

Cardiac Rehabilitation Patient and Organizational Factors: What Keeps Patients in Programs?

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Background—Despite documented benefits of cardiac rehabilitation, adherence to programs is suboptimal with an average dropout rate of between 24% and 50%. The goal of this study was to identify organizational and patient factors associated with cardiac rehabilitation adherence.

Methods and Results—Facilities of the Wisconsin Cardiac Rehabilitation Outcomes Registry Project (N=38) were surveyed and records of 4412 enrolled patients were analyzed. Generalized estimating equations were used to account for clustering of patients within facilities. The results show that organizational factors associated with significantly increased adherence were relaxation training and diet classes (group and individual formats) and group-based psychological counseling, medication counseling, and lifestyle modification, the medical director's presence in the cardiac rehabilitation activity area for ≥ 15 min/week, assessment of patient satisfaction, adequate space, and adequate equipment. Patient factors associated with significantly increased adherence were aged ≥ 65 years, the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) high-risk category, having received coronary artery bypass grafting, and diabetes disease. Non-white race was negatively associated with adherence. There was no significant gender difference in adherence. None of the baseline patient clinical profiles were associated with adherence including body mass index, total cholesterol, low-density lipoprotein, high-density lipoprotein, triglycerides, and blood pressure.

Conclusions—Factors associated with adherence to cardiac rehabilitation included both organizational and patient factors. Modifiable organizational factors may help directors of cardiac rehabilitation programs improve patient adherence to this beneficial program. (*J Am Heart Assoc.* 2013;2:e000418 doi: 10.1161/JAHA.113.000418)

Key Words: adherence • cardiac rehabilitation • coronary heart disease • exercise • secondary prevention

Cardiac rehabilitation (CR) is a class I indication for patients with coronary heart disease (CHD).¹ Several major meta-analyses have shown that participation in CR promotes a healthy lifestyle, reduces risk factors, improves health-related quality of life, and decreases mortality and morbidity.^{2–7} Importantly, recent studies have demonstrated a dose-response relationship with higher attendance associated with lower mortality and morbidity.^{8,9} However, between 24% and 50% of patients who enroll in CR programs withdraw from the program.^{10,11} This problem of dropout is persistent, having been documented in the literature for at least 4

decades,^{12,13} and continues to pose a challenge to health policy makers in the management of CHD.^{11,14}

Several studies have been directed toward factors that improve patient adherence and completion of CR programs; the majority of these studies have examined patient factors.^{14–17} While health system-level factors that impact CR enrollment have been examined recently,^{18–21} few studies have investigated the role of organizational and system-level factors on CR adherence^{22,23}; also they are qualitative studies that do not quantify the strength of key findings. Moreover, to the best of our knowledge, there have been no studies that have examined the role of organizational and patient factors in patient adherence concurrently. Therefore, the aim of this study was to concurrently investigate the role of organizational and patient factors in CR adherence in a multisite study of 38 CR facilities in Wisconsin.

Methods

Data Sources

Data were provided by 38 of the 69 CR facilities in the Wisconsin Cardiac Rehabilitation Outcomes Registry (WiCORE)

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Received August 27, 2013; accepted September 18, 2013.

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Project in 2010. Program managers or coordinators of the 69 CR facilities were contacted via email requesting consent for participation in the study. A web-based survey that inquired into key organizational data was sent via email to 38 program managers and coordinators who chose to participate in the study. Patient data obtained from the WiCORE files included 4412 patients who enrolled in CR programs in these 38 CR facilities during the time period from January 1 to December 31, 2010, and were collected by the CR staff at each facility using the WiCORE web-based interface. The present study was approved by the Institutional Review Board of Brandeis University.

