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Comparison of Use of Medications After Acute Myocardial Infarction in the Veterans Health Administration and Medicare

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Background—There is concern that care provided in the Veterans Health Administration (VA) may be of poorer quality than non-VA health care. We compared use of medications after acute myocardial infarction in the VA with that in non-VA healthcare settings under fee-for-service (FFS) Medicare financing.

Methods and Results—We used clinical data from 2486 VA and 29 249 FFS men ≥65 years old discharged with a confirmed diagnosis of acute myocardial infarction from 81 VA hospitals and 1530 non-VA hospitals. We reported odds ratios (ORs) for use of thrombolytics, β-blockers, ACE inhibitors, or aspirin among ideal candidates adjusted for age, sample design (hospital academic affiliation, availability of cardiac procedures, and volume), and within-hospital clustering. Ideal VA candidates were more likely to undergo thrombolytic therapy at arrival (OR [VA relative to Medicare] 1.40 [1.05, 1.74]) or to receive ACE inhibitors (OR 1.67 [1.12, 2.45]) or aspirin (OR 2.32 [1.81, 3.01]) at discharge and equally likely to receive β-blockers (OR 1.09 [1.03, 1.40]) at discharge.

Conclusions—Ideal candidates in VA were at least as likely as those in FFS to receive medical therapies of known benefit for acute myocardial infarction. **(*Circulation*. 2001;104:2898-2904.)**

Key Words: myocardial infarction ■ drugs ■ health care ■ thrombolysis

The organization and financing (or structure[1]) of health care is known to affect healthcare quality. For example, one comparison of quality-of-care measures for investor-owned and not-for-profit health maintenance organizations demonstrated that investor-owned health maintenance organizations were less likely to provide β-blockers for patients after acute myocardial infarction (AMI).[2] In another study, angiography after AMI was used less often among Medicare beneficiaries in managed-care plans than in fee-for-service plans.[3] Other studies comparing fee-for-service with health maintenance organization care have not found significant quality differences.[4,5]

Many have criticized the performance of the Veterans Health Administration (VA),[6,7] the largest integrated healthcare system in the US, but we are not aware of any peer-reviewed national empirical data comparing the relative quality of VA and non-VA health care using process-of-care measures. In fact, the Government Accounting Office has criticized VA for lack of oversight of quality and access to care.[6] Given the widespread comparisons between other types of healthcare systems, as well as the size, scope, and budget of the VA healthcare system, the lack of such comparison data is surprising.

The goal of this study was to compare use of medications for AMI in VA and non-VA healthcare facilities. Given opinion reflected by the views of Senator John McCain (Republican primary campaign, 2000) and others,[6,7] our previous hypothesis was that use of clinically indicated medications after AMI was lower in VA than under fee-for-service Medicare financing. We chose to assess medication use as our process-of-care measure, because thrombolytic therapy,[8] β-blockers,[9] aspirin,[10] and ACE inhibitors[11] improve outcome in carefully controlled trials with large numbers of patients suffering from AMI. Failure to use these effective medical treatments may lead to as many as 18 000 preventable deaths each year in the United States.[12]

To minimize confounding, we collected data from a uniform clinical cohort, used the same data abstraction instrument with the same variable definitions for both samples, restricted our samples to male patients ≥65 years old, and used standard definitions of eligibility for medical therapies.

Methods

Medicare Sample

The Medicare sample was obtained through the Cooperative Cardiovascular Project undertaken by the Health Care Financing Adminis-

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tration (HCFA) to improve the quality of care for Medicare patients with AMI.[13] Patients discharged with a principal diagnosis of AMI (*International Classification of Diseases, 9th Revision, Clinical Modification*[14] [ICD-9-CM]-410 [excluding a fifth digit of 2, indicating AMI in the previous 8 weeks]) in all nonfederal acute care hospitals during February 1, 1994, and July 30, 1995, were included. Our study cohort is a subset of the sample, composed of all hospital AMI discharges within the states of California, Florida, Massachusetts, New York, Ohio, Pennsylvania, and Texas.[15,16] After we had excluded women, those without a clinically confirmed AMI according to published criteria,[13] those enrolled in a health maintenance organization, and those with missing data, we identified 29 249 male Medicare patients discharged from 1530 non-VA hospitals.

