The Role of Systematic Inpatient Cardiac Rehabilitation Referral In Increasing Equitable Access and Utilization

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Abstract

Background—While systematic referral strategies have been shown to significantly increase cardiac rehabilitation (CR) enrolment to approximately 70%, whether utilization rates increase among patient groups who are traditionally under-represented has yet to be established. This study compared CR utilization based on age, marital status, rurality, socioeconomic indicators, clinical risk, and comorbidities following systematic versus non-systematic CR referral.

Methods—2635 coronary artery disease inpatients from 11 Ontario hospitals utilizing either systematic (n=8 wards) or non-systematic referral strategies (n=8 wards) completed a survey including sociodemographics and activity status. Clinical data were extracted from charts. At one-year, 1680 participants completed a mailed survey that assessed CR utilization. The association of patient characteristics and referral strategy on CR utilization was tested using chi-square.

Results—When compared to non-systematic referral, systematic strategies resulted in significantly greater CR referral and enrolment among obese (32 vs 27% referred, $p=.044$; 33 vs 26% enrolled, $p=.047$) patients of lower socioeconomic status (41 vs 34% referred, $p=0.26$; 42 vs 32% enrolled, $p=.005$) and lower activity status (63 vs 54% referred, $p=.005$; 62 vs 51% enrolled, $p=.002$). There was significantly greater enrolment among those of lower education ($p=.04$) when

systematically referred, however no significant differences in degree of CR participation based on referral strategy.

Conclusion—Up to 11% more socioeconomically-disadvantaged patients and those with more risk factors utilized CR where systematic processes were in place. They participated in CR to the same high degree as their non-systematically referred counterparts. These referral strategies should be implemented to promote equitable access.

Introduction

Cardiovascular disease (CVD) remains the leading cause of mortality worldwide,{{5235 World Health Organization (WHO) 2010;}} mainly attributable to modifiable risk factors such as hypertension, dyslipidemia, obesity, smoking, and a sedentary lifestyle.{{188 Yusuf, S. 2004;}} Cardiac rehabilitation (CR) offers a comprehensive approach to chronic disease management by addressing these risk factors, and has been shown to significantly reduce morbidity and mortality by 25% when compared to usual care.{{405 Taylor, R.S. 2004; 2999 Clark, A.M. 2005;}}

Unfortunately, utilization of CR remains suboptimal, as evidenced by data from the United States, Canada, and the United Kingdom demonstrating that only approximately 30% of eligible cardiac patients participate in CR after hospital discharge.{{4832 Thompson, D.R. 2009; 2997 Suaya, J.A. 2007; 5034 Swabey, T. 2004;}} In addition there are robust disparities in access for vulnerable subpopulations who often have a risk profile demonstrating need for CR. For instance, CR use is reliably established to be lower among patients of lower socioeconomic status (SES), {{110 Pell, J. 1996;}} those that are older, {{1757 Cortes, O. 2006; 1758 Arthur HM 2006;}} non-white, rural habitants,{{5328 Leung, Y.W. 2010; }} obese, sedentary, smokers.{{511 Cooper, A.F. 2002; }}

In an effort to increase the “reach” of CR, strategies have been developed and shown to significantly increase CR enrolment, including systematic CR referral.{{5016 Gravely-Witte, S. 2010; 350 Beswick, A.D. 2005;}} Systematic referral strategies are defined as the use of electronic patient records or standard discharge orders as a universal prompt for CR referral on inpatient units.{{5341 Grace, S.L. 2011; 4160 Fischer, J.P. 2008;}} Indeed these strategies have been shown to achieve 85% referral and 70% CR enrolment.{{5341 Grace, S.L. 2011; 4285 Higgins, R.O. 2008; }} However, it has yet to be tested whether a universal approach to identifying inpatients for referral can mitigate the disparities in access. The present study aimed to compare rates of referral, enrollment, and participation following systematic vs. non-systematic CR referral among diverse CVD patients, to determine whether these access disparities could be overcome.

