Predictors of Patient Participation and Completion of Home-Based Cardiac Rehabilitation in the Veterans Health Administration for Patients With Coronary Heart Disease

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Traditional, facility-based cardiac rehabilitation (CR) is vastly underutilized in the United States. The Veterans Health Administration (VA) has developed new home-based cardiac rehabilitation (HBCR) programs to address this issue. However, the characteristics of patients who choose HBCR are unknown. We sought to determine predictors of participation and completion of HBCR at the San Francisco VA (SFVA). We evaluated patients hospitalized for ischemic heart disease between 2013 and 2016 at SFVA. Logistic regression models were used to identify predictors of participation and completion of HBCR. In 724 patients with ischemic heart disease who were eligible for CR between 2013 and 2016, 314 (43%) enrolled in HBCR. Older age was associated with lower odds of participation in HBCR (odds ratio [OR] 0.84; $p < 0.01$). Additionally, patients with coronary artery bypass grafting (CABG) were twice as likely as those with percutaneous coronary intervention to participate in HBCR (OR 2.03; 95% confidence interval 1.40, 2.97). In HBCR participants, 48% (150/314) completed ≥9 sessions. Patients with CABG were twice as likely as those with percutaneous coronary intervention to complete the HBCR program (OR 2.02; 95% confidence interval 1.18, 3.44). There were no differences in participation or completion rates by gender, race, ethnicity, or rurality. Our study showed that the SFVAMC HCBR program achieved a 43% participation rate, well above the VA average of 13%. There were no disparities by gender, race, or rurality in terms of participation and adherence. CABG as the indication for CR was the most significant predictor of participation and completion of HBCR. **(Am J Cardiol 2019;123:19−24)**

Cardiac rehabilitation (CR) is a multidisciplinary secondary prevention program aimed at lifestyle modification and improvement of cardiovascular risk factors such as hypertension, hyperlipidemia, diabetes control, smoking, and physical inactivity. However, this service is vastly underutilized. In veterans with ischemic heart disease, <15% participate in 1 or more sessions of CR,[1−3] whereas participation rate is <3% in veterans with heart failure.[4] To improve participation in CR, the Veterans Health Administration (VA) is developing new home-based cardiac rehab (HBCR) programs. HBCR and traditional center-based programs have been shown to similarly improve exercise capacity, health-related quality of life and risk of mortality in patients with coronary heart disease and heart failure.[5,6] However, limited data are available regarding the characteristics of patients who might choose to participate in HBCR programs at the VA. We sought to determine the predictors of participation and completion of the HBCR program at the San Francisco VA.

Methods

We used data collected between August 1, 2013 and December 31, 2016 through surveys and electronic health record review as part of the San Francisco VA Healthy Heart Program (a HBCR program implemented at the SF VA in 2013), previously described in detail.[7] Briefly, patients hospitalized for angina, myocardial infarction, percutaneous coronary intervention (PCI), or coronary artery bypass grafting (CABG) were referred to the program via an automated referral system. All referred patients were approached at the bedside by a CR nurse or exercise physiologist and offered education about health behaviors and cardiovascular risk factors (Phase I CR). The patients were then assessed for their

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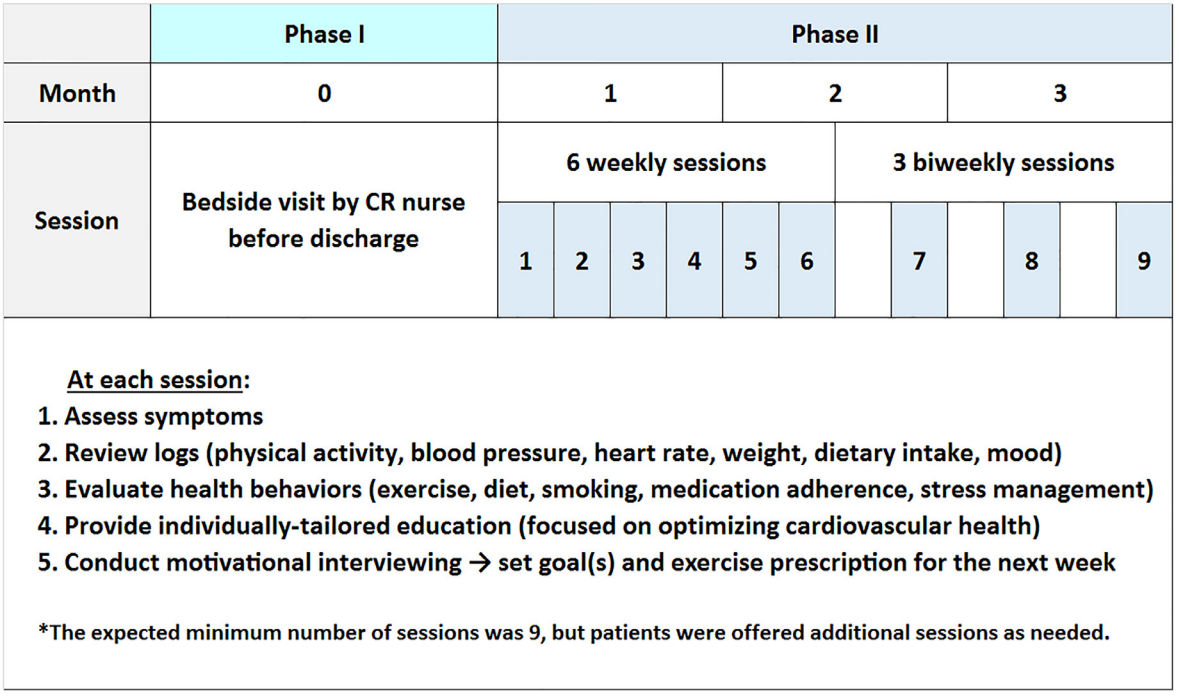