VA Sample

Because the number of VA hospitals in the 7 states of the Medicare cohort was too small to provide adequate power for the analysis, we used a national VA sample. We identified all men with a primary diagnosis of AMI (ICD-9-CM-410, excluding a fifth digit of 2) discharged between January 1, 1994, and September 30, 1995, by use of the Patient Treatment File, the centralized national discharge database of all VA utilization.[17]

From the 139 VA acute care hospitals, we randomly chose 81 hospitals and generated a national random sample of 5503 VA patients.[18] After we had excluded those who did not meet clinical criteria for AMI,[13] patients who were <65 years of age, patients discharged to an acute care non-VA facility, and those with incomplete information (such as missing discharge date or date of birth), we identified 2486 veterans.

Data Sources

We used the Cooperative Cardiovascular Project[19] structured review instrument to obtain medical record data for both samples. Variables collected from the medical record included patient demographics, symptoms on presentation, past medical history, laboratory values, test findings, and hospital course.[13,18,20,21] For the Medicare cohort, data were abstracted at 2 Clinical Data Abstraction Centers under contract with HCFA. Data abstraction and quality control procedures have been described previously.[20] Data quality was monitored through random reabstraction of cases on a continuous basis, and overall variable agreement averaged 95%.[13] Medical record data for the VA cohort were entered directly into a computer database by use of the CCP interactive software by trained nurses.[21] Overall variable agreement was 96% for VA data abstraction.[18]

The HCFA Provider of Service File and American Hospital Association databases were linked to our samples to obtain structural characteristics such as cardiac service availability, number of beds, and presence of university affiliation. "University-affiliated" for both samples was defined as at least one intern or resident in an accredited allopathic or osteopathic residency training program according to the American Hospital Association database. We obtained VA hospital characteristics from the American Hospital Association database, Department of Veterans Affairs Cardiac Services Directory, and the 1995 version of the *Federal Practitioner*.

Use of Medical Therapies

We identified 4 patient groups for the medication analyses: the entire population (regardless of contraindications), the ideal population, ideal candidates for both thrombolytic therapy and aspirin, and maximum beneficiaries.

For the first group, we assessed use of thrombolytic therapy at the time of arrival, so the denominator for the thrombolytic therapy analysis was all patients at the time of admission. For other medications, we assessed prescription of the medication at the time of discharge for those discharged alive.

In the second group of analyses, we assessed use of medications in ideal candidates only. Ideal candidates for thrombolytic therapy, β-blockers, ACE inhibitors, and aspirin were identified according to recommendations from the American College of Cardiology/American Heart Association Guidelines for the Treatment of Acute Myocardial Infarction.[22] Criteria for medical therapies are given in Table 1. We excluded patients with contraindications to therapy whether they received the therapy or not.

Because optimal care for AMI would consist of simultaneous use of all treatments for which the patient is eligible, we created a composite measure of process of care by assessing use of 2 of the indicated medications in ideal candidates in the third analysis. Because the sample size for thrombolytic therapy was the smallest and that for aspirin was largest, we determined how many patients were ideal candidates for both thrombolytic therapy at arrival and aspirin at the time of discharge. We then assessed the number of patients who received both treatments during the hospital stay among those ideal for both.

TABLE 1. Criteria for Ideal Candidates and Subsets of Ideal Candidates Who Would Benefit Most from Medical Therapies

Thrombolytic therapy[22]
Presentation within 12 hours of onset of symptoms AND
ST elevation in ≥2 leads or LBBB on ECG AND
No history of stroke or evidence of stroke on arrival AND
No cardiopulmonary resuscitation (CPR) AND
No recent trauma or surgery AND
No active bleeding or bleeding diathesis, and no elevation of the prothrombin time (PT) or international normalized ratio (INR) AND
No angioplasty in the first 12 hours after arrival
Most benefit from Thrombolytic Therapy[22]
Meet ideal candidate criteria above AND
Arrived within 6 hours of onset of AMI symptoms AND
ST elevation in 2 contiguous leads on ECG
Beta-blockers[20]
Discharge systolic blood pressure ≥100, AND
Discharge pulse ≥60 AND
Absence of pulmonary edema, congestive heart failure, peripheral vascular disease, diabetes treated with insulin, shock, second- or third-degree heart block, asthma, chronic obstructive pulmonary disease (COPD), and absence of a reaction to β-blocker drugs
Most benefit from β-blockers[20]
Meet ideal candidate criteria above AND
History of a prior MI OR
Reinfarction during the hospital stay OR
Cardiac arrest OR
Positive stress test during the hospitalization OR
Ventricular tachycardia OR
Recurrent angina
ACE inhibitors[24]
Discharge systolic blood pressure ≥100 mm Hg AND
Serum creatinine ≤2.0 mg/dL AND
Absence of aortic stenosis AND
Absence of a reaction to the medication
Most benefit from ACE inhibitors
Meet ideal candidate criteria above AND
Left ventricular ejection fraction <40% AND
History of diabetes mellitus[25]
Aspirin[22]
No bleeding or elevation of the PT or INR
No treatment with warfarin on discharge
No aspirin intolerance