Measures

Patient factors

The WiCORE patient data set included: gender, race, age, educational level, social support, health insurance status, tobacco use (“current” smoker defined as actively using tobacco products at the time of the assessment or having quit within the past 12 months; “former” smoker defined as having used tobacco products in the past, but quit more than 12 months prior to the assessment; or “never smoked”), American Association of Cardiovascular Pulmonary Rehabilitation (AACVPR) risk category for cardiac events during exercise (low, moderate, high, as defined in the AACVPR Guidelines (p 63),²⁴ history of depression defined as whether the patient has a documented history of clinical depression (yes/no), days to start CR program (days from hospital admission, due to a cardiac event or referral date for angina diagnosis, to the first CR exercise session), admitting diagnosis and coronary procedures (yes/no): acute myocardial infarction (AMI), angina, heart failure, coronary artery bypass surgery (CABG), percutaneous coronary intervention (PCI), and valve replacement, comorbid conditions including diabetes, arthritis, gastrointestinal disease, pulmonary disease, back pain, peripheral vascular disease, renal disease, stroke, and musculoskeletal disease, as well as previous history of heart diseases (yes/no). Baseline levels of clinical measures were also collected including body mass index (BMI), total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides, systolic blood pressure, diastolic blood pressure, hemoglobin A1-c (A1C) for diabetic patients, left ventricular ejection fraction (%), physical activity (min/week), and medication use (yes/no): beta-blockers, angiotensin-converting enzyme inhibitors or angiotensin receptor blockers (ACEI/ARB), lipid medications, and aspirin.

Organizational factors

Facility variables included: (a) facility characteristics: geographical location (urban, rural defined by U.S. Census Bureau

at <http://www.census.gov/geo/www/ua/2010Urbanrural-class.html>), CR program location (in-hospital, outside hospital), medical school affiliation (yes/no), and whether other rehabilitation services were offered (maintenance or Phase III CR, pulmonary rehabilitation) (yes/no); (b) reminders after missing 2 classes (yes/no); (c) medical director involvement at the activity area for ≥ 15 min/week (yes/no), as observed by the CR staff (program managers or coordinators); (d) CR program resources: offering gender-specific classes (yes/no), scheduling classes before work and/or after work (yes/no), adequate equipment as judged by the CR staff (program managers or coordinators) (yes/no), adequate space as judged by the CR staff (program managers or coordinators) (yes/no), CR promotion to patients and healthcare providers (quarterly versus yearly/never), rewarding patients (yes/no), assessment of patient satisfaction (yes/no), provision of transportation (yes/no), and provision of parking (yes/no); and (e) types of CR services attended by patients (yes/no) including sessions on relaxation training (either individual or group format), diet (individual and group formats), psychological counseling (individual and group formats), lifestyle modification (individual and group formats), smoking cessation (individual and group formats), and medication counseling (individual and group formats).

Outcome

The outcome variable is adherence, which, in this study, is defined as attending at least the median number of exercise sessions (≥ 21) attended by the entire cohort.

Statistical Analyses

Summary statistics were used to describe the baseline characteristics and the proportion of adherents. Bivariate analyses were performed on patient- and organization-level factors to assess differences between adherent patients (adherents) and nonadherents. The differences were assessed using *P* values obtained by generalized estimating equations (GEE) with the LOGIT link function. A logistic regression model was fitted to identify significant patient and organizational predictors for CR adherence, the dependent (dichotomous) variable. This final parsimonious model was chosen with a stepwise forward variable selection technique in which all patient and organizational factors listed under Methods: “Patient Factors” and “Organizational Factors” were entered in the model one by one. If a variable had a value of $P < 0.05$, it was kept in the model for the next run in which a new variable was entered for examination. If a variable had a value of $P \geq 0.05$, it was removed from the model. Admitting diagnosis, age, sex, and race were always kept in the model as they have frequently been reported to be associated with adherence and

the process continued until all patient and organizational variables were examined. The GEE procedure was used to account for clustering of patients within CR facilities. The LOGIT link function and the exchangeable working correlation matrix were used in the GEE analysis. A value of $P < 0.05$ was considered statistically significant. All statistical analyses were performed using SPSS 19.0 (IBM Corporation).²⁵

