Healthcare Utilization and Associated Time and Out-of-Pocket Expenditures for Cardiovascular Disease Patients in a Publicly-Funded Healthcare System

Short Title: Cardiac Patient Time & Out-of-Pocket Costs

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Brief Summary:

This paper characterizes out-of-pocket (OOP) and time costs borne by cardiac patients over 2 years for healthcare. Patients most often had visits to their general practitioner, electrocardiograms, and treatment for angina. Time costs ($73.70±275.84) were modest if considered only in those working; OOP costs were $377.01±321.72 ($525.93±467.08 overall), with significantly higher costs in women and less educated patients. Cardiac rehabilitation participants spent $939.43±1333.29 (1.6% share of 1 year's income).

Abstract

Background: The objectives of this study were to describe: (1) healthcare utilization and associated patient time and out-of-pocket costs (OOP) over 2 years following a cardiac diagnosis, (2) the sociodemographic and clinical drivers of these costs, and (3) patient costs related to cardiac rehabilitation (CR) participation.

Methods: Secondary analysis was conducted on an observational, prospective CR program evaluation cohort in Ontario which has a publicly-funded healthcare system. A convenience sample of patients from one of 3 CR programs was approached at their first visit, and consenting participants completed a survey. Participants were emailed surveys again 6 months, 1 and 2 years later; these assessed their cardiac care and medications, and the time and OOP costs associated with care visits. Patient time was valued based on average wages in Ontario.

Results: Of 411 consenting patients, 240 (58.3%) completed CR, and 192 (46.7%) were retained at 2 years. Patients most often had visits to their general practitioner, electrocardiograms, and treatment for angina. The total cost to patients over 2 years was $73.70±275.84 for time and $377.01±321.72 for OOP costs ($525.93±467.08 overall). With adjustment, there were significantly higher OOP costs for females ($p<.001$), and less educated ($p<.001$) patients. Participants spent considerable money relatively OOP on CR visits alone ($384.78±269.67), with time costs at $379.07±1035.49 ($939.43±1333.29 overall; 1.6% share of 1 year's income).

Conclusions: In conclusion, time and OOP costs are modest for cardiac patients, except for CR. Alternative delivery models are needed, in particular for low-income patients.

INTRODUCTION

Cardiovascular disease (CVD) is among the leading burdens of disease and disability globally.[1] Due to advances in acute treatment, there are many patients living chronically with CVD. They are at risk for recurrent events, and require long-term follow-up and management. This includes regular visits with specialists, testing of their cardiovascular risk factors and function, taking on average 3-4 classes of medications, and participating in cardiac rehabilitation (CR).

The costs of CVD to the healthcare system have previously been characterized,[2,3,4] and are substantial. CVD is the costliest of any health condition. However, there has been little consideration of the costs (not only out-of-pocket [OOP] costs, but also time-related costs) to patients to attend visits for tests and treatments, including CR, as well as for medications.[5] These have been characterized in cancer patients, who also require ongoing monitoring and management.[6] In a publicly-funded healthcare system or one with a good system of private healthcare insurance, costs to patients would certainly be lower than in systems without such coverage. In Canada for example, healthcare services are generally covered, but there is limited coverage of medications for those <65 years old (except in Quebec which has a publicly-funded medication coverage plan, or the Ontario Trillium Drug Program for those who are eligible when costs are > 4% of income, for example). These patients must pay OOP if they do not have a benefit plan through an employer or purchased privately.

CR is a chronic disease management program that successfully prolongs quality and quantity of life,[7,8,9] and clinical practice guidelines recommend CVD patients participate.[10,11] Most patients attend supervised programs located in academic centers;[12] on average patients attend 2-3 times per week for 5 months.[13,14] While CR services are reimbursed in some jurisdictions in Canada, there can also be significant costs borne by patients associated with transportation and parking at hospitals. These have been infrequently considered[15] (and only characterized once in Canada approximately 25 years ago);[16] costs for CR sessions when not reimbursed by government or private insurance companies are also scantly reported.[5] In addition, most programs offer sessions during business hours,[17] and therefore participants must miss paid work to attend.

The objectives of this study were to: (1) describe cardiac healthcare utilization (including CR) and associated patient time and out-of-pocket costs (OOP) over 2 years following a CVD diagnosis or event; (2) understand the drivers of time and OOP costs incurred by outpatients living with CVD, namely sociodemographic (e.g., age, sex, work status, educational level, marital status, ethnocultural background, area of residence), and clinical (e.g., smoking, disease severity, and functional capacity); and (3) describe patient's time and OOP costs related to CR participation.

METHODS

Design and Procedure

We conducted this prospective, observational study as part of a CR program evaluation. Approval was received from the research ethics review boards at the institutions of each participating CR site. Patients referred to CR at one of 4 sites following a qualifying hospitalization or diagnosis were approached to participate at their initial visit between July 2010 and February 2014. Based on median times from hospital discharge to CR initiation in the region,[18] baseline assessment would have occurred approximately 1.5 months post event/procedure. Consenting participants were asked to complete surveys at CR intake and discharge (or the expected time of graduation for those who did not complete), as well as 1 and 2 years from CR initiation (online or paper). Clinical data were extracted from participants' medical charts for their CR intake and discharge assessments (where available).

Setting and Participants

This study was undertaken in Canada, which has a publicly-funded healthcare system. Therefore, all CVD tests and acute treatments are covered by provincial health insurance plans. There is a pharmacare program for Canadians above the age of 65. Most patients under the age of 65 years must pay OOP for medications, unless they have a very low income or very high medication costs in proportion to their annual income, have a health benefit plan through an employer or purchase a benefit plan privately.

