Title: Traditional versus hybrid outpatient cardiac rehabilitation: A comparison of patient outcomes

Short title: Alternative models in cardiac rehabilitation

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ABSTRACT

PURPOSE: Due to the sub-optimal uptake of cardiac rehabilitation (CR), alternative models have been proposed. This study compared the effectiveness of a traditional supervised program in a medical setting versus a hybrid CR model, where patients transition to unsupervised programming.

METHODS: This was a prospective, two-arm, non-randomized study. Health related quality of life (HRQoL), functional capacity, physical activity, diet, smoking, blood pressure, lipids, blood glucose, anthropometrics and depressive symptoms, were assessed before and after the eight-week program models. Program adherence and completion was also recorded. Both models offered outpatient supervised exercise sessions, group health education classes and a resource manual. The hybrid model involved a blend of supervised and unsupervised, independent home-based exercise, and follow-up phone calls.

RESULTS: 125 cardiac patients consented to the study, of whom 72 (57.6%) and 52 chose the traditional and hybrid program, respectively. 110 (Traditional n=62, 86.1%; Hybrid n=48, 92.3%; p>.05) participants completed their program. Significant improvements were observed for both models over time in HRQoL (p<.001), physical activity (p<.001), and diet (p<.001). Significant reductions in smoking (p=.043), systolic blood pressure (p<.001), total cholesterol (p<.001), low-density lipoprotein (p<.001), waist circumference (p<.001) and depressive symptoms (p<.001) were also observed. There were no significant differences pre and post between models for any outcome.

CONCLUSIONS: Hybrid CR was not significantly different compared to the traditional model in terms of HRQoL, functional capacity, heart-health behaviours and risk factors, with no differences in completion rates.

KEY WORDS: Cardiac Rehabilitation, Hybrid Models, Cardiac Risk Factors, Health Related Quality of Life

CONDENSED ABSTRACT

Hybrid cardiac rehabilitation, where patients transition from supervised to home exercise, may overcome barriers to program use. Results of this quasi-experimental study indicated patients participating in a hybrid or traditional model improved health related quality of life and cardiovascular risk factors. No differences between models or completion rates were observed.

Cardiovascular disease (CVD) is among the leading causes of morbidity globally.[1] With advances in acute treatment, patients are surviving acute cardiac events but remain at high risk of recurrence and subsequent mortality. Cardiac rehabilitation (CR) is an outpatient secondary prevention program composed of structured exercise training, comprehensive education, and counseling, which has been shown to reduce recurrence and increase survival.[2]

Despite the benefits associated with CR participation, only approximately 30% of eligible participants are referred to CR programs[3] and of that, only 30% choose to participate.[4, 5] These low participation rates are due to patient, provider, health system level barriers.[6-9] To address these barriers and improve CR participation rates, alternative CR models have been developed.[10, 11] Most commonly, home-based models are offered at many CR programs, where patients are delivered the core components of CR, the delivery is multi-modal, and patients complete their exercise in their home independently. Meta-analyses have established the equivalent benefit of home-based CR[12] and patients often prefer a home-based program,[13] but may be considered ineligible due to the increased risk of an acute event during exercise. Accordingly, hybrid models have been developed, where patients start in the supervised setting, but can transition to a home-based program if deemed appropriate, while still receiving all of the core CR components. Hybrid models afford patients more flexibility if they lack access to transportation, need to return-to-work or have other time constraints. Furthermore, they also allow flexibility for those who have an exercise history but are not considered candidates for unsupervised exercise at intake.

Due to the novelty of hybrid models, there is little research on various indications for referral to CR[10] and variety of patient outcomes achieved following these programs. In the study by Najafi & Nalini (2015) on coronary bypass surgery patients, the hybrid model involved a

preliminary phase of two to four weeks supervised CR followed by a complimentary phase of eight-weeks (one time per week independent exercise sessions i.e., accountability was strictly based on the patient's need to ask for assistance) for patients stratified as low risk. Results showed improvements in functional capacity, blood pressure, anthropometrics, lipids, and health related quality of life (HRQoL) in those participating in either traditional and hybrid models. Although, the magnitude of improvement was often greater among participants in the traditional model. Korzeniowska-Kubacka and colleagues (2011; 2014) compared a traditional to a hybrid model for myocardial infarction patients stratified as low risk. All patients completed interval training three times per week for the first four weeks in a hospital setting, then half the group transitioned into a hybrid tele ECG-monitored home program, where the participants telephoned in the data from the ECG's, while the traditional model patients continued with supervised CR in the outpatient clinic (Korzeniowska-Kubacka et al., 2014). Results showed that maximal workload and exercise duration increased in men and women in both models (Korzeniowska-Kubacka et al., 2011; 2014). Given the lack of research on various cardiac diagnosis requiring CR and multiple patient outcomes achieved, the objective of this study was to assess the impact of a hybrid CR model compared to a traditional CR model on HRQoL, functional capacity, heart health behaviours and CVD risk factors.

