HSR Health Services Research

DOI: 10.1111/j.1475-6773.2010.01138.x
RESEARCH ARTICLE

Mortality among Patients with Acute Myocardial Infarction: The Influences of Patient-Centered Care and Evidence-Based Medicine

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Background. Recent studies have suggested that there is a positive impact of patient-centered care (PCC) on both the patient–physician relationship and subsequent patient health-related behaviors. One recent prospective study reported a significant relationship between the degree of PCC experienced by patients during their hospitalization for acute myocardial infarction (AMI) and their postdischarge cardiac symptoms. A limitation of this study, however, was a lack of information regarding the technical quality of the AMI care, which might have explained at least part of the differences in outcomes. The present study was undertaken to test the influence of both PCC and technical care quality on outcomes among AMI patients.

Methods. We analyzed data from a national sample of 1,858 veterans hospitalized for an initial AMI in a Department of Veterans Affairs medical center during fiscal years 2003 and 2004 for whom data had been compiled on evidence-based treatment and who had also completed a Picker questionnaire assessing perceptions of PCC. Cox proportional hazards models were used to estimate the relationship between PCC and survival 1-year postdischarge, controlling for technical quality of care, patient clinical condition and history, admission process characteristics, and patient sociodemographic characteristics. We hypothesized that better PCC would be associated with a lower probability of death 1-year postdischarge, even after controlling for patient characteristics and the technical quality of care.

Results. Better PCC was associated with a significantly but modestly lower hazard of death over the 1-year study period (hazard ratio 0.992, 95 percent confidence interval 0.986–0.999).

Conclusions. Providing PCC may result in important clinical benefits, in addition to meeting patient needs and expectations.

Key Words. Patient assessment, satisfaction, patient outcomes, functional status, ADLs, IADLs, quality of care, patient safety (measurement)

Recently, a great deal of attention has been given to the definition, measurement, and improvement of patient-centered care (PCC) (Cleary and Edgman-Levitan 1997; Landon et al. 1998, 2004; Zaslavsky et al. 2004; O'Malley et al. 2005; Davies et al. 2008; Keenan et al. 2009). This focus has been motivated mainly by the inherent importance of providing patient-centered medical care, but there is also increasing evidence that PCC is related to trust (Keating et al. 2002), adherence to recommended treatment (Fitzpatrick 1991; Golin et al. 1996; Brown 2001; Bartlett 2002), and continuity with health care providers (Rodriguez et al. 2007). In addition, many have suggested that PCC may be related to better outcomes because of the effects of the aforementioned mediating variables (Anderson et al. 1996; Marshall et al. 1996; Da Costa et al. 1999; Guldvog 1999; Maly et al. 1999; Stewart et al. 2000; Brown 2001; Fremont et al. 2001).

There are few studies directly linking PCC to outcomes (Greenfield et al. 1985, 1988; Brody et al. 1989; Safran et al. 1998; Covinsky et al. 2000). Fremont et al. (2001) examined the relationship between the quality of PCC received by patients who were hospitalized for an acute myocardial infarction (AMI) and their health status 1 year after discharge. After controlling for postdischarge health status, cardiac symptoms, and comorbid conditions, 1 year after discharge, patients reporting the most problems with their inpatient care had significantly worse overall health, physical health, and mental health, and they were significantly more likely to have chest pain and shortness of breath than patients who reported the least problems with PCC.

There were several limitations to the Freemont study, however. First, data were not available on the quality of technical care received during the hospitalization. Thus, patients reporting a greater degree of PCC may have also received better technical care, and it might be better technical quality of care that was responsible for some or all of the better outcomes for patients with better PCC. Second, Freemont and colleagues only had information from

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the hospital discharge summary and self-reported health status to assess patient clinical characteristics. Worse health is related to both more problems during care (Carlson et al. 2000; Hargraves et al. 2001; Zaslavsky et al. 2001) and survival, and they may not have been able to adjust adequately for an important confounding variable.

To address these limitations in previous studies, we analyzed the association between the quality of PCC and 1-year mortality in a sample of AMI patients treated in Veterans Administration (VA) hospitals for which measures of the technical quality of care received and clinical characteristics were available.