The cohort consisted of participants from 3 CR centres and one satellite program (total 4) in the Greater Toronto Area of Ontario, Canada. The attributes of each site are described elsewhere.[19] In brief, one program was located within the city and the others in the suburbs of Toronto. The programs were 4-6 months in duration, offering 1-2 sessions / week. Three programs offered CR at no cost to participants (one program charged a nominal fee for educational materials). In the remaining program, patients were required to pay a monthly fee of $55CDN to participate, which was reimbursable through private healthcare insurance for patients with such coverage (i.e., through work or purchased privately). This fee was added to OOP costs for participants attending this program (i.e., $55 x 6 months).

This convenience sample consisted of all consenting participants attending an initial visit at 1 of the CR programs. Participants were generally systematically referred to the CR programs following hospitalization for cardiac conditions or procedures, such as: 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.[20] 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.

Measures

Sociodemographic characteristics such as participants' ethnocultural background (adapted from Statistics Canada categorizations), marital status, highest educational attainment and work status (also assessed in the 2nd survey), were assessed via self-report in the initial survey. Participants from the CR program in the city were considered "urban" for their area of residence, with those attending the other programs considered "suburban". Age, sex, as well as clinical data were extracted from CR referral forms, as well as CR intake and discharge assessments, where available. The following variables were collected: CR referral indications, and cardiac risk factors (e.g., blood pressure, lipids, blood glucose, and anthropometrics; smoking was assessed via self-report). Functional capacity was obtained from the graded exercise stress test at intake (i.e., peak Metabolic Equivalents of Task [METs]), and the Duke Activity Status Index[21] was administered in the discharge survey.

Patient Costs Related to Cardiac Healthcare Utilization

Costs were considered from the patient perspective, based on the human capital method. CVD-related healthcare utilization was assessed via self-report at each assessment point following intake. Participants were asked to report the number of times they visited a primary and specialist care provider, as well as emergency department visits and hospital admissions. They were also asked to indicate whether they had experienced any in a list of CVD-related tests, events or procedures. Completion of CR was ascertained from CR charts where available (defined as engagement to a sufficient degree in the program to warrant formal post-program re-assessment and completion of said re-assessment);[22] otherwise dropout of CR was confirmed via self-report in the discharge survey. Healthcare system costs were not considered.

Patient OOP and time costs were assessed via self-report in each follow-up survey. Items were based on those developed for cancer survivors,[6] and adapted for cardiac patients. Participants were asked to report OOP costs (e.g., transportation, parking, food) as well as time (e.g., "in the last 12 months, how much time was associated with these health care visits, including travel and waiting?") for the above healthcare visits, tests and treatments. Whether participants lost time from paid work, and required assistance with unpaid work were also assessed in the CR discharge survey specifically. Participants were asked to report costs since the last assessment point (i.e., the discharge / 6-month survey assessed costs since CR intake; the 1 year survey assessed costs since the 6 month survey and the 2 year survey assessed costs for the full year). Costs were only reported in those with complete data at all applicable time points.

Patient cost for medication was assessed in the 1 year and 2-year follow-up surveys. Participants were asked to list all of their cardiac-related prescribed and herbal/alternative medications, whether secured over (e.g., acetylsalicylic acid) or under-the-counter. Participants were asked to list them from the pill bottles to ensure accurate responses. They were then asked to self-report OOP costs for these medications during the previous 12 months. Finally, OOP costs associated with CR (e.g., transportation to and from each session, parking, shoes) and time associated with CR participation (i.e., travel to and from sessions) were assessed in the discharge survey only, based on Oldridge et al.[16]

Patient time was valued as per the average hourly wages in August 2016 in Ontario, namely $28.76/hour for those above the age of 55 (http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/labr69g-eng.htm; based on 50 weeks of work / year @ 40 hours / week this would be $57,520/year [value also used to calculate share of income]). This was computed relative to work status: the hourly wage was multiplied by the patient time among those working full-time, multiplied by half the hourly wage among those working part-time, and no time cost was computed for those reporting any other work status (e.g., retired, on disability). Total patient time cost was calculated for each follow-up time point, and summed for a grand total time cost across the 2 years from CR initiation. Total OOP costs, namely costs for healthcare visits and medications, were similarly summed at each assessment point, and then across all assessment points for a grand total. This was only computed in participants who completed surveys at all 3 assessment points. Finally, OOP and time costs were also averaged, to ascertain total patient cost.

Statistical Analysis

IBM SPSS software version 24 (IBM, Armonk, NY) was used for statistical analysis. A significance cut-off value of $p < .05$ was applied throughout. Descriptive statistics were used to describe the sociodemographic and clinical characteristics of the sample, as well as healthcare system and patient costs at each assessment point.

To test the second objective, the associations between sociodemographic as well as clinical characteristics with total patient time and OOP costs were tested using t-tests and Pearson's correlation, as appropriate. A general linear model (log-link, Poisson distribution) was computed to test the association of any significant characteristics, with adjustment for characteristics which differed by retention status (Supplemental Table 1) as well as age, sex and indication. One model was run with time costs as the dependent variable, and the second with OOP costs. To test the final objective, patient time and OOP costs related to CR use specifically were described.

