Feasibility and Effectiveness of Remote, Telephone-Based Delivery of Cardiac Rehabilitation

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The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs.

Abstract

Objectives: Cardiac rehabilitation (CR) provides significant benefit for persons with cardiovascular disease. However, access to CR services may be limited by driving distance, costs, need for a driver, time away from work, or being a family primary caregiver. The primary aim of the project was to test the reach (i.e., patient and provider uptake), effectiveness (safety and clinical outcomes), and implementation (time and costs) of a remote telephone-based Phase 2 CR program. A secondary aim was to compare outcomes between patients attending the remote program (home-CR) and those attending an on-site program (comparison group). **Subjects and Methods:** Subjects were given a choice of the remote or face-to-face program. Remote CR participants (n=48) received education and assessment during 12 weekly by telephone calls. Data were compared with those for face-to-face CR program participants (n=14). Independent t tests and chi-squared tests were used for continuous and categorical variables, respectively. Repeated-measures analysis of covariance models were used to assess differences in outcomes. Costs were analyzed using a cost-minimization analysis. **Results:** Of 107 eligible patients, 45 refused participation, 5 dropped out, and 1 died unrelated to the study. Participants had a mean age of 64 (standard deviation 7.5) years. Remote CR participants were highly satisfied with their care and had a higher completion rate (89% of authorized sessions versus 73% of face-to-face). Costs for each program were comparable. There were no significant changes over time in any measured outcome between groups at 12 weeks except medication adherence, which decreased over time in both groups; face-to-face patients reported a greater decrease (p=0.05).

Conclusions: This is the first study to test a remote CR program in a population of older Veterans. Many hospitals do not provide comprehensive CR services on-site; thus remote CR is a viable alternative to bring services closer to the patient.

Key words: telecommunications, cardiology/cardiovascular disease, home health monitoring

Introduction

Cardiac rehabilitation (CR) services provide significant benefit for persons with cardiovascular disease.^{1–4} In spite of these benefits, such services are not universally available. Access to CR services may be limited by driving distance and travel costs, need for a driver because of comorbid conditions, time away from work, or being the primary caregiver to children or ill family members.^{5,6}

Small hospitals, including many Veterans Affairs (VA) medical centers with a high percentage of rural patients, do not offer on-site Phase 2 CR programs. Consequently, the VA has implemented a mechanism to ensure Veterans have access to CR through contracted services at hospitals in larger, metropolitan areas. However, even these contracted programs are not available in all areas and thus create a considerable travel burden for patients who live at a distance from the program site.

To address access issues and low attendance rates at on-site CR programs, investigators have evaluated home-based CR. Differences in outcomes between home- and on-site CR are minimal for risk factor modification, mortality, quality of life, clinical events, and costs.^{7–10} However, unknown is whether patients and providers would willingly adopt this approach in practice. Given the evidence of the effectiveness of CR, the efficacy of home-based programs, and known low attendance rates and access limitations to on-site programs, it was important to use the approach of giving the patient/provider a choice of home-based versus center-based CR. We used a well-known implementation five-element framework—Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM)¹¹—to evaluate implementation of a remote, telephone-based, Phase 2 CR program. RE-AIM is a framework for guiding implementation of evidence-based programs into practice settings.¹¹

“Reach” is the extent to which the program reaches its intended audience. “Effectiveness” measures outcomes improvement and adverse consequences that occur as a result of the program. “Adoption” is assessed at an organizational level and measures the participation rate of potential settings (i.e., how many

organizations or settings adopt the program). "Implementation" assesses intervention fidelity over time and among different staff involved in delivering the intervention or program, as well as costs of implementation. "Maintenance" assesses long-term effects on individuals over time and the sustainability of the program at an organizational level.¹¹

The primary aim of the project was to test the reach (i.e., patient and provider uptake), effectiveness (safety and clinical outcomes), and implementation (time and costs) of a remote telephone-based Phase 2 CR program. A secondary aim was to compare outcomes between patients attending the remote program (home-CR) and those attending an on-site program (comparison group).