Methods

Design and Procedure

The study design was prospective and observational. The study was powered to detect proportional differences of 0.10 in overall CR utilization by referral strategy (80% power, $\alpha=.05$) which were previously demonstrated,{{5341 Grace, S.L. 2011; }} and the current study presents results of pre-specified secondary hypotheses. The study compared outcomes

across the following 2 CR referral conditions: (1) systematic referral versus (2) non-systematic referral. For the purposes herein, non-systematic referral refers to usual practice, which may involve provision of written materials, discussion of CR at the bedside during cardiac education, or referral at the discretion of a physician. Ethics approvals were obtained from all participating institutions' research ethics boards.

Medically stable cardiac inpatients from 11 community and academic hospitals between Windsor, Sudbury, and Ottawa, Ontario were approached to participate between 2006 and 2008. CR services are covered through provincial health insurance in this jurisdiction. The intervention sites were chosen based on their reported use of CR referral strategies in the Ontario CR Pilot Project.{{142 Cardiac Care Network. 2002; }} Overall, there were 16 wards from 11 hospitals, of which 5 hospitals had 2 cardiac wards (i.e., surgery vs. other) which each used a different referral strategy. Eight (50%) cardiac wards used a systematic referral strategy.

Consenting inpatients completed a sociodemographic survey. Clinical data were extracted from medical charts. Participants were then mailed a follow-up survey one year later, assessing self-reported CR referral, enrollment and participation. A modified Dillman's method was used to maximize retention rate.{{4461 Dillman, D.A. 2000; }}

Participants

A total of 2635 stable cardiac inpatients were recruited. Inclusion criteria were: confirmed acute coronary syndrome diagnosis, patients who had undergone percutaneous coronary intervention (PCI) or coronary artery bypass graft surgery (CABG), patients with a concomitant diagnosis of heart failure or arrhythmia, eligibility for CR based on guidelines of the Canadian Association of CR, and proficiency in English, French, or Punjabi (surveys were translated into each of these languages). Patients were excluded if they had participated in CR within the past 2 years, or had a significant orthopedic, neuromuscular, visual, cognitive or serious mental illness (i.e., schizophrenia, but not including depression or anxiety) that precluded CR participation.

Measures

Dependent Variables - CR Utilization—In the follow-up survey, participants self-reported whether or not they were referred to CR (yes/no), whether they attended a CR intake assessment (i.e., enrollment), and whether or not they participated in CR by providing an estimate of the percentage of prescribed sessions they attended. Degree of participation was categorized as high vs. low according to the self-reported percentage of prescribed sessions attended. Participants who self-reported attending 80% of prescribed sessions were categorized as high, whereas those who self-reported <80% of prescribed CR sessions were categorized as low.

Independent Variable- CR Referral Strategy—The referral strategy implemented on each ward was determined at an investigator meeting held with clinical representatives from the participating institutions. All participants were stratified into systematic and non-

systematic referral categories based on the strategies adopted on the hospital ward where the patient was recruited.

Sociodemographic and clinical characteristics—Self-reported sociodemographic variables assessed in the survey provided to inpatients were dichotomized using a median split as follows: marital status (married: yes/no), education level (some post-secondary: yes/no), ethnocultural background (white: yes/no), annual family income (<\$50,000 Canadian dollars: yes/no), work status (retired: yes/no). Patients were asked at time of recruitment whether they lived within a 30-minute drive of a hospital, and were coded as rural if they responded “no”. Sociodemographic data obtained from the medical chart included age and sex. Finally, the MacArthur scale of subjective socioeconomic status (SES) [2742 The MacArthur Network on SES & Health;] was included in the survey. The self-report scale captures an individual’s sense of their place on the social ladder, on rungs from one to ten. A median split was applied to denote “low” vs. “high” SES. The scale has been validated in many populations, including ethno-culturally diverse groups. [5674 Ostrove, Joan M. 2000;]

With regard to clinical characteristics, the patient survey included the Duke Activity Status Index [371 Hlatky, M.A. 1989;] to assess functional status. Physical Activity Status for Elderly (PASE) [1515 Washburn, R.A. 1993;] was used to assess exercise behavior. Finally, nature of cardiac condition or procedure (i.e., MI, PCI, CABG, heart failure, arrhythmia, valve repair/replacement) as well as presence of CVD risk factors (i.e., family history of CVD, hypertension, dyslipidemia, diabetes, body mass index [BMI] to ascertain obesity, smoking), musculoskeletal problems and comorbidities (e.g., cancer, neurological problems) were also obtained from the medical chart. Where the latter were unavailable, patient self-report was used.

