Clinical and sociodemographic correlates of referral for cardiac rehabilitation following cardiac revascularization in Ontario

Scott Brady, MSc [a], Dan Purdham, PhD [b], Paul Oh, MD [a,c], Sherry Grace, PhD [a,c,d,*]

[a] University of Toronto, Toronto, Canada
[b] GlaxoSmithKline Inc., Toronto, Canada
[c] GoodLife Center of Excellence in Cardiovascular Rehabilitation Medicine, University Health Network, Toronto, Canada
[d] York University, Toronto, Canada

ARTICLE INFO

ABSTRACT

Objectives: Describe rates of, and examine factors affecting, referral to cardiac rehabilitation (CR) following revascularization in Ontario.
Background: CR reduces mortality following cardiac revascularization, but is largely underutilized, partly due to poor referral rates.
Methods: In this retrospective study, the sample consisted of all CR-indicated patients who underwent revascularization at the Cardiac Care Network of Ontario hospitals between October 2011 through March 2012. Referral rates were described, and multivariate analyses performed to identify disparities.
Results: Of the 3739 patients included, 51.8% were referred to CR. Patients aged ≥85 or requiring a translator, and patients with hyperlipidemia, heart failure, or comorbid pulmonary, renal or peripheral vascular disease, were significantly less likely to be referred. Patients with a history of smoking or myocardial infarction, or who underwent coronary artery bypass graft surgery, were significantly more likely.
Conclusions: A national policy statement recommends 85% referral of indicated patients to CR, a target currently missed by almost 35%.

Introduction

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality worldwide.[1] While revascularization — the augmentation of blood flow to a body part — will improve myocardial perfusion, it is important to promote cardiovascular health to optimize patient long-term health outcomes. Therefore, guidelines for percutaneous coronary intervention[2] (PCI) and coronary artery bypass graft (CABG) surgery,[3] the two primary modalities of cardiac revascularization, recommend referral to cardiac rehabilitation (CR) following the procedures.

CR is a comprehensive chronic disease management program designed to enhance and maintain cardiovascular health through the delivery of individualized, but integrated inter-professional care. As such, CR plays a key role in the secondary prevention of CVD following revascularization.[4] Through participation in CR programs, patients gain access to additional medical assessment, tailored exercise training, heart-health education, and CVD risk factor management strategies. Through exercise, medication adherence, smoking cessation, improved nutrition and mental health, CR offers a longer-term approach to managing CVD following revascularization.[5,6] Indeed, evidence demonstrates that the delivery of CR following revascularization is associated with significantly lower mortality and morbidity.[7—9] CR participation is also related to improved continuity of care, better patient functional capacity, risk reduction, greater psychosocial well-being,[10] the adoption of physical activity among other heart-healthy behaviors, and improved inter-provider communication, all in a cost-effective manner.[11]

Despite its benefits, use of CR programs by eligible patients is conservatively estimated to be approximately 30% in high-income countries,[12—14] and even lower in low-to-middle-income countries.[15] Enrollment rates in Canada are not known, with the most

comprehensive understanding of usage rates being from the province of Ontario in 2001 (22%).[16] In addition to this low overall utilization, certain patient groups, such as women, smokers,[17] older patients and those with limited English-language proficiency may be less likely to access CR, despite arguably greater need and demonstrated benefit.[18] Conversely, variation has also been observed by procedure, with patients being more likely to attend CR following CABG when compared to PCI.[19]

The under-utilization of CR is a result of multiple factors influenced by all levels of healthcare, from the patients to the system itself. However, patients who do not enroll in CR programs most often cite the lack of referral to a program as the primary reason for their failure to participate.[20,21] In North America, the "typical" method of referral to CR depends on a physician initiating a referral discussion, then completing and transmitting an institution-specific CR referral form,[22] although many institutions are adopting systematic referral strategies such as inclusion of referral on discharge order sets or clinical pathways.[23] Previous studies have found referral rates ranging from 28% to 60%,[18,24,25] well below multiple national guidelines that recommend referral rates of at least 85% of eligible patients.[6,26]