In the fourth group of analyses, we assessed use of medications in subsets of ideal candidates who would be expected to benefit maximally from the medication (Table 1). For example, in high-risk patients, such as those with ongoing cardiac ischemia, use of β-blockers has an even greater benefit[23] than in the AMI population as a whole. Use of β-blockers would be expected to be even greater than in the ideal population. Similarly, ACE inhibitors have greater benefit in certain subgroups, such as those with depressed ejection fraction[24] and diabetes mellitus,[25] and rates of use should be greater than in ideal candidates alone.

Statistical Analysis

We calculated the frequency of comorbid conditions, admission characteristics, and other inclusion characteristics in each of the 2 cohorts.[26] We report the frequencies of variables used to establish both ideal candidates and contraindications. χ^2 tests and *t* tests were used to examine differences between the 2 groups for discrete-valued and continuous-valued variables, respectively. When possible, we also tabulated the frequency of missing data. For the ideal candidate criteria, if a patient was missing a key variable to specify ideal candidate status (eg, serum creatinine for the ACE inhibitor analysis), the patient was excluded from the analysis and was not considered an ideal candidate for the therapy. For this reason, our results pertain only to those patients "known" to be ideal candidates.

To determine whether there was differential use of therapies in the 2 healthcare systems, we calculated the OR of use of a therapy in a VA patient relative to a Medicare patient. Because increasing age has been shown to decrease the likelihood of receipt of medications after AMI,[27] we adjusted each OR by age, using 5-year age intervals. To account for differences in sampling design methodology used to create the 2 cohorts, we also adjusted for on-site availability of cardiac procedures and hospital volume. The adjusted ORs were modeled via a hierarchical logistic regression model[28] to account for within-hospital clustering of patients and estimated using the Bayesian inference Using Gibbs Sampling (BUGS) software.[29] Estimates of the adjusted ORs and corresponding 95% CIs were constructed. Finally, because university-affiliated teaching hospitals have been shown to provide better process of care and have better risk-adjusted survival than nonaffiliated hospitals,[30–32] we also adjusted our findings for affiliated teaching hospital status.

Results

Table 2 displays the characteristics of the sample. Patients cared for in VA were younger and less likely to be white. Almost half of the VA patients were initially admitted to a noncatheterization hospital, whereas half of the Medicare patients were initially admitted to a cardiac surgery hospital. More patients in the VA sample than the Medicare sample were initially admitted to a university-affiliated hospital. VA patients were significantly more likely than Medicare patients to have a recorded history of a number of comorbidities, such as hypertension, chronic obstructive pulmonary disease, diabetes, or prior MI.

We assessed overall use of medications in the entire population, without exclusions for ideal candidates (Table 3). On admission, there was no difference in use of thrombolytic therapy overall. Of those patients surviving to discharge, more VA than Medicare patients overall received ACE inhibitors or aspirin at discharge. There was no difference in the likelihood of receiving β-blockers at discharge.

In the subset of patients who met the definition of ideal candidate, those cared for in the VA were more likely than ideal candidates cared for under Medicare financing to receive thrombolytic therapy on arrival (Table 3) or to receive ACE inhibitors or aspirin at the time of discharge. There was no difference in the likelihood of receiving β-blockers at discharge.

Of 1714 patients who were ideal candidates for both thrombolytic therapy and aspirin, there was no significant difference between the percentage of those receiving both medications in VA and Medicare (40.3% versus 42.5%, respectively; OR 0.98 [0.63, 1.33]).