Subjects and Methods

PATIENT POPULATION

Admission and appointment lists were screened by study staff (an exercise physiologist and a registered nurse) to identify potentially eligible patients from the cardiology clinic, the cardiac catheterization laboratory, or the inpatient medical service in a Midwestern VA Medical Center. Recruitment was augmented with the use of posters with program criteria and contact information placed on the inpatient floors in the physician workrooms, monthly attendance at orientation meetings for new resident physicians staffing in patient wards, and regular visits to areas most likely to have eligible patients. Inclusion criteria included an eligible diagnosis (i.e., acute myocardial infarction/acute coronary syndrome, post-coronary artery bypass graft surgery, percutaneous coronary intervention, or stable angina) in the prior 3 months, age 18 years or older, English-speaking, and medically cleared to participate in Phase 2 CR. Exclusion criteria included decompensated congestive heart failure, unstable angina, complex ventricular arrhythmias, CABG surgery redo, ejection fraction <35%, history of arrhythmia with syncope, severe symptomatic valvular disease, resting systolic blood pressure >200 mm Hg or diastolic blood pressure >100 mm Hg, dementia or other cognitive impairment (based on chart diagnosis or treating physician assessment), life expectancy less than 1 year due to advanced medical illness, and/or other medical illness precluding participation. Enrollment criteria were the same for both home-CR and comparison group participants and were consistent with VA enrollment criteria for Phase 2 CR, prior investigations comparing home and on-site programs,^{12,13} and advice from the cardiology department defining low-risk patients. Usual-care participants attended a Phase 2 CR on-site program that was selected based on geographic proximity to their home. The study was approved by the University of Iowa Institutional Review Board and the Iowa City Veterans Affairs Medical Center Research and Development Committee.

DATA COLLECTION

Once a potential patient was identified, his or her provider was contacted to ensure the patient met inclusion

criteria and could benefit from CR. Following provider approval, patients were approached by the study coordinator(s), who explained the study and informed the patient that he or she could choose the remote, telephone-based program, choose referral to a local face-to-face program, or refuse CR altogether. If a patient preferred to attend a face-to-face program, a study coordinator made the appropriate referral to VA staff to ensure that the consult was initiated and gave the patient the opportunity to participate as a comparison participant. Informed consent was obtained, and baseline data were collected in person from both home-CR and comparison group participants; outcome data were collected at 12 weeks from both home-CR and comparison group participants by telephone.

INTERVENTION DESCRIPTION

Following enrollment, participants who chose the remote CR program were trained on the program and instructed how to use the study equipment provided. Equipment included a portable exercise peddler, pedometer, heart rate monitor, and blood pressure cuff. Participants were also instructed how to contact local emergency medical services (EMS) in the event of chest pain (CP) or a medical emergency. The program was based on a Phase 2 CR program endorsed by the American Heart Association using a 206-page workbook and DVD "An Active Partnership for the Health of Your Heart." In addition, the investigative team developed a participant workbook that included worksheets for recording exercise, food diaries, written instructions for equipment, and other materials to supplement the "Active Partnership" book. To deliver the program, participants were telephoned each week for 12 weeks at a scheduled time to review program content. *Figure 1* outlines the elements of

Week Number and Topic
1. Introduction to Materials and Logs
2. Building a Healthier Future (understanding heart disease, the warnings and risk factors)
3. Improving Communication for Better Health (learning how to speak up and ask questions, prepare for visits)
4. Medications (improving medication adherence)
5. Eating Well
6. Physical Activity for Life (exercise and progression)
7. Losing Weight (controlling hunger, healthier choices, more physical activity)
8. Reducing Stress (stress reduction and relaxation techniques, stress and heart disease)
9. Feelings and Support (coping and finding support)
10. Smoking Cessation
11. Building a Better Future (review of topics, encouraging continuation of what they have learned in the program)
12. Review and Program Completion

Fig. 1. Outline of remote cardiac rehabilitation content.

