Understanding models of care in cardiac rehabilitation programs to maximize outcomes in women

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ABSTRACT

Cardiovascular Disease (CVD) is the leading cause of death worldwide, causing a global health epidemic that contributes to more than 17 million deaths each year. While the understanding of CVD continues to increase around the world, its prevalence has continued to rise significantly. Cardiac Rehabilitation (CR) is multifaceted secondary prevention intervention that includes physical, psychological and social components in order to attempt to educate clients on management of disease risk factors, exercise training, nutrition, cardio protective drug therapy as well as providing psychological counseling services. CR produces many benefits across a variety of CVD populations, such as reducing mortality amongst clients. However, CR is not utilized to its full potential and the extent of its capabilities as a disease management strategy. This is an issue especially in Canada and the United States, where referral and participation rates differ significantly between the two countries, despite their close proximity to each other. This review acts as a first step towards better understanding the differences between the two countries in order to increase CR referrals and participation, therefore improving the ability to decrease overall CVD mortality and the global economic burden.

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Abbreviations

AACVPR – American Association of Cardiovascular and Pulmonary Rehabilitation

ACC – American College of Cardiology

AHA – American Heart Association

AHD – Atherosclerosis/Atherosclerotic Heart Disease

AMI – Acute Myocardial Infarction

BP – Blood Pressure

CACPR – Canadian Association of Cardiovascular Prevention and Rehabilitation

CCS – Canadian Cardiovascular Society

CVD – Cardiovascular Disease

CR - Cardiac Rehabilitation

DBP – Diastolic Blood Pressure

HTN – Hypertension

LHIN – Local Health Integration Network

SCAD – Spontaneous Coronary Artery Dissection

SBP – Systolic Blood Pressure

WHO – World Health Organization

1.1 Global Burden of Cardiovascular Disease

Cardiovascular Disease (CVD) is the number one cause of death worldwide, and in 2015 it was responsible for approximately 17.7 million deaths globally, which accounts for approximately 31 percent of all deaths.[1] In 2013, CVD was the cause for 112,200 deaths in Canadian men and women, with generally equivalent numbers for both sexes.[2] On average, the Canadian government spends 21 billion dollars annually on CVD related issues.[3] CVD is currently the leading cause of death and disability in Ontario. In Windsor-Essex, the region surrounding the University of Windsor, approximately 1000 deaths and 4000 hospital admissions every year are attributed to CVD.[11]

This burden is similar in the United States and in Michigan, a country which is close in proximity to Canada, and a state that borders Ontario. Approximately 610,000 people die each year from CVD, and an estimated 863 billion dollars is spent on CVD-related costs annually.[3] In Michigan, more than 25 percent of all deaths were due to CVD in 2013.[3] In 2010, 10.2 billion dollars was spent on heart disease related medical costs in the state and it is predicted that the prevalence of CVD is not declining. By 2030 Michigan expects to see a rise from 600 000 to 2.9 million cases of CVD.[3]

CVD is an umbrella term referring to the various disorders affecting normal functioning of the cardiovascular system, including the cardiac muscle itself, and the network of blood vessels linking the myocardial, systemic and neural vasculature.[1] These disorders can impair the ability of the vascular system to provide the heart, brain and vital organs with adequate blood supply[1]. Moreover, these disorders include, but are not limited to, cerebrovascular disease or stroke, peripheral artery disease, rheumatic heart disease, congenital heart disease, heart failure, and coronary heart disease; also known as

coronary artery disease or as it will be referred to here, atherosclerotic heart disease/atherosclerosis (AHD) which is the most common form of CVD.[1]

AHD is a slow, progressive vascular disease that can be characterized by the accumulation of fatty deposits within the endothelium of the vasculature supplying the heart muscle.[1] Non-modifiable risk factors for the disease include age, sex, ethnicity, mental illness and hereditary factors, however there are multiple behavioural risk factors that are often modifiable.[1] Hypertension (HTN) also known as high blood pressure (BP), diabetes, high cholesterol levels, excessive alcohol consumption, an unhealthy diet, physical inactivity and tobacco use are common risk factors known to increase the risk of developing AHD, and thus are well known features of primary and secondary prevention strategies.[1] These risk factors increase the likelihood of plaque development within the coronary arteries, ultimately causing a reduction in blood flow to the heart muscle.[1] This can often lead to the development of angina, a medical condition which is characterized by chest pain and discomfort.[1] If the plaque ruptures, a blood clot can form within the coronary artery and block blood flow to the heart, causing an acute myocardial infarction (AMI).[1] Heart failure may occur if AHD progresses, with the most common cause being damage to the heart as a result of a previous AMI.[4] Some common treatment options for AHD include lifestyle changes and management, pharmacological therapies, as well as surgical interventions such as a percutaneous coronary intervention or coronary artery bypass graft surgery.[5] The global burden of AHD is immense in both sexes, however it is particularly problematic in women. Over the last decade, the number of middle-aged women between the ages of 35 to 54 years of age dying from AHD has steadily risen.[6] Since 1989, more women have died annually than men worldwide.[6]

1.1.1 Burden of CVD in Women

CVD in women is often under recognized by the health care system. Education regarding CVD as a women's disease is severely lacking and might be a reason for the shortage of knowledge of CVD from a female perspective for the physicians and patients themselves, therefore greatly contributing to this lack of recognition.[7] CVD is responsible for the death of on average 500 000 women annually, in which AHD is the primary cause for approximately half of those deaths.[8] AHD affects more than 50 percent of all women and is a major cause of death and disability across the globe.[7]

Moreover, mortality rates for CVD in women rise significantly post-menopause.[9] Evidence from the Framingham Heart Study suggests that the onset of atherosclerosis in women is delayed ten years in comparison to men due to factors such as sex hormones.[9] Estrogen is a specific sex hormone that provides cardio-protective effects to women before menopause.[9] Shortly after the commencement of menopause when estrogen levels decline drastically, many women experience a rise in cholesterol levels, diabetes, and HTN which are all risk factors for CVD, therefore making them much more vulnerable to the development of AHD post-menopause.[9]

