THE QUALITY AND VARIABILITY OF CARDIAC REHABILITATION DELIVERY

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ABSTRACT

Background: Cardiac care, including cardiac rehabilitation (CR), is most effective if it is high-quality. The aim of this study was to describe CR quality, using the recently-developed Canadian Cardiovascular Society CR quality indicators (QIs). As secondary and tertiary objectives, site differences in quality were measured, and the criterion validity of 4 of the QIs in comparison to self-report data were established.

Methods: Secondary analysis was conducted on an observational, prospective, multi-site CR program evaluation cohort. A convenience sample of patients from one of 3 CR programs was approached at their first CR visit, and consenting participants completed a survey. Clinical data were extracted from charts pre and post-program. Of the 30 CR QIs, 21 (70.0%) were assessable: 10 process, 9 outcome and 2 structure QIs.

Results: Of 411 consenting patients, 209 (53.0%) completed CR. The greatest quality was observed for assessment of blood pressure (98.1%), communication with primary healthcare at CR discharge (94.2%), and patient enrollment (93.7%). The lowest quality was observed for wait time from hospital discharge (9.2%), assessments of blood glucose (42.1%), and lipid control (53.0%). Of the 7 QIs that had an established benchmark, quality for 2 (28.6%) was above the benchmark (particularly assessment of blood pressure). Significant site differences were observed in 11 (64.7%) QIs. The magnitude of quality differences between sites was largest for assessment of lipid control (72.6%), assessment of blood glucose control (69.0%), and wait time in median days from referral to enrollment (30.6 days). Validity was fair for QIs 2a and 3. None to slight validity was found for QI-17, and 18 respectively.

Conclusion: There is wide variability in CR program quality, both overall and between CR sites. Quality improvement in particular aspects of CR care is required.

DEDICATION

I dedicate my thesis work to my family and friends who made this journey possible with their constant love and support.

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1.0 INTRODUCTION

Cardiovascular disease (CVD) is a leading cause of death in Canada. Effective secondary prevention requires multi-factorial behavioural and risk factor management. Cardiovascular Rehabilitation (CR) is a comprehensive outpatient chronic disease management program that is designed to improve CV health.[1] CR programs offer medical assessment, structured programs of exercise training, patient and family education, and the delivery of comprehensive CV risk factor management strategies. Participation in CR is related to 25% lower mortality when compared to usual medical care.[2] Based on the proven benefits of CR, the American Heart Association Guideline for secondary prevention and risk reduction therapy[3] promote referral to CR as the standard of care for acute coronary syndrome, following revascularization, among other indications.

The benefits of CR can be further reinforced by providing the highest quality of care to patients. However, there remains a large gap between what we know to be effective CR care and what is actually delivered.[4,5] Quantifying the quality of CR involves translating evidence-based recommendations into well-defined measurements of care called Quality Indicators (QIs)[6]. The Canadian Cardiovascular Society (CCS) embarked on a process to develop QIs (http://bridge.ccs.ca/index.php/en/) to enable quality improvement in care nationally[7]. Thirty CR QIs specifically were since developed.[6] To date 14 of them have been assessed, and a wide variation between QIs was observed.[8] This study will assess 21 CR QIs (10 of which have been assessed previously and 11 which have not), through secondary analysis of an evaluation database of CR programs within the Greater Toronto Area (GTA).

2.0 REVIEW OF LITERATURE

CVD is a class of diseases that involve the heart or blood vessels. Globally, CVD is high in prevalence and incidence, and is the leading cause of mortality.[9,10] One in every 20 Canadians reports being diagnosed with a CV disease, but the actual number with undetected heart disease is much higher.[11] The burden of CVD is expected to increase dramatically over the next decade, in part due to the aging population and the rising incidence of diabetes mellitus and obesity.[12]

While CVD mortality has been declining in Canada due to advances in treatment, there are many Canadians living with CVDs.[11] Over time, this CVD burden becomes more complex, and has negative impacts for a patient's quality of life as well as the Canadian healthcare system. CVD is the largest health-related economic cost in Canada with major direct (i.e. hospital care, drugs, physician care, other institutional care) and indirect (i.e. mortality, and short and long-term disability) costs.[13] This cost has increased over recent years and now amounts to CAD$22 billion per year, with 3 of the top 4 most expensive health conditions in Canada being CVDs.[12] Thus, there is a critical need for comprehensive and effective chronic disease management to address this health system burden.

2.1 Cardiac Rehabilitation

CR programs are effective in managing and controlling chronic CVD. The Canadian Association of Cardiovascular Prevention and Rehabilitation (CACPR) defines CR as being a hospital or community-based program, with the following components: appropriate medical assessment; a multidisciplinary team of healthcare professionals, including a physician; a core element of exercise; the ability to provide and/or access approved exercise testing procedures; client and family education; structured risk factor identification, and behaviour modification.[1] Other components include: referrals, patient assessment, lifestyle risk factor management (i.e., exercise, diet, smoking), management of psychosocial health, medical risk factor management,

cardio-protective therapies, leisure time activities, outcomes assessment, and long-term management.[14] In Ontario, CR is funded by the provincial health insurance program.[15]

In regards to accessing CR, patients are referred by a physician[1]. Once the referral is received, patients undergo an intake interview by program personnel[1]. This includes a medical assessment and exercise stress test to assess their suitability for exercise training, and to assign an appropriate exercise prescription. Patients then participate in group exercise classes about 1-3 times per week on-site, and are taught to exercise safely on non-CR days at home[1]. Patients also participate in education sessions. At the end of the program, patients receive a repeat medical assessment: to update their exercise prescription, for recommendations to be made in regards to supporting the long-term management of their CVD, and to ensure they meet their risk factor treatment targets[1]. The median length of CR programs in Ontario is 5 months.[15]

Peer-reviewed scientific evidence, including randomized controlled trials, systematic reviews, and meta-analyses, have consistently established that patient participation in CR reduces mortality by approximately 25% when compared to usual care.[16] The magnitude of the benefits achieved by participation in a CR program is comparable to that of other standard cardiac therapies, including statins,[16] aspirin, and percutaneous coronary interventions (in low risk patients).[17] Through the metabolic and physiological effects of exercise, promotion of medication adherence, smoking cessation, and improved nutrition and mental health, CR provides a comprehensive means of addressing a pathological atherosclerotic milieu which cannot be modified by surgical or percutaneous intervention alone.[18–20] CR has also been shown to reduce the need for re-hospitalization, the use of interventional procedures, and to have beneficial effects on cardiac risk factors such as systolic blood pressure and total cholesterol.[21] CR participation can result in significant health behaviour changes such as increased exercise,[22]

improved diet, and smoking cessation[23]. CR is related to increased exercise capacity when compared to usual care.[24,25]

2.2 Quality and CR

Cardiac care, including CR, is most effective if it is high-quality care. Care quality refers to a multidimensional construct that, as articulated by the Institute of Medicine,[26] encompasses the concepts of safety, equity, evidence-based medicine, timeliness of care, efficiency, and patient-centeredness. Quality of care is defined as "the degree to which health services for individuals and populations increases the likelihood of desired health outcomes and are consistent with current professional knowledge."[26] The ability to quantify the quality of CR care critically depends on the translation of evidence-based recommendations into the measurement of that care. Without the ability to measure or quantify quality, and without the opportunity to identify practices that lead to higher-quality care, CR quality cannot be improved.

QIs are intended to measure adherence to specific practice guidelines in order to reduce the gap between the evidence and actual clinical practice.[27] QIs define the standard of care. They are used broadly to evaluate the quality of care locally or to compare between institutions, regions or countries, so as to support quality improvement. At the healthcare system level, they can be used to address performance by evaluating, for example, accessibility, safety, equity and efficiency. QIs can also be used to evaluate clinical aspects of care, namely the structure, processes and outcomes of cardiovascular secondary or tertiary care.[28]

The impact of achieving quality improvement within Canadian CR programs has not been empirically established. However a recent study which computed the impact of using Coronary Heart Disease (CHD) QI benchmarks on mortality, found that the utilization of CR lowered mortality rates.[29] Based on 2005 CR utilization rates post-MI in Ontario, if CR uptake

was increased to a 90% benchmark, 135 deaths could be prevented or postponed, with a 1.3% (95% CI, 1.0-1.6) reduction in CVD mortality. Thus, given that QIs are developed based on evidence of their impact on health outcomes, improving our attainment of CR QI benchmarks should similarly improve the health outcomes of Canadians.

Among the first to develop QIs for CR was the American Association of Cardiovascular and Pulmonary Rehabilitation (AAVCPR), who developed a subtype of QIs, namely performance measures.[30] These are specifically suitable for public reporting, external comparisons, and pay-for-performance.[30] The European Association of Cardiovascular Prevention and Rehabilitation (EACPR) recently developed a QI on CR referral.[31] Finally, a Dutch group in Europe also developed QIs.[32] In Canada, CR QIs have recently been developed and are arguably the most rigorous and comprehensive fashion of all QIs internationally. The development of the Canadian CR QIs is described below.

2.3 Development of Canadian CR QIs

The Canadian Heart Health Strategy and Action Plan (CHHS-AP) provides an overarching framework for the future of the Canadian cardiac health system.[33] Following recommendation by the CHHS-AP, an initiative was established by the CCS, with financial support from the Public Health Agency of Canada (PHAC), to develop pan-Canadian QIs for cardiovascular care.[34] In 2011, the CCS Data Definitions and QI Steering Committee chose CR as the next chapter for QI development.

A standardized methodology for QI development was developed, composed of 3 phases.[7] In phase 1, members representative of stakeholder organizations and experts in the field from across Canada were invited to serve on the working group. They created 5 sub-theme or domain groups, namely: (1) Referral, access, and wait times; (2) Secondary prevention, assessment, risk stratification, and control; (3) Behavioral change, program adherence, psychosocial issues,

education, and return-to-work; (4) CR model and structure; and (5) Discharge transition, linkage, and communication. These were populated with experts in the field, who were asked to develop candidate QIs in the structure, process and outcome dimensions of care, as described by Donabedian[28].

In phase 2, the working group considered candidate QI's from existing Canadian[1] and American[35] sources – the latter being the only CR QI peer-reviewed publication identified by a 2012 environmental scan prefacing this project.[33] These and additional CR QIs suggested by the sub-theme groups underwent rapid review. Based on the summary of findings, 38 QIs was generated by the working group.

Each CR QI was then drafted by the corresponding sub-theme group, with the following elements: name and definition, numerator, denominator (i.e., reference item or population, exclusions), sources of data, method of calculation, rationale, clinical recommendation(s) with corresponding guideline citations, and challenges to implementation. The CR QI working group provided the subgroups with input on the 38 preliminary CR QIs, which subsequently underwent formal expert panel rating. Eight indicators were removed from the list following the results of the ranking survey.

With regard to the third phase, further external input was solicited. The 30 QIs were posted for a one-month web-consultation process on the CCS QI website. QI technical specifications were refined and standardized by a methodologist from the Canadian Institute of Health Information. Approvals were solicited and received from CCS and CACPR. Two out of the final list of 30 QIs were then field-tested.[36] The 30 QIs were then published.[6]

To date there is only one publication to our knowledge describing the quality of CR in Canada. Fourteen of the QIs were assessed, and wide variation in quality across the indicators

was observed. This was undertaken using the Canadian Cardiac Rehab Registry (CCRR). The CCRR is a web-based tool that captures 200 variables from CR participants, pre and post-program. The tool allows CR program data stewards to enter data concurrently during the program or after patient discharge. Following the reconciling of each QI with CCRR data definitions, it was found that 14 out of the 30 QIs (46.7%) could be assessed within the CCRR. Five thousand four hundred and forty seven patient records collected from all 11 CR programs in the CCRR were utilized for analysis[8]

All of the CR QIs are expressed as a percentage except for QI- 2b which measures wait time from referral to enrolment in median days. Results showed that wait times for enrollment grossly exceeded the 30-day QI target,[37] with a median of 84 days. QIs that measured assessment of blood pressure and adiposity were high (90% and 85% respectively).[8] However QIs that measured assessment for lipids (41%), blood glucose among diabetic patients (23%), and depression screening amongst patients (13%) were low.[8] Only 68% of patients had achieved a half metabolic equivalent of task (MET) increase in exercise capacity at program discharge. Only 61% of smokers were referred to smoking cessation therapy.[8] Thirty percent of participants were offered stress management.[8] Ninety percent of patients completed the CR program, however this was considered an over-estimation due to failure to enter non-participating patients into the Registry.[8] Regardless, there are areas in which this inquiry suggests CR quality is poor and that further research is required.

2.4 Objective

The objective of this study is to assess more CR QIs than has been done previously, and to investigate the variation in these QIs. The quality of 3 CR programs in the GTA will described using the recently published 30 Canadian CR QIs. Twenty-one out of 30 QIs have been deemed

assessable and will be described. Eleven of the QIs which will be assessed herein, including the structure QIs, have yet to be assessed (Table 1).To establish the level of criterion validity in this study, the QIs will be measured against corresponding self-report data. Four out of the 21 QIs can be tested for criterion validity. Thus this research will more fulsomely characterize CR quality, which is an essential first step before we can work towards improved CR delivery, outcomes and efficiency.

2.5 Candidate's Role

My primary role in this study was to coordinate the CR Program Evaluation database (for participants recruited during graduate training). This included managing the participant database in MS Excel, entry of patient chart data from Case Report Forms (CRFs) into the IBM SPSS 22[38] database, emailing out participant surveys online, following up with non-responding participants via phone and email according to a modified Dillman method[39], data merging and cleaning, as well as Knowledge Transfer (KT). Other study oversight included maintaining the study binders, ensuring secure storage of Informed Consent Forms (ICFs) and other source documents, as well as communication with Research Ethics Boards. I also performed all of the statistical analyses and writing for this research.

3.0 METHODS

3.1 Design

A CR program evaluation cohort was utilized for this secondary analysis. This study was observational, and prospective in design. Approval from the research ethics review boards at each of the 3 CR sites as well as York University was received. Data from participants who were recruited into one of 3 CR programs between July 2010 and February 2014 were used in this study. Data from the first two assessment points (i.e., corresponding to CR intake and discharge

approximately 6 months later for those who stayed in the program) were analyzed for the purposes of this study.

3.2 Setting

The cohort consisted of participant data collected from 3 CR sites in the Greater Toronto Area: the Toronto Western Hospital (Toronto), Mackenzie Health (Richmond Hill), and Southlake Regional Health Centre (Newmarket). Two of the CR programs were located adjacent to community hospitals within a suburban setting, while the third CR program was located within an academic hospital in an urban setting. All 3 programs offered CR in accordance with CACPR Guidelines.[1]

Table 2 describes the attributes of each site. Each offered an initial group education session prior to an individual intake assessment. The program located in an academic hospital offered 90 minute twice-weekly classes, for a duration of 4 months. The community CR programs offered 60-90 minute twice-weekly classes, and one 90 minute weekly class, respectively, for 6 months. All three programs offered education classes, on-site exercise programs, dietary counselling for groups or individuals, smoking cessation referrals, and psychosocial assessment/support. In addition, the two community CR programs offered vocational counselling, spousal/family support, as well as stress management on an individual basis. All three programs offered morning and afternoon classes. However the community CR programs offered evening classes as well.

