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Caregiver Status: A Simple Marker to Identify Patients at Risk for Longer Post-Operative Length of Stay, Rehospitalization or Death

Heidi Mochari-Greenberger, PhD, MPH[a], **Matthew Mosca, BS**[a], **Brooke Aggarwal, EdD, MS**[a], **Tianna Umann, PA-C, MAb**[b], and **Lori Mosca, MD, MPH, PhD**[a]

[a]Department of Medicine, Columbia University Medical Center, 601 West 168th Street, Suite 43, New York, NY 10032

[b]Department of Surgery, Columbia University Medical Center, 177 Fort Washington Ave, Suite 7-435, New York, NY 10032

Abstract

Background—Patients who have undergone cardiac surgery, especially those with greater comorbidities, may be cared for by family members or paid aides.

Objective—The purpose of this study was to evaluate the association between caregiving among post-operative cardiac patients and clinical outcomes at 1-year. We hypothesized that patients with a caregiver would have longer length-of-stays, and higher rehospitalization or death rates 1-year after surgery.

Methods—We studied 665 consecutively admitted cardiac surgery patients as part of the NHLBI-sponsored Family Cardiac Caregiver Investigation To Evaluate Outcomes (FIT-O). Participants (mean age 65 years; 35% female; 21% racial/ethnic minorities) completed an interviewer-assisted questionnaire to determine caregiver status. Outcomes were documented by a hospital-based information system; demographics/comorbidities by electronic records. Associations between caregiving and outcomes were evaluated by logistic regression, adjusted for demographic and comorbid conditions.

Results—At baseline, 28% of patients (n=183) had a caregiver (8% paid; 20% informal only). Having a caregiver was associated with longer (>7 days) post-operative length-of-stay in univariate analysis among patients with *paid* (OR=3.00;95%CI=1.57–5.74) or *informal* (OR=1.55;95%CI=1.04–2.31) caregivers versus none; the association remained significant for patients with *paid* (OR=2.13;95%CI=1.00–4.55), but not *informal* (OR=1.12; 95%CI=0.70–1.80) caregivers after adjustment. Having a *paid* caregiver was significantly associated with rehospitalization/death at 1-year in univariate analysis (OR=2.09;95%CI=1.18–3.69), *informal* caregiving was not (OR=1.39;95%CI=0.94–2.06). Increased odds of rehospitalization/death associated with *paid* caregiving attenuated after adjustment (OR=1.39;95%CI=0.74–2.62).

Corresponding Author: Dr. Lori Mosca, Columbia University Medical Center, 601 West 168th Street, Suite 43, New York, NY 10032; Tel #: 212-305-4866, Fax #: 212-342-5238; ljm10@columbia.edu; copy Lmr2@columbia.edu.

Conflicts of Interest: None.

Conclusions—Post-operative cardiac patients who had a paid caregiver had significantly longer length-of-stay independent of comorbidity. The increased risk of rehospitalization/death associated with paid caregiving was explained by demographics and comorbidity. These data suggest caregiver status assessment may be a simple method to identify cardiac patients at risk for adverse outcomes.

Introduction

Recent attention has been given to the prevalence of caregiving among patients with chronic conditions in the United States (1). It is estimated that 65 million caregivers provide care annually to persons with disabilities and chronic illness, including cardiovascular disease (CVD) (1). Chronic conditions, such as diabetes and heart failure, are associated with longer length of stay and readmission among cardiac surgery patients (2–4). Surgical patients with and without chronic conditions may receive assistance with medical and personal needs from paid or informal (unpaid) caregivers, such as family members or friends, prior to and during their hospital stay (1, 5). The relation between having a caregiver and cardiac surgery outcomes is not established and may be confounded by a greater prevalence of comorbid conditions among those with caregivers. Past study of outcomes in cardiac patients with caregivers has largely been limited to studies in non-surgical populations (6–9), those that examined non-clinical (e.g. psychosocial) patient outcomes (10–12), those that did not have a referent group (13), and/or those focused on outcomes in the caregiver, but not the patient (14–18). Assessment of caregiver status may have the potential to identify cardiac surgery patients at risk of adverse clinical outcomes and prolonged length-of-stay but this has not been established.