Results

Adherence and Patient Factors

Our cohort consisted of 4412 patients who attended a median of 21 CR sessions with a range of 1 to 67 sessions. The mean age (\pm standard deviation) of patients was 65 ± 12 years; within the cohort, 30.4% were women and 95.3% were whites. The mean number of days from hospital admission due to a cardiac event, or referral date for angina diagnosis, to the first CR exercise session was 20 ± 13 days. Among patient characteristics, adherence was significantly ($P < 0.05$) associated with race, age, and AACVPR risk categories (Table 1). Adherence was also significantly associated with CABG procedure and diabetes diagnosis (both $P < 0.001$) (Table 2). Conversely, adherence was not significantly associated with gender, educational status, social support, health insurance status, smoking status, history of depression, or comorbid conditions (Tables 1 and 2). LDL cholesterol was the only variable among baseline clinical or physical variables that was significantly different between adherents and nonadherents 2.5 ± 1.0 mmol/L (95.3 ± 37.5 mg/dL) and 2.6 ± 1.0 mmol/L (99.1 ± 37.6 mg/dL), respectively ($P = 0.04$). However, this small difference (0.1 mmol/L or 3.8 mg/dL) is not clinically significant.

Adherence and Organizational Characteristics

Of the 38 CR facilities, one facility was affiliated with a medical school and one facility offered transportation for patients. All except 3 facilities offered a maintenance CR program (phase III). Table 3 presents organizational characteristics associated with adherence. Four organizational characteristics were positively associated with adherence: medical director involvement ≥ 15 min/week at the activity area ($P = 0.04$), adequate equipment ($P = 0.03$), adequate space ($P = 0.02$), and assessment of patient satisfaction ($P < 0.02$).

Table 4 presents the CR services attended by patients. Six services were positively associated with adherence ($P < 0.05$): group- and individual-based diet sessions, group-based psychological counseling, relaxation training, group-based lifestyle modification, and group-based medication counseling.

Table 1. Patient Characteristics Associated With CR Adherence (Attending ≥ 21 CR Sessions)

Characteristics	Adherent Group (N=2219), % (N)	Nonadherent Group (N=2193), % (N)	P Value
Gender			0.26
Male	69.1 (1533)	70.1 (1538)	
Female	30.9 (686)	29.9 (655)	
Race			<0.001
Whites	96.2 (2135)	94.4 (2070)	
Non-whites	3.8 (84)	5.6 (123)	
Age group			<0.001
<65 years	40.9 (907)	54.4 (1193)	
≥ 65 years	59.1 (1312)	45.6 (1000)	
Education*			0.16
<College degree	55.6 (1234)	48.6 (1066)	
\geq College degree	39.4 (874)	45.4 (996)	
Social support*			0.49
Living alone	26.5 (589)	26.4 (580)	
Living with adult	70.3 (1559)	69.9 (1533)	
Health insurance			0.07
Yes	96.3 (2136)	95.8 (2100)	
No	3.9 (86)	4.2 (93)	
Smoking			0.33
Never	40.1 (890)	38.0 (833)	
Former	46.8 (1038)	43.4 (952)	
Current	13.1 (290)	18.0 (394)	
AACVPR risk category			0.007
Low	28.7 (637)	36.6 (802)	
Moderate	39.8 (884)	36.2 (793)	
High	31.5 (698)	27.3 (598)	
History of depression	15.8 (351)	15.1 (331)	0.51

AACVPR indicates American Association of Cardiovascular and Pulmonary Rehabilitation; CR, cardiac rehabilitation.

*Missing data.