With regard to cost, the CR program located within an academic setting is covered entirely by provincial healthcare, and is accessible by public transit. Parking at the site costs $4.50 per ½ hour visit and $9 per day. One of the community CR programs costs $55 plus tax

per month, while parking is free. The other community CR program is covered by provincial healthcare, however education materials costs $100, and parking is $3 per visit.

3.3 Procedure

At their first CR visit, all patients are approached to solicit informed consent by personnel involved in the circle of care (Appendix A). From study inception (July 2010) to February 2012, consenting patients were provided 2 copies of the Informed Consent Form (ICF) with a stamped pre-addressed return envelope. Later on, in an effort to reduce costs, new patients were provided a study information sheet with instructions to email the study coordinator. Once the study coordinator received an email, the patient was sent a link to where the site-specific ICF was presented. Patients were asked to read through and check the box at the bottom to indicate consent.

All patients completed an intake assessment as part of their standard care. This included risk factor assessment, an exercise stress test, and blood work (e.g., lipid panel, glycated hemoglobin or $HbA1_c$). Some of this data, as well as some referral form information, was extracted onto the Case Report Form (CRF) (Appendix B). This assessment protocol was repeated at the end of CR for those who completed the program. CR charts for all consenting participants were audited at expected CR discharge to ascertain program participation and to record available discharge asssessment data (Appendix C).

Participants were also asked to complete a self-administered survey (relevant excerpts in Appendix D) in paper or online format, in accordance with the format through which they provided informed consent. The intake survey's purpose was to describe the sample by assessing socio-demographic characteristics such as income, education, marital status and, ethno-cultural background through forced-choice items. Online surveys were administered using a secure web

survey program called "Survey Monkey". These surveys were administered once consent was obtained, and hence they were generally completed by participants who had participated in initial CR sessions.

A modified Dillman protocol[39] was applied at all assessment points to optimize survey response rate. If after the survey was emailed the first time the participant did not respond within two weeks or had not clicked the "opt-out" button, a replacement survey would be emailed. If patients did not respond or click the "opt-out" button within the next two weeks, the patient would be called to ascertain whether they received the e-mail correspondence or if they had any questions. If the patient still had not completed the survey two weeks after the patient call, the patient would be considered a non-responder for that assessment.

Two structure QIs was measured in this study: one measures whether the program has an emergency response strategy (QI-31; Appendix E), and the other whether the program has Medical Director supervision (QI-32; Appendix E). To assess these QIs, written program policies were audited and clinicians were interviewed at each of the 3 CR sites.

3.4 Participants

This convenience sample consisted of all consenting participants referred to the 3 CR programs. Four hundred and eleven participants consented to the study from all three programs (128 from Toronto Western Hospital, 99 from Southlake Regional Hospital, and 184 from Mackenzie Health). Participants were referred to the CR programs with the following cardiac diagnoses or procedures: acute coronary syndrome, chronic stable angina, or stable heart failure, as well as percutaneous coronary or valvular intervention, coronary artery bypass graft (CABG) ± valve surgery, cardiac transplantation, or mild non-disabling stroke.[1] The inclusion criterion was that participants were deemed eligible to complete CR following the intake assessment (i.e.

no co-morbidities identified or indications from the exercise stress test that would preclude CR participation). Participants who were not proficient in the English language were excluded from the study.

3.5 Measures

Sociodemographic characteristics of the sample such as income, education, marital status, and ethno-cultural background were assessed through forced-choice items in the intake survey (Appendix D). Clinical measures were extracted from CR referral forms, as well as CR intake and discharge assessments, onto intake and discharge CRFs (Appendix B & C). This enabled description of the sample, including: previous cardiac diagnoses, referral and intake dates, referral indications, age, sex, comorbid conditions, cardiac medications, cardiac risk factors (e.g. lipids, blood pressure, blood glucose, Body Mass Index, and waist circumference), as well as program participation and completion. Peak Metabolic Equivalents of Task (METs) were obtained from the graded exercise stress tests. The level of change from intake to the discharge assessment was necessary to measure QI-17 or increase in exercise capacity (Table 3).

Quality Indicators

Twenty-one out of the 30 CR QIs were assessable within the study: 10 process (QI-2a, 2b, 3, 5, 13, 14, 15, 16, 26, 30), 9 outcome (QI-7, 8, 9, 10, 12, 17, 18, 24, 37), and 2 structure (Appendix E). Each process and outcome QI were assessed using the CR charts as outlined in Table 3. Seven of the QIs had established benchmarks to which performance could be compared.[40,41]

The definitions of QIs 2a, 3, 26, and 30 were slightly modified due to what data was available. Specifically, QI-2a measured wait time from hospital discharge to enrollment in all participants, not just those who were eligible and were in-patients. For QI-3, the percentage of

participants who enrolled and underwent an intake assessment was captured, not who attended any first visit (as all participants had already attended an initial visit during which time they were invited to participate in the study). QIs- 26 and 30 captured patients who received, instead of were referred to, a smoking cessation or stress management intervention, respectively.

In regards to the structure QIs, the strategy in place to enable prompt defibrilliation (e.g. accessible "crash cart", automated external defibrillator, code blue policies), and current Basic Cardiac Life Support certification of all clinical staff, was reviewed for QI-31. For QI-32, medical director supervision was determined by reviewing the program's organizational chart and the job description of the most senior physician, if available.

3.6 Statistical Analyses

IBM SPSS version 22 was used.[38] Sociodemographic and clinical characteristics of participants were computed and described. These were compared by site using analysis of variance (ANOVA) with post-hoc least significant differences (LSD) tests. A p-value of <0.05 was defined as a significant difference between groups.

Retention for the discharge assessment was calculated. The sociodemographic and clinical characteristics at intake of the retained and non-retained samples in terms of graduation from the program were compared using Chi-square and Student's t-test analyses as applicable.

For the first objective, each of the QIs were described. The values for each QI was computed in accordance with the definitions provided in Appendix E. The value for QI-2b was calculated in median days (Appendix E). Some QIs were assessed only in those who completed CR (i.e., QIs- 5, 7, 8, 9, 10, 12, 17, 18, 26, 30, 34, and 37 as per Table 3). The graduation status of the participant was obtained from the discharge CRF (Appendix C p2 q5). To test the second

objective, ANOVA was utilized to analyze differences on each QI (dependent variable) by CR site (independent variable).

4.0 RESULTS

4.1 Respondent Characteristics

Of the participants approached, 411 consented. Figure 1 shows the participant flow diagram. Table 4 displays the pre-CR sociodemographic and clinical characteristics of the cohort by site. Participants significantly differed by marital status, racial /ethnic background, peak METs, CABG surgery as a referral indication, the risk factors dyslipidemia and hypertension, and medication use (i.e. Acetylsalicyclic Acid [ASA], statins, beta-blockers, anti-coagulants, and other cardiac medications).

CR charts were available for 394 (96.1%) participants at post-test. Of these, 209 (53.0%) completed a discharge assessment, and were thus considered to have completed the program (Figure 1). Characteristics of those who graduated and those who did not, are shown in Table 5. Participants who completed CR were significantly less likely to have been referred due to arrhythmia, and more likely to have been prescribed ASA at discharge. No other differences were observed.

4.2 CR Quality

QI findings (percentages or median days for QI-2b) are displayed in Table 6. Of the 7 QIs for which there exists an established benchmark, quality for 2 (28.6%) of the indicators exceeded the benchmark (QIs 3 enrollment and 13 assessment of blood pressure).

For QIs without an established benchmark, performance was 75% or above for: participants who received education (QI-5), assessment of adiposity (QI-15), participants who received a stress management intervention (QI-30), programs with medical director oversight

(QI-32), programs with a documented emergency response strategy (QI-31), and communication with the primary healthcare provider at discharge (QI-34; i.e. discharge summary on file addressed to primary care). QIs for which performance was observed to be below 50% were (in ascending order): wait time from hospital discharge to enrollment (QI-2a), prescription of other anti-platelets at discharge (QI-8), and assessment of blood glucose control (QI-16; the latter has a benchmark).

Differences in CR quality by site are displayed in Table 7. QIs which had an insufficient sample size for analysis at the site level (i.e. less than 2 cases) were excluded. These indicators were: smoking cessation support (QI-26), programs with medical director oversight (QI-31), and programs with a documented emergency response strategy (QI-32). Thus, 17 (81.0%) QIs were analyzed. Significant differences in performance between sites were observed for 11 (64.7%) QIs. Exceptions were QIs- 2a, 3, 8, 12, 13, and 34. The magnitude of quality differences between sites was largest for assessment of lipid control (72.6%), followed by assessment of blood glucose control (69.0%), and wait time from referral to enrollment in median days (30.6 days).

5.0 DISCUSSION

There are gaps between what we know to be effective CR care and the care we provide. Results of this study demonstrate that efforts are needed to improve CR quality in some areas, and that it varies considerably across programs. Quality was greatest for the 2 CR structure indicators, assessment of blood pressure control, communication with primary care, enrollment and patient education and was lowest for wait times, assessments of blood glucose, and lipid control.

Quality in terms of wait-time from hospital discharge to enrollment was the lowest of all indicators assessed. Reduction in wait times could be achieved by targeting the referral stage.

Systematic strategies have proven to reduce wait times by ensuring patients are referred as inpatients prior to hospital discharge, not weeks later at an outpatient visit.[42,43] Lack of capacity for new patients, or lack of human resources to process referrals received could also explain the unduly long wait times observed. The wait times observed are disconcerting, given emerging evidence of the negative impact of prolonged waits on many outcomes from cardiac remodeling to program enrollment.[43,44]

Program completion could be improved, given that a dose-response association exists between CR adherence and mortality.[45] Interventions to improve CR adherence have been recently reviewed.[46] Of the 8 trials identified, only 3 had a significant effect in increasing adherence. These interventions included self-monitoring of activity, action planning and tailored counselling by CR staff. Although the root causes of low CR adherence are multifactorial and complex, these interventions could be applied to optimize patient outcomes. Low assessment of blood glucose and lipids may be explained in that CR staff aim to avoid duplicate testing to save costs to the health care system. These tests may have already been completed by another of the patients' healthcare providers. This could be overcome where electronic medical records could be shared between specialist, generalist and CR providers to ensure programs have access to such results. Alternatively, the patients may have reported that they do not have diabetes, or staff may have observed that their lipids were well-controlled pharmacologically.

Cardiac medication use post-CR was surprisingly low. Given individual indications and contraindications were not taken into consideration in this study, the prescription of certain drugs may not have been appropriate for all patients (e.g., in post-myocardial infarction patients only those with poor left ventricular function and heart failure are indicated for a beta-blocker). The data was recorded from program charts, and likely reflects patient report to CR staff of

medications taken, as medication prescription is usually undertaken by a patient's specialist rather than these CR programs. It is hoped that the post-program communication from the CR program to the patients' primary care provider (which was frequent) lists their medications and recommendations for medication additions and changes in accordance with guidelines.

Upon comparison of the QI findings from this study to those obtained from the Canadian Cardiac Rehab Registry (CCRR),[8] similarities and differences were observed. Indicators that were fairly consistent in the CCRR and in this study, respectively, were: QI-13 assessment of blood pressure control (90% versus 98%), QI-15 assessment of adiposity (85% versus 88%), QI-17 increase in exercise capacity (69% versus 68%), and QI-16 assessment of lipid control (41% versus 42%). Inconsistencies were seen in some indicators as well. Assessment of blood glucose was about half the rate in the CCRR as was observed herein (23% vs. 42%).

This study was the first to examine QI differences between CR sites. For approximately two-thirds of the QIs, significant site differences were observed. These findings are worrisome, as they suggest that some of the sites are providing much lower quality care than their counterparts. Differences may have arisen from variation in levels of resources or staff complement at each program, and in provider practice. Another explanatory factor could be the lack of standardization in charts and charting practices across the CR sites. Site differences in delivery of care could have negative repercussions for the outcomes of patients who are referred to one CR program over another for reasons such as geographic location. However as the results showed, patients differed significantly between sites in terms of their sociodemographic and clinical characteristics at intake. Thus this likely also contributed to the site differences in quality observed.

Improvement initiatives are needed to increase quality where it was low, and also to reduce CR site variation. Indeed, some organizations have developed CR standards[31,47] which, where implemented, may reduce variability. Moreover, a recent American study demonstrated how a series of quality improvement activities, namely program policy changes as well as patient educational materials and incentives, significantly improved CR program session attendance among graduating patients.[24] CR programs could also form a "community of practice" to share best practices enacted by high-performing programs with lower-performing ones.

5.1 Limitations

Caution is warranted when interpreting the findings. First, the representativeness of the cohort is unknown, as the CR sites did not record which patients were approached to participate but declined. As well, consenting patients may have had particular psychological characteristics, such as high motivation and perseverance, that set them apart from patients who did not, and this could have affected the results. Thus, selection bias may be at play. More broadly, the majority of cardiac patients indicated for CR are not referred, and hence the findings will only be generalizable to those who are referred and ultimately attend an initial CR session.

Second, the generalizability of the findings for the 14 QIs which required CR discharge data is not known, considering only half of the patients completed the program. The retained cohort did not differ greatly from those lost to follow-up however. Nevertheless, these QIs should be interpreted with caution as they may be under or over-inflated.

Third, due to the use of secondary analysis, there was an inability to assess all of the QI exclusions spelled out by the CCS (see Table 11), and to establish the criterion validity of all 22 QIs analyzed. QI-2b, however, which was not analyzed for criterion validity in this study has been field-tested previously demonstrating high validity.[49] Therefore, some of the findings should be interpreted with caution.

Fourth, the sample size was very small for the structure QIs, and hence these findings should not be over-interpreted. Finally, the generalizability of the study results to other CR programs is unknown, particularly to CR programs with differing payment models, and location (e.g. rural).

6.0 EXTENDED METHODS

Given the newness of the Canadian CR QIs, the criterion validity of the QIs was assessed. Based on available data, there were 4 (19.0%; QIs- 2a, 3, 17, and 18) QIs that could be assessed for validity as outlined in Table 8. The criterion validity of each was tested by assessing the association of chart with self-report data from the discharge surveys. The discharge survey included many of the same measures in the intake survey to assess change. This survey was adminstered 6 months following intake (relevant excerpts in Appendix F). These were sent independent of the CR programs, such that participants would be willing to complete them regardless of whether or not they completed the program. The validity of 3 of the QIs (2a, 3, and 18) were tested with investigator-generated items.

With regard to QI-17, the survey also included the Duke Activity Status Index (DASI,[50]; see Appendix F, section A), which is a 12-item scale, where patients are asked about activities of daily living. Scores can be converted to METs, with higher scores denoting greater functional capacity.

