Special Article

OUTCOME OF MYOCARDIAL INFARCTION IN VETERANS HEALTH ADMINISTRATION PATIENTS AS COMPARED WITH MEDICARE PATIENTS

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ABSTRACT

Background Some have the opinion that patients cared for in Veterans Health Administration (VHA) hospitals receive care of poorer quality than those cared for in non-VHA institutions. To assess the quality of care in VHA hospitals, we compared the outcome of acute myocardial infarction among patients in VHA and non-VHA institutions while controlling for potential confounders, including coexisting conditions and severity of illness.

Methods We studied 2486 veterans discharged from 81 VHA hospitals and 29,249 Medicare patients discharged from 1530 non-VHA hospitals, restricting our samples to men at least 65 years of age who were discharged with confirmed acute myocardial infarction. We compared coexisting conditions, severity of illness, and 30-day and 1-year mortality in the two samples.

Results VHA patients were significantly more likely than Medicare patients to have a recorded history of hypertension (64.3 percent vs. 57.3 percent), chronic obstructive pulmonary disease or asthma (30.9 percent vs. 23.5 percent), diabetes (34.8 percent vs. 29.0 percent), stroke (20.4 percent vs. 14.2 percent), or dementia (7.2 percent vs. 4.8 percent) ($P<0.001$ for all comparisons). According to both multivariate logistic regression and an analysis using 2265 matched pairs of VHA and Medicare patients, there were no significant differences in 30-day or 1-year mortality. The matched-pairs analysis found that the difference in mortality at 30 days (the mortality rate among Medicare patients minus the mortality rate among VHA patients), averaged over the 5-year age groups, was −0.8 percent (95 percent confidence interval, −2.8 to 1.3), and the difference in mortality at 1 year was −1.3 percent (95 percent confidence interval, −3.9 to 1.3).

Conclusions VHA patients had more coexisting conditions than Medicare patients. Nevertheless, we found no significant difference in mortality between VHA and Medicare patients, a result that suggests a similar quality of care for acute myocardial infarction. (N Engl J Med 2000;343:1934-41.)

IN the United States, eligible veterans 65 years of age or older may receive health care funded either by the Veterans Health Administration (VHA) or by the Health Care Financing Administration (HCFA) under Medicare. The VHA is the largest integrated health care system in the United States, with a medical care budget of $17.9 billion in fiscal year 1998.[1] It is characterized by a Congressional appropriation of a fixed amount of money (a global budget) and salaried physicians. Of the approximately 26 million veterans, more than 3.4 million used the VHA health care system in fiscal year 1998. Access to VHA services is determined by disability associated with military service or by economic disadvantage.

In contrast to health care provided by the VHA, Medicare coverage for the majority of its 39 million beneficiaries consists of indemnity insurance combined with fee-for-service payments to physicians.[2] A patient 65 years of age or older becomes eligible by having worked for at least 10 years in Medicare-covered employment, and a younger patient becomes eligible because of disability (including end-stage renal disease).

Some have the opinion that patients cared for in VHA institutions receive care of poorer quality than those cared for in non-VHA institutions.[3] However, valid comparisons between VHA and non-VHA care are difficult to carry out, since VHA patients may have more coexisting conditions and greater severity of illness than patients in non-VHA institutions,[4,5] confounding comparisons of outcome as a measure of quality of care. Comparisons between VHA and non-VHA care may also be confounded by differences in the patients' age, sex, and socioeconomic status[6] and by unmeasured differences in patients' preferences for

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site of care. Differences among hospitals in the availability of services and in teaching status may also affect the validity of comparisons.

Given these problems with comparisons, there are few published data to address the relative quality of VHA and non-VHA health care. We are aware of only two studies, conducted at a single VHA hospital, that used clinical data to compare the outcome of care in VHA and non-VHA institutions.[5,7] Our goal was to compare the coexisting conditions, severity of illness, and outcome of acute myocardial infarction in VHA and non-VHA hospitals using nationally representative clinical data. We assessed outcome (as defined by Donabedian[8]) to measure quality. Our first hypothesis was that VHA patients had a greater burden of illness at the time of admission with acute myocardial infarction. Our second hypothesis was that after adjustment for patients' characteristics, mortality rates would be higher among VHA patients than among Medicare patients, reflecting poorer quality of care.