RESULTS

Respondents Characteristics

Figure 1 displays the flow of participants through the study. Supplemental Table 1 displays participant sociodemographic and clinical characteristics pre-CR. As shown, there were some differences in the characteristics of participants retained at 2 years versus those lost-to-follow-up. With regard to sociodemographic characteristics, retained participants were more likely to self-report "North American" ethnocultural background compared to those lost to follow-up. No other differences were observed.

Patient healthcare use and associated time and out-of-pocket costs

Cardiac-related healthcare visits (i.e., costs to the healthcare system) participants reported at CR discharge, as well as at 1 and 2-year follow-up are shown in Table 1. These were primarily visits to general practitioners, electrocardiograms and blood tests, as well as treatment of angina and other cardiac events (these were most commonly atrial fibrillation).

Time and OOP patient costs (in Canadian dollars) related to this healthcare utilization is also shown in Table 1 by assessment point. Patient costs in the first year were on average $410.08±391.68. Including OOP medication costs (see below), the average grand total cost to patients living with CVD for 2 years in a publicly-funded healthcare system was $525.93±467.08 This represents 0.91% share of income spent by patients for non-CR cardiac care. Approximately 10% of patients required an accompanying person to aid them in attending their healthcare appointments (associated costs not considered, as the patient perspective is taken herein).

In the CR discharge survey, 18 (16.8%) participants (who were not retired) reported difficulty working at their paid job because of their CVD. They reported having difficulty working 13.93±16.43 days, and that their work capacity was reduced by 65.00±26.29% during this time. With regard to unpaid work (e.g., household chores), 46 (20.0%) participants reporting requiring assistance since their event/procedure (regardless of work status). They required 79.40±157.89 hours of assistance, and the cost for this was $856.43±2089.90 (median=340.00).

Cardiac medication use, by class, in this cohort is reported elsewhere.[19] Participants reported taking an average of 5.40±2.34 medications at 1 year and 5.01±2.32 at 2-year follow-up. Mean OOP medication costs are shown in Table 1 by assessment point; the total OOP medication cost to patients over the 2 years following their event procedure was $271.86±324.77. Participants under the age of 65 (i.e., less likely to have some form of coverage) at study initiation reported spending $287.67±354.69 OOP on medication at 1 year, and $29.50±34.34 at 2 years. Figure 2a displays the breakdown of costs, including medications, in those working full-time for illustrative purposes (and 2d in those who are retired).

The association between participant sociodemographic and clinical characteristics and patient costs are shown Table 2. As expected, time costs were significantly higher for younger participants (i.e., time costs were only considered in participants who were working). OOP costs were significantly higher among female, unmarried, less educated patients than their male, married, more educated counterparts respectively. As shown, no other differences were observed.

A full model was tested, with adjustment for ethnocultural background as there was retention bias for this characteristic, of the association of age to time costs, with adjustment for ethnocultural background, sex and indication. The overall model was not significant (F=1.38, p=.24).

A second full model was also tested of the association of sex, marital status, and education to OOP costs. The overall model was significant (p<.001), with sex (p<.001) and education remaining significant (p<.001).

Patient Costs Related to CR

As shown in Figure 1, less than two-thirds of participants completed the CR discharge assessment and were considered to have completed CR; 60 (25.4%) of these participants were working full or part-time. Participants were on average prescribed 41.50±13.27 CR sessions by the program, and completed 25.80±16.66 sessions.

They reported spending a mean of 44.82±51.81 hours (including travel) to participate in these sessions. The total patient cost to attend CR was $939.43±1333.29 (1.63% share of 1 year's income): $384.78±2269.67 OOP and $379.07±1035.49 on time associated with CR visits. Figures 2b and c display the breakdown of costs, including CR, in those who are working full-time or are retired for illustrative purposes.

DISCUSSION

In this first characterization of CVD patient costs in a publicly-funded healthcare system, results show that these are quite modest. OOP costs were somewhat higher than those reported by cancer survivors.[6] The costs can be attributed to visits to general practitioners, for tests such as electrocardiograms and bloodwork, and treatment for angina and atrial fibrillation, as well as medications. Workforce participation was not highly hindered by 6 months post-event/procedure. There were some potential drivers of patient costs however, suggesting women and less educated patients have higher costs. Finally, the cost of CR participation to patients was shown to be double that for all other cardiac care over the 2 years.

That medication costs were lower over time could be explained by participants achieving the age of 65 and hence their medication costs may be covered by government or work benefits, or medication cessation due to excessive OOP costs. Optimal medical therapy is key to secondary prevention, and hence more investigation of the impact of OOP costs for medication on cardiac patient use and adherence is warranted.[23,24,25]

There were significantly higher costs in women and less educated patients. While reasons were not ascertained in this study, one could surmise that costs were higher for women as they often suffer from a higher burden of comorbidities than men.[26] Reasons for higher OOP costs for less educated patients are likely socio-economic, as patients of lower socioeconomic means often have more severe disease, comorbidities and poorer outcomes. As less educated patients likely earn less money, it could also be the case that they were more likely to recall expenses related to their cardiac care, and to perceive them as greater, than their more educated, higher-income earning counterparts.

Participation in CR costs patients almost $1000CAD. Time costs in the HF-ACTION trial were $1045USD (2008) for an average of 33 sessions requiring 53 hours.[15] This is considerably higher than the findings reported herein (~$400), likely because no time cost was assigned to non-working patients. In the only Canadian study ever characterizing costs for CR participation to our knowledge,[16] patients paid $99 (1987) OOP for travel and other expenses (not including time) to attend 16 sessions over 8 weeks. Considering inflation (purchasing power parity of $178 in 2017 Canadian dollars) and the greater number of sessions in which patients participated in the current study, this is considerably lower than the costs reported in the current cohort.