Statistical Analyses

Sociodemographic and clinical characteristics of participants by referral strategy were compared using chi-square analyses for categorical variables and t-test for continuous variables where applicable. Subgroup analyses were conducted to test for differences in CR referral, enrolment, and participation among participants referred systematically vs. non-systematically by the sociodemographic and clinical characteristics where disparities in access are demonstrated. Sex differences are not reported herein as they are presented elsewhere (manuscript in preparation). All analyses were conducted with SAS 9.2. [5324 SAS Institute Inc. 2009;]

Results

Participant Characteristics

Of the 5767 inpatients approached, 2635 consented to participate, and 1449 were ineligible (61.0% response rate). Of these participants, 2500 (94.9%) were successfully linked to the administrative databases. To ensure each patient had sufficient survival time to receive CR referral, 47 participants who died within 90 days from index hospitalization were excluded

from the current analysis, leaving 2453 participants. Of 2453 participants, 1680 completed the one-year follow-up survey (retention rate 83.5%).

Participant age ranged from 26–97, and the median subjective SES score was 6.5 out of 10. The most frequent comorbidities included musculoskeletal problem, and diabetes. Overall, 1376 (52.2%) participants were referred to CR via a systematic strategy.

Table 1 shows participants' sociodemographic and clinical characteristics by referral strategy. The bivariate analyses show that participants referred via the systematic strategy were more likely to be male, from an ethnocultural minority group, married, have lower SES, have had a MI, undergone CABG, and valve repairs, have a greater BMI, were less likely to have undergone PCI, to be diabetic, and have lower functional status than participants referred in non-systematic fashion.

Cardiac Rehabilitation Utilization

Rates of CR referral, enrollment and participation by strategy are shown in Table 2. Overall, participants were referred to 1 of 31 CR programs, and enrollees participated in a mean of $82.8 \pm 27.1\%$ of prescribed CR sessions. There were significantly greater rates of referral, and enrollment following systematic when compared to non-systematic referral. No significant differences were found in degree of participation among those enrolled by referral strategy.

Table 2 also shows the subgroup analyses where participants were stratified by the known disparities in CR access. For all variables, rates of referral were higher with systematic strategies. The systematic referral strategy resulted in significant higher rates of CR referral than the non-systematic strategy for participants of lower subjective SES, who were obese, and had lower activity status.

With regard to enrolment, systematic referral resulted in significantly higher enrolment rates among patients with lower educational attainment, of lower subjective SES, who were obese, and had lower activity status. Finally, with regard to degree of participation among enrollees, there were no significant differences by referral strategy.

Discussion

Despite its known morbidity and mortality benefits, {{405 Taylor, R.S. 2004; }} CR remains highly under-utilized, {{5295 Chan, P.S. 2010; }} primarily due to low rates of referral. {{396 Pasquali, S.K. 2001; }} Quality improvement initiatives such as the American Heart Association's Get with the Guidelines program have been implemented to increase CR referral systematically. {{3965 LaBresh, K.A. 2007; 3967 Mazzini, M.J. 2008; 4432 Brown, T.M. 2009; }} It has now been well established that such systematic approaches to CR referral can significantly increase utilization rates. {{350 Beswick, A.D. 2005; 5016 Gravelly-Witte, S. 2010; 5341 Grace, S.L. 2011; }} While previous research has shown that some disparities in access persist where quality improvement initiatives have been applied, {{4432 Brown, T.M. 2009; }} the present study was the first controlled test of whether these significant increases in CR use following systematic referral extend to under-represented groups. This multi-centre observational study showed that systematic referral resulted in

more lower-functioning patients being referred to and enrolling in CR. Moreover, once enrolled, there were no differences in level of participation by referral strategy.