In 1999, CVD was the leading cause for hospitalization in women, excluding that of pregnancy and childbirth.[10] In women over the age of 50 years, 21 percent of all hospital admissions were attributed to CVD, and in older women that percentage was significantly higher.[10] For Canadian women, AHD is the leading cause of premature death, yet AHD in women is still misdiagnosed and under researched.[10] If a woman is properly diagnosed when a cardiac event occurs, most are under supported during their

recovery period, suggesting that women face very significant challenges with AHD management.[10]

In Windsor-Essex the mortality rate specifically for women associated with CVD is 73.8 per 100,000 compared to Ontario's rate of 61.7 per 100,000 individuals.[12] In a recent study it was found that location of residence in Ontario might play a role in risk of developing CVD. The Erie-St. Clair Local Health Integration Network (LHIN) was rated one of the least healthy regions most at risk for development of CVD, for both sexes.[13]

In comparison to Canada, in the state of Michigan, which borders Ontario, CVD is the leading cause of death for women and there is a rise in women being diagnosed with hypertension (HTN) each year, which is a major risk factor for CVD.[14] Just across the border from Windsor, in the city of Detroit, AHD is listed as the leading cause of morbidity and mortality for women.[14]

1.1.2 Risk Factors for Women

Despite the traditional risk factors for HTN that men and women share, there are some risk factors that are specific to women. Pregnancy can lead to the development of health conditions in women that may heighten their risk of developing a CVD.[15]

Preeclampsia is a common pregnancy specific disease. The condition leads to heightened BP and the increased potential for organ damage to the kidneys, liver and lungs.[15] Currently, the only treatment for the condition is the end of pregnancy and the delivery of the neonate and placenta.[15] Decades of research has determined that the underlying mechanism for the condition is endothelial disease, and there is increasing evidence to suggest that the symptoms of the condition do not always stop after a

pregnancy has ended, but rather women can have increased risk for developing systemic HTN and CVD later in life as well.[15]

Moreover, gestational diabetes mellitus is a form of diabetes specific to pregnancy, increasing their risk of HTN CVD in women who become pregnant and develop this condition.[16] Developing this condition puts the offspring at a long-term risk for obesity and glucose intolerance as well as increasing the risk of the mother developing diabetes mellitus thereafter.[16]

Additionally, Spontaneous Coronary Artery Dissection (SCAD) is a tear in the intima of the arterial wall that facilitates formation of thrombi in the lungs and heart, abdomen or legs,[17] and is a significant risk factor in women specifically.[17] SCADs occur most commonly in young women between the ages of 40 to 50 years old who demonstrated no previous CVD risk factors.[17]

In North America, oral contraceptive hormone therapy is one of the most common forms of prescribed birth control that women utilize.[18] Overall, the simplicity, low frequency of side effects and relative safety of the method has lead to widespread use.[18] A variety of studies have suggested that oral contraceptives have anti-atheromatus effects, however little data has been collected thus far with regards to their effect on AHD, thrombosis, vasomotion and arrhythmogenesis.[18] Newer oral contraceptive formulas have shown no evidence of increased risk for an AMI, however they have indicated a persistent increased risk of venous thrombo-embolism, which is a condition where a blood clot forms most often in veins of the leg, groin or arm.[18] Further studies must be conducted in order to gain a better understanding of the acute and long-term effects of oral contraceptives on the cardiovascular health of women.[18]

Additionally, the lack of education and awareness that women have regarding their risk of developing CVD is a risk factor in and of itself.[19] Moreover, extensive research on CVD in women has not occurred, thus there is still much to be examined with regards to sex-specific clinical manifestations and treatment for a cardiac event.[19] However, it has recently been proposed that women can experience and identify their symptoms differently than men when a cardiac event occurs which can lead to misdiagnoses, delays in treatment and greater mortality risk following an AMI.[20] In a recent study published by the American Journal of Cardiology, physicians were interviewed on a variety of cardiac-health related issues, and the majority agreed that there is a lack of education with respect to women-specific cardiac health.[21] Only 22 percent of primary care physicians and 42 percent of cardiologists indicated that they felt confident in assessing heart disease in women and expressed a desire to improve their knowledge in the area of cardiac care for women.[21]

1.1.3 Sex Differences with the Mechanisms of the Cardiovascular System and CVD

As mentioned above, women face challenging circumstances with respect to misdiagnoses of cardiac symptoms and delays in treatment for cardiac events. It is not entirely clear why these discrepancies exist, however there are certain factors that may play a role in the issue.

There are inherent sex-differences in the function and structure of the cardiovascular system when comparing men and women that evidently result in CVD appearing differently between sexes.[22]

Anatomically speaking, women have a significantly smaller heart with respect to chamber size and 10 percent less left ventricular mass than the average male.[23] Coronary

arteries in women are smaller than in men, corresponding with the smaller heart size.[23] Women have a higher resting heart rate, cardiac index and pulse pressure resulting in a lower overall blood pressure, whereas men have a higher total peripheral resistance. There are also noted differences in the electrical patterns in women's hearts.[22]

It has been suggested that there are some significant differences in the symptoms women experience when having a cardiac event such as an AMI compared to men. Women experiencing a cardiac event such as an AMI may show symptoms such indigestion, nausea and vomiting, leading to a false diagnosis, initial oversight of the cardiac event and delays in proper treatment.[20] Although chest pain is the most common symptom of an AMI in both sexes, women are more likely than men to arrive at the hospital with mild or no chest pain as a symptom, making a proper diagnosis challenging.[20] It is not uncommon for women to mistake their cardiac symptoms for illnesses such as the flu or acid reflux even though AHD is the leading cause of death for women.[20] Additionally, longer delays in seeking proper medical treatment have been linked to poorer outcomes in comparison to men as well as higher in-hospital mortality for cardiovascular events in women.[20] These factors may contribute to the higher all-cause mortality rates that are observed in women younger than 75 years old, in comparison to men of the same age post-AMI.[23-25] Furthermore, studies have found similar results in pre-menopausal young women having a higher mortality risk than men after experiencing an AMI.[23-25] Furthermore, during surgical interventions women are at a higher risk of experiencing complications such as major bleeding compared to their male counterparts.[26]

It is imperative that we improve the detection of cardiac events in women, particularly due to their high risk of mortality after experience their first AMI, as well as the higher risk of complications with surgical interventions and hospitalizations. It is also crucial that we diminish the delay in proper diagnoses and treatment during an event to improve the patient standard of care and reduce the increased health risks associated with delayed treatment in women.