METHODS

Design and Procedure

This study was prospective and quasi-experimental in design. Consecutive new patients at the CR center were invited to participate in the study. Rolling recruitment occurred from February 2015 to July 2015. All patients were offered the choice of participating in either the

traditional or hybrid program. Participants were assessed both pre- and post-program. Participants completed questionnaires and CR staff collected clinical outcome data. Data were entered into the Canadian Cardiac Rehab Registry (www.cacpr.ca/resources/registry.cfm) in accordance with their data dictionary. Ethical approval was obtained from the University of British Columbia's Behavioural Research Ethics Board and the COACH (Central Okanagan Association for Cardiac Health) board of directors. All participants provided informed consent prior to starting their selected program.

Setting and Participants

The traditional and hybrid models are delivered by the Central Okanagan Association for Cardiac Health (COACH) in British Columbia, Canada. COACH is a not-for-profit, fee-for-service CR program which provides comprehensive CR to indicated cardiac patients [10] or those at high CVD risk. Inclusion criteria were age ≥19 years, and for those with CVD, no clinical conditions that would put them at risk of an adverse event during exercise.

Traditional and Hybrid CR Models

The traditional and hybrid models, described in Table 1, were both eight weeks in duration. Briefly, in the traditional model, patients were on-site two days per week for supervised exercise throughout the program. The hybrid model involved one day per week of supervised exercise for four consecutive weeks, and instructions on how to exercise safely at home for the remaining four weeks. Follow-up phones calls were made at weeks six and eight. In addition, an on-site counselor was available to support participants experiencing depressive symptoms or other psychosocial distress in either model. Both models included six core education classes weekly. The topics covered during these education classes included; heart

anatomy and procedures, healthy eating, exercise guidelines, cardiac risk factor reduction, medication and stress management (Table 1).

Measures

Sociodemographic characteristics were assessed at program entry via questionnaire. Clinical outcomes were assessed via questionnaire and by clinical CR staff pre- and post-program.

HRQoL was measured by self-report using Cantril's Ladder of Life.[17] This one-item scale has demonstrated validity in CVD populations.[18-20] Participants were asked to rate their perceived HRQoL on a 10-point Likert scale, where 10 reflects the best possible life imaginable and 1 reflects the worst possible life imaginable.

Functional capacity was operationalized using metabolic equivalents (METs). Patients were tested on a motor driven treadmill, using the modified-Naughton protocol, or stationary bicycle reaching their peak exercise tolerance.[10, 21, 22]

Heart health behaviours (i.e., physical activity (PA), diet, smoking) were measured via self-report. PA was measured using a modified version of the valid and reliable Godin Leisure-Time Exercise Questionnaire (GLTEQ).[23] The GLTEQ consists of three questions assessing number of 10 minute bouts of PA completed in a week at an intensity level of mild, moderate and vigorous. Each level of intensity has a corresponding value which is multiplied by the frequency of PA. Scores greater than 24 represent sufficient levels of PA such that health benefits are derived. Diet and smoking status were assessed via self-report[24]; 1 item each, as this was the common measurement protocol used by COACH and the Canadian Cardiac Rehab Registry. Participants were asked "how many servings of fruits and vegetables do you consume in a day?" using a Likert scale where 1= 1 serving and 7= 7 servings. For smoking, participants

were asked to select 1 of 3 options: “I have never smoked”; “I currently smoke”; or “I quit smoking”.

