capacity are also observed, although these benefits deteriorate following discharge from rehabilitation\textsuperscript{72}. Between one to three years following their stroke, 21% of patients demonstrated a decline in mobility, with inactivity and cognitive problems as primary predictors of declining outcomes\textsuperscript{73}. Rapid deterioration post-stroke is associated with increased use of assistive devices and dependence on caregivers, irrespective of treatment approach\textsuperscript{74}, compounding disability and socioeconomic impact.

Canadian best practice guidelines for stroke recommend that all individuals with residual impairments related to their stroke should be assessed for rehabilitation\textsuperscript{69}. Despite these recommendations, Canadians experience inadequate provision of stroke rehabilitation\textsuperscript{75}. Canadian patients are admitted to rehabilitation later and stay longer than those in the United States\textsuperscript{76}, impacting wait times and further delaying access. There is a need to balance the allocation of resources targeting functional training in order to improve access to rehabilitation post-stroke. For patients reporting transportation and inaccessibility as a barrier to current programs\textsuperscript{77}, alternative delivery
strategies are likely to promote activity, thereby decreasing likelihood of functional deterioration\textsuperscript{73}.

1.2.2.3 Chronic Obstructive Pulmonary Disease

Pulmonary rehabilitation (PR) is a therapeutic intervention for individuals with COPD targeting the secondary impairments of the disease\textsuperscript{78}. It is provided by a multi-disciplinary team and typically consists of supervised exercise, disease-specific education and self-management, and psychological and social support\textsuperscript{78}. A variety of exercise training modalities are effective, including interval training, strength training, and upper extremity training\textsuperscript{79}. PR increases exercise tolerance, reduces dyspnea, and improves health-related quality of life in individuals with COPD\textsuperscript{80}. These beneficial effects are independent of age and use of supplemental oxygen\textsuperscript{81-83}, and extend to individuals following an acute exacerbation\textsuperscript{84}. Furthermore, PR effectively reduces hospital admissions and mortality\textsuperscript{79}, in addition to the number of days spent in hospital\textsuperscript{85}. Despite these initial improvements, benefits tend to diminish following completion of an institutionally-based rehabilitation program\textsuperscript{86}. This diminution has been directly attributed to a lack of adherence to the home exercise program upon discharge from PR\textsuperscript{85}. Coupled with the knowledge that COPD is a common and costly condition, strategies to improve access and prevent functional decline will almost certainly result in a continued decrease in health resource utilization\textsuperscript{87}.

International guidelines cite the effectiveness of PR for individuals with COPD across the stages of their disease, with benefits extending to other chronic lung conditions\textsuperscript{79}. Despite this, the current availability of PR programs services $< 1.2\%$ of the population in both Canada and internationally\textsuperscript{88}. As the main drawback of PR is that benefits are gradually lost following completion\textsuperscript{13}, developing community-based exercise programs and supporting the transition is crucial in successful long-term maintenance of benefits. These programs may also improve access for the 45\% of patients referred to PR who declined participation, citing transportation as the primary reason\textsuperscript{89}.

1.2.2.4 Diabetes & Dysvascular Amputees
Rehabilitation interventions for individuals with diabetes are designed to improve glycemic control and educate patients regarding exercise and maintain a healthy lifestyle. Canadian clinical practice guidelines for diabetes recommend 150 minutes of moderate-vigorous activity per week, incorporating both aerobic and resistance training\textsuperscript{90}. Despite the evidence, many individuals with diabetes are not able to access the care they need\textsuperscript{91}. Rehabilitation programs are available to address increasingly prevalent secondary impairments, including prosthetic rehabilitation for individuals requiring an amputation. With 80% of care delivered in the primary care setting\textsuperscript{92}, innovative models of delivering care may help to improve access, especially for individuals who experience complications secondary to diabetes.

Lower-extremity amputations are among the most serious and costly complications of diabetes\textsuperscript{55,56}; in fact, dysvascularity with comorbid diabetes is well established as the leading cause of non-traumatic amputations, accounting for 50-70% of all cases\textsuperscript{57,93}. Management for the subset of diabetic adults who experience an amputation includes formal prosthetic rehabilitation programs, which target the physical, emotional, and psychosocial changes\textsuperscript{94}. The primary focus of prosthetic rehabilitation is to restore mobility and functional independence through prosthetic training in order to minimize these changes. As prosthetic use requires a higher relative fitness\textsuperscript{95}, PA is fundamental goal as it improves fitness and facilitates successful mobility and independence.

Dysvascular amputees have an average of 6.5 comorbidities\textsuperscript{96}, complicating medical management and requiring a comprehensive treatment approach. Although no formal guidelines exist, it is recommended that almost all dysvascular amputees would benefit from prosthetic rehabilitation\textsuperscript{97}, with below-knee amputations maximizing the likelihood of success\textsuperscript{98}. A recent study of geriatric amputees noted that 65% rehabilitated successfully, with the presence of diabetes and high premorbid function predicting discharge to independent living\textsuperscript{99}. Although outcomes are positive, there is no research surrounding the short and long-term outcomes following prosthetic rehabilitation. Studies addressing this objective will help to illuminate the needs of this population when considering strategies for long-term management.
The physical improvements following formal rehabilitation are well-established in chronic disease\textsuperscript{11,16,100-103}, however these gains often diminish over time across multiple conditions. Non-adherence to exercise is one of the universal factors associated with this functional decline\textsuperscript{13,85}. This reversion to baseline function threatens the overall value of formal rehabilitation if we are not able to sustain the improvements. This decline in physical function is linked to physical inactivity, which correlates with increased morbidity, mortality and disease burden\textsuperscript{104}. Recommended levels of physical activity are associated with improved cardiac and respiratory muscle function, skeletal muscle metabolism, autonomic nervous system, central and peripheral circulation\textsuperscript{105}, thereby mitigating functional decline. This underscores the need for strategies to mitigate this functional decline and achieve recommended physical activity levels following the completion of rehabilitation. As many individuals with these conditions exhibit similar symptoms, including fatigue and dyspnea, and experience similar consequences such as reduced exercise capacity and reduced health related quality of life\textsuperscript{106,107}, symptom-directed models of management may support improvements in physical activity levels following rehabilitation for individuals with similar levels of function.

1.2.3 Measuring Physical Activity

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure\textsuperscript{108}. Several measures of physical activity have been used in the literature, with considerable variability across the use of single questions, questionnaires, or accelerometers. Single question methods of evaluation lead to a categorical approach to describing PA levels. These strategies ask participants to self-identify as active or inactive\textsuperscript{109}, dichotomizing the continuum of PA, or report their weekly\textsuperscript{110} or yearly\textsuperscript{7} activity levels. Common problems with recall\textsuperscript{111} and over-reporting\textsuperscript{112} lend to inaccurate results, and overall poor association with sedentary activity levels\textsuperscript{7}. Questionnaires provide greater detail, however the low cost and convenience must be balanced against the risks of self-report. Social desirability bias often leads to over-reporting of physical activity\textsuperscript{112}, with further unintentional bias
resulting from problems with recall\textsuperscript{111}. Strategies to enhance recall, including the use of diaries, enhances participant burden and often requires sustained cooperation.

The International Physical Activity Questionnaire (IPAQ) is commonly utilized for individuals with HF\textsuperscript{113-115}, COPD\textsuperscript{116}, and diabetes\textsuperscript{117}, estimating habitual physical activity across 25 items. The IPAQ has been shown to overestimate PA\textsuperscript{118-117}, with participants reporting more vigorous and less sedentary time when compared to accelerometry results\textsuperscript{119}. The IPAQ has also utilized to estimate habitual PA in amputee populations, although the Trinity Amputation and Prosthesis Experience Scale (TAPES) was developed to capture the unique experience of prosthetic users. Evaluating PA across athletic, functional, and social subscales, the TAPES demonstrates internal consistency, as well as face, construct, content, and predictive validity\textsuperscript{120}. Not surprisingly, self-report strategies have failed to demonstrate accuracy when compared to accelerometry measurements\textsuperscript{121}. Another widely used measure is the Physical Activity Scale for the Elderly (PASE). The PASE is a 15-item questionnaire that asks participants to recall activities over the previous seven days, and is valid and reliable in a COPD population\textsuperscript{122}. It discriminates between categories of PA well, supporting its utility in epidemiological studies, however it does not accurately measure individual energy expenditure\textsuperscript{123}. Furthermore, at the PASE includes several activities that are weather-dependent, it may lead to inaccurate reports of PA in chronic disease populations\textsuperscript{123}. The Physical Activity Scale for Individuals with Physical Disabilities (PASIPD) was developed from the PASE to accommodate the use of assistive devices and is used in stroke populations\textsuperscript{124-126}. Despite demonstrating good test-retest reliability\textsuperscript{127} and construct validity\textsuperscript{128}, it also exhibits poor correlation with accelerometry measurements\textsuperscript{127}.

Accelerometers have become increasingly popular as objective instruments, with the SenseWear Armband (SWA) and the StepWatch Activity Monitor (SAM) most frequently used in chronic disease populations. They demonstrate clinical and research-based advantages over pedometers, which detect vertical acceleration of the hip during gait cycles\textsuperscript{129} and are limited by non-specificity and inability to store data. Worn on the upper limb, the SWA is used as a surrogate measure for daily energy expenditure and demonstrates good test-retest reliability and a high intraclass correlation with the
doubly-labelled water method\textsuperscript{130}. The SWA has been shown to significantly underestimate step count in stroke and should be used with caution when measuring energy expenditure\textsuperscript{131}. It has been validated versus indirect calorimetry in individuals with COPD who are not using a rollator\textsuperscript{132}. Measurements were sensitive to small changes and demonstrated repeatability, however PA was significantly underestimated at slow speeds\textsuperscript{132}. As results were highly variable for individuals using a rollator\textsuperscript{132}, a common walking aid in COPD, results obtained from the SWA are limited in their generalizability. Conversely, the SAM is a 2D accelerometer worn at the ankle and was developed to detect differences in ambulatory functioning in chronic populations, providing a daily step count used to calculate energy expenditure\textsuperscript{133}. Validated for use in chronic populations in both the laboratory and community setting, step counts reported by the SAM have an accuracy of 98-99\textsuperscript{\%}\textsuperscript{134}. The SAM is the most widely-used accelerometry measure in stroke populations\textsuperscript{135} and has established test-retest reliability\textsuperscript{136} and accuracy\textsuperscript{137} in community dwelling individuals and the user’s natural environment. More recently, the SAM has been used to measure PA in individuals with COPD\textsuperscript{138,139}. Validated in COPD populations\textsuperscript{140}, the SAM is accurate at slow speeds, with and without a rollator\textsuperscript{139}. It is also a common instrument in amputee literature\textsuperscript{121,141,142}, highlighting its diverse application and utility.

The SAM, along with many other accelerometers, reports a calculated activity index in addition to step count and activity intensity. As the calculations underlying an accelerometer’s activity index are often unique to the specific device, this measurement can only be compared to data collected from the same device. This limits the ability to compare results across studies, thereby decreasing the overall utility of the results. Daily step counts and minutes of low, moderate, and high intensity activity were used to measure PA across the studies in this thesis as these outputs are common across accelerometers. Furthermore, daily step counts are easily translated into exercise prescriptions and can be easily monitored in the community using pedometers or accelerometer-based technology. Accelerometer data was collected 24 hours a day, for a total of seven days. Data collection began at 12 midnight the day after the participant received the SAM and continued for nine consecutive days to ensure seven complete days of data.
1.2.4 Physical Activity Levels and Association with Clinical Measures

Canadian physical activity guidelines encourage at least 150 min of moderate- to vigorous-intensity aerobic physical activity per week for older adults over the age of 65 and individuals with chronic disease\textsuperscript{143}. These guidelines are associated with a 20-30% lower risk for premature all-cause mortality, with greater benefits observed with higher volumes and/or intensities of activity\textsuperscript{144}. This reduced risk likely results from physiological benefits, as regular PA influences cardiac and respiratory muscle function, skeletal muscle metabolism, autonomic nervous system, central and peripheral circulation\textsuperscript{105}. Smaller bouts of gradually increasing activity are recommended for those with activity limitations, or for individuals with chronic disease. Recommended levels of physical activity are associated with a reduced risk of cardiovascular disease, osteoporosis, diabetes, obesity, high blood pressure, depression, stress, and anxiety\textsuperscript{144-146}. Although higher levels of activity correspond to greater health benefits\textsuperscript{144-146}, the majority of Canadian adults are not achieving recommended levels. Healthy Canadian men average 9544 steps/day, which is significantly higher than the female average of 8385 steps/day\textsuperscript{147}. Activity declines with age, with average levels of 7869 steps/day and 6970 steps/day observed in males and females aged 60-79, respectively\textsuperscript{147}. Physical inactivity, defined as levels that fail to meet recommended guidelines, is responsible for 9% of premature mortality worldwide, the equivalent of over 5.3 million deaths in 2008\textsuperscript{148}. This sedentary behavior impacts the incidence of chronic disease, with 7.2% of Type 2 Diabetes and 5.8% of coronary heart disease attributed to physical inactivity\textsuperscript{148}. These numbers are higher in Canada, with 20-25% of stroke, diabetes, and heart disease attributed to physical inactivity\textsuperscript{5}.

1.2.4.1 Heart Failure

Regular PA reduces hospitalizations, mortality, and the risk of additional chronic disease in individuals with heart failure\textsuperscript{149}. Despite the evidence in support of PA, 50% of patients living with HF have a sedentary lifestyle\textsuperscript{66}. Low levels of PA predict hospitalization and mortality in HF patients\textsuperscript{150}, underscoring the importance of
objectively measuring and understanding PA levels. Average PA levels for individuals with stable HF range from $3501 \pm 2315^{151}$ to $4666 \pm 2648$ steps per day$^{152}$ and starkly contrast the average step count of $9550 \pm 3383$ observed in a healthy elderly population$^{153}$. Prior to enrolment in CR, Izawa et al.$^{154}$ found patients with lower exercise capacity ($\leq 4$ METS) averaged $4399 \pm 589$ steps per day, while those with higher exercise capacity averaged significantly more with $6948 \pm 268$ steps. As CR improves exercise capacity$^{60}$, it may also influence PA levels in individuals with HF. Further research is required to describe PA levels following CR, and understand how the transition from formal rehabilitation to the community affects the maintenance of PA.

Despite the association between exercise capacity and PA levels, few studies have investigated the association between objective PA levels and outcome measures commonly utilized in the clinic setting. Self-reported measures of PA demonstrate weak correlation with PA, measured in steps per day ($r=0.35$, p < 0.01)$^{155}$, highlighting the need for alternative measures to screen for PA levels. Distance covered during the 6MWT is strongly correlated with measures of PA, including total steps ($r=0.52$, p <0.01) and percentage of time active ($r=0.59$, p<0.01)$^{155}$. Lower self-efficacy is also associated with decreased PA following discharge from acute care$^{66,156}$ and in stable outpatients$^{66}$, with self-efficacy as the most important factor explaining variance in steps per day and time spent doing moderate activity in NYHA III patients$^{66}$. No research to date has examined the association between clinically utilized outcome measures and objectively measured PA in individuals with HF following discharge from formal rehabilitation. As PA levels have been shown to decrease following exercise training$^{61}$, future research is needed to explore indicators of physical inactivity after completion of CR in order to identify patients at-risk of physical decline.

1.2.4.2 Stroke

Participation in PA is a critical component of optimal health and the prevention of cardiovascular disease$^{143}$. In individuals with chronic cardiovascular disease, lower levels of PA are associated with a higher risk of all-cause and cardiovascular mortality$^{6}$. Individuals post-stroke demonstrate decreased PA levels compared to healthy controls, with a range of $1389 \pm 797$ to $7369 \pm 3107$ steps per day reported in the literature$^{157}$. 
When directly compared to healthy controls, individuals post-stroke recorded significantly more hours of sedentary behavior, with an inverse relationship noted between physical activity and time since stroke\textsuperscript{158}. PA has been shown to increase up to three months post-stroke following discharge home from a rehabilitation hospital\textsuperscript{159,160}, while improvements in exercise capacity\textsuperscript{72}, gait speed\textsuperscript{161}, and time spent walking\textsuperscript{161} are observed up to one year post-stroke.