Strategies to identify patients at risk of adverse outcomes prior to cardiac surgery are needed so that appropriate preventive interventions and resources can be targeted (19, 20). Predictive risk models designed to identify cardiac surgery patients at increased risk for poor post-operative outcomes are available, but may be perceived as time consuming or too cumbersome to utilize in a clinical setting (21). Moreover, predictive risk models may include a large number of parameters as well as variables that may not be immediately available preoperatively (22). Systematic identification of cardiac surgery patients at risk for adverse clinical outcomes is an important initial step in developing interventions aimed to reduce postoperative length of stay, rehospitalization or death. The purpose of this study was to examine the association between having a caregiver and clinical outcomes (length of postoperative hospital stay and rehospitalization or death at 1-year) among patients who have undergone cardiac surgery, independent of traditionally collected demographic and clinical information.

Methods

Study participants were 665 consecutive surgical patients admitted to the CVD service at New York-Presbyterian Hospital/Columbia University Medical Center who took part in the National Heart Lung and Blood Institute (NHLBI)-sponsored **F**amily Cardiac Caregiver **I**nvestigation **T**o Evaluate **O**utcomes (**FIT-O**) Study. FIT-O was a prospective observational study designed to evaluate the association between caregiving and clinical outcomes of

medical and surgical patients hospitalized with CVD. Enrollment began in November 2009 and 1-year follow up was completed in September 2011. Consecutive patient participant recruitment was achieved through daily systematic review of hospital admission logs to identify new admissions to the CVD service. Patients were included if they underwent cardiac surgery during their admission and were excluded from participation if they were unable to read or understand English or Spanish, lived in a full-time nursing facility, mental status rendered them unable to participate, or if they refused to complete the survey. Trained bilingual research staff distributed surveys in English and Spanish to potential participants to assess whether or not they had a caregiver in the past year and the extent of caregiving they received. Hospital logs were checked weekly for quality purposes to ensure that consecutive patients had been identified and approached for enrollment. If uncollected surveys were noted, research staff attempted to contact the patient prior to discharge, or if this was not feasible the survey was mailed with a pre-stamped return envelope for the patient to complete and return. The overall enrollment rate was 93%. The study was approved by the Institutional Review Board of Columbia University Medical Center.

A caregiver was defined as a paid professional or nonpaid (informal) person (e.g. a family member or friend) who assists the patient with medical and/or preventive care (5). The definition of caregiving was adopted from the National Alliance for Caregiving and AARP (23). Patients were asked if they had a caregiver in the past year leading up to hospitalization and self-categorized themselves as having: 1) a paid caregiver, 2) an informal caregiver, 3) both a paid caregiver and an informal caregiver, or 4) no caregiver. Those who had both a paid caregiver and an informal caregiver (n=13) were classified as having a paid caregiver in the analysis as this did not materially alter results.

The extent of caregiving provided to participants was systematically assessed based on the specific tasks defined using Basic Activities of Daily Living (e.g., assistance with dressing, bathing), and Instrumental Activities of Daily Living (e.g., assistance with meal preparation, transportation). Extent of caregiving was categorized as 1) extensive (patient has a paid caregiver or an informal caregiver who provides assistance with Basic Activities of Daily Living only, or Basic Activities of Daily Living plus Instrumental Activities of Daily Living) or 2) nonextensive (patient has an informal caregiver who provides assistance with Instrumental Activities of Daily Living or less, or no caregiver).

Post-operative length of hospital stay was defined as the number of days between first surgical procedure and discharge, and was calculated by subtracting the surgical procedure date from the discharge date. All-cause rehospitalization was systematically collected by hospital electronic clinical information system which is updated daily. To supplement outcome data collected by the clinical system, all cardiac surgery participants were systematically contacted via mail or by telephone 1 year after the index hospitalization that corresponded to their baseline survey date and queried regarding rehospitalization in the past year (86% response rate). Rehospitalization was defined as rehospitalization at New York-Presbyterian Hospital or elsewhere. The analyses using this definition were similar to the analyses limited to readmission to New York-Presbyterian Hospital only. Vital status was obtained via hospital clinical information system, which is updated monthly with National Death Index data.

Demographic characteristics (i.e. age, gender, race/ethnicity, marital status, and health insurance status), medical history (including diabetes mellitus, renal disease, myocardial infarction, stroke, peripheral vascular disease, heart failure, and chronic obstructive pulmonary disease), current smoking status, baseline anthropometric data, and postoperative hemodynamic status were documented by standardized electronic chart review conducted by HIPAA trained research staff. Current and prior medical conditions were determined using ICD-9 billing codes and physician or nurse practitioner notes. Type of surgery (i.e. Coronary Artery Bypass Graft (CABG) versus no CABG, valve/other) was defined using congenital and acquired cardiac procedure codes from the New York State Department of Health Division of Quality and Patient Safety Cardiac Services Program.