Moreover, inconsistencies have been noted in physician referral patterns that may lead to inequality in access to CR as reflected in the disparities outlined above.[18,24,27–29] Certain patient groups, such as women, older patients and those with limited English-language proficiency may be less likely to receive a referral to CR, despite arguably greater need and demonstrated benefit.[18] On the other hand, younger patients, those who are male, or those who have insurance coverage, have been demonstrated to be at increased likelihood of receiving a referral.[18,24,29] Variation has also been observed by procedure, with patients being more likely to be referred to, as well as attend, CR following CABG when compared to PCI.[18,19,29] Furthermore, certain comorbid illnesses, such as heart failure, diabetes, and renal, peripheral vascular, and chronic obstructive pulmonary disease have all been shown to be associated with decreased referral to CR.[18,24] Evidence with respect to cardiac risk factors is less clear. A diagnosis of hyperlipidemia or a history of smoking have both been consistently linked to increased referral, while data for patients who have a history of myocardial infarction or a diagnosis of hypertension have been contradictory.[18,24,29]

Given the benefits of CR, referral is recommended in national guidelines for the management of CVD post-revascularization.[2,3,6,11] Referral is a performance measure in the United States, which has led to some recent population-based reports of CR referral rates.[18,24] However, few studies have investigated referral to CR within Canada, and those that have focused on single centers or regions.[25] Thus, the objectives of this study were to: (1) describe rates of CR referral post-revascularization in Ontario, and (2) describe the association between sociodemographic and clinical factors and referral to CR.

Methods

Design & data source

This study was retrospective in design. Administrative data were obtained from a database maintained by the Cardiac Care Network of Ontario (CCN). The database contains information for patients undergoing various cardiac procedures at each of the CCN's eighteen member hospitals in Ontario, each of which provide advanced cardiac services (minimum requirement to be a CCN member hospital is the ability to perform diagnostic cardiac catheterization). Within the CCN database is stored, for each patient, demographic information, the type of procedure underwent, health status indicators, comorbidities, and procedural outcomes. At each CCN institution, a Regional Cardiac Care Coordinator, who is trained to ensure standardized data entry, is responsible for collecting patient data on a standardized form. The gathered data are provided to a data clerk, who then enters the data into the database.

In October of 2011, the CCN added a variable to their forms for the purpose of tracking patient referral to CR. Within the form is recorded each patient's referral status (yes/no). For this study, this variable was used to identify patients who had been referred to CR, and to calculate each hospital's performance at referring patients.

Ethics approval was obtained from the University of Toronto and York University's research boards, and the data access request was approved by the CCN.

Population

The sample was comprised of all CR-indicated patients who underwent revascularization, via either PCI or CABG, at the CCN member hospitals from October 2011 through March 2012. PCI and CABG surgery patients were considered for this study, as guidelines recommend the use of CR following these procedures.[2,3] Those patients who died before discharge were excluded.

Measures

Patient sex, age, whether they required an interpreter, their clinical characteristics (i.e., comorbidities, risk factors, cardiac history), the revascularization procedure they underwent (PCI versus CABG), and whether or not they were referred to CR (yes/no) were extracted from the administrative database. The latter was the dependent variable. All requested variables were selected from those defined in the CCN data dictionary, and all available fields describing clinical characteristics were requested.

Statistical analysis

Analysis of the dataset was performed using the software package SPSS version 19. Univariate analysis was performed to describe the clinical and sociodemographic characteristics of the patients, and to determine the proportion of patients referred to CR. Bivariate analysis was then used to describe differences in CR referral with respect to the sociodemographic and clinical characteristics outlined above. Patient sex, age, translator requirement, procedure type, comorbidities (renal disease, diabetes, peripheral vascular disease, and chronic obstructive pulmonary disease), cardiac history (heart failure and history of myocardial infarction), and cardiac risk factors (hyperlipidemia, hypertension, history of smoking, and BMI) were all included in the bivariate analysis. All variables were categorical, and as such two-tailed, chi-square testing was done. A p value of less than 0.05 was considered statistically significant.

Finally, a binary logistic regression model was used to identify the clinical and sociodemographic characteristics related to CR referral. The covariates used to generate the model were all those listed above, with the exception of BMI. It was not included because BMI data was missing for 678 (18.1%) patients, and as such would have greatly decreased the sample size used in the regression.