1.2 Cardiac Rehabilitation

Cardiac Rehabilitation (CR) is a relatively new form of secondary prevention that focuses on providing coordinated, multi-faceted interventions geared towards optimizing a cardiac patient's physical, psychological and sociological functioning while stabilizing, slowing or reversing the progression of AHD.[27-28] Over the past few decades that CR has been utilized as a therapy for CVD patients, there has been a lot of evolution pertaining to what CR is and how it should be executed in various programs internationally.[29] Currently, 54.7 percent of the world offers some form of CR programming, be it home-based with minimal supervision and check-ins, constantly supervised and on-site, or some alternative form.[30]

1.2.1 Known Benefits of Cardiac Rehabilitation

CR programs have been shown to reduce CVD-related mortality, improve functional capacity, improve quality of life and to decrease the incidence of re-hospitalization for cardiac complications and overall financial burden associated with CVD in both men and women.[31] After attending a 12 to 24-week CR program successfully, it has the potential to result in a 31 percent reduction in readmissions to the hospital and a 25 percent reduction in cardiovascular mortality.[31] Cornerstone

components of CR programs generally include exercise training (aerobic, resistance and flexibility), cardio-protective therapies/pharmaceutical therapies (statins, antiplatelet drugs, angiotensin converting enzymes and beta blockers for secondary prevention), health and behaviour education (risk factor management, smoking cessation, physical activity and nutrition guidance), and counseling services (relaxation strategies, stress management and vocational counseling).[28, 32]

As mentioned previously, CR is used in more than half of the world as a secondary prevention and management strategy for CVD.[30] Despite the use of CR programming worldwide and the evidence pertaining to the outlined benefits above, a study from the United Kingdom National Institute for Care and Excellence stated that there is no evidence to suggest that CR is clinically or cost effective for managing AHD.[33] Shortly thereafter, a Cochrane review was published looking at various studies conducted in recent years examining the effectiveness of CR programs from a clinical and economical standpoint. It was concluded that due to the small number of trials and the small sample sizes, as well as potential concerns regarding bias and imprecision, the effects of exercised-based CR compared to control on mortality, morbidity, hospital admissions, adverse events, return to work and health related quality of life in those living with AHD still remain uncertain.[33] These findings were met with widespread criticism by researchers across the globe. More studies must be conducted in order to better understand the benefits of CR programs globally, however the Canadian Cardiovascular Society (CCS), the American College of Cardiology (ACC)/The American Heart Association (AHA) and the European Society of Cardiology still indicate the benefits of exercised-based CR in their guidelines for individuals with AHD.[33]

1.2.2 Current Cardiac Rehabilitation Guidelines Within Canada and the United States

Within North America, the associations responsible for publishing national-level guidelines for CR programming include the Canadian Association of Cardiovascular Prevention and Rehabilitation (CACPR; former Canadian Association of Cardiac Rehabilitation), American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR), the ACC and the AHA. The recommendations between Canada and the United States have many similarities, however there are some components within each that differ.

More specifically, the CACPR suggests that the core components of a CR program are patient referral processes, patient assessments, lifestyle and risk factor modifications, nutritional counseling, patient exercise and education programs, lifestyle and medication adherence strategies, outcome assessment programs, and continuous quality improvement and professional development programs.[34] The AACVPR/AHA CR program components include patient assessment, nutritional and physical inactivity counseling, exercise training, hypertension, diabetes, smoking and psychosocial management.[35]

1.2.3 Differences in Eligibility Criteria

Before an individual may begin CR, they must first be referred based on a set of eligibility criterion that can vary for each country. In both Canada and the United States, CR is generally recommended for individuals with acute coronary syndrome, coronary artery bypass graft surgery, percutaneous transluminal coronary angioplasty, chronic heart failure, and peripheral arterial disease as well as anyone who is receiving a heart

transplant or valve replacement/repair.[36-37] Both the United States and Canada have similar eligibility criteria for CR program referral, with the exception of Canada's guidelines that include referral to individuals suffering from unstable angina, heart failure or with an implantable cardioverter defibrillator.[36] This suggests that Canada is more inclusive compared to the United States with respect to eligibility criteria.

1.2.4 Differences in Referral Procedures

Once an individual meets the eligibility criteria determined by their physician, they are then referred to CR. Usual referral procedures is the traditional method of referral for CR clients, where referral is dependent on the physician's recommendation, their thorough explanation of what CR programming entails as well as the completion of the necessary paperwork for the patient to commence a CR program. A significant limitation in using usual referral procedures is often an inadequate knowledge base surrounding CR programs and their components. Due to this issue, both Canada and the United States have begun to implement more formal referral procedures in order to increase rates of referral and enrollment of patients into CR programs.[38] Formal referral procedures are characterized by utilizing a standardized form to be filled out for all patients being directed to CR programs. Prior to the discharge of a patient, the nurse will send the completed referral form to the specific CR program and schedule a first visit or intake session for the patient.[38] In addition to formal referral procedures, automatic referral procedures have shown encouraging results for increasing patient referral.[39] Automatic referral is the process by which both Canada and the United States currently utilize for referral to CR programming. This process uses computerized systems that prompt individuals who are deemed eligible based on specific criteria to be automatically

referred to a CR program.[40] When comparing various types of CR referral procedures, a 20% increase in CR enrollment is observed when automatic referral procedures replace usual referral procedures (52% vs. 32%).[41]

In Ontario, Canada referral procedures are changing similar to that of the United States where there has been a significant increase in automatic referral procedures and increased physician education on CR programming. Cardiologists, residents, and cardiology support staff are more knowledgeable on CR guidelines and referral procedures than primary care physicians and internal medicine residents and staff.[42] Moreover, primary care physicians place emphasis on the barriers to CR participation for patients.[43] This highlights the need for better education for physicians regarding CR programs in order to increase physician referrals thereby also increasing the rates of enrollment.