Table 4 presents results of medication use in subsets of patients who would be expected to benefit maximally from use of certain medications after AMI. For thrombolytic therapy, we identified ideal candidates who also arrived within 6 hours of onset of AMI symptoms and had ST elevation in 2 contiguous leads on ECG. Of these patients, 52.6% of VA and 56.3% of Medicare patients received thrombolytic therapy on arrival at the hospital (adjusted OR 1.14 [0.81, 1.52]).

For β-blockers, we identified ideal candidates who also had a history of a prior MI, reinfarction during the hospital stay, cardiac arrest, a positive stress test during the hospitalization, ventricular tachycardia, or recurrent angina.[23] In this subset of patients, 66.7% of VA patients and 56.4% of Medicare patients received β-blockers at discharge (adjusted OR 1.19 [0.83, 1.69]).

Discussion

In this study, we compared use of medical therapies for AMI in the VA with that delivered under fee-for-service Medicare financing. To minimize potential confounding, we collected comparable clinical data from a uniform clinical cohort, restricted our samples to male patients ≥65 years old, and used standard criteria from randomized trials and published clinical guidelines for use of medical therapies.

In adjusted analyses, elderly men with AMI who were ideal candidates for thrombolytic therapy, ACE inhibitors, or aspirin were more likely to receive these medications at discharge in VA than in non-VA healthcare settings. Ideal candidates in VA and Medicare were equally likely to receive β-blockers at discharge.

Why might VA patients be more likely to receive some of the treatments we studied? The VA, unlike fee-for-service Medicare, is a national system with a common electronic information system for patient data and national care and quality monitoring standards. VA disseminates information on best practices to practitioners,[33] collects and monitors data, and provides feedback on performance measures to clinicians.[34] Also, many more hospitals in VA than in fee-for-service Medicare are affiliated teaching hospitals (80.5% versus 34.2%, respectively; $P<0.001$). University-affiliated teaching hospitals have been shown to provide better process of care and have better risk-adjusted survival than nonaffiliated hospitals.[30–32] Thus, to ensure that differences in teaching affiliation alone do not explain our findings, we performed our analyses both with and without control for teaching affiliation. None of the results changed in direction, although the significance levels of 2 of the findings did change, such that the OR for use of β-blockers in ideal candidates became significant and the OR for use of thrombolytic therapy became insignificant when not controlled for teaching affiliation.

TABLE 2. Characteristics of Patients Treated for AMI in VA and Medicare

Cohort	Medicare (n=29 249)	VA (n=2486)	*P*
Patient sociodemographic characteristics [n (%)]			
Mean age, y (SD)	75.5 (±7.0)	73.4 (±5.7)	<0.001
Age categories, y			<0.001
65–69	6877 (23.5)	787 (31.7)	
70–74	7651 (26.2)	834 (33.6)	
75–79	6278 (21.5)	542 (21.8)	
80–84	4883 (16.7)	229 (9.2)	
85–89	2597 (8.9)	75 (3.0)	
>89	963 (3.3)	19 (0.8)	
Race			<0.001
White	26 711 (91.3)	2059 (82.8)	
Black	1084 (3.7)	337 (13.6)	
Other/unknown	1454 (4.9)	90 (3.6)	
Admission characteristics			
Time since chest pain started, h			<0.001
<6	14 943 (56.1)	1354 (57.7)	
6–12	2539 (9.5)	233 (9.9)	
>12	4235 (15.9)	711 (30.3)	
No pain	4909 (18.4)	49 (2.1)	
Systolic blood pressure on arrival, mm Hg			<0.001
<100	2196 (7.5)	259 (10.4)	
≥100	26 907 (92.0)	2224 (89.5)	
Not measured/missing	146 (0.5)	3 (0.1)	
Admission ECG			
Not performed/missing	393 (1.3)	99 (4.0)	<0.001
ST elevation if ECG	12 169 (41.6)	1167 (47.0)	<0.001
Ventricular tachycardia if ECG	275 (0.9)	20 (0.8)	0.50
Atrial fibrillation if ECG	2773 (9.5)	250 (10.1)	0.35
Left bundle branch block if ECG	1754 (6.0)	172 (6.9)	0.07
Chest pain >60 minutes after arrival	10 147 (34.7)	625 (25.1)	<0.001
Comorbidities			
Congestive heart failure	5939 (20.3)	507 (20.4)	0.92
Prior MI	9695 (33.2)	899 (36.2)	0.002
Hypertension	16 759 (57.3)	1598 (64.3)	<0.001
Diabetes	8489 (29.0)	866 (34.8)	<0.001
Diabetes treated with insulin	1920 (6.6)	271 (10.9)	<0.001
Asthma or chronic obstructive pulmonary disease	6864 (23.5)	768 (30.9)	<0.001
History of gastrointestinal bleeding	2661 (9.1)	332 (13.4)	<0.001
Hemorrhage or bleeding	5866 (20.1)	590 (23.7)	<0.001
Chronic liver disease	153 (0.5)	17 (0.7)	0.29
Coagulopathy	1982 (6.8)	163 (6.6)	0.68
Surgery in past month	766 (2.6)	28 (1.1)	<0.001
Recent head trauma	884 (3.0)	110 (4.4)	<0.001
History of stroke or uncontrolled hypertension	4064 (13.9)	508 (20.4)	<0.001
Aortic stenosis	801 (4.6)	44 (3.0)	0.004
Test results			
Creatinine,* mg/dL			0.83
≤2.0	24 932 (88.3)	1986 (88.2)	
>2.0	3290 (11.7)	266 (11.8)	