Despite this recovery, subsequent declines in exercise capacity have been noted between 3-48 months following the completion of exercise programs\textsuperscript{72,162}. Individuals discharged from acute care engaged in a supervised exercise program immediately following stroke, with completion of the exercise program at one year. Functional decline was observed at the 36-month follow-up (48 months post-intervention), with a greater decline in walking capacity observed for individuals who had decreased motor function at baseline\textsuperscript{72}. Similarly, community dwelling stroke survivors who completed a 4-week exercise intervention an average of 3 years following their stroke noted significant improvements in the 6MWT when compared to controls, but did not retain the improvements 3 months following completion of the program\textsuperscript{162}. PA, measured in steps per day, significantly correlates with 6MWT\textsuperscript{137,163,164} and walking speed\textsuperscript{137,164,165} in stroke populations. As exercise capacity and walking speed deteriorate over time\textsuperscript{72}, it is reasonable to assume that PA levels would exhibit a similar trend. As significant associations have also been observed with measures of balance and self-selected walking velocity\textsuperscript{137}, these measures may be useful as surrogate measures to screen for physically inactive individuals, in order to provide timely and appropriate intervention.

1.2.4.3 Chronic Obstructive Pulmonary Disease

Physical inactivity is a primary predictor of hospitalizations\textsuperscript{166} and all-cause mortality in COPD\textsuperscript{9}. In individuals with stable COPD, PA levels are significantly lower than healthy controls and demonstrate a natural decline over time\textsuperscript{167}. A study examining mortality in 170 stable outpatients noted significant differences in PA levels between survivors and non-survivors over a median follow-up of 4 years (range 10-53 months). The absolute risk for 4-year mortality was 31\% for very inactive patients, and 0\% for active patients, with an average baseline step count of 6424 ± 3679 and 3006 ± 2081 for survivors and
non-survivors, respectively\textsuperscript{9}. This level of inactivity is mirrored in a post-acute exacerbation population, who took an average of 3,575 ± 2,799 steps one month following discharge from hospital\textsuperscript{168}. Studies to date unanimously demonstrate an inverse relationship between physical activity and declining lung function, highlighting the physiological consequences of physical inactivity\textsuperscript{169}. Collectively, physical inactivity is prevalent across all stages of COPD, highlighting the need for targeted education and intervention for individuals with COPD throughout the acute, sub-acute, and maintenance phase of their disease.

Although accelerometry measurements are the most accurate estimate of energy expenditure, the time commitment involved in data collection precludes its utility as a screening tool. Given the significance of PA levels in COPD, it is important to identify an associated measure to accurately screen patients for physical inactivity. Self-report PA questionnaires are inaccurate and subject to misclassification bias\textsuperscript{170}, highlighting the need to identify a surrogate measure to be used by clinicians and researchers. Moderate to weak relationships have been observed between the incremental and endurance shuttle walk tests\textsuperscript{171} and gait speed\textsuperscript{172} when compared to daily PA in individuals with COPD. A Medical Research Council Dyspnea Score (MRC) ≥ 3 is strongly associated with severe physical inactivity\textsuperscript{122} and represents a quick and efficient screening tool for clinicians to identify those at risk of severe inactivity. This information supports clinicians in providing referrals for further assessment and subsequent intervention in a timely manner.

1.2.4.4 Diabetes

There is a dearth of literature relating to PA levels in individuals with diabetes, although PA is associated with a lower risk of cardiovascular disease and reduced mortality in diabetic populations\textsuperscript{7}. In adults with diabetes, accelerometer-based physical activity has ranged from 3350\textsuperscript{173} to 6045 steps/day\textsuperscript{174}. Individuals with diabetes spend an average of 311 minutes per day engaging in light PA, with only 12 minutes spent in moderate to vigorous PA\textsuperscript{175}. Moderate to vigorous levels of self-reported PA reduce the incidence of cardiovascular events, microvascular complications and all-cause mortality\textsuperscript{176}, highlighting the significance of further research in this area.
Non-traumatic amputations are a known consequence of diabetes and have a more established foundation of PA literature. In addition to its impact on cardiorespiratory fitness\textsuperscript{177}, PA has been shown to improve psychosocial issues, including body image\textsuperscript{178}. Despite this, individuals with a lower extremity amputation have been shown to be more inactive than the general population\textsuperscript{179}. An average daily step count of 3063 ± 1893 was reported in lower limb amputees at least 6 months post rehab\textsuperscript{121}. A longitudinal assessment of transfemoral amputees revealed average PA levels of 1,540 ± 726 steps per day over a 12-month period\textsuperscript{141}. The trajectory of PA levels over the study period was not reported, although participants demonstrated a 20-25\% reduction in activity during the winter months and a 10-15\% increase in activity during the spring\textsuperscript{141}. Broad inclusion criteria limits generalizability, as study populations include amputations secondary to a multitude of causes, including trauma, malignancy, physical deformity and vascular insufficiency. As individuals with vascular insufficiency experience symptoms of exercise intolerance\textsuperscript{51,52}, fatigue\textsuperscript{53}, and pain\textsuperscript{51} prior to amputation, these symptoms are likely to be magnified in dysvascular amputees. Although diabetes is the leading cause of amputations in Canada\textsuperscript{55}, no studies to date have focused solely on PA in individuals with amputations secondary to vascular insufficiency. Future research should focus on investigating this sub-population of amputees to determine characteristics of PA over time.

Although physical activity literature is increasing exponentially, variability in assessment techniques and assessment timelines precludes comparison across chronic diseases. Future research is needed in heart failure and dysvascular amputees to allow for an accurate comparison of physical activity and functional performance following discharge from rehabilitation. Further comprehensive investigation into the association between clinical measures and physical activity levels will help to inform clinical screening for variables that may influence community-based physical activity.

1.2.5 Barriers to Physical Activity

Common barriers to PA have been reported across stages of care for chronic disease\textsuperscript{179-181}, further establishing the overlap between chronic diseases and supporting
the integration of multiple conditions in a single program. During formal rehabilitation, individuals with HF cite financial constraints, lack of time, motivation, and physical symptoms as barriers to exercise adherence\textsuperscript{182}. A recent systematic review summarized barriers to PR in COPD, including health status, personal issues, and lack of support, while social and professional support and setting goals enabled PA\textsuperscript{180}. Factors related to program design were reported as both a barrier and facilitator, depending on the specific program. These factors included availability of disease-specific exercises, appropriate progression, and clearly communicated benefits\textsuperscript{180}. For individuals with diabetes participating in a supervised exercise program, barriers fluctuate over time, with work commitments, illness, and weather becoming increasingly prevalent as barriers at time progressed\textsuperscript{183,184}. Additional barriers exist for those individuals experiencing an amputation as a secondary consequence of diabetes as the physical environment becomes a primary barrier alongside weather and income\textsuperscript{181,185}. Of those amputees involved in rehabilitation, 68% are inactive and identify limited services and psychosocial issues as barriers to PA\textsuperscript{185}. As health benefits and social interaction facilitate PA in this population\textsuperscript{185}, identifying strategies to promote community-based exercise is likely to improve activity levels among individuals with amputations.

Similar barriers persist following the completion of rehabilitation, with participants reported lack of time, motivation, fatigue, and the absence of staff feedback as barriers to home exercise adherence following CR\textsuperscript{186}. Those who were motivated to improve their appearance or perform specific tasks reported these motivations as facilitators of exercise, alongside social support from family members and healthcare providers\textsuperscript{186}. Following completion of PR, barriers and facilitators of PA remain similar to those experienced during rehabilitation. Barriers are most often health-related, involving COPD symptoms or comorbidities, and environment-related, including transportation, weather, and cost\textsuperscript{187,188}. Facilitators of PA include perceived health benefits and enjoyment\textsuperscript{187}. A short-term study showed that 70% of patients self-report low levels of activity four months after discharge from PR\textsuperscript{188}. Of these individuals, 21% were engaging in high levels of PA immediately following discharge, yet gradually declined over the four-month period\textsuperscript{188}. Those who deteriorated from high to low levels of PA reported more barriers at baseline when they initiated community-based exercise. The
decline in self-reported endurance activities following PR highlights the difficulty of the transition to community activity and emphasizes the importance of understanding patient barriers and facilitators in order to optimize patient outcomes. Individuals with diabetes who participated in an exercise program explicitly cited the need for strategies to transition to the post-program reality of less support and supervision\textsuperscript{184}. Those who successfully maintained PA levels following program completion reported a greater number of facilitators, including support from exercise trainers, strategies for exercise, perceived future benefits, enjoyment, and social support\textsuperscript{183}. No differences in barriers were found between those who maintained their activity level and those who did not, suggesting that a focus on facilitators may be more effective in encouraging long-term maintenance of PA.

For individuals with HF and stroke living in the community, commonly experienced barriers included physical symptoms and comorbidities, lack of motivation, access, and cost\textsuperscript{189,190}. Low self-efficacy presents an additional barrier to activity following HF\textsuperscript{189} and stroke\textsuperscript{191}, highlighting the need for personal and professional support when transitioning to community-based activity. A position statement from the European Society of Cardiology echoed these findings and cited the role of age, inadequate social support, and anxiety and depression as barriers to exercise\textsuperscript{192}. In addition to low self-efficacy, cognitive deficits and co-morbid psychosocial conditions may influence an individual’s ability to self-manage their condition. Strategies to overcome these barriers include screening for depression, assessing the preferred mode of exercise, engaging the patient as a therapeutic partner, and supporting patients in problem solving\textsuperscript{192}. These recommendations overlap with facilitators of PA reported by independently mobile individuals post-stroke, which include social support, a group environment, and the need to perform daily tasks\textsuperscript{190,193}.

Although the literature demonstrates overlap in the barriers and facilitators experienced by individuals with chronic disease, these factors were evaluated using a variety of methods, precluding a true comparison. Further research is needed utilizing a standard approach to evaluate barriers and facilitators across chronic diseases to determine the degree to which these individuals perceive similar barriers and facilitators of PA. The existence of common barriers and facilitators of PA across populations would support
an integrated approach to long-term management and encourage the optimization of resource management.

1.2.6 Overlap in Manifestation and Management of Chronic Conditions

Individuals with chronic disease often present with a unique constellation of signs and symptoms, impacting their medical management and requiring an interdisciplinary approach. Despite the presence of a specific primary diagnosis, many individuals experience several comorbidities that manifest as similar global symptoms.

The overlap between COPD and HF is high, with an estimated COPD prevalence of 23-38% in patients with HF\textsuperscript{194,195} and an estimated prevalence of heart failure in patients with COPD of 16-31%\textsuperscript{43}. Although the primary underlying pathologies in HF and COPD differ, their secondary impairments and subsequent impact on symptoms of fatigue, dyspnea, reduced exercise capacity and reduced health related quality of life (HRQL) are remarkably similar\textsuperscript{106}. While disease-specific indices of primary organ failure (EF for HF and forced expiratory volume in one second for COPD) are poor determinants of exercise capacity, impaired peripheral muscle function remains an important predictor of exercise limitation in both populations\textsuperscript{196}. Muscle dysfunction is comparable in individuals with HF and COPD with similar exercise capacity, with both groups demonstrating decrease muscle strength and increased levels of fatigue compared to controls\textsuperscript{106}. There is recent evidence that symptom-directed models of pulmonary rehabilitation (PR) can be successfully applied to patients with HF\textsuperscript{197}. Patients with HF who underwent PR achieved comparable improvements in exercise tolerance and HRQL\textsuperscript{198} when exercising alongside individuals with COPD, with both groups being trained by the same therapists.

In the field of stroke rehabilitation, attention is turning to multisystem approaches that address the interaction of neuromuscular, cardiovascular, and respiratory systems in the context of the person and the person’s environment\textsuperscript{199}. Comorbidities are a strong prognostic indicator of both short and long-term mortality\textsuperscript{200} and high incidences of co-morbid cardiovascular conditions are common. Diabetes prevalence rates of 24%-75%
have been reported in stroke populations, along with hypertension rates of 35%-75%\textsuperscript{201,202}. Long-term impairments in mobility and exercise capacity are not unique to stroke, and are observed in other chronic conditions including HF and COPD\textsuperscript{106}. Despite the cardiovascular etiology and presence of cardiac comorbidities, current models of stroke rehabilitation do not sufficiently challenge the cardiorespiratory system in order to overcome limitations\textsuperscript{199}. CR improves aerobic capacity and is feasible for individuals post-stroke, suggesting it can accommodate individuals with a range of post-stroke disability\textsuperscript{100}.

In individuals with diabetes, comorbidities are highly prevalent, with comorbid symptoms often muting the presence of diabetes\textsuperscript{203}. Up to 40% of diabetic patients have at least three comorbidities, with most individuals having at least one\textsuperscript{204}. Diabetes prevalence rates of 27% have been observed in stable HF patients\textsuperscript{154}, in addition to rates of 35% and 20% in stroke\textsuperscript{205} and COPD\textsuperscript{206} populations, respectively. As a result of the overlap, individuals with diabetes are frequently enrolled in stroke rehabilitation, PR, and CR programs\textsuperscript{205,207,208}. Given the impairments in lower extremity strength\textsuperscript{209} and gait speed\textsuperscript{209,210} experienced by individuals with diabetes, formal rehabilitation programs are well-suited to improving functional outcomes in this population.

The overlap between chronic diseases extends beyond concomitant comorbidities and impairments, as components of exercise training, education, and psychological support are common to the rehabilitative management of these conditions\textsuperscript{10,78}. Notably, chronic diseases also share a strong association with physical inactivity, a strong predictor of mortality in HF, COPD, and diabetes\textsuperscript{9,150,176}. Responsible for a $5.3 billion burden to the Canadian healthcare system in 2001\textsuperscript{5}, physical inactivity continues to be a threat to public health. As common barriers to PA have emerged across chronic disease literature\textsuperscript{182,184,187,190}, developing integrated strategies is likely to address the needs of multiple populations while simultaneously improving population health.
1.3 Summary of Research Objectives

The overlap in physical impairments and rehabilitative management for HF, COPD, stroke, and diabetes supports the potential for an integrated approach to long-term management and physical activity promotion. Studies are needed to align the evidence across conditions to allow for comparison of PA levels following rehabilitation and to determine whether clinical measures accurately predict levels of PA in dysvascular amputees. In addition, a standardized approach is needed to evaluate whether these populations experience similar barriers to PA following discharge from rehabilitation. Given the availability of current evidence, the specific research objectives of this thesis are as follows:

1. To characterize physical activity levels for diabetic adults with a transtibial amputation (TTA) and describe the association between clinical measures and physical activity levels in the community. We hypothesized that diabetic adults with a lower extremity amputation would fail to meet recommended levels of physical activity; and that exercise capacity would correlate with objectively measured physical activity. (Chapter 2)

2. To explore the attitudes of individuals with CHF and COPD towards an integrated post rehabilitation community based maintenance program and characterize their physical activity levels. We hypothesized that individuals with HF and COPD would be open to participation in an integrated exercise program provided it was appropriate for their functional ability; and that individuals with HF and COPD would fail to meet recommended physical activity levels. (Chapter 3)

3. To describe the perceived barriers and facilitators to community-based exercise from the perspective of individuals with HF, COPD, stroke, and diabetic adults with a TTA and compare barriers across groups. We hypothesized that the majority of barriers would be common to individuals across all groups. (Chapter 4)
Chapter 2
Physical activity in diabetic adults following prosthetic rehabilitation

2 Physical activity in diabetic adults following prosthetic rehabilitation

2.1 Abstract

Objective: To determine whether diabetic adults with a transtibial amputation (TTA) are meeting the recommended guidelines for physical activity intensity and daily step counts for individuals with diabetes. The secondary objectives were to determine the extent to physical activity levels are maintained following discharge from prosthetic rehabilitation and determine whether clinical measures of physical function are associated with physical activity.

Methods: Adults ≥ 40 years of age with a TTA secondary to diabetes were recruited following discharge from prosthetic rehabilitation. Outcomes included accelerometer-measured physical activity (worn on the ankle of the intact limb), the two-minute walk test (2MWT), gait speed, the L-Test, and balance confidence. Assessments were conducted at three months (baseline) and nine months following discharge from rehabilitation. Analyses included paired samples t-tests and Pearson correlation coefficients.

Results: Mean age for all participants (n=22) was 63 ± 12 years. Participants took 3809 ± 2189 steps/day at follow-up, markedly lower than the 6500 steps/day recommended for older adults with chronic illness. Participants exercised for 24 ± 41 minutes/week of moderate to vigorous physical activity. An improvement was observed for performance on the L-Test of functional mobility at follow-up (-8.7 s ± 11.4, p=0.008). All other outcomes remained stable over time. Physical activity was strongly correlated with 2MWT distance (r=0.753, p<0.001) and gait speed (r=0.752, p<0.001).