Methods

Sample

Data were obtained from the VA's External Peer Review Program (EPRP) administered by the VA Office of Quality and Performance. These data are part of a national performance measurement program that collects clinical data via chart audit and assesses the quality of care for AMI inpatients. All VA hospitalizations for AMI are reviewed by trained nurse abstractors. During fiscal years (FY) 2003 and 2004, these same patients were administered the VA Survey of Healthcare Experiences of Patients (SHEP) following their hospitalization. Ordinarily, the SHEP survey is mailed monthly to random samples of veterans discharged from every acute-care VA hospital, and there would only be a small chance overlap between EPRP and SHEP sampling. All hospitalized AMI patients, however, were sent a SHEP survey in order to develop a quality improvement database containing measures of both technical quality and patient perceptions of care. For patients with multiple AMI events, we selected the first (index) hospitalization within the 2-year period. Of the 2,815 AMI patients, 1,858 (66 percent) provided an assessment of the extent to which the care during their AMI hospitalization was patient centered on SHEP surveys mailed to them 4–6 weeks after the end of the month in which they were discharged.

Survey

The inpatient SHEP survey includes a modified version of the PCC questionnaire developed by the Picker Institute (Cleary et al. 1991), as well as several questions about patient sociodemographic characteristics. The Picker PCC component of the survey consists of 55 questions asking patients to evaluate nine domains of their inpatient experience: access, courtesy, information about their illness and care, coordination of care, attention to patient preferences, emotional support, family involvement, physical comfort, and preparation for transition to outpatient care. Response categories are "yes, always," "yes, sometimes," and "no." We calculated the proportion of questions that were answered "yes, always" for each domain. We also calculated a PCC index computed as the unweighted average of the nine domains; to facilitate interpretation this score was multiplied by 100 so that the transformed score had a potential range of 0–100. The SHEP survey also asked respondents to report their education, marital status, employment status, race, and total household income for the previous year.

Technical Quality of Care

Fourteen measures of adherence to Joint Commission guidelines for the care of AMI patients were obtained from the EPRP medical record review. These included seven measures of care during the first 24 hours after presentation at the hospital, two measures of care during the hospital stay, and five measures related to preparation for discharge and follow-up care within 30 days of discharge (see Table 1). An overall index of the technical quality of care was computed for each patient as the proportion of guidelines relevant to that patient's care that were met. Patient date of birth and gender were obtained from VA administrative data at the time of sampling.

Clinical Condition and History, and Admission Process

The EPRP chart abstraction also coded data on 14 clinical measures that previous research (Maynard et al. 2006) had shown to be predictive of 30-day mortality among veterans with AMI. Ten of these measures were related to the patient's medical history (e.g., history of congestive heart failure) and clinical condition at the time of admission (e.g., systolic blood pressure upon arrival at the hospital). The four other measures represented differences in time of admission (e.g., was the patient admitted on the weekend) or transfer status (e.g., was the patient transferred to the treating hospital from the emergency department of another hospital). All these variables were considered in the present study as potential controls for severity of illness and aspects of admission that might affect the process of care (see Table 2).

Table 1: Measures of the Technical Quality of AMI Care

Measure
First 24 hours after presentation at hospital
1 ASA upon admission
2 Beta blockers administered
3 Reperfusion thrombolytic therapy within 30 minutes, STEMI patients
4 Reperfusion PCI within 120 minutes, STEMI patients
5 Cardiology involvement within 24 hours, STEMI patients and moderate/high risk non-STEMI patients
6 Troponin returned within 60 minutes of initial draw or arrival
7 ECG within 10 minutes of arrival, symptomatic patients
During hospital stay
8 Tobacco counseling
9 Reperfusion as applicable
At discharge and afterwards
10 LVEF assessed prior to discharge
11 Patient on ACEI at discharge if LVEF < 40
12 Beta blockers prescribed at discharge
13 ASA prescribed at discharge
14 STEMI patients and non-STEMI patients at moderate/high risk seen by cardiologist within 30 days after discharge

AMI, acute myocardial infarction.

Mortality

Date of death was determined for the period within 365 days of admission for the index AMI using VA administrative data, which included information from the Beneficiary Indicator Record Locator System and the Social Security Administration as well as from the VA Patient Treatment Files themselves. We created a dummy variable indicating whether each patient had died within a year of admission.