TABLE 2. Continued

Cohort	Medicare (n=29 249)	VA (n=2486)	*P*
Ejection fraction,† %			<0.001
<35	6648 (22.7)	425 (17.1)	
≥35	10 115 (34.6)	590 (23.7)	
Stress-induced ischemia			<0.001
Present	1453 (5.0)	350 (14.1)	
Absent/not measured	2297 (7.8)	316 (12.7)	
No test performed	25 302 (86.5)	1721 (69.2)	
Missing	197 (0.7)	99 (4.0)	
Hospital characteristics			
Admitting hospital type			<0.001
Noncatheterization	8099 (27.7)	1175 (47.3)	
Catheterization-only	6386 (21.8)	674 (27.1)	
Cardiac surgery	14 764 (50.5)	637 (25.6)	
University-affiliated	10 002 (34.2)	2022 (80.5)	<0.001
Bed size			<0.001
<100 beds	2146 (7.3)	63 (2.5)	
100–500 beds	19 862 (67.9)	1871 (75.3)	
>500 beds	7233 (24.7)	552 (22.2)	
Death during hospital stay	4567 (15.6)	406 (16.3)	0.34

*Creatinine was unmeasured for 3.5% of Medicare and 9.4% of VA patients.
†Ejection fraction was unmeasured for 39.0% of Medicare and 34.9% of VA patients.

TABLE 3. Adjusted Odds* of Medication Use in VA Patients Relative to Medicare Patients Treated for AMI

Cohort	Medicare (n=29 249)	VA (n=2486)	OR (95% CI)†
Thrombolytic therapy at arrival			
All patients	4941 (16.9%)	393 (15.8%)	0.87 (0.73, 1.02)
Denominator, ideal only	3484	257	
Ideal only‡	1644 (47.2%)	132 (51.4%)	1.40 (1.05, 1.74)
Cohort§	**Medicare (n=24 682)**	**VA (n=2080)**	
Use of β-blockers at discharge			
All patients	10 259 (41.6%)	1033 (49.7%)	1.13 (0.94, 1.30)
Denominator, ideal only	6729	416	
Ideal only‡	3735 (55.5%)	273 (65.6%)	1.09 (0.83, 1.40)
Use of ACE inhibitors at discharge			
All patients	8022 (32.5%)	927 (44.6%)	1.55 (1.37, 1.75)
Denominator, ideal only	4103	172	
Ideal only‡	2378 (58.0%)	122 (70.9%)	1.67 (1.12, 2.45)
Use of aspirin at discharge			
All patients	16 927 (68.6%)	1605 (77.2%)	1.48 (1.29, 1.71)
Denominator, ideal only	7323	668	
Use in ideal only‡	5557 (75.9%)	584 (87.4%)	2.32 (1.81, 3.01)

*OR is odds of use of medication in VA patient relative to Medicare patient adjusted for patient age, and sample design characteristics (hospital academic affiliation, hospital availability of cardiac procedures, and hospital volume). OR was adjusted for within-hospital clustering using hierarchical generalized linear model.
†The 95% CI for the OR.
‡For definitions of ideal candidates, see Table 1.
§The denominator for "All patients" is smaller for the analyses assessing use of β-blockers, ACE inhibitors, or aspirin because these analyses were restricted to patients surviving to discharge.