Cohen's kappa and Pearson's correlation analyses were employed as appropriate to determine the magnitude of the relationship between chart and self-report data. Pearson's Correlation analysis was also used to determine the relationship between wait time (in days) indicated in the discharge surveys versus chart data (QI-2a), as well as change in METs

measured in both discharge surveys and charts (QI-17). Kappa coefficients were interpreted in accordance with established guidance[51] as follows: less than 0 to indicate no agreement, 0-0.20 as slight, 0.21-0.4 as fair, 0.41-0.6 as moderate, 0.61-0.80 as substantial, and 0.81-1 as almost perfect agreement. A correlation coefficient of 0.30 was the minimum value to indicate a relationship.

7.0 EXTENDED RESULTS

Two-hundred and forty-four (59.4%) participants completed the discharge survey. Values for QIs 2a, 3, 17 & 18 which were ascertained using chart (criterion) versus self-report are shown in Table 9. The criterion validity results are shown in Table 10. Cohen's kappa analysis showed that there was slight agreement for QI-17, and fair agreement for QIs-2a and 3. Pearson's correlation analysis for QI-18 revealed a coefficient well under 0.30, indicating lack of agreement and hence lack of validity. Pearson's correlation analyses revealed that there was no relationship between self-reported wait time and wait time indicated in charts (in days) (r=-0.02), and between change in METs ascertained through the DASI questionnaire and peak METs indicated in charts (r=0.09).

8.0 EXTENDED DISCUSSION

No to fair QI validity was observed. The lack of high validity in the QIs assessed could have been due to the poor reliability of the investigator-generated items utilized (relevant to QIs 2a, 3, and 18). However, the absence of criterion validity for QI 18 was in contrast to findings from a past study which demonstrated high validity between self-report and chart data for adherence to program sessions.[52] Perhaps, patients may not have been able to accurately recall the percentage of classes that they had attended when completing their discharge survey. In

terms of QI-17, DASI scores are a highly correlated measure of functional capacity.[50] However it has been found that patient responses to DASI questions often under or over-estimate their exercise capacity in comparison to what would have been measured clinically.[53,54] A primary study specifically designed to test QI validity is needed before definitive conclusions can be drawn.

9.0 KNOWLEDGE TRANSLATION

Knowledge translation or KT is defined by the Canadian Institute of Health Research as "a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically sound application of knowledge to improve health, provide more effective health services and products, and strengthen the health care system".[55] Given the applied nature of this study, it was determined that programs would benefit from learning of the areas where the QIs were valid and poor or variable quality was observed.

Thus, as part of the KT process, each CR site was emailed with an offer of a site-specific presentation of the findings. I developed a confidential site-specific presentation for the 1 program which responded. The presentation compared the site's QI findings to the aggregate of those of the other 2 sites. The site was informed as to where, in terms of quality, it was performing well and where improvement was required.

I was also able to contribute to KT as a member of the CCRR Research and Program Liaison sub-committees. The Research sub-committee established the CCRR minimum data set based on the CR QIs. The QIs were also integrated into the quarterly progress reports for programs. The program liaison sub-committee trains programs entering data into the CCRR, and provides them with their progress reports. In the near future, TWH and Southlake will receive information on their quality in this manner.

In terms of academic KT, I have presented my research findings at the 2014 Toronto General Research Institute Research day,[56] and will be presenting at the 2015 American Psychology Association convention in Toronto. A manuscript of the research findings was recently submitted to the Journal of Cardiopulmonary Rehabilitation and Prevention, and is currently under review.

10.0 DIRECTIONS FOR FUTURE RESEARCH

In addition to translating knowledge from these findings into practice at the participating programs and beyond, there are several key directions for future research stemming from this thesis. First, given the low validity observed for the QIs which could be assessed, refinement of these QIs is warranted. Assessment of the validity of the other QIs is also imperative.

Second, the following QIs have yet to be assessed in any study to our knowledge: QIs 1, 20, 21, 35, and 36. In future, assessment of these should be undertaken within a consecutive sample of patients to ensure generalizability, in a random selection of programs nationally.

11.0 CONCLUSION

In conclusion, areas of high and low quality within GTA CR programs were identified using a higher number of CCS CR QIs than what was assessed in the past. As well for the first time, program differences were measured and observed in about half of the QIs tested. Methods that could be employed to increase quality in lacking areas, and to minimize site differences include: the use of systematic referral, use of electronic patient records across the continuum of care, and better inter-provider communication regarding use of evidence-based cardiac medications. Given the low validity found within the sub-set of QIs assessed, a primary study is warranted to fulsomely assess their validity and possibly refine the QIs.

KT initiatives underway have ensured that programs involved in this study and those reporting to the CCRR receive ongoing feedback on their quality, giving them evidence from which they can take steps towards improving their CR delivery. Given the recent integration of the QIs into the CCRR data definitions, recruiting as many CR programs as possible into the CCRR may facilitate standardization of CR care on a national scale.

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Figure 1: Patient Flow Diagram

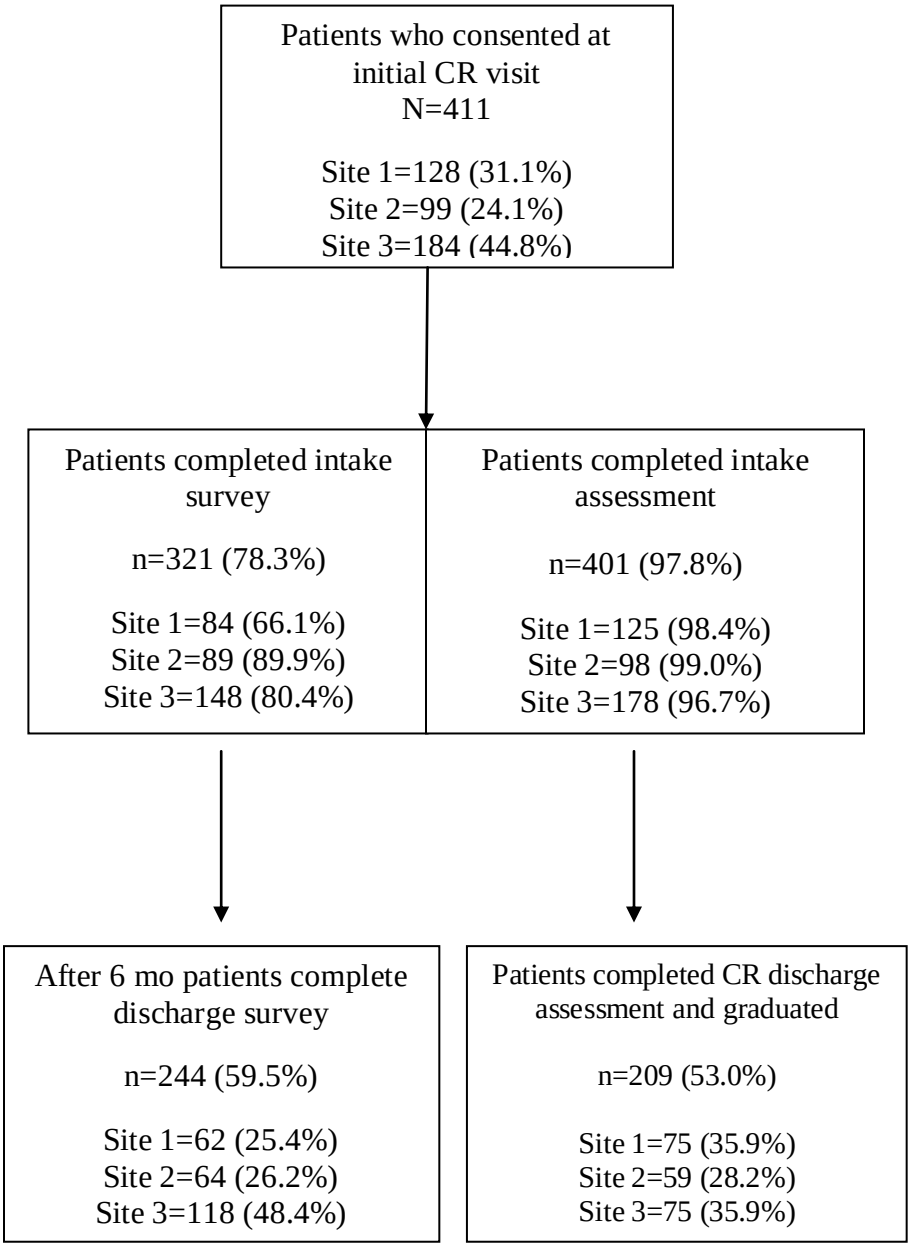

Table 1: Canadian Cardiovascular Society Cardiac Rehabilitation and Secondary Prevention Quality Indicators assessed in the Canadian Cardiac Rehabilitation Registry vs. this study

QI#	QI name	Assessed previously in CCRR (14)	Assessed in Thesis (21)
1	In-patients referred to a CR Program		
2a	CR Wait time from hospital discharge		x
2b	CR Wait time from referral to enrolment	x	x
3	CR Enrolment	x	x
4	Risk Assessment for adverse CR events	x	
5	Patient self-management education		x
7	Secondary Prevention medications: Acetylsalicyclic Acid (ASA)		x
8	Secondary prevention medications: Anti-platelet agents other than ASA		x
9	Secondary prevention medications: Beta Blockers		x
10	Secondary prevention medications: Statins		x
12	Secondary prevention medications: ACE_i/ARB		x
13	Assessment of BP control	x	x
14	Assessment of lipid control	x	x
15	Assessment of adiposity	x	x
16	Individual assessment of blood glucose control (HbA1c)	x	x
17	Increase in exercise capacity	x	x
18	Adherence to CR program		x
20	Meeting physical activity guideline		
21	Promotion of post-CR physical activity		x
22	Assessment of depression	x	
23	Referral of patients screening positive for possible depression	x	
26	Smoking cessation support	x	x
27	Smoking cessation	x	
30	Stress management	x	x
31	Medical director supervision		x
32	Emergency response strategy		x
34	Communication with the primary health care practitioner		x
35	Recommended elements in discharge summary		
36	Summative communication with patient		
37	CR program completion	x	x

CR= Cardiac Rehabilitation; ACE_i= Angiotensin Converting Enzyme Inhibitors; ARB=Angiontensin II Receptor Blockers; BP= Blood Pressure; $HbA1_c$= Glycated hemoglobin

Table 2: Attributes of CR Sites studied

	Site Name		
	TWH	SRHC	MH
Duration (months)	4	6	6
Annual volume	400	700	550
Academic vs. Community	Academic	Community	Community
Frequency of sessions per week	2	1	2
Automatic inpatient referral	Yes	Yes	No
Costs	Free	Free (educational materials cost $100)	$55+HST/month

TWH= Toronto Western Hospital
SRHC= Southlake Regional Health Centre
MH= Mackenzie Health

Table 3: Description of Where each QI is Assessed Within the Study Documents

QI	QI Name	Where?	Details
2a†	CR Wait time from hospital discharge	CRF1	p2 q4 input discharge date p2 q5 input Date CR Referral received ;created syntax to subtract dates
2b	CR Wait time from referral to enrolment	CRF1	p2 q5 Date CR Referral received p2 q6 Date of CR Intake Appointment ;created syntax to subtract dates
3†	CR Enrolment	CRF1	p2 q6: Date of Intake Appointment ;if date was present then patient attended intake appointment
5†	Patient self-management education	CRF2	p2 q1: Program elements utilized by patient (tick all that apply)
7†	Secondary Prevention medications: Acetylsalicyclic Acid	CRF2	p3 q4: Medications at discharge (check all that apply)
8†	Secondary prevention medications: Anti-platelet agents other than ASA	CRF2	p3 q4: Medications at discharge (check all that apply)
9†	Secondary prevention medications: Beta Blockers	CRF2	p3 q4: Medications at discharge (check all that apply)
10†	Secondary prevention medications: Statins	CRF2	p 3 q4: Medications at discharge (check all that apply)
12†	Secondary prevention medications: ACE_i/ARB	CRF2	p3 q4: Medications at discharge (check all that apply)
13	Assessment of BP control	CRF1	p3 q7: Risk Factors- Hypertension (Systolic and Diastolic BP)
14	Assessment of lipid control	CRF1	p3 q7: Risk Factors- Dyslipidemia (Total cholesterol, HDL, LDL, triglycerides)

15	Assessment of adiposity	CRF1	p3 q7: Risk Factors- Obesity (BMI OR waist circumference)
16	Assessment of blood glucose control (HbA1C)	CRF1	p3 q7: Risk Factors- Diabetes (HbA1c%) only in those who have diabetes
17*	Increase in exercise capacity	CRF1/CRF2	CRF1: p4 q15b- Peak METs at intake CRF2: p3 q2c- Peak METs at discharge ;created syntax to count patients who had increased capacity by ½ of intake MET by discharge
18	Adherence to CR program	CRF2	p2 q2-3 Number of sessions prescribed and number of sessions completed; calculated percentage
26†	Smoking cessation support	CRF2	p2 q1 – Program elements utilized by patient (tick all that apply)
30†	Stress management	CRF2	p2 q1 – Program elements utilized by patient (tick all that apply)
31	Medical director supervision	policy from site	Reviewed organization chart and job description of senior physician
32	Emergency response strategy	audit at site	Reviewed BLS certification of clinical staff and emergency strategy
34†	Communication with the primary health care practitioner	CRF2	p3 q3- Chart Indication discharge report mailed to PCHP?- Yes/No
37†	CR program completion	CRF2	p2 q5- Did patient complete the program? - Yes/No

CRF=Case Report Form
p=page
q= question
BMI= Body Mass Index
HbA1c= Glycated Hemoglobin
†Quality Indicators measured at discharge
*Quality Indicators measured at intake and discharge
HDL=High Density Lipoprotein
LDL=Low Density Lipoprotein
MET=Metabolic Equivalent of Task
PCHP=Primary Care Health Care Provider

Table 4: Pre-CR Sociodemographic and Clinical Characteristics of Participants by CR Site