Figure 1. The San Francisco VA Healthy Heart Program.

eligibility to enroll in home and center-based CR. Eligibility for CR was defined using standard criteria.[8] Patients were considered ineligible for HBCR for conditions such as significant frailty, left ventricular ejection fraction $<35\%$ without implantable cardiac defibrillator, or cognitive limitations.[9] Eligible patients were offered referral to either (1) a non-VA center-based CR program through the VA community care program (also known as fee basis or CHOICE) or (2) a 12-week HBCR program. Following enrollment into the HBCR program, participants were provided with educational materials, exercise equipment (bikes, therabands) and heart rate trackers in addition to a log book to record their physical activity, weight, blood pressure, and heart rate. HBCR participants received telephone coaching with motivational interviewing on topics such as physical activity, healthy eating, medication adherence, and stress management on a weekly basis for 6 weeks and every 2 weeks for the following 6 weeks (Figure 1). The minimum expected number of sessions for completion of the program was 9; however, patients were offered additional weekly sessions as needed for specific topics such as smoking cessation or diabetes management.

We collected data on patient demographics (age at admission, gender, race, ethnicity, rurality, and body mass index) and comorbid conditions (previous history of ischemic heart disease, hypertension, diabetes mellitus, dyslipidemia, heart failure, and stroke) from VA electronic health records (VA Corporate Data Warehouse and Observational Medical Outcomes Partnership databases). Patients who were referred to non-VA center-based CR were excluded from the analysis due to lack of complete data. To determine the predictors of participation in HBCR, we used logistic regression models to run comparisons between HBCR participation and nonparticipation. We defined completion of the HBCR program as having completed 9 or more telephonic sessions. To evaluate the predictors of completion of HBCR, univariate and multivariate logistic regression models were used to compare characteristics of patients who completed HBCR to those who did not complete the program.

The study was funded by the Patient Centered Outcomes Research Institute and approved by the San Francisco Veterans Health Administration and University of California, San Francisco Institutional Review Boards.

Results

Between August 2013 and December 2016, 724 patients with IHD at the SF VA met eligibility criteria for HBCR. Of these, 410 (57%) did not participate in CR whereas 314 (43%) enrolled in our HBCR program (Table 1). The patients were predominantly White (78%), non-Hispanic (91%), and male (98%) veterans with an average age of 67 years. Sixty percent of patients had a PCI as the primary indication for CR. A comparison of the baseline characteristics between HBCR participants and nonparticipants revealed significant differences in age, CR indication, and prevalence of hypertension and dyslipidemia (Table 1).

We further compared characteristics associated with participation in HBCR to nonparticipation after adjusting for patient demographics and comorbid conditions (Table 2). We found that older patients were significantly less likely to participate in HBCR. Each 5-year increase in age was associated with a 16% lower odds of participation in HBCR (odds ratio [OR] 0.84; 95% confidence interval [CI] 0.76, 0.93, $p<0.01$). Moreover, patients with CABG as the

Table 1
Characteristics of patients eligible for cardiac rehabilitation at the San Francisco VA Medical Center from 2013 to 2016

