Cardiac Rehabilitation and Survival of Dialysis Patients after Coronary Bypass

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Patients who are on renal dialysis are at high risk for cardiac death and have a large burden of cardiovascular disease and cardiovascular disease risk factors. Cardiac rehabilitation can promote improved survival of nondialysis patients after coronary artery bypass grafting (CABG) surgery and is covered by Medicare, but no previous studies have investigated whether dialysis patients’ survival after CABG may be improved as a function of cardiac rehabilitation. A prospective cohort study was conducted using Medicare claims (1998 to 2002) for CABG and cardiac rehabilitation and patient information from the United States Renal Data System database for 6215 renal patients who initiated hemodialysis and underwent CABG between January 1, 1998, and December 31, 2002, with mortality follow-up to December 31, 2003. Cardiac rehabilitation was defined by Current Procedural Terminology codes for monitored and nonmonitored exercise in Medicare claims data. Dialysis patients who received cardiac rehabilitation after CABG had a 35% reduced risk for all-cause mortality and a 36% reduced risk for cardiac death compared with dialysis patients who did not receive cardiac rehabilitation, independent of sociodemographic and clinical risk factors, including recent hospitalization. Only 10% of patients received cardiac rehabilitation after CABG, compared with an estimated 23.4% of patients in the general population, and lower income patients of all ages as well as women and black patients who were aged 65+ were significantly less likely to receive cardiac rehabilitation services. This observational study suggests a survival benefit of cardiac rehabilitation for dialysis patients after CABG.

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data that were available for analysis. The patients identified were those
who had procedure codes 36.10 to 36.19 of the International Classification
of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) in Part A
and/or Part B Medicare claims. For patients who were younger than 65
yr, only those with CABG procedure dates that occurred day 90 or later
of ESRD were included, because many patients who are younger than
65 yr do not become eligible for Medicare for up to 90 d after initiating
dialysis and therefore may have incomplete claims data before this.

Determination of Cardiac Rehabilitation, Patient
Characteristics and Medical History, and Vital Status

Cardiac rehabilitation, the primary independent variable in this
study, was identified by Current Procedural Terminology codes 93797
for nonmonitored exercise and 93798 for monitored exercise. These are
Health Care Financing Administration Common Procedure Coding
Standard codes. Code 93797 indicates physician services for outpatient
cardiac rehabilitation without continuous electrocardiogram monitor-
ing per session, whereas code 93798 indicates physician services for
outpatient cardiac rehabilitation with continuous electrocardiogram
monitoring per session. Medicare coverage of participation by eligible
patients in up to 36 sessions of a cardiac rehabilitation exercise program
is considered reasonable and necessary, with three sessions a week in a
single 12-wk period of therapy (5).

Patient age, gender, race, and dialysis start date were obtained from
the USRDS Patient Standard Analysis File (SAF), along with Medicaid
coverage at treatment start (yes/no), which was included as an indica-
tor of socioeconomic status (Medicaid is a federal/state health insur-
ance entitlement program for low-income people). Clinical characteris-
tics that were documented at treatment start (primary diagnosis of
diabetes, number of existing cardiovascular conditions [congestive
heart failure, coronary artery disease, history of AMI, cardiac arrest,
dysrhythmia, cerebral vascular disease, peripheral vascular disease],
ambulation status [yes/no], chronic obstructive pulmonary disease,
serum albumin [g/dl], and hemoglobin [g/dl]) were also obtained from
the USRDS Patient SAF. AMI that occurred before CABG but after
dialysis start was identified by the appearance of ICD-9-CM diagnosis
codes 410, 410.X0, and 410.X1 in Part A or Part B Medicare claims.

Type of dialysis facility (hospital-based, non–hospital-based) in
which the patient initiated dialysis was identified from USRDS Patient
History Files (RXHIST and RXHIST60) that are constructed by the
USRDS Coordinating Center and contain information about patients’
original Centers for Medicare and Medicaid Services dialysis providers.
Although approximate, this measure was the best indicator of the
patient’s probable type of dialysis facility when cardiac rehabilitation
services were received. A transplant event that occurred after CABG
was identified from the USRDS Transplant SAF.