Results showed that some cardiac wards may be more amenable or more likely to implement systematic referral strategies than others. Systematically referred patients were more likely to have undergone cardiac surgery (i.e., CABG and/or valve). Surgical inpatients have a longer length of stay, and have more exposure to allied health professionals promoting mobilization, which may facilitate CR referral. Moreover, the characteristics of patients on a surgical versus general cardiac ward are more homogeneous, which may further facilitate systematic referral processes. The fact that systematically referred patients were more likely to have recently undergone cardiac surgery than PCI may also explain why they also had lower functional status, and potentially why they had greater rates of diabetes and obesity than patients not systematically referred as well.

Arguably the most noteworthy findings were the greater rates of CR enrolment following systematic referral across two indicators of low SES. Systematic referral resulted in 5% more patients of low educational attainment, and 10% more patients of lower subjective SES, enrolling in CR. The socioeconomic gradient in overall health, cardiovascular health, {{5619 Alter, D.A. 2011;}} and healthcare access has been well established. Indeed, patients of low SES face significantly greater barriers to accessing CR, {{5647 Shanmugasagaram, S. 2011;}} and a greater burden of risk factors such as physical inactivity, poor diet, and smoking, demonstrating greater need for CR. Clearly, these patients have so much to gain from CR.

Moreover, it has been demonstrated that often some of the healthiest patients access CR preferentially. {{4124 Burns, K.J. 1998;369 Harlan, W.R., III 1995;}} Systematic referral however had the effect of ensuring 7% more obese and 11% more patients of low functional status to be enrolled in CR. Although under-powered, it did appear as well that twice as many smokers enrolled and participated in CR where systematically referred. Indeed, previous research has shown that earlier access (which is achieved by systematic referral from the inpatient setting {{2953 Grace, S.L. 2007;}}) induces greater enrolment in smokers. {{5180 Parker, K.L. 2009;}} Overall, this systematic approach may help ensure scarce healthcare dollars are being used to treat patients who are most in need and at greater risk of recurrent morbidity and mortality.

Implications

The results of this study, while they warrant replication in a cluster randomized trial, suggest that systematic referral strategies have the potential to reduce disparities in access to outpatient care in chronic disease. This increased access for under-represented groups has been achieved pragmatically at multiple acute care institutions from academic health sciences centers to regional community hospitals. Indeed, Canada has recently released a policy position recommending systematic referral of all indicated inpatients. {{5341 Grace, S.L. 2011;}} Tools such as American Heart Association's Get with the Guidelines, {{1698 LaBresh, K.A. 2004;}} and the American Association of Cardiovascular and Pulmonary Rehabilitation's Performance Measures {{2827 Thomas, R.J. 2007;5430 American

Association of Cardiovascular and Pulmonary Rehabilitation 2010;}} are readily-implementable to facilitate systematic CR referral at more inpatient institutions.

Limitations

This was a quasi-experimental study. For ethical reasons, participants could not be randomized to acute care site, nor could we randomize referral strategy within units due to the potential for contamination. Consequently, there were significant differences in sociodemographic and clinical characteristics of patients by referral strategy which may have biased results. The second main limitation pertains to measurement. Although self-reported CR referral and utilization was not verified, there is evidence that supports the “almost-perfect” congruence between self-report and CR site-report data.{{2653 Kayaniyl, S. 2007;}} However, the potential for social desirability biases in participant responses cannot be ruled out. The third limitation pertains to potential for inflated error rates due to multiple comparisons. Future appropriately-powered research is needed to replicate these findings, however if we conservatively applied a p-value of .004 (i.e., .05/12 for under-represented subgroups), the greater rates of enrolment among patients of low activity status sustain this criterion, and there is a trend for subjective SES. The fourth limitation pertains to a potential Hawthorne effect. The study was presented to participants as investigating secondary prevention generally, nevertheless the rates of CR utilization herein may be somewhat inflated. However, given that this was a controlled study, this potential source of bias cannot explain the observed differences by referral strategy.