Ontario has utilized liaison referral practices[44] along with the common procedures utilized by the United States as well (automatic referral and physician education). Liaison strategies include an allied health professional meeting with the patient to discuss CR and answer questions the patient may have regarding CR.[44] When automatic and liaison referral procedures are used simultaneously, referral and enrollment rates increase to 85.8% and 73.5%, respectively.[44] In comparison, when only automatic procedures are implemented, referral and enrollment rates are 70.2% and 60%, respectively. This demonstrates that utilizing a referral strategy that combinines liaison and automatic referral methods may result in the most optimal amount of referrals and enrollment in CR programs.

Despite the implementation of automatic referral procedures, referral rates are higher in the United States and even Michigan specifically than in Ontario.[45] While more referrals are being made in Michigan, Ontario sees higher participation rates in the CR programs (34%) than Michigan (18.4%) overall. However, it is important to note that Ontario may be accommodating the maximum number of participants possible, due to smaller maximum capacities for providing CR services, whereas Michigan CR centres could possibly accommodate more individuals prior to reaching their maximum capacity.[45] It is interesting that there are such discrepancies in referral and participation rates seeing as they are in such proximity to each other geographically.[45] AHD is the leading cause of death and disability in Ontario, and in Windsor-Essex, nearly 1000 deaths and 400 hospital admissions per year can be attributed to CVD. These rates are similar to those reported in Canada, the United States and internationally.

1.2.5 Differences in Program Characteristics

Once an individual has been referred to and has enrolled into a CR program, there are many varying program characteristics that can significantly influence their adherence and completion.[46] In Canada, there are approximately 220 programs running with roughly 75 percent of the programs existing in urban areas.[47] In contrast, the United States has approximately 2,621 CR programs available for clients to enroll in,[48] the majority of these programs being located in more rural settings[49] in comparison to the geographical distribution of CR programs in Canada, which is essentially the opposite (urban instead of rural).

Patient wait time between from discharge to first visit is an important factor that may influence adherence, uptake, attendance and furthermore the completion

of a CR program. In Canada, the average wait time was 64 days[50] and in more recent data, was shown to be up to 84 days from referral to CR up until enrollment.[51] In the United States, the average wait time was significantly shorter for incoming CR clients. Patient wait time from discharge to enrollment average 21-28 days,[52] meaning that patients were starting CR programming more than twice as quickly than those individuals in Canada. This difference in countries may be due to various factors such as halting clients from beginning programs until they are back to adequate health to participate safely, delays in physician paperwork as well as in Canada, CR centres working at maximum capacity, creating added wait time for individuals coming in to a program. The United States is much better equipped to take in more participants, as there are more than ten times the amount of CR centres available. In Canada, these centres may be full with current participants, creating added wait time for incoming referrals.[50]

Canada and the United States have differences regarding the number of phases within a CR program. Canada's model contains four phases: Phase I (Inpatient) occurs following an AMI or prior to a scheduled cardiovascular intervention. It focuses on education on disease and risk factors, medications, and managing symptoms; Phase II/III (Outpatient) commences after the patient is discharged and involves on-site exercise sessions or home-based sessions; and Phase IV (Ongoing maintenance) is the long-term maintenance stage of lifestyle changes where patients have the option to continue through the program by way of a hospital or community provider.[53] The United States' CR programs differ to that of Canada's as they only recognize three major phases: Phase I (Inpatient) involves

treatment and the commencement of secondary prevention strategy implementation; Phase II (Outpatient) begins when the patient has been discharged and consists of exercise and lifestyle modifications taking place at either the hospital or offsite facilities; Phase III (Ongoing maintenance) is the maintaining of lifestyle modifications with monitoring occurring periodically by healthcare professionals.[6,54]

In the both Canada and the United States, personnel and interventional guidelines exist for all phases of CR programs. Both countries require medical personnel, which should include physicians, nurses, allied health professionals such as exercise physiologists, physical therapists (physiotherapists), health educators, dieticians, occupational therapists, and mental health professionals in order to provide physical as well as psychological support during the process of recovery.[6,53,55] Canada's CR programs include pharmacists[55] and the United States' programs include vocational counselors to aid the client towards a quicker and successful return to work,[6,55] and interventional guidelines in both countries include nutritional education, risk factor management, psychological counseling, smoking cessation, and physical activity and vocational counselling as part of their.[6,53,55] Additionally, Canada offers medication adherence and stress management counseling for all clients.[53]

1.2.6 Obstacles for Women Participating in Cardiac Rehabilitation Programs

Despite the known benefits of CR participation, women are still being under referred, have lower rates of enrollment, and when enrolled, have a higher dropout rate than men.[34] There is a gender bias that women do not benefit as much as men from CR

programming however this is false.[56] One of the most significant issues stems from physician referrals with respect to women. Physicians' are less likely to refer women to CR programs due to a lack of knowledge surrounding women and CVD, with the incorrect idea that women are at a lower risk for CVD than men.[57] Aside from low referral rates from medical professionals, women are half as likely to decide to participate in the programs.[57] This issue is thought to be due to various social and economic factors as well as intrapersonal reasons.[57] Some of the suggested reasons for decreased participation for women include a lack of time to go to CR programming and lower social support and encouragement to partake in the programs.[56] Additionally, women tend to be the primary caretakers within a family setting, therefore having higher perceived family responsibility.[56] Program characteristics such as the core objectives of CR including the exercise component, and inconvenient timing of sessions are thought to play a role in why women may not adhere as well to traditional CR programming.[56]