Data Analysis

To check for potential biases, we compared our final sample of AMI patients who had returned a SHEP PCC survey ($n = 1{,}858$) to those who had not ($n = 957$) on four variables available for both groups: gender (by χ^2), age, length of hospital stay, and technical quality of care (by *t*-tests). The 1,858 patients in the present study received their AMI care at 128 different VA hospitals. If variation in survival was significantly related to hospital, a hierarchical analysis that accounted for the clustering of patients by medical center would be indicated. To test this, we computed an intraclass correlation

Table 2: Patient Demographic, Clinical, and Admission Process Characteristics

Characteristic (n = 1,858)	*Parameter**	*Pct Missing*
Demographic characteristics		
Age in years at admission: mean (SD)	68.0 (11.1)	10.4
Gender (% male)	98.2	5.8
Education (%)		
High school (HS) or less	57.7	3.4
Some college or post-HS	28.4	
Four years college or more	13.9	
Marital status (% married)	58.6	10.4
Employed (% yes)	16.1	
Racial background (%)		
Caucasian	85.9	5.1
African American	10.4	
Other minority	3.6	
Annual household income (%)		
Under U.S.$15,000	47.1	8.3
U.S.$15–U.S.$30,000	38.7	
Over U.S.$30,000	14.1	
Clinical condition and history		
History of cancer (% yes)	6.1	7.7
History of lipid disorders (% yes)[†]	69.9	7.6
History of CHF (% yes)	32.8	0
History of dementia (% yes)	7.2	0
Stroke within past 5 years (% yes, FY 2004 only)	2.2	0 (FY04)
Highest serum creatinine: mean (SD)	1.55 (1.26)	11.7
First troponin level was negative (% yes, FY 2004 only)	31.9	0 (FY04)
Heart rate upon hospital arrival: mean (SD)	84.1 (22.0)	27.3
Systolic BP upon hospital arrival: mean (SD)	145.4 (27.5)	27.3
Pain symptoms (%)		
Chest pain	39.5	27.3
Chest pressure	16.2	
Radiating pain	26.9	
Admission process characteristics		
Night admission (% yes)[‡]	25.1	2.1
Weekend admission (% yes)[§]	32.1	2.2
Transfer from ED of another hospital (% yes)	0.9	3.2
In hospital already when had AMI (% yes)	2.9	0.2

*Percentages based on total nonmissing cases.

[†]And/or on lipid-lowering medications before hospitalization.

[‡]Between 11:00 P.M. and 8:00 A.M. any day.

[§]Between 5:00 P.M. Friday and 7:00 A.M. Monday.

AMI, acute myocardial infarction; BP, blood pressure; CHF, congestive heart failure; ED, emergency department; FY, fiscal year.

coefficient (ICC) between hospital and postdischarge survival days using the between hospital and within hospital variance estimates from an unconditional means hierarchical linear model (HLM).

Next we screened all potential predictor and control variables to identify a parsimonious subset of variables to use in the final models. Chi-square tests were used to test association between the nominal-level candidate predictors and mortality. For continuous variables, *t*-tests were computed to determine whether there were significant differences between patients who had and had not died within a year of admission. In order to include all variables that were potentially important predictors of survival, all variables that had a *p*-value of .20 or less were used in subsequent analyses.

To assess the association between survival within 1 year of admission for the index hospitalization and PCC, we estimated Cox proportional hazards regression models that controlled for patient sociodemographic characteristics, clinical history and condition at the time of admission, the admission process, and the technical quality of care. We estimated separate models using the PCC index and each of the nine specific Picker dimensions. To assess the robustness of these results, we reestimated all models using 6-month mortality as the dependent variable. Missing values on all predictors were estimated using multiple imputation, which replaces missing values with a set of plausible values and allows one to assess variability of the estimated values. This has been suggested as an effective way of preventing loss of cases and thus analytic power even when 20 or 30 percent or more of the data are missing (Schafer 1997; Schafer and Graham 2002; Streiner 2002). Given the asymptotic relationship between the relative efficiency of a given number of imputations compared with an infinite number at any given rate of missing information, and considering our maximum missing information rate, we elected to use five imputations (Schafer 1999). This was implemented by the Markov Chain Monte Carol method using *PROC MI* in *SAS* 9.1. The five complete data sets thus generated were each subsequently analyzed using Cox proportional hazards regression, and the results from these analyses were then consolidated using PROC MIANALYZE to produce single parameter estimates, their standard errors, and valid statistical inferences.