the 12-week program. Patients were advised to either watch the DVD or read the information in the "Active Partnership" book on the appropriate topics before each weekly call. Patients were reminded the week before what topic would be covered the following week and where to find that in the book. A syllabus was also provided with page numbers or DVD topic titles for each week. Study staff then reviewed the material with the patient on the weekly call. During this time questions were answered about the previous week, if needed. If the patient did not have a chance to read the material, he or she was reminded where to find the material, and specific pages or charts were identified that might be useful. Some patients' spouses or family members also assisted in the education materials, helping them read or review them for future weeks. During the weekly calls, patients were queried about adverse events (i.e., CP and/or shortness of breath [SOB] using the Borg Perceived Exertion scale^{14,15}).

Participants were given an individualized exercise prescription based on the American College of Sports Medicine guidelines.¹⁶ Participants were instructed to exercise (i.e., walking or lower/upper extremity exercise for individuals with limited mobility using the portable exercise peddler) according to the prescription, ideally at least 30 min three times per week using a rating of perceived exertion. During the weekly calls, patients were assessed for physical activity or exercise completed during the week, including mode of exercise, duration, frequency, and intensity. Each week the patient's progression was assessed, and, based on the prior week's exercise, individualized advice was given to patients concerning exercise progression. Feedback was provided, encouraging patients who were exercising regularly, or advice on the need to increase exercise or physical activity in their daily life. Patients were advised about how to exercise, signs and symptoms to watch for to stop exercising, what exercises or activities were appropriate, how to monitor symptoms and vitals before, during, and post-exercise, how to contact EMS in case of an emergency, and the importance of having emergency medications available (e.g., inhalers, nitroglycerin). Strategies to help patients engage in their rehabilitation program included motivational interviewing techniques, goal setting, positive reinforcement, assisting patients in finding ways to incorporate activity into their daily activities, and finding hobbies or enjoyable activities that incorporated exercise.

MEASURES

Baseline data included age, gender, race, marital status, years of education, presence of a caregiver in the home (e.g., companion/spouse in home/nearby), and access to walking (e.g., indoor mall, gym, sidewalks, gravel road). Clinical parameters obtained from the electronic medical record included the most recent ejection fraction, blood pressure, pulse, and lipids (i.e., total cholesterol, low-density lipoprotein, high-density lipoprotein, and triglycerides). Weight was measured using a standard scale for all participants, and body mass index was calculated. Medication adherence, depressive symptoms, quality of life, and knowledge were collected by interview at baseline and 12 weeks following enrollment. Satisfaction with care, adverse

events, resource utilization, program completion rates, and program costs were measured at 12 weeks.

Medication adherence was measured by the Morisky Self-Reported Medication Taking scale,¹⁷ which includes four items addressing medication-taking behavior in patients with hypertension. Higher scores indicate better adherence. In prior studies, individuals scoring high on the scale were significantly more likely to have their blood pressure under control compared with individuals who scored low ($r=0.58$; $p<0.01$). The scale has been validated and used successfully in Veterans with hypertension (Cronbach's $\alpha=0.84$).¹⁸

The Geriatric Depression Scale (GDS)^{19,20} was used to screen for depression. The GDS contains 15 statements assessing depressed mood over the past week.²¹ The advantage of the GDS in older persons is its focus on symptoms that are less likely to be directly influenced by somatic illness compared with instruments designed for the general population. A score of >5 is suggestive of depressive symptoms; scores of >10 indicate presence of depressed mood. The GDS short form has a sensitivity of 92% and a specificity of 81% using a cutoff point of 5.²²

Health-related quality of life was measured using the Seattle Angina Questionnaire (SAQ),²³ which is a 19-item disease-specific health status measure for patients with coronary artery disease that quantifies current symptoms. The reliability of the SAQ has been established.²³ Subscales of the SAQ include physical limitation, angina stability, angina frequency, and quality of life scores, where higher scores are better. Lower SAQ scores are independently associated with increased risks of mortality and admissions for acute coronary syndrome.²⁴