In conclusion, while further study is needed, the results of this study provide preliminary support for the role of systematic inpatient referral strategies in addressing disparities and promoting equitable access across the continuum of cardiac care. The current study showed that systematic referral may in particular promote greater access to CR among patients of low SES, who are obese and of low functional status. Institutions should be encouraged to adopt such strategies, using established techniques to promote dissemination and implementation.

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References

1. World Health Organization. [Accessed May 9, 2011] Cardiovascular diseases. <http://www.who.int/mediacentre/factsheets/fs317/en/index.html>. Updated 2010
2. Yusuf S, Hawken S, Ounpuu S, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. *Lancet*. 2004; 364(9438):937–952. [PubMed: 15364185]

3. Taylor RS, Brown A, Ebrahim S, et al. Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. *Am J Med.* 2004; 116:682–692. [PubMed: 15121495]
4. Clark AM, Hartling L, Vandermeer B, McAlister FA. Meta-analysis: secondary prevention programs for patients with coronary artery disease. *Ann Intern Med.* 2005; 143:659–672. [PubMed: 16263889]
5. Thompson DR, Clark AM. Cardiac rehabilitation: into the future. *Heart.* 2009; 95:1897–1900. [PubMed: 19815940]
6. Suaya JA, Shepard DS, Normand SL, Ades PA, Prottas J, Stason WB. Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery. *Circulation.* 2007; 116:1653–1662. [PubMed: 17893274]
7. Swabey T, Suskin N, Arthur HM, Ross J. The Ontario cardiac rehabilitation pilot project. *Can J Cardiol.* 2004; 20:957–961. [PubMed: 15332143]
8. Pell J, Pell A, Morrison C, Blatchford O, Dargie H. Retrospective study of influence of deprivation on uptake of cardiac rehabilitation. *BMJ.* 1996; 313(7052):267–268. [PubMed: 8704538]
9. Cortes O, Arthur HM. Determinants of referral to cardiac rehabilitation programs in patients with coronary artery disease: a systematic review. *Am Heart J.* 2006; 151:249–256. [PubMed: 16442885]
10. Arthur HM. Determinants of referral to cardiac rehabilitation programs in patients with coronary artery disease: a systematic review. *J Clinical Outcomes Management.* 2006; 13:572–577.
11. Leung YW, Bruhal J, Macpherson A, Grace SL. Geographic issues in cardiac rehabilitation utilization: a narrative review. *Health Place.* 2010; 16:1196–205. [Accessed May 9, 2011] <http://www.sciencedirect.com.myaccess.library.utoronto.ca/science/article/B6VH5-50RP256-1/2/a8b45fbb2cefa5a3bfb086e6811580c>. [PubMed: 20724208]
12. Cooper AF, Jackson G, Weinman J, Horne R. Factors associated with cardiac rehabilitation attendance: a systematic review of the literature. *Clin Rehabil.* 2002; 16:541–552. [PubMed: 12194625]
13. Gravely-Witte S, Leung YW, Nariani R, et al. Effects of cardiac rehabilitation referral strategies on referral and enrollment rates. *Nat Rev Cardiol.* 2010; 7:87–96. [PubMed: 19997077]
14. Beswick AD, Rees K, West RR, et al. Improving uptake and adherence in cardiac rehabilitation: Literature review. *J Adv Nurs.* 2005; 49:538–555. [PubMed: 15713186]
15. Grace SL, Arthur HM, Chan C, et al. Systematizing inpatient referral to cardiac rehabilitation: a joint policy position of the Canadian Association of Cardiac Rehabilitation and Canadian Cardiovascular Society. *Can J Cardiol.* 2011; 27:192–199. [PubMed: 21459268]
16. Fischer JP. Automatic referral to cardiac rehabilitation. *J Cardiovasc Nurs.* 2008; 23:474–479. [PubMed: 18953208]
17. Higgins RO, Murphy BM, Goble AJ, Le Grande MR, Elliott PC, Worcester MU. Cardiac rehabilitation program attendance after coronary artery bypass surgery: overcoming the barriers. *Med J Aust.* 2008; 188:712–714. [PubMed: 18558894]
18. Cardiac Care Network. The Ontario cardiac rehabilitation pilot project: report and recommendations. Toronto, Ontario, Canada: Cardiac Care Network; 2002. <http://www.ccn.on.ca/pdfs/Rehab-Pilot-Project-Sep2002.pdf> [Accessed May 9, 2011]
19. Dillman, DA. Mail and Internet Surveys: The Tailored Design Method. 2. New York, NY: John Wiley; 2000.
20. [Accessed May 9, 2011] The MacArthur Network on SES & Health. MacArthur Scale of Subjective Social Status. <http://www.macses.ucsf.edu/research/psychosocial/subjective.php>. Updated 2007
21. Ostrove JM, Adler NE, Kuppermann M, Washington AE. Objective and subjective assessments of socioeconomic status and their relationship to self-rated health in an ethnically diverse sample of pregnant women. *Health Psychol.* 2000; 19:613–618. [PubMed: 11129365]
22. Hlatky MA, Boineau RE, Higginbotham MB, et al. A brief self-administered questionnaire to determine functional capacity (the Duke Activity Status Index). *Am J Cardiol.* 1989; 64:651–654. [PubMed: 2782256]
23. Washburn RA, Smith KW, Jette AM, Janney CA. The Physical Activity Scale for the Elderly (PASE): development and evaluation. *J Clin Epidemiol.* 1993; 46:153–162. [PubMed: 8437031]