METHODS

We created two cohorts retrospectively: one consisted of all fee-for-service Medicare beneficiaries discharged with a diagnosis of acute myocardial infarction from acute care hospitals located in seven states, and the other consisted of a national sample of veterans discharged with a diagnosis of acute myocardial infarction from nonpsychiatric VHA facilities.

Medicare Sample

The Medicare sample was obtained through the Cooperative Cardiovascular Project, which was undertaken by HCFA to improve the quality of care for Medicare patients with acute myocardial infarction.[9] As part of the Cooperative Cardiovascular Project, HCFA studied all patients discharged with a principal diagnosis of acute myocardial infarction (code 410 of the *International Classification of Diseases, 9th Revision, Clinical Modification* [ICD-9-CM],[10] excluding a fifth digit of 2, which would indicate acute myocardial infarction in the preceding eight weeks) from all nonfederal acute care hospitals in each state during a specified eight-month period between January 1, 1994, and June 30, 1995. Our cohort is a subgroup of the larger HCFA study, including all patients in the Cooperative Cardiovascular Project who were discharged from hospitals in California, Florida, Massachusetts, New York, Ohio, Pennsylvania, and Texas. These states were selected because they were known to differ in the frequency of use of cardiac procedures, are large and geographically diverse, and served as the basis of a study examining the appropriateness of care after acute myocardial infarction.[11,12] Eliminating women, we initially identified 41,754 male Medicare beneficiaries who were 65 years of age or older.

We excluded 12,505 patients from the study. The numbers of excluded patients and the reasons for their exclusion were as follows (some patients met more than one of the exclusion criteria): 4498 patients did not meet the clinical criteria for acute myocardial infarction[9] (creatine kinase MB fraction above 0.05; lactate dehydrogenase level exceeding 1.5 times the upper limit of normal, with isoenzyme 1 level higher than isoenzyme 2 level; or the presence of two of the following three conditions: chest pain, a doubling of the creatine kinase level, or detection of a new acute myocardial infarction on an electrocardiogram); 6576 patients were discharged from the hospital to which they were transferred without a diagnosis of ICD-9-CM code 410; 423 patients were discharged alive after a length of stay of less than three days; data were incomplete for 1969 patients who resided outside the United States, whose medical records were unavailable, or who were transferred more than once; 3196 patients were enrolled in a health maintenance organization at the time of the index event, and we could not ascertain the details of their subsequent care; 641 patients were admitted or discharged outside the study period; 187 patients were transferred to hospitals out of the seven study states; 10 patients were hospitalized for more than 180 days; and an incorrect date of death was recorded for 10 patients (e.g., a date of death before admission). After these exclusions, there remained 29,249 male Medicare patients who were at least 65 years of age and who had been discharged from 1530 non-VHA hospitals.

VHA Sample

Since there are many fewer VHA hospitals than non-VHA hospitals in the seven sampled states, we used a national VHA sample. We used the Patient Treatment File, a national centralized data base that records all use of VHA facilities, to identify all male patients with a primary diagnosis of acute myocardial infarction (ICD-9-CM code 410) who were discharged between January 1, 1994, and September 30, 1995. Only patients discharged from nonpsychiatric VHA facilities with a length of stay of at least three days (if discharged alive) and without a fifth digit ICD-9-CM code of 2 were included.[13] We initially identified 13,310 VHA patients.

We sampled patients stratified according to the capability of the hospital cardiac service.[14-16] Each of the 139 VHA hospitals was classified as one of four types. Noncatheterization hospitals do not perform on-site catheterization, percutaneous transluminal coronary angioplasty, or coronary-artery bypass grafting. The hospitals in the lowest quartile of admissions for acute myocardial infarction were defined as having a low volume, and all other hospitals were defined as having a high volume. Cardiac-catheterization-only hospitals perform on-site catheterization but not revascularization. Cardiac-surgery hospitals perform all the cardiac procedures named above. Within each type of hospital, we randomly included up to 100 patients, generating a stratified national random sample of 5503 patients from 81 VHA hospitals. We reviewed the records of 5193 (94.4 percent) of these patients.

We excluded 2707 patients for one or more reasons: 433 who did not meet the clinical criteria for acute myocardial infarction,[9] 2029 who were less than 65 years of age, 181 who were discharged to an acute care non-VHA facility, and 64 for whom information was incomplete (missing discharge date or date of birth). After these exclusions, there remained 2486 male veterans who were at least 65 years of age and who had been discharged from 81 VHA hospitals.