CVD risk factors included blood pressure (BP), body mass index (BMI), waist circumference and depressive symptoms. BP was assessed using a manual sphygmomanometer. Lipids and blood glucose levels (ie, fasting blood sugar and hemoglobin $A1_c$) were retrieved from hospital discharge records pre-program, and requisitions were provided immediately to patients for the post-program assessments. Height and weight were measured on-site by trained CR staff using a standardized professional weigh scale and stadiometer, and BMI was calculated as mass/height^2. Waist circumference was also measured using anthropometric tape at the midpoint of the last rib and top of the hip bone. Depressive symptoms were assessed using the Patient Health Questionnaire (PHQ-2), a valid and reliable self-report screening tool[25]recommended for this population.[26] The PHQ-2 assesses two cardinal depressive symptoms, namely low mood and anhedonia. Scores range from zero to six, with mean scores ≥3 indicative of “elevated” symptoms.[25]

Statistical Analysis

Differences in the sociodemographic and pre-CR clinical characteristics of participants who chose either of the two models were compared using t-tests and chi-square as appropriate. CR completion rates were compared between groups with an independent sample t-test.

Two-way analysis of variance (ANOVA) was then used to determine differences in all dependent variables. Both between-subject (program model) and within-subject (time) factors were tested for all primary and secondary outcome variables. All underlying assumptions of ANOVA were satisfied and chi-square tested the smoking variable.[27] Statistical analyses were

performed using SPSS Statistics version 21.0 and a significance level of $p < .05$ was set for all analysis.

A standard deviation obtained from the literature of 0.7 units[28] a two-tailed alpha of 0.05 were utilized and that approximately four patients choose the traditional model for every three patients that choose the hybrid model. It was determined that 102 patients would detect a 0.5 unit difference in the primary outcome variable of HRQoL with a power of 0.8. As attrition rates from the COACH program are ~15%, we aimed to recruit 125 patients into the study obtaining the required sample size in each group.

RESULTS

Respondent Characteristics

A total of 125 patients consented to participate. Of these, 53 (42.4%) chose the hybrid program. Fifteen participants who did not complete the post-program assessment, due to drop-out (n=11) or interim cardiac events (n=4), were not included in the outcome analysis (88.8% retention). However, the required sample size was maintained to detect a 0.5 unit change. Reasons for drop-out across both models were physical and/or mental health issues (n=5), time constraints due to occupational commitments (n=3), transportation barriers (n=1) and unknown (n=2).

Participant characteristics are shown in Table 2, overall and by chosen CR model. There were no differences in program completion between the models with 62 (86.1%) traditional and 48 (91.0%) hybrid participants (p=.85). High adherence rates were reported for both models; 97% for the traditional model and 100% for the hybrid model. There were no differences in sociodemographic characteristics, travel time, risk factor burden or medications between the

participants chosing the traditional or hybrid models. There were however, differences in terms of referral indication with participants who chose the traditional model more often having "other" cardiac indications than did hybrid participants (ie, valve surgery).

Participant Outcomes by Model

Mean scores on all outcome measures are shown in Table 3, by time and model. For HRQoL, the overall model was not significant (F=.52, *p*=.47). There was no effect for model or time x model.

With regard to functional capacity (METs), the overall model was not significant (F=.32, *p*=.57). The mean increase in METs in both models was 1.3±2.0. In terms of health behaviours, overall for PA and diet were significant (F=61.0, *p*<.001 and F=28.3, *p*<.001, respectively). For both, there was no significant effect for model or time x model, however both groups increased over time. There were no differences in smoking status post-program by model $X^2(1, N=110) = .96$, *p*=.76, however, there were reductions in smoking over time $X^2(1, N=110) = 4.17$, *p*=.04. For CVD risk factors, over time the models for systolic BP (F=4.85, *p*=.03), total cholesterol (F=19.60, *p*<.001), low density lipoprotein (F=12.13, *p*<.001), waist circumference (F=29.5, *p*<.001) and depressive symptoms were significant. However, diastolic BP (F=1.37, *p*=.24), high density lipoprotein (F=.45, *p*=.51), fasting blood sugar (F=.54, *p*=.47), $HbA1_c$ (F=.12, *p*=.74) and BMI (F=1.07, p=.30) were not. For the significant risk factors, as per above, there was no effect for model or time x model, but there was a significant effect for over time, with improvements for each. No other differences were observed.