1.2.7 Gaps in the Literature Regarding Cardiac Rehabilitation

CR is an effective form of secondary prevention, yet is under-utilized, particularly in women. Not only are women less likely to attend, they are also less likely to successfully complete a CR program. Barriers to CR participation in women include intrapersonal, interpersonal, logistical and health system factors.[57] Suggested strategies for improving CR use in women include automatic referral procedures in conjunction with a health care liaison to communicate between the client, physician and specific CR program coordinators, early intake, incentives such as recognition for meeting specific goals, increased support from other CR clients, friends and family, women-only sessions

and home program availability, where clients can opt to partake in CR programming off site if appropriate based on their risk stratification.[57]

Increasing CR use amongst women has the potential to lower the personal and economic burden of CVD in our community as well as around the world. As noted above, various models of CR exist. Exploring the influence of program characteristics, including strategies believed to improve CR uptake and adherence and on attendance and completion rates of CR in women, specifically, is an important first step in creating equal access to CR and successful completion, thus promoting the best possible patient standard of care.

Chapter 2: Research Proposal

2.1 Purpose & Hypothesis

The primary purpose of this study is to establish the effect of CR program characteristics including strategies believed to improve uptake and adherence, on CR attendance and completion rates among women in order to maximize program success. Using database dictionaries, program characteristic profiles, and a dataset that encompasses 2 different models of care (one from Canada and one from the United States), the following AIMS will be explored:

AIM 1: Determine common and unique database women-only dictionary variables collected by individual CR centres.

HYPOTHESIS 1: Numerous common variables will be identified (e.g. demographics, event history), however unique variables may also be identified (e.g. nuances in quality of life assessments, baseline fitness assessments)

AIM 2: Characterize the women-only population at each site and compile site-specific intermediary (time of first post-event contact, wait time average for first visit-time between first contact and intake session, referral, uptake, adherence and drop-out rates) and clinical outcome averages (risk factors, events, in-program mortality, fitness, quality of life).

HYPOTHESIS 2: Referral procedures, time of first contact, wait time average, psychosocial services offered, medical control procedures, pattern of instruction, incentivization, home-programming, onsite monitoring, staffing and allied support, early intervention (Phase II) duration, maintenance/follow-up tracking and patterns, safety/efficacy (e.g. telemetry) will be similar within Canadian-based and US-based CR programs, but will differ between countries. It is further hypothesized that within-country nuances may exist (e.g. parking, transportation barriers).

The information collected from the data dictionaries to accomplish Objective 1, and the program characteristics obtained for Objective 2 will not require statistical analysis. These variables will be compared qualitatively to determine similarities and differences.

AIM 3: Determine the effect on attendance at intake to CR, after controlling for factors known to reduce enrollment, in women of: automatic referral procedures, time of post-event contact, and time between first contact and intake session.

HYPOTHESIS 3A: Women referred to CR via automatic referral procedures (computerized prompt) will have superior attendance rates at intake versus clients referred using usual procedures (physician discretion).

HYPOTHESIS 3B: Women having earlier post-discharge contact, and the shortest times between first contact and intake to early outpatient CR will have superior intake attendance.

- To determine if women referred to CR via automatic referral procedures (computerized prompt) will have superior attendance rates at intake versus women referred using usual procedures (physician discretion), a Chi-Square Test of Independence will be performed. Referral procedures will include either automatic or usual referrals, and attendance at intake session will either be yes or no. A logistical regression analysis will be conducted to determine if method of referral is predictive of attendance at intake after controlling for socio-demographic factors known to affect enrollment (e.g., age, presence of comorbidities, socioeconomic status, and race)
- To assess whether women having earlier post-discharge contact, and the shortest times between first contact and intake will have superior intake attendance, separate logistical regression analyses will be performed to determine if time of post-discharge contact, and time from first contact to intake is predictive of attendance at intake after controlling for known confounders as noted above.

AIM 4: Explore the influence of program characteristics including strategies believed to improve CR uptake and adherence, on attendance and completion rates in women, after controlling for factors known to reduce CR program enrollment and completion.

HYPOTHESIS 4: Women participating in a CRP that offers incentives, has more interaction with allied care workers, and has home-based programming options will attend the greatest number of CR sessions and have the highest completion rates.

- To determine if incentives and home-based programming options increase the number of CR sessions attended by women, as well as rates of program completion, we will compare attendance and completion rates of sites who offer these options compared to sites that do not. Logistical regression analyses will be conducted to determine if employment of these strategies predicts attendance and completion rates after controlling for socio-demographic factors known to reduce enrollment and completion.
  To ascertain if women who have more interaction with allied health professionals will attend the greatest number of CR sessions and have the highest completion rates, logistical regression analyses will be conducted. Factors known to reduce CR program enrollment and completion will again be considered.

2.2 Methods

Objective 1: Each site will send individual data dictionaries (either in WORD or Excel) via password protected institutional-based email for compilation into a master Excel document that will be housed at the University of Windsor.

Objective 2: Each site will send individual site program characteristics via password protected institutional-based email for compilation into a master Excel document that will be housed at the University of Windsor.