Data Sources

We used the Cooperative Cardiovascular Project[17] structured review instrument to obtain medical-records data for Medicare patients. The records of transfer patients were linked with the initial admitting hospital. The data were abstracted at two abstraction centers under contract with HCFA.[9,18] The overall agreement between abstracters averaged 95 percent.[9] Mortality was determined from the Health Insurance Master File. The HCFA Provider of Service File and the American Hospital Association data bases were linked to our sample to obtain structural characteristics of the hospitals, such as availability of cardiac services, teaching affiliation, and number of beds.

Medical-records data for the VHA patients were abstracted by trained nurses using the Cooperative Cardiovascular Project interactive software.[19] Overall agreement between abstracters with respect to key variables was 96 percent. Mortality was determined from the inpatient discharge status in the Patient Treatment File as well as from the Veterans Affairs Beneficiary Identification and Record Location Subsystem (BIRLS).[20,21] We obtained the characteristics of the VHA hospitals from the American Hospital Association data base, the Department of Veterans Affairs Cardiac Services Directory, and the 1995 version of the *Federal Practitioner*. For both samples, a hospital was considered to have a university teaching affiliation if it had at least one intern or resident in an accredited allopathic or osteopathic residency training program according to the American Hospital Association data base.

Statistical Analysis

Differences in Coexisting Conditions and Severity of Acute Myocardial Infarction

We calculated the frequency of coexisting conditions and measures of the severity of acute myocardial infarction in both samples.[22] Chi-square tests were used to examine differences between the two groups in discrete variables, and t-tests were used to examine differences in continuous variables. For continuous variables, means ±SD were calculated. When appropriate, we also calculated the frequency with which a variable was missing or a test was not performed. We adjusted for multiple comparisons using a Bonferroni adjustment, so that the overall level of significance was 0.05 within each class of comparisons.

Differences in Mortality

In addition to calculating crude 30-day and 1-year rates of mortality from all causes, we estimated differences in mortality by two adjustment methods. First, we calculated the risk-adjusted odds of mortality for Medicare patients relative to VHA patients using logistic regression, the standard method of controlling simultaneously for observed covariates.[23] We included in the model sociodemographic features, coexisting conditions, severity of acute myocardial infarction, hospital characteristics (availability of cardiac services and presence or absence of university teaching affiliation), and other admission characteristics known to affect mortality, as well as a binary variable indicating to which cohort (Medicare or VHA) the patient belonged.[22]

Second, because we might not have accounted for all confounders appropriately, we created a matched sample using a propensity-score approach to compare the survival of VHA and Medicare patients.[24] This technique balances patients from each cohort on the basis of observed characteristics to replicate a randomized, controlled trial. To create the propensity scores, we created a logistic-regression model in which the response was the log of the odds of belonging to the VHA cohort. Characteristics of the patient (sociodemographic features, coexisting conditions, and severity of acute myocardial infarction) and the hospital (availability of cardiac services and presence or absence of university affiliation) were included in the model. Once the model was fitted, we stratified the sample according to the cardiac services available in the hospital (noncatheterization services, catheterization only, or cardiac surgery) and five-year age group. Within each of these strata, we matched each VHA patient to the Medicare patient with the closest estimated propensity score. We included in our analyses only the matches that were within 0.60 of the pooled standard error of the estimated propensity score.[25] If no match was found, the VHA patient was excluded from the analyses. To measure how well we balanced the two cohorts in terms of observed covariates, we calculated how far apart

TABLE 1. SOCIODEMOGRAPHIC FEATURES OF MEDICARE AND VETERANS HEALTH ADMINISTRATION (VHA) PATIENTS ADMITTED FOR ACUTE MYOCARDIAL INFARCTION AND CHARACTERISTICS OF THE ADMITTING HOSPITALS.*