Patient mortality data for up to 6 yr were obtained from USRDS
Patient Files that contained information through December 31, 2003,
on date of death and primary cause of death. Cardiac causes of death
were AMI, hyperkalemia, pericarditis, atherosclerotic heart disease, cardio-
myopathy, cardiac arrhythmia, cardiac arrest, valvular heart disease,
and pulmonary edema. Data for individual patients from the various
USRDS files were linked using the unique patient identifier that was
assigned to each patient by the USRDS Data Coordinating Center.

Statistical Analyses

The hazard function of cardiac rehabilitation, among alive patients,
was modeled as a time-to-event outcome using the Cox proportional
hazards model. The study start date was defined as the CABG proce-
dure date. Separate models were estimated for patients who were aged
65+ and patients who were younger than age 65. Predictors in these
models included patient demographics and clinical measures, as well
as type of facility in which the patient initiated dialysis (hospital-
based/non–hospital-based).

To explore the effect of cardiac rehabilitation on survival, we ana-
yzed both all-cause death and cardiac death using the Cox propor-
tional hazards model. The analyses were restricted to patients who
survived at least 90 d after CABG to minimize the effect on patient
survival of postsurgery complications that are likely to be associated
with early death. For patients who received a transplant, the follow-up
time was censored at the time of transplantation. Cardiac rehabilitation
as a time-varying indicator was included in these models, along with
time-independent patient demographic and clinical predictors. To ad-
dress concern about the potential confounding effect of a patient’s
health status at the initiation of cardiac rehabilitation, we further con-
sidered two additional sets of models. The first set added an indicator
of hospitalization during the post 30 d. The second set included cardiac
rehabilitation within 6 mo of CABG only, which was treated as a
time-independent indicator; approximately 90% of observed cardiac
rehabilitation occurred within 6 mo of CABG surgery. Statistical anal-
yses were performed using SAS (SAS Institute, Cary, NC).

Results

Demographic and medical characteristics of the study cohort
are shown in Table 1. More patients who underwent CABG
were male (61%) than female, and the average patient age was
almost 68 yr. More than three fourths of patients in the cohort
were white. The average number of documented cardiovascular
conditions at dialysis start was 1.4 ± 1.4 (range 0 to 7); 79%
of patients had zero to two documented conditions, and the
remainder had three or more documented conditions. Half of
the patients who underwent CABG had developed ESRD as a
result of diabetes, and 41% sustained an AMI after starting
dialysis. The average number of months on dialysis at the time
of CABG surgery was 11.6 ± 13.1.

Approximately 10% of dialysis patients who underwent
CABG subsequently received cardiac rehabilitation (10.4% of
patients aged <65, 9.9% of patients aged 65+). The mean ± SD
number of days between CABG and cardiac rehabilitation was
88 ± 100 d; 50% of patients who received cardiac rehabilitation
did so within 60 d after CABG, and 90% of patients who
received cardiac rehabilitation did so within 183 d after CABG,
<i.e.</i>, 6 mo. The majority of patients who received cardiac reha-
bilitation received monitored exercise.

Lower income patients of all ages, as measured by Medicaid
coverage at treatment start, were less likely to receive cardiac
rehabilitation (Table 2). Among patients who were aged 65 and
older, men were significantly more likely than women to re-
ceive cardiac rehabilitation, whereas black patients and patients
who were nonambulatory were less likely to receive cardiac
rehabilitation. There was a trend for older patients with dia-
betic ESRD to be less likely to receive cardiac rehabilitation and
for older patients with higher serum albumin to be more likely
to receive cardiac rehabilitation (Table 2).

To investigate the effect of cardiac rehabilitation on all-cause
and cardiac death, several sets of models were adopted to
address the potential confounding effect of a patient’s health
status at the initiation of cardiac rehabilitation. All models
provided similar results. The results for the model with cardiac
rehabilitation and hospitalization within 30 d as time-varying indicators are given in Table 3.