Retrospective, de-identified data of women CR clients will be examined using established databases from Michigan Medicine Cardiac Rehabilitation, Hôtel-Dieu Grace Healthcare-Cardiac Wellness Program, St. Joseph's Health Care London and Henry Ford Health System that will be provided through the establishment of data sharing agreements. Extracted variables will include the following: a) independent variables: referral procedure, time of post-event contact, time between first contact and intake session, b) dependent variables: attendance at intake, % age of sessions attended, attendance at graduation session, and c) socio-demographic and clinical characteristic variables. Data analysis will take place on a secure, password protected computer source at the University of Windsor, where rates of women-specific patient referral, uptake, adherence, and drop-out rates will be determined and compared between the sites, and the influence of program characteristics affecting women will be explored.

2.3 Statistical Analyses

Descriptive characteristics will be presented as means ± standard deviations, provided it is not otherwise specified. Logistic Regression Analyses and a Chi-Square Test of Independence will be utilized in order to determine if there are significant differences that exist between CR program characteristics with respect to women-specific rates of referral, uptake, adherence and rate of dropout after controlling for socio-demographic factors known to reduce women enrollment and completion rates. SPSS will

be used to analyze all of the data, using an alpha level of ≤ 0.05 to be considered statistically significant.

2. 4 Timelines for Major Step Completion

1. Approval of the Research Ethics Board (REB) Addendum to get access to Michigan Medicine Cardiac Rehabilitation (Red Cap), Hôtel-Dieu Grace Healthcare-Cardiac Wellness Program (Cardiologica), St. Joseph's Health Care London and Henry Ford Health System – November 30, 2018
2. Begin analyzing data as soon as REB Addendum is approved – December 1, 2018
3. Data analysis complete – February 28, 2019
4. Thesis rough draft complete – March 10, 2019
5. Final draft of thesis complete – April 15, 2019

References

1. World Health Organization. (2017). Cardiovascular diseases (CVDs). Retrieved from http://www.who.int/mediacentre/factsheets/fs317/en/

2. Public Health Agency of Canada. (2017). Canadian Chronic Disease Indicators Edition. Retrieved from: https://infobase.phac-aspc.gc.ca/ccdi-imcc/data-tool/

3. Abdullah, M. M. H., Jones, J. P. H., & Jones, P. J. H. (2015). Economic benefits of the Mediterranean-style diet consumption in Canada and the United States. *Food and Nutrition Research*, *59*, 1–10. https://doi.org/10.3402/fnr.v59.27541

4. Reed, G.W., Rossi, J.E., Cannon, C.P. (2017). Acute myocardial infarction *Lancet*, *389*, 197-210

5. Yusuf, S., Hawken, S., Ounpuu, S., Dans, T., Avezum, A., Lanas, F., McQueen, M., Budaj, A., Pais, P., Varigos, J., Lisheng, L. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet, 364*(9438), 937-52.

6. American Association of Cardiovascular and Pulmonary Rehabilitation. (2013). *Guidelines for cardiac rehabilitation and secondary prevention programs* (5th ed.). Champaign, IL: Human Kinetics.

7. Allen, J., Scott, L., Stewart, K., & Young, D. (2004). Disparities in women's referral to and enrollment in outpatient cardiac rehabilitation. *Journal of General Internal Medicine, 19*(7)*,* 747-753. doi:10.1111/j.1525-1497.2004.30300.x

8. Wenger, N.K., Speroff, L., Packard, B. (1993). Cardiovascular health and disease in women. *The New England Journal of Medicine, 329*, 247–56.

9. Kannel, W.B., Wilson, P.W. (1995). Risk factors that attenuate the female coronary disease advantage. *Arch Intern Med*, *155*(1), 57-61.

10. Grace, S.L., Fry, R., Cheung, A., Stewart, D.E. (2004). Cardiovascular disease. *BMC Womens Health,* doi:10.1186/1472-6874-4-S1-S15

11. Public Health Ontario. (2017). Cardiovascular Disease. Retrieved from: https://www.publichealthontario.ca/en/BrowseByTopic/Pages/Topic.aspx?k=Cardio vascular%2 0disease%20InformationByTopic:%22Cardiovascular%20disease%22

12. Statistics Canada. (2013). Windsor-Essex County Health Unit (Health Region), Ontario and Ontario (table). *Health Profile*. Statistics Canada Catalogue no. 82-228-XWE. Ottawa. Retrieved from: http://www12.statcan.gc.ca/health-sante/82-228/index.cfm?Lang=E

13. Tu, J.V., Chu, A., Maclagan, L. et al. (2017). Regional variations in ambulatory care and incidence of cardiovascular events. *Canadian Medical Association Journal, 89*(13), 494-501. doi: 10.1503/cmaj.160823

14. National Center for Health Statistics. (2016). Number of deaths and age-adjusted mortality rates for the ten leading causes of death, City of Detroit Health Department and Michigan, 2016, and United States residents, 2016. *2016 Michigan Death Certificate Registry*. Retrieved from https://www.mdch.state.mi.us/pha/osr/chi/Deaths/leadUS/LeadingUSObject2.asp?AreaCode=09&AreaType=L&JS=No

15. Bokslag A, et al. (2016). Preeclampsia; short and long-term consequences for mother and neonate. *Early Human Development*, *102*, 47.

16. Buchanan, T. A., Xiang, A. H., & Page, K. A. (2012). Gestational Diabetes Mellitus: Risks and Management during and after Pregnancy. *Nature Reviews. Endocrinology*, *8*(11), 639–649. http://doi.org/10.1038/nrendo.2012.96

17. Tweet, M.S., Kok, S.N., & Hayes, S.N. (2018). Spontaneous coronary artery dissection in women: What is known and what is yet to be understood. *Clinical Cardiology*, *41*(2), 203–210. http://doi.org/10.1002/clc.22909

18. Shufelt, C. L., & Bairey Merz, C. N. (2009). Contraceptive hormone use and cardiovascular disease. *Journal of the American College of Cardiology*, *53*(3), 221-31.

19. Flink, L. E., Sciacca, R. R., Bier, M. L., Rodriguez, J., & Giardina, E. G. (2013). Women at risk for cardiovascular disease lack knowledge of heart attack symptoms. *Clinical cardiology*, *36*(3), 133-8.