Results

Sample characteristics

Overall, there were 6065 patients who underwent PCI or CABG surgery during the period of study. Upon examination of referral rates by site, only 10 (55.5%) of the 18 CCN member hospitals reported any CR referral. Of the 10 sites reporting referral, 5 (50%) were academic hospitals and 7 (70%) offered CR onsite, whereas of the 8 sites that failed to report referral, 3 (37.5%) were academic and 4 (50%) had onsite CR. Only patients who were treated at one of the 10 hospitals that reported on referral were included, of which there were 3773 (61.5%). Thirty-four (0.9%) patients who did not survive to discharge were excluded. The sociodemographic and clinical characteristics of the sample of 3739 patients are shown in Table 1.

CR referral

With regard to the first objective, which was to describe the rate of CR referral, overall, 1936 (51.8%) patients from the 10 sites were referred to CR. The second objective was to examine sociodemographic and clinical factors related to referral. Table 1, which displays the results of the bivariate analysis, lists the demographic and clinical characteristics of the overall population as well as among those referred and not referred to CR. Patients who required a translator and those aged 85 and older were significantly less likely to be referred to CR than their counterparts ($p = 0.011$ and $p < 0.001$, respectively). With regard to clinical characteristics, in the bivariate analysis patients who underwent PCI or who had comorbid renal disease, peripheral vascular disease, chronic obstructive pulmonary disease, heart failure or hyperlipidemia were significantly less likely to be referred to CR, whereas patients who underwent CABG or who had a history of myocardial infarction or smoking were significantly more likely to be referred to CR (Table 1).

Table 2 displays the adjusted odds ratio, 95% confidence interval, and p value for each covariate included in the binary logistic regression model. The statistical assumptions needed for a valid binary logistic regression were met. The model was statistically significant overall ($p < 0.001$). Of the 13 variables included as covariates in the regression, 10 were found to be independently significantly associated with referral to CR. Indicators of effect size showed only small explanatory power with respect to referral (Cox & Snell $R^2 = 0.067$; Nagelkerke $R^2 = 0.090$). Patients who required a translator or were aged 85 and older, and those who underwent PCI or who had comorbid renal disease, peripheral vascular disease, chronic obstructive pulmonary disease, heart failure or hyperlipidemia were significantly less likely to be referred to CR. Younger patients and those who underwent CABG or who had a history of myocardial infarction or smoking were significantly more likely to be referred to CR.

Discussion

This study is the first using administrative data from the province of Ontario to examine the referral rates of revascularization patients to CR. Only half of revascularization patients were referred to CR, well below the 85% recommended in a national policy statement.[6] A 51.8% referral rate is comparable to recent studies in the U.S. that investigated similar populations and reported referral rates from 50% to 64%.[18,24]

Table 1
Sociodemographic and clinical characteristics of the overall population, and comparisons by CR referral.

Characteristic	Overall population ($n = 3739$)	Not referred to CR ($n = 1803$)	Referred to CR ($n = 1936$)	p value[a]
Sociodemographic characteristics				
Sex				
Male	2838 (75.9%)	1357 (75.3%)	1481 (76.5%)	0.378
Female	901 (24.1%)	446 (24.7%)	455 (23.5%)	
English-language proficiency				
No translator	3689 (98.7%)	1770 (98.2%)	1919 (99.1%)	0.011*
Translator required	50 (1.3%)	33 (1.8%)	17 (0.8%)	
Age				
≤54	517 (13.8%)	246 (13.6%)	271 (14.0%)	0.776
55—64	1011 (27.0%)	476 (26.4%)	535 (27.6%)	0.397
65—74	1233 (33.0%)	581 (32.2%)	652 (33.7%)	0.348
75—84	837 (22.4%)	403 (22.4%)	434 (22.4%)	0.969
≥85	141 (3.8%)	97 (5.4%)	44 (2.3%)	<0.001*
Clinical characteristics				
Index procedure				
PCI	1903 (50.9%)	1093 (60.6%)	810 (41.8%)	<0.001*
CABG	1836 (49.1%)	710 (39.4%)	1126 (58.2%)	
Comorbidities				
Renal disease	109 (2.9%)	74 (4.1%)	35 (1.8%)	<0.001*
Diabetes	1244 (33.3%)	585 (32.4%)	659 (34.0%)	0.302
PVD	295 (7.9%)	174 (9.7%)	121 (6.3%)	<0.001*
COPD	284 (7.6%)	153 (8.5%)	131 (6.8%)	0.047*
Cardiac history				
History of MI	931 (24.9%)	423 (23.5%)	508 (26.2%)	0.049*
Heart failure	269 (7.2%)	158 (8.8%)	111 (5.7%)	<0.001*
Cardiac risk factors				
History of smoking	2030 (54.3%)	892 (49.5%)	1138 (58.8%)	<0.001*
Hypertension	2700 (72.2%)	1311 (72.7%)	1389 (71.7%)	0.510
Hyperlipidemia	2689 (71.9%)	1327 (73.6%)	1362 (70.4%)	0.027*
BMI > 25	2168 (58.0%)	1001 (72.2%)	1167 (69.7%)	0.137