Variable	All patients (n = 724)	Home based CR participants (n = 314)	Nonparticipants (n = 410)	p value
Age (years ± SD)	66.76 ± 7.86	65.59 ± 7.56	67.65 ± 7.98	< 0.01
Female	12 (2%)	7 (2%)	5 (1%)	0.29
Male	712 (98%)	307 (98%)	405 (99%)	
Non-White	97 (13%)	49 (16%)	48 (12%)	0.16
White	564 (78%)	242 (77%)	322 (79%)	
Hispanic	41 (6%)	18 (6%)	23 (6%)	0.95
Non-Hispanic	656 (91%)	285 (91%)	371 (90%)	
Rural	363 (50%)	158 (50%)	205 (50%)	0.90
Urban	360 (50%)	155 (49%)	205 (50%)	
Hypertension	399 (55%)	190 (61%)	209 (51%)	< 0.01
Diabetes mellitus	234 (32%)	108 (34%)	126 (31%)	0.28
Dyslipidemia	357 (49%)	171 (54%)	186 (45%)	0.01
Heart failure	39 (5%)	16 (5%)	23 (6%)	0.77
Stroke	69 (10%)	29 (9%)	40 (10%)	0.82
Body mass index (kg/m^2)				
< 25	125 (17%)	54 (17%)	71 (17%)	0.96
≥ 25	599 (83%)	260 (83%)	339 (83%)	
Indication				
Angina/myocardial infarction	104 (14%)	48 (15%)	56 (14%)	< 0.01
Coronary artery bypass surgery	187 (26%)	99 (32%)	88 (21%)	
Percutaneous coronary intervention	433 (60%)	167 (53%)	266 (65%)	

Number of patients with missing race = 63, missing ethnicity = 27, and missing rurality = 1.

indication for CR were twice as likely as those with PCI to participate in HBCR (OR 2.03; 95% CI 1.40, 2.97; p < 0.01). Patients with angina were also 1.6 times more likely than PCI patients to participate in HBCR, although this association was not statistically significant (OR 1.60; 95% CI 1.00, 2.56; p = 0.05). There were no significant differences in participation by gender, race, ethnicity, rurality, body mass index category, or comorbid conditions.

Table 2
Multivariate model to predict participation in home-based cardiac rehabilitation

Predictor variables	HBCR participation vs nonparticipation	
	OR (95% CI)	p value
Age (5-year increment)	0.84 (0.76, 0.93)	< 0.01
Female	Ref.	-
Male	0.66 (0.19, 2.35)	0.52
White	Ref.	-
Non-White	1.41 (0.89, 2.22)	0.14
Non-Hispanic	Ref.	-
Hispanic	1.00 (0.50, 2.02)	0.99
Urban	Ref.	-
Rural	1.08 (0.78, 1.49)	0.66
Hypertension	1.35 (0.90, 2.04)	0.15
Diabetes mellitus	0.90 (0.62, 1.31)	0.58
Dyslipidemia	1.36 (0.91, 2.03)	0.13
Heart failure	0.70 (0.33, 1.47)	0.35
Stroke	1.04 (0.60, 1.80)	0.88
Body mass index (kg/m^2)		
< 25	Ref.	-
≥ 25	0.89 (0.58, 1.37)	0.59
Indication		
Percutaneous coronary intervention	Ref.	-
Angina/myocardial infarction	1.60 (1.00, 2.56)	0.05
Coronary artery bypass surgery	2.03 (1.40, 2.97)	< 0.01

We evaluated the characteristics of the 314 patients who enrolled in the HBCR program between 2013 and 2016. Figure 2 demonstrates the distribution of number of sessions completed by the HBCR participants. Forty-eight percent (150 of 314) of patients completed the HBCR program during this period.

We compared patients who completed ≥ 9 sessions with those who completed 1−8 sessions to evaluate the predictors of completion of the HBCR program. On conducting univariate analysis, we found that patients who had undergone CABG were significantly more likely to complete ≥ 9 sessions in comparison to those who had undergone a PCI (OR 1.91; 95% CI 1.13, 3.22; Table 3). No other significant differences were seen in unadjusted analysis. On conducting a multivariate analysis, we found that CABG as the indication for CR was still significantly predictive of HBCR program completion. Patients with CABG were twice as likely as those with a PCI to complete the HBCR program (OR 2.02; 95% CI 1.18, 3.44; p = 0.01). There were no significant differences in completion rates by age, gender, race, ethnicity, rurality, body mass index category, or comorbid conditions.

Given the small sample size of females in our population and wide CIs for the OR estimates, we reran the participation and completion models without gender as a covariate. The results and model fit did not change, suggesting that the models were stable.