Only patients who survived at least 90 d beyond CABG were included in the survival analysis, to exclude in-hospital and other early deaths after surgery. Cardiac death accounted for 45% of all deaths that were observed in the study cohort. Cardiac rehabilitation was a significant predictor of reduced risk for all-cause death (hazard ratio 0.65; 95% confidence interval 0.56 to 0.76; \( P < 0.001 \)) and risk for cardiac death (hazard ratio 0.64; 95% confidence interval 0.51 to 0.81; \( P < 0.001 \)). In addition, older patient age (≥65), higher number of cardiovascular conditions at dialysis start, AMI before undergoing CABG, chronic obstructive pulmonary disease, nonambulatory status, longer time since starting dialysis, and recent hospitalization were associated with increased risk for both all-cause and cardiac death. Black race and higher serum albumin were associated with reduced risk for all-cause death, and lower income, as measured by Medicaid coverage, was associated with reduced risk for cardiac death.

### Discussion

Cardiac rehabilitation is recommended as a standard component of care for patients who are recovering from CABG (6). A national survey of 500 randomly selected cardiac rehabilitation programs found that 23.4% of CABG survivors enrolled in these programs (6), a rate more than twice as high as the rate that we observed (10%) among CABG survivors who were on dialysis. In addition, in the dialysis cohort that we studied, lower income patients were less likely to receive cardiac rehabilitation, and older women and older black patients were less likely to receive cardiac rehabilitation after CABG.

Determinants of participation in cardiac rehabilitation can be classified broadly as patient-related factors, including ease of transportation, severity of disease, personal preferences, and family support; physician-related factors, including perception of benefit for the patient and strength of recommendation to enroll in cardiac rehabilitation; and program-related factors, including location/availability and facility desirability (6). Lack of insurance reimbursement can be a barrier for cardiac patients in the general population, but dialysis patients are already Medicare entitled. A recent study in Canada found that in the context of an automatic referral system, perceived need for and benefits from cardiac rehabilitation and fewer logistical barriers (e.g., distance) in gaining access to programs were much more influential on program participation than any sociodemographic characteristics of patients, such as age, gender, ethnic group, or educational level (14). It is possible that dialysis patients may be more likely to participate in cardiac rehabilitation when they receive dialysis in a hospital-based dialysis facility, where an outpatient cardiac rehabilitation program may be physically located. Whether programs are conducted in specialized, free-standing clinics or in outpatient hospital departments, a physician must be available to perform medical duties, the program must be staffed by personnel who are trained in basic and advanced life support techniques and in exercise therapy for coronary disease, and medically necessary cardiopulmonary emergency diagnostic and therapeutic lifesaving equipment must be available (5).

Exercise, which is prescribed individually for each patient, is the key component of cardiac rehabilitation programs that are covered by Medicare (5). The National Kidney Foundation Kidney Disease Outcomes Quality Initiative Cardiovascular Disease Work Group was not able to identify any randomized clinical trials in dialysis patients that had assessed the effects of exercise on cardiovascular risk profile, but the work group noted that randomized trials in dialysis patients have demonstrated effects of exercise training on physical functioning (15). Improvements in HD patients’ physical fitness as measured by reaction time and lower extremity muscle strength (16), left ventricular systolic function (17), and psychosocial functioning (18) have been demonstrated in randomized clinical trials. Other studies of exercise interventions in patients who were on HD have provided evidence to support improvement in arterial stiffness (19), decrease in pulse pressure (20), increase in aerobic capacity (21–26), reduced need for antihypertensive medications (23,27,28), increase in hemoglobin concentration and hematocrit levels (28), and improved lipid metabolism (28).