20. Mehta, L.S., Beckie, T.M., DeVon, H.A., Grines, C.L., Krumholz, H.M., Johnson, M.N., et al. (2016). Acute Myocardial Infarction in Women: A Scientific Statement From the American Heart Association. *Circulation, 133*(9), 916-947.

21. Bairey Merz, C.N., Andersen, H., Sprague, E., *et al.* (2017). Knowledge, attitudes, and beliefs regarding cardiovascular disease in women: the women's heart alliance. *J Am Coll Cardiol, 70*(2), 123-132. doi: 10.1016/j.jacc.2017.05.024.

22. Smulyan, H., & Michel, S. (2004). Blood Pressure Measurement: Retrospective and Prospective Views. *American Journal of Hypertension. 24*(6), 628-634. https://doi.org/10.1038/ajh.2011.22

23. Purkiss, S., & Huckell, V.F. (1997). Cardiovascular Physiology: Similarities and Differences Between Healthy Men and Women. *Journal of Obstetrics and*

Gynaecology Canada. Women's Health, 19, 853 -859. https://www.jogc.com/article/S0849-5831(97)80008-0/pdf

23. Bucholz, E.M., Butala, N.M., Rathore, S.S., Dreyer, R.P., Lansky, A.J., Krumholz, H.M. (2014). Sex differences in long-term mortality after myocardial infarction: a systematic review. *Circulation, 130*(9), 757-767.

24. Vaccarino, V., Krumholz, H.M., Yarzebski, J., Gore, J.M., Goldberg, R.J. (2001). Sex differences in 2-year mortality after hospital discharge for myocardial infarction. *Ann Intern Med, 134*(3), 173-181.

25. Champney, K.P., Frederick, P.D., Bueno, H., Parashar, S., Foody, J., Merz, C.N., et al. (2009). The joint contribution of sex, age and type of myocardial infarction on hospital mortality following acute myocardial infarction. *Heart*, *95*(11), 895-899.

26. Redfors, B., Angeras, O., Ramunddal, T., Petursson, P., Haraldsson, I., Dworeck, C., et al. (2015). Trends in gender differences in cardiac care and outcome after acute myocardial infarction in western sweden: a report from the swedish web system for enhancement of evidence-based Care in heart disease evaluated according to recommended therapies (SWEDEHEART). *J Am Heart Assoc, 4*(7). doi:10.1161/JAHA.115.001995.

27. Ades, P., Keteyian, S., Wright, J., Hamm, L., Lui, K., Newlin, K., ... Thomas, R. (2017). Increasing cardiac rehabilitation participation from 20% to 70%: A road map from the Million Hearts Cardiac Rehabilitation Collaborative. *Mayo Clinic Proceedings, 92*(2), 234-242. doi:10.1016/j.mayocp.2016.10.014

28. Leon, A. S., Franklin, B. A., Costa, F., Balady, G. J., Berra, K. A., Stewart, K. J., … Lauer, M. S. (2005). Cardiac rehabilitation and secondary prevention of coronary heart disease. *Circulation*, *111*(3), 369–376. https://doi.org/10.1161/01.CIR.0000151788.08740.5C

29. Mampuya, W. M. (2012). Cardiac rehabilitation past, present and future: An overview. *Cardiovascular Diagnosis and Therapy*, *2*(1), 38–49. https://doi.org/10.3978/j.issn.2223-3652.2012.01.02

30. Turk-Adawi, K., Supervia Pola, M., Lopez Jimenez, F., Pesah, E., Rongjing, D., Britto, R., ... & Babu, A. (2018). Global cardiac rehabilitation availability, volumes, capacity, and density. *JAMA Int. Med*.

31. Anderson, L., Oldridge, N., Thompson, D. R., Zwisler, A.-D., Rees, K., Martin, N., & Taylor, R. S. (2016). Exercise-based cardiac rehabilitation for coronary heart disease. *Journal of the American College of Cardiology*, *67*(1), 1–12. doi:10.1016/j.jacc.2015.10.044

32. Price, K. J., Gordon, B. A., Bird, S. R., & Benson, A. C. (2016). A review of guidelines for cardiac rehabilitation exercise programmes: Is there an international consensus? *European Journal of Preventive Cardiology*, *0*(0), 1–19. https://doi.org/10.1177/2047487316657669

33. Long, L., Anderson, L., Dewhirst, A.M., He, J., Bridges, C., Gandhi, M., Taylor, R.S. (2018) Exercise-based cardiac rehabilitation for adults with stable angina. *Cochrane Database of Systematic Reviews*, Issue 2. Art. No.: CD012786. DOI: 10.1002/14651858.CD012786.pub2

34. Stone, J., & Arthur, H. (2004). *Canadian guidelines for cardiac rehabilitation and cardiovascular disease prevention: Enhancing the science, refining the art*. *Canadian Journal of Cardiology* (2nd ed.). Canadian Association of Cardiac Rehabilitation.

35. Balady, G., Williams, M., Ades, P., Bittner, V., Comoss, P., et al. (2007). Core components of cardiac rehabilitation/secondary prevention programs: 2007 update. *Circulation*, *115*(20), 2675–2682. https://doi.org/10.1161/CIRCULATIONAHA.106.180945

36. Briffa, T., Chow, C., Clark, A., & Redfern, J. (2013). Improving outcomes after acute coronary syndrome with rehabilitation and secondary prevention. *Clinical Therapeutics*, *35*(8), 1076–1081. https://doi.org/10.1016/j.clinthera.2013.07.426

37. Overbaugh, K. (2009). Acute coronary syndrome. *American Journal of Nursing*, *109*(5), 42–52. https://doi.org/10.1097/01.NAJ.0000351508.39509.e2

38. Dahhan, A., Maddox, W., & Sharma, G. (2015). The gaps in cardiac rehabilitation referral: The elephant in the room. *Journal of the American College of Cardiology*, *66*(22), 2574. https://doi.org/10.1016/j.jacc.2015.03.521

39. Overbaugh, K. (2009). Acute coronary syndrome. *American Journal of Nursing*, *109*(5), 42–52. https://doi.org/10.1097/01.NAJ.0000351508.39509.e2

40. Grace, S., Chessex, C., Arthur, H., Chan, S., Cyr, C., Dafoe, W., … Stone, J. (2011). Systematizing inpatient referral to cardiac rehabilitation: A joint policy position of the Canadian As sociation of Cardiac Rehabilitation and Canadian Cardiovascular Society. *Canadian Journal of Cardiology*, *27*(2), 192–199.