Surveys were created and processed using the intelligent character recognition software EzDataPro32™ (version 8.0.7, Creative ICR, Inc., Beaverton, OR) and Image Formula (version Dr-2580C, Canon U.S.A., Inc., New York, NY). The data were double checked for errors and stored in a Microsoft Access database. Descriptive statistics are presented as frequencies and percentages. Post-operative length of stay was dichotomized at > 7 days versus ≤ 7 days based on national survey data documenting approximately 7 days as the mean post–operative length of stay for coronary artery bypass and valve procedures (3, 24). Univariable associations between caregiving, demographic factors, and comorbidities with post-operative length of stay and rehospitalization or death at 1-year were evaluated using chi-square statistics. Multiple logistic regression models were used to evaluate the association between caregiving and outcomes adjusted for the categorical demographic and comorbid conditions listed and defined in Table 4. Due to non-experimental study design, propensity score weights were calculated and propensity score weighted logistic models were fitted to evaluate the potential role of exposure selection bias in observed associations; model covariates for propensity score weighted logistic models included age, race/ethnicity, gender, marital status, health insurance, myocardial infarction, heart failure, peripheral vascular disease, stroke, renal disease, chronic obstructive pulmonary disease, diabetes mellitus, post-operative hemodynamic status, and surgical type (25). Analyses were completed using SAS software (version 9.2, SAS Institute, Cary, NC). Statistical significance was set at $p < 0.05$.

Results

Baseline participant characteristics are presented in Table 1. The prevalence of caregiving in the year prior to surgery this population was 28%, with 8% of participants (n=54) reporting having a paid caregiver and 20% (n=129) only having an informal caregiver.

Caregiving and Post-Operative Length of Stay

Among patients with a caregiver, 66% had a post-operative length of stay longer than 7 days, compared to 51% among patients without a caregiver. Having a caregiver (paid or informal) was significantly associated with post-operative length of stay longer than 7 days in univariate analysis (OR=1.86; 95%CI=1.30–2.65). A gradient was observed for type of caregiver (paid versus informal versus none) and odds of a longer post-operative length of stay; odds of a longer stay were highest among patients with a paid caregiver versus no

caregiver and among those who received extensive versus non-extensive caregiving (Table 2).

Age, marital status, and several comorbid conditions were significantly associated with postoperative length of stay > 7 days including prior myocardial infarction, heart failure, peripheral vascular disease, renal disease chronic obstructive pulmonary disease, diabetes mellitus, and unstable post-operative hemodynamic status or shock (Table 3). The association between having a caregiver and longer post-operative length of stay remained significant in propensity score weighted analysis (OR=1.76; 95%CI=1.19–2.60). In multivariable analysis adjusted for demographic and comorbid conditions, the association between caregiving and longer post-operative length of stay was attenuated, but retained significance among patients with paid caregivers versus none (Table 4).

Caregiving and Rehospitalization or Death at 1-Year

At 1 year, 264 participants had been rehospitalized and 26 had died (n=9 rehospitalized and subsequently died within 1 year). Among patients with a caregiver, 50% were rehospitalized or had died within one year, compared to 39% among patients without a caregiver. Having a caregiver (paid or informal) was associated with rehospitalization or death at 1-year in univariate analysis (OR=1.57; 95%CI=1.11–2.21). There was a gradient observed for paid versus informal versus no caregiving and risk of rehospitalization or death at 1-year; patients who received extensive versus non-extensive caregiving were more likely to be rehospitalized or dead at 1 year (Table 2). Propensity score weighted analysis of the association between having a caregiver and rehospitalization or death at 1-year was not significant (OR=1.22; 95%CI=0.83–1.81). The association between having a caregiver and rehospitalization or death at 1-year did not retain statistical significance after multivariable adjustment (Table 4).

Discussion

In this prospective study of caregiving and clinical outcomes among patients who underwent cardiac surgery, we documented a significant association between having a caregiver in the year prior to surgery and longer post-operative length-of-stay, and rehospitalization or death at 1-year. Paid caregiving was independently associated with longer post-operative length of stay after adjustment for confounders and comorbidities. There was a significant association between having a caregiver and rehospitalization or death at 1-year, which was attenuated after adjustment for demographic variables and comorbid conditions. These data suggest that systematic assessment of pre-operative caregiver status may be a simple way to identify patients at risk of longer post-operative length of stay; pre-operative caregiver status may also identify those at increased risk of rehospitalization or death at 1-year in the absence of measures for other predictive factors.