Nevertheless, it is no wonder patients of low socioeconomic status are under-represented in CR programs,[27,28] and that utilization rates overall are suboptimal.[29,30,31]

Strategies to mitigate these costs to patients include a national pharmacare program, tele-healthcare,[32] and home-based CR.[33] Providing care to patients in their home contexts remotely may reduce costs to the healthcare system[34] (although this is not the case for home-based CR which is equivalent in cost to delivering traditional supervised CR),[35] and would discernibly reduce costs to patients as well.[34] Reviews demonstrate equivalent outcome improvement with home[35] and telehealth-based[36,37,8] versus traditional supervised CR. At present, there is not broad availability of care via these means.

Caution is warranted in interpreting these results. First, cost data were collected through self-report. There is previous research to suggest patient report of health care costs is generally in agreement with administrative databases, but some discrepancies were also noted.[38] There was no source of information to validate patient report for this study. Second, given it was collected at fixed assessment points, inaccurate recall and recall failure may have biased results.[39] In particular, there may have been more error associated with patient estimation of costs over the full second year of the study follow-up period. Third, time costs were computed using average provincial wages rather than actual income, as this information was not collected. On a related note, fourth, coverage for medications was not directly assessed. Assumptions were made based on age, so further research is needed to better understand cardiac patient OOP for medications. Fifth, there was some selection and retention bias in the sample, and there was much loss to follow-up. Sixth, generalizability is limited in several additional ways. Results are likely not very generalizable to other funding systems. In particular, patient costs for CR will vary widely by Canadian province given reimbursement policies differ, and as does prescribed CR dose.[40,41]

Moreover, results may not be generalizable outside major urban centers in Canada, as costs such as parking are likely higher in more densely-populated areas for example. Finally, generalizability is further limited to patients who access CR. While CR is the standard of care for this population, only approximately 30% of patients access it.[42] Moreover, patients who attend CR are shown to be different than those who do not.[43,44]

Conclusion

Time and OOP costs were generally modest for cardiac patients over the course of their chronic disease, and would generally not represent a barrier to care. This excludes CR however, which cost almost double all their other cardiac care over 2 years combined. The heavy costs explain the low rates of CR use, particularly in those of low socioeconomic means. Alternative delivery approaches which reduce these costs must be delivered more broadly, so more patients access and complete these life-saving programs.

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Disclosures

The authors have no conflicts of interests to disclose.

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Figure Captions

Figure 1 displays participant flow over the 2 years of the study.

Figure 2 displays patient CVD-related costs by work status and cardiac rehabilitation participation from CR intake over 2 years

Table 1: Healthcare Utilization, Patient Time and Out-of-Pocket Costs by Time from CVD Diagnosis/Event

Indicator	CR Intake to Discharge / 6 Months Later§ N=240	CR Discharge / 6 Months Later to 1 year N=178	1 year post-CR Intake to 2 years N=192
Healthcare Visits			
General Practitioner Visits (mean ± SD)	2.13±2.38	3.21±3.40	2.64±2.09
CVD Specialist visits (mean ± SD)	1.23±1.40	1.46±1.71	1.37±1.09
Emergency Department (mean ± SD)	0.15±0.53	0.29±0.91	0.17±0.55
Hospital Admissions (mean ± SD)	0.08±0.39	0.13±0.53	0.06±0.24
CVD Events and Procedures (n, %)			
Myocardial Infarction	5 (2.9)	4 (1.5)	3 (2.5)
Angina	22 (12.0)	13 (13.4)	19 (14.6)
Percutaneous Coronary Intervention	6 (3.5)	4 (4.2)	3 (2.5)
Bypass Surgery	2 (1.2)	1 (1.0)	1 (0.8)
Valve surgery	0 (0.0)	3 (3.1)	0 (0.0)
Heart Failure	2 (1.2)	2 (2.1)	0 (0.0)
Heart Transplant	0 (0.0)	0 (0.0)	0 (0.0)
Left Ventricular Assist Device	0 (0.0)	0 (0.0)	1 (0.8)
Rhythm Device	2 (1.2)	3 (3.1)	1 (0.8)
Ablation	0 (0.0)	2 (2.1)	1 (0.8)
Stroke	3 (1.7)	1 (1.0)	3 (2.5)
Peripheral Vascular Disease	0 (0.0)	1 (1.1)	2 (1.7)
Other	21 (11.7)	9 (9.0)	13 (10.5)
Cardiac Tests (n, %)			
X-Ray	43 (9.3)	50 (10.8)	60 (40.7)
Electrocardiogram	95 (46.1)	121 (74.2)	118 (69.8)
Blood Test	167 (76.6)	148 (89.2)	153 (87.4)
Urine Test	68 (34.5)	98 (70.0)	106 (68.8)
CT Scan	19 (10.4)	34 (29.1)	31 (23.7)
Echocardiogram	50 (25.8)	87 (60.8)	83 (54.2)
Stress Test	82 (40.6)	92 (59.7)	82 (53.9)
Other	21 (11.6)	18 (16.2)	25 (19.7)
Time & Out-of-Pocket Costs			
Cost for healthcare visits* (mean ± SD)	$98.94±163.21	$79.03±88.32	$52.93±47.98

Time† (mean ± SD hours)	11.18±26.10	9.56±11.06	8.17±9.54
Medications	-	$240.09±299.48[a]	$25.95±30.47
Total time cost‡	$72.37±306.14	$75.04±191.03	$72.70±168.52
Total out-of-pocket cost	$47.78±121.15	$272.40±275.58	$58.57±49.34
Average total patient cost	$123.74±341.43	$381.42±355.37	$157.11±205.10

Note: Due to missing data, percentages for each characteristic were computed using a denominator value specific to the sample size with complete data for that variable.