DISCUSSION

This study demonstrated that hybrid and traditional models of CR were not significantly different in terms of improvements in HRQoL and CVD risk reduction. Furthermore, both models reported high adherence and completion rates, thus supporting positive engagement in short-term behavior change[29]regardless of referral diagnosis. This is a novel addition to the literature as it is among preliminary studies reporting on completion of CR[30] and in this case, hybrid CR models[31] with various referral indications. While there were no significant differences in outcomes between patients choosing and participating in either program, improvements were observed in heart health behaviours and CVD risk factors among all patients, supporting future use of hybrid models to increase CR participation rates.[32]

The primary outcome, HRQoL, has been recognised as an important contributing factor to the overall health of CVD patients and has been shown to improve as a result of participation in CR programs.[11, 33-38] Enhanced HRQoL has been observed in other alternative CR program models[39, 40]where supervision is limited, thus it is encouraging that both models in this study improved this important outcome. The enhancement of HRQoL could be due to the core education components, exercise, social interaction and supportive counseling sessions which were consistently offered in both models. There was also substantial family and friend support reported in the traditional (88.9%) and hybrid (90.6%) program; this support may have strengthened psycho-social well-being.[14, 36]The work of Yusuf et al., (2004) and Leung et al., (2011) underscores the importance of CR programs that offer psycho-social support to assist in improving HRQoL, further indicating that lack of support is associated with diminished HRQoL, which in turn contributes to disease progression, increased morbidity and mortality.[10, 21, 22]

There were significant improvements in health behaviors, specifically PA, diet and smoking. PA improvements observed in both program models may be due to a focused intention to increase PA by including education classes that discussed the importance of PA for reductions in subsequent cardiac events and risk factors, and to address individual barriers (i.e., time, accessibility). These increases in PA reflect improvement in exercise capacity (METs), which is clinically meaningful and is supported by previous research indicating that higher MET levels can reduce mortality rates experienced in CVD populations.[38, 41] Healthy dietary behaviors (i.e., appropriate fruit and vegetable intake) also increased in both models, which is vital for this population as previous research has shown that low intake of fruit and vegetables is a modifiable risk factor for heart disease.[8] Pomerleau, Lock, Knai et al. (2005) observed patients recently diagnosed with chronic disease increased consumption of fruit and vegetables and attributed this to having enhanced motivation to improve their health. The high adherence and completion rates of the current study lends support to the notion that participants may have been highly motivated to improve their health status after a cardiac event. Lastly, the reductions in the number of smokers over time for both models may be attributed to the smoking cessation components offered; a small group support session, on-site specialized trained staff and BC Quit Now services. Similar components utilized in other smoking cessation programs have shown comparable results.[14, 35, 43, 44]

There were also improvements in CVD risk factors, specifically BP, lipids, waist circumference and depressive symptoms. Many variables would interact with the reductions observed. Firstly, 73% of participants had a history of high BP and participants (78.4% from traditional: 57.6% from hybrid) were taking prescribed beta-blockers and ace inhibitors, which are common anti-hypertensive medications prescribed at hospital discharge. Similarly, 80% of

participants started the CR programs with statins prescribed. However, both models focused on PA, healthy eating, cardiac risk factor reduction and compliance to medications, which would contribute to BP and lipid reductions as minimal changes were made to medication treatments during the study. These health behavior changes should be recognized, as many of the cardiac medications were taken since hospital discharge to the completion of CR. The reduction in waist circumference, but not BMI, is not surprising and commensurate with findings of similar CR research. It has been suggested that waist circumference may be a better predictor of improvements in metabolic and CV health when PA increases and dietary behaviors improve.[14, 44]Moreover, the reduction in waist circumference also signifies a loss in visceral fat mass, which is an important indicator to reduce CVD and diabetes complications. Lastly, the improvements in depressive symptomology in both groups are similar to research on previous CR programs that have observed reductions in depressive symptoms and enhanced HRQoL [38, 45] possibly due to increases in other health behaviours described. Previous research has also found a direct positive relationship between PA and depressive symptoms.[38, 46-48]However, over time participants may experience a reduction in the acuity of the cardiac event by learning how to live with their cardiac condition, perhaps relieving depressive symptoms.[36, 37, 49]

This study adds to the fundamentals of the hybrid model in many ways. First, there were multiple clinical outcomes obtained, thus allowing for further comparisons to the traditional model. Secondly, the hybrid model in this study included reduced clinically monitored exercise sessions, which may alleviate program cost pressures and improve patient uptake. Thirdly, this study maintained the core components offered in the traditional model, which supports quality of patient care. Lastly, this study further extends the hybrid model research in that it can be offered

to various cardiac diagnoses typically participating in the traditional model (i.e., heart failure, atrial fibrillation and valve surgery).