Conclusion: Physical activity levels for diabetic adults with a TTA remain stable following discharge from prosthetic rehabilitation but fall well below recommended guidelines of 150 minutes/week for adults with diabetes.
2.2 Introduction

Over 2.4 million Canadians are living with diabetes, while more than 20% of additional cases remain undiagnosed\(^2\). The prevalence of diabetes is rising and projected to affect almost 8% of the global adult population by 2030\(^2\). This growth is driven by a 69% expected increase in prevalence across developing countries, where the clinical consequences pose a considerable burden to healthcare systems\(^2\). Lower-extremity amputations are among the most serious and costly complications of diabetes\(^5,56\); in fact, dysvascularity with comorbid diabetes is well established as the leading cause of non-traumatic amputations, accounting for 50-70% of all cases\(^57,93\). Canadians with diabetes are 20 times more likely to be hospitalized for a lower extremity amputation than their non-diabetic counterparts\(^2\), underscoring the need for effective management strategies.

In Canada, current management for adults with diabetes following an amputation includes a comprehensive course of rehabilitation which focuses on optimizing health through the restoration of mobility, functional independence, and prosthetic use\(^2\). Few studies have examined the transition from rehabilitation to community living, although clinicians have expressed concern that the functional gains made during rehabilitation may quickly diminish following discharge\(^2\). Furthermore, despite any gains made, walking ability and balance confidence remain limited after discharge from prosthetic rehabilitation\(^2\). This results in decreased social activity and overall physical activity in the community\(^2\). Physical inactivity is associated with a greater cardiovascular mortality among adults with diabetes\(^2\), and has been shown to decrease steadily over time in this population\(^1\). This highlights the need for interventions to improve engagement in physical activity in the community following rehabilitation.

The Canadian Diabetes Association guidelines recommend a weekly total of 150 minutes of moderate to vigorous physical activity for individuals with diabetes\(^2\). This level of activity is associated with a reduced incidence of cardiovascular events, microvascular complications, and all-cause mortality\(^1\), and may counteract the
adverse effects of diabetes. Individuals with marked functional limitations may achieve this target by repeated brief bouts of exercise throughout the week\textsuperscript{220}.

No study to date has examined the maintenance of physical activity levels in diabetic adults with a lower extremity amputation immediately following discharge from intensive rehabilitation. Individuals with a TTA, who were 21 years from amputation, took 3395 ± 1965 steps/day ≥ six months following rehabilitation\textsuperscript{121}, which is well below the 9550 steps/day typically observed in healthy, elderly adults\textsuperscript{153}. A systematic review of studies reporting activity levels for adults with a chronic illness recommended a minimum of 6500 steps/day\textsuperscript{222}. This target corresponds to the daily step count associated with the recommended level of physical activity energy expenditure, or 1,500 kcal/week\textsuperscript{223}.

Thus, the primary objective of this study was to determine whether diabetic adults with a TTA meet recommended guidelines for activity intensity and daily step counts. The secondary objectives were: 1) to determine the extent to which they maintain physical activity following discharge from prosthetic rehabilitation; and 2) determine whether clinical measures of physical function are associated with objective measures of physical activity.

### 2.3 Methods

This study utilized a prospective, cross-sectional, repeated measures design. Individuals with diabetes were eligible for participation if they met the following inclusion criteria: (1) major unilateral transtibial amputation resulting from vascular deficiency; (2) prosthetic user, with or without gait aids; (3) ≥ 40 years of age; and (4) 3 months post-discharge from rehabilitation. Individuals were excluded if their prosthetic device was a transfer limb, or if they had a significant lesion on the opposite limb. Consecutive patients were recruited through the outpatient follow-up clinic. The study protocol was approved by the Joint Bridgepoint/West Park/Toronto Central Community Care Access Centre/Toronto Grace Research Ethics Board.
2.3.1 Descriptive Measures

Descriptive measures included age, sex, use of a gait aid, co-morbidities, and quality of life using the WHOQOL-Bref. The WHOQOL-Bref is a 26-item quality of life instrument consisting of four domains; physical health (7 items), psychological health (6 items), social relationships (3 items), and environmental health (8 items) plus two overall quality of life and general health items. Individual items are scored on a scale of 1–5 to give domain scores and can be transformed to a standardized scale ranging from 0-100, with a higher score indicating better quality of life. The scale has shown good discriminant validity, concurrent validity, internal consistency and test–retest reliability in a general adult population, in addition to individuals with physical limitations and those in rehabilitation settings.

2.3.2 Assessment Measures

Measures were assessed at three months (baseline) and nine months following discharge from rehabilitation. Baseline measures were taken three months following discharge to ensure that participants had learned to ambulate and that any issues with their prosthesis had been resolved.

Physical Activity

Participants were provided with a StepWatch activity monitor (SAM) (OrthoCare Innovations; Mountlake Terrace, Washington) to measure physical activity. This has an overall accuracy of 99.7% in the lower limb amputee population. Participants were instructed to wear the SAM around the ankle of their intact limb for a total of nine consecutive days to ensure at least five days of accurate data collection. Physical activity data were reported as average daily step counts (SAM counts as reported multiplied by 2) and the number of minutes spent engaging in moderate-to-vigorous physical activity per week. Moderate to vigorous physical activity was defined as a step rate ≥ 90 steps/minute.

Functional Exercise Capacity
The 2-minute walk test (2MWT) was administered in a quiet corridor according to a standardized protocol. Subjects were instructed to walk as far as they could in 2 minutes, while the test administrator walked behind the subject to avoid pacing. Subjects were provided with clear instructions and were allowed to rest during the 2-minute time period, if required. Distance walked was recorded in meters. The 2MWT has been shown to be valid and responsive in individuals with a lower extremity amputation\textsuperscript{228}. Average speed during the test was calculated from the total distance walked.

Functional Mobility

The L-test is a valid and reliable measure of functional mobility skills for individuals with a lower extremity amputation\textsuperscript{229}. It involves a 10 meter course, including two transfers and four turns, for an overall distance of 20 meters. Standardized instructions are provided prior to the test, including an example by the test administrator. The total time to complete the test is recorded in seconds, with lower scores indicating greater functional ability.

Balance Confidence

The Activities-specific Balance Confidence (ABC) Scale is a 16-item measure of perceived balance confidence across a range of activities\textsuperscript{230}. Participants estimate how confident they are that they could perform activities such as picking a slipper up off of the floor or walking on a slippery surface without losing their balance on a scale of 0% to 100%. The sum of scores for each item is calculated and divided by 16 to provide an overall mean balance confidence score. The ABC Scale is a valid and reliable measure in individuals with a lower extremity amputation\textsuperscript{231}.

2.3.3 Sample Size

As there is no minimal clinically importance difference (MCID) for the study outcomes specific to an amputee population, sample size was calculated using two separate approaches each of which applied MCID estimates from populations that also exhibit isolated lower limb dysfunction.
The first sample size calculation for physical activity, measured in steps/day, was obtained from a previous study in lower extremity amputees that reported the difference in average daily step counts between Medicare Functional Classification Levels (MFCL)\textsuperscript{141}. Halsne et al.\textsuperscript{141} found a significant difference in the steps taken by individuals classified as MFCL level 3 versus level 4. We use the observed difference (1114 steps/day) to reflect a clinically important difference over the six-month study period. Using a standard deviation of 765 steps/day\textsuperscript{141}, with a type one error of 0.05 and a power of 80%, the required sample size was 4 participants. The second sample size calculation for gait speed measured in metres/second, was obtained from the post stroke population with unilateral limb deficits. Using the MCID of 0.16 m/s a standard deviation of 0.22 m/s\textsuperscript{232}, type one error of 0.05 and a power of 80%, the required sample size was also 15.

2.3.4 Statistical Analysis

Physical activity data were compared to recommended guidelines in order to address the primary objective. The secondary analysis utilized a paired samples t-test for normally distributed data and a Wilcoxon Signed Ranks Test for non-parametric data to compare the outcomes of individuals at baseline to six months later. Correlations were calculated using the Pearson correlation coefficient to determine the association of physical activity (measured in steps/day) with physical performance measures and balance confidence. Baseline values for all participants enrolled in the study were used for this analysis, regardless of whether or not they completed the study. Correlation coefficients were interpreted according to a scheme used by Portney and Watkins\textsuperscript{233}, whereby correlations ranging from 0 to .25 were interpreted as little to no correlation; .25 to .50 a fair correlation; .50 to .75 a moderate to good correlation; and greater than .75 a good to excellent correlation. Descriptive summary statistics were reported for all subjects assessed at baseline. All analyses were completed using the Statistical Package for the Social Sciences, version 21.0 (SPSS Inc., Chicago, IL), with significance set at $p < 0.05$. 
2.4 Results

The average age for all participants was 63 ± 12 years (Table 1). Of the 22 participants enrolled at baseline, 15 completed the follow-up assessment. Reasons for dropouts included current hospitalization (n=3) and the inconvenience of follow-up (n=4). There were no significant differences in age (p=0.238), gender (p=0.333), number of co-morbidities (p=0.317), or physical performance (L-Test and 2MWT, p=0.242 and p=0.146, respectively) between those who completed the study and those who did not.

An improvement at 6 months was observed for performance on the L-Test of functional mobility, with participants completing the test an average of 8.7 ± 11.4 seconds faster (p=0.001). All other outcomes remained stable (Table 2). Participants achieved an average of 3213 steps/day at baseline and 3809 steps/day at follow-up (p=0.300), both of which are markedly lower than the 6500 steps/day recommended for older adults with chronic illness\textsuperscript{222} and the 9550 steps/day observed in healthy elderly\textsuperscript{153}, a trend that is consistent with previous reports\textsuperscript{234}. Only one participant achieved the recommended 150 minutes of moderate to vigorous physical activity at baseline. No participants reached the recommended amount at follow-up, with an average of 24 ± 41 minutes spent in moderate to vigorous physical activity.

Table 2-1: Demographic Characteristics of Participants

<table>
<thead>
<tr>
<th>Enrolled in Study</th>
<th>Completed Study</th>
</tr>
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<tbody>
<tr>
<td>(n=22)</td>
<td>(n=15)</td>
</tr>
<tr>
<td><strong>Age (Mean ± SD)</strong></td>
<td>63 ± 12</td>
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<tr>
<td><strong>Male</strong></td>
<td>16</td>
</tr>
<tr>
<td><strong>BMI (Mean ± SD)</strong></td>
<td>25.5 ± 8.6</td>
</tr>
<tr>
<td><strong>Gait Aid</strong></td>
<td></td>
</tr>
<tr>
<td>Rollator</td>
<td>7</td>
</tr>
<tr>
<td>Two Canes</td>
<td>2</td>
</tr>
<tr>
<td>Single Cane</td>
<td>7</td>
</tr>
<tr>
<td>No Aid</td>
<td>6</td>
</tr>
<tr>
<td><strong>Comorbidities</strong></td>
<td></td>
</tr>
<tr>
<td>Average Number (Mean ± SD)</td>
<td>2.2 ± 1.4</td>
</tr>
<tr>
<td>Cardiac\textsuperscript{a}</td>
<td>7</td>
</tr>
<tr>
<td>Hypertension</td>
<td>12</td>
</tr>
<tr>
<td>CVA</td>
<td>4</td>
</tr>
<tr>
<td>Respiratory\textsuperscript{b}</td>
<td>4</td>
</tr>
</tbody>
</table>
Arthritis 5 4
Dyslipidemia 3 1
Other 13 7

**Quality of Life (Mean ± SD)***

<table>
<thead>
<tr>
<th></th>
<th>Physical Health</th>
<th>Psychological Health</th>
<th>Social Relationships</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>56.7 ± 12.3</td>
<td>63.0 ± 13.2</td>
<td>63.8 ± 19.3</td>
<td>69.1 ± 15.3</td>
</tr>
<tr>
<td>6 Months</td>
<td>58.5 ± 10.7</td>
<td>63.8 ± 14.2</td>
<td>66.6 ± 15.7</td>
<td>69.3 ± 15.5</td>
</tr>
</tbody>
</table>

*Data reported is the transformed scale (scored out of 100).

Data reported as number of participants unless otherwise stated. Quality of life measured using the WHO-QOL BREF.

*a* Cardiac comorbidities include coronary artery disease, previous myocardial infarction, and a history of heart surgery.

*b* Respiratory comorbidities included asthma, COPD, pulmonary fibrosis, and sleep apnea. Other comorbidities include anxiety, depression, anemia, cancer, peripheral vascular diseases, and visual impairments.

CAD= coronary artery disease; COPD= chronic obstructive pulmonary disease; CVA= cerebrovascular accident; SD= standard deviation.

### Table 2-2: Comparison of Physical Outcomes at Baseline and Follow-Up

<table>
<thead>
<tr>
<th>Clinical Measures</th>
<th>Baseline n=15</th>
<th>6 Months n=15</th>
<th>Difference n=15</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gait Speed (m/s)</td>
<td>0.87 ± 0.30 (0.91)</td>
<td>0.95 ± 0.32 (0.94)</td>
<td>0.05 ± 0.13</td>
<td>0.097</td>
</tr>
<tr>
<td>L-Test (s)</td>
<td>40.2 ± 23.2 (31.0)</td>
<td>31.5 ± 13.6 (27.1)</td>
<td>-8.7 ± 11.4</td>
<td>0.001&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>2MWT (m)</td>
<td>103.9 ± 36.4 (113.0)</td>
<td>114.0 ± 39.2 (109.2)</td>
<td>6.0 ± 16.1</td>
<td>0.100</td>
</tr>
<tr>
<td>ABC Scale</td>
<td>72.4 ± 22.5 (82.8)</td>
<td>77.9 ± 14.5 (81.9)</td>
<td>6.2 ± 13.6</td>
<td>0.245&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PA- Steps Per Day</th>
<th>Baseline n=14</th>
<th>6 Months n=15</th>
<th>Difference n=15</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps per Day</td>
<td>3213 ± 1906 (2640)</td>
<td>3809 ± 2189&lt;sup&gt;a&lt;/sup&gt; (3814)</td>
<td>665 ± 2563</td>
<td>0.300&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Minutes of MVPA/Week</td>
<td>31 ± 52 (0)</td>
<td>24 ± 41 (5)</td>
<td>-6 ± 25</td>
<td>0.398&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Note: Data reported as Mean ± SD (median) for baseline and 6 month outcomes.

<sup>a</sup>n=14

<sup>b</sup>Calculated using a Wilcoxon Signed Ranks Test as data was not normally distributed.
2MWT= 2 minute walk test; ABC Scale= Activities Specific Balance Confidence Scale; MVPA= Moderate to Vigorous Physical Activity.

Average physical activity levels measures in steps/day correlated with clinical measures, including a strong, positive association with gait speed ($r=0.752$, $p<0.001$) and the distance walked during the 2MWT ($r=0.753$, $p<0.001$). Moderate associations were also observed with performance on the L-Test and balance confidence (refer to Table 3).

**Table 2-3: Association between Daily Physical Activity (steps/day) and Clinical Measures**

<table>
<thead>
<tr>
<th></th>
<th>Baseline (n=22)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Physical Activity (steps/day)</td>
</tr>
<tr>
<td>Gait Speed</td>
<td>0.752</td>
</tr>
<tr>
<td>2MWT</td>
<td>0.753</td>
</tr>
<tr>
<td>L-Test</td>
<td>-0.634</td>
</tr>
<tr>
<td>ABC Scale</td>
<td>0.544</td>
</tr>
</tbody>
</table>

2MWT= 2 minute walk test; ABC Scale= Activities Specific Balance Confidence Scale.

### 2.5 Discussion

This study examined physical activity in diabetic adults following a lower extremity amputation. Despite improved functional mobility (L-Test) over six months, physical activity remained well below the 6500 steps/day\(^\text{222}\) and the 150 minutes/week of moderate to vigorous physical activity\(^\text{220}\) recommended for individuals with diabetes. Physical activity was moderately associated with functional exercise capacity, mobility, and balance confidence.

Community-based physical activity levels among adults with diabetes have ranged from 3980\(^\text{235}\) to 8498 steps/day\(^\text{236}\), with participants in the current study falling at the low end of this range. Daily physical activity levels observed in the current study are similar to previous reports that used the SAM to monitor individuals with a TTA. A weekday average of 3079 ± 1515 steps/day was reported among moderate ambulators who had been using a prosthesis for at least two years\(^\text{142}\), while Stepien et al\(^\text{121}\) observed 3395 ±
1893 steps/day in a sample of individuals with a traumatic etiology. The variability in step counts observed in these studies is comparable to the current study, suggesting that the range of functional abilities among individuals with a TTA secondary to diabetes is not unique to this population. Participants spent less time engaged in moderate to vigorous physical activity (24 minutes/week) compared to a previous report citing 12 ± 13 minutes/day (or 84 minutes/week) in lower extremity amputees, although the study utilized a lower step threshold (≥60 steps) to define vigorous activity levels237. Activity intensity was also lower in comparison to the 86 minutes/week previously reported for adults with diabetes175. These discrepancies are likely attributable to the combined burden of diabetes and a TTA, each of which has been associated with a reduction in cardiorespiratory endurance and physical fitness when compared to healthy adults177,238. No prior study has examined outcomes in diabetic adults with a TTA, precluding the ability to compare our results beyond each condition in isolation.