This study filled several gaps in the current literature by documenting a link between having a caregiver (versus no caregiver) and clinical outcomes among cardiac surgery patients. Prior to this study, the majority of research related to outcomes in cardiac patients with caregivers had been limited to studies in non-surgical populations, those that examined non-

clinical patient outcomes, and/or those focused on outcomes in the caregiver, but not the patient (6–18).

Recent work conducted in a variety of clinical settings has shown that comorbidity data, in conjunction with clinical data, significantly increased the performance of length-of-stay and mortality prediction models (26, 27). Demographic and comorbid conditions associated with longer post-operative length of stay or rehospitalization or death in cardiac surgery patients in this study were consistent with those reported by others including older age, female gender, diabetes mellitus, heart failure, renal failure, chronic obstructive pulmonary disease, and history of peripheral vascular disease (2, 3, 28–32). Data from our study add to prior research, and to our knowledge, these findings are the first to document a link between caregiving and clinical outcomes among cardiac surgery patients.

The association between caregiving and rehospitalization or death at 1-year in this study is similar to what was observed for non-surgical patients in our previous work (33) and extends the finding to post-operative length of stay. The observed gradient for paid versus informal versus no caregiver was also similar (33). Adjustment for demographic variables and comorbid conditions explains much of the association with clinical outcomes for both surgical and non-surgical patients, but the link between paid caregiving and post-operative length of stay among surgical patients is not fully explained by adjustment of measured confounders.

Unmeasured factors that predict post-operative length-of-stay that are not traditionally collected as part of routine clinical assessment may be captured by paid caregiver status and residual confounding may have contributed to the observed association. For example, psychosocial factors such as depression and social isolation, and social factors such as disposition after discharge, were not measured in this study. These were not included in included in propensity analysis, and may be linked to longer length-of-stay and to having a paid caregiver (34, 35). Similarly, data regarding patient income or financial status beyond health insurance type were not available, limiting our ability to assess the role of financial or socioeconomic status as a potential confounder.

There are other limitations to this study to consider in the interpretation of results. Caregiver status was self-reported and there may have been misclassification, however assessment was unlikely to be differential with respect to outcomes and non-systematic error would have reduced our ability to observe an association. Additionally, the gradient observed for the association for paid, informal, and no caregiving and for extensive versus non-extensive caregiving supports the definitions are robust. Outcomes measurement for rehospitalization at other hospitals was obtained through self-report; however the response rate was high and non-differential with respect to caregiver status. Multiple tests of association were conducted for this research and some observed associations could have been due to chance; the consistency of the associations between comorbid conditions and clinical outcomes with other studies suggests the results are unlikely to be artifact. Severity of each comorbid condition was not adjusted for in multivariable analysis. This was a single center study which may limit translation of results to other settings; however the patient population was

diverse and greater than 90% of consecutively admitted patients participated which increases potential generalizability of results.

Conclusions

Our finding among patients who underwent cardiac surgery that having a paid caregiver was associated with post-operative length of stay after adjustment for comorbidities suggests it may be a simple marker that adds predictive value to traditionally collected clinical information. This result may have important policy implications, especially for reimbursement for length of stay. Caregiver status assessment may add value to risk-adjusted models that predict postoperative length of stay, or rehospitalization or death. Systematic assessment of caregiver status may identify patients to target for social or preventive interventions aimed to reduce postoperative length of stay and healthcare costs. Future research should evaluate the incremental value of adding caregiver status to risk prediction models, as well as address the potential for interventions targeted at patients with caregivers to reduce post-operative length of stay and improve quality outcomes.