Limitations

Patients were not randomized to program model, and although patients were very similar in their sociodemographic and clinical characteristics between models, there may be unmeasured factors that differed between participants choosing the traditional versus hybrid model. Additionally, visible minorities were not represented. A low proportion of females (29.6%) and ethnic minorities, such as South Asians (0%) and Aboriginals (2.8%), made up a small proportion of the sample. These minority groups have some of the highest incidences of CVD and are less likely to engage in health promoting behaviours[50-51], thus efforts should be made to engage these minority groups in CR programs. This was a single-site study; whether results are generalizable to other CR settings is unknown. There was no incidence of safety issues collected during the intervention (i.e., chest pain, use of health care services due to adverse event, and falls, etc.). This may limit the rationale of utilizing the hybrid model in place of a more traditional model. Some selection bias might be at play, as it is unknown how patients who consented to participate differ from CR participants more broadly. The primary outcome was measured with one item and some outcome variables were self-reported, thus socially-desirable responses and recall bias [52, 53]may influence the findings. There was no post program follow up included in this study. Further short (i.e., 6 months post program) and long term (i.e., 18 months post program) follow-up is warranted in order to monitor sustainability and maintenance of behaviour changes.

Future Recommendations

Future studies are required to assess patient satisfaction in the hybrid model; transitioning from the supervised to unsupervised phase and support from CR staff during this transition. Further, clinical evidence is required to determine the optimal number of supervised weeks in the hybrid model and whether other forms of technology (i.e., CR interactive app) could maintain patient engagement during unsupervised sessions while keeping required resources minimized. Future research should also include cost-benefit analysis of the hybrid model, as well as, randomised control trials in order to determine causal effect of the different CR intervention models.

CONCLUSIONS

The results of this study suggest that almost half of patients will chose a hybrid model if given the choice, and that patients remain actively engaged in hybrid models through the unsupervised portion, with comparable completion rates to traditional models. While this non-randomized, single-center study cannot solely form the basis of policy decisions regarding the virtues of hybrid programs, nonetheless taken with the results of similar studies[14-16], participation in hybrid models appears to result in important improvements in CR outcomes, comparable to what is observed with traditional models. Future development and evaluation of hybrid CR models is warranted.

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Table 1 • Description of CR program models (interventions)

	Traditional	Hybrid
Week 1	• Consent provided, demographics, primary and secondary outcome data collected, medication reconciliation, schedule provided (exercise and education times). • If depressive symptoms indicated, referred to counselor. • 2 d/wk, 20-60 min or bouts of 10 mins/2-3 times supervised aerobic exercise • RPE of 3 to 6 (on the Borg 0-10 scale) or maximum 70% HRR.	• Consent provided, demographics, primary and secondary outcome data collected, medication reconciliation, schedule provided (exercise and education times). • If depressive symptoms indicated, referred to counselor. • 1 d/wk, 20- 60 min or bouts of 10 minutes/2-3 times supervised aerobic exercise • RPE exertion of 3 to 6 (on the Borg 0-10 scale) or maximum 70% HRR).
Week 2	• 2 d/wk, 20-60 min or bouts of 10 mins/2-3 times supervised aerobic exercise • RPE of 3 to 6 (on the Borg 0-10 scale) or maximum 70% heart HRR. • Goal 150 mins/wk of aerobic exercise. • Group education class: exercise guidelines/safety precautions and cardiac risk factors.	• 1 d/wk, 20- 60 min or bouts of 10 minutes/2-3 times supervised aerobic exercise • RPE exertion of 3 to 6 (on the Borg 0-10 scale) or maximum 70% HRR). • Goal 150 mins/wk of aerobic exercise. • Group education class: exercise guidelines/safety precautions and cardiac risk factors.
Week 3	• 2 d/wk, 20- 60 min or bouts of 10 mins/2-3 times supervised aerobic exercise, RPE 3-6 • Modify the exercise prescription/plan to accommodate any identified problems • Group education class; medications	• 1 d/wk, 20- 60 min or bouts of 10 minutes/2-3 times supervised aerobic exercise, RPE 3-6 • Modify the exercise prescription/plan to accommodate any identified problems • Group education class; medications
Week 4	• 2 d/wk, 20- 60 min or bouts of 10 mins/2-3 times supervised aerobic exercise, RPE 3-6 • Continue to modify exercise plan • Group education class; first series healthy eating • Introduce resistance training as appropriate	• 1 d/wk, 20- 60 min or bouts of 10 minutes/2-3 times supervised aerobic exercise, RPE 3-6 • Continue to modify exercise plan • Review safety precautions for exercising and symptom management • Group education class; first series healthy eating • Introduce resistance training as