VARIABLE	MEDICARE PATIENTS (N=29,249)	VHA PATIENTS (N=2486)	P VALUE†
Age — yr	75.5±7.0	73.4±5.7	<0.001
Race — no. (%)			<0.001
White	26,711 (91.3)	2059 (82.8)	
Black	1,084 (3.7)	337 (13.6)	
Other	1,444 (4.9)	74 (3.0)	
Unknown	10 (0.0)	16 (0.6)	
Cardiac services available in hospital — no. (%)			<0.001
Noncatheterization	8,099 (27.7)	1175 (47.3)	
Catheterization only	6,386 (21.8)	674 (27.1)	
Cardiac surgery	14,764 (50.5)	637 (25.6)	
University-affiliated hospital — no. (%)	10,002 (34.2)	2022 (81.3)	<0.001
No. of hospital beds — no. (%)‡			<0.001
<100	2,146 (7.3)	63 (2.5)	
100–500	19,862 (67.9)	1871 (75.3)	
>500	7,233 (24.7)	552 (22.2)	
Location of hospital — no. (%)			<0.001
California	4,228 (14.5)	101 (4.1)	
Florida	5,784 (19.8)	96 (3.9)	
Massachusetts	1,937 (6.6)	43 (1.7)	
New York	4,358 (14.9)	161 (6.5)	
Ohio	3,587 (12.3)	75 (3.0)	
Pennsylvania	5,158 (17.6)	139 (5.6)	
Texas	4,197 (14.3)	224 (9.0)	
Other states	0	1647 (66.3)	
Length of stay for index admission — days	9.6±7.4	13.5±11.0	<0.001
Diagnostic catheterization performed — no. (%)	13,289 (45.4)	775 (31.2)	<0.001
Percutaneous transluminal coronary angioplasty performed — no. (%)	5,273 (18.0)	201 (8.1)	<0.001
Coronary-artery bypass grafting performed — no. (%)	3,696 (12.6)	116 (4.7)	<0.001

*Plus–minus values are means ±SD.

†P values less than 0.002 were deemed significant, after the Bonferroni adjustment.

‡The number of hospital beds was missing in the case of eight patients.

the two cohorts were in terms of each observed covariate. To achieve this, we measured the average difference in each covariate, expressed as a percentage of the pooled standard deviation of the covariate, before and after matching. For example, if the fraction of VHA patients who were black minus the fraction of Medicare patients who were black, as measured by the percentage of the pooled standard deviation, was 20 percent, the means of the two samples were considered to differ by 2/10 of a standard deviation. Differences larger than 10 percent indicate that the two samples were far apart in terms of the distribution of the covariate and therefore might not be appropriately balanced.[26]

Using the matched pairs, we then estimated differences in 30-day and 1-year mortality. Paired differences (and their corresponding standard errors) were calculated within each five-year age group and then within each hospital type. We estimated the overall average difference by combining the paired differences among the five-year age groups using precision weights[27,28] and constructed a 95 percent confidence interval for the overall average difference. We repeated this across the hospital strata, calculating the precision-weighted average difference in mortality across the three types of hospitals.

RESULTS

Characteristics of the Patients and the Hospitals

Table 1 shows the sociodemographic features of the patients and the characteristics of the hospitals. VHA patients were younger, were less likely to be white, and had a longer inpatient stay than Medicare patients. Almost half the VHA patients were initially admitted to a noncatheterization hospital, whereas half the Medicare patients were initially admitted to a cardiac-surgery hospital. More VHA patients than Medicare patients were initially admitted to a university-affiliated hospital.

Coexisting Conditions and Severity of Acute Myocardial Infarction

Table 2 shows the clinical characteristics of the patients. VHA patients were significantly more likely than Medicare patients to have a history of various coexisting conditions, such as hypertension, chronic obstructive pulmonary disease or asthma, diabetes, stroke, and dementia.

Table 3 shows the severity of coronary artery disease on admission. On presentation with acute myocardial infarction, VHA patients were more likely to have ST elevation on the electrocardiogram, but there was no significant difference between the two groups in the number of patients who presented with cardiac arrest, shock, congestive heart failure or pulmonary edema, or tachycardia.

Mortality

The unadjusted 30-day mortality rates for VHA and Medicare patients were 17.3 percent and 18.1 percent, respectively (P=0.30) (Table 4). At one year, the unadjusted mortality rates were also nearly indistinguishable in the two cohorts: 31.5 percent for VHA patients and 31.8 percent for Medicare patients (P=0.77).