<table>
<thead>
<tr>
<th>Characteristic Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr; mean [SD]) 67.9 (10.3)</td>
</tr>
<tr>
<td>Male (%) 61.4</td>
</tr>
<tr>
<td>Race (%)</td>
</tr>
<tr>
<td>Asian 3.4</td>
</tr>
<tr>
<td>Black 17.5</td>
</tr>
<tr>
<td>Native American 1.3</td>
</tr>
<tr>
<td>White 76.9</td>
</tr>
<tr>
<td>Other 0.9</td>
</tr>
<tr>
<td>Medicaid coverage at HD start (%) 19.7</td>
</tr>
<tr>
<td>No. of cardiovascular conditions at HD start (mean [SD]) 1.4 (1.4)</td>
</tr>
<tr>
<td>Congestive heart failure (%) 39.9</td>
</tr>
<tr>
<td>Coronary artery disease (%) 44.9</td>
</tr>
<tr>
<td>History of AMI (%) 18.9</td>
</tr>
<tr>
<td>Cardiac arrest (%) 1.2</td>
</tr>
<tr>
<td>Dysrhythmia (%) 8.8</td>
</tr>
<tr>
<td>Cerebral vascular disease (%) 11.0</td>
</tr>
<tr>
<td>Peripheral vascular disease (%) 20.0</td>
</tr>
<tr>
<td>Hemoglobin (g/dl; mean [SD]) 9.9 (1.6)</td>
</tr>
<tr>
<td>Serum albumin (g/dl; mean [SD]) 3.1 (0.6)</td>
</tr>
<tr>
<td>Diabetic ESRD (%) 50.8</td>
</tr>
<tr>
<td>AMI before CABG (%) 41.1</td>
</tr>
<tr>
<td>COPD (%) 9.1</td>
</tr>
<tr>
<td>Nonambulatory (%) 3.4</td>
</tr>
<tr>
<td>Vintage (mo receiving dialysis when underwent CABG; mean [SD]) 11.6 (13.1)</td>
</tr>
<tr>
<td>Started HD in hospital-based facility (%) 29.6</td>
</tr>
</tbody>
</table>

*CABG, coronary artery bypass grafting; HD, hemodialysis; AMI, acute myocardial infarction; COPD, chronic obstructive pulmonary disease.
We chose to focus on dialysis patients who had undergone CABG because Medicare coverage of cardiac rehabilitation programs is considered reasonable and necessary for all patients who have had CABG, and CABG may be the optimal therapy for CVD in patients with ESRD (33). In addition, there is evidence from the general population that enrollment in cardiac rehabilitation is higher among CABG survivors than among patients who have had PCI or AMI (6). Medicare coverage of cardiac rehabilitation also is considered reasonable and necessary for patients who have a documented diagnosis of AMI within the past 12 mo or have stable angina, and those diagnoses also may characterize dialysis patients who undergo CABG. Two fifths (41%) of the patients whom we studied sustained an AMI after starting dialysis, and 25% had a diagnosis of angina.

Because patients who are on renal dialysis are at high risk for cardiac death and have a large burden of CVD risk factors, increasing attention is being given to outcomes that are associated with use of coronary revascularization and other cardiovascular interventional therapies in patients with ESRD (2,3,15,34,35). There is evidence that cardiac rehabilitation can promote improved survival of nondialysis patients after CABG surgery, but no previous studies have investigated whether the survival of dialysis patients after CABG may be improved as a function of cardiac rehabilitation. Our study showed that dialysis patients who received cardiac rehabilitation after CABG had a 35% reduced risk for all-cause mortality and a 36% reduced risk for cardiac death compared with dialysis patients who did not receive cardiac rehabilitation, independent of sociodemographic and clinical risk factors, including recent hospitalization. Studies that are based on administrative data such