		appropriate • Determine readiness to apply self-management skills and prepare for independent exercise
Week 5	• 2 d/wk, 20- 60 min or bouts of 10 mins/2-3 times supervised aerobic exercise, RPE 3-6 • Group education; second series healthy eating	• Group education; second series healthy eating • Exercise independently, advocate minimum 150 min/wk, RPE 3-6
Week 6	• 2 d/wk, 20- 60 min or bouts of 10 mins/2-3 times supervised aerobic exercise, RPE 3-6 • Group education: Anatomy and procedures	• Exercise independently, minimum 150 min/wk, RPE 3-6 • Group education: Anatomy and procedures • 10-15 min phone call reviewing exercise prescriptions, concerns, risk factors, medication and physician follow-up
Week 7	• 2 d/wk, 20- 60 min or bouts of 10 mins/2-3 times supervised aerobic exercise, RPE 3-6 • Group education; Stress management	• Exercise independently, minimum 150 min/wk, RPE 3-6 • Group education; Stress management
Week 8	• 2 d/wk, 20- 60 min or bouts of 10 mins/2-3 times supervised aerobic exercise, RPE 3-6 • Post assessment; collecting primary, secondary outcome data and medication reconciliation	• Exercise independently, minimum 150 min/wk, RPE 3-6 • Brief phone call reminding participant of upcoming assessment, address any questions or concerns • Post assessment; collecting primary, secondary outcome data and medication reconciliation

Note: D=day, HRR=Heart rate reserve, Min=minute, RPE=Ratings of perceived exertion, Wk=week.

Table 2 • Sociodemographic and Clinical Characteristics of Participants

Characteristic	Traditional Model (n=72), n (%)	Hybrid Model (n=53), n (%)	Total (N=125), n (%)	*p*
Age, years	68.1 ±10.9	65.7 ±10.4	67.1±10.6	0.20*
Sex				
Male	48 (66.7)	40 (75.5)	88 (70.4)	0.29
Ethnic Origin				
Caucasian	70 (97.2)	52 (98.1)	122 (97.6)	0.75
Aboriginal	2 (2.8)	1 (1.9)	3 (2.4)	
Marital Status				
Single	4 (5.6)	3 (5.7)	7 (5.6)	0.32
Married	53 (73.6)	44 (83.0)	97 (77.6)	
Divorced or widowed	12 (16.6)	4 (7.6)	16 (11.2)	
Education				
Less than high school	2 (2.8)	1 (2.8)	3 (2.4)	0.83
High school	32 (44.4)	27 (50.9)	59 (47.2)	
College or Trade	21 (29.1)	13 (24.5)	33 (27.2)	
University	17 (23.6)	11 (20.8)	28 (22.4)	
Work Status				
Employed full-time	9 (12.5)	14 (26.4)	23 (18.0)	0.10
Employed part-time	4 (5.6)	3 (5.7)	7 (5.6)	
Retired	55 (76.3)	32 (60.4)	87 (68.8)	
Disability	4 (5.6)	1 (1.9)	5 (4.8)	
Unemployed	0 (0.0)	3 (5.7)	3 (2.8)	
Family Support				
Lives alone	8 (11.1)	5 (9.4)	12 (10.4)	0.38
Lives with spouse/partner	58 (80.6)	47 (88.7)	105 (84.0)	
Lives with friends/family	6 (8.3)	1 (1.9)	7 (5.6)	
Travel time to CR				
0-30 min	66 (91.7)	44 (83.0)	110 (88.0)	0.21
31-45 min	3 (4.2)	6 (11.3)	9 (7.2)	
> 60 min	0 (0.0)	2 (3.8)	2 (1.6)	
Clinical				
Overweight (>24.9 kg/m^2)	60 (83.3)	47 (89.0)	107 (85.6)	0.40
Currently Smoking	10 (13.9)	8 (15.1)	18 (14.4)	0.85
Hypertension	52 (72.2)	39 (73.6)	91 (72.8)	0.87
Diabetes	21 (29.2)	13 (24.5)	34 (27.2)	0.57
Physically inactive	28 (38.9)	22 (41.5)	50 (40.0)	0.77
Family History of CVD	44 (61.1)	30 (56.6)	74 (59.2)	0.61
Referral Indication				
Angina				0.04
Stable	3 (4.2)	7 (13.2)	10 (8.0)	
Unstable	2 (2.8)	3 (5.7)	5 (4.0)	