TABLE 2. CLINICAL CHARACTERISTICS OF MEDICARE AND VETERANS HEALTH ADMINISTRATION (VHA) PATIENTS ADMITTED FOR ACUTE MYOCARDIAL INFARCTION.*

VARIABLE	MEDICARE PATIENTS (N=29,249)	VHA PATIENTS (N=2486)	P VALUE†
Coexisting condition — no. (%)			
Congestive heart failure	5,939 (20.3)	507 (20.4)	0.92
Prior myocardial infarction	9,695 (33.1)	899 (36.2)	0.002
Percutaneous transluminal coronary angioplasty	2,264 (7.7)	152 (6.1)	0.003
Coronary-artery bypass graft surgery	4,968 (17.0)	447 (18.0)	0.21
Hypertension	16,759 (57.3)	1598 (64.3)	<0.001
Diabetes	8,489 (29.0)	866 (34.8)	<0.001
Diabetes treated with insulin	1,920 (6.6)	271 (10.9)	<0.001
Asthma or chronic obstructive pulmonary disease	6,864 (23.5)	768 (30.9)	<0.001
Stroke	4,154 (14.2)	508 (20.4)	<0.001
Cirrhosis or hepatic failure	153 (0.5)	17 (0.7)	0.29
HIV infection or AIDS	17 (0.1)	3 (0.1)	0.23
Cancer	960 (3.3)	63 (2.5)	0.04
Immunosuppression	583 (2.0)	106 (4.3)	<0.001
Peptic ulcer	4,217 (14.4)	416 (16.7)	0.002
Dementia	1,413 (4.8)	178 (7.2)	<0.001
Terminal illness	139 (0.5)	12 (0.5)	0.96
Order for limitation of resuscitation	4,442 (15.2)	465 (18.7)	<0.001
Body-mass index measured — no. (%)	25,607 (87.5)	1905 (76.6)	<0.001
Body-mass index	26.1±4.5	26.7±5.1	<0.001

*Plus–minus values are means ±SE. HIV denotes human immunodeficiency virus, and AIDS the acquired immunodeficiency syndrome. The body-mass index is the weight in kilograms divided by the square of the height in meters.

†P values less than 0.001 were deemed significant, after the Bonferroni adjustment.

TABLE 3. SEVERITY OF CORONARY ARTERY DISEASE AND RESULTS OF LABORATORY TESTS AT ADMISSION OF MEDICARE AND VETERANS HEALTH ADMINISTRATION (VHA) PATIENTS FOR ACUTE MYOCARDIAL INFARCTION.

VARIABLE	MEDICARE PATIENTS (N=29,249)	VHA PATIENTS (N=2486)	P VALUE*
Chest pain lasting more than 60 min after arrival — no. (%)	10,147 (34.7)	625 (25.1)	<0.001
Pulse on arrival — no. (%)			0.07
<60 beats/min	2,774 (9.5)	188 (7.6)	
60–99 beats/min	19,220 (65.7)	1564 (62.9)	
≥100 beats/min	7,110 (24.3)	555 (22.3)	
Not measured or data missing	145 (0.5)	179 (7.2)	
Systolic blood pressure on arrival — no. (%)			<0.001
<100 mm Hg	2,196 (7.5)	259 (10.4)	
≥100 mm Hg	26,907 (92.0)	2224 (89.5)	
Not measured or data missing	146 (0.5)	3 (0.1)	
Shock on arrival — no. (%)†	1,087 (3.7)	106 (4.3)	0.17
Cardiac arrest on arrival — no. (%)	1,282 (4.4)	120 (4.8)	0.30
Congestive heart failure or pulmonary edema on arrival — no. (%)	8,161 (27.9)	668 (26.9)	0.27
Results of chest radiography on arrival — no. (%)			
Not performed or data missing	2,647 (9.0)	681 (27.4)	<0.001
Cardiomegaly‡	9,839 (37.0)	562 (31.1)	<0.001
Congestive heart failure‡	6,612 (24.9)	449 (24.9)	0.99
Stroke on arrival — no. (%)	268 (0.9)	9 (0.4)	0.004
Admission electrocardiography — no. (%)			
Not performed or data missing	393 (1.3)	99 (4.0)	<0.001
ST elevation	12,169 (41.6)	1167 (46.9)	<0.001
Ventricular tachycardia	275 (0.9)	20 (0.8)	0.50
Atrial fibrillation	2,773 (9.5)	250 (10.1)	0.35
Left bundle-branch block	1,754 (6.0)	172 (6.9)	0.07
Peak creatine kinase MB fraction ≤48 hr after arrival			
Not measured or data missing — no. (%)	3,442 (11.8)	320 (12.9)	0.11
Mean (±SD) — U/ml	11.2±6.7	12.5±17.5	<0.001
Ejection fraction — no. (%)			0.08
<35%	6,648 (22.7)	425 (17.1)	
≥35%	10,115 (34.6)	590 (23.7)	
Not measured or data missing	12,486 (42.7)	1471 (59.2)	
Creatinine — no. (%)§			0.007
<1.5 mg/dl	19,023 (65.0)	1456 (58.6)	
≥1.5 mg/dl	9,199 (31.5)	796 (32.0)	
Not measured or data missing	1,027 (3.5)	234 (9.4)	
Stress-induced ischemia — no. (%)			<0.001
Present	1,453 (5.0)	350 (14.1)	
Absent	2,297 (7.9)	316 (12.7)	
No test performed	25,302 (86.5)	1721 (69.2)	
Data missing	197 (0.7)	99 (4.0)	