Adherence and Regression Analysis

Patient characteristics

Results of the logistic regression model examining both the patient and organizational factors role in CR adherence are presented in Tables 5 and 6. Patient predictors of CR adherence are presented in Table 5. Older patients (aged ≥ 65 years) were more likely to adhere with CR than younger patients (aged < 65 years). Non-white patients were less likely to adhere than white patients. Patients with CABG, patients in the AACVPR high-risk category, and diabetic patients were

Table 2. Patient Diagnosis and Comorbidities Associated With CR Adherence (Attending ≥ 21 CR Sessions)

Characteristics	Adherent Group (N=2219), % (N)	Nonadherent Group (N=2193), % (N)	P Value
Admitting diagnosis and procedures			
AMI	5.5 (123)	5.2 (115)	0.78
CABG	35.6 (790)	23.6 (518)	<0.001
PCI	42.1 (934)	54.2 (1188)	0.12
Angina	3.1 (69)	2.7 (59)	0.1
VR	8.9 (198)	9.5 (208)	0.74
Heart failure	4.3 (95)	4.5 (99)	0.54
Comorbid conditions			
Diabetes mellitus	33.1 (734)	26.2 (575)	<0.001
Arthritis	29.0 (644)	27.3 (599)	0.77
Gastrointestinal disease	16.2 (359)	19.1 (419)	0.34
Pulmonary disease	10.6 (235)	11.0 (241)	0.5
Back pain	11.1 (246)	10.7 (235)	0.94
Peripheral vascular disease	7.6 (169)	6.0 (132)	0.92
Renal	7.4 (164)	7.3 (160)	0.7
Stroke	5.4 (120)	4.8 (105)	0.3
Musculoskeletal disease	3.7 (82)	3.9 (86)	0.84
Previous history of heart diseases			
Angina	5.6 (124)	4.9 (107)	0.57
CABG	10.7 (237)	9.7 (213)	0.12
MI	11.5 (255)	11.6 (254)	0.68
PCI	17.7 (393)	18.3 (401)	0.83
Heart failure	4.7 (104)	4.2 (92)	0.36
VR	1.5 (33)	1.5 (33)	0.61
Peripheral artery disease	1.9 (42)	1.2 (26)	0.33

AMI indicates acute myocardial infarction; CABG, coronary artery bypass graft surgery; CR, cardiac rehabilitation; PCI, percutaneous coronary intervention; VR, valve repair/replacement.

more likely to adhere than patients who did not have a CABG procedure, patients in the AACVPR low-risk category, and patients without diabetes, respectively. None of the baseline clinical (lipid profile, blood pressure, hemoglobin A1-c for diabetic patients, body mass index) or physical activity variables were a predictor of adherence.

Organizational characteristics

Table 6 describes organizational predictors of adherence. Patient attendance at each of the following CR services was positively and significantly associated with adherence: group-

Table 3. CR Facility Characteristics and Adherence Rates (Attending ≥ 21 CR Sessions)

Characteristics	Adherent Group (N=2219), % (N)	Nonadherent Group (N=2193), % (N)	P Value
Geographical area			0.54
Urban	81.0 (1797)	83.0 (1821)	
Rural	19.0 (422)	17.0 (372)	
CR location			0.83
Inside hospital	85.7 (1902)	81.0 (1777)	
Outside hospital	14.3 (317)	19.0 (416)	
Provide pulmonary rehabilitation	81.4 (1806)	86.6 (1900)	0.97
Reminders after missing 2 sessions	32.5 (722)	44.6 (977)	0.74
Medical director involved ≥ 15 min/week	39.9 (886)	36.0 (790)	0.04
Offer gender-specific classes	7.2 (159)	2.8 (62)	0.42
Offer CR class before work	53.0 (1176)	57.0 (1251)	0.93
Offer CR class after work	17.5 (388)	11.5 (252)	0.81
Adequate equipment	84.3 (1871)	79.0 (1732)	0.03
Adequate space	59.8 (1327)	42.4 (930)	0.02
CR promotion quarterly	26.5 (588)	20.1 (441)	0.41
Rewarding patients	91.5 (2031)	91.7 (2010)	0.24
Assessment of patient satisfaction	73.9 (1640)	66.2 (1452)	0.02
Offer parking	91.1 (2022)	89.5 (1963)	0.84

CR indicates cardiac rehabilitation.

and individual-based diet classes, group-based psychological counseling, medication counseling, and lifestyle modification, as well as relaxation training (either individual or group format) classes. Other organizational factors positively and significantly associated with adherence included: presence of the medical director in the exercise area for ≥ 15 min/week as observed by program managers and coordinators, assessment of patient satisfaction, adequate space, and adequate equipment as judged by program managers and coordinators.