RESULTS

There were no significant differences on gender, length of stay, or technical quality of care between our sample of AMI subjects with SHEP-based PCC index scores and those AMI patients who did not return a SHEP survey; *p*-values ranged from .12 (gender) to .85 (length of stay). However, the SHEP survey respondents were about 2 years younger (67.6) on average than those who did not return a survey (69.7; $t = 4.42$, $p < .001$). The average study subject was a married 68-year-old white male with a high-school education or less (see Table 3). About 70 percent either had a history of lipid disorders, were on lipid-lowering medication at the time of admission, or both. Just under a third had a history of congestive heart failure. About 25 percent of patients were admitted at night, and about a third were admitted on a weekend (see Table 2). The mean technical quality of care index score was 0.88 (standard deviation [SD] = 0.15); 52 percent of cases had a value of 1.0. The mean PCC index score was 76.5 (SD = 22.6) with an interquartile range of 31.5 points (25th percentile: 63.5; 75th percentile: 95.0). Basic descriptive statistics for the nine specific Picker dimensions of inpatient care are reported in Table 3. The mean survival time from day of admission was 705.3 days (SD = 256.0) with an interquartile range of 382 days (25th percentile: 546 days; 75th percentile: 928 days).

The ICC estimated from the unconditional means HLM was 0.0073, indicating that a very small proportion of total variance in mortality was accounted for by differences between medical centers. Therefore, it was not necessary to take clustering by hospital into account to accurately model survival for this sample.

Approximately 5 percent ($n = 90$) of the sample had died within 6 months, and 9 percent ($n = 175$) within 1 year, of being admitted for their index AMI hospitalization. Gender and marital status did not have large ($p < .20$) associations with mortality at 1-year postdischarge (data not shown). However, all other sociodemographic characteristics met our criterion and

Table 3: Components of the Patient-Centered Care (PCC) Index: Patient-Level Basic Descriptive Statistics ($n = 1,858$)

Component	*Mean*	*SD*
Access to providers	79.9	25.7
Courtesy	90.8	19.2
Information about illness and care	69.3	32.7
Coordination of care	79.9	24.1
Attention to patient preferences	74.7	29.4
Emotional support	66.4	35.6
Family involvement	72.5	35.1
Physical comfort	85.9	24.4
Preparation for transition to outpatient	64.6	38.5

were included in subsequent models. All of the clinical conditions previously found to be predictive of 30-day mortality among veterans with AMI had noteworthy ($p < .20$) relationships with 1-year mortality except history of lipid disorders. Two other clinical variables—history of stroke during the past 5 years, and initial troponin level—could not be included in the final regression models because differences in EPRP data abstraction guidelines between FY 2003 and FY 2004 resulted in noncomparable data. Only one of the admission process measures—having an AMI secondary to hospital admission for another cause—met the preliminary screening criterion and was included in the survival models.

In the Cox regression model including the composite PCC index and other control variables, including the index of technical quality of care, greater age at admission, higher peak creatinine level, history of cancer, history of congestive heart failure, and history of dementia, were all associated with significantly higher risk of death. Better PCC was associated with slightly but significantly lower mortality at 1 year after discharge ($p = .015$; see Table 4). Controlling for all covariates, an increase of one point on the PCC index was related to a reduction in the 1-year mortality hazard of 0.99 or about 1 percent. Thus, an increase of 1 SD in the PCC index would be associated with a 1-year mortality hazard of 0.84, a reduction of about 16 percent compared with the average level of PCC. In the model predicting 6-month mortality, the protective effect of PCC was evident (hazard ratio 0.992, 95 percent confidence interval [CI] 0.98–1.00, $p = .059$), but among the control variables only age at admission (hazard ratio 1.05, 95 percent CI 1.02–1.07, $p = .0003$) and history of congestive heart failure (hazard ratio 3.08, 95 percent CI 1.92–4.95, $p < .0001$) were significant; both were associated with higher risk of death. In models that included the same control variables and single Picker dimension scores as predictors, better access, attention to patient preferences, coordination of care, and attention to patient physical comfort, including pain management, were significantly related to better survival (see Table 5). In the models predicting 6-month mortality, the same four individual Picker dimensions were significant (hazard ratios ranged from 0.987 to 0.992, $p < .03$ for all four).