Comparatively low levels of physical activity in the current study contrast with relatively high levels of physical performance. The distance walked during the 2MWT is 1.5 times greater than the 69.6 m observed three months after inpatient prosthetic rehabilitation in a sample of lower limb amputees from the same institution as participants from the current study228. Gait speed at follow-up exceeds the 0.8 m/s required for community ambulation239 and the improvement over time approached an established meaningful change of 0.1 m/s240. L-Test performance at follow-up is similar to previous reports of 29.5 seconds among individuals with a TTA and markedly faster than the 40.2 seconds observed in lower extremity amputees with a vascular etiology229. Baseline balance confidence scores were similar to previous reports in lower extremity amputees three months following discharge from prosthetic rehabilitation218. Follow-up scores are high compared to values observed for individuals with a TTA (64.9), vascular etiology (50.6), and for those who use a mobility device (47.6)231. Further exploration is needed to understand the disparity between improvements in physical performance and physical activity levels.

The positive association between levels of physical activity observed and measures of physical performance used in clinical settings was consistent with previous reports in individuals with an amputation237,241. Our findings of positive association also
align observations in other chronic disease populations, including those with heart
disease, COPD, and stroke\textsuperscript{137,155,172}. Although a larger sample is needed to explore the
predictive validity of these associations, healthcare providers can use clinical measures
of physical activity to inform and direct education and self-management in this
population. The association of physical activity with functional mobility and balance
confidence underscores the importance of optimizing prosthetic fit and incorporating
balance training into individual exercise programs post TTA.

As the reduced physical activity further accentuates the negative effects of diabetes\textsuperscript{175},
transition from prosthetic rehabilitation to the community offers an opportunity to support
an active lifestyle for diabetic adults with a TTA. Interventions to increase physical
activity among adults with diabetes have achieved the recommended levels of 10,000
steps/day for healthy individuals\textsuperscript{222}. Successful strategies summarized in a systematic
review\textsuperscript{242}, such as personalized coaching, goal setting, peer support groups, computer
technology and activity monitors, may be adapted for the post TTA population following
prosthetic rehabilitation.

The results of our observations should not be assumed to be identical among those with
other amputation levels or those who have not completed formal rehabilitation. As all
participants in this study were able to ambulate independently with or without gait aids,
the results should also not be generalized to include those with more impaired levels of
ambulation. Information from subjects recruited from a single urban centre should be
shown to hold true for other centres, both urban and non-urban. Long term post
rehabilitation patterns in physical activity and function cannot be assumed from data
collected over six-months. The absence of an established MCID for the outcomes of
interest among adult diabetics with TTA obliged us to use data from individuals with
lower limb dysfunction attributable to multiple sclerosis and stroke, in order to calculate
sample size. These two distinct approaches resulted in the same required sample size.
Although both conditions are associated with lower limb dysfunction, use of the MCID
derived as above must consider the different underlying pathophysiological mechanisms
of impairment. A population specific MCID would be preferred.
Our study provides evidence that, despite improvements in functional ability over a six-month period following discharge from prosthetic rehabilitation, weekly levels of physical activity (steps/day) and time spent in moderate to vigorous activity remains well below recommended guidelines for adults with diabetes. Low levels of community-based physical activity, especially at a time when functional ability is improving, highlight the need for post-rehabilitation strategies targeted to promote an active lifestyle and encourage continued exercise.
Chapter 3
Symptom-Directed Community-Based Exercise Programs After Rehabilitation

Desveaux L, Harrison S, Lee A, Mathur S, Goldstein R, Brooks D. Community Exercise After Rehabilitation in Patients with Congestive Heart Failure and Chronic Obstructive Pulmonary Disease. Preparing manuscript for submission.
3 Symptom-Directed Community-Based Exercise Programs After Rehabilitation

3.1 Abstract

**Background:** Shared symptoms in individuals with congestive heart failure (CHF) and chronic obstructive pulmonary disease (COPD) have led to their successful integration in pulmonary rehabilitation (PR). Post PR, there may be a role for integrating these individuals in community based maintenance programs. The primary aim of this study was to explore the attitudes of individuals with CHF and COPD, who have completed rehabilitation, towards an integrated community based maintenance program. The secondary aim was to compare their function and physical activity levels to determine whether they are sufficiently similar to support integration into the same program.

**Methods:** Semi-structured interviews were conducted with individuals with CHF or COPD (n=11) who had completed formal rehabilitation. Functional exercise capacity and accelerometer-measured physical activity levels, measured over seven days, were compared using an independent samples t-test (n=23).

**Results:** Five themes were identified: 1) the missing links in supporting the transition to maintenance exercise; 2) modifiable barriers to community-based maintenance; 3) program structure that can facilitate participation; 4) preferences for the delivery of community-based maintenance; and 5) patient support for integrated exercise programs. Participants expressed a desire for scheduled, group-based exercise programs and supported the integration of multiple conditions based on functional ability. Narratives highlight the importance of a motivating program leader and access to appropriate facilities to maintain exercise. A significant between-group difference was found for functional exercise capacity (p=0.024), with no between-group differences in overall physical activity or inactive time.

**Conclusions:** Participants expressed the need for minimally supervised community-based programs to support adherence to exercise and prescribed activity following rehabilitation. A program tailored according to functional ability appears to be most feasible, rather than a disease-specific program. Similar levels of physical activity after rehabilitation support the potential integration of individuals with a primary diagnosis of CHF or COPD.
3.2 Introduction

Congestive heart failure (CHF) and chronic obstructive pulmonary disease (COPD) are highly prevalent in the general population, with reported rates of 38% and 35%, respectively. The overlap between these diagnostic categories is high, with an estimated COPD prevalence of 23-38% in patients with a primary diagnosis of CHF and an estimated CHF prevalence of 16-31% in patients with a primary diagnosis of COPD. Systemic manifestations are remarkably similar, and include symptoms of fatigue, dyspnea, reduced exercise capacity and health related quality of life (HRQL), despite differing underlying pathologies. Rehabilitation models are also similar, with comprehensive cardiac (post-heart failure) and pulmonary rehabilitation programs (CR and PR, respectively) sharing common components of exercise training, education, and psychosocial management. The two populations have been successfully integrated in a rehabilitation setting.

Although the physical improvements following CR and PR are well-established, these gains often diminish soon after program completion. This decline is associated with decreased physical inactivity, which correlates with increased morbidity, mortality and disease burden. Older age and the presence of comorbid chronic diseases further reduces physical activity. Innovative strategies are needed to counteract functional decline and maintain physical activity levels following rehabilitation.

Community based exercise can reduce post rehabilitation functional decline and inactivity when delivered by accredited fitness instructors, although the exercise programs across locations are inconsistent in their delivery. Post PR physical activity levels in COPD have been described using a variety of outcomes including the percentage of time spent mobile (55%), average walking time (65 minutes/day), and steps/day (4183 steps/day). Post CR physical activity levels have not been specifically reported although the importance of maintaining physical activity has been emphasized. Physical activity levels for individuals with stable CHF range from 3501 to 4666 steps per day in contrast with the average step count of 9550 in a healthy elderly population. If physical activity levels and function post-rehabilitation were similar in the two populations, it would encourage the development of
a symptom-directed integrated approach in a community setting.

Although preliminary models of community exercise have integrated individuals with various chronic conditions into a single program, no studies to date have explored the perspectives of individuals with HF and COPD with respect to integrated exercise programs delivered in the community. Although no negative interactions occurred in an integrated formal rehabilitation program, the transition to community-based maintenance is a challenging time for individuals with chronic disease that presents unique challenges. Individuals with COPD reported positive experiences in a community-based maintenance program following formal rehabilitation, supporting the potential of this community-based model of management. To fill these gaps in the literature, the objectives of the current study were 1) to determine whether post rehabilitation daily physical activity and functional performance of individuals with CHF and COPD are similar and 2) to explore the attitudes of individuals with CHF and COPD towards an integrated post rehabilitation community based maintenance program.

3.3 Methods

This was a prospective, cross-sectional study using a mixed-methods approach. Participants were eligible if they had a diagnosis of CHF (with an ejection fraction ≤ 40%) or COPD (FEV₁/FVC < 0.70) and had successfully completed formal, hospital-based rehabilitation. Ejection fraction and pulmonary function data were collected at the beginning of the rehabilitation program. Both CR and PR programs were delivered by an interdisciplinary team and included supervised exercise, risk factor and lifestyle education, and psychosocial support.

3.3.1 Sampling

This was a purposive sample that recruited consecutive patients from two institutions immediately prior to discharge from their respective programs. All individuals completed the quantitative phase and were invited to participate in the qualitative phase. The study protocol was approved by the Joint Bridgepoint/West Park/Toronto Central Community Care Access Centre Research Ethics Board and the University Health Network Research Ethics Board.
3.3.2 Quantitative Phase

Quantitative Measures

All participants completed a physical assessment during their final week of formal rehabilitation. Following the assessment, participants were provided with a physical activity monitor, the StepWatch™ Activity Monitor (SAM) (OrthoCare Innovations; Mountlake Terrace, Washington).

Functional Exercise Capacity

The six-minute walk test (6MWT) is a self-paced test that quantifies functional exercise capacity in terms of the distance walked in six minutes and is conducted over a 30 m level straight course within an enclosed corridor. Each participant performed two tests, with the greatest distance recorded. The 6MWT is a valid, responsive, interpretable, self-paced test in patients with CHF and COPD. Six minute walk distance (6MWD) was also expressed as percent predicted.

Physical Activity

The SAM is a multi-axial accelerometer, meaning that it measures acceleration in all three planes of movement. It is worn over the lateral aspect of the ankle, which has been shown to have increased accuracy detecting slower walking speeds typical of individuals with chronic diseases, when compared to monitors worn at the hip. Monitors were programmed with each participant’s height, with ‘walking speed’ and ‘leg motion’ set to the default response (normal). Seven (7) consecutive days of community-based activity were recorded, with data reported as average steps per day and percentage of time spent inactive. Physical activity data was collected following the final rehabilitation session to ensure activity levels were not influenced by program participation.

Quality of Life

Individuals with CHF completed the Minnesota Living with Heart Failure Questionnaire (MLCHFQ), while individuals with COPD completed the Chronic Respiratory Disease
Questionnaire (CRQ).

The MLHFQ is the most commonly used quality of life instrument among individuals with heart failure and evaluates a physical and emotion domain. Participants are asked a series of 21 questions and answers are scored on a five-point Likert Scale. It has been shown to be more responsive to change than other quality of life measures\textsuperscript{263}, with established reliability\textsuperscript{264,265} and construct validity\textsuperscript{265}.

The CRQ is a self-reported, disease-specific instrument evaluating four domains considered important to individuals with chronic airflow limitation: dyspnea, fatigue, emotional function and mastery. Participants are required to quantify the impact of their breathlessness on events and/or experiences that have taken place over the preceding 2-week period\textsuperscript{266}. Answers are scored on a seven-point scale ranging from 1 (maximum impairment) to 7 (no impairment). Results can be expressed as the mean score for each domain and the mean overall score. The CRQ is valid, responsive and interpretable when used among patients with COPD\textsuperscript{267}.

\textit{Data Analysis}

Quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS) version 22.0 (SPSS Inc., Chicago, IL). Descriptive statistics were used to describe the study population (refer to Table 1). Between-group comparisons were made for functional exercise capacity and physical activity, using an independent-samples t-test or a Mann-Whitney U Test. An alpha (\(\alpha\)) value <0.05 was defined as significant.

3.3.3 Qualitative Phase

\textit{Individual Semi-Structured Interviews}

An informal interview schedule consisting of open-ended questions was developed by the research team and informed by the literature relating to community-based maintenance exercise (refer to Appendix). The schedule was then reviewed and revised according to feedback from clinicians (n=4) and patients (n=5) involved in CR and PR to ensure the questions both stimulated narratives focusing on community-based
maintenance and encouraged other topics, salient to the patient, to emerge. These individuals were not eligible for participation in the study. Once the final interview schedule was established, study participants were invited to participate in an individual, semi-structured interview within three to six months following completion of a rehabilitation program. This criterion was selected to ensure participants had sufficient experience with respect to maintaining their prescribed exercise routine at home, optimizing their ability to provide insight and recommendations. Individuals took part in a face-to-face interview with a member of the research team (LD). The interviews took place in a quiet room at the participant’s rehabilitation hospital. All interviews were recorded and transcribed verbatim by a third party not involved in the research study and checked by the researchers for consistency. Interviews were audio-recorded and were approximately 40 minutes in duration.

Data Analysis

All data were analyzed using the NVivo 10 qualitative data analysis software (QSR International Pty Ltd., 2012) for data management. A deductive thematic framework approached was used. Analysis consisted of six stages, as described by Braun and Clarke: 1) familiarization with the data (undertaken by LD); 2) organization of initial codes derived from the research aims capturing barriers and facilitators to maintenance exercise and thoughts surrounding the design of community-based maintenance programs. Two researchers (LD and SH) independently coded the first two transcripts, comparing the results to ensure a consistent approach before LD coded the remaining transcripts; 3) searching for themes involved an iterative approach which allowed the researcher (LD) to move back and forth between transcripts as new themes were established; 4) review of generated codes involved two members of the research team (LD and SH); 5) defining and summarizing themes was conducted using thematic mapping by two researchers (LD and SH) to explore relationships between themes; and 6) writing the report.
3.4 Results

3.4.1 Quantitative Findings

The average age was 70 ± 14 years (Table 3-1). Individuals in the CHF sample were classified as New York Heart Association (NYHA) II-IV\textsuperscript{269}. Lung function in the COPD sample was consistent with Stage III as defined by GOLD classification criteria\textsuperscript{259}. Post rehabilitation, the average six-minute walk distance (6MWD) was 79 ± 16% of age predicted values for individuals with CHF and 65 ± 14% for individuals with COPD (p<0.024). One individual with CHF used a rollator, compared to eight individuals with COPD. Three individuals with COPD were receiving supplemental oxygen. There was no significant difference in physical activity between the two groups, with an overall mean (SD) of 3256 (1620) steps/day and 82% (6%) of time spent inactive.

Table 3-1: Participant Demographics and Functional Performance

<table>
<thead>
<tr>
<th></th>
<th>CHF (n=11)</th>
<th>COPD (n=12)</th>
<th>Between Group Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>66 ± 16</td>
<td>73 ± 12</td>
<td>-</td>
</tr>
<tr>
<td>Female [n(%)]</td>
<td>4 (36)</td>
<td>8 (67)</td>
<td>-</td>
</tr>
<tr>
<td>Ejection Fraction (%)</td>
<td>27 ± 9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FEV\textsubscript{1} (% predicted)</td>
<td>-</td>
<td>39 ± 16</td>
<td>-</td>
</tr>
<tr>
<td>Quality of Life\textsuperscript{a}</td>
<td>30 ± 31</td>
<td>15 ± 3</td>
<td>-</td>
</tr>
<tr>
<td>6MWD (m)</td>
<td>511 ± 124</td>
<td>370 ± 54</td>
<td>0.002</td>
</tr>
<tr>
<td>6MWD (% of Predicted)</td>
<td>79 ± 16</td>
<td>65 ± 14</td>
<td>0.024</td>
</tr>
<tr>
<td>Steps/day</td>
<td>3514 ± 2071</td>
<td>3116 ± 1066</td>
<td>0.576</td>
</tr>
<tr>
<td>MVPA/week</td>
<td>146 ± 141 (91)\textsuperscript{b}</td>
<td>67 ± 51 (60)\textsuperscript{b}</td>
<td>0.288\textsuperscript{c}</td>
</tr>
</tbody>
</table>

Note: Data reported as mean ± standard deviation unless otherwise stated.

\textsuperscript{a}Quality of life measures were the Minnesota Living with Heart Failure Questionnaire for Heart Failure and the Chronic Respiratory Disease Questionnaire for COPD.

\textsuperscript{b}Data reported as mean ± standard deviation (median).

\textsuperscript{c}Calculated using a Mann-Whitney U Test as data was not normally distributed.

6MWD=six minute walk distance; FEV\textsubscript{1}=Forced expiratory volume in one second; MVPA= Moderate to Vigorous Physical Activity.
Figure 3-1: Weekly minutes of moderate to vigorous intensity physical activity (MVPA) versus daily step counts (steps/day) for A=all participants with HF and COPD and B=HF outliers removed (n=3).
On average, individuals with HF took more steps per day and spent more minutes engaged in moderate to vigorous physical activity per week. Three individuals with HF recorded approximately twice as many minutes in moderate to vigorous physical activity as compared to their peers (see Figure 3-1). These three participants were more active than the remaining individuals with HF, achieving 86 more minutes of activity per day.