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References

1. National Alliance for Caregiving and AARP. National Alliance for Caregiving and AARP; 2009. Caregiving in the US, 2009. http://www.caregiving.org/data/Caregiving_in_the_US_2009_full_report.pdf [Accessed September 6, 2012]
2. Katz NM, Ahmed SW, Clark BK, et al. Predictors of Length of Stay after Cardiac Surgery. Ann Thorac Surg. 1988; 45:656–660. [PubMed: 3377578]
3. Lazar HL, Fitzgerald C, Gross S, et al. Determinants of Length of Stay after Coronary Artery Bypass Graft Surgery. Circulation. 1995; 92:20–24.
4. Hannan EL, Racz MJ, Walford G, et al. Predictors of Readmission for Complications of Coronary Artery Bypass Graft Surgery. JAMA. 2003; 290:773–780. [PubMed: 12915430]
5. Mosca L, Mochari-Greenberger H, Aggarwal B, et al. Patterns of Caregiving among Patients Hospitalized with Cardiovascular Disease. J Cardiovasc Nurs. 2011; 26(4):305–311. [PubMed: 21330929]
6. Dunbar SB, Clark PC, Deaton C, Smith AL, De AK, O'Brien MC. Family education and support interventions in heart failure: a pilot study. Nurs Res. 2005; 54(3):158–166. [PubMed: 15897791]
7. Chin MH, Goldman L. Correlates of early hospital readmission or death in patients with congestive heart failure. Am J Cardiol. 1997; 79:1640–1644. [PubMed: 9202355]
8. Luttik ML, Jaarsma T, Veeger N, van Veldhuisen DJ. Marital status, quality of life, and clinical outcome in patients with heart failure. Heart Lung. 2006; 35(1):3–8. [PubMed: 16426930]
9. Saunders MM. Family Caregiver Support and Hospitalizations of Patients with Heart Failure. Home Healthcare Nurs. 2008; 26:624–632.
10. Hooley PJD, Butler G, Howlett JG. The relationship of quality of life, depression, and caregiver burden in outpatients with congestive heart failure. Congest Heart Fail. 2005; 11(6):303–310. [PubMed: 16330905]
11. Evangelista LS, Dracup K, Doering L, Westlake C, Fonarow GC, Hamilton M. Emotional well-being of heart failure patients and their caregivers. J Card Fail. 2002; 8(5):300–305. [PubMed: 12411980]

12. Meagher-Stewart D, Hart G. Social support and the quality of life of individuals with heart failure and stroke and their family caregivers. Can J Cardiovasc Nurs. 2002; 12(1):17–30.
13. Bakas T, Pressler SJ, Johnson EA, Nauser JA, Shaneyfelt T. Family caregiving in heart failure. Nurs Res. 2006; 55(3):180–188. [PubMed: 16708042]
14. Pressler SJ, Gradus-Pizlo I, Chubinski SD, Smith G, Wheeler S, Wu J, Sloan R. Family Caregiver Outcomes in Heart Failure. Am J Crit Care. 2009; 18:149–159. [PubMed: 19255105]
15. Dunbar SB, Howard C, Clark PC, Quinn C, Gary RA, Kaslow NJ. Family Influences on Heart Failure Self-care and Outcomes. J Cardiovasc Nurs. 2008; 23:258–265. [PubMed: 18437068]
16. Schulz R, Beach SR. Caregiving as a Risk Factor for Mortality. JAMA. 1999; 282:2215–2219. [PubMed: 10605972]
17. Saunders MM. Indicators of Health-Related Quality of Life in Heart Failure Family Caregivers. J Community Health Nurs. 2009; 26:173–182. [PubMed: 19866385]
18. Randall G, Molloy GJ, Steptoe A. The Impact of an Acute Cardiac Event on the Partners of Patients: A Systematic Review. Health Rev Psych. 2009; 3:1–89.
19. Roger VL, Go AS, Lloyd-Jones DM, et al. American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart Disease and Stroke Statistics – 2011 Update: A Report from the American Heart Association. Circulation. 2011; 123:e18–e2009. [PubMed: 21160056]
20. Goldfield NI, McCullough EC, Hughes JS, et al. Identifying Potentially Preventable Readmissions. Health Care Financ Rev. 2008; 30:75–91. [PubMed: 19040175]
21. Dupius JY. Predicting Outcomes in Cardiac Surgery: Risk Stratification Matters? Curr Opin Cardiol. 2008; 23:560–567. [PubMed: 18830070]
22. Nilsson J, Algotsson L, Hoglund P, et al. Comparison of 19 Pre-operative Risk Stratification Models in Open Heart Surgery. Eur Heart J. 2006; 27:867–874. [PubMed: 16421172]
23. National Alliance for Caregiving and AARP. Caregiving in the US. Washington, DC: National Alliance for Caregiving and AARP; 2004. http://www.caregiving.org/data/04finalreport.pdf
24. [Accessed September 6, 2012] Adult Cardiac Surgery Database Executive Summary 10 Years Society for Thoracic Surgery Report – Period Ending 12/31/2011. http://www.sts.org/sites/default/files/documents/2012%20-%201stHarvestExecutiveSummary.pdf
25. Leslie, S.; Thiebaud, P. [Accessed September 6, 2012] Using Propensity Scores to Adjust for Treatment Selection Bias SAS Global Forum. 2007. http://www2.sas.com/proceedings/forum2007/184-2007.pdf
26. Liu V, Kipnis P, Gould MK, et al. Length of stay predictions: improvements through the use of automated laboratory and comorbidity variables. Med Care. 2010; 48:739–744. [PubMed: 20613662]
27. Geraci J, Johnson ML, Gordon HS, et al. Mortality After Cardiac Bypass Surgery: Prediction from Administrative Versus Clinical Data. Med Care. 2005; 43:149–158. [PubMed: 15655428]
28. Rosen AB, Humphries JO, Muhlbaier LH, et al. Effect of Clinical Factors on Length of Stay After Coronary Artery Bypass Surgery: Results of the Cooperative Cardiovascular Project. Am Heart J. 1999; 138:69–77. [PubMed: 10385767]
29. Herman C, Karolak W, Yip AM, et al. Predicting Prolonged Intensive Care Unit Length of Stay in Patients Undergoing Coronary Artery Bypass Surgery Development of an Entirely Perioperative Scorecard. Interact CardioVasc Thorac Surg. 2009; 9:654–658. [PubMed: 19640868]
30. Anderson JA, Peterson NJ, Kistner C, et al. Determining Predictors of Delayed Recovery and the Need for Transitional Cardiac Rehabilitation after Cardiac Surgery. J Am Acady Nurse Pract. 2006; 18:386–392.
31. Nickerson NJ, Murphy SF, Davila-Roman VG, et al. Obstacles to Early Discharge after Cardiac Surgery. Am J Managed Care. 1999; 5:29–34.
32. Weintraub WS, Jones EL, Craver J, et al. Determinants of prolonged length of hospital stay after coronary bypass surgery. Circulation. 1989; 80:276–284. [PubMed: 2787709]
33. Mosca L, Aggarwal B, Mochari-Greenberger H, et al. The Association between Having a Caregiver and Clinical Outcomes 1 Year after Hospitalization for Cardiovascular Disease. Am J Cardiol. 2012; 109:135–139. [PubMed: 21962999]