Discussion

CR is an underutilized service that has been shown to reduce cardiovascular mortality, hospital readmissions, and

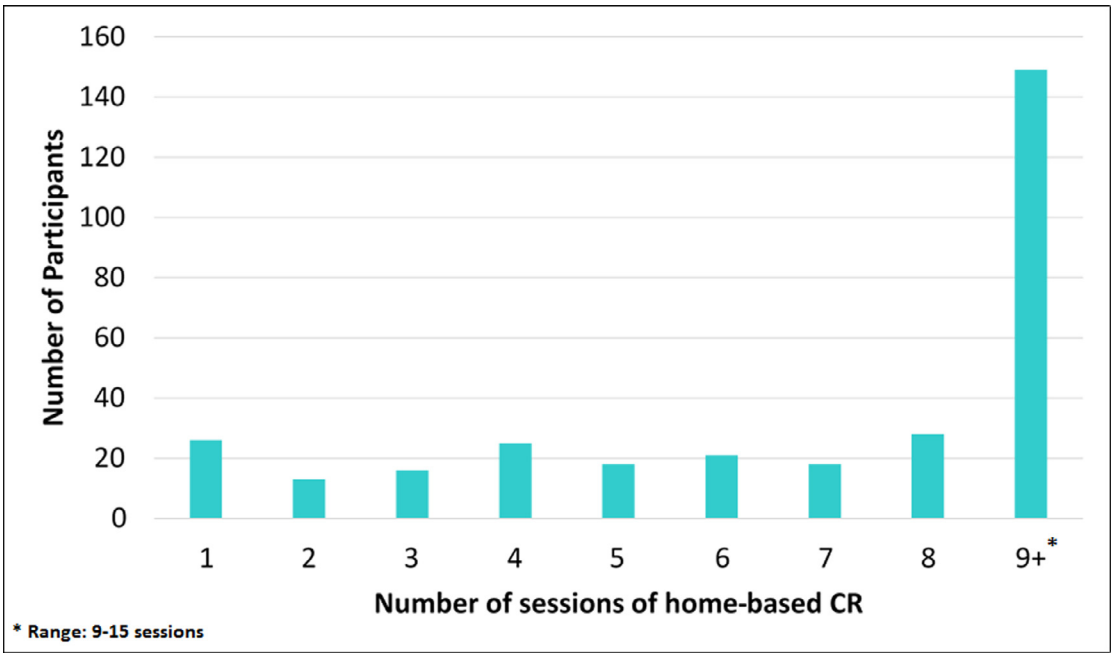

Figure 2. Distribution of number of sessions completed by HBCR participants. HBCR = home-based cardiac rehabilitation.

associated healthcare costs and improve health-related quality of life.[10–12] Efforts are underway to significantly improve participation in cardiac rehabilitation by the year 2020.[13] Our study showed that the SF VA HCBR program was able to achieve a participation rate of 43%, a rate much higher than the overall VA average of 13%.[3]

Moreover, we saw no evidence of disparities by gender, race or geography in terms of participation and adherence. CABG as the indication for CR was the most significant predictor of participation and completion of HBCR. Taken together, these findings suggest that offering HBCR has the potential to achieve the cardiac rehabilitation collaborative

Table 3
Patient characteristics associated with completion of 9 or more sessions of home-based CR

	Completed 1−8 sessions (n = 164)	Completed 9 or more sessions (n = 150)	Completion of ≥ 9 sessions vs 1-8 sessions		
			Univariate model	Multivariate model	
			OR (95% CI)	OR (95% CI)	p value
Age (years)	65.42 ± 8.57	65.78 ± 6.30	1.01 (0.87, 1.18)*	1.04 (0.89, 1.22)*	0.63
Female	4 (2%)	3 (2%)	Ref.	Ref.	-
Male	160 (98%)	147 (98%)	0.93 (0.19, 4.69)	0.94 (0.18, 5.05)	0.94
White	123 (75%)	119 (79%)	Ref.	Ref.	-
Non-White	28 (17%)	21 (14%)	0.77 (0.41, 1.43)	0.79 (0.41, 1.52)	0.48
Non-Hispanic	148 (90%)	137 (91%)	Ref.	Ref.	-
Hispanic	9 (5%)	9 (6%)	0.95 (0.36, 2.54)	0.88 (0.32, 2.47)	0.81
Urban	79 (48%)	76 (51%)	Ref.	Ref.	-
Rural	85 (52%)	73 (49%)	0.95 (0.60, 1.50)	0.83 (0.51, 1.37)	0.47
Hypertension	101 (62%)	89 (59%)	0.87 (0.55, 1.40)	0.84 (0.46, 1.55)	0.57
Diabetes mellitus	61 (37%)	47 (31%)	0.78 (0.48, 1.28)	0.79 (0.45, 1.38)	0.41
Dyslipidemia	90 (55%)	81 (54%)	1.00 (0.63, 1.59)	1.09 (0.62, 1.92)	0.77
Heart failure	10 (6%)	6 (4%)	0.79 (0.27, 2.34)	0.90 (0.28, 2.85)	0.86
Stroke	15 (9%)	14 (9%)	0.99 (0.45, 2.18)	1.11 (0.48, 2.58)	0.81
Body mass index (kg/m^2)					
< 25	34 (21%)	20 (13%)	Ref.	Ref.	-
≥ 25	130 (79%)	130 (87%)	1.66 (0.89, 3.10)	1.67 (0.87, 3.24)	0.13
Indication					
Percutaneous coronary intervention	99 (60%)	68 (45%)	Ref.	Ref.	-
Angina/myocardial infarction	22 (13%)	26 (17%)	1.73 (0.89, 3.36)	1.70 (0.86, 3.36)	0.13
Coronary artery bypass surgery	43 (26%)	56 (37%)	1.91 (1.13, 3.22)	2.02 (1.18, 3.44)	0.01