3.4.2 Qualitative Results

Participants

Data saturation occurred after nine participants, with no new themes emerging from the data. A total of 11 interviews were conducted, including six individuals with a primary diagnosis of COPD and five with CHF. The characteristics of interview participants can be found in Table 3-2.

All themes were considered by patients in the light of their experiences of formal rehabilitation, which were largely positive. As the benefits of formal rehabilitation are well understood\textsuperscript{270-272}, these quotes were largely 'bracketed', but were used to inform the interpretation of additional themes. Analysis revealed five themes with associated sub-themes (Table 3-3). Themes included: 1) Patient Support for Integrated Exercise Programs; 2) The Missing Links in Supporting the Transition to Maintenance Exercise; 3) Modifiable Barriers to Community-Based Maintenance; 4) Program Structure That Can Facilitate Participation; 5) Preferences for the Delivery of Community-Based Maintenance.
<table>
<thead>
<tr>
<th>Table 3-2: Demographics of Interview Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>ID</td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Lives With</td>
</tr>
<tr>
<td>Comorbidities</td>
</tr>
<tr>
<td>QOL</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>6MWD (m)</td>
</tr>
<tr>
<td>6MWD (% Age Predicted)</td>
</tr>
<tr>
<td>Current Exercise Routine at Home</td>
</tr>
</tbody>
</table>

Note: Full exercise maintenance includes both prescribed components, including aerobic exercise, resistance training, and balance training. 6MWD=six minute walk distance; Chronic Respiratory Disease Questionnaire; MLHQ=Minnesota Living with Heart Failure Questionnaire; QOL=quality of life.
Table 3-3: Participant Quotes from Interviews

<table>
<thead>
<tr>
<th>Theme</th>
<th>Participant Comments</th>
</tr>
</thead>
</table>
| Patient Support for Integrated Exercise Programs             | Thoughts on Integrated Rehab  
““And I just want to be able to… and I don’t care if the class has all different kinds of abilities or whatever, we are all there for the same purpose, to improve.” (ID 6)  
“The goal is to make everybody better and it doesn’t matter what their illness is if the exercise is going to do them some good, that’s great.” (ID 8)  

Potential Benefits  
“Because everybody … we’re just not all sitting around going oh you got the same as me? No. You’ve got the same as me? You know? I mean…It’s a bit silly to say but it’s the spice of life type of thing.” (ID 1)  
“It’s always kind of broadening to meet other people and other … I mean you are not the only person around who has got a problem and how they cope with it and how you’ve, you know…I think it could be really beneficial.” (ID 10)  

Potential Weaknesses  
“I think for some people yeah because they would get turned off, you know, if somebody is not too well and sharing how they feel and whatnot. But I would think they would be in the minority.” (ID 8)  
“For the leader because, depending on the mix of disabilities you have, you are going to have some very different kinds of exercise groups for varying people. So I would assume if they are trying to get a group together they are trying to get enough affinities that they can do one program and not try and run four at the same time.” (ID 10)  

Recognition of What is Feasible  
“I don’t think you’re going to find too many places that are strictly COPD. So uh … you know, like that would probably be a real prime situation for me but I’m not, you know, I’d have to think there is very little of those and maybe what you get there wouldn’t be as good as where there is multiple problems.” (ID 2)  
“So it would be more important to have let’s say a group located in your immediate area with enough people for quorum or whatever, even if they are different conditions versus making it mandatory to have everyone with the same condition then someone has to drive ten miles away to find enough people with that condition, right?” (ID 11)  

The Missing Link in Supporting the Transition to Maintenance Exercise | Reality of Unstructured Maintenance  
“There was no walking. I just couldn’t do it and too much snow and ice and everything else. We don’t have a mall, like a big one, so I did a few runs at Home Depot and places like that but that’s about all I could do.” (ID 10)  
“I’m not saying I haven’t done any of them. Like I do the breathing and um … I walk… walk outside with my rollator. I walk for about 20 minutes and I try some of the balance exercises just holding onto the counter.” (ID 3) |
"Well there should be a…not an interim period but a gradual decreasing of their being involved with you to develop that motivation and get used to it so that you are going to be able to continue on, which I thought would happen, but it didn’t." (ID 5)

Good Intentions but no Actions
"You know there is community centres…one in…well two different locations that are within 15 minutes of home but…so I guess I should check them out. I just haven’t done it.” (ID 2)
"Where I live there are a couple of very active community centres that I was…my wife and I are going to look into it with regard to doing exercises for seniors such as yoga, etc, which we haven’t done.” (ID 4)

Lack of Appropriate Programs
"People say the [YMCA] but when you don’t know where all these things are and that they don’t…they don’t really know how to deal with people like myself.” (ID 7)
"I think most of the gyms are not really effective in what they are doing or providing right now to people with heart conditions.” (ID 9)

The Role of Healthcare Professional Referral
“Just to know where these places are would be a big benefit and how to get into them.” (ID 7)

<table>
<thead>
<tr>
<th>Modifiable Barriers to Community-Based Maintenance</th>
<th>Availability of Space and Equipment</th>
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<tbody>
<tr>
<td>&quot;It’s just…not the same environment. I mean, you walk into a living room and you don’t see everything there that you can use, you know.” (ID 1)</td>
<td>&quot;We all want everything to be free but it’s not realistic so I think the cost for the client is going to be an issue. And for some, I don’t know if you do the sliding scale or if you just try to find a fee suitable for the median, I don’t know.” (ID 3)</td>
</tr>
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</table>

Cost
"Being motivated to do it was my biggest problem. Just getting to it, it was alright once I started, you know, working on the treadmill or lifting some weights, whatever, but just getting the routine to do it on a regular basis was sort of my biggest problem.” (ID 2)

Lack of Motivation
Physical Symptoms
"I’ve been having trouble with colds so that I cough a lot and it stops me from breathing and so then, therefore I get lightheaded and clammy and it’s…the feeling I get is almost like I did before, like heart failure.” (ID 6)

Weather
"What happens to the ground when it snows or ices up and you can’t really do a serious walk if it’s all ice, right?” (ID 9)
<table>
<thead>
<tr>
<th>Program Structure That Can Facilitate Participation</th>
<th>Physical Benefits of Exercise</th>
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<tbody>
<tr>
<td>“I came in wearing oxygen 24 hours a day. I was here less than three weeks and they had got rid of the oxygen … So I knew the exercise and routine really helped me a lot and since then, you know, the last month with the cold and whatnot, I can really tell the difference that doing the exercises or not doing them has really had an impact on me.” (ID 2)</td>
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<tr>
<td>“Nearly dying, I guess. You know, a wake-up call and realizing that you want to maintain heart health is a motivation.” (ID 11)</td>
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<tr>
<th>The Importance of Routine &amp; Accountability</th>
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<tr>
<td>“If I knew every Tuesday morning I was expected to be here for, you know, half a day or whatever, I would be here and I would do it.” (ID 2)</td>
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<tr>
<td>“I know the instructor has set aside that time for me, it gets me there, I'm going to be there.” (ID 5)</td>
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<tr>
<th>Confidence in the Program</th>
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<tr>
<td>“They have exercise programs but they are not based on cardio and I know with cardio that there are different forms of exercise … So it just doesn't seem to be there for me to do.” (ID 6)</td>
</tr>
<tr>
<td>“If it is associated with a hospital it carries that much more credence with me, okay? Because you know that the healthcare system is interested in what's going on with your exercise program.” (ID 8)</td>
</tr>
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<table>
<thead>
<tr>
<th>Preferences for the Delivery of Community-Based Maintenance</th>
<th>Location</th>
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<tr>
<td>“Where it takes place depends on what’s the most convenient location. So if you have something in this area, I don’t know, maybe a facility like this or a church or a gym. I think you just have … I think proximity is more important in that case than having a consistent facility.” (ID 11)</td>
<td></td>
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<th>Components</th>
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<tr>
<td>“You know, they usually… the big thing… is if they’ve got exercise.” (ID 7)</td>
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<tr>
<td>“Some people are dealing with a lot of psychological issues over these things and I don’t think it's addressed as well as it could be. … some people might benefit from it being there.” (ID 9)</td>
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<tr>
<th>Healthcare Professional Involvement</th>
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<tr>
<td>“I think they might want to drop in on classes just to see how the program is going. I mean they could just drop in even if the participants don’t know, say hey I’m involved in the program, just want to see and get feedback to see how things are going, right? … That way they … the people get the perception that there is support from a larger structure.” (ID 11)</td>
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<tr>
<th>Staff</th>
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<tr>
<td>“I think that whoever … if you are not having a physiotherapist lead the class and you are having a trained instructor I think that they should report to the physiotherapist right away on each person, how they are doing, what they are not doing.” (ID 5)</td>
</tr>
<tr>
<td>“I don’t think that the type of exercises we are doing are so demanding that it requires a professional…The ideal situation would be to have a trained physiotherapist mixing in with all the people, even one per 12 or 14, you know.”</td>
</tr>
</tbody>
</table>
Patient Support for Integrated Exercise Programs

All but one participant articulated their support for the integration of multiple chronic disease populations in a single program. Participants expressed the importance of having individuals with similar functional abilities and recognized that individuals with different chronic conditions often have similar fitness levels. One individual expressed that his fitness level was much greater than his peers in CR and indicated that he preferred to exercise alone as he was not limited by the abilities of a group. The remaining participants unanimously expressed their willingness to attend an integrated, community-based exercise maintenance program.

Participant narratives revealed that, although disease-specific programs might be ideal, it is unlikely that enough individuals would live in a given area to support a disease specific program long-term. Many individuals felt that any burden introduced by including multiple conditions would be felt by the staff supervising the program, who would be required to be familiar with multiple conditions.

The Missing Links in Supporting the Transition to Maintenance Exercise

Participants described the transition from hospital-based rehabilitation to community-based maintenance, voicing concerns about their ability to maintain prescribed exercise following discharge. Participant narratives portray difficulty adhering to their exercise program at home, citing a lack of equipment and appropriate facilities.

The Reality of Unstructured Maintenance
Participants described the transition from hospital-based rehabilitation to community-based maintenance, voicing concerns about their ability to maintain prescribed exercise following discharge. Participant noted the lack of equipment and facilities as contributing to their difficulty in adhering to their exercise program at home and suggested that a supported transition, with improved discharge materials and information on community-based support would assist their transition.

*Good Intentions Do Not Equal Actions*

Six participants expressed a desire to find an organized, community-based exercise program that was appropriate for their level of fitness and established a permanent routine. Participants readily acknowledged their role in taking action although they identified that active exploration of community options had not yet occurred.

*Lack of Appropriate Programs*

The majority of participant narratives described familiarity with local community facilities although this did not guarantee the existence of an appropriate program. Participants expressed that chronic disease populations exhibit different levels of fitness and function, and voiced concerns that standard exercise classes did not allow for individual variation to the same extent as rehabilitation programs.

The role of healthcare professionals was recognized by nine participants as important in informing patients of appropriate programs. This knowledge was perceived as a mechanism to facilitate the transition from rehabilitation to a community program while inspiring confidence that the program is appropriate for individuals with chronic disease.

*Modifiable Barriers to Community-Based Maintenance*

The majority of references to barriers were categorized according to one of four subthemes, which included: logistical barriers, personal barriers, the weather and a lack of personal motivation. There was overlap of barriers and facilitators, as many of the barriers were modifiable and could be overcome with the development of appropriate community-based programs.
Logistical Barriers

Three participants articulated the modifiable nature of barriers related to program cost, distance, and lack of appropriate facilities, all of which could be overcome by access to an appropriate program. The lack of appropriate equipment prevented the continuation of exercises and the distance to reach the program prohibiting participation.

Personal Barriers

Six participants described the challenge of self-motivation in the absence of a structured group environment. Eight participants felt that the lack of an ongoing program negatively affected their health. The episodic nature of the diseases was recognized and the need for professional support following an exacerbation was expressed.

Weather as an External Barrier

The impact of colder weather on physical symptoms was a prominent feature of many participant narratives. The weather was also noted as preventing them from safely going outside to exercise, resulting in a failure to maintain their prescribed walking routine.

Program Structure That Can Facilitate Participation

Participants discussed factors that are thought to support the maintenance of exercise. Many individuals commented on personal experiences relating to the physical benefits of exercise and several suggestions were made concerning the design or delivery of programs.

Physical Benefits of Exercise

Improved physical functioning was described as translating into personal motivation and improved quality of life. Individuals acknowledged the importance of exercise in maintaining function and avoiding a deterioration in health status or an exacerbation of their condition.

The Importance of Routine & Accountability
Participants felt that attendance was facilitated by a structured program, including a specific time and place. Both participation in a group and exposure to an instructor were seen as helping with ongoing support.

Confidence in the Program

Six participants describe the benefits of affiliating community-based programs with hospitals. This alliance was seen as ongoing support from the healthcare system. Programs endorsed by a hospital were acknowledged as involving an appropriate level of exercise.

Patient Preferences for Community-Based Maintenance

Participants made recommendations relating to the design and delivery of community-based maintenance programs. Those delivered in close proximity to participants, using a scheduled, group-based format were identified as desirable and feasible across all transcripts. Acceptable facilities included public community centers, churches, and gymnasiums.

Components

Exercise was cited as the most important aspect of maintaining function and overall health status across all narratives. Participants also suggested the inclusion of occasional social activities and the importance of goal-setting. Three participants recommended including psychological support or establishing a direct referral network, as they had observed the impact of anxiety and depression on their peers during the rehabilitation program.

Staff

All participants acknowledged the importance of an instructor who is knowledgeable about equipment and exercise progression. They considered a ratio of one instructor to eight to ten participants as appropriate to enable access as well as feedback and monitoring. Although the instructor did not have to be a healthcare professional, participants expressed the importance of a healthcare professional being affiliated with
the program for ongoing support to both the program instructor and program participants.

Participants felt strongly that the personal attributes of the program leader were crucial to the success of the program. The ability of the leader to motivate and inspire program participants was perceived to be as important as their knowledge of chronic conditions.

3.5 Discussion

This is the first paper to explore the perceptions of individuals with CHF and COPD regarding the design and delivery of community-based post-rehabilitation maintenance programs and whether the two groups might be integrated based on functional similarities. Enrolling participants in a program based on functional status instead of primary diagnosis is a feasible and accepted approach\textsuperscript{245,246} and offers an opportunity to individuals with chronic conditions to participate in regular exercise\textsuperscript{273}. With a dearth of community-based programs specific to individuals with CHF and COPD, this is a practical strategy to extend the availability of exercise to individuals with these conditions. This integrated approach to community-based exercise has been described in models around the world, including Europe\textsuperscript{273}, Australia\textsuperscript{245}, and Canada\textsuperscript{274}, and represents an effective strategy to improve outcomes while efficiently utilizing resources. This strategy is not universally appropriate, as some individuals demonstrate a higher level of function following the completion of rehabilitation. For example, a participant with CHF in the current study achieved 100\% of his age-predicted 6MWD and was less amenable to an integrated program as his level of fitness was much higher than his peers.

Healthy community-dwelling elderly adults achieve an average of 9550 steps/day\textsuperscript{153}. Individuals with CHF and COPD exhibited significantly lower levels at discharge from rehabilitation, which were consistent with the 3501\textsuperscript{151} to 4666\textsuperscript{152} steps/day reported in stable CHF patients living in the community. Physical activity levels in the COPD subgroup were consistent with previous reports following PR\textsuperscript{257,275}. COPD participants are strikingly similar to those classified as ‘inactive maintainers’, defined as severely inactive or sedentary\textsuperscript{257}. These individuals averaged 3133 steps/day and 333 m on the
6MWT, and represented 84% of 294 participants who had completed PR\textsuperscript{257}. The results of the current study reveal that rehabilitation alone is not sufficient in supporting individuals with chronic disease to achieve recommended physical activity levels. This underscores the need for post-rehabilitation strategies to promote an active lifestyle in individuals with chronic disease\textsuperscript{257} and encourage continued exercise among these populations. Individuals with HF had a higher average of total minutes spent in moderate to vigorous activity per week, however this average was heavily influenced by the inconsistently high scores of three participants. Removing these participants from the analysis revealed a similar trend between daily steps per day and weekly intensity targets for both groups. The three outliers were active for an additional 86 minutes of each day, on average, compared to their peers. As quality of life did not explain this difference in behavior, future research is needed to explore possible explanations for this observation.