Costs are reported in Canadian dollars.

CVD, Cardiovascular Disease; SD, Standard deviation; CT, Computed tomography.

*transportation, parking, food, lodging.

†for healthcare visits, including travel and waiting. ‡ household chores, caregiving, running errands.

ǂ Total hours spent on health care visits were multiplied by the average hourly wages in 2016 in Ontario ($28.76/hour for those above the age of 55) working full-time. The hourly rate was halved for those working part-time. No time costs were considered for non-working patients.

§Assessment point 6 months post-initial CR visit.

[a]Respondents were asked to report their medication costs in the previous 12 months, whereas all other values in this column were for the 6 months since the previous assessment, as per column header.

Table 2: Participant sociodemographic and pre-CR clinical characteristics, with associated time and out-of-pocket healthcare costs (N=411)

Characteristics	N (%) or mean ± SD	Total Patient Time Cost○ ($73.70±275.84)	Total Out-of-Pocket Cost○ ($377.01±321.72)
Sociodemographic			
Age† (% <65 years)	207 (51.2)	147.18±398.27**	423.19±380.13
(≥65 years)		28.02±142.36	337.30±258.85
Sex† (% Male)	287 (70.2)	76.89±302.36	314.41±239.97
(Female)		67.62±218.77	522.34±429.95**
Self-reported Ethnocultural Background (% North American)	126 (39.9)	81.89±243.32	364.66±335.01
(Other)		36.88±131.15	405.34±343.72
Marital Status (% married)	236 (74.7)	56.43±178.03	337.47±292.06
(Other)		52.03±207.87	557.09±438.98*
Education (% completed < college / university)	160 (50.6)	42.13±178.98	504.43±413.62**
(≥ college / university)		70.91±194.51	283.17±215.30
Work Status (% Full-Time / Part-Time)	83 (35.2)	491.36±557.42	317.98±354.50
(Other)		-	412.80±301.40
Area of residence (% urban)	128 (31.1)	44.30±133.10	319.89±252.09
(Suburban)		83.21±308.01	398.02±343.07
Clinical			
Peak METs†§‖ (mean ± SD at intake)	7.17±2.93	0.08	-0.03
Functional capacity‡‖ (mean ± SD at discharge)	25.10±10.28	0.07	-0.03
CR Referral Indication†			
PCI (% yes)	153 (39.8)	43.79±123.92	409.76±342.56
(no)		91.40±337.70	330.56±297.06
CABG (% yes)	109 (28.5)	99.52±270.61	322.10±260.74

(no)		63.42±284.82	370.12±320.63
Other (% yes)	211 (80.5)	48.84±133.55	362.73±324.92
(no)		143.35±590.03	527.54±274.17
Risk Factors†			
Dyslipidemia (% yes)	293 (82.5)	60.33±272.29	359.35±310.75
(no)		84.74±253.65	433.22±377.53
Hypertension (% yes)	290 (76.9)	73.27±294.72	388.17±337.10
(no)		80.34±244.44	329.66±255.80
Obesity (% yes)	154 (42.4)	86.60±381.49	461.26±355.84††
(no)		72.61±215.20	325.91±296.75
Diabetes (% yes)	77 (21.8)	126.19±499.13	394.84±210.21
(no)		67.31±206.63	384.55±345.98
Smoker (% yes)	11 (4.5)□	81.23±161.23	234.11±170.96
(no)		73.74±281.64	380.16±324.07

Note: Due to missing data, percentages for each characteristic were computed using a denominator value specific to the sample size with complete data for that variable.

Costs are reported in Canadian dollars.

for test of association between characteristic and cost, using t-test or Pearson correlation as appropriate, **p<.01; *p<.05; ††trend p<.10.

SD, standard deviation; CABG, Coronary artery bypass grafting; PCI, Percutaneous Coronary Intervention; MET, Metabolic Equivalent of Task.

- Participants who were not working were considered to have no time costs.

†source is medical chart (hospital or cardiac rehabilitation program). ǂsource is medical chart and/or self-report.

§from pre-cardiac rehabilitation graded exercise stress test. ‡from Duke Activity Status Index.

‖Pearson's r reported in this row for correlation with costs. ○Sum of CR discharge, 1 and 2 year costs.

□inferential test not calculated due to small cell sizes.