34. Rosenberger PH, Jokl P, Ickovics J. Psychosocoal Factors and Surgical Outcomes: An Evidence-Based Literature Review. J Am Acad Orthop Surg. 2006; 14:397–405. [PubMed: 16822887]

35. Contrada RJ, Boulifard DA, Heckler EB, et al. Psychosocial Factors in Heart Surgery: Presurgical Vulnerability and Postsurgical Recovery. Health Psychol. 2008; 27:309–319. [PubMed: 18624595]

What's New?

- Among patients hospitalized for cardiac surgery, having a self-identified caregiver was a significant independent predictor of prolonged (>7 days) postoperative length-of-stay, and those with paid caregivers were three-fold more likely to have an increased length-of-stay.
- Compared to patients without a caregiver, the odds of rehospitalization or death at 1 year were significantly higher among cardiac surgery patients with a caregiver, which was explained by greater comorbid conditions in multivariable models adjusted for confounders.
- These data suggest caregiver status assessment at the time of hospitalization may be a simple method to identify cardiac surgery patients at risk for adverse clinical outcomes.

Table 1

Prevalence of Demographic and Comorbid Conditions by Caregiver Status among Hospitalized Cardiac Surgery Patients (N=665)

	Overall	Patients With a Caregiver (N=183)	Patients Without a Caregiver (N=482)	p-value
Demographic Conditions	**n (%)**	**n (%)**	**n (%)**	
Age ≥ 65 years	389 (59)	108 (59)	281 (58)	0.87
Male	434 (65)	112 (61)	322 (67)	0.18
Minority Race/Ethnicity[a]	133 (21)	41 (24)	92 (19)	0.18
Not Married/Not With Partner[b]	227 (36)	70 (39)	157 (35)	0.31
No Health Insurance/Self Pay	81 (12)	25 (14)	56 (12)	0.47
Comorbid Conditions				
Prior/Current Myocardial Infarction	140 (21)	45 (25)	95 (20)	0.17
Prior/Current Heart Failure	153 (23)	73 (40)	80 (17)	<0.0001
Prior/Current Peripheral Vascular Disease	81 (12)	29 (16)	52 (11)	0.07
Prior/Current Stroke	61 (9)	21 (11)	40 (8)	0.21
Prior/Current Renal Disease[c]	112 (17)	50 (27)	62 (13)	<0.0001
Chronic Obstructive Pulmonary Disease	50 (8)	15 (8)	35 (7)	0.68
Diabetes Mellitus	151 (23)	50 (27)	101 (21)	0.08
Post-Operative Hemodynamic Status Unstable/Shock	31 (5)	12 (7)	19 (4)	0.15
Underwent CABG this Admission	268 (40)	58 (32)	210 (44)	0.005