Discussion

This is the first study, to the best of our knowledge, to examine the role of organizational factors in explaining adherence to CR programs. The study includes a large number of patients (N=4412) who participated in CR at 38 program sites in Wisconsin from January 1 to December 31, 2010, and provides a comprehensive examination of organizational program

Table 4. CR Services Associated With Adherence (Attending ≥21 CR Sessions)

CR Service	Adherents (N=2219), % (N)	Nonadherents (N=2193), % (N)	P Value
Group diet class	70.2 (1558)	42.1 (923)	0.003
Individual diet counseling	49.5 (1098)	31.2 (684)	<0.001
Group psychological counseling	20.2 (448)	9.9 (217)	0.005
Individual psychological counseling	5.8 (129)	5.3 (116)	0.94
Relaxation training	49.5 (1098)	28.4 (623)	0.04
Group lifestyle modification	69.2 (1535)	47.3 (1037)	0.04
Individual lifestyle modification	62.2 (1380)	62.6 (1373)	0.37
Individual medications counseling	66.0 (1465)	61.9 (1357)	0.88
Group medications counseling	66.6 (1477)	42.9 (941)	<0.001
Individual smoking cessation counseling*	47.0 (142)	37.5 (156)	0.59
Group smoking cessation counseling*	6.3 (19)	5.3 (22)	0.28

CR indicates cardiac rehabilitation.
 *Number of smokers=718 (adherents=302, nonadherents=416).

factors as well as patient factors. A median number of 21 CR sessions was attended by this cohort, a number comparable to the median number of 25 sessions in 2 recent Medicare studies.^{8,9} In fact, the actual number of sessions patients attended upon completion of the CR program in our study varied by program and by patient though a standard program consists of 36 exercise sessions for Medicare beneficiaries.²⁶ Because more than half of the cohort in this study is Medicare beneficiaries (aged ≥65 years), we expected to have a median number of sessions comparable to that of the Medicare beneficiaries (25 sessions).^{8,9}

Notably, the average time from hospital admission due to a cardiac event or referral date for angina diagnosis to the first CR exercise session was 20±13 days. This was faster than the average in 2 recent studies, which average times from hospital discharge to CR enrollment of approximately 35 days.^{27,28} Nevertheless, it will be worthwhile to investigate the reasons for such a lag in time documented in all these studies.

Patient Factors

Older patients (aged ≥65 years) were more likely to adhere than younger patients (aged <65 years) and non-white

Table 5. Adjusted ORs of CR Adherence (Attending ≥21 CR Sessions) by Patient Characteristic

Characteristic	ORs	95% CI	
		Lower	Upper
Age group			
<65 years	1.00	Reference group	
≥65 years	1.56	1.24	1.97
Race			
Whites	1.00	Reference group	
Non-whites	0.60	0.41	0.88
CABG procedure			
No	1.00	Reference group	
Yes	1.54	1.24	1.82
AACVPR risk category			
Low	1.00	Reference group	
Moderate	0.91	0.68	1.22
High	1.42	1.15	1.76
Diabetes mellitus			
No	1.00	Reference group	
Yes	1.30	1.13	1.49

Forward stepwise variable selection model was used for identifying significant predictors. For the total list of variables examined, see “Patient Factors” and “Organizational Factors” under “Methods.” AACVPR indicates American Association of Cardiovascular and Pulmonary Rehabilitation; CABG, coronary artery bypass graft surgery; CI, confidence interval; CR, cardiac rehabilitation; OR, odds ratio.