Presented for each characteristic is the percentage of the overall population with the characteristic, the percentage of all patients not referred to CR that have the characteristic, and the percentage of all patients people referred to CR that have the characteristic. PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft surgery; PVD, peripheral vascular disease; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; BMI, body mass index. BMI values are based on an Overall Population $n = 3061$, Not Referred to CR $n = 1387$, and Referred to CR $n = 1674$. Significant difference between patients referred and not referred to CR for each characteristic *$p < 0.05$.
[a] Based on chi-square analyses.

Table 2
Crude rates and adjusted odds ratios of CR referral by patient sociodemographic and clinical characteristics calculated via binary logistic regression, $N = 3739$.

Characteristic	CR referral rate	Adjusted OR	Lower 95% confidence limit	Upper 95% confidence limit	p value
Sociodemographic characteristics					
Sex					
Male	52.2%	1.00			
Female	50.5%	1.13	0.97	1.33	0.125
English-language proficiency					
No translator	52.0%	1.00			
Translator required	34.0%	0.53	0.29	0.98	0.042*
Age					
≤54	52.4%	1.00			
55–64	52.9%	0.98	0.79	1.22	0.872
65–74	52.9%	1.01	0.82	1.26	0.901
75–84	51.9%	1.02	0.81	1.29	0.837
≥85	31.2%	0.57	0.38	0.87	0.009*
Clinical characteristics					
Index procedure					
PCI	42.6%	1.00			
CABG	61.3%	2.25	1.96	2.57	<0.001*
Comorbidities					
Renal disease	32.1%	0.36	0.24	0.56	<0.001*
Diabetes	53.0%	1.15	0.99	1.33	0.063
PVD	41.0%	0.61	0.47	0.79	<0.001*
COPD	46.1%	0.74	0.57	0.96	0.024*
Cardiac history					
History of MI	54.6%	1.29	1.10	1.51	0.002*
Heart failure	41.3%	0.66	0.50	0.86	0.002*
Cardiac risk factors					
Hyperlipidemia	50.7%	0.80	0.68	0.94	0.006*
Hypertension	51.4%	1.00	0.85	1.18	0.966
History of smoking	56.1%	1.53	1.33	1.76	<0.001*

Presented for each characteristic is the percentage of the overall population with the characteristic that was referred to CR, and the adjusted odds ratio and 95% confidence interval of referral to CR for each characteristic. PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft surgery; PVD, peripheral vascular disease; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction, OR odds ratio. The sociodemographic and clinical characteristics listed in this table were all included as covariates in the generation of the binary logistic regression model. Statistically significant odds ratio for each characteristic *$p < 0.05$.

Rates of referral following PCI were significantly lower than following CABG, which is also consistent with the literature.[18,19] There is now a fairly substantive literature supporting the benefits of CR following PCI,[7,8] so the reasons for this discrepancy would likely not be entirely evidence based. This discrepancy could perhaps be due to lower perceived severity of disease in those undergoing PCI versus CABG. However, arguably there may be more to gain by intervening on behalf of PCI patients in order to slow the progression of their disease.