Knowledge was measured using the Coronary Heart Disease Awareness and Knowledge questionnaire,²⁵ which is a 23-item instrument developed to measure patient knowledge in pathophysiology, risk factors, symptoms, treatment, and leading causes of death from coronary artery disease. In this study, we used 21 items and scored each correct answer with a 1, resulting in a range of 0–21 with a higher score indicated better knowledge. We removed two items because patients had difficulty understanding them: "A percutaneous coronary intervention is used to diagnose coronary heart disease" and "An angiogram can improve blood flow through narrow or blocked arteries." Satisfaction with care was assessed for home-CR participants through completion of an investigator-developed six-item survey assessing their perceptions of the remote program, where 0=completely unsatisfied to 5=completely satisfied.

Adverse event data included ambulance calls and CP with exertion or physical activity. Patients reported if they experienced pain doing household chores or yard work and SOB during the week for the home-CR group; these data were collected during weekly phone sessions. Veteran resource utilization data (i.e., hospitalizations and urgent care visits) were collected from the electronic medical record during the 12-week program time period. Program completion data were collected from program logs and payment records for the VA (number of sessions authorized and reimbursed) for participants who attended the face-to-face program.

Cost data for the comparison group were collected from VA payment records, which provided information on the number of face-to-face sessions attended and the amount reimbursed to the local program. Cost data for the home-CR participants included personnel salary, equipment, and materials. Costs estimated to be attributable to the research nature of the study were excluded (i.e., time to identify patients, get the consent form signed) as these costs would not be present in a clinical program.

ANALYSES

Descriptive statistics were calculated for demographic variables and outcomes. Independent *t* tests and chi-squared tests were used to check for significant differences between the comparison and home-CR groups at baseline with regard to continuous and categorical variables, respectively. For categorical variables with expected cell counts of less than 5 in at least 25% of cells, Fisher's exact test was used. For skewed continuous variables, the Mann-Whitney U test was used.

For outcome variables, repeated-measures analysis of covariance models were used to assess differences in baseline and 12-week outcomes between the two groups. Analysis of covariance models included variables to control for any covariates that were significantly unbalanced between the two groups at baseline. Residual plots and diagnostics were analyzed to assess the existence of outliers and influential observations. A significance level of $\alpha=0.05$ was used for all tests.

Cost data were analyzed using a cost-minimization analysis approach to identify the least costly intervention, on the assumption that both programs produced equivalent outcomes. Costs were analyzed from the perspective of the organization.^{26,27}

All analyses were conducted using SAS® statistical software version 9.2 (SAS Institute, Cary, NC).

Results

From August 2010 through August 2011, in total, 2,757 patients from the cardiology clinic, the cardiac catheterization laboratory, or the inpatient medical service were reviewed for potential study eligibility. From this group, 533 patients were identified as potentially eligible for CR and underwent additional screening based on inclusion and exclusion criteria. Of these, 426 were excluded by their treating physician for a variety of reasons, including cardiovascular condition too unstable to enroll ($n=312$; internal cardiac defibrillator placement, heart failure exacerbation, arrhythmias,

pulmonary hypertension), psychiatric diagnoses ($n=47$; substance abuse, impaired cognition), conditions limiting participation in a home-based program ($n=34$; orthopedic injuries limiting activity, hospice, dialysis, homelessness), known to be exceptionally non-adherent to treatment recommendations ($n=10$), discharged ($n=22$), or died prior to study staff contact ($n=1$).

There were 107 eligible patients who were then approached for possible participation. Of those, 45 (42%) refused, primarily because of lack of interest in attending any CR program. Of the remaining 62, 48 (77%) patients chose the home-CR program, and 14 (23%) chose the on-site program. Subsequently, five home-CR participants dropped out (8%) (two because of spouse illness, two who consented but could not be contacted after discharge, and one who decided she could not adhere to the program). One comparison participant decided not to complete the face-to-face CR program because of long driving time, and one died unrelated to the study, resulting in 43 home-CR participants and 12 comparison subjects for data analysis.