[a] n=22 without reported race/ethnicity,

[b] n=39 without reported marital status,

[c] Defined as chronic renal insufficiency, chronic renal disease, or renal failure on dialysis

Table 2

Univariate Associations between Caregiving and Clinical Outcomes among Cardiac Surgery Patients

	Clinical Outcomes	
	Post-Operative Length-of-Stay >7 Days	**Rehospitalization or Death at 1-Year**
	OR (95%CI); p	**OR (95%CI); p**
Type of Caregiving		
Any Caregiving (n=183) vs. None (n=482)	**1.86 (1.30–2.65); p=0.0006**	**1.57(1.11–2.21); p=0.01**
Paid (n=54) vs. None[a] (n=482)	**3.00 (1.57–5.74); p=0.0006**	**2.09(1.18–3.69); p=0.01**
Informal (n=129) vs. None (n=482)	**1.55(1.04–2.31); p=0.03**	1.39 (0.94–2.06); p=0.10
Paid (n=54) vs. Informal (n=129)	1.93 (0.94–3.96); p=0.07	1.50 (0.79–2.85); p=0.21
Extent of Caregiving		
Extensive (n=77) vs. Non-Extensive (n=535)[b]	**2.17(1.29–3.64); p=0.003**	**1.91(1.18–3.10); p=0.008**

[a] Patients who reported having both paid *and* informal caregivers [n=13] were categorized as having a paid caregiver

[b] n=53 missing data on extent of caregiving

Table 3

Univariate Associations between Demographic and Comorbid Conditions and Clinical Outcomes among Cardiac Surgery Patients

	Clinical Outcomes	
	Post-Operative Length-of-Stay >7 Days	**Rehospitalization or Death at 1-Year**
	OR (95%CI); p	**OR (95%CI); p**
Demographic Conditions		
Age ≥ 65 years vs. < 65 years	**1.64 (1.20–2.24); p=0.002**	1.15 (0.84–1.58); p=0.37
Male vs. Female	**0.68 (0.49–0.94); p=0.02**	1.07 (0.78–1.48); p=0.67
Minority Race/Ethnicity vs. White[a]	**1.29 (0.87–1.90);** p=0.20	1.24 (0.84–1.82); p=0.27
Not Married/Not With Parmer vs. Married/With Partner[b]	**1.78 (1.27–2.48); p=0.0007**	1.18 (0.85–1.64); p=0.32
No Health Insurance/Self Pay vs. Has Health Insurance	1.27 (0.79–2.04); p=0.32	1.39 (0.87–2.21); p=0.17
Comorbid Conditions		
Prior/Current Myocardial Infarction (Yes vs. No)	**2.20 (1.48–3.29); p<0.0001**	1.29 (0.88–1.87); p=0.19
Prior/Current Heart Failure (Yes vs. No)	**3.53 (2.33–5.35); p<0.0001**	**2.16(1.50–3.12); p0.0001**
Prior/Current Peripheral Vascular Disease (Yes vs. No)	**2.08 (1.26–3.45); p=0.0037**	1.47 (0.92–2.34); p=0.10
Prior/Current Stroke (Yes vs. No)	1.74 (0.99–3.03); p=0.05	1.36 (0.80–2.31); p=0.25
Prior/Current Renal Disease (Yes vs. No)[c]	**3.00 (1.89–4.78); p<0.0001**	**1.66(1.10–2.50); p=0.01**
Chronic Obstructive Pulmonary Disease (Yes vs. No)	**1.98 (1.06–3.69); p=0.03**	1.40 (0.79–2.50); p=0.25
Diabetes Mellitus (Yes vs. No)	**1.94 (1.32–2.84); p=0.0006**	**1.69 (1.18–2.44); p=0.004**
Post-Operative Hemodynamic Status Unstable/Shock (Yes vs. No)	**12.62 (2.99–53.33); p<0.0001**	1.70 (0.82–3.51); p=0.15
Underwent CABG this Admission (Yes vs. No)[d]	1.16 (0.85–1.58); p=0.37	0.83 (0.61–1.14); p=0.25