Heart Failure	14 (19.4)	6 (11.3)	20 (16.0)	0.22
LV function				
Moderate (30-39%)	6 (8.3)	6 (11.3)	12 (9.6)	
Severe (<30%)	5 (6.9)	3 (5.7)	8 (6.4)	
High-Risk Primary Prevention	4 (5.6)	3 (5.7)	7 (5.6)	0.98
Other	7 (9.7)	0 (0.0)	7 (5.6)	0.02
Medications				
β-Blockers	55 (76.4)	42 (79.2)	97 (78.4)	0.71
ACE-Inhibitors	41 (56.9)	31 (58.5)	72 (57.6)	0.86
Statins	57 (79.2)	43 (81.1)	100 (80.8)	0.79
Anti-coagulants	20 (32.2)	11 (20.8)	31 (25.6)	0.13
Anti-platelets	55 (76.4)	46 (86.8)	100 (81.6)	0.14
Calcium Channel Blockers	20 (27.8)	15 (28.3)	35 (28.8)	0.95

Note; All model comparisons tested with Chi-square, except age which was compared with a t-test*.

Abbreviations: CR, cardiac rehabilitation; CVD, cardiovascular disease; MI, myocardial infarction; STEMI, ST elevation myocardial infarction, NSTEMI, non-ST elevation myocardial infarction; LV, left ventricular; ACE- angiotensin converting enzyme, Other, trans-ischemic attack and peripheral vascular disease.

Table 3 • Patient Outcomes by Assessment Point and Model

	Traditional Model (n=62)		Hybrid Model (n=48)		
	Pre-CR	**Post-CR**	**Pre-CR**	**Post-CR**	***p*** [a]
Primary Outcome	7.1±1.9	7.5±1.5	7.1±2.0	7.8±1.3	.474[b,d]
HRQOL					
Secondary Outcomes					
Functional capacity (peak METs)	4.9±1.7	6.3±2.1	5.7±2.1	6.9±2.2	.574[b,d]
Heart-Health Behaviours					
Physical Activity	22.0±20.0	36.2±19.0	25.9±20.0	41.9±22.7	.631[b,d]
Dietary Behavior	3.7±1.5	4.3±1.5	3.5±1.4	4.4±1.4	.215[b,d]
Smoking (current)	10 (13.9%)	8 (11.1%)	8 (11.1%)	6 (11.3%)	.757[c,d]
RSBP, mmHg	127.0±20.0	117.0±15.0	118.0±21.0	113.0±17.0	.051[b,d]
RDBP, mmHg	73.0±16.0	69.0±10.0	69.0±10.0	69.0±14.0	.244
Lipid Profile					
Tc (mmol/L)	4.68±1.19	4.14±1.26	4.15±1.11	3.67±.96	.800[b,d]
LDL (mmol/L)	2.71±1.01	2.30±1.02	2.24±.76	1.92±.63	.668[b,d]
HDL (mmol/L)	1.17±.41	1.14±.36	1.04±.28	1.10±.24	.074
FBS (mmol/L)	5.78±1.16	5.82±1.02	5.95±1.20	5.76±1.12	.273
$HbA1_c$, %	6.9±0.6	7.3±0.9	6.5±0.8	6.8±1.3	.317
Depressive symptoms	.95±1.2	.61±.93	.85±1.2	.28±.62	.227[b,d]
BMI, kg/m^2	30.0±5.0	30.0±5.0	29.0±4.0	29.0±4.0	.990
WC, cm	106.1±13.4	103.8±12.6	103.0±11.0	102.0±11.0	.137[b,d]

Abbreviations; HRQOL, health related quality of life; PA, physical activity; RSBP, resting systolic blood pressure; RDBP, resting diastolic blood pressure; Chol, cholesterol; Tc, total cholesterol; LDL, low-density lipoprotein; HDL, high-density lipoprotein; FBS, fasting blood sugar; HbA1c; hemoglobin A1c; METs, metabolic equivalents; BMI, body mass index; WC, waist circumference.

[a] Represents significant difference for within-subject effects, interaction term for time by model.

[b] Represents significant difference over time at $p<.001$.

[c] Represent significant difference over time at $p<.05$.