Table 1. Demographics for Intervention and Usual-Care Groups

	INTERVENTION (N= 43)	USUAL-CARE (N= 12)	P VALUE
Mean (SD) age (years)	63.7 (8.2)	63.8 (5.3)	0.97 ^a
Race (% white)	95	100	0.61 ^b
Gender (% male)	98	100	0.78 ^b
Years of education [median (IQR)]	13 (12–14)	12 (12–12)	< 0.01 ^c
Marital status (% married/living with partner)	63	67	0.26 ^b
Access to walking (% yes)	100	100	—
Caregiver (% yes)	81	83	0.33 ^b
Ejection fraction (%) [mean (SD)]	57.5 (7.9)	55.7 (11.3)	0.60 ^a
Smoker (% yes)			0.12 ^b
Never	9	33	
Former	56	50	
Current	35	17	
Reason for referral			0.01 ^b
PCI/stent	19	5	
Stable angina	14	0	
AMI/ACS	4	4	
Post-CABG	3	3	
Other CAD	3	0	

^aBy Student's *t* test.

^bBy Fisher's exact test.

^cBy Mann-Whitney U test.

ACS, acute coronary syndrome; AMI, acute myocardial infarction; CABG, coronary artery bypass graft; CAD, coronary artery disease; IQR, interquartile range; PCI, percutaneous intervention; SD, standard deviation.

For demographic variables there was a significant difference between the two groups for years of education and reason for referral ($p=0.01$, Mann-Whitney U test). Relative to the comparison group, the home-CR group had a lower percentage of participants referred for acute myocardial infarction (10% versus 33%) and post-coronary artery bypass graft (7% versus 25%) and a higher percentage of participants with stable angina (33% versus 0%). No other demographic variable was significantly different (Table 1). There were significant univariate differences in outcome variables over the 12-week time period for the home-CR group, including improvements in total cholesterol, low-density lipoprotein, depression, physical limitations, angina, disease perceptions, and knowledge (all at $p \leq 0.01$). Among the analysis of covariance models for the adjusted analysis, a significant main effect was detected for the Morisky Self-Reported Medication Taking scale ($p=0.05$) (Table 2). That is, both groups decreased in medication adherence over the 12 weeks, but the comparison group had a significantly greater decrease. No interaction effects were found. Veterans who used the home program were highly satisfied (Table 3).

Of the 48 participants in the home-CR group, 24 (50%) reported at least one episode of CP during a weekly call, and 22 (46%) reported SOB; 17 (35%) reported at least one episode of both CP and SOB. Frequencies of CP reports were then categorized into low (reported during 1–2 weekly calls out of 12), medium (reported during 3–5 weekly calls out of 12), and high (reported during 6–8 weekly calls out of 12). Although the number of participants reporting CP episodes decreased as reporting frequency went from low to high, the mean number of episodes increased, as did the pain severity rating. Participants were asked each week whether symptoms such as CP resulted in a call to the local EMS, and no participant reported calling EMS. Data on CP and SOB were not collected from comparison participants; thus it is not known whether they had similar rates of CP and SOB. Home-CR and comparison group participants had similar rates of hospitalizations and urgent care visits within the VA.

Program completion rates were higher in the home-CR group, where 36 of 43 participants (84%) completed at least 10 program calls (attendance ranged from 4 to 12 calls completed). The home-CR completion rate was 89% of all authorized sessions. Completion rate for the 12 comparison participants who attended the local CR pro-

Table 2. Comparison of Baseline and 12-Week Outcomes in the Intervention and Usual-Care Groups