*P values less than 0.002 were deemed significant, after the Bonferroni adjustment. For the calculation of P values for the following variables, the category "Not measured or data missing" was not included: pulse, systolic blood pressure, ejection fraction, and creatinine level.

†The patient was in shock on arrival at the hospital.

‡Percentages are based on the number of patients with available data.

§To convert values for creatinine to micromoles per liter, multiply by 88.4.

Risk-Adjusted Differences in Mortality

Table 4 shows the odds ratios and 95 percent confidence intervals for each covariate used in the logistic model. The estimated odds of 30-day mortality for Medicare patients as compared with VHA patients were 0.94 (95 percent confidence interval, 0.82 to 1.07; receiver-operating-characteristic curve, 0.800). The corresponding estimate at one year was 0.94 (95 percent confidence interval, 0.84 to 1.05; receiver-operating-characteristic curve, 0.799).

Matched Analysis

Using a model with 29 covariates to predict VHA use, we were able to obtain an accuracy of 88 percent (receiver-operating-characteristic curve, 0.88) and to match 2265 (91.1 percent) of the VHA patients to Medicare patients. Before matching, 16 of the 29 covariates had a standardized difference larger than 10 percent, whereas after matching, all standardized differences were less than 5 percent.

Using the matched sample, we observed no statis-

TABLE 4. LOGISTIC-REGRESSION ANALYSIS OF MORTALITY AMONG MEDICARE PATIENTS AS COMPARED WITH VETERANS HEALTH ADMINISTRATION (VHA) PATIENTS 30 DAYS AND 1 YEAR AFTER ACUTE MYOCARDIAL INFARCTION.*