Figure 1: Participant Flow Diagram

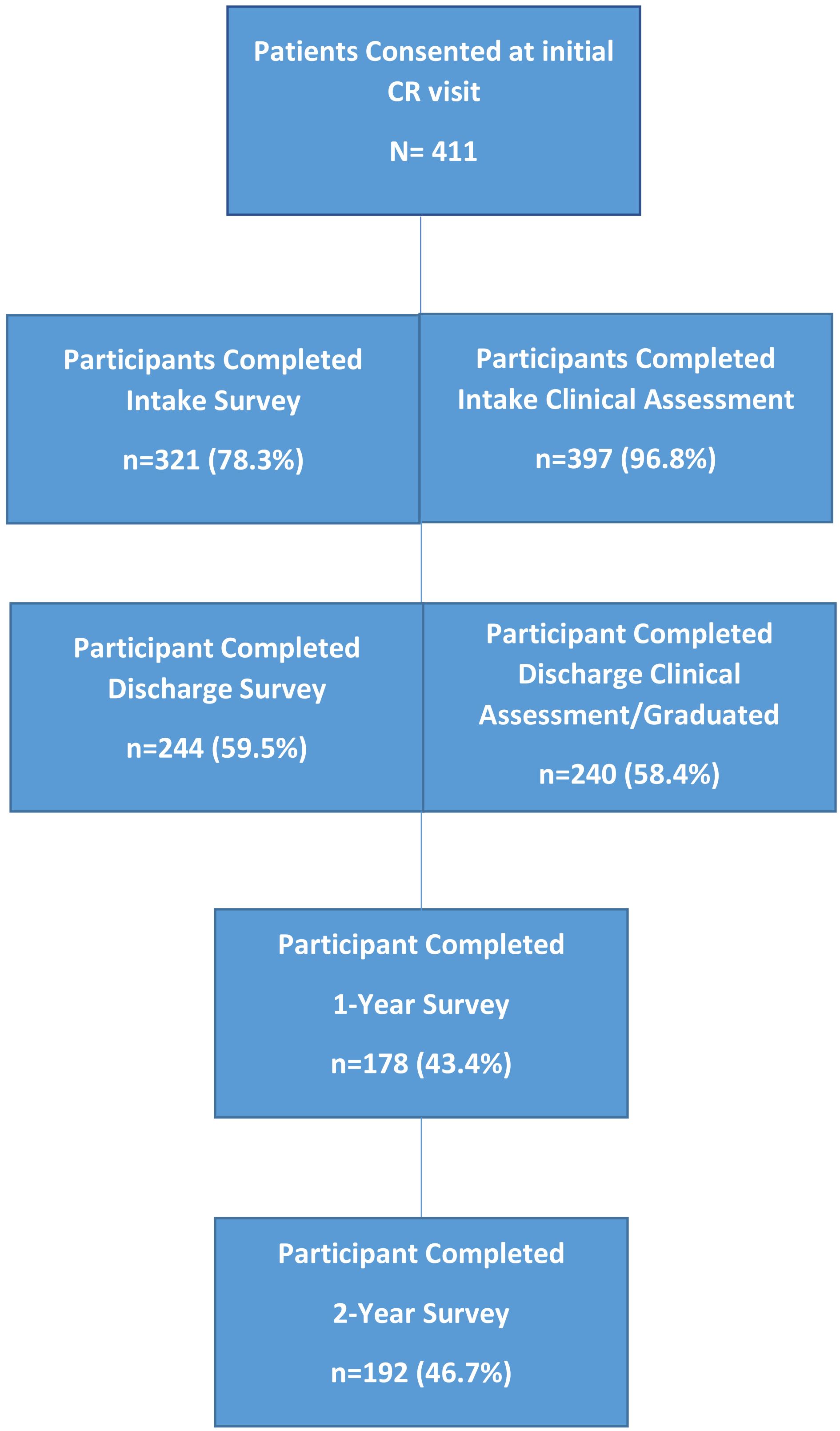
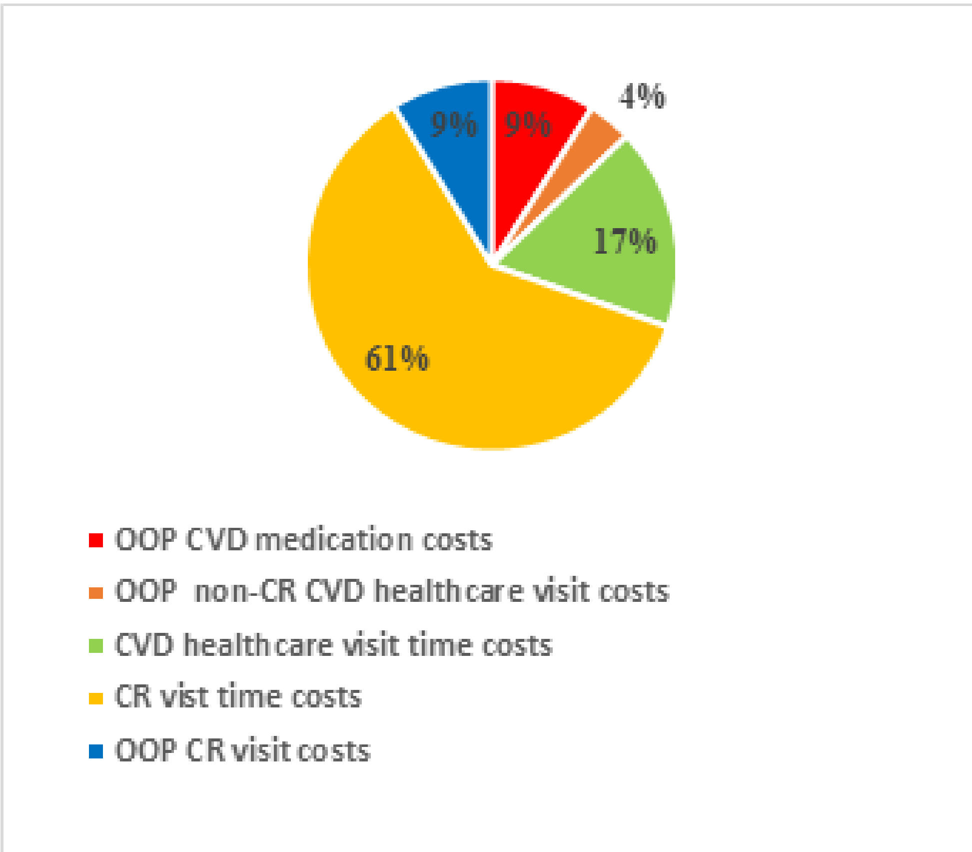
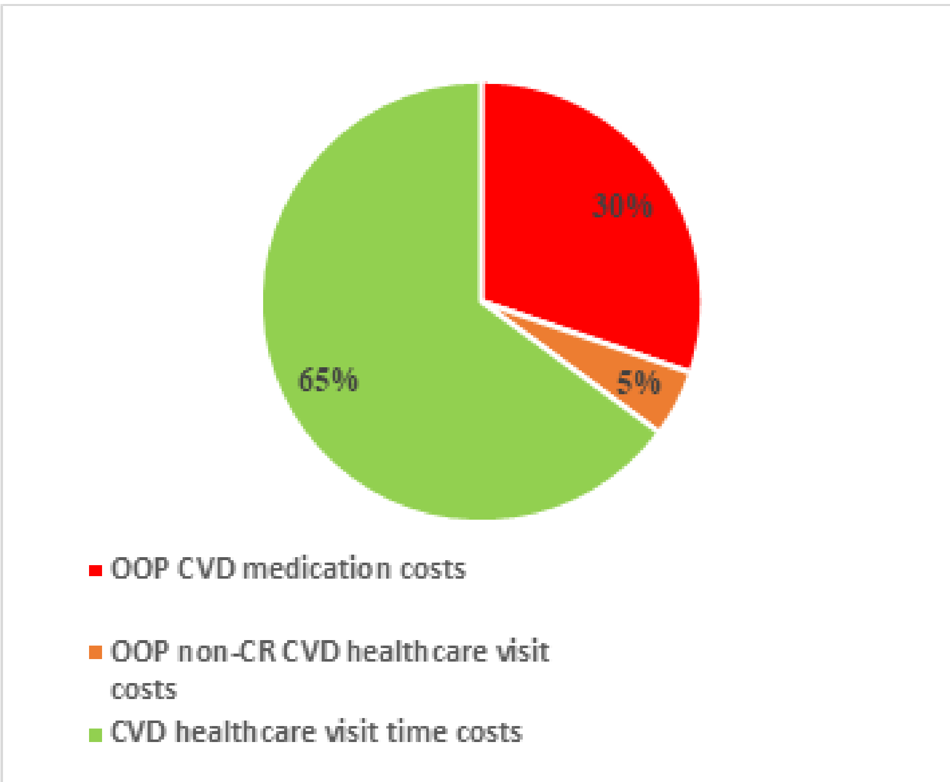