While appropriateness of referral decisions cannot be ascertained from administrative data, results suggest that some patients with indications for CR are not being referred. Patients with hyperlipidemia were significantly less likely to be referred to CR, despite the fact that CR offers these patients the opportunity to collaborate over time with clinical staff to ensure that evidence-based therapies, including the consumption of a low-fat diet and the use of lipid-lowering agents, are prescribed and that patients are educated about the importance of long-term adherence. Moreover, consistent with previous studies,[18,24,29] several commonly-occurring comorbidities — peripheral vascular, renal, and chronic obstructive pulmonary disease — that are known to both respond to exercise therapy and to share underlying risk factors with CVD, were associated with patients being significantly less likely to be referred to CR than patients without these comorbidities. Indeed, such individuals with a complex presentation may particularly benefit more from CR, although this remains to be investigated further.[30–32]

Results demonstrating that some patients with greater need are less likely to access CR are striking, albeit consistent with the literature.[18,24] Older patients and those with limited English-language proficiency were also less likely to be referred, which is worrisome given that older patients are shown to benefit from CR.[33] While we found no discrepancy in referral patterns prior to age 85, previous studies have found that patients as young as 65 may be less likely to be referred.[18,29] Lack of referral of patients at an advanced age may be due to physicians assuming that these patients will not participate in the program. However, data from randomized trials support the benefits of CR participation even among older populations.[33] Moreover, patients with limited English-language proficiency are also less likely to be referred to CR, despite the fact that patient education materials can be translated and many hospitals have interpretation services. In both this study and a previous one,[29] speaking English has been identified as one of the strongest predictors of being referred to CR.

Results regarding potentially vulnerable populations were not all disappointing. Unlike in previous studies,[18,20,24,25,29] females and males were equally likely to be referred to CR. The lack of sex difference in referral was promising, and may indicate improved recognition by physicians of the benefits CR offers both sexes.

Implications

Unfortunately, rates of CR referral for indicated patients are not well synthesized, and we do not have a good understanding of variation in rates by region or by nation. Indeed, norms around CR referral and the nature of health systems vary widely, but the evidence for the benefit of CR and recommendations promoting referral are universal. With the advent of pay-for-performance in the United States for CR referral, it is hoped a significant increase in referral rates will be observed uniformly in that country. Canada has recently developed national CR quality indicators, which similarly include inpatient CR referral (http://ddqi.ccs.ca/index.php/quality-indicators/cardiac-rehabilitation-secondary-prevention-quality-indicators-chapter). Finally, work by our group has

demonstrated the significant increases in CR referral and enrollment where systematic referral strategies are in place.[34] Moreover, systematic referral is demonstrated to overcome many of the identified disparities in CR referral observed herein.[35]

Limitations

Caution is warranted when interpreting these results. First, the process of tracking CR referrals was new. Of the 18 CCN hospitals, 8 (44.4%) did not report CR referral. Following personal communication with some of the coordinators, we approached the data by assuming that these sites failed to report the new variable on the form despite training, rather than that no patients were referred to CR. For example, one coordinator reported that all patients are systematically referred and therefore reporting the variable was moot, while in reality referral rates at the institution do not reflect systematic referral practices.[34] In addition to the observed reporting failure, the fact that tracking CR referrals was new may have resulted in reporting errors as users became accustomed to doing so. Nevertheless, data were collected for 3739 patients from 10 different hospitals. This is a large and robust sample, and as such offers good insight into referral practices across Ontario.

Third, there are also limits to the generalizability of these findings. Considering that only hospitals offering advanced cardiac services were included, it is likely that the rates of referral are higher than what would be seen at other hospitals. Moreover, CR services are provided free-of-charge to patients through government healthcare coverage. Thus, these findings may not generalize to other healthcare systems. Fourth, in the context of administrative data, individual factors that would preclude patient referral cannot be ascertained. For instance, as per the 2010 AACVPR Performance Measures,[22] exclusion criteria for referral can be patient related (i.e., being discharged to a nursing facility for long-term care), or medically-related (i.e., patient has co-morbid medically unstable, life-threatening condition). However, this is taken into consideration within the benchmark of 85% referral. Finally, this study did not investigate the rate of CR participation among those patients who were referred. However, previous studies have suggested 85% of referred patients ultimately enroll in CR.[36]

Conclusion

While the approximately 50% referral rate reported herein is consistent with recent reports, the target referral rate is still missed by almost 35%. Older patients, those with limited English-language proficiency, and patients with complex comorbidities, uncontrolled risk factors and more severe disease are at greatest risk of going unreferred by their physicians. These results are particularly disheartening given that such patients are likely to benefit the most from CR services. Physicians play an important role in assisting high-risk patients access CR services in Ontario. Successfully directing patients to CR may greatly improve the health of those referred, as well as further improve the impressive return-on-investment the service already generates.

Acknowledgments

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