Characteristic	Site 1 (n=128, 31.1%)	Site 2 (n=99, 24.1%)	Site 3 (n=184, 44.8%)	p
Sociodemographic				
Age (mean±SD years)†	64.2±10.9	65.8±10.4	63.9±10.1	0.33
Sex (% male)†	84 (67.2)	69 (69.7)	133 (72.3)	0.63
Marital status (% married)	52 (40.6)†††§§§	68 (68.7)†††	116 (63.0)§§§	<0.001
Education (% university or higher)	63 (49.2)	55 (55.6)	99 (53.8)	0.60
Racial / Ethnic background, (% North American)	38 (29.7)††	48 (48.5)††§§§	40 (21.7)§§§	<0.001
Work status (% retired)	36 (28.1)	42 (42.4)	67 (36.4)	0.08
Clinical†				
Previous cardiac diagnosis (% yes)	14 (10.9)	13 (13.1)	12 (6.5)	0.16
Peak METs§ (mean±SD)	7.8±3.2††	6.5±2.9††	7.1±2.7	0.007
Referral Indication (% yes)				
Percutaneous Coronary Intervention	53 (44.9)	42 (45.2)	58 (33.5)	0.07
Coronary Artery Disease	41 (34.7)	21 (23.1)	65 (37.6)	0.06
Myocardial Infarction	23 (19.5)	25 (27.2)	52 (30.2)	0.12
Coronary Artery Bypass Graft Surgery	20 (16.9)†§§	30 (33.0)†	59 (33.9)§§	0.004
Arrhythmia	11(9.3)	7 (7.8)	18 (10.5)	0.78
Other	17 (13.3)	11 (11.1)	25 (13.6)	0.83
Risk Factors (% yes)				
Dyslipidemia	85 (80.2)$^{\dagger\dagger\dagger\Delta\Delta}$	46 (58.2)†††§§§	162 (95.3)$^{\S\S\S\Delta\Delta}$	<0.001
Hypertension	69 (60.5)†††§§§	76 (82.6)†††	145 (84.8)§§§	<0.001
Obesity	48 (49.0)	36 (40.4)	70 (39.8)	0.31
Diabetes	26 (25.7)	22 (25.9)	29 (17.3)	0.15
Current Smoker	6 (7.6)	4 (4.7)	4 (2.7)	0.25
Cardiac Medications (% yes)				
ASA	82 (70.7)	46 (58.2)††	131 (74.9)††	0.03
Statins	89 (76.7)††	44 (55.7)††§§§	140 (80.9)§§§	<0.001
Beta-blockers	94 (81.0)$^{\dagger\dagger\dagger\Delta}$	42 (53.2)†††§§	122 (70.1)$^{\S\S\Delta}$	<0.001
ACE-inhibitors	58 (50.0)	29 (36.7)†	90 (52.0)†	0.07
Calcium antagonists	26 (22.4)†	8 (10.1)†	24 (13.9)	0.05

Anti-platelets	39 (30.5)	25 (25.3)	56 (30.4)	0.61
Anti-coagulants	23 (19.8)†††	10 (12.7)	10 (5.8)†††	0.001
Other anti-platelets	14 (10.9)	4 (4.0)	14 (7.6)	0.16
Other	75 (58.6)$^{\dagger\dagger\Delta\Delta\Delta}$	42 (42.4)††§§§	144 (78.3)$^{\S\S\S\Delta\Delta\Delta}$	<0.001

†source is medical chart (hospital or cardiac rehabilitation program).
§from pre-CR graded exercise stress test.

†p<0.05, ††p<0.01; †††p<.001; §p<0.05, §§ p<0.01; §§§ p<.001; $^{\Delta}$p<0.05, $^{\Delta\Delta}$p<0.01, $^{\Delta\Delta\Delta}$p<0.001

ASA= Acetylsalicyclic Acid; ACE=Angiotensin Converting Enzyme; MET=Metabolic Equivalent of Task; SD=Standard Deviation.

Table 5: Pre-CR Sociodemographic and Clinical Characteristics of Participants by CR Completion Status

Characteristic	Did not Complete CR (n=185; 47.0%)	Completed CR (n=209; 53.0%)	Total N=394	P
Sociodemographic				
Age (mean±SD years)†	63.7±10.9	65.4±9.7	64.5±10.4	0.18
Sex (% male)†	96 (69.6)	151 (72.2)	286 (70.1)	0.34
Marital status (% married)	75 (54.3)	130 (62.2)	236 (57.4)	0.09
Education (% university or higher)	71 (51.4)	112 (53.6)	217 (52.8)	0.39
Racial / Ethnic background, (% North American)	40 (29.0)	68 (32.5)	126 (30.7)	0.28
Work status (% retired)	43 (31.2)	80 (38.3)	145 (35.3)	0.11
Clinical†				
Previous cardiac diagnosis (% yes)	13 (9.4)	21 (10.0)	39 (9.5)	0.50
Peak METs§ (mean±SD)	7.24±2.6	7.17±3.0	7.17± 2.9	0.08
Referral Indication (% yes)				
Percutaneous Coronary Intervention	47 (34.8)	87 (42.9)	153 (39.8)	0.09
Coronary Artery Disease	47 (34.8)	62 (30.8)	127 (33.2)	0.26
Myocardial Infarction	31 (23.0)	53 (26.4)	100 (26.2)	0.28
Coronary Artery Bypass Graft Surgery	36 (26.9)	61 (30.0)	109 (28.5)	0.31
Arrhythmia	17 (12.7)	13 (6.5)	36 (9.5)	0.04
Other	23 (16.7)	26 (12.4)	53 (12.9)	0.17
Risk Factors (% yes)				
Dyslipidemia	110 (85.9)	149 (80.5)	293 (82.5)	0.14
Hypertension	106 (79.7)	146 (73.4)	290 (76.9)	0.12
Obesity	58 (43.9)	79 (42.0)	154 (42.4)	0.41
Diabetes	34 (26.4)	37 (20.2)	77 (21.8)	0.13
Current Smoker	6 (5.8)	7 (4.3)	14 (4.5)	0.39
Cardiac Medications (% yes)				
ASA	83 (63.4)	144 (73.5)	259 (70.0)	0.04
Statins	98 (75.4)	144 (73.8)	273 (74.2)	0.43
Beta-blockers	86 (66.2)	141 (72.3)	258 (69.9)	0.14
ACE-inhibitors	62 (47.7)	92 (47.2)	177 (48.1)	0.51
Calcium antagonists	25 (19.2)	25 (12.8)	58 (15.8)	0.08

Anti-platelets	42 (30.4)	61 (29.2)	120 (29.2)	0.45
Anti-coagulants	9 (6.9)	26 (13.3)	43 (11.7)	0.05
Other anti-platelets	9 (6.5)	17 (8.1)	32 (7.8)	0.37
Other	97 (70.3)	129 (61.7)	261 (63.5)	0.06

*p<0.05 based on results of t-test or chi-square, as applicable.
†source is medical chart (hospital or cardiac rehabilitation program).
§from pre-CR graded exercise stress test.

ASA= Acetylsalicyclic Acid; ACE=Angiotensin Converting Enzyme; MET=Metabolic Equivalent of Task; SD=standard deviation.

Table 6: Quality Indicators and Findings

QI#	Domain	Name	Definition	Indicator Finding (%)	Available Benchmark
CR-2a (P)	Referral, access, and wait times	CR wait time from hospital discharge	% CR eligible inpatients who enrolled within 30 days after hospital discharge*	9.2%	n/a
CR-2b (P)		CR wait time from referral to enrollment	Median days between receipt of referral to patient enrollment	Median # days 35	n/a
CR-3 (P)		CR enrollment	% patients who enrolled and underwent an intake assessment*	93.7%	70%[57]
CR-7 (O)	Secondary prevention: assessment, risk stratification and control	Medication: ASA	% CR patients who were prescribed ASA at program discharge	70.0%	90%[29]
CR-8 (O)		Medication: Other Anti-platelet	% CR patients prescribed anti-platelet agents other than ASA at program discharge	33.5%	n/a
CR-9 (O)		Medication: Beta-Blockers	% CR patients prescribed beta-blockers at program discharge	69.9%	90%[29]
CR-10 (O)		Medication: Statins	% CR patients prescribed statins at program discharge	74.2%	90%[29]
CR-12 (O)		Medications: ACE-i/ARB	% CR patients prescribed ACE-i or ARBs at program discharge	51.8%	90%[29]
CR-13 (P)		Assessment of blood pressure	% CR patients with assessment of blood pressure control	98.1%	90%[6]

CR-14 (P)		Assessment of lipids	% CR patients with assessment of lipid control	53.0%	n/a
CR-15 (P)		Assessment of adiposity	% CR patients with assessment of adiposity	87.8%	n/a
CR-16 (P)		Assessment of blood glucose	% diabetic patients with assessment of blood glucose control ($HbA1_C$)	42.1%	90%[6]
CR-17 (O)	Behaviour change, program adherence & psychosocial education	Increase in exercise capacity	% CR patients with half MET increase in exercise capacity	691%	n/a
CR-18 (O)		Adherence to CR program	% prescribed exercise sessions completed	64.1%	n/a
CR-26 (P)		Smoking cessation support	% current or recent smokers who received smoking cessation support*	66.7%	n/a
CR-30 (P)		Stress management	% patients who received a stress management intervention*	81.3%	n/a
CR-5 (P)		Self-management education	% CR patients who received self-management education	90.8%	n/a
CR-31 (S)	CR program model and structure	Medical Director supervision	% CR programs that have a physician medical director providing oversight	100.0%	n/a
CR-32 (S)		Emergency response strategy	% CR programs with a documented emergency response strategy and appropriately qualified staff	100.0%	n/a

CR-34 (O)	Discharge transition, linkage & communication	Communication with PHCP	% CR patients with a documented communication between program and PHCP	94.2%	n/a
CR-37 (O)		CR Program completion	% patients enrolled in CR who completed the program	60.2%	n/a

n/a=not applicable or available.

CR= Cardiac Rehabilitation
ASA= Acetylsalicyclic Acid
ACE-i= Angiotensin Converting Enzyme-inhibitor
ARB= Angiotensin Receptor Blocker
MET= Metabolic Equivalent of Task
PHCP= Primary Health Care Provider
$HbA1_C$= Glycated Hemoglobin
P=process indicator
O=outcome indicator
S=structure indicator
*QI definition slightly modified.

Table 7: Quality Indicators by Cardiac Rehabilitation Site

QI	Name	Indicator %			p*
		Site 1 (n=128, 31.1%)	Site 2 (n=99, 24.1%)	Site 3 (n=184, 44.8%)	
2a	CR wait time from hospital discharge to enrollment	10.2	8.3	0.0	0.62
2b	CR wait time from referral to enrollment (median days)	59.9†††	50.3§§§	29.3†††§§§	<0.001
3	CR enrollment	89.8	94.9	95.7	0.10
5	Self-management education	80.0§§†††	98.3†††	95.9§§	<0.001
7	Medication: ASA	70.7	58.2††	74.9††	0.03
8	Medication: Other Anti-platelet	26.4	38.8	37.0	0.27
9	Medication: Beta-Blockers	81.0$^{\dagger\dagger\dagger\Delta}$	53.2†††§§	70.1$^{\S\S\Delta}$	<0.001
10	Medication: Statins	76.7††	55.7††§§§	80.9§§§	<0.001
12	Medications: ACE-$_i$/ARB	58.9	38.8	53.4	0.09
13	Assessment of blood pressure	98.7	100.0	96.0	0.22
14	Assessment of lipid control	76.2†††	19.3†††§§§	91.9§§§	<0.001
15	Assessment of adiposity	71.9†††§§§	93.9†††	95.7§§§	<0.001
16	Assessment of blood glucose control	70.7†††§§§	1.7$^{\dagger\dagger\dagger\Delta\Delta\Delta}$	45.3$^{\S\S\S\Delta\Delta\Delta}$	<0.001
17	Increase in exercise capacity	65.7†	82.4†§§	59.7§§	0.01

18	Adherence to CR program	71.4§§§	77.0†††	57.0†††§§§	<0.001
34	Communication with PHCP	95.7	91.1	94.6	0.58
37	CR Program completion	71.4§§§	73.8†††	46.3†††§§§	<0.001

*based on Analysis of Variance.

†p<0.05, ††p<0.01; †††p<.001; §p<0.05, §§p<0.01; §§§p<.001; ^{Δ}p<0.05, ^{ΔΔ}p<0.01, ^{ΔΔΔ}p<0.001

CR= Cardiac Rehabilitation
ASA= Acetylsalicyclic Acid
ACE-i= Angiotensin Converting Enzyme-inhibitor
ARB= Angiotensin Receptor Blocker
PHCP= Primary Health Care Provider

Table 8: Criterion Validity Exercise for CR QIs assessed in thesis

QI#	QI Name	Original Variables used to compute the QI	Variables that can be used to measure against
2a	CR Wait time from hospital discharge	CRF1: p2 q4 discharge date p2 q5 Date CR Referral received ;created syntax to subtract dates	Discharge survey p23 q2 "Approx. how many wks passed between discharge and starting program?"
3	CR Enrolment	CRF1: Date of CR Intake Appointment- if one is present then, yes they enrolled	Discharge Survey: Section M p21 "Did you attend a cardiovascular rehabilitation assessment (intake appointment)? –Yes/No
17	Increase in exercise capacity	CRF1: p4 q15b- Peak METs at intake CRF2: p3 q2c- Peak METs at discharge ;created syntax to count patients who had increased capacity by ½ of intake MET by discharge	Intake Survey Section B p4 q1-12- DASI score Discharge Survey Section A p2 q1-12- DASI score ;compare DASI score from pre to post
18	Adherence to CR program	CRF2 p2 q2-3 Number of sessions prescribed and number of sessions completed; calculated percentage	Discharge survey p23 q4 "Approx. what % of CR sessions did you attend?"

Table 9: Values for each QI assessed for criterion validity from chart and corresponding self-report data

QI#	QI name	Chart (%)	Self-report (%)
2a	CR Wait time from hospital discharge	9.2	15.3
3	CR Enrollment	83.7	47.4
17	Increase in exercise capacity	69.1	28.7
18	Adherence to CR program	64.1±32.1	66.9±39.8

Table 10: Criterion validity results for 4 CR QIs

QI#	QI name	Cohen's kappa coefficient	Pearson's Correlation coefficient	Interpretation[51]
2a	CR Wait time from hospital discharge	0.21	n/a	Fair
3	CR Enrollment	0.22	n/a	Fair
17	Increase in exercise capacity	0.17	n/a	Slight
18	Adherence to CR program	n/a	0.17	None

Table 11: Canadian Cardiovascular Society Quality Indicator Exclusions not captured

QI	QI Definition	QI Exclusion not captured
QI-2a	Wait time from hospital discharge	➢ CR eligible patients with a documented medical reason and documented patient-centered reason for non-referral ➢ Patients being discharged to long-term care facility or inpatient rehabilitation.
QI-2b	Wait time from referral to enrollment	➢ Patients experienced a new clinical event which is documented. ➢ Patient delayed initial appointment date due to non-clinical factors, which are documented
QI-3	% of patients enrolled in a program post-hospital discharge	➢ Patient who at initial CR program assessment is determined to be not eligible for CR due to documented medical reason, such as co-morbid life-threatening condition, serious mental illness, or inability to ambulate. ➢ Referred in-patients who are triaged or who attend another CR site. ➢ CR Eligible patients with a documented medical reason for enrollment, such as recurrent event. ➢ CR Eligible Patients with a documented patient-centered reason for non-referral. Patient being discharged to long-term care facility or inpatient rehabilitation.
QI-7	% patients taking ASA at program discharge	➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patients with a documented reason (medical or patient-centered) for not taking ASA (e.g. post-surgical valve patient without CAD, allergy, severe bleeding).
QI-8	% patients on anti-platelets other than ASA at program discharge	➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patients with a documented reason (medical or patient-centered) for not taking ASA (e.g. post-surgical valve patient without CAD, allergy, severe bleeding).