Participants identified program proximity and a scheduled, group-based format as key features. Participants were comfortable with the instructor not being a certified healthcare professional, but preferred the idea of the instructor having prompt access to a healthcare professional for support. The idea of integrating exercise was supported provided that the participants demonstrated similar physical limitations. Individuals with CHF and COPD exhibited similar levels of physical activity, supporting the rationale for their integration into a single program.

Adherence to home exercise programs decreases to 50% nine months after completion of an intensive rehabilitation program\textsuperscript{13,186}. As lack of adherence is a key factor associated with functional decline, it is important to understand how the patients’ experiences with the transition from the hospital to a community based program affects their maintaining their exercise routine. Individuals with CHF and COPD have previously reported physical symptoms and financial constraints as barriers to community-based exercise, as well as poor motivation, and lack of support\textsuperscript{51,52}. Participant narratives in this report also identified social and professional support, disease-specific exercises and appropriate exercise progression as facilitators to participation. Consideration of these barriers and facilitators will inform the design of community based maintenance exercise programs for the two populations.
Program logistics are a strategy to facilitate participation, including the presence of a program instructor, which promotes a sense of safety and comfort\textsuperscript{258,276}. The desirability of specific traits such as empathy, focus, effective communication and the ability to motivate were highlighted as contributors to the maintenance of functional capacity and quality of life. Program proximity was also a strong facilitator of participation, echoing the experiences of individuals with COPD who participated in a community-based program\textsuperscript{258}. A scheduled, group-based exercise format, and a supported referral process, were preferred elements that are consistent with the findings of Adsett et al\textsuperscript{245}. Beyond the physical benefits, experiencing a social connection with members of the general community promotes feelings of social inclusion and makes participants of community-based programs feel valued\textsuperscript{258}. Participants in the current study expressed that exposure to individuals with a variety of physical limitations and abilities can provide a breadth of perspective beyond one’s immediate health condition that is often motivating. Future program development should draw on these aspects of design in order to design effective, patient-directed models of community-based exercise.

Participants in the current study were recruited from two single rehabilitation programs and therefore the results may not be reflective of individuals from other clinical populations or institutions. As we enrolled only patients who had already completed a formal hospital-based rehabilitation program, the results may not be generalizable to individuals without previous rehabilitation experience. The cross-sectional study design precludes the ability to comment on the consistency of the identified barriers over time. The difference observed for 6MWT performance may be related to the high proportion of individuals with COPD who used a gait aid, as rollator use reduces walking speeds in COPD\textsuperscript{139}. Between-group comparison is also affected by the variation observed in individuals with CHF, as four participants achieved a 6MWD ≥ 88% of their age predicted distance. Inclusion criteria required an ejection fraction ≤ 40%, however this criteria reflects admission to CR as updated values were not available for participants at discharge. Disproportionately higher performance may reflect an improved ejection fraction over the course of CR and reduced disease severity.

Similar levels of physical inactivity emphasize the need for ongoing community-based support for individuals with CHF and COPD following discharge from rehabilitation.
Exercise programs using existing community facilities can be designed to meet the needs of individuals with chronic disease in conjunction with minimal healthcare system support. Individuals with CHF and COPD support the integration of multiple disease populations in a community-based exercise program. The results of the current study will inform strategies for developing and facilitating successful transitions to community exercise programs to encourage physical activity in individuals with chronic disease.
Chapter 4

Barriers to Physical Activity Following Rehabilitation: Perspectives of Older Adults with Chronic Disease

Desveaux L, Goldstein R, Mathur S, Brooks D. Barriers and Facilitators of Community-Based Exercise: Perspectives of Older Adults with Chronic Disease. Journal of Aging and Physical Activity. 2015 Sep 15. [Epub ahead of print]
4 Symptom- Barriers to Physical Activity Following Rehabilitation: Perspectives of Older Adults with Chronic Disease

4.1 Abstract

Non-adherence to exercise is a main cause of reduced function for older adults with chronic disease following completion of rehabilitation. This quantitative study utilized a questionnaire to evaluate the barriers and facilitators to community-based exercise following rehabilitation, from the perspectives of older adults with chronic diseases and their healthcare professionals (HCPs). Questionnaires were administered one-on-one to 83 older adults and 35 HCPs. Those with chronic disease perceived cost (43%), travel time (43%), and physical symptoms (39%) as primary barriers to program participation, with similar perceptions across all chronic conditions. Access to a case manager (82%), a supported transition following rehabilitation (78%), and a condition-specific program (78%) were the primary facilitators. Significant between group differences were found between HCPs and older adults with chronic disease across all barriers (p<0.001), with a greater number of HCPs perceiving barriers to exercise participation. There were no between group differences in the perception of factors that facilitate participation in exercise.
4.2 Introduction

Chronic diseases are increasingly prevalent in older adults. Heart disease, stroke, diabetes, and chronic obstructive pulmonary disease (COPD) represent four of the top five causes of global mortality from non-communicable diseases\(^1\), with rising numbers projected into 2030\(^3\). Formal rehabilitation is a key component of management for these conditions, with each respective program incorporating similar components of supervised exercise, education, and psychosocial support\(^2,77\). The physical improvements following formal rehabilitation are well-established\(^11,16,100-103\), however these gains often diminish soon after program completion. Non-adherence to exercise is one of the key factors associated with this functional decline\(^13,85\). Reduced activity levels among older adults with chronic disease correlate with increased morbidity, mortality and disease burden\(^104\). Innovative strategies are needed to mitigate this functional decline and achieve recommended physical activity levels in this population. Many individuals with these conditions exhibit similar symptoms such as of fatigue, dyspnea and experience similar consequences such as reduced exercise capacity and reduced health related quality of life\(^106,107\). The overlap of symptoms and program structure supports the rationale for an integrated chronic disease management model allowing for diagnosis-specific adaptations.

Community-based exercise (CBE) programs that follow intensive rehabilitation appeal to individuals with chronic disease\(^258,278\) as they help maintain or even improve their functional exercise capacity\(^279\). CBE programs allowing for the integration of multiple chronic conditions will maximize access, and utilize existing community resources. The social interaction provided by CBE is an important benefit and strong motivator in older adults, regardless of whether or not they had a chronic condition\(^280\). They have the added advantage of providing an alternative for individuals who are unable to access formal rehabilitation. This approach uses minimal healthcare resources when compared to telemonitoring or institutionally-based maintenance exercise, shifting wellness maintenance from the health care system to the community\(^14\). Establishing partnerships between HCP and exercise counselors also effectively increases the frequency and
total amount of weekly physical activity. To maximize adherence to CBE following rehabilitation, a better understanding of the barriers and facilitators to participation, from both the patient and the healthcare professional (HCP) perspective, is needed. In those with heart failure, stroke, diabetes, and COPD, older age and the presence of comorbid chronic diseases has been noted to limit physical activity. Little is known of the specific barriers and facilitators to CBE program following discharge from intensive rehabilitation, although the transition to improved health that follows rehabilitation has been highlighted as challenging in COPD. Moreover, despite their role in the promotion of physical activity, information is limited as to how HCPs perceive these barriers. Primary care physicians identified the existence of chronic disease, transportation constraints, existing routines, and lack of confidence as barriers to engaging in physical activity for older adults. Knowledge of these barriers might assist patients and HCPs in promoting adoption of exercise after rehabilitation.

The primary objective of the study was to describe the perceived barriers and facilitators to participation in CBE after rehabilitation, from the perspective of older adults with heart failure, stroke, amputations secondary to diabetes, and COPD. The purpose was to better understand this transition in order to better support it. The secondary objectives were to: 1) compare the perception of barriers and facilitators from the perspective of individuals with chronic conditions; and 2) describe the perceived barriers and facilitators from the perspective of HCPs and compare them to those of patients.

4.3 Methods

4.3.1 Study Design

This quantitative study used a cross-sectional design involving a modified version of the Cardiac Rehabilitation Barriers Scale (CRBS), a patient-based barriers questionnaire. The clinical supervisor of each rehabilitation program identified eligible individuals and approached them to describe the study. Interested individuals were approached by a member of the research team, who further explained the study and obtained either written or verbal informed consent. Participants were consecutively recruited following completion of formal rehabilitation. Individuals were excluded if they were actively...
participating in a maintenance exercise program as the study aimed to capture the perspectives of older adults who were not currently engaged in maintenance exercise, in an effort to help facilitate this transition. HCPs working with each chronic disease population were also invited to participate. Both older adults with chronic disease and their HCPs completed the same questionnaire in order to quantitatively evaluate the perceived barriers to patient participation in CBE. As the rehabilitation facilities for pulmonary, cardiac, stroke and amputee patients were located in two separate centres, the study protocol was approved by the Joint Bridgepoint/West Park/Toronto Central Community Care Access Centre Research Ethics Board and the University Health Network Research Ethics Board.

4.3.2 Inclusion Criteria

Four chronic disease populations, including heart failure, stroke, diabetes, and COPD, were selected for inclusion in this study. These four conditions represent four of the top five causes of global mortality in the category of non-communicable diseases\(^1\). The fifth chronic disease, lung cancer, was excluded as a result of limited access to this population. The most widespread rehabilitation programs in Canada include cardiac, neurological, prosthetic, and pulmonary rehabilitation.

*Heart Failure*

Older adults with heart failure who previously enrolled in rehabilitation at the Toronto Rehabilitation Institute were included. Diagnosis of heart failure was confirmed by ejection fraction and physician diagnosis.

*Stroke*

Older adults with a diagnosis of ischemic stroke who were previously enrolled in rehabilitation at West Park Healthcare Centre were included in the study, provided they were able to ambulate independently (with or without the use of a gait aid). Stroke was confirmed by medical imaging and physician diagnosis. Individuals were excluded if they demonstrated cognitive impairments as determined and documented by their HCP.

*Amputation Secondary to Diabetes*
Older adults with a diagnosis of diabetes and a lower extremity amputation secondary to limb ischemia who were previously enrolled in rehabilitation at West Park Healthcare Centre were included in the study, provided they were able to ambulate independently (with or without the use of a gait aid). Individuals were excluded if they had bilateral amputations.

*COPD*

Older adults with COPD who were previously enrolled in rehabilitation at West Park Healthcare Centre were included in the study. Diagnosis of COPD was made by a physician according to international guidelines\(^{259}\), including a post-bronchodilator FEV\(_1\)/FVC < 0.70.

*Healthcare Professionals*

All registered physicians and non-physician HCPs (physiotherapists and kinesiologists) who worked directly with the specified populations as part of their rehabilitation program were invited to participate in the study.

4.3.3 Questionnaire

The questionnaire is a modified version of the CRBS\(^{284}\), which assesses barriers to program enrollment across four subscales, including healthcare, logistical, work/time conflicts, and comorbidities. CRBS scores are significantly related to participation in rehabilitation, and subscales demonstrate good internal consistency\(^{284}\).

The CRBS was modified using expert opinion and the addition of specific barriers and facilitators to participation outlined in existing literature. HCPs with expertise in rehabilitation and maintenance of exercise provided feedback on the questionnaire. As the participant population included older adults who were predominantly retired, the work/time conflicts subsection was removed. The resulting questionnaire included five subscales, including healthcare (no HCP support, referral from HCP, supported transition, access to a case manager, and a condition-specific program); personal (motivation, confidence, and opportunity for social interaction); logistical (cost, distance); and physical (severity of symptoms). The patient guide was modified slightly for
administration to HCPs, asking them to evaluate the barriers their patients encounter. The guide was then pilot tested on HCP (n=10) working in the field of heart disease, stroke, amputees, and COPD and their patients (n=12). As no recommendations were made as a result of the pilot test, no subsequent revisions were made to either guide. The final questionnaire included a total of 18 questions, including four demographic questions, twelve questions rating the impact barriers and facilitators, and two open-ended questions to identify additional barriers and facilitators. As no changes were made to the questionnaire following the pilot testing, the items retained their construct validity as established for the CRBS284.

Participants were asked to rate the perceived impact of each barrier and facilitator on a 5-point Likert-type scale that ranges from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicate that the associated barrier or facilitator has a greater impact on the participant’s ability to participate in CBE. Open-ended questions were asked at the end of each section to allow for participants to identify additional barriers and facilitators that were not previously identified in the literature (refer to Appendix). Recruitment continued in each diagnostic category for a total of six months, at which time participant responses were demonstrating consistent responses across barriers. Questionnaires were administered one-on-one, and in person wherever possible. When distance prevented the ability to meet in person, the questionnaire was conducted over the phone and verbal consent was documented on the participant’s consent form.

4.3.4 Statistical Analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 22.0 (SPSS Inc., Chicago, IL). The demographic characteristics of patients and HCPs and the perception of barriers and facilitators for each patient subgroup were described using frequencies. For the purposes of group comparison, a participant was considered to view a factor as a barrier or facilitator if they responded with “Agree” or “Strongly Agree”. The resulting categorical variable was used to analyze the perceptions of individuals with chronic disease compared to those of healthcare providers using a chi-squared test, with a significance level of p<0.05. Results of open-ended questions were reported directly as no specific ratings were requested. Finally,
chi-squared analyses were conducted to assess whether there were significant differences in the perception of barriers and facilitators across chronic conditions. For each comparison, participants with the condition in question (e.g., heart failure) were compared to all other participants as a whole (e.g., stroke, diabetic amputees, and COPD). A Bonferroni correction was applied to control against inflated error due to multiple comparisons, resulting in a p-value < .005 (.05/11) considered as statistically significant.

4.4 Results

4.4.1 Study Sample

Participants were recruited between April 2012 and December 2014. The diagnostic categories of the individuals approached and enrolled in the study were as follows: 24/32 COPD, 24/45 post-stroke, 16/17 heart failure and 19/24 amputees. Patients declining participation cited a lack of time (60%) or disinterest (40%) as their reason for refusal. In addition, 34/46 HCPs approached, none of whom were involved with piloting the interview guide, participated in the study. In total, 83 patients (49 males and 34 females), mean age 67 ± 9 years, and 35 HCPs (19 physiotherapists, 10 kinesiologists, and 6 physicians) completed interviews. All interviews were conducted one-on-one, with the majority conducted in person. Five interviews were conducted over the phone as distance prevented participants from meeting face-to-face.

4.4.2 Individuals with Chronic Disease

The demographic characteristics of each patient subgroup can be found in Table 1. All participants were able to walk independently, with or without the use of a gait aid and would therefore be able to access a community exercise facility. Cardiovascular co-morbidities were the most frequently reported (71%), followed by metabolic co-morbidities (55%) (Table 4-1).
Table 4-1: Participant Demographics

<table>
<thead>
<tr>
<th>Individuals with Chronic Disease</th>
<th>Heart Disease n=16</th>
<th>Stroke n=24</th>
<th>Amputees n=19</th>
<th>COPD n=24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Mean ± SD)</td>
<td>66 ± 9</td>
<td>68 ± 9</td>
<td>64 ± 9</td>
<td>68 ± 7</td>
</tr>
<tr>
<td>Male/Female [n (%)]</td>
<td>10/6 (63/37)</td>
<td>18/6 (75/25)</td>
<td>10/9 (53/47)</td>
<td>11/13 (46/54)</td>
</tr>
<tr>
<td>Comorbidities (n)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>11</td>
<td>19</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>Arthritis</td>
<td>6</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Asthma/COPD</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Metabolic</td>
<td>5</td>
<td>14</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>4</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

Note: Cardiovascular co-morbidities include previous myocardial infarction, atrial fibrillation, hypertension, coronary artery bypass graft, and aneurysm repair. Metabolic co-morbidities include diabetes and dyslipidemia. Other co-morbidities include peripheral vascular disease, depression, anxiety, and cancer, among others.

Patients perceived cost (43%), travel time (43%), and severity of physical symptoms (39%) to be the top three barriers to program participation (Figure 4-1). Several participants reported weather as an additional barrier, while a lack of guidance regarding appropriate exercises and the lack of availability of a nearby facility were also noted. The top three facilitators perceived to impact on participation included assigning an HCP as a case manager (82%), a facilitated transition from rehabilitation which includes an introduction to the program by an HCP (78%), and a program designed specifically for the patient's condition (78%) (Figure 4-2). Participants elaborated on program design expressing their desire for the program to be designed specifically for chronic disease populations and that the instructor be trained on an appropriate approach to progressing individual exercise programs for these populations. Many individuals noted that the opportunity for group exercise is preferred as it presented an added benefit establishing a weekly routine and a sense of accountability, in addition to social support. Of the 83 patient participants, 78 (94%) indicated that they would participate in a CBE program. Of the remaining five individuals, one was unsure, three stated that they did not like exercise and one cited a busy schedule.
Figure 4-1: Perceived Barriers to Participation in Community-Based Exercise by Condition

The impact of barriers is plotted for each condition (Likert scale). Darker colors indicate a greater impact. Although agreement across conditions is strong for most barriers, older adults with heart failure were more likely to perceive symptom severity as a barrier and amputees were more likely to perceive cost as a barrier. Note older adults post-stroke were less likely to perceive a lack of motivation as a barrier.
**Figure 4-2: Perceived Facilitators of Participation in Community-Based Exercise by Condition**

The impact of facilitators is plotted for each condition (Likert scale). Darker colors indicate a greater impact. There were no differences in the perceptions of facilitators across conditions.