patients were less likely to adhere than white patients confirming similar findings in published studies.^{15,29,30} The positive association between adherence and CABG observed in this study also supports previously reported findings.^{9,31} We found that AACVPR high-risk patients attended more CR sessions than AACVPR low-risk patients—also confirming previously reported findings.³² We also observed higher adherence in patients with diabetes than without diabetes. Although the literature on adherence and diabetes is inconsistent: other studies have reported that patients with diabetes were more likely to adhere than patients without diabetes,³² less likely to adhere,³³ and to have similar adherence rates.¹⁵ Differences in the association between diabetes and adherence may partially be explained by the variation in the cut-off point, in terms of number of CR sessions, used for adherence definition across published studies. However, an additional possible explanation for our finding could be that patients with diabetes were prescribed more CR sessions than patients without diabetes because diabetic patients were at higher AACVPR risk compared to their counterparts; in this study, 75.6% of patients with diabetes were either at high- (38.0%) or moderate-risk (37.6%) according to the AACVPR-risk categories.

Table 6. Adjusted ORs of CR Adherence (Attending ≥ 21 CR Sessions) by Characteristics of CR Facilities

Facility Characteristic	ORs	95% CI	
		Lower	Upper
Diet class (group)			
No	1.00	Reference group	
Yes	1.75	1.34	2.27
Diet counseling (individual)			
No	1.00	Reference group	
Yes	1.55	1.13	2.11
Psychological counseling (group)			
No	1.00	Reference group	
Yes	1.49	1.08	2.07
Medications counseling (group)			
No	1.00	Reference group	
Yes	1.41	1.02	1.95
Relaxation training			
No	1.00	Reference group	
Yes	1.25	1.01	1.56
Lifestyle modification (group)			
No	1.00	Reference group	
Yes	1.32	1.01	1.74
Medical director involvement			
<15 min/week	1.00	Reference group	
≥ 15 min/week	1.76	1.02	3.04
Assessing patient satisfaction			
No	1.00	Reference group	
Yes	3.32	1.30	8.51
Adequate space			
No	1.00	Reference group	
Yes	2.57	1.65	4.00
Adequate equipment			
No	1.00	Reference group	
Yes	2.03	1.08	3.81

Both Tables 5 and 6 report findings from the same regression model. CI indicates confidence interval; CR, cardiac rehabilitation; OR, odds ratio.

Organizational Factors

Diversity in the services offered and meeting explicit patient needs have been underlined as means to improve adherence to CR.^{34,35} In this study, patients were more likely to adhere in CR programs where patients attended diet classes and relaxation training (either individual or group format) and group-based psychological counseling, medication counseling, and lifestyle modification. Interestingly, adherence was associated with

group rather than individual classes for psychological counseling, medication counseling, and lifestyle modification.

Group sessions in which participants felt they were members of a group, or a club, and were welcomed, felt they belonged, and shared their experiences with patients with similar conditions have all been shown to be strong motivating factors to adhere to CR whereas patients who did not experience group solidarity were more likely to drop out.^{22,36} Our observation that group-based sessions seem to keep patients in CR programs longer than individual-based sessions is consistent with these observations.

Diet classes were predictors of adherence in the present study. This result may indicate that patients who attended diet classes perceived additional benefits of the CR program—a factor frequently documented as a predictor of adherence.^{22,36,37} In diet classes, patients learn strategies to translate knowledge into behavioral change such as healthy eating habits for eating at or outside home and using recipes of inexpensive and healthy foods. In addition, participation of patients' spouses at group diet classes may provide a family support for patients to attend more CR sessions as reported by some program managers/coordinators who participated in our study. Patients whose spouses participated actively in group counseling were found to have the highest compliance with weekly exercise compared to other groups in which spouses did not participate.³⁸

Previous studies have demonstrated psychological distress as a predictor of patient drop-out from CR programs^{17,39} while relaxation training has been associated with reduced distress and depression.^{40,41} Consistent with these observations, patients in our study who received relaxation training and psychological counseling were more likely to adhere to CR than patients not participating in these services.