QI-9	% patients on beta blockers at program discharge	➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patients with a documented reason (medical or patient-centered) for not taking Beta-blockers.
QI-10	% of patients on statins at program discharge	➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patients with a documented reason (medical or patient-centered) for not taking Statins (e.g. patients who are statin-resistant).
QI-12	% of patients taking ACE_i/ARB at program discharge	➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patients with a documented reason (medical or patient-centered) for not taking ACE_i/ ARB.
QI-13	% patients who received individualized assessment of blood pressure control	➢ Patients who are re-admitted to hospital before being discharged from CR program
QI-14	% patients who received individualized assessment of lipid control	➢ Patients who are re-admitted to hospital before being discharged from CR program.
QI-15	% patients who received individualized assessment of adiposity	➢ Patients who are re-admitted to hospital before being discharged from CR program.
QI-16	% patients who received individualized assessment of blood glucose control:	➢ Patients who are re-admitted to hospital before being discharged from CR program.
QI-30	% patients who were referred to a stress management intervention	➢ Patients who have a documented patient-centered reason for not being offered stress management (i.e., perceive no difficulty with stress)
QI-34	% patients with a documented communication between the CR program and primary health care practitioner	➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patient has no primary health care provider.

CR= Cardiac Rehabilitation; ASA= Acetylsalicyclic Acid; CAD= Coronary Artery Disease
ACE_i= Angiotensin Converting Enzyme Inhibitor; ARB= Angiotensin II Receptor Blockers

13.0 APPENDICES

Appendix A: Example of site-specific Informed Consent Form

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

STUDY NAME: **Cardiovascular Rehabilitation—Chronic Disease Management Program Evaluation and Cost-Effectiveness Analysis**

STUDY SPONSOR: N/A

INVESTIGATORS:

Sherry L. Grace, PhD (Principal Investigator)	**York University and University Health Network**
Caroline Chessex, MD (Co-Principal Investigator)	**University Health Network**
Doug S. Lee, MD (Co-Investigator)	**Institute for Clinical Evaluative Sciences and University Health Network**
Harindra Wijeysundera, MD (Co-Investigator)	**Sunnybrook Health Sciences Centre and University of Toronto**
Mansoor Husain, MD (Co-Investigator)	**University Health Network**
Nickan Motamedi (BSc Student)	**York University**
Yongyao Tan, MSc (Research Associate)	**University Health Network**
Raquel Britto, PT, PhD	**Minas Gerais, Brazil**

You are being asked to take part in a research study. Please read this explanation about the study and its risks and benefits before you decide if you would like to take part. You should take as much time as you need to make your decision. You should ask the study doctor or study staff to explain anything that you do not understand and make sure that all of your questions have been answered before signing this consent form. Before you make your decision, feel free to talk about this study with anyone you wish. Participation in this study is voluntary.

Background and Purpose

You have already agreed to participate in the PMCC Cardiovascular Rehabilitation and Prevention Program. In this research study, we would like to include your information collected in this program for research purposes. We would like to use this information to learn how we can better meet the needs of our patients and to improve the services we provide. We would like to better understand how your quality of life, heart risk factors, knowledge and health behaviors change following participation in CR. We are also interested in studying the cost-effectiveness of the services we provide to you.

Study Design and Procedures

As part of our program, you will be asked to complete 4 surveys online: one at the beginning of the cardiovascular rehab program, one 6 months, 12 months, 24 months. The surveys include questions about your exercise and nutrition habits, medication adherence, quality of life, and mood. These questions help us understand how you are managing your health condition. Your completion of all surveys is voluntary. You can provide your email address at the end of this form to receive an email link to the survey. Alternatively, you can complete the survey on paper and mail it back to us in a pre-paid envelope.

If you consent to participate in this study, your survey responses would be used for research purposes. If your survey responses in the mood section suggest that you may have elevated depressive symptoms, we will send a letter to your family doctor to let him/her know. We would also like to extract clinical information from your charts (e.g., disease history, other health problems, risk factors, exercise stress test results, cholesterol levels, your medications). Finally, we would also like your permission to link your information gathered from this program with a provincial database to determine your health care use and health outcomes over time. This would not require any paperwork on your behalf.

Potential Benefits and Risks

The risks and benefits involved in the program have already been explained to you.

You may or may not receive any direct benefit from being in this study. Information learned from this study may help other people with your condition in the future.

There are no additional risks to you if you take part in this study. Being in this study may make you feel uncomfortable. You may refuse to answer questions if there is any discomfort.

As a general reminder, email may not always be a secure method of communication. For this study, email is being used for general communication purposes only, and will not be used to collect/provide personal health information. If you take part in this study, please be reminded that personal information will be collected in a de-identified manner through the online survey.

Confidentiality

If you agree to join this study, the study doctor and his/her study team will look at your personal health information and collect only the information they need for the study. Personal health information is any information that could be used to identify you and includes your:

- name,
- email address
- address,
- OHIP number, new or existing medical records, that includes types, dates and results of medical tests or procedures.

The information that is collected for the study will be kept in a locked and secure area by the study doctor for 10 years. Only the study team or the people or groups listed below will be allowed to look at your records. Your participation in this study also may be recorded in your medical record at this hospital.

Representatives of the University Health Network Research Ethics Board may look at the study records and at your personal health information to check that the information collected for the study is correct and to make sure the study followed proper laws and guidelines.

We are collaborating with some other programs in the province, to study how self-management education varies in different programs. Therefore, parts of the information you provide in your survey may be securely and anonymously shared with the research investigators from this larger study.

Please note that any information that you provide for this study in the online survey, even though de-identified, when transferred to the U.S, is subject to U.S. laws, and in particular, to the U.S. Patriot Act. The US Patriot Act allows authorities access to the records of study participants in the event of auditing by authorities.

All information collected during this study, including your personal health information, will be kept confidential and will not be shared with anyone outside the study unless required by law. You will not be named in any reports, publications, or presentations that may come from this study.

If you decide to leave the study, the information about you that was collected before you left the study will still be used. No new information will be collected without your permission.

Questions About the Study

Feel free to speak to one of our staff members if you have any questions or concerns. You may contact the study coordinator at cdmstudy@yorku.ca or (416) 736-2100 ext 20575.

Should you have any questions about your rights as a research participant, please contact the University Health Network Research Ethics Board at (416) 946-4438.

CONSENT

☐ ***This study has been explained to me and any questions I had have been answered. I know that I may leave the study at any time. I agree to take part in this study.***

Date: _____

Appendix B: Intake Case Report Form

1. Site:
   - ☐ UHN
   - ☐ YCH
   - ☐ Southlake

2. Patient Ineligible for Study:

   ☐ Yes (if yes, specify below)
   ☐ No

☐ Lack of proficiency in language of ICF and surveys ☐ Other, please specify: _____

3. Patient Declined to Participate:

   ☐ No ☐ Yes -Reason, if willing:

_____

Stop here if patient is ineligible or declined.

PAGE 2: Study ID#: _____

1. Age | | yrs |
2. Sex ☐ Male ☐ Female
3. Inpt Admission Date-
4. Inpt Discharge Date-
5. Expected Date of CR-
6. Referral Indication (check all that apply)
   - ☐ Cardiac

- ☐ PCI
- ☐ CABG Surgery and/or Valve surgery
- ☐ TAVI/PAVI
- ☐ Stable Angina / CAD
- ☐ MI
- ☐ HF
- ☐ Congenital
- ☐ Arrhythmia / ICD / Pacemaker
- ☐ Heart Transplant
- ☐ VAD

☐ Stroke / TIA
☐ Diabetes
☐ Renal
☐ PVD
☐ Arthritis Clinic
☐ Other, please specify _____

3. CCS Angina Class:
   ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4

   → ☐ IV-a ☐ IV-b ☐ IV-c ☐ IV-d

4. NYHA Functional Class:
   ☐ 1 ☐ 2 ☐ 3 ☐ 4

5. LV Function:
   ☐ Nuclear ☐ Echo ☐ Angiogram
   ☐ LVEF %: _____
   ☐ Narrative: _____ _____

   ☐ Normal ☐Mild ☐Moderate ☐Severe

   ☐ Date assessed: _____

6. Complications during stay:

☐ Arrhythmia ☐ Recurrent Angina / ischemia ☐ Cardiogenic shock ☐ Cerebrovascular Accident ☐ Readmit (ICU / CCU) ☐ Infection	☐ Cardiac Arrest ☐ Pericarditis ☐ Pneumonia ☐ Acute Renal Fail ☐ DVThrombosis ☐ MI ☐ Cardioversion ☐ Cardiac Tamponade ☐ Other: specify:

7. Risk Factors

Yes	No	Factor	Details			
☐	☐	Diabetes	Type	☐ Type I		☐ Type II
			HbA1c%			
			Date assessed			
				dd	mmm	yyyy
☐	☐	Obesity (BMI>30)	BMI (kg/m2)			
			Waist circ (cm)			
			Date assessed			
				dd	mmm	yyyy
☐	☐	Hypertension	Blood Pressure			
				systolic		diastolic
			Date assessed			
				dd	mmm	yyyy
☐	☐	Dyslipidemia	Total Cholesterol			
			HDL			
			LDL			
			Triglycerides			
			Date assessed			
				dd	mmm	yyyy

8. Previous cardiac diagnoses (check all that apply)?

☐ CAD	☐ Infection
☐ HF	☐ Valve condition
☐ Arrhythmia/Device	☐ TAVI/PAVI
☐ Congenital HD	☐ Cardiomyopathy
☐ ACS/MI	☐ Other: _____
☐ VAD	☐ None

9. Comorbid Conditions (check all that apply)

- ☐ Cancer
- ☐ Hyperthyroid
- ☐ Liver Disease
- ☐ PAD/PVD
- ☐ Depression
- ☐ Renal Disease
- ☐ MSK / Joint Replacement, specify: _____
- ☐ Other: _____

Resting heart rate: _____

10. hs-CRP: _____
11. BNP: _____
12. CBC: _____

dd	mmm	yyyy

13. Intake Exercise Stress Test (circle one for each)
    a. Completed: ☐No ☐Yes, date:

    b. Peak METs: _____

    c. Peak VO_2: _____

    d. ☐GXT or ☐CPA
    e. Symptom-limited? ☐ Yes ☐No
    f. Mode? ☐Treadmill ☐Bike
    g. Protocol? ☐Bruce ☐Modified Bruce ☐Other, specify:
    h. Other comments:
    _____
    _____

14. Current Medications (check all that apply):

☐ ACE Inhibitors	☐ Beta-blockers
☐ Anti-coagulants	☐ Digoxin
☐ ASA	☐ Nitrates (not PRN)
☐ Ca2+ antagonists	☐ ARBs
☐ Statin	☐ Anti-depressant
☐ LL – fibrate	☐ Coumadin
☐ LL – nicotinic acid	☐ Heparin
☐ LL – resin drugs	☐ HRT
☐ Diuretics	☐ Insulin
☐ Clopidogrel or ticlopidine	☐ Oral hypoglycemic
☐ Other anti-platelet	☐ Anti-inflammatory
☐ Nicotine Replacement	☐ Other _____
☐ Anti-arrhythmic	☐ Not reported in chart
☐ Anti-platelets	

Appendix C: Discharge Case Report Form

1. Program elements utilized by patient (check all that apply):
   - ☐ Education session(s)
   - ☐ On-site exercise
   - ☐ Home-based exercise program
   - ☐ Dietitian consult
   - ☐ Smoking cessation referral or consult
   - ☐ Pharmacy consult
   - ☐ Diabetes education referral or consult
   - ☐ Stress management, or psychosocial referral / consult
   - ☐ Other, please specify:_____

2. Number of Sessions prescribed: _____

3. Number of sessions completed: _____ or ☐ information not available in chart

4. Any untoward events detected during exercise sessions:
   - ☐ Yes, please specify: _____
   - ☐ No
   - ☐ Not documented in chart

5. Did the patient complete the program? ☐Yes ☐No

   *If **yes***: Date of graduation:

dd	mmm	yyyy

   *If **no***, reason indicated in chart?

   - ☐ No
   - ☐ Yes, please specify whether:
     ☐clinical ☐not clinical

6.

Yes	No	Risk Factors	Details			
☐	☐	Diabetes	Type	☐ Type I		☐ Type II
			HbA1c%			
			Date assessed			
				dd	mmm	yyyy
☐	☐	Obesity (BMI>30)	BMI (kg/m2)			
			Waist circ (cm)			
			Date assessed			
				dd	mmm	yyyy
☐	☐	Hypertension	Blood Pressure (BP)			
				systolic		diastolic
			Date assessed			
				dd	mmm	yyyy
☐	☐	Dyslipidemia	Total Cholesterol			
			HDL			
			LDL			
			Triglycerides			
			Date assessed			
				dd	mmm	yyyy

1. Resting heart rate: _____
   Date assessed

dd	mmm	yyyy

2. Discharge Exercise Stress Test
   a. Completed: ☐No ☐Yes, date:

   b. Peak METs: _____

   c. Peak VO2: _____

dd	mmm	yyyy

   d. ☐GXT or ☐CPA (circle one for each)

   e. symptom-limited? ☐ Yes ☐No

   f. mode? ☐Treadmill ☐Bike

g. Protocol? ☐Bruce ☐modified Bruce ☐Other, specify:

h. Other comments:
_____
_____

3. Chart indication discharge report mailed to other healthcare provider(s) involved in patient care?
   - ☐ Yes
   - ☐ No

4. Medications at Discharge (check all that apply):
   - ☐ ACE Inhibitors
   - ☐ Anti-coagulants
   - ☐ ASA
   - ☐ Ca2+ antagonists
   - ☐ Statin
   - ☐ LL – fibrate
   - ☐ LL – nicotinic acid
   - ☐ LL – resin drugs
   - ☐ Diuretics
   - ☐ Clopidogrel or ticlopidine
   - ☐ Other anti-platelet
   - ☐ Nicotine Replacement
   - ☐ Anti-arrhythmic
   - ☐ Anti-platelets
   - ☐ Beta-blockers
   - ☐ Digoxin
   - ☐ Nitrates (not PRN)
   - ☐ ARBs
   - ☐ Anti-depressant
   - ☐ Coumadin
   - ☐ Heparin
   - ☐ HRT
   - ☐ Insulin
   - ☐ Oral hypoglycemic
   - ☐ Anti-inflammatory
   - ☐ Other:
     _____
     _____
   - ☐ Not reported in chart

Appendix D: Intake Survey sections utilized

SECTION A: YOUR SOCIO-DEMOGRAPHIC CHARACTERISTICS

1. What do you consider to be your racial/ethnic background? Please check ☑ one (1) of the following boxes:
   - ❑ North American (e.g., Canadian, American)
   - ❑ French (not French-Canadian)
   - ❑ British Isles (e.g., British, Scottish, Irish)
   - ❑ Western European (e.g., Austrian, Belgian, German, Swiss)
   - ❑ Northern European (e.g., Danish, Finnish)
   - ❑ Eastern European (e.g., Hungarian, Ukrainian, Polish, Czech)
   - ❑ Southern European (e.g., Greek, Italian, Spanish)
   - ❑ Jewish
   - ❑ African
   - ❑ Arab
   - ❑ West Asian (e.g., Afghan, Armenian, Iranian)
   - ❑ South Asian (e.g., East Indian, Punjabi, Pakistani)
   - ❑ East or South East Asian (e.g., Chinese, Filipino, Japanese, Vietnamese, Thai, Laotian)
   - ❑ Oceania (e.g., Australian, New Zealander, Pacific Islanders)
   - ❑ Caribbean
   - ❑ Latin, Central, or South American
   - ❑ Aboriginal (e.g., Métis, Inuit)
   - ❑ Other (**specify:** _____)

   - ❑ Multiple cultural backgrounds (**specify**: _____)

2. Please rate how comfortable you are speaking, reading and writing in English:
   - ❑ Not comfortable
   - ❑ I can get by, but am more comfortable using a language other than English
   - ❑ Fairly comfortable
   - ❑ Very comfortable communicating in English

3. What is your marital status:
   - ❑ Married/common-law
   - ❑ Separated/divorced
   - ❑ Single
   - ❑ Widow

4. What is the highest level of education you have completed?
    - ❑ less than grade 9
    - ❑ less than high school
    - ❑ completed high school
    - ❑ some college or university courses
    - ❑ completed college or university degree
    - ❑ Graduate School/Professional Program

5. Which option best matches your <u>current</u> work status?
    - ❑ full-time work
    - ❑ part-time work
    - ❑ full-time caregiver or homemaker (inside your home)
    - ❑ unemployed
    - ❑ receiving disability
    - ❑ retired
    - ❑ other: _____

Appendix E: Full Quality Indicators assessed

PROCESS INDICATOR NO: CR-2a CARDIAC REHABILITATION WAIT TIME FROM HOSPITAL DISCHARGE	
Description	Percentage of eligible in-patients who were referred to CR and who enroll in CR within 30 days after hospital discharge.