	INTERVENTION (N=43)		USUAL-CARE (N=12)		P VALUE ^a
	BASELINE	12 WEEKS	BASELINE	12 WEEKS	
Blood pressure (mm Hg)					
Systolic	125 (18)	122 (18)	126 (14)	121 (12)	0.52
Diastolic	70 (9)	71 (12)	73 (13)	70 (10)	0.96
Heart rate (beats/min)	67 (8)	65 (13)	73 (13)	66 (9)	0.13
Total cholesterol (mg/dL)	169 (42)	150 (34)	158 (33)	148 (27)	0.15
High-density lipoprotein (mg/dL)	45 (12)	44 (11)	40 (9)	41 (11)	0.49
Low-density lipoprotein (mg/dL)	101 (31)	83 (28)	97 (30)	90 (22)	0.87
Triglycerides (mg/dL)	185 (146)	160 (102)	155 (109)	153 (93)	0.09
Body mass index (kg/m ²)	33 (6)	33 (6)	30 (6)	30 (6)	0.09
Weight (pounds)	226 (46)	226 (46)	212 (46)	215 (50)	0.23
Self-Reported Medication Taking ^b	0.93 (0.88)	0.80 (0.77)	0.63 (1.0)	0.36 (0.50)	0.05
Geriatric Depression Scale ^c	3.8 (3.4)	3.5 (3.5)	3.9 (3.6)	4.3 (3.8)	0.18
Seattle Angina Questionnaire ^d					
Physical Limitation	64.8 (20.4)	74.7 (26.8)	67.3 (24.7)	68.7 (22.3)	0.27
Angina Stability	53.2 (27.0)	55.1 (21.6)	52.1 (31.0)	54.2 (35.1)	0.66
Angina Frequency	72.5 (27.8)	84.0 (23.0)	74.2 (22.7)	82.5 (17.1)	0.56
Treatment Satisfaction	89.7 (13.4)	87.7 (16.4)	94.8 (7.5)	87.5 (15.8)	0.90
Disease Perception	53.6 (22.8)	71.6 (25.3)	62.5 (28.5)	75.0 (23.6)	0.92
CHD Knowledge ^e	17.4 (2.0)	18.4 (2.0)	17.5 (2.2)	18.5 (1.6)	0.95

Data are mean (standard deviation) values.

^aBy analysis of covariance model.

^bOn a scale of 0–4, higher is better.

^cOn a scale of 0–15, higher indicates more depressive symptoms.

^dFor each subscale, higher is better.

^eTwenty-one items. Higher is better.

CHD, coronary heart disease.

gram was 73% (202 of 276 authorized sessions) (number of authorized sessions planned ranged from 8 to 24). Attendance ranged from attendance from 1 session to 24 of the authorized sessions. One comparison participant did not attend CR because of driving distance.

A cost analysis showed that the cost of the remote program was comparable to the costs the VA paid for comparison participants to attend an on-site program. When delivered by an exercise physiologist, the cost of the program for the 48 participants enrolled was comparable to contracted costs (\$1,245 versus \$1,157). Because we found that approximately 100 patients per year would be eligible for the program, the cost per patient was extrapolated to a panel of 100 patients for a year; using this scenario, costs per patient were

Table 3. Intervention Group Patient Satisfaction (*n*=40)

QUESTION	MEAN (SD) ^a
The information I was given about the program before I started was helpful.	4.6 (0.6)
The educational information given to me during the rehab program was helpful.	4.7 (0.5)
Completing the rehab program at home was convenient.	4.8 (0.5)
The person who guided my cardiac rehab was helpful.	4.8 (0.4)
The person who guided my cardiac rehab had a good understanding of my medical condition.	4.7 (0.6)
I would recommend this program to other Veterans who would need it.	4.8 (0.4)

^aOn a rating scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.

SD, standard deviation.

reduced (\$807 versus \$1,157). When estimating the cost of the program using a registered nurse, the cost for the remote program increased to \$1,092/patient for 100 patients for the year. Thus, if the program employed a registered nurse instead of an exercise physiologist, costs would be slightly higher because of increased salary costs.

Not included in these calculations were miles traveled by participants who attended on-site programs. On average, the 12 participants who attended local programs traveled 14.8 miles round trip (median, 11.8; standard deviation, 10.8). Total actual miles traveled for all attended sessions were, on average, 258.9 miles (median 142.3; standard deviation, 280.5). If all scheduled sessions had been attended, total miles on average were 347.7 miles (median 276.7; standard deviation, 263.3).