Figure 2: Patient CVD-related costs by work status and cardiac rehabilitation participation from CR intake over 2 years

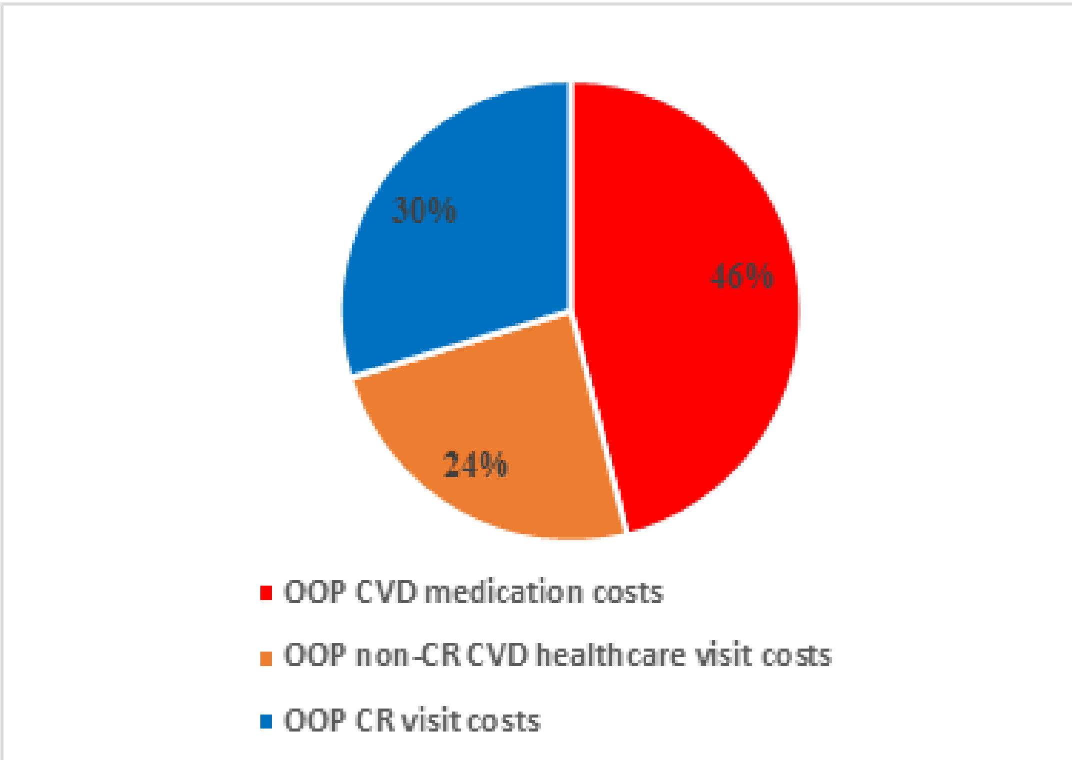
A) Full-Time, did not attend cardiac rehabilitation