Numerator	The total number of eligible in-patients enrolled in the CR Program within 30 calendar days post-discharge for any of the qualifying conditions or interventions:
	• Acute coronary syndrome;
	  ○ Acute Myocardial Infarction (STEMI, non-STEMI);
	  ○ Unstable angina;
	• Percutaneous coronary intervention;
	• Coronary artery bypass surgery;
	
	Enrollment is defined as patient attendance at a first CR program visit.

Denominator	The total number of eligible in-patients (see numerator) enrolled in the CR Program. **Exclusions:** • CR Eligible Patients with a documented medical reason for non-referral, such as comorbid life-threatening condition, serious mental illness, or inability to ambulate. • CR Eligible Patients with a documented patient-centered reason for non-referral. • Patient being discharged to long-term care facility or inpatient rehabilitation.
Period of Assessment	At least annually.
Sources of Data	Electronic medical records, retrospective chart review, prospective flow sheets, Provincial and territorial hospital discharge abstract databases, CIHI hospital database, and/or cardiac registries.

Rationale

At present, there is limited evidence testing whether timely referral and entry into CR reduces morbidity and mortality compared with delayed referral and/or entry into CR. There is some evidence that facilitated referral to CR and rapid program enrollment may increase rates of program attendance and program completion (Parker et al., 2009; Russell et al., 2011), even among smokers, and is safe in low-risk patients (Robinson et al., 2011). Moreover, there is some evidence that early initiation of exercise has beneficial effects on exercise self-efficacy (Dolansky et al., 2011), maximum oxygen consumption achieved in CR (Valkeinen et al., 2010) and left ventricular function (Haykowsky et al., 2011).

References:

- Parker, K., Stone, J. A., Arena, R., Lundberg, D., Aggarwal, S., Goodhart, D., & Traboulsi, M. (2011). An Early Cardiac Access Clinic Significantly Improves Cardiac Rehabilitation Participation and Completion Rates in Low-Risk ST-Elevation Myocardial Infarction Patients. *Canadian Journal of Cardiology*, *27*(5), 619-627.
- Russell, Kelly L., Tanya M. Holloway, Margaret Brum, Veola Caruso, Caroline Chessex, and Sherry L. Grace. "Cardiac rehabilitation wait times: effect on enrollment." *Journal of Cardiopulmonary Rehabilitation and Prevention* 31, no. 6 (2011): 373.
- Robinson HJ, Samani NJ, Singh SJ. Can low risk cardiac patients be 'fast tracked' to Phase IV community exercise schemes for cardiac rehabilitation? A randomised controlled trial. International Journal of Cardiology 2011 Jan 21;146(2):159-63.
- Dolansky MA, Zullo MD, Boxer RS, Moore SM. Initial efficacy of a cardiac rehabilitation transition program: Cardiac TRUST. Journal of Gerontological Nursing 2011 Dec;37(12):36-44.
- Valkeinen H, Aaltonen S, Kujala UM. Effects of exercise training on oxygen uptake in coronary heart disease: A systematic review and meta-analysis. Scandinavian Journal of Medicine and Science in Sports 2010 Aug;(4):August.

Clinical Recommendation(s)

All patients referred to CR should undergo entry assessment in a timely fashion.

Modified from Reference:

- Canadian Cardiovascular Society Access to Care Working Group on Cardiac Rehabilitation, Dafoe et al., 2006). (Strong Recommendation, Moderate to Low Quality Evidence)

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation
➢ May be difficult to determine date of discharge where inpatients are referred post-discharge.

PROCESS INDICATOR NO: CR-2b CARDIAC REHABILITATION WAIT TIME FROM REFERRAL TO ENROLLMENT	
Description	The median number of days between referral at the Cardiac Rehabilitation (CR) program to patient enrollment.
Numerator	The number of calendar days from receipt of referral at the CR program to patient enrollment
Denominator	All patients enrolled in the CR program in the reference period. **Exclusions:** ➢ Patient experienced a new clinical event, which is documented. ➢ Patient delayed initial appointment date due to non-clinical factors, which are documented (e.g. personal travel).
Method of Calculation	Median number of days, calculated for the population of reference as described in the denominator section.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

At present, there is limited evidence testing whether timely referral and entry into CR reduces morbidity and mortality compared with delayed referral and/or entry into CR. There is some evidence that facilitated referral to CR and rapid program enrollment may increase rates of program attendance and program completion (Parker et al., 2009; Russell et al., 2011), even among smokers, and is safe in low-risk patients (Robinson et al., 2011). Moreover, there is some evidence that early initiation of exercise has beneficial effects on exercise self-efficacy (Dolansky et al., 2011), maximum oxygen uptake (Valkeinen et al., 2010) and the left ventricle (Haykowsky et al., 2011).

References:

- Parker, K., Stone, J. A., Arena, R., Lundberg, D., Aggarwal, S., Goodhart, D., & Traboulsi, M. (2011). An Early Cardiac Access Clinic Significantly Improves Cardiac Rehabilitation Participation and Completion Rates in Low- Risk ST-Elevation Myocardial Infarction Patients. Canadian Journal of Cardiology, 27(5), 619-627.
- Russell, K. L., Holloway, T. M., Brum, M., Caruso, V., Chessex, C., & Grace, S. L. (2011). Cardiac rehabilitation wait times: effect on enrollment. Journal of Cardiopulmonary Rehabilitation and Prevention, 31(6), 373
- Robinson, H. J., Samani, N. J., & Singh, S. J. (2011). Can low risk cardiac patients be 'fast tracked'to Phase IV community exercise schemes for cardiac rehabilitation? A randomised controlled trial. International journal of cardiology,146(2), 159-163.
- Dolansky, M. A., Zullo, M., Boxer, R., & Moore, S. M. (2011). Initial Efficacy of a Cardiac Rehabilitation Transition Program: Cardiac TRUST. Journal of Gerontological Nursing, 37(12), 36.
- Valkeinen, H., Aaltonen, S., & Kujala, U. M. (2010). Effects of exercise training on oxygen uptake in coronary heart disease: a systematic review and meta-analysis. Scandinavian journal of medicine & science in sports, 20(4), 545-555.
- Haykowsky, M., Scott, J., Esch, B., Schopflocher, D., Myers, J., Paterson, I., ... & Clark, A. M. (2011). A Meta- analysis of the effects of Exercise Training on Left Ventricular Remodeling Following Myocardial Infarction: Start early and go longer for greatest exercise benefits on remodeling. *Trials*, *12*(1), 92.

Clinical Recommendation(s)

All patients referred to CR should undergo entry assessment in a timely fashion so their CR program can be initiated.

Modified from Reference:

- Dafoe, W., Arthur, H., Stokes, H., Morrin, L., & Beaton, L. (2006). Canadian Cardiovascular

Society Access to Care Working Group on Cardiac Rehabilitation. Universal access: but when? Treating the right patient at the right time: access to cardiac rehabilitation. Can J Cardiol, 22(11), 905-911 (Strong Recommendation, Low Quality Evidence)

Method of Reporting

The reported statistic will be a median.

Challenges to Implementation/Interpretation

- Information required to identify exclusions may be variably ascertained and documented.

PROCESS INDICATOR NO: CR-3 **CARDIAC REHABILITATION ENROLLMENT**	
Description	Percentage of CR-eligible patients enrolled in a program post hospital discharge.
Numerator	The total number of eligible patients enrolled in the CR Program. Enrollment is defined as patient attendance at a first CR program visit.
Denominator	The total number of eligible patients referred to the CR Program post hospital discharge. A referral is deemed being made if both of the following criteria are satisfied: 1. There is an official written or electronic communication on behalf of the health care provider for referral to CR. 2. The referral information has been received by the CR program. **Exclusions:** • Patient who at initial CR program assessment is determined to be not eligible for CR due to documented medical reason, such as comorbid life-threatening condition, serious mental illness, or inability to ambulate. • Referred inpatients who are triaged or who attend another CR site. • CR Eligible Patients with a documented medical reason for enrollment, such as recurrent event. • CR Eligible Patients with a documented patient-centered reason for non-referral. • Patient being discharged to long-term care facility or inpatient rehabilitation.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

CR improves mortality and morbidity. Evidence supports high concordance between referral and patient enrollment rates. Enrolment rates of 80% of those referred have been reported in institutions where systematic CR referral is deployed.

Modified from Reference:

- Grace, S. L., Chessex, C., Arthur, H., Chan, S., Cyr, C., Dafoe, W., et al. (2011). Systematizing inpatient referral to cardiac rehabilitation 2010 CANADIAN ASSOCIATION OF CARDIAC REHABILITATION AND CANADIAN CARDIOVASCULAR SOCIETY JOINT POSITION PAPER. Journal of Cardiopulmonary Rehabilitation and Prevention, 31(3), E1-E8.

Clinical Recommendation(s)

All eligible CR in-patients should enroll in a CR program following hospital discharge.
(Strong Recommendation, Moderate Quality Evidence)

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- Lack of systematic CR referral information capture by programs. Systematic (electronic preferred) prospective

information capture will help alleviate challenges.

PROCESS INDICATOR NO: CR-5 PATIENT SELF-MANAGEMENT EDUCATION	
Description	The percentage of patients in the Cardiac Rehabilitation (CR) Program who received patient self- management education either individually or within a group prior to program discharge
Numerator	A subset of the denominator representing a number of patients for whom there is documentation of receiving patient self-management education as defined by the CACR Guidelines (see below) before program discharge. This education is defined as not only information provision concerning the core areas of CR, but also theoretically-informed behaviour change techniques (see Clinical Recommendations for the definition of the self-management education).
Denominator	The number of patients discharged from the CR program in the reference period.
Method of Calculation	Numerator / Denominator * 100 .
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

While patient education may not reduce all-cause mortality or cardiac morbidity, educational interventions can significantly improve health-related quality of life. We would argue that a key objective of patient education is to increase knowledge and understanding, which is necessary for heart-healthy behaviour change, which in turn reduces cardiac risk

Reference

- Brown, J. P., Clark, A. M., Dalal, H., Welch, K., & Taylor, R. S. (2012). Effect of patient education in the management of coronary heart disease: a systematic review and meta-analysis of randomised controlled trials. European Journal of Preventive Cardiology

Clinical Recommendation(s)

European Guidelines on Cardiovascular Disease Prevention in Clinical Practice (v2012):

- Multimodal interventions integrating education on healthy lifestyle medical resources are recommended.

Based on the CACR 3rd Edition Guidelines, patient self-management education:

- Includes an informational component which:
    1. Discusses specific health goals;
    2. Is personalized;
    3. Explains the risks of not changing, the benefits of changing, and seeks to influence outcome beliefs regarding the outcome efficacy of interventions or behavioural changes;
    4. Often emphasizes proximal risks and benefits over distal ones;
    5. Seeks to heighten self-efficacy concerning possible effective self-regulation of specific behaviours; and,
    6. May seek to elicit positive emotions, to increase optimism about the possibility of change, and to heighten the salience of personal experience or other evidence supporting self-efficacy
- Is led by professional staff, and not by lay persons, with regular contact between staff and patients.
- Can be delivered as stand-alone sessions (which is preferred) or incorporated into other activities. Where the delivery is incorporated into other activities the goals of the education must be clearly defined and delivered.
- Education can be delivered in individual or group settings.

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- Detailed information on the content of the self-management education is required for this indicator to be comparable across CR programs.

OUTCOME INDICATOR NO: CR-7 SECONDARY PREVENTION MEDICATIONS: ACETYLSALICYLIC ACID (ASA)	
Description	Percentage of patients who were taking ASA at time of CR program discharge.
Numerator	The total number of patients enrolled in a CR program who were taking ASA at time of discharge from CR program. Enrollment is defined as patient attendance at a first CR program visit. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team.
Denominator	The total number of patients discharged from the CR program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team. **Exclusions:** ➢ Patients who died before being discharged from CR program. ➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patients with a documented reason (medical or patient-centered) for not taking ASA (e.g. post-surgical valve patient without CAD, allergy, severe bleeding).
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

Antiplatelet agents are a cornerstone therapy for patients with documented atherosclerotic vascular disease. There is clear evidence showing its benefit in preventing adverse cardiovascular events in patients with vascular diseases.

CR program staff should discuss medication use with patients at program initiation and completion at a minimum, and this should be documented in the patient's chart. Drug regimen changes should be done in the appropriate manner during the CR program in order to reach optimal CV medication use and risk reduction.

Communication should be made with the primary care provider as well as the pharmacist.

Clinical Recommendation(s)

AHA/ACCF Secondary Prevention and Risk Reduction Therapy for Patients with Coronary and other Atherosclerotic Vascular Disease: 2011 Update:

- Aspirin 75–162 mg daily is recommended in all patients with coronary artery disease unless contraindicated. (Class I; Level of Evidence: A).

CCS 2011 Antiplatelet Guidelines.

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- ➢ Contraindication or significant side effects to ASA will need to be specifically documented.
- ➢ Because ASA is provided over-the-counter, use may be more difficult to ascertain.