* 5-year increment in age as predictor variable.

goal of increasing participation by 2020 in an equitable manner.

The predictors of enrollment and adherence to center-based programs have been extensively studied in the past. Lack of access to CR programs,[1,14] health-related behaviors and socio-economic status have been associated with lower rates of participation.[15,16] Previous studies have reported differences in CR participation rates by gender, race, ethnicity, patient education and insurance status, in both national[17−22] and international[23−25] settings. Several center-based programs have reported lower participation rates in women compared with men.[19,20] Although our study population had only 2% women, we did not find any differences in participation or completion rates by gender. Similarly, while previous studies reported lower participation rates in nonwhite racial minorities[1,4,20−22], we did not find any significant differences by race or ethnicity.

Distance to a facility and transportation issues are also often cited as important barriers to enrollment in center-based CR.[26−28] This has particular relevance in the veteran population due to older age and a high burden of other medical conditions that might necessitate dependence on a caregiver for transportation. Nearly 3 million veterans enrolled in the VA healthcare system reside in a rural area, and tend to be sicker and older than urban veterans.[29] The high burden of cardiovascular diseases and very low participation rates in CR in the VA necessitate urgent measures for improving participation in secondary prevention programs. The introduction of home-based CR programs might be the solution to this challenge. As evidenced by our study, HBCR programs offer the opportunity to improve participation and eliminate geographical barriers at sites that only offer center-based programs.

Our study found that older veterans were less likely to enroll in CR. This might result from older veterans experiencing higher frailty, requiring closer monitoring or preferring supervised exercise therapy. Remote tele-monitoring mechanisms, patient education, and improvement of patient confidence can help promote CR participation in older patients. Indication for CR was the strongest predictor of both participation and completion of HBCR. We hypothesize that the negative experience of undergoing open heart surgery strongly motivates patients to participate in and complete the CR program, as opposed to a perceptively less invasive procedure such as PCI. Interestingly, one study conducted in 1999−2000 looking at the predictors of a HBCR program at a Colorado Kaiser Permanente clinic found comparable results: whereas older age was inversely associated with participation but not completion of the program, CABG was the strongest predictor of participation and completion of the HBCR program.[30]

Our study has several limitations. The patient population had relatively small sample sizes of women and Hispanics; larger studies are needed to study if disparities in HBCR participation and adherence exist in the VA system. Establishing standardized coding practices for HBCR will be necessary to enable identification in administrative data. will help us expand this study to a national level and additionally offer the power to examine clinical outcomes of HBCR in the VA. Moreover, the use of remote-monitoring technology in HBCR programs can help validate and quantify physical activity, serving as both a clinical and research tool for patient health improvement. Differences in length of stay, interactions within the healthcare system during the visit, and emotional trauma associated with the disease may play important roles in determining differential participation rates by indication of CR that we were unable to account for. We were also unable to obtain data on patient income, education level, and employment status, which have been identified as barriers in traditional center-based CR programs. Further research is needed to examine if HBCR can serve to eliminate these barriers.

Although HBCR has been previously proved to be an effective model for delivery of CR, there is a need for qualitative research looking at motivational and psychological factors determining participation and adherence to HBCR to improve this model of care. Particularly in the older veteran population, tools such as telemedicine and group support systems can be used to offer psychological support and reinforce patient motivation to participate in HBCR and transition into a healthier lifestyle. In conclusion, HBCR programs may offer a novel and sustainable solution to the issue of CR access in the VA healthcare system. Further research and implementation of HBCR programs should be considered to improve secondary cardiovascular prevention across the VA and reach the goal of 70% participation by year 2020.

Disclosures

The authors have no conflicts of interest to disclose.

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