TABLE 4. Adjusted Odds* of Use of Beneficial Medications in Subsets of Ideal Candidates Treated for AMI in VA Relative to Medicare

Cohort	Medicare (n=29 249)	VA (n=2486)	OR (95% CI)†
Denominator‡	2810	249	
Use of thrombolytic therapy at arrival	1583 (56.3%)	131 (52.6%)	1.14 (0.81, 1.52)
Cohort	Medicare (n=24 682)	VA (n=2080)	
Denominator§	4044	300	
Use of β-blockers at discharge	2283 (56.4%)	200 (66.7%)	1.19 (0.83, 1.69)
Denominator‖	1328	61	
Use of ACE inhibitors at discharge	819 (61.7%)	46 (75.4%)	1.68 (1.07, 2.33)

*OR is odds of use of medication in VA patient relative to Medicare patient adjusted for patient age, and sample design characteristics (hospital academic affiliation, hospital availability of cardiac procedures, and hospital volume). OR was adjusted for within-hospital clustering using hierarchical generalized linear model.

†The 95% CI for the OR.

‡In those who were ideal candidates AND arrived within 6 hours of onset of acute myocardial infarction symptoms AND had ST elevation in 2 contiguous ECG leads. For definitions of ideal candidates, see Table 1.

§In those who were ideal candidates AND had history of prior myocardial infarction, OR reinfarction during the stay, OR cardiac arrest, OR positive stress test, OR ventricular tachycardia, OR recurrent angina.

‖In those who were ideal candidates AND had left ventricular ejection fraction <40% AND history of diabetes mellitus.

In another article, we reported similar short- and long-term mortality after AMI in VA and Medicare patients.[18] Given the superior or equivalent use of medications of known benefit, one might expect a mortality advantage among VA patients. It may be that the lack of mortality advantage is due to the known lower use of invasive procedures in VA patients[35] and is not completely offset by use of medications reported here. Our work on this issue is ongoing.

From studies of patients who use both VA and Medicare services, we know that most VA users are initially hospitalized for AMI under Medicare financing.[35] This is because ambulances that are called to assist patients having cardiac symptoms may be required to take patients to the nearest emergency department, not necessarily to a VA facility. Thus, the findings of this study cannot be generalized to all veterans, but only to veterans who are cared for in VA hospitals for AMI.

To ensure that our findings were not an artifact of sampling, we repeated our analyses in the subset of VA patients cared for in the same 7 states as the Medicare patients in our cohort. In this subset, we found that VA patients are as likely as or more likely than Medicare patients to receive medications of known benefit after AMI. This finding suggests that our results are not due to confounding by our choice of sample or by geographic variation.

Limitations of this study include the possibility that differential rates of missing data biased our findings. For example, if a patient was missing data needed to specify a key exclusion criterion (eg, serum creatinine for ACE inhibitors), the patient was excluded from the ideal-candidate analysis. Because serum creatinine was slightly more likely to be unmeasured in VA patients than in Medicare patients (9.4% versus 3.5%, respectively), our results apply only to those patients known to be ideal candidates. Our findings of medication use in the entire population are consistent with our findings in the subset of patients who are ideal candidates, however, supporting the assertion that biases due to missing data would not explain our findings. Another potential limitation of this study is that the VA data were collected by a different group of people than those who collected data for the Medicare patients. To minimize potential systematic differences in data quality between the 2 projects, we used the Cooperative Cardiovascular Project data collection instrument and variable definitions. Reassuringly, the interrater reliability for VA data abstractors is virtually the same as that reported for the Medicare data abstractors.[13,18] Last, because this is a retrospective, observational study, there is always the possibility that unmeasured confounders may have biased our findings.

In summary, in a large sample of patients with AMI, we found that patients cared for in the VA were as likely as or more likely than fee-for-service Medicare patients to receive medications of known benefit. These findings are not explained merely by differences in age of the patients or differences in teaching affiliation between the 2 samples. Further studies should compare long-term use of medications and preventive care for patients with AMI across differing systems of care.

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