24. SAS Institute Inc. Statistics Analytical Software (SAS: Version 9.2). Cary, NC: 2009.
25. Chan PS, Oetgen WJ, Buchanan D, et al. Cardiac performance measure compliance in outpatients: the American College of Cardiology and National Cardiovascular Data Registry's PINNACLE (Practice Innovation and Clinical Excellence) program. *J Am Coll Cardiol*. 2010; 56:8–14. [PubMed: 20620710]
26. Pasquali SK, Alexander KP, Lytle BL, Coombs LP, Peterson ED. Testing an intervention to increase cardiac rehabilitation enrollment after coronary artery bypass grafting. *Am J Cardiol*. 2001; 88:1415–1416. A6. [PubMed: 11741563]
27. LaBresh KA, Fonarow GC, Smith SC Jr, et al. Improved treatment of hospitalized coronary artery disease patients with the get with the guidelines program. *Crit Pathw Cardiol*. 2007; 6:98–105. [PubMed: 17804969]
28. Mazzini MJ, Stevens GR, Whalen D, Ozonoff A, Balady GJ. Effect of an American Heart Association Get With the Guidelines program-based clinical pathway on referral and enrollment into cardiac rehabilitation after acute myocardial infarction. *Am J Cardiol*. 2008; 101:1084–1087. [PubMed: 18394437]
29. Brown TM, Hernandez AF, Bittner V, et al. Predictors of cardiac rehabilitation referral in coronary artery disease patients: findings from the American Heart Association's Get With The Guidelines Program. *J Am Coll Cardiol*. 2009; 54:515–521. [PubMed: 19643312]
30. Alter DA, Stukel T, Chong A, Henry D. Lesson from Canada's Universal Care: socially disadvantaged patients use more health services, still have poorer health. *Health Aff (Millwood)*. 2011; 30:274–283. [PubMed: 21289349]
31. Shanmugasagaram S, Alter DA, Oh P, Stewart DE, Grace SL. Socioeconomic status and barriers to participation in cardiac rehabilitation. *EuroPrevent 2011 Congress*. *Eur J Cardiovasc Prev Rehabil*. 2011; 18(1):S32–S55.
32. Burns KJ, Camaione DN, Froman RD, Clark BA III. Predictors of referral to cardiac rehabilitation and cardiac exercise self-efficacy. *Clin Nurs Res*. 1998; 7:147–163. [PubMed: 9633337]
33. Harlan WR, Sandler SA, Lee KL, Lam LC, Mark DB. Importance of baseline functional and socioeconomic factors for participation in cardiac rehabilitation. *Am J Cardiol*. 1995; 76:36–39. [PubMed: 7793400]
34. Grace SL, Scholey P, Suskin N, et al. A prospective comparison of cardiac rehabilitation enrollment following automatic vs usual referral. *J Rehabil Med*. 2007; 39:239–245. [PubMed: 17468793]
35. Parker KL, Hauer T, Arena R, et al. The effect of participation in an early discharge clinic on cardiac rehabilitation attendance and outcome in current cigarette smokers suffering a STEMI. *Can J Cardiol Supplement*. 2009; 25(suppl SB) [Accessed November 15, 2011] <http://www.pulsus.com/ccc2009/abs/061.htm>.
36. LaBresh KA, Ellrodt AG, Gliklich R, Liljestrand J, Peto R. Get with the guidelines for cardiovascular secondary prevention: pilot results. *Arch Intern Med*. 2004; 164:203–209. [PubMed: 14744845]
37. Thomas RJ, King M, Lui K, et al. AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services. *J Am Coll Cardiol*. 2007; 50:1400–1433. [PubMed: 17903645]
38. American Association of Cardiovascular and Pulmonary Rehabilitation, American College of Cardiology Foundation, American Heart Association Task Force on Performance Measures. . AACVPR/ACCF/AHA 2010 update: performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services. *J Am Coll Cardiol*. 2010; 56:1159–1167. [PubMed: 20863958]
39. Kayaniyil S, Leung YW, Suskin N, Stewart DE, Grace SL. Concordance of self and program reported rates of cardiac rehabilitation referral, enrollment and participation. *Can J Cardiol*. 2009; 25:e96–e99. [PubMed: 19340365]