VARIABLE	30-DAY MORTALITY	1-YEAR MORTALITY
Death — no. (%)		
Medicare patients	5291 (18.1)	9306 (31.8)
VHA patients	429 (17.3)	784 (31.5)
	multivariate odds ratio (95% confidence interval)	
Sociodemographic characteristics		
Medicare care	0.94 (0.82–1.07)	0.94 (0.84–1.05)
Adjusted age (age minus 65) — yr	1.52 (1.37–1.70)	1.42 (1.30–1.56)
(Age minus 65)^2 — yr	0.84 (0.76–0.92)	0.97 (0.89–1.06)
Black race	0.80 (0.68–0.95)	0.89 (0.78–1.02)
Other race	0.89 (0.77–1.04)	0.96 (0.84–1.09)
Characteristics of the admitting hospital		
University-affiliated hospital	0.91 (0.85–0.98)	1.01 (0.94–1.07)
Hospital offering cardiac surgery	0.96 (0.88–1.03)	0.90 (0.84–0.96)
Hospital offering catheterization only	1.05 (0.96–1.14)	1.04 (0.96–1.12)
Findings or coexisting conditions at admission		
Body-mass index	0.77 (0.71–0.84)	0.65 (0.61–0.70)
Body-mass index not measured or missing	1.19 (0.94–1.50)	0.61 (0.50–0.75)
History of congestive heart failure	0.99 (0.92–1.08)	1.48 (1.38–1.58)
History of hypertension	0.97 (0.91–1.04)	0.99 (0.93–1.04)
History of percutaneous transluminal coronary angioplasty	0.76 (0.66–0.87)	0.85 (0.76–0.95)
History of stroke	1.27 (1.17–1.38)	1.41 (1.31–1.52)
History of chronic obstructive pulmonary disease or asthma	1.09 (1.01–1.17)	1.41 (1.32–1.50)
History of cancer	1.45 (1.24–1.70)	2.55 (2.21–2.95)
History of dementia	1.28 (1.13–1.45)	1.78 (1.58–2.00)
Severity of illness at admission		
Log mean arterial pressure†	0.27 (0.24–0.31)	0.35 (0.32–0.39)
Shock on arrival	2.42 (2.10–2.80)	2.39 (2.04–2.79)
Pulmonary edema on arrival	1.36 (1.27–1.47)	1.74 (1.63–1.86)
Cardiomegaly on admission according to radiography‡	1.28 (1.19–1.37)	1.36 (1.28–1.44)
ST elevation on admission electrocardiogram	1.21 (1.13–1.29)	1.12 (1.06–1.18)
ST elevation not measured or data missing	1.28 (1.01–1.61)	1.32 (1.07–1.64)
Cardiac arrest	4.39 (3.84–5.01)	2.87 (2.50–3.29)
Chest pain lasting more than 60 min after arrival	1.07 (1.00–1.15)	0.97 (0.92–1.03)
Results of tests		
Stress-induced cardiac ischemia	1.55 (1.06–2.26)	1.22 (1.01–1.48)
Ischemia not measured or data missing	8.99 (6.90–11.7)	3.16 (2.78–3.60)
Creatinine, 1.5–7.0 mg/dl§	1.92 (1.79–2.06)	2.07 (1.95–2.20)
Creatinine not measured or data missing	1.56 (1.33–1.83)	1.73 (1.51–1.98)
Conduction disturbance on electrocardiogram¶	1.10 (1.02–1.18)	1.21 (1.14–1.29)
Model C statistic‖	0.800	0.799

*The reference category for all variables is 0, except for age, body-mass index, and mean arterial pressure, where an increase of one unit in the odds ratio represents an increase of 1 SD of the continuous variable. For age this represents an increase of 7.0 years, for body-mass index an increase of 9.8, and for log mean arterial pressure an increase of 0.33.

†Mean arterial pressure was defined as (systolic pressure + 2[diastolic pressure]) ÷ 3.

‡Cardiomegaly was considered present if a chest radiograph obtained within 48 hours after admission documented cardiomegaly, an enlarged heart, borderline cardiomegaly, an enlarged cardiac silhouette, or a cardiothoracic ratio greater than 0.5.

§To convert values for creatinine to micromoles per liter, multiply by 88.4.

¶Conduction disturbance was considered present if any of the following were found on the electrocardiogram: atrial fibrillation, heart block, hemiblock, left bundle-branch block, right bundle-branch block, or clinically significant ventricular arrhythmia.

‖The model C statistic is a measure of the degree to which the model is able to discriminate between outcomes, where a value of 1 indicates perfect discrimination.

tically significant difference in 30-day or 1-year mortality between Medicare and VHA patients. The difference in mortality at 30 days (mortality among Medicare patients minus mortality among VHA patients) averaged over the 5-year age groups was −0.8 percent (95 percent confidence interval, −2.8 to 1.3), and the difference in mortality at 1 year was −1.3 percent (95 percent confidence interval, −3.9 to 1.3). After averaging among types of hospital, similar results were observed: −0.8 percent for 30-day mortality (95 percent confidence interval, −2.9 to 1.3) and −0.9 percent for 1-year mortality (95 percent confidence interval, −3.6 to 1.7).

Our findings with regard to mortality were not consistent with our prior hypotheses. To try to explain our findings, and because survival is improved by the use of a number of medications after acute myocardial infarction,[29] we calculated the crude rates of use of thrombolytic agents at the time of arrival at the hospital and of use of beta-blockers, angiotensin-converting–enzyme inhibitors, aspirin, or combinations of these drugs at the time of discharge. A similar percentage of VHA and Medicare patients underwent thrombolysis at the time of arrival (15.8 percent vs. 16.9 percent, $P=0.16$). Of the patients who survived to discharge, more VHA patients than Medicare patients were receiving beta-blockers (49.7 percent vs. 41.6 percent, $P<0.001$), angiotensin-converting–enzyme inhibitors (44.6 percent vs. 32.5 percent, $P<0.001$), or aspirin (77.2 percent vs. 68.6 percent, $P<0.001$) at discharge.