### 4.4.3 Comparison across Chronic Conditions

Although there are many barriers for which agreement among groups is strong, there were a few differences in responses across the patient groups. Older adults with heart failure were significantly more likely to perceive symptom severity as a barrier to participation in CBE as compared to other older adults with other chronic conditions (p<0.001). Older adults with an amputation secondary to diabetes were significantly
more likely to perceive cost as a barrier to participation (p=0.002). Older adults post-stroke were significantly less likely to perceive a lack of motivation and symptom severity as a barrier compared to participants with heart failure, diabetic amputations, or COPD (p=0.003 and p=0.002, respectively). There was no significant difference across conditions for the remaining barriers. Responses were consistent across all conditions for facilitators.

4.4.4 Healthcare Professionals

The majority of HCPs were physiotherapists (54%) who split their time between inpatient and outpatient programs (64%). HCPs perceived travel time (91%), lack of motivation (89%), cost (86%) and severity of symptoms (86%) to be the primary barriers to program participation (Table 4-2). HCPs also identified the ability to communicate in English, and the lack of program awareness as barriers to participation. The main facilitators identified as having a positive impact on program participation included a referral from an HCP (91%) and a facilitated transition to the program (91%). Suggested strategies to improve program participation included; a short transition time from rehabilitation to community maintenance exercise, a clear transportation strategy, and a physically accessible, socially supportive community environment.

4.4.5 Comparing the Perspectives of Patients and Healthcare Professionals

HCPs perceived more barriers to participation than did patients (Table 4-2). There were significant between group differences for the perceived impact of all six barriers (p<0.001), with effect sizes ranging from moderate (φ=0.38 for lacking HCP support) to large (φ=0.74 for motivation). The two groups had similar perceptions of program facilitators.
Table 4-2: Comparing the Perceived Impact of Barriers and Facilitators

<table>
<thead>
<tr>
<th>Perceived Barriers</th>
<th>Individuals with Chronic Disease n=83</th>
<th>Healthcare Professionals n=35</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>36 (43)</td>
<td>30 (86)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Travel Time/Distance to Facility</td>
<td>36 (43)</td>
<td>32 (91)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lack of Motivation</td>
<td>17 (20)</td>
<td>31 (89)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lack of Confidence with Exercise</td>
<td>12 (14)</td>
<td>23 (66)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lack of Healthcare Professional Support</td>
<td>23 (28)</td>
<td>24 (69)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Severity of Physical Symptoms</td>
<td>32 (39)</td>
<td>30 (86)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Perceived Facilitators</th>
<th>Individuals with Chronic Disease n=83</th>
<th>Healthcare Professionals n=35</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referral to the Program from a Healthcare Professional</td>
<td>63 (76)</td>
<td>32 (91)</td>
<td>0.052</td>
</tr>
<tr>
<td>Introduction to the Program &amp; Transition Supported by a Healthcare Professional</td>
<td>65 (78)</td>
<td>32 (91)</td>
<td>0.089</td>
</tr>
<tr>
<td>Access to a Case Manager</td>
<td>68 (82)</td>
<td>26 (74)</td>
<td>0.346</td>
</tr>
<tr>
<td>Opportunity to Exercise with Other People</td>
<td>62 (75)</td>
<td>28 (80)</td>
<td>0.536</td>
</tr>
<tr>
<td>Condition-Specific Program</td>
<td>65 (78)</td>
<td>26 (74)</td>
<td>0.634</td>
</tr>
</tbody>
</table>

4.5 Discussion

This study is the first to examine the perspectives of older adults with chronic disease and those of HCPs regarding participating in CBE after intensive rehabilitation. Older adults with heart failure, stroke, diabetes, and COPD perceive similar barriers and facilitators with respect to participation in CBE. The results highlight a discrepancy between the barriers perceived by HCPs and those with chronic disease, which underscores the importance of engaging those with chronic disease in planning their transition to CBE. Of note, both groups had similar perceptions of facilitators, suggesting that a therapeutic alliance based on facilitators may be an effective approach to encouraging participation.
The identification of barriers to CBE, such as cost and symptom distress were consistent with previous reports. The impact of symptom distress on participation is particularly relevant as it underscores the unique experience of older adults with chronic disease compared to their healthy peers, which has been alluded to previously in the literature. However, patient participants perceived that the facilitators were more likely to influence their participation. Motivation to participate was high despite the presence of limited mobility and shortness of breath. Coupling this high motivation with care transition strategies, such as patient empowerment, improved self-care and bridging the discharge process might be effective in encouraging continued physical activity during the transition from institution-based rehabilitation to community-based maintenance exercise.

A significantly greater percentage of HCP perceived barriers would negatively impact participation compared to patients with chronic disease. Zalewski et al. reported on the perceptions of physiotherapists and patients regarding barriers to exercise following general physical therapy. Participants over the age of 65 completed a self-report questionnaire evaluating five internal and two external barriers. As in our findings, there was a discrepancy in perceptions with patients identifying lack of willpower and lack of skill as barriers more frequently than did the physiotherapists. In contrast, the physiotherapists perceived that fear of injury and lack of time, were the main barriers to patient participation. Our study was more specific, tackling older adults with a variety of chronic conditions who were preparing to transition to community-based exercise maintenance following formal intensive rehabilitation.

A narrative review of qualitative studies noted that patients did not play as active a role as they desired in the physiotherapist-patient interactions. Although the patients wanted to be asked their opinions in regards to their overall program and goals, the therapist’s lack of communication skills and the struggle around shared responsibility were barriers to patient participation. This review underscores the relevance of engaging patients in order for HCPs to appreciate patient barriers and facilitators of participation. Patient preference should inform the delivery and style of exercise interventions when possible. It may be pivotal as a precursor to the development of successful CBE programs. The optimal strategies to improve communication between patients and HCPs
to enable an understanding of the patients’ perspective and to encourage collaborative decision making surrounding transitions, remain to be established.

CBE programs promote wellness maintenance through physical activity, a strategy that reduces healthcare utilization\textsuperscript{291,292} and shifts the management of chronic conditions from healthcare based acute rescue to community based preventative maintenance. When older adults with COPD completed a minimally supervised community-based program following formal rehabilitation\textsuperscript{279}, they demonstrated improved functional exercise capacity\textsuperscript{279}. A structured program for individuals with chronic cardiorespiratory conditions that offered weekly classes led by a fitness instructor, was both feasible and sustainable\textsuperscript{245}. Both programs featured facilitated transition coupled with condition-specific design through the incorporation of fitness instructors trained to supervise individuals with chronic disease. Additionally, participants were provided with the opportunity for group exercise and social support, two key program features desired by patients.

Our study limitations include recruitment from two urban centres, which may limit generalizability beyond urban areas. As all participants in this study were able to ambulate independently, the results may not be generalized to include those in whom ambulation is more severely impaired. Notwithstanding the above, the responses provided by patients and HCP support the potential utility of CBE to alleviate the strain on institutionally-based programs where appropriate. Although the sample size was modest, participant responses were consistent across each group for both barriers and facilitators at the conclusion of the study. This suggests that recruiting additional participants was not likely to provide new information. As the study design was cross-sectional, the consistency of these barriers over time is unknown. Given that we evaluated patients previously enrolled in a formal hospital-based rehabilitation program, the results may be less applicable to individuals without access to a prior more intensive rehabilitation services. Lastly, as municipal and community resources available for post-rehabilitation community maintenance will vary among different jurisdictions, the recommended approaches to removing barriers and promoting facilitators may not be consistently implemented in some regions.
In summary, the results of this study will inform strategies for developing and facilitating successful transitions to community exercise programs that promote long-term physical activity in older adults with chronic disease. The perception of similar barriers and facilitators across chronic conditions supports the potential for an integrated approach to management following the completion of formal rehabilitation. Program costs, travel time, and severity of symptoms were identified as the top three barriers to enrollment. The transition from hospital based rehabilitation to community based maintenance exercise can be facilitated by the presence of a case manager, in response to referral by an HCP. A focus on enhancing facilitators rather than reducing barriers may be the more effective approach to encouraging long-term exercise in a community setting.
Chapter 5

5 Discussion and Conclusion

5.1 Overview of Findings

The studies in this thesis contribute new and important knowledge to the literature on physical activity in individuals with chronic disease, with a specific focus on community-based activity following formal rehabilitation. The novel findings of this thesis are:

1. Individuals with HF, COPD, and diabetes are not meeting recommended guidelines for daily physical activity following completion of rehabilitation;

2. Individuals with HF, COPD, and diabetes are not meeting recommended weekly targets for moderate to vigorous physical activity following completion of rehabilitation;

3. Individuals with HF, COPD, diabetes, and stroke perceive similar barriers to physical activity following rehabilitation;

4. There is a significant difference in the perception of barriers to physical activity from the perspectives of patients vs. their HCP;

5. Individuals with HF and COPD expressed the need for structured, minimally supervised exercise programs delivered in community facilities to support adherence to exercise and prescribed activity following rehabilitation.

6. Exercise programs integrating multiple chronic conditions are an acceptable option for individuals with HF and COPD.

These findings highlight similarities in physical activity levels and barriers to participation across multiple chronic disease populations. Specifically, individuals with HF, COPD, and diabetic adults with a TTA fail to achieve the recommended amount of daily physical activity following discharge from rehabilitation. These individuals also fell well below the recommended weekly target of 150 minutes of moderate to vigorous physical activity required for health benefits. Furthermore, the results demonstrate that
individuals with HF, COPD, stroke, and diabetes perceive similar barriers to physical activity participation in the community. These similarities suggest that a program aimed at eliminating such perceived barriers could be effectively applied across multiple chronic disease populations. We provide evidence in support of the integration of individuals with different chronic diseases in a single exercise program to promote physical activity.

5.2 Physical Activity in Chronic Disease Populations

Physical inactivity is associated with reduced function, greater incidence of hospitalization, and increased mortality in individuals with HF, COPD, and diabetes\textsuperscript{6,7,9,149,166}. This thesis highlighted low levels of physical activity in chronic disease populations following discharge from rehabilitation, and has shown that the failure to meet public health recommendations for physical activity is common to multiple populations.

In Chapter 2, we showed that older adults with diabetes who have a TTA are not meeting recommended guidelines in terms of daily steps or weekly minutes of moderate to vigorous physical activity. Furthermore, we showed that physical activity levels remain stable over a six month period following discharge from rehabilitation. Daily step counts of $1606 \pm 953$ steps/day reported in this thesis for diabetic adults with a TTA are comparable to the $1536 \pm 106$ steps/day observed immediately following rehabilitation in stroke\textsuperscript{160}. This similarity may be attributable to the underlying unilateral limb deficit and resulting activity limitations characteristic of both populations\textsuperscript{181,293}. The failure to meet weekly intensity targets is also consistent with observations in individuals with stroke, where only 18\% of individuals met the target of 150 minutes of moderate to vigorous physical activity per week\textsuperscript{158}. In Chapter 3, we showed similarly low levels of daily physical activity in individuals with HF and COPD following discharge from rehabilitation. These levels were similar to average daily step counts reported in older adults aged 50-85 years with stable HF\textsuperscript{151} but lower than previously reported levels of daily physical activity following PR\textsuperscript{257}. 
Post-rehab daily physical activity levels reported in this thesis fall at the lower end of the normative data range of 1,200-8,800 steps/day among chronic disease populations\textsuperscript{222}. In a study of community-dwelling patients with cardiopulmonary illness, Nguyen et al.\textsuperscript{155} observed higher levels of physical activity than the post-rehab samples in our studies, with documented daily totals of 5319 ± 2712 steps/day in the COPD subgroup and 7464 ± 3724 steps/day for those with HF. A similar study of individuals with stable HF achieved 5619 ± 3384 steps/day in the community\textsuperscript{66}, while individuals with stroke who were independently mobile achieved a comparable community-based average of 5927 ± 4091 steps/day\textsuperscript{294}.

This finding may be attributable to the greater number of co-morbidities among post-rehab participants. Multimorbidity prevalence ranges from 55-98% in individuals over the age of 60\textsuperscript{295,296} and is linked to poor functional status and higher rates of hospital readmission\textsuperscript{297,298}. The presence of multimorbidity impacts functional outcomes achieved during rehabilitation\textsuperscript{205,299,300} and is associated with lower physical activity levels in individuals with COPD\textsuperscript{301}. The prevalence of multimorbidity is particularly common among individuals with a primary diagnosis of HF, COPD, stroke, or diabetes\textsuperscript{175,302,303}. Participants in Chapter 2 had an average of 2.2 comorbidities in addition to their primary diagnoses of diabetes and a TTA. The vast majority of participants (87%) in Chapter 3 exhibited multimorbidity, with only three participants having a diagnosis of a single chronic condition. This trend extends into Chapter 4, where we noted a 71% prevalence of cardiovascular comorbidities, unrelated to the primary diagnosis, among individuals with a primary diagnosis of HF, COPD, stroke, or diabetes. This thesis utilized a pragmatic approach to outcome evaluation that did not restrict participants based on the presence of co-morbid conditions that may limit function, and physical activity. Therefore, the resulting study samples are representative of actual patient cohorts discharged from rehabilitation programs.

The tendency towards insufficient physical activity levels extends to multiple populations, including both those with chronic conditions and healthy elderly\textsuperscript{5,304-307}, making it a significant public health priority. While specific primary diagnoses may differ, many people with chronic disease experience common comorbidities that manifest as similar global symptoms, including exercise intolerance, fatigue, and muscle
An integrated, symptom-directed approach to long-term management presents a more efficient use of limited resources that overcomes the challenge of addressing multimorbidity by treating the symptoms instead of the disease.

The novel finding of similarly reduced levels of physical activity following rehabilitation is a key feature of this thesis, as the transition from an institutionally-based program to the community represents an opportunity to promote engagement in exercise programs. Community-based exercise interventions improve physical activity levels in chronic disease populations and their use represents a feasible strategy to shift wellness maintenance to the community setting.

5.3 Barriers to Physical Activity Post-Rehab

The transition to improved health following discharge from formal rehabilitation has been highlighted as both critical and challenging. This underscores the need to understand the barriers to physical activity specific to this crucial period. In Chapter 3, individuals with HF and COPD expressed the need for a supported transition to community-based exercise, citing an intention to maintain exercise following discharge but poor follow-through due to a lack of motivation and a dearth of appropriate programs. In Chapter 4, we examined the barriers and facilitators of participation in a community-based exercise program immediately following the completion of rehabilitation. We found that the barriers to physical activity were not disease-specific, which is consistent with previous findings by Malone et al. Our results also align with the pattern of common barriers to physical activity reported across the chronic disease literature. This overlap among chronic diseases suggests the development of integrated, community-based programs would meet the needs of multiple chronic disease populations.

Although a variety of patient, provider, and health-system barriers may influence behaviour, we focused on exploring barriers that could be targeted through the design and logistics of community-based programs. We took this approach as identification of these barriers will directly inform the subsequent development of integrated community-based programs. We explored the barriers experienced during this transition in
Chapters 3 and 4. Financial constraints, travel time, lack of motivation, and physical symptoms were the primary barriers to engaging in physical activity for individuals with HF, COPD, diabetes, and stroke. These align with barriers to activity reported in disease-specific literature\textsuperscript{77,189,286,310}, as well as in an elderly population\textsuperscript{283}. Most notably, these barriers are consistent with those influencing attendance in post-rehab community-based maintenance exercise programs following cardiac and pulmonary rehabilitation\textsuperscript{258,311}. The short- and long-term success of community-based exercise programs is contingent upon adequate diminution of these barriers. Similarities across a broad range of populations suggest that disease categories alone do not inform the perception of barriers to physical activity. Instead, previous work suggests that underlying health beliefs\textsuperscript{311} or age\textsuperscript{312} may influence the perception of such barriers; however, further, necessary work will provide guiding clarification with respect to the foundation of these barriers.