DISCUSSION

This study of a national sample of veterans hospitalized for an initial AMI in FY 2003 and FY 2004 at VA medical centers provided a unique opportunity to

Table 4: Predictors of One-Year Mortality: Multivariate Adjusted Hazard Ratios

Predictor	*Hazard Ratio*	*95% CI*	*p-Value*
Patient-centered care (composite index)	0.992	0.986–0.998	.015
Adherence to care guidelines	0.901	0.347–2.340	.830
Demographic characteristics			
Age at admission	1.034	1.017–1.051	<.0001
Education: some post-HS	1.162	0.795–1.699	.436
Education: 4 years college or more	0.881	0.501–1.549	.660
Employed	0.629	0.350–1.296	.208
Racial background: minority	0.966	0.417–1.194	.192
Income: U.S.$15,000–U.S.$30,000	0.828	0.583–1.178	.293
Income: over U.S.$30,000	0.705	0.395–1.258	.236
Clinical condition and history			
History of cancer	1.900	1.194–3.023	.006
History of CHF	2.507	1.803–3.484	<.0001
History of dementia	1.722	1.128–2.628	.011
Highest serum creatinine	1.135	1.045–1.231	.003
Heart rate upon hospital arrival	1.020	0.941–1.106	.620
Systolic BP upon hospital arrival	0.943	0.871–1.022	.145
Pain symptom count	0.977	0.787–1.214	.833
Admission process characteristics			
In hospital already when had AMI	1.086	0.525–2.246	.824

AMI, acute myocardial infarction; BP, blood pressure; CHF, congestive heart failure; HS, high school.

assess the long-term impact of PCC. In addition to including a measure of such care, we also had a measure of the technical quality of care and detailed information about the clinical characteristics of patients. There was a relatively

Table 5: Predictors of One-Year Mortality: Multivariate Adjusted Hazard Ratios for Individual Dimensions of Patient Centered Care

Predictor	*Hazard Ratio*	*95% CI*	*p-Value*
Access to providers	0.994	0.989–0.999	.020
Courtesy	0.995	0.998–1.002	.227
Information about illness and care	0.996	0.992–1.000	.076
Coordination of care	0.992	0.987–0.998	.008
Attention to patient preferences	0.993	0.989–0.998	.004
Emotional support	0.996	0.992–1.000	.074
Family involvement	0.997	0.993–1.001	.179
Physical comfort	0.989	0.984–0.995	<.001
Preparation for transition to outpatient	0.999	0.995–1.003	.488

high level of adherence to technical care guidelines in our sample. This may have resulted in a ceiling effect and may account for the absence of a stronger relationship in this study between technical quality and survival. This result is broadly consistent with Bradley and colleagues, who found that seven core process measures of AMI care measured and reported by the Centers for Medicare & Medicaid Services and the Joint Commission on Accreditation of Healthcare Organizations individually explained between 0.1 and 3.3 percent, and collectively only 6 percent, of the hospital-level variation in 30-day risk-standardized mortality (Bradley et al. 2006). Using 1-year postadmission survival data, however, PCC was significantly related to survival, even after controlling for patient sociodemographic characteristics, clinical condition and history, technical quality of care, and admission process characteristics. This is consistent with the findings of Fremont et al. (2001) that postdischarge symptoms of angina and dyspnea and global health ratings were better in patients that reported better PCC during their hospitalization.

Increasingly, eliciting patient reports about their care experiences is seen as an important part of care quality assessment (Cleary and Edgman-Levitan 1997; Cleary 1999; Goldstein et al. 2001; Hargraves et al. 2003; Landon et al. 2004; Keenan et al. 2009). This study suggests that in addition to providing information about aspects of care that patients think are important, there may be important clinical consequences associated with the interpersonal and information needs of patients. Thus, efforts to improve PCC (Cleary et al. 1993; Goldstein et al. 2001; Davies et al. 2008) by enhancing aspects of care such as coordination of care, attention to patient preferences, emotional support, and physical comfort might result not only in better patient experiences but also better clinical outcomes. Although studies examining the relationship between PCC and technical quality of care have had mixed results, the results of the present study argue for the desirability of continuing to assess the relationship between PCC and outcomes until the nature and degree of the impact of PCC is more clearly established.