DISCUSSION

We conducted a national study using clinical data to compare the coexisting conditions, severity of acute myocardial infarction, and outcome in patients cared for in VHA hospitals and patients cared for under fee-for-service Medicare financing. To minimize potential confounding, we collected comparable data from a uniform clinical cohort, restricted our samples to men 65 years or age or more, and matched the cohorts according to patient and hospital characteristics to carry out risk-adjusted comparisons of mortality.

We found that among elderly men with acute myocardial infarction, those treated at VHA hospitals are more likely to have coexisting conditions, such as chronic obstructive pulmonary disease or asthma, diabetes, hypertension, stroke, and dementia, than those cared for under Medicare financing. Given these baseline differences, the ideal way to answer our question of whether the quality of care is poorer in VHA hospitals would be to randomly assign patients with acute myocardial infarction to either fee-for-service Medicare or VHA care and then to examine their long-term outcome. Given that we could not perform this experiment, we used a propensity-score approach to replicate randomization within our observational data set. Using this technique to match patients on the basis of their propensity to use VHA services, we compared survival among those who were treated within the VHA system and those who were not, within each type of hospital and five-year age group. After this matching technique had been applied, there were no significant differences between the two groups of patients in 30-day or 1-year mortality.

Our findings with regard to mortality were not consistent with our prior hypotheses. The use of thrombolytic agents was similar in both groups, but more VHA patients than Medicare patients were receiving beta-blockers, angiotensin-converting–enzyme inhibitors, or aspirin at discharge. We postulate that the similar outcomes with regard to mortality are at least partly accounted for by the higher rates of use of medications that are known to decrease mortality in the VHA cohort. Of course, none of these unadjusted rates of use account for important differences among patients (in, for example, age or coexisting conditions), hospitals, or indications for or contraindications to treatment. Thus, process of care, as defined by Donabedian,[8] in VHA hospitals may be better (or worse), but our data do not allow us to judge that dimension of the quality of health care.

To assess whether our exclusions from the VHA cohort might have biased our mortality findings in favor of the VHA, we determined the one-year mortality rate for the patients who were discharged to an acute care hospital from a VHA facility and were excluded from our sample. Among these 181 patients, one-year mortality was 30 percent, suggesting that the transfer of sicker patients out of VHA hospitals did not explain our findings. Since only 8.9 percent of our patients were transferred from another VHA hospital, it is unlikely that our mortality findings could be accounted for by transfer into VHA hospitals of patients who received care elsewhere. Because there is little variation in the population-based rates of hospitalization for acute myocardial infarction in most areas[30] and little disagreement about the appropriateness of hospitalization for this condition, it is unlikely that differences in the threshold for admission for VHA and Medicare patients confounded our findings. Furthermore, the findings in Table 3 do not support the view that VHA hospitals selectively admit patients with less severe disease.

Our findings with regard to mortality are consistent with those of a previous single-institution study that used clinical data to compare outcomes of VHA patients and those treated by the private sector,[7] although the authors of that study noted that their power to demonstrate even a 50 percent difference in mortality was only 55 percent. Other comparative studies have used administrative data and either have reported unadjusted mortality rates[31] or have not been able to account for a number of possible confounders of their results.[32,33]

From data-base studies of patients who use both

VHA and Medicare services, we know that most users of VHA services are initially hospitalized for acute myocardial infarction under Medicare financing.[34] This is because ambulances that are called to assist patients with cardiac symptoms may be required to take them to the nearest emergency department, which may not be a VHA facility. Thus, the findings of this study cannot be generalized to all veterans with acute myocardial infarction, but only to veterans who are cared for in VHA hospitals for this condition.

There are many methodologic challenges to be overcome in carrying out comparisons between different systems of health care, but given the size, scope, and budget of the VHA health care system, the lack of such comparative data is surprising. We have demonstrated that patients cared for in VHA hospitals have a greater burden of illness than patients cared for under Medicare financing. With extensive risk adjustment, we have found no differences in mortality between VHA patients and fee-for-service Medicare patients, suggesting that VHA patients receive care of similar quality for acute myocardial infarction.

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