Table 1
In-Hospital Sociodemographic and Clinical Characteristics by Cardiac Rehabilitation Referral Strategy (N=2453)

Characteristic	Systematic (n=1280, 47.8%)		Non-Systematic (n=1173, 52.2%)		Total (n=2453)	Chi-Square/t-test (p)	
Sociodemographic							
Mean age (mean, SD)	64.6	10.3	65.2	12.0	64.9	11.1	0.1867
Sex, female (n, %)	296	23.1%	362	30.9%	658	26.8%	<0.0001
White ethnocultural background (n, %)	1022	84.9%	851	76.4%	1873	80.8%	<0.0001
Married (n, %)	971	76.3%	816	70.6%	1787	73.6%	0.001
Some post-secondary education (n, %)	906	72.3%	838	74.0%	1744	73.1%	0.362
Retired (n, %)	612	50.1%	561	50.5%	1173	50.3%	0.859
Family income \$50000CAD (n, %)	489	48.8%	417	44.7%	906	46.9%	0.074
Subjective SES (mean, SD)	6.27	1.82	6.26	1.86	6.26	1.83	0.912
Rural living (n, %)	160	12.5%	128	10.9%	288	11.8%	0.220
Clinical							
Index Cardiac condition/procedure (n, %)							
MI	408	32.0%	295	25.4%	703	28.9%	0.001
PCI	317	24.8%	501	43.2%	818	33.6%	<0.0001
CABG	661	51.7%	235	20.3%	896	36.8%	<0.0001
Heart failure	151	11.8%	167	14.4%	318	13.1%	0.058
Arrhythmia	160	12.5%	140	12.1%	300	12.3%	0.704
Valve repair/replacement	132	10.3%	50	4.3%	182	7.5%	<0.0001
Diabetes (n, %)	386	31.8%	393	39.3%	779	35.2%	0.001
BMI (mean, SD)	28.6	5.2	28.0	5.8	28.3	5.5	0.010
Family history of CVD (n, %)	664	63.5%	451	64.8%	1115	64.0%	0.592
Hypertension (n, %)	875	72.3%	783	75.1%	1658	73.6%	0.139
Dyslipidemia (n, %)	926	82.1%	772	81.6%	1698	81.4%	0.793
Smoker (n, %)	93	7.6%	99	8.9%	192	8.2%	0.235
Activity Status (mean, SD)	26.5	17.7	28.5	18.1	28.5	17.7	0.015
Exercise Behavior (mean, SD)	74.3	83.14	78.3	83.31	75.9	82.93	0.298
Comorbidities present (n, %)	821	70.0%	711	67.4%	1532	68.8%	0.186
Musculoskeletal problems (n, %)	640	51.6%	601	53.3%	1241	52.4%	0.024