OUTCOME INDICATOR NO: CR-8 SECONDARY PREVENTION MEDICATIONS: ANTI-PLATELET AGENTS OTHER THAN ASA	
Description	Percentage of patients on anti-platelet agents other than ASA (i.e. Clopidogrel/Prasugrel/Ticagrelor) at time of CR program discharge.
Numerator	The total number of patients enrolled in CR program who have an indication for anti-platelets as per CCS guidelines taking anti-platelet agents other than ASA (i.e. Clopidogrel/Prasugrel/Ticagrelor) at time of CR program discharge. Enrollment is defined as patient attendance at a first CR program visit. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team.
Denominator	The total number of patients discharged from the CR program who have an indication for other anti-platelet agents. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team. **Exclusions:** ➢ Patients who died before being discharged from CR program. ➢ Patients who are re-admitted to hospital before being discharged from CR program. • Patients with a documented reason (medical or patient-centered) for not taking other anti-platelet agents.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

Antiplatelet agents are a cornerstone therapy for patients with documented atherosclerotic vascular disease. There is clear evidence showing its benefit in preventing adverse cardiovascular events in patients with vascular diseases.

CR program staff should discuss medication use with patients at program initiation and completion at a minimum, and this should be documented in the patient's chart. Drug regimen changes should be done in the appropriate manner during the CR program in order to reach optimal CV medication use and risk reduction.

Some patients will enter CR on another antiplatelet agent, which will appropriately be discontinued during the time of CR.

Communication should be made with the primary care provider as well as the pharmacist.

Clinical Recommendation(s)

CCS 2011 Antiplatelet Guidelines.

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

➢ Contraindication or significant side effects to Clopidogrel/Prasugrel/Ticagrelor will need to be specifically documented.

OUTCOME INDICATOR NO: CR-9 SECONDARY PREVENTION MEDICATIONS: BETA BLOCKERS	
Description	Percentage of patients on a Beta-blocker at CR discharge.
Numerator	The total number of patients in the CR program who were indicated for and taking Beta-blockers at time of CR program discharge. Enrollment is defined as patient attendance at a first CR program visit. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team.
Denominator	The total number of patients indicated for beta-blockers discharged from the CR program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team. **Exclusions:** ➢ Patients who died before being discharged from CR program. ➢ Patients who are re-admitted to hospital before being discharged from CR program. • Patients with a documented reason (medical or patient-centered) for not taking Beta-blockers.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

The appropriate use of preventive medications can reduce recurrent cardiovascular events and improve patient outcomes. CR program staff should discuss medication use with patients at program initiation and completion at a minimum, and this should be documented in the patient's chart. Drug regimen changes should be done in the appropriate manner during the CR program in order to reach optimal CV medication use and risk reduction. Communication should be made with the primary care provider as well as the pharmacist.

Clinical Recommendation(s)

CACR 3rd Edition Guidelines:

- All patients with clinically-significant coronary artery disease or heart failure who have an indication for beta-blockade, without clear contraindications or a history of beta-blocker intolerance, should be considered for chronic beta-blocker therapy.

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

➢ Contraindication or significant side effects to Beta-blockers will need to be specifically documented.

OUTCOME INDICATOR NO: CR-10 SECONDARY PREVENTION MEDICATIONS: STATINS	
Description	Percentage of CR patients on statins at program discharge.
Numerator	The total number of patients enrolled in CR program who were taking Statins at program discharge. Enrollment is defined as patient attendance at a first CR program visit. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team.
Denominator	The total number of patients discharged from the CR program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team. **Exclusions:** ➢ Patients who died before being discharged from CR program. ➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patients with a documented reason (medical or patient-centered) for not taking Statins (e.g. patients who are statin-resistant).
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

A lipid profile should be established in all patients, with lipid-lowering therapy initiated. An adequate does of statin should be used to achieve lipid targets. Statin therapy has a beneficial effect on atherosclerotic CVD outcomes.

Statin-intolerant patients should be considered for other hypo-lipidemic agents.

Clinical Recommendation(s)

AHA/ACCF Secondary Prevention and Risk Reduction Therapy for Patients with Coronary and other Atherosclerotic Vascular Disease: 2011 Update:

- In addition to therapeutic lifestyle changes, statin therapy should be prescribed in the absence of contraindications or documented adverse effects (Level of Evidence: A)

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- Contraindication or significant side effects to Statins will need to be specifically documented.

OUTCOME INDICATOR NO: CR-12 SECONDARY PREVENTION MEDICATIONS: ACE/ARB	
Description	Percentage of patients at CR discharge on angiotensin-converting enzyme (ACE) inhibitors / Angiotensin Receptor Blockers (ARBs)
Numerator	The total number of patients enrolled in CR program indicated for ACE / ARB who were taking ACE / ARB at program discharge. Enrollment is defined as patient attendance at a first CR program visit. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team.
Denominator	The total number of patients indicated for ACE / ARB discharged from the CR program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team. **Exclusions:** ➢ Patients who died before being discharged from CR program. ➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patients with a documented reason (medical or patient-centered) for not taking ACE / ARB.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

The appropriate use of preventive medications can reduce recurrent cardiovascular events and improve patient outcomes.

Clinical Recommendation(s)

AHA/ACCF Secondary Prevention and Risk Reduction Therapy for Patients with Coronary and other Atherosclerotic Vascular Disease: 2011 Update

- ACE inhibitors
  a. ACE inhibitors should be started and continued indefinitely in all patients with left ventricular ejection fraction ≤40% and in those with hypertension, diabetes, or chronic kidney disease, unless contraindicated. (Class I; Level of Evidence: A)
  b. It is reasonable to use ACE inhibitors in all other patients.126 (Class IIa; Level of Evidence: B)

- ARBs
  a. The use of ARBs is recommended in patients who have heart failure or who have had a myocardial infarction with left ventricular ejection fraction ≤40% and who are ACE-inhibitor intolerant. (Class I; Level of Evidence: A)
  b. It is reasonable to use ARBs in other patients who are ACE-inhibitor intolerant. (Class IIa; Level of Evidence: B)

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- Contraindication or significant side effects to ACE / ARB will need to be specifically documented.

PROCESS INDICATOR NO: CR-13 ASSESSMENT OF BLOOD PRESSURE CONTROL	
Description	Percentage of patients in CR program who received individualized assessment of blood pressure (BP) control.
Numerator	The total number of enrolled CR patients for whom an assessment of blood pressure control was made. Enrollment is defined as patient attendance at a first CR program visit.
Denominator	The total number of patients discharged from the CR program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team. **Exclusions:** ➢ Patients who died before being discharged from CR program. ➢ Patients who are re-admitted to hospital before being discharged from CR program.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

Assessment of cardiovascular (CV) risk factors including blood pressure should be made at program entry and exit in order to determine cardiovascular risk, identify patients who are not at target and monitor antihypertensive treatment. Canadian Hypertension Education Program recommendations regarding patient preparation, posture and position, equipment, and technique should be followed to ensure accurate assessment.

Subsequently, risk factor management should be undertaken in the appropriate manner during the CR program in order to reach optimal CV risk factor goal by program completion. Blood pressure control is defined as systolic and diastolic mmHg values which are ≤ the guideline-recommended threshold. Programs should aim to achieve blood pressure control in at least 90% of patients (benchmark).

Clinical Recommendation(s)

Canadian Hypertension Education Program Recommendations 2012

a. Health care professionals who have been specifically trained to measure BP accurately should assess BP in all adult patients at all appropriate visits to determine cardiovascular risk and monitor antihypertensive treatment (Grade D).
b. Use of standardized measurement techniques is recommended when assessing BP (Grade D).

AHA/ACCF Secondary Prevention and Risk Reduction Therapy for Patients with Coronary and other Atherosclerotic Vascular Disease: 2011 Update

a. All patients should be counseled regarding the need for lifestyle modification to achieve blood pressure control: weight control; increased physical activity; alcohol moderation; sodium reduction; and emphasis on increased consumption of fresh fruits, vegetables, and low-fat dairy products. (Class I; Level of Evidence: B)
b. Patients with blood pressure ≥140/90 mm Hg should be treated, as tolerated, with blood pressure medication, treating initially with beta-blockers and/or ACE inhibitors, with addition of other drugs as needed to achieve goal blood pressure. (Class I; Level of Evidence: A)

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- Blood pressure should be measured in each individual several times, on several separate occasions.
- Blood pressure target varies by assessment modality: resting blood pressure, home blood pressure, ambulatory monitoring blood pressure.
- Blood pressure target for diabetes, renal failure patients may differ in comparison to CAD patients.

PROCESS INDICATOR NO: CR-14 ASSESSMENT OF LIPID CONTROL	
Description	Percentage of patients in CR who received individualized assessment of lipid control.
Numerator	The total number of enrolled CR patients for whom an assessment of lipid control was made. Enrollment is defined as patient attendance at a first CR program visit.
Denominator	The total number of patients discharged from the CR program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team. **Exclusions:** ➢ Patients who died before being discharged from CR program. ➢ Patients who are re-admitted to hospital before being discharged from CR program.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

Assessment of cardiovascular (CV) risk factors including dyslipidemia should be made at program entry and exit in order to evaluate and identify patients who are not at target according to Canadian guidelines. A period of at least 6 weeks should pass before assessment of drug changes. Subsequently, medication changes should be done in the appropriate manner during the CR program in order to reach optimal CV risk factor goal. Communication should be made with the primary care provider as well as the pharmacist.

Targets as defined by current Canadian secondary prevention guidelines (Treatment target is for LDL-C <2.0 mmol/L or > 50% reduction).

Clinical Recommendation(s)

CCS Dyslipidemia Guidelines 2012

- All patients with evidence of atherosclerosis should undergo lipid profile screening.

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- ➢ Not all programs have MDs.
- ➢ LDL target may be different depending of the CVD risk assessment (high vs. very high risk patient).
- ➢ Alternative target to LDL: apoB vs. non-HDL.

PROCESS INDICATOR NO: CR-15 ASSESSMENT OF ADIPOSITY	
Description	Percentage of patients in CR program who received individualized assessment of adiposity.
Numerator	The total number of enrolled CR patients for whom an assessment of adiposity was made. Enrollment is defined as patient attendance at a first CR program visit.
Denominator	The total number of patients discharged from the CR program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team. **Exclusions:** ➢ Patients who died before being discharged from CR program. ➢ Patients who are re-admitted to hospital before being discharged from CR program.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

Both overweight and obesity are associated with a risk of death in cardiovascular (CV) disease. There is a positive linear association of body mass index with all-cause mortality. Assessment of CV risk factors, including excess body weight, should be made at program entry and exit in order to evaluate and identify patients who are not at target, according to WHO thresholds.

One of the components of abdominal fat, namely visceral adipose tissue, is a metabolically active endocrine organ whose action impacts CV risk factors. Thus, assessment of waist circumference, measured in accordance with current Canadian Cardiovascular Society Lipid and Canadian Diabetes Association Guidelines, over and above body mass index, is warranted.

Targets as defined by current Canadian guidelines (Goals: Body mass index: 18.5 to 24.9 kg/m^2; Waist circumference: women<35 inches (<89 cm), men <40 inches (<102 cm)).

Clinical Recommendation(s)

European Guidelines on Cardiovascular Disease Prevention in Clinical Practice (v2012)

- Weight reduction in overweight and obese people is recommended as this is associated with favourable effects on blood pressure and dyslipidemia, which may lead to less CVD (class I, level A; Grade- Strong).

AHA/ACCF Secondary Prevention and Risk Reduction Therapy for Patients with Coronary and other Atherosclerotic Vascular Disease: 2011 Update

a. If waist circumference (measured horizontally at the iliac crest) is <35 inches (<89 cm) in women and <40 inches (<102 cm) in men, therapeutic lifestyle interventions should be intensified and focused on weight management. (class I; Level of Evidence: B)
b. The initial goal of weight loss therapy should be to reduce body weight by approximately 5% to 10% from baseline. With success, further weight loss can be attempted if indicated. (class I; Level of Evidence: C)

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- What index should be chosen for the assessment of adiposity (weight, body mass index, waist circumference, waist-to-hip ratio, waist-to-height ratio, bioimpedance)?
- Method of assessment of waist circumference – ensure standardized measurement.

PROCESS INDICATOR NO: CR-16 INDIVIDUAL ASSESSMENT OF BLOOD GLUCOSE CONTROL (HBA1C)	
Description	Percentage of patients in CR who received individualized assessment of blood glucose control.
Numerator	The total number of enrolled CR patients for whom an assessment of glucose control was made. Enrollment is defined as patient attendance at a first CR program visit.
Denominator	The total number of patients discharged from the CR program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team. **Exclusions:** ➢ Patients who died before being discharged from CR program. ➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patients without diabetes mellitus
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

Assessment of cardiovascular (CV) risk factors, including fasting blood glucose and HbA1c, should be made at program entry and thereafter as recommended in order to identify and treat patients who are not at target. The CR setting represents an excellent opportunity for health care providers to monitor and manage diabetes mellitus (DM) because of the frequent contact and close relationship that personnel and patients usually develop. Improving glycemic control significantly reduces the risk of microvascular complications, and there is a relationship between increased levels of glycemia and cardiovascular events.

Target indicative of control as defined by current Canadian Diabetes Association guidelines: hemoglobin A1c ≤7.0. Programs should aim to achieve HbA1c target levels in at least 90% of patients (benchmark).

Clinical Recommendation(s)

AACVPR Statement "Recommendations for Managing Patients with Diabetes Mellitus in Cardiopulmonary Rehabilitation" 2012

- A key recommendation for patients with diabetes mellitus is optimal blood glucose control. An important role of the CR team is to assess risk factors for recurrent coronary events and guide patients in risk modification.

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- ➢ Not all programs have MDs
- ➢ Cost of measurement in non-diabetics
- ➢ Criteria for screening for diabetes
- ➢ Risk engine for the screening of diabetes?

OUTCOME INDICATOR NO: CR-17 INCREASE IN EXERCISE CAPACITY	
Description	The percentage of Cardiac Rehabilitation (CR) patients who achieved a half metabolic equivalent (MET) increase in their exercise capacity from the initial to the final exercise session.
Numerator	A subset of the denominator representing a number of patients who achieved a half metabolic equivalent (MET) increase in their exercise capacity from the initial to the final exercise session.
Denominator	The total number of patients who completed the CR Program in the reference period. To complete the CR program a patient must have attended at least some of the CR intervention components and have had a formal re-assessment by the CR team at the conclusion of the CR intervention. See definition of CR intervention components in preamble. **Exclusions** • Patients who cannot walk on a treadmill unaided, or who cannot cycle on a bike ergometer. • Patients who do not meet the ACSM safety recommendations for undertaking a stress test.
Method of Calculation	Numerator / Denominator * 100
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

Systematic programs of CR that included prescribed exercise training can significantly improve patients' functional capacity. Enhanced cardiovascular fitness (evaluated by treadmill stress testing and expressed in METs) is associated with better survival and fewer CV events. The positive effect of exercise training and improved cardiometabolic fitness, as a means of improving patient outcomes, is firmly grounded in the positive effects these interventions have on exercise vascular biology. A half MET improvement is related to health benefit.