The results presented in Chapter 4 also highlight a discrepancy between patients with chronic disease and their healthcare providers with respect to the perception of barriers. Our inclusion of physicians and kinesiologists, in addition to physiotherapists, extend the findings of Zalewski et al.\textsuperscript{288}, who reported a similar discrepancy in perception of barriers to physical activity between physiotherapists and their patients. Understanding the discrepancy in barrier perception is a key component of establishing a strong patient-provider relationship. As healthcare providers are optimally positioned to encourage physical activity, an accurate understanding of the barriers to and facilitators of patient participation in community-based physical activity is of critical importance. This is especially relevant following discharge from rehabilitation as this transition in care is followed by a reduction in direct support from healthcare professionals\textsuperscript{313}. The observed discrepancy highlights the need for a dialogue between individuals with chronic disease and their healthcare providers in order to draw on strategies that minimize barriers and promote facilitators on an individual basis.

Results in Chapter 4 illustrate congruence between individuals with chronic disease and their healthcare providers with respect to perceived facilitators of physical activity. Further, access to a case manager, a supported transition following rehabilitation, and a program specific to chronic disease were primary facilitators; this aligns with the
qualitative findings presented in Chapter 3. Chapters 3 and 4 also reveal that motivation to participate in exercise post-rehab was high, despite limited mobility and shortness of breath. Similarly high levels of motivation among individuals with chronic disease have been reported previously\textsuperscript{36,37}, although motivation and exercise adherence attenuates over time\textsuperscript{186,314,315}. Improved transition strategies that bridge the discharge process may capitalize on this motivation and encourage long-term adoption of a physically active lifestyle. The strategies highlighted in Chapter 3, including timely referral and access to appropriate programs, are in line with previous reports\textsuperscript{287} and are likely to encourage continued physical activity following discharge from rehab. Given the consistent evidence of high patient motivation to enroll in post discharge programs, a stronger focus on capitalizing on facilitators may be a more pragmatic approach to supporting community-based exercise among individuals with chronic disease.

5.4 Developing an Intervention to Support Physical Activity Maintenance

Pragmatic interventions are needed to counteract the effects of physical inactivity, which is associated with a progression of exercise intolerance and muscle depletion\textsuperscript{316}. Maintenance exercise programs supervised by health care professionals in a healthcare facility are costly, resource intensive, and may erode confidence in and inclination towards exercising outside a clinical setting\textsuperscript{245}. Home-based models present a more geographically convenient option, yet the possibility of long-term success is plagued by a lack of motivation\textsuperscript{315,317}.

Participation in exercise programs in community facilities following formal rehabilitation improves pain and physical function in adults with arthritis\textsuperscript{318} and functional capacity and HRQL in those with COPD\textsuperscript{319}. Community-based programs delivered in existing community facilities have been emphasized as a potential strategy to mitigate functional decline and physical inactivity in chronic disease populations\textsuperscript{251,279}. Along with access to supervised and structured exercise in an accessible location, community-based programs provide a supportive social atmosphere that may influence long-term motivation and facilitate physical activity adherence\textsuperscript{320} and are valued by individuals with chronic disease\textsuperscript{321}.
Programs supervised by accredited fitness instructors in existing community facilities are feasible and sustainable following rehabilitation\textsuperscript{245,252}; nevertheless, concerns have been raised around staff training and the ability of the instructor to appropriately manage complex patients\textsuperscript{245,322}. There is little consistency with regards to the ideal design or delivery of community exercise programs, although the potential role of such programs in maintaining function and promoting activity post-rehab has been established\textsuperscript{252-254}.

A systematic review and meta-analysis of community-based exercise programs revealed that programs have similar components irrespective of the chronic disease they target, supporting the theory that an integrated program could meet the needs of multiple populations\textsuperscript{254}. Furthermore, these programs are superior to standard care with respect to improving functional capacity and quality of life\textsuperscript{254}. The results of Chapter 3 provide insight into the ideal design of post-rehabilitation community-based programs from the perspective of individuals with chronic disease. The presence of a program instructor with the ability to motivate was highlighted as a key component of program design. Program proximity, a scheduled, group-based exercise format, and a supported referral process were identified as ideal components that would facilitate participation. This is consistent with previous work\textsuperscript{245,274,308}. These aspects of program logistics address the facilitators identified in Chapter 4, including patient desire for access to a case manager and a supported transition from rehabilitation. Preliminary evidence has shown this integrated delivery model is feasible across a range of venue types when delivered by a trained fitness instructors to individuals following cardiac and pulmonary rehabilitation\textsuperscript{245}; however program effectiveness has only been demonstrated in a disease-specific population of individuals with COPD\textsuperscript{252}.

As the need for interventions functioning outside the healthcare system is growing\textsuperscript{323}, the development of optimal delivery models must follow. It is worth emphasizing that enrollment based on functional capacity instead of primary diagnosis is a promising approach, as greater disease severity across each diagnostic category presents unique physical challenges. Further, delivery models must be formulated with a view to facilitating adoption and scale-up across multiple populations.
5.5 Limitations

The findings of this thesis should be considered in the light of several limitations. First, the populations included, though reflective of multiple chronic conditions, may not be generalizable beyond a post-rehab population; to other conditions not included in this thesis; or to smaller rural settings. While we utilized accelerometer-measured physical activity as our primary outcome, there is a need to establish the MCID for daily step counts and activity intensity in chronic disease populations. This limits the interpretability of our findings, particularly in Chapter 2, where we evaluated the maintenance of physical activity over a six month period following discharge from rehabilitation. Furthermore, the SAM is an ankle-mounted accelerometer and therefore PA outputs do not accurately reflect upper extremity activity. It is also important to note the large proportion of participants in Chapters 2 and 3 who used a gait aid during community ambulation. As the use of a gait aid increases relative energy expenditure, it is unclear whether fewer steps are required to reach the desired level of weekly energy expenditure and achieve physiological benefits. The cross-sectional nature of the study in Chapter 3 limits our ability to comment on the maintenance of physical activity in individuals with HF and COPD over time. Finally, we did not include an exhaustive list of barriers in Chapter 4, limiting our conclusions to only those barriers which were evaluated. Although we identified the perceived impact of barriers and facilitators, we did not ask participants to weigh the perceived impact of the barriers against one another, which would allow us to establish the relative importance.

5.6 Future Directions

Notwithstanding the similarities in physical activity levels and barriers to participation across multiple chronic conditions, there remain several important areas for further investigation, especially how physical activity levels respond to ongoing exercise training following rehabilitation. This is necessary if a community-based maintenance program is to achieve the recommended levels of physical activity in older adults with chronic disease. It is also important to know whether such models of care can be effectively integrated among a variety of medical conditions. Given the many studies utilizing accelerometer-measured physical activity as a primary outcome, it is critical to
establish a context-specific MCID for this measure in both elderly and chronic disease populations. This is particularly relevant for individuals who have a unilateral functional deficit (e.g., stroke or amputation) or those who ambulate using a gait aid, as these factors will have a direct influence on gait speed and physical activity. Finally, we need to be confident that the suggested evidence-based interventions do promote behavior change.

5.7 Concluding Remarks

Management of elderly patients with chronic diseases often draws on disease-specific guidelines to direct pathways of care. In the presence of increasing multi-morbidity, management is often challenging. This thesis contributes to the emerging perspective relating to the integration of individuals with chronic diseases into a shared model of symptom-directed long-term management of physical activity. Physical inactivity constitutes a significant and modifiable public health concern in individuals with chronic disease and this thesis outlines similar activity levels observed in individuals with HF, COPD, diabetes, and stroke following the completion of formal rehabilitation.

In light of recent work highlighting the adverse effects of physical inactivity, the development of interventions to achieve recommended levels in chronic disease populations is of particular interest. Participants expressed the need for minimally supervised community-based programs to support adherence to exercise and prescribed activity following rehabilitation. A program tailored according to functional ability appears to be most feasible, rather than a disease-specific program.
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Appendices

Appendix 1: Interview guide for study 2

Barriers & Facilitators
Since completing rehabilitation have you been able to continue your exercises at home? How have you found this?
1. What, if anything, helped you to be able to continue exercising?
2. What, if anything, made it more difficult?
   Probes:
   - External Factors ➔ effect of weather conditions, equipment/space at home, cost of community gym membership, lack of confidence exercising outside of rehab setting, job, time pressures, etc.
   - Personal factors ➔ such as health, supportive relationships, etc.
4. Is there anything that you can think of that would have made the transition easier?

Information & delivery
1. For those who believe that a maintenance program is beneficial, what type of structure, if any, would you prefer for maintenance exercise?
   (group or individual exercise)
   (scheduled classes or open access)
2. Where, if at all, would you like to see maintenance exercise delivered?
   (community center, outdoor space, or in your home)
3. Who do you think should run these exercise programs? Does it need to be a physiotherapist or would supervision by a trained exercise instructor be OK?
4. Are there any other features would you like to see in a maintenance exercise program?

Input from HCP’s
1. How important, if at all, is it to have contact with a healthcare professional during a maintenance program?
   o Why is it, or is it not important to you?
   o How would you like them to be available, if at all?
     (by phone, email, available for face-to-face appointments)
2. Would you be more or less likely to attend a maintenance program if you were referred to one by a healthcare professional?
   o Follow up with “why is that”
3. What about if it was affiliated with a hospital?

Integrated Rehabilitation
1. If you think that a maintenance program is beneficial, how would you feel about attending a maintenance program that included individuals with a variety of chronic conditions and limitations?
   o Do you think people would or would not share their experiences?
   o How do you feel including multiple conditions would impact individual participation?
- What would be the benefits of this approach?
- What would be the disadvantages of this approach?

Clarification: Think of a program where participants have muscle weakness, fatigue, and shortness of breath, but these symptoms result from different conditions, including respiratory disease, heart disease, and stroke.

Closing
Is there anything else you think we should know?
Appendix 2: Patient and healthcare provider barrier questionnaires for study 4

PATIENT QUESTIONNAIRE

Socio-demographic and Medical Information
For the following items, please place a mark in the appropriate box that indicates your response.

1. What is your gender?
   □ 1 Female      □ 2 Male

2. What is the primary nature of your chronic condition?
   □ 1 Heart Condition
   □ 2 Lung Condition
   □ 3 Other, please specify: _________________________

3. What is your age? __________________

4. Do you have any of the following co-conditions: (Check all that apply)
   □ 1 Coronary Artery Disease
   □ 2 Previous Myocardial Infarction
   □ 3 Atrial Fibrillation
   □ 4 Hypertension
   □ 5 Arthritis
   □ 6 Asthma
   □ 7 Emphysema
   □ 8 Diabetes
   □ 9 Peripheral Vascular Disease
   □10 Cerebral Vascular Disease
   □11 Other, please specify: __________________________________________
The following questions ask about your perceptions of the potential barriers that exist and the likelihood that they would impact your participation in a community-based exercise program after you complete your rehabilitation:

For the following items, please place a mark in the appropriate box that indicates your response. Indicate how much you feel each of these factors is a barrier to participation in a community-based exercise program.

5. **Cost of the Program**
   - □ 1 Not at all a barrier
   - □ 2 Not very likely to be a barrier
   - □ 3 Neutral
   - □ 4 Very likely to be a barrier
   - □ 5 Extremely likely to be a barrier

6. **Travel Time/Distance to the Community Center**
   - □ 1 Not at all a barrier
   - □ 2 Not very likely to be a barrier
   - □ 3 Neutral
   - □ 4 Very likely to be a barrier
   - □ 5 Extremely likely to be a barrier

7. **Personal Motivation to Exercise**
   - □ 1 Not at all a barrier
   - □ 2 Not very likely to be a barrier
   - □ 3 Neutral
   - □ 4 Very likely to be a barrier
   - □ 5 Extremely likely to be a barrier

8. **Lack of Confidence Exercising in a Community Facility**
   - □ 1 Not at all a barrier
   - □ 2 Not very likely to be a barrier
   - □ 3 Neutral
   - □ 4 Very likely to be a barrier
   - □ 5 Extremely likely to be a barrier

9. **Lack of Physician or Physiotherapist Support Throughout the Program**
   - □ 1 Not at all a barrier
   - □ 2 Not very likely to be a barrier
   - □ 3 Neutral
   - □ 4 Very likely to be a barrier
   - □ 5 Extremely likely to be a barrier

10. **How I am Feeling on a Given Day**
    - □ 1 Not at all a barrier
    - □ 2 Not very likely to be a barrier
    - □ 3 Neutral
    - □ 4 Very likely to be a barrier
    - □ 5 Extremely likely to be a barrier

11. **Please list any additional barriers to program access or adherence:**

    ___________________________________________________
    ___________________________________________________
The following questions ask about your perceptions of the potential positive factors that exist and the likelihood that they would encourage your participation in a community-based exercise program after you complete your rehabilitation:

For the following items, please place a mark in the appropriate box that indicates your response. Indicate how each of these factors will encourage your participation in a community-based exercise program.

12. Introduction to Program/Transition by a Healthcare Professional
   - □ 1 Not at all likely
   - □ 2 Not very likely
   - □ 3 Neutral
   - □ 4 Very likely
   - □ 5 Extremely likely

13. Peer and Social Support
   - □ 1 Not at all likely
   - □ 2 Not very likely
   - □ 3 Neutral
   - □ 4 Very likely
   - □ 5 Extremely likely

14. Recommendation to Attend Program by your Physician or Physiotherapist
   - □ 1 Not at all likely
   - □ 2 Not very likely
   - □ 3 Neutral
   - □ 4 Very likely
   - □ 5 Extremely likely

15. Access to a Case Manager to Answer Specific Questions Throughout the Program
   - □ 1 Not at all likely
   - □ 2 Not very likely
   - □ 3 Neutral
   - □ 4 Very likely
   - □ 5 Extremely likely

16. Program Specific to my Condition
   - □ 1 Not at all likely
   - □ 2 Not very likely
   - □ 3 Neutral
   - □ 4 Very likely
   - □ 5 Extremely likely

17. Please list any additional factors that would promote program access or participation:
   __________________________________________
   __________________________________________

18. Would you access a community-based exercise program?
   - □ 1 Yes
   - □ 2 No

If no, please explain:
   __________________________________________
HEALTHCARE PROVIDER QUESTIONNAIRE

Practice Information

For the following items, please place a mark in the appropriate box that indicates your response.

1. What is your area of practice?
   □ 1 Inpatient  □ 2 Outpatient

2. Which category represents the majority of your patients?
   □ 1 Cardiovascular
   □ 2 Respiratory
   □ 3 Amputee
   □ 4 Stroke

The following questions ask about your perceptions of the potential barriers that exist and the likelihood that they would impact patient participation in a community-based exercise program after the completion of rehabilitation:

For the following items, please place a mark in the appropriate box that indicates your response. Indicate how each of these factors is a barrier to patient participation in a community-based exercise program after they complete rehab.

7. Cost of the Program
   □ 1 Not at all a barrier  □ 2 Not very likely to be a barrier  □ 3 Neutral  □ 4 Very likely to be a barrier  □ 5 Extremely likely to be a barrier

8. Patient Lacks Personal Motivation to Exercise
   □ 1 Not at all a barrier  □ 2 Not very likely to be a barrier  □ 3 Neutral  □ 4 Very likely to be a barrier  □ 5 Extremely likely to be a barrier

9. Patient Lacks Confidence Exercising in a Community Facility
   □ 1 Not at all a barrier  □ 2 Not very likely to be a barrier  □ 3 Neutral  □ 4 Very likely to be a barrier  □ 5 Extremely likely to be a barrier

10. Travel Time/Distance to Community Center
    □ 1 Not at all a barrier  □ 2 Not very likely to be a barrier  □ 3 Neutral  □ 4 Very likely to be a barrier  □ 5 Extremely likely to be a barrier

11. Lack of Health Professional Support at the Community Facility
    □ 1 Not at all a barrier  □ 2 Not very likely to be a barrier  □ 3 Neutral  □ 4 Very likely to be a barrier  □ 5 Extremely likely to be a barrier

12. Severity of Condition
    □ 1 Not at all a barrier  □ 2 Not very likely to be a barrier  □ 3 Neutral  □ 4 Very likely to be a barrier  □ 5 Extremely likely to be a barrier

13. Please list any additional barriers to program participation:

   ________________________________________________________
The following questions ask about your perceptions of the potential facilitators that exist and the likelihood that they would promote patient participation in a community-based exercise program after the completion of rehabilitation:

For the following items, please place a mark in the appropriate box that indicates your response. Indicate how each of these factors will facilitate patient participation in a community-based exercise program after they complete rehab.

14. Referral to Program from Healthcare Professional

15. Introduction/Transition Supported by a Healthcare Professional

16. Peer Support/Social Relationships

17. Access to a Case Manager (Health Professional) to Provide Ongoing Support

18. Program Specific to the Patient’s Condition

19. Please list any additional facilitators of program participation:

________________________________________________________

________________________________________________________

20. Would you promote patient participation in a community-based secondary prevention program? □1 Yes □2 No

If no, please explain:

________________________________________________________