All cardiac condition/procedures are presented for each participant. MI, myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft; BMI, body mass index; CVD, cardiovascular disease;

Table 2

Cardiac Rehabilitation Referral, Enrolment, and Participation among Vulnerable Subgroups by Referral Strategy, N=1680

	Referral (Yes)			Enrollment (Yes)			Participation >80%		
	Systematic	Non-Systematic	p*	Systematic	Non-Systematic	p	Systematic	Non-Systematic	p
Sociodemographic									
Age (>median)	343/731 (46.9%)	160/355 (45.1%)	0.566	277/604 (45.9%)	128/279 (45.9%)	0.996	195/445 (43.8%)	86/204 (42.2%)	0.691
Work Status (Retired)	350/706 (49.6%)	158/344 (45.9%)	0.267	286/584 (49.0%)	130/272 (47.8%)	0.748	210/434 (48.4%)	94/198 (47.5%)	0.834
Family Income (<\$50000CAD [†])	248/574 (43.2%)	139/301 (46.2%)	0.400	252/474 (40.7%)	99/236 (42.0%)	0.753	167/444 (37.6%)	70/204 (34.1%)	0.547
Education Level (< high school)	168/718 (23.4%)	66/340 (19.4%)	0.145	124/594 (20.9%)	40/266 (15.0%)	0.044	80/440 (18.2%)	27/196 (13.8%)	0.170
Subjective SES (<median)	298/730 (40.8%)	120/355 (33.8%)	0.026	252/603 (41.8%)	89/279 (31.9%)	0.005	167/444 (37.6%)	70/204 (34.1%)	0.418
Marital Status (Not Married)	141/727 (19.4%)	66/350 (18.9%)	0.834	103/600 (17.2%)	49/276 (17.8%)	0.831	68/445 (15.3%)	37/203 (18.2%)	0.345
Rural (Yes)	80/730 (11.0%)	39/355 (10.9%)	0.989	63/603 (10.5%)	29/279 (10.4%)	0.981	38/445 (8.5%)	19/204 (9.3%)	0.746
Clinical									
Obesity (BMI≥=30)	226/682 (33.1%)	89/331 (27.0%)	0.044	183/564 (32.5%)	68/265 (25.7%)	0.047	123/422 (29.2%)	48/192 (25%)	0.288
Physical Activity (<median)	297/573 (51.8%)	134/279 (48.0%)	0.297	243/472 (51.5%)	105/216 (48.6%)	0.484	166/349 (47.6%)	79/161 (49.1%)	0.752
Functional Status (<median)	461/731 (63.1%)	192/355 (54.1%)	0.005	375/604 (62.1%)	143/279 (51.3%)	0.002	263/445 (59.1%)	107/204 (52.5%)	0.112
Comorbidities (Yes)	457/668 (68.4%)	203/312 (65.1%)	0.298	374/551 (67.9%)	159/246 (64.6%)	0.369	273/405 (67.4%)	114/180 (63.3%)	0.337
Smoking Status (Yes)	42/707 (5.9%)	18/340 (5.3%)	0.673	34/584 (5.8%)	9/270 (3.3%)	0.122	23/433 (5.3%)	5/197 (2.5%)	0.117
Total	731/947 (77.2%)	355/733 (48.4%)	<0.0001	600/724 (82.9%)	277/348 (79.6%)	<0.0001	445/575 (77.4%)	204/258 (79.1%)	0.063

Note: BMI, body mass index; CABG, coronary artery bypass graft; CAD, Canadian dollar; SES, socioeconomic status Denominators reflect missing data for some variables.

* p-values based on chi-square tests.

[†] equivalent to \$51,978 USD.

Significant p-value=0.004