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Patients Aged &lt;65 Yrb</th>
<th></th>
<th>Patients Aged 65 Yr and Older</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hazard Ratio (95% CI)</td>
<td>P Value</td>
<td>Hazard Ratio (95% CI)</td>
<td>P Value</td>
</tr>
<tr>
<td>Male gender</td>
<td>1.10 (0.74 to 1.38)</td>
<td>0.97</td>
<td>2.04 (1.62 to 2.58)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Race (referent = white)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0.73 (0.34 to 1.58)</td>
<td>0.43</td>
<td>0.54 (0.24 to 1.21)</td>
<td>0.13</td>
</tr>
<tr>
<td>black</td>
<td>0.71 (0.49 to 1.03)</td>
<td>0.07</td>
<td>0.50 (0.34 to 0.72)</td>
<td>0.0002</td>
</tr>
<tr>
<td>Native American</td>
<td>1.82 (0.89 to 3.72)</td>
<td>0.10</td>
<td>0.64 (0.16 to 2.59)</td>
<td>0.53</td>
</tr>
<tr>
<td>other</td>
<td>0.42 (0.06 to 3.02)</td>
<td>0.39</td>
<td>0.41 (0.06 to 2.94)</td>
<td>0.38</td>
</tr>
<tr>
<td>Medicaid coverage at HD start</td>
<td>0.59 (0.42 to 0.85)</td>
<td>0.004</td>
<td>0.49 (0.33 to 0.73)</td>
<td>0.0005</td>
</tr>
<tr>
<td>No. of cardiovascular conditions at HD start</td>
<td>0.91 (0.79 to 1.05)</td>
<td>0.21</td>
<td>0.95 (0.88 to 1.02)</td>
<td>0.13</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>0.98 (0.90 to 1.07)</td>
<td>0.70</td>
<td>1.01 (0.95 to 1.07)</td>
<td>0.81</td>
</tr>
<tr>
<td>Serum albumin</td>
<td>1.08 (0.87 to 1.36)</td>
<td>0.48</td>
<td>1.16 (0.99 to 1.36)</td>
<td>0.07</td>
</tr>
<tr>
<td>Diabetic ESRD</td>
<td>0.89 (0.66 to 1.19)</td>
<td>0.41</td>
<td>0.82 (0.67 to 1.00)</td>
<td>0.05</td>
</tr>
<tr>
<td>AMI before CABG</td>
<td>0.80 (0.58 to 1.09)</td>
<td>0.15</td>
<td>0.88 (0.72 to 1.07)</td>
<td>0.20</td>
</tr>
<tr>
<td>COPD</td>
<td>0.70 (0.32 to 1.50)</td>
<td>0.36</td>
<td>0.89 (0.63 to 1.24)</td>
<td>0.49</td>
</tr>
<tr>
<td>Nonambulatory</td>
<td>0.27 (0.04 to 1.93)</td>
<td>0.19</td>
<td>0.35 (0.14 to 0.85)</td>
<td>0.02</td>
</tr>
<tr>
<td>Vintage</td>
<td>1.00 (0.99 to 1.01)</td>
<td>0.83</td>
<td>1.01 (1.00 to 1.01)</td>
<td>0.26</td>
</tr>
<tr>
<td>Started HD in hospital-based facility</td>
<td>1.25 (0.92 to 1.70)</td>
<td>0.15</td>
<td>1.16 (0.95 to 1.42)</td>
<td>0.14</td>
</tr>
</tbody>
</table>

CI, confidence interval. bRestricted to patients who underwent coronary bypass >90 d after start of ESRD treatment.

The National Kidney Foundation Kidney Disease Outcomes Quality Initiative Clinical Practice Guidelines for Cardiovascular Disease that were released in 2005 recommend that chronic kidney disease patients who qualify for cardiac rehabilitation be referred to a specialist (15). It is not known how likely dialysis patients are to be referred for cardiac rehabilitation and what impact this practice guideline may have on referral. Once the patient is referred, the potential benefits of cardiac rehabilitation must be valued by patients, and feasible opportunities for participating in cardiac rehabilitation must be available.

Our study indicates that dialysis patients who received cardiac rehabilitation after CABG had reduced risk for both all-cause and cardiac death, compared with patients who did not receive cardiac rehabilitation, but it is important to consider potential limitations of our data sources and interpretation of results. First, the survival benefit that was observed in this study may reflect patient selection effects instead of or in addition to therapeutic benefit. Patients who are referred to and participate in cardiac rehabilitation may differ in disease severity or prognosis from patients who are not referred and do not participate. We did endeavor to control for patients’ health status by including recent hospitalization in the Cox models. Second, no information was available in the database to indicate whether patients were referred by their physician for cardiac rehabilitation services. Patients may have been referred but did not participate, a recognized issue in the general population (29). The strength and the content of the physician’s recommendation may be an important variable. Eligible patients in the general population who fail to attend cardiac rehabilitation programs are less likely to perceive that their physician recommends cardiac rehabilitation (6,30,31) and are less likely to understand how cardiac rehabilitation can help them (32).
as Medicare claims are necessarily exploratory in nature. Randomized clinical trials are needed to study the effects of exercise training on cardiovascular risk in dialysis patients (15) and to provide definitive evidence about the effect of dialysis patients’ participation in cardiac rehabilitation after CABG.

Acknowledgments
This study was supported by National Institutes of Health contract N01-DK-1-2471.

A preliminary version of this study was presented at the American Society of Nephrology annual meeting; October 31, 2004; St. Louis, MO.