Discussion

As noted in the Introduction, there are minimal differences between home and on-site CR patient outcomes. Using a well-known implementation framework, we demonstrated that patients and providers accepted a telephone-based, remotely delivered Phase 2 CR program (reach) and had similar clinical outcomes compared with participants who enrolled in a traditional face-to-face program (effectiveness). Although some participants experienced episodes of CP and SOB, none resulted in a call to the local EMS. Participants enrolled in the remote program were highly satisfied with the home-based program and had better attendance rates compared with face-to-face program participants. Costs analyses show the program is similar to a face-to-face program (implementation).

Maintenance assesses long-term effects on individuals over time and the sustainability of the program at an organizational level. We are currently embedding the remote program within our medical center, including development of standardized consult and documentation templates. Based on the results of this study, sev-

eral additional medical centers within the VA system have expressed interest in implementing the remote program within their settings; we will be providing assistance to these centers over the next year.

Although we limited enrollment to low-risk patients, there was some initial reluctance to refer patients to a home-based CR program due to potential adverse events occurring outside of a typical face-to-face CR program. Half of our participants experienced at least one episode of CP or SOB. A few (*n*=3) experienced CP during more than half of the weeks while enrolled in the program (6–8 weeks of 12 weeks). Safety precautions were emphasized during each weekly call (i.e., use of nitroglycerin and/or placing calls to local EMS). Although no participant called EMS, clearly, adverse events should be monitored in these types of programs. Organizations considering adoption of a remote program should carefully select enrollment criteria. One adjunct monitoring system to consider is a remote heart rate monitoring system for use during exercise sessions.

There are several limitations that should be considered. First, the program was implemented at only one medical center, and most of the participants were male, thus limiting the generalizability of the findings. Second, participants could self-select to the remote or face-to-face programs or chose not to participate in CR, which may have introduced bias. However, because our goal was to test patient and provider uptake of the remote program, participants were not randomized so as to introduce patient choice, an important unanswered question in prior trials of home-CR.¹⁰ We did not systematically collect data on why patients chose the remote program. Of note is that 77% of participants chose the remote program, frequently indicating it was a highly desirable option because of either driving distance to a face-to-face program and/or the ability to schedule the program around work schedules. Third, our sample size was small and uneven between the two groups; thus we could be underpowered to detect differences. Fourth, the comparison participants attended different CR programs that may not have had similar components, intensity, or duration. We did not assess the patient's history of exercise at baseline data, which may have introduced selection bias. We do not have data on the frequency of CP or SOB during on-site programs, so it is unclear whether the rates we report are comparable.

Conclusions

In the context of the RE-AIM model, this novel, telephone-based, remote CR program demonstrated similar outcomes to those of traditional face-to-face CR programs (effectiveness). The program was adopted by patients and providers (reach), resulted in high levels of patient satisfaction, was similar in cost, and reduced distance traveled for care (implementation). These findings suggest that a remote program may be either a feasible alternative or an adjunct to on-site programs. This program has the potential to be adopted by smaller hospitals that cannot support a traditional program or may be a service offered by traditional programs to provide a wider range of option for patients who can benefit from Phase 2 CR. A remote, telephone-based CR program brings services closer to the patient and

his or her home and offers patients a choice, a fundamental principle of patient-centered care.

Acknowledgments

The work reported here was supported by the Department of Veterans Affairs, Veterans Health Administration, Office of Rural Health, Veterans Rural Health Resource Center-Central Region, and the VA Health Services Research and Development Service through the Comprehensive Access and Delivery Research and Evaluation Center (grant REA 09-220). The authors acknowledge Kevin Dell-sperger, MD, PhD, for contributions to the design of the remote program and Jason Hockenberry, PhD, for assistance with the cost analysis.

Disclosure Statement

No competing financial interests exist. The authors had full access to and take responsibility for the integrity of the data.

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Received: March 18, 2013
Revised: April 23, 2013
Accepted: April 25, 2013