Lifestyle modification has been perceived as a challenge to CHD patients in a qualitative study; this is probably due to both the implementation of too many changes at once and to the lack of professional support in the community.⁴² Our finding of positive association between lifestyle modification and adherence to CR reveals the potential of this aspect of CR services in addressing this challenge for CHD patients. In particular, lifestyle modification classes addressed content aspects critical to CHD patients, including assessment, education, and monitoring of weight loss, tobacco cessation, stress management, and dietary and physical activity behaviors, as well as support from a health professional who helps empower patients to make practical lifestyle changes and to overcome obstacles.^{18,43,44} Pertinent to CR staff support, we found that involvement in the exercise area by the medical director for ≥ 15 min/week was positively associated with adherence. It may well be an indirect effect of the medical director whose presence in the activity area positively influences the CR staff, and consequently they have greater

influence on patients' adherence and performance. Another explanation could be that the visibility of the medical director to patients during exercise keeps patients in a program, particularly if the director is the referring physician as previous studies have shown that the referring physician's support is an influential factor in CR participation and adherence.^{18,43} Frequent encouragement by professionals and discussing progress has been reported to be among the most important CR features for continuing in CR programs.⁴⁵

Our finding of a positive association between assessment of patient satisfaction and CR adherence supports recent recommendations by the Michigan Society for Cardiovascular and Pulmonary Rehabilitation⁴⁶ on the use of patient satisfaction surveys as a tool to improve adherence to CR. Assessment of patient satisfaction has increasingly gained the attention of policy makers because it provides an opportunity for CR managers to identify and address problems and, therefore, potentially improve health services.⁴⁷ Adequate resources, including space and equipment, as judged by our survey respondents, including program managers and coordinators, were positively associated with adherence in this study. Conversely, inadequate physical space and lack of equipment have been identified as barriers to CR enrollment in qualitative studies.^{48,49} Our results support and extend adequate space and equipment as predictors of CR adherence.

Limitations

Due to data limitations, we were unable to examine a number of factors that have been associated with adherence in other published studies; these factors included copayment,⁵⁰ income,³⁷ self-motivation,^{37,51} and work demands.³² Another factor for which data were unavailable was the number of CR sessions covered by the patient's health insurance plan, which could have limited the number of CR sessions an individual patient was permitted to attend. An additional limitation is related to the nature of observational studies. Some of the services attended by patients could be considered as outcomes in our GEE modeling rather than predictors (Table 6). For example, the more exercise sessions patients attend, the more likely they are to get the educational classes because these classes are usually held in conjunction with the exercise session. Self-selection bias must be considered as only 38 of the 69 CR facilities in the WiCORE Project (55%) chose to participate in our study in 2010, hence limiting the generalizability of our findings. In addition, the relatively small number of CR programs included in the analysis (n=38) may explain the failure to detect statistically significant relationships between adherence indicators and some of the organizational factors. For example, nonsignificant trends were observed in the associations between adherence and the following factors: CR programs located inside hospitals,

gender-specific classes, CR classes held after work hours, available parking, and CR promotion. Therefore, we suggest replicating the present adherence study with a larger number of CR facilities.

Conclusions

Both organizational and patient factors have key roles in CR adherence. The interpretation of the results of this study has important implications for CR program directors; organizational factors do influence patient adherence with CR programs. Some modifiable organizational factors have been identified, including medical director involvement, adequate space and equipment, assessment of patient satisfaction, and the characteristics of educational classes, each of which may help decision makers improve patient adherence to CR programs.

Acknowledgments

The authors would like to thank the Wisconsin Society for Cardiovascular and Pulmonary Health and Rehabilitation members particularly the WiCORE administrators and staff who provided the data, specifically, Mark Vitcenda, MS (WiCORE Project Manager) for providing the data files and reviewing the manuscript, Sandra Zemke, BSN (Supervisor of CR programs, Aurora St. Luke's Medical Center) for her contribution in the development of the organizational questionnaire, and the many CR staff participating in WiCORE for their efforts in entering patient data and providing invaluable feedback.

Disclosures

None.

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