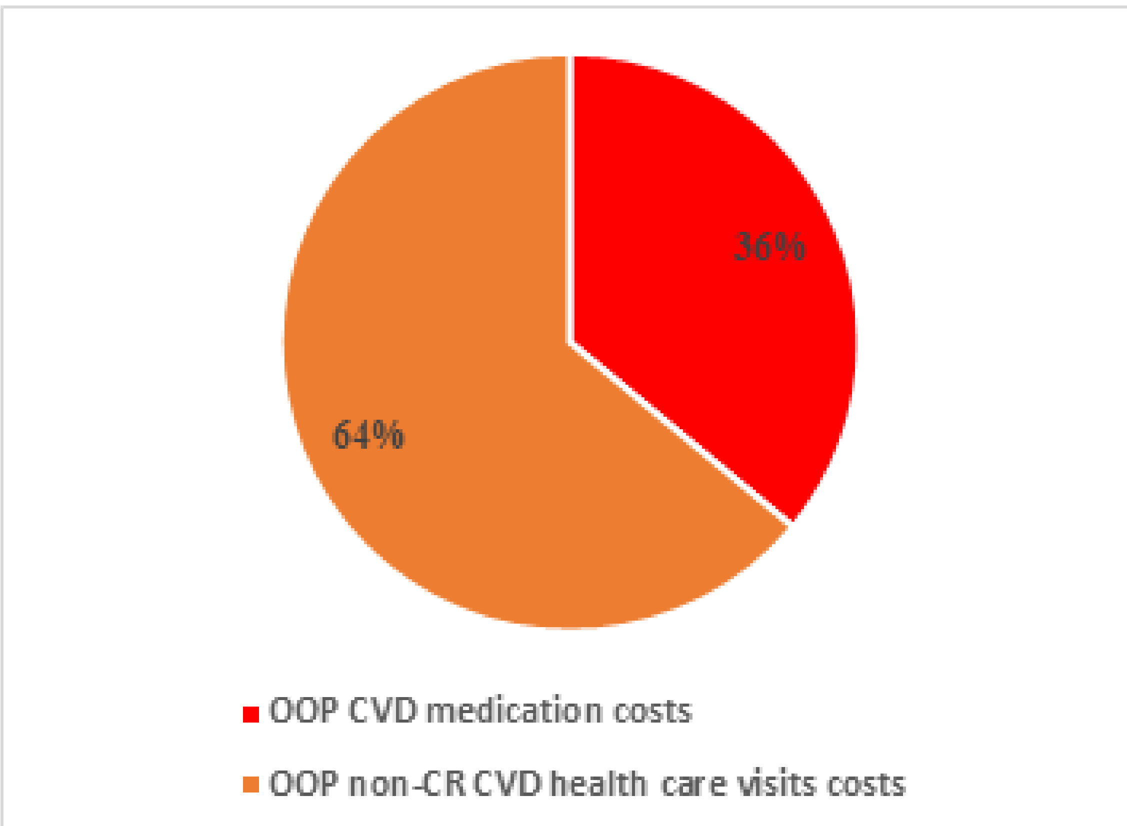
B) Full-Time, attended cardiac rehabilitation



C) Retired participants who participated in cardiac rehabilitation



D) Retired participants who did not participate in cardiac rehabilitation



Supplemental Table 1: Sociodemographic and Clinical Characteristics of Participants at Cardiac Rehabilitation intake by 2-year Survey Completion

Characteristics	Retained at 2 years (n= 192, 46.7%)	Lost to follow-up (n=219, 53.3%)	Total (N= 411)
Sociodemographic			
Age† (mean years ± SD)	65.17 ± 9.32	63.82 ± 11.30	64.47 ± 10.42
Sex† (% Male)	138 (71.9)	148 (68.5)	286 (70.1)
Ethnocultural background (% North American)	74 (46.5)	52 (33.1)	126 (39.9)*
Marital Status (% married)	100 (77.5)	91 (71.7)	191 (74.6)
Education (% < college/university)	74 (48.7)	69 (52.3)	143 (50.4)
Work Status (% retired)	74 (47.7)	48 (52.7)	122 (51.5)
Clinical			
Previous cardiac diagnosis (% yes)	7 (41.2)	12 (41.4)	19 (41.3)
Peak METs§ (mean ± SD)	7.26 ± 2.93	7.08 ± 2.95	7.17 ± 2.94
CR Referral Indication†			
PCI	72 (39.3)	81 (40.3)	153 (39.8)
CABG	56 (30.8)	53 (26.4)	109 (28.5)
Other	141 (73.4)	150 (68.5)	291 (70.8)
Risk Factors†			
Dyslipidemia	86 (80.4)	86 (74.8)	172 (77.5)
Hypertension	96 (81.4)	104 (81.3)	200 (81.3)
Obesity	69 (39.9)	85 (44.7)	154 (42.4)
Diabetes	31 (18.8)	46 (24.3)	77 (21.8)
Current Smoker	10 (5.4)	0 (0.0)	10 (5.4)

SD, standard deviation; CABG, Coronary artery bypass grafting; PCI, Percutaneous Coronary Intervention; MET, Metabolic Equivalent of Task.

†source is medical chart (hospital or cardiac rehabilitation program)

§from pre-CR graded exercise stress test.

*p<.05