We do not know the mechanism(s) whereby PCC during hospitalization could result in better health outcomes. Research has demonstrated that communication and other aspects of PCC can have a positive effect on important patient behaviors, such as adherence (Lowes 1998), that are related to illness management and outcomes (Bartlett et al. 1984; Greenfield et al. 1985, 1988; Brody et al. 1989; Horwitz et al. 1990; Horwitz and Horwitz 1993; Safran et al. 1998). Some recent research suggests that supportive interactions between clinicians and patients may lead to enhanced patient trust in their providers (Keating et al. 2002); such trust may in turn lead patients to assume greater personal responsibility for their health (Becker and Gerhart 1996). The results of this study are consistent with earlier studies showing that patient reports about their hospital care are associated with better outcomes (Covinsky et al. 2000; Fremont et al. 2001) but addresses some of their methodological weaknesses, including better measures of technical quality of care, better measures of health status, and independent assessments of PCC and outcomes.

This study has several potential limitations. The sample was predominately male and consisted of veterans seeking care within the VA system. Whether the same findings would have been obtained in a more representative sample of AMI patients is not clear. Further, our sample was about 2 years younger on average than the AMI patients who were not included because they lacked SHEP survey data on which to base a PCC index score. Given our finding that higher age at admission was associated with a significantly higher hazard for 1-year posthospitalization mortality, and that in general age has also been found to be associated with perceptions of more PCC, this nonresponse bias may have affected the observed results. Had more, older patients with high PCC index scores been included, and had they contributed to an increased 1-year mortality rate as indicated by the observed hazard ratio for age (1.03), this would have attenuated the findings regarding the protective effect of PCC. The observed relationship between age and perceptions of PCC in our sample was weak, however, with a maximum correlation of 0.06 (between age and the Picker family involvement dimension). This suggests that the inclusion of more patients who were somewhat older would not have greatly elevated PCC scores, even though their mortality rate may have been higher. Nonetheless, caution should be exercised in generalizing the reported findings to older patients until they can be confirmed by future research.

An additional limitation concerns the noncomparability of two of the clinical condition and history variables in the EPRP database across FY. Analyses using the data available for FY 2004 cases indicate that neither history of stroke nor initial troponin level was related to mortality at 1 year. However, the results may have been different had comparable data for these two variables been available for all cases.

The estimated positive effect of PCC was modest, and we attribute this in part to the use of mortality as an outcome variable. Although the extensive VA data made it possible to control for the technical quality of care and thereby close an important gap in previous research, relying on secondary data limited our selection of outcome measures. Mortality over the course of a year is likely to be an insensitive measure of the impact of technical quality or PCC, and this may account in part for the small size of the observed effect. A better design would be to prospectively include more sensitive measures such as symptoms and functional status (Wilson and Cleary 1995). Indeed, the lack of measures of symptoms or quality of life at the time of discharge is a weakness of the present study as compared with that of Fremont and colleagues, inasmuch as overall health at the time of discharge could lead patients to subsequently view their hospital experience more favorably and to be associated with longer survival. Thus, the design of the present study does leave open the possibility that some other factor such as overall health status at discharge might explain the higher levels of PCC among those who were living 1 year after their index hospitalization. Finally, there may be limitations in the technical quality of care measures used in the present study. Although there is consensus around many of these indicators, the 14 measures used in this study do not entirely overlap with other proposed sets of quality of care indicators (Tu et al. 2008). Thus, a different result may have been obtained regarding the impact of technical quality if additional measures had been included, such as those related to postdischarge out-of-hospital care.

Finally, patients who either died in the hospital or within the 4–6 weeks after discharge before the patient survey sample was identified would have been excluded from the SHEP survey and this study. This is an important limitation that could have biased the results of this study depending on the profile of technical quality and PCC among that group of patients. If, for example, this group of patients had both high technical quality and high PCC, their mortality may have attenuated the reported findings.

In spite of these potential limitations, the finding that PCC is related to survival in a nationally representative sample of hospitalized veterans who were treated for an AMI suggests that future research should investigate the impact of patients' experiences as well as the quality of technical care on outcomes.

Acknowledgments

Joint Acknowledgment/Disclosure Statement: This research was supported by a grant from the Picker Institute. Marjorie Nealon-Seibert, M.B.A., Survey Administrator at COLMR, assisted with preparation and submission of the study for IRB review by the VA Boston Healthcare System. There are no financial or other disclosures.

Disclosures: None.

Disclaimers: None.

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Appendix SA1: Author Matrix.

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