References
12. Hemmelgarn BR, Southern D, Culleton BF, Mitchell LB, Knudtson ML, Ghali WA, for Alberta Provincial Project for Table 3. Multivariable Cox proportional hazards models predicting all-cause and cardiac mortality risk of 5274 incident HD patients after CABG

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>All-Cause Mortality Hazard Ratio (95% CI)</th>
<th>P Value</th>
<th>Cardiac Mortality Hazard Ratio (95% CI)</th>
<th>P Value</th>
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<tbody>
<tr>
<td>Age ≥ 65 y</td>
<td>1.56 (1.40 to 1.74)</td>
<td>&lt;0.0001</td>
<td>1.37 (1.17 to 1.61)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Male gender</td>
<td>0.98 (0.90 to 1.07)</td>
<td>0.69</td>
<td>0.98 (0.86 to 1.11)</td>
<td>0.70</td>
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<tr>
<td>Race (referent = white)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0.99 (0.77 to 1.26)</td>
<td>0.90</td>
<td>1.29 (0.93 to 1.79)</td>
<td>0.13</td>
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<tr>
<td>black</td>
<td>0.84 (0.75 to 0.95)</td>
<td>0.004</td>
<td>0.87 (0.73 to 1.03)</td>
<td>0.11</td>
</tr>
<tr>
<td>Native American</td>
<td>0.80 (0.53 to 1.21)</td>
<td>0.29</td>
<td>0.59 (0.30 to 1.20)</td>
<td>0.14</td>
</tr>
<tr>
<td>other</td>
<td>1.08 (0.67 to 1.75)</td>
<td>0.75</td>
<td>0.97 (0.46 to 2.05)</td>
<td>0.94</td>
</tr>
<tr>
<td>Medicaid coverage at HD start</td>
<td>0.92 (0.82 to 1.02)</td>
<td>0.11</td>
<td>0.83 (0.70 to 0.97)</td>
<td>0.02</td>
</tr>
<tr>
<td>No. of cardiovascular conditions at HD start</td>
<td>1.05 (1.02 to 1.09)</td>
<td>0.001</td>
<td>1.07 (1.02 to 1.12)</td>
<td>0.004</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>1.02 (0.99 to 1.05)</td>
<td>0.21</td>
<td>1.02 (0.98 to 1.06)</td>
<td>0.44</td>
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<tr>
<td>Serum albumin</td>
<td>0.91 (0.85 to 0.97)</td>
<td>0.006</td>
<td>1.02 (0.92 to 1.13)</td>
<td>0.78</td>
</tr>
<tr>
<td>Diabetic ESRD</td>
<td>0.95 (0.87 to 1.03)</td>
<td>0.20</td>
<td>1.07 (0.94 to 1.21)</td>
<td>0.33</td>
</tr>
<tr>
<td>AMI before CABG</td>
<td>1.11 (1.02 to 1.20)</td>
<td>0.02</td>
<td>1.29 (1.14 to 1.46)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>COPD</td>
<td>1.27 (1.12 to 1.45)</td>
<td>0.003</td>
<td>1.25 (1.03 to 1.52)</td>
<td>0.03</td>
</tr>
<tr>
<td>Nonambulatory</td>
<td>1.70 (1.40 to 2.06)</td>
<td>&lt;0.0001</td>
<td>1.60 (1.19 to 2.16)</td>
<td>0.002</td>
</tr>
<tr>
<td>Vintage</td>
<td>1.01 (1.01 to 1.02)</td>
<td>&lt;0.0001</td>
<td>1.01 (1.00 to 1.01)</td>
<td>0.01</td>
</tr>
<tr>
<td>Recent hospitalization</td>
<td>7.76 (7.13 to 8.44)</td>
<td>&lt;0.0001</td>
<td>8.11 (7.16 to 9.20)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Cardiac rehabilitation</td>
<td>0.65 (0.56 to 0.76)</td>
<td>&lt;0.0001</td>
<td>0.64 (0.51 to 0.81)</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

aRestricted to patients who survived at least 90 d after undergoing CABG.

bTime-varying covariate.


29. Daly J, Sindone AP, Thompson DR, Hancock K, Chang E, Davidson P: Barriers to participation in and adherence to cardiac rehabilitation programs; a critical literature review. *Prog Cardiovasc Nurs* 17: 8–17, 2002