41. Grace, S., Scholey, P., Suskin, N., Arthur, H. M., Jaglal, S., Abramson, B. L., &

Stewart, D. E. (2007). A prospective comparison of cardiac rehabilitation enrolment following automatic versus usual referral. *Journal of Rehabilitation Medicine*, *39*(3), 239–245. https://doi.org/10.2340/16501977-0046.A

42. Duncan, A., Natarajan, M., & Schwalm, J. (2016). Assessing physician barriers to cardiac rehabilitation referral rates in a tertiary teaching centre. *Canadian Journal of General Internal Medicine*, *11*(1), 14–18.

43. Grace, S., Grewal, K., & Stewart, D. (2008). Factors affecting cardiac rehabilitation referral by physician specialty. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *28*(4), 248–252.

44. Grace, S. L., Russell, K., Reid, R., Oh, P., Anand, S., Rush, J., … Stewart, D. (2011). Effect of cardiac rehabilitation referral strategies on utilization rates. *Archives of Internal Medicine*, *171*(3), 235–241. https://doi.org/10.1001/archinternmed.2010.501

45. Candido, E., Richards, J., Oh, P., Suskin, N., Arthur, H., Fair, T., & Alter, D. (2011). The relationship between need and capacity for multidisciplinary cardiovascular risk-reduction programs in Ontario. *Canadian Journal of Cardiology*, *27*(2), 200–207.

46. Turk-Adawi, K. I., Oldridge, N. B., Tarima, S. S., Stason, W. B., & Shepard, D. S. (2013). Cardiac rehabilitation patient and organizational factors: What keeps patients in programs? *Journal of the American Heart Association*, *2*(5), 1–9. https://doi.org/10.1161/JAHA.113.000418

47. Grace, S., Bennett, S., Ardern, C. I., & Clark, A. M. (2014). Cardiac rehabilitation series: Canada. *Progress in Cardiovascular Diseases*, *56*(5), 530–535.

https://doi.org/10.1016/j.pcad.2013.09.010

48. Thomas, R. J. (2015). The gap in cardiac rehabilitation referral: A system-based problem with system-based solutions. *Journal of the American College of Cardiology*, *65*(19), 2089–2090. https://doi.org/10.1016/j.jacc.2015.03.521

49. Kaminsky, L. A., Thur, L. A., & Riggin, K. (2013). Patient and program characteristics of early outpatient cardiac rehabilitation programs in the united states. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *33*(3), 168–172. https://doi.org/10.1097/HCR.0b013e318289f6a8

50. Grace, S. L., Tan, Y., Marcus, L., Dafoe, W., Simpson, C., Suskin, N., & Chessex, C. (2012). Perceptions of cardiac rehabilitation patients, specialists and rehabilitation programs regarding cardiac rehabilitation wait times. *BMC Health Services Research*, *12*(1), 1. https://doi.org/10.1186/1472-6963-12-259

51. Grace, S. L., Parsons, T. L., Duhamel, T. A., Somanader, D. S., & Suskin, N. (2014). The Quality of Cardiac Rehabilitation in Canada: A Report of the Canadian Cardiac Rehab Registry. *Canadian Journal of Cardiology*, *30*(11), 1452–1455. https://doi.org/10.1016/j.cjca.2014.06.016

52. Pack, Q. R., Squires, R. W., Lopez-Jimenez, F., Lichtman, S. W., Rodriguez-Escudero, J. P., Lindenauer, P. K., & Thomas, R. J. (2015). Participation Rates, Process Monitoring, and Quality Improvement Among United States Cardiac Rehabilitation Programs: A National Survey. *Journal of Cardiopulmonary Rehabilitation and Prevention*, *35*(3), 173–180. https://doi.org/10.1097/HCR.0000000000000108

53. Stone, J., Arthur, H., & Suskin, N. (2009). *Canadian guidelines for cardiac rehabilitation and cardiovascular disease prevention: Translating knowledge into action* (3rd ed.). Winnipeg, MB: Canadian Association of Cardiac Rehabilitation.

54. Suaya, J. A., Shepard, D. S., Normand, S.-L. T., Ades, P. A., Prottas, J., & Stason, W. B. (2007). Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery. *Circulation*, *116*(15), 1653–1662. https://doi.org/10.1161/CIRCULATIONAHA.107.701466

55. Balady, G., Williams, M., Ades, P., Bittner, V., Comoss, P., Foody, J. A., … Southard, D. (2007). Core components of cardiac rehabilitation/secondary prevention programs: 2007 update. *Circulation*, *115*(20), 2675–2682. https://doi.org/10.1161/CIRCULATIONAHA.106.180945

56. Resurreccion, D., Motrico, E., Rigabert, A., Rubio-Valera, M., Conejo-Ceron, S., Pastor, L., & Moreno-Peral, P. (2017). Barriers for nonparticipation and dropout of women in cardiac rehabilitation programs: A systematic review. *Journal of Women's Health*, *26*(8), 845–859.

57. Daniels, K., Arena, R., Lavie, C., & Forman, D. (2012). Cardiac rehabilitation for women across the lifespan. *American Journal of Medicine*, *125*(9), 937.e1-937.e7. https://doi.org/10.1016/j.amjmed.2011.10.028