[a] n=22 without reported race/ethnicity,

[b] n=39 without reported marital status,

[c] Defined as chronic renal insufficiency, chronic renal disease, or renal failure on dialysis,

[d] CABG=Coronary Artery Bypass Graft

Table 4

Multivariable Models: Association between Caregiving and Clinical Outcomes among Cardiac Surgery Patients

	Post-Operative Length of Stay > 7 Days		Rehospitalized or Dead at 1-Year	
Variable	**Demographic Adjusted Model**	**Demographic and Comorbidity Adjusted Model**	**Demographic Adjusted Model**	**Demographic and Comorbidity Adjusted Model**
	OR (95% CI) [p-value]	**OR (95% CI) [p-value]**	**OR (95% CI) [p-value]**	**OR (95% CI) [p-value]**
Had a Paid Caregiver vs. None[a]	**2.84 (1.40–5.79) [0.004]**	**2.13(1.00–4.55) [0.05]**	1.72(0.94–3.17) [0.08]	1.39(0.74–2.62) [0.31]
Had an Informal Caregiver vs. None	**1.65 (1.08–2.52) [0.02]**	1.12(0.70–1.80) [0.64]	1.40(0.93–2.12) [0.11]	1.16(0.75–1.80) [0.51]
Age ≥65 years vs. < 65 years	**1.79 (1.28–2.52) [0.0008]**	1.44(0.99–2.11) [0.06]	1.34(0.95–1.88) [0.10]	1.20 (0.84–1.72) [0.32]
Minority Race/ Ethnicity vs. White	1.22 (0.78–1.89) [0.38]	1.10(0.68–1.76) [0.70]	1.30 (0.85–2.00) [0.23]	1.27(0.82–1.96) [0.29]
Male vs. Female	0.79(0.55–1.13) [0.20]	**0.66 (0.45–0.97) [0.04]**	1.20(0.84–1.71) [0.31]	1.18(0.82–1.70) [0.37]
Not Married/No Parmer vs. Married/With Parmer	**1.53 (1.01–2.20) [0.02]**	**1.55 (1.05–2.28) [0.03]**	1.14(0.80–1.62) [0.47]	1.11(0.78–1.60) [0.56]
No Health Insurance/Self Pay vs. Health Insurance	1.36 (0.79–2.33) [0.27]	1.21(0.68–2.15) [0.51]	1.27(0.76–2.13) [0.36]	1.21 (0.72–2.04) [0.48]
Prior/Current Myocardial Infarction (Yes vs. No)		**1.69 (1.03–2.77) [0.04]**		1.07(0.68–1.67) [0.77]
Prior/Current Heart Failure (Yes vs. No)		**3.21 (1.96–5.28) [<0.0001]**		**1.59 (1.05–2.42) [0.03]**
Prior/Current Peripheral Vascular Disease (Yes vs. No)		1.32 (0.74–2.34) [0.34]		1.17(0.70–1.96) [0.54]
Prior/Current Stroke (Yes vs. No)		1.44 (0.78–2.69) [0.25]		1.33 (0.76–2.33) [0.31]
Prior/Current Moderate/ Severe Renal Disease (Yes vs. No)		**2.05 (1.20–3.49) [0.009]**		1.18(0.74–1.88) [0.49]
Chronic Obstructive Pulmonary Disease (Yes vs. No)		1.48 (0.73–3.00) [0.28]		1.20 (0.65–2.23) [0.57]
Diabetes Mellitus (Yes vs. No)		**1.66 (1.04–2.62) [0.03]**		**1.57 (1.04–2.38) [0.03]**

	Post-Operative Length of Stay > 7 Days		Rehospitalized or Dead at 1-Year	
Variable	**Demographic Adjusted Model**	**Demographic and Comorbidity Adjusted Model**	**Demographic Adjusted Model**	**Demographic and Comorbidity Adjusted Model**
	OR (95% CI) [p-value]	**OR (95% CI) [p-value]**	**OR (95% CI) [p-value]**	**OR (95% CI) [p-value]**
Post-Operative Status Unstable/ Shock (Yes vs. No)		**7.84 (1.70–36.1) [0.008]**		1.43 (0.60–3.46) [0.42]
Underwent CABG vs. Valve/Other Surgery		1.08(0.73–1.61) [0.70]		0.85 (0.58–1.24) [0.39]

[a] Patients who reported having both paid *and* informal caregivers [n=13] were categorized as having a paid caregiver