Reference:

- Kavanagh, T., Mertens, D. J., Hamm, L. F., Beyene, J., Kennedy, J., Corey, P., & Shephard, R. J. (2002). Prediction of long-term prognosis in 12 169 men referred for cardiac rehabilitation. Circulation, 106(6), 666-671.
- Myers, J., Prakash, M., Froelicher, V., Do, D., Partington, S., & Atwood, J. E. (2002). Exercise capacity and mortality among men referred for exercise testing. New England Journal of Medicine, 346(11), 793-801.
- Piepoli MF, Corra U, Benzer W, Bjarnason-Wehrens B, Dendale P, Gaita D, McGee H, Mendes M, Niebauer J, Zwisler AO, and Schmid J. 2010. Secondary prevention through cardiac rehabilitation: physical activity counselling and exercise training. Eur Heart J 31(16): 1967-1974. doi: 10.1093/eurheartj/ehq236

Clinical Recommendation(s)

Assessment of exercise capacity should be made at program entry and exit in order to evaluate change in exercise capacity.

Reference :

- Sanderson, B. K., Southard, D., & Oldridge, N. (2004). AACVPR consensus statement. Outcomes evaluation in cardiac rehabilitation/secondary prevention programs: improving patient care and program effectiveness. *Journal of cardiopulmonary rehabilitation*, *24*(2), 68.

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- Modality used to measure exercise capacity may vary by program which may inhibit cross-comparison (i.e. 6- minute walk test, graded exercise test, cardiopulmonary test; measured capacity vs. estimated).
- While exercise stress tests are recommended, not all programs have MDs to supervise them.
- Variation in exercise stress testing protocols from pre to post-program inhibits comparison over time.

- Symptom limits to tests inhibits ability to ascertain maximum capacity.

OUTCOME INDICATOR NO: CR-18 ADHERENCE TO CARDIAC REHABILITATION PROGRAM	
Description	Percentage of prescribed CR exercise sessions completed by patient.
Numerator	The total number of scheduled centre-based exercise sessions attended during CR among enrolled patients. Enrollment is defined as patient attendance at a first CR program visit.
Denominator	The total number of exercise sessions offered or prescribed to enrolled patients for a given scheduled centre-based CR program, to the point where a patient is discharged from the program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

All patients in CR should be encouraged to attend all sessions during CR, as the number of CR sessions attended correlates with improved prognosis (GOSPEL study; Hammill et al. Circ 2010;121:63; Martin et al. Circ 2012;126:677). Given the complexity of CR program offerings, adherence to prescribed exercise can serve as a "proxy" measure for overall program adherence. Adherence to PA sessions during CR has been linked to increased longevity, reduced morbidity, and improved QoL.

Clinical Recommendation(s)

Canadian Association of Cardiac Rehabilitation guidelines, 3rd Edition

- Adherence and persistence with prescribed exercise, health behaviour interventions and pharmacological therapies (i.e., improvements in cardiometabolic fitness) is associated with significantly improved outcomes.

Challenges to Implementation

- Some programs prescriptions include non-supervised sessions which may be hard to confirm were completed and thus included in the database.

PROCESS INDICATOR NO: CR-26 SMOKING CESSATION SUPPORT	
Description	Percentage of CR patients who are current or recent smokers and who were referred for smoking cessation.
Numerator	The total number of patients discharged from CR who were current or recent (< 6 months) smokers at enrollment, and who were referred to a smoking cessation program. Enrollment is defined as patient attendance at a first CR program visit. An internal referral is defined as a referral to a member of the interdisciplinary CR team (e.g. psychologist, counselor, social worker). An external referral is defined as a referral to a mental health professional who is not part of the CR program.
Denominator	The total number of current or recent smokers at enrollment who were discharged from the CR program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

There is evidence illustrating that the identification and treatment of smokers can dramatically increase the chance of cessation, aiding in the secondary prevention of CAD. CAD patients often relapse within a year without assistance. It is recommended that patients be referred for cessation assistance. Health care providers should be knowledgeable with the principles and practice of smoking cessation; both smoking cessation pharmacology and behaviour modifications. Counselling and pharmacotherapy, alone or together, improve cessation success.

Clinical Recommendation(s)

"It is the view of CCS that all patients should have their smoking status systematically identified and documented and be offered specific assistance initiating a cessation attempt."

Reference:

- Smoking Cessation and the Cardiovascular Specialist; Canadian Cardiovascular Society Position Paper. Pipe et al. Canadian J Cardiology. Volume 27, Issue 2, pg 132-137. March 2011

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- None

PROCESS INDICATOR NO: CR-30 STRESS MANAGEMENT	
Description	Percentage of CR patients who were referred to a stress management intervention.
Numerator	The total number of enrolled CR patients who were referred to a stress management intervention either within or outside the CR program. Enrollment is defined as patient attendance at a first CR program visit. An internal referral is defined as a referral to an intervention delivered by qualified members of the CR team (e.g., psychologist, counselor, social worker). An external referral is defined as a referral to a programme, delivered by a qualified individual, or professional who is not part of the CR program.
Denominator	The total number of patients discharged from the CR program. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team. **Exclusions:** • Patients who have a documented patient-centered reason for not being offered stress management (i.e., perceive no difficulty with stress)
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.
Rationale	
Acute stress can cause ischemia. Reviews have demonstrated the benefits of stress management in CR in improving psychosocial outcomes of participants. Stress management interventions in a CR setting have been shown to improve psychosocial and CV risk outcomes in participants. In addition, they provide key life skills which can be utilised to reduce future stress. Data on the efficacy of such interventions to reduce hard outcomes is contradictory (though generally null findings have been reported) and limited. Stress management is considered a key element of CR programs. Note, any intervention given must be empirically-validated and/or theoretically-based and should be given by someone qualified to deliver the intervention.	
Clinical Recommendation(s)	
Stress or psychosocial management is defined as a core component in both the AACVPR guidelines (Circulation. 2000; 102: 1069-1073) and is a recommended element of the CACR guidelines (see Chapter 6).	
Method of Reporting	
The reported statistic will be a percentage	
Challenges to Implementation	
• None	

STRUCTURE INDICATOR NO: CR-31 MEDICAL DIRECTOR SUPERVISION	
Description	Percentage of CR programs that have a physician medical director providing program oversight.
Numerator	The total number of CR programs with a physician Medical Director who is responsible for the oversight of the CR program.
Denominator	The total number of CR programs within Canada/province/regional health care authority.
Period of Assessment	At least annually.
Sources of Data	Audit of written program policies, review of program structure and delivery through interviews with medical director, clinical director, manager and / or clinical staff, or provincial/regional/national CR program survey

Rationale

The physician Medical Director is responsible to ensure that the policies and procedures are consistent with evidence-based standards and guidelines for the delivery of contemporary CR.

The medical director works alongside clinical and administrative leadership to oversee delivery of CR services provided by a multidisciplinary and trans-disciplinary staff of health care professionals. Physician to physician referral is often the pre-requisite medical pathway that connects patients in to the CR program from acute care or community-based practice settings. Taking action directly with the patient or referring source on findings from new medical assessments, changes in evidence based pharmacotherapies or laboratory/diagnostic testing will require physician input. Increasing age, complexity and co-morbidity of patients entering CR requires more direct physician engagement with screening and oversight of the program.

Reference:

- King et al. Medical Director Responsibilities for Outpatient Cardiac Rehabilitation / Secondary Prevention Programs: 2012 Update. A statement for healthcare professionals from the AACVPR and AHA. JCRP, 2012; 32:410-419.

Clinical Recommendation(s)

The physician Medical Director is ultimately responsible for the medical well-being of the patients within the CR Program and provides oversight of safety, efficacy and connection with the referring medical community (reference: CACR Guidelines, 3rd edition, p437, p410).

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- None

STRUCTURE INDICATOR NO: CR-32 EMERGENCY RESPONSE STRATEGY	
Description	The percentage of CR programs with a documented emergency response strategy and appropriately qualified staff.
Numerator	A subset of the denominator representing a number of CR programs that meet both of the following criteria: 1. An emergency response strategy enabling prompt defibrillation is in place to deal with medical emergencies. 2. All clinical staff have current basic life-support (BLS) certification including use of Automated External Defibrillation (AED) devices.
Denominator	The total number of CR programs within Canada/province/regional health care authority.
Method of Calculation	Numerator / Denominator * 100
Sources of Data	Audit of written program policies, interviews with program staff, or provincial/regional/national CR program survey.

Rationale

Emergency response strategies are important since exercise training and or stress testing is associated with a small incremental risk over and above the co-incidental risk for a cardiovascular emergency experienced by any cardiac patient. Prompt defibrillation has been demonstrated to be the most effective form of management for cardiac arrest. Prompt defibrillation is often facilitated by other basic and advanced life saving support strategies to promote good outcomes in patients who have experienced cardiac arrest.

Reference:

- Thomas, R. J., King, M., Lui, K., Oldridge, N., Piña, I. L., Spertus, J., ... & Whitman, G. R. (2007). AACVPR/ACC/AHA 2007 Performance Measures on Cardiac Rehabilitation for Referral to and Delivery of Cardiac Rehabilitation/Secondary Prevention Services: Endorsed by the American College of Chest Physicians, American College of Sports Medicine, American Physical Therapy Association, Canadian Association of Cardiac Rehabilitation, European Association for Cardiovascular Prevention and Rehabilitation, Inter-American Heart Foundation, National Association of Clinical Nurse Specialists, Preventive .... Journal of the American college of Cardiology, 50(14), 1400-1433.

Clinical Recommendation(s)

CACR Guidelines, 3rd Edition (Chapter 12: Program Administration and Human Resources, p.430)

- All CR programs require a process in place that addresses site-specific facility equipment in conjunction with safety requirements and considerations
- All CR programs require policies and procedures for the management of medical emergency situations.

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- There may be variation in the response strategy, making comparison across CR programs difficult. For example, a policy and procedure for cardiac arrest; pre-arranged link to local ambulance service; and / or on-site automated external defibrillator (AED) devices. Moreover, for programs located in a hospital setting, there may be existing hospital-wide cardiac emergency response with more advanced resuscitation care protocols and equipment.

OUTCOME INDICATOR NO: CR-34 COMMUNICATION WITH THE PRIMARY HEALTH CARE PRACTITIONER	
Description	Percentage of CR patients with a documented communication between the CR program and primary health care practitioner (PHCP).
Numerator	The total number of discharged patients with at least one documented communication from the CR program to the primary health care practitioner. Program discharge is defined as patient participated in at least some of the program and the file was closed out by the CR team.
Denominator	The total number of patients discharged from the CR program. **Exclusions:** ➢ Patients who died before being discharged from CR program. ➢ Patients who are re-admitted to hospital before being discharged from CR program. ➢ Patient has no primary health care provider.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

Communication between CR and PHCP may improve further management of patients' cardiac risk by the PHCP. A CR Program should have strategies in place to communicate CR participants' status at entry/exit from the CR Program to their PHCP. Inter-current communication may be clinically warranted in some cases. It is recommended that the summative communication be received by the PHCP prior to the patient's subsequent visit. Communication should be sent to the PHCP at program exit regardless of patient continuation in a maintenance program.

Clinical Recommendation(s)

BACPR Core Components and Standards, 2012

- On programme completion there should be a formal assessment. This should be communicated by discharge letter to the referrer and the patient as well as those directly involved in the continuation of healthcare provision.
- There should be communication and collaboration between primary and secondary care services to achieve the long-term management plan.

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- None

OUTCOME INDICATOR NO: CR-37 CARDIAC REHABILITATION PROGRAM COMPLETION	
Description	Percentage of patients enrolled in CR who completed the program.
Numerator	The total number of enrolled patients who completed the CR program. To complete the CR program a patient must have attended at least some of the CR intervention components and have had a formal re-assessment by the CR team at the conclusion of the CR intervention. The CR intervention components are defined as per the BACPR Core Components, namely: health behaviour change and education, lifestyle risk factor management, psychosocial health, medical risk factor management, and cardio-protective therapies.
Denominator	The total number of patients enrolled in the CR program. Enrollment is defined as patient attendance at a first CR program visit. **Exclusions:** • Patients that experience a recurrent cardiac or other clinical event that prevents a patient from completing the CR program such as a comorbid life-threatening condition, a serious mental illness, or the inability to ambulate.
Period of Assessment	At least annually.
Sources of Data	Program databases and/or Canadian Cardiac Rehabilitation Registry.

Rationale

A dose-response relationship between CR program attendance and reduced morbidity and mortality has been established.

Ideally, at program completion participants will have attained their CR goals, be meeting exercise and nutrition guidelines, and be within recommended targets for blood pressure, and lipids.

Clinical Recommendation(s)

CACR guidelines, 3rd Edition

- Adherence and persistence with prescribed exercise, health behaviour interventions and pharmacological therapies (i.e., improvements in cardiometabolic fitness) is associated with significantly improved outcomes.

Method of Reporting

The reported statistic will be a percentage.

Challenges to Implementation

- Program variation in terms of CR intervention, and comprehensiveness of post-program assessment.

Appendix F: Discharge Survey sections utilized

SECTION A: USUAL ACTIVITIES

Instructions: The following questions have to do with your current activity status.

Please circle (Yes) or (No) in response to each question.

1.	Can you take care of yourself, that is, eating, dressing, bathing or using the toilet?	Yes	No
2.	Can you walk indoors, such as around your house?	Yes	No
3.	Can you walk a block or two on level ground?	Yes	No
4.	Can you climb a flight of stairs or walk up a hill?	Yes	No
5.	Can you run a short distance?	Yes	No
6.	Can you do light work around the house like dusting or washing dishes?	Yes	No
7.	Can you do moderate work around the house like vacuuming, sweeping floors, or carrying in the groceries?	Yes	No
8.	Can you do heavy work around the house like scrubbing floors, or lifting or moving heavy furniture?	Yes	No
9.	Can you do yard work like raking leaves, weeding or pushing a power mower?	Yes	No
10.	Can you have sexual relations?	Yes	No
11.	Can you participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?	Yes	No
12.	Can you participate in strenuous sports like swimming, singles tennis, football, basketball or skiing?	Yes	No

SECTION M: CARDIOVASCULAR REHABILITATION PARTICIPATION

Instructions: Cardiovascular rehabilitation (CR) is an outpatient program of structured exercise and education to maximize your recovery. Please check the appropriate box in response to each question. If your checked answer has an arrow leading to another box, answer the questions in the attached box. Please print any written answers clearly.

1. Did you attend a cardiovascular rehabilitation assessment (intake appointment)?

❑ **Yes** →

(If Yes) 1.Where? _____

2. How many minutes did you take you to travel there one-way? _____

❑ **No** →

(If No) Why not?

2. Did you participate in cardiac rehabilitation?

❑ **Yes** →

(If Yes) 1. What type of program did you attend? (please ☑ one answer)

- ❑ Women-only hospital-based
- ❑ Men and women hospital-based
- ❑ Home-based

2. Approximately how many weeks passed between being discharged from hospital, and starting the cardiac rehab program? _____ wks

3. Did you consider this to be an acceptable or unacceptable length of time to wait for cardiac rehab?

- ❑ acceptable
- ❑ unacceptable

Why?