NBER WORKING PAPER SERIES

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Working Paper 8065
http://www.nber.org/papers/w8065

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January 2001

Dr. Heidenreich is supported by a Career Development Award from the Veterans Affairs Health Services Research and Development Service. The analysis upon which this publication is based were performed under Contract number 500-96-P535, entitled "Utilization and Quality Control Peer Review Organization for the State of California," sponsored by the Health Care Financing Administration (HCFA), Department of Health and Human Services. The content of this publication does not necessarily reflect the views or policies of the Department of Health and Human Services, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government. The author assumes full responsibility for the accuracy and completeness of the ideas presented. This article is a direct result of the Health Care Quality Improvement Program initiated by HCFA, which has encouraged identification of quality improvement projects derived from analysis of patterns of care, and therefore required no special funding on the part of this Contractor. Ideas and contributions to the author concerning experience in engaging with issues presented are welcomed. The views expressed herein are those of the authors and not necessarily those of the National Bureau of Economic Research.

The Relation Between Managed Care Market Share and the Treatment of Elderly Fee-For-Service Patients with Myocardial Infarction.

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NBER Working Paper No. 8065
January 2001
JEL No. I1

ABSTRACT

Managed care may affect medical treatments for non-managed-care patients if it alters local market structure or physician behavior. We investigate whether higher levels of overall managed care market share are associated with greater use of recommended therapies for fee-for-service patients with acute myocardial infarction using data on 112,900 fee-for-service Medicare beneficiaries residing in one of 320 metropolitan statistical areas, with age ≥65 years, and admitted with an acute myocardial infarction between February 1994 and July 1995 from the Cooperative Cardiovascular Project. After adjustment for patient characteristics, severity of illness, characteristics of the hospital of admission, specialty of treating physicians, and other area characteristics, patients treated in areas with high levels of managed care had greater relative use of β-blockers during hospitalization and at discharge and aspirin during hospitalization and at discharge, consistent with more appropriate care. Patients in high HMO areas may be less likely to receive angiography when compared to areas with low levels of managed care, although this result was only marginally significant. In unadjusted comparisons, patients in high HMO market share areas had lower 30 day mortality, but there were no differences in 30 day mortality when all of the control variables were included in the model. We conclude that managed care can have widespread effects on the treatment of patients and the quality of care they receive, even for patients not enrolled in managed care organizations.

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1. Introduction

The growth in managed care in the United States is likely to have affected the delivery of medical care.(1) These effects can occur both directly to patients enrolled in managed care plans, and indirectly ("spillover" effects) to patients with fee-for-service insurance who reside in areas of high managed care activity. Past studies indicate that spillover effects of managed care have occurred. Fee-for-service patients residing in areas with high managed care activity have been shown to have lower overall Medicare expenditures than patients residing in areas with less managed care.(2) Areas with high managed care activity have also been shown to have lower availability and use of new technologies (3, 4) and lower overall hospital costs.(5)

The spillover effects of managed care may occur by several mechanisms. Health care providers who take care of patients in managed care plans will likely make treatment decisions based in part on incentives and restrictions provided by the managed care organization. If these providers also treat fee-for-service patients they may treat them similarly preferring to treat all patients equally, rather than altering their care based on different methods of reimbursement. In addition, interaction between managed care and non-managed care providers may lead to similar care for managed care and fee-for-service patients.(6)

Previous work has reported that acute MI patients enrolled in managed care organizations receive care that is more in compliance with recommended therapies and process of care measures than care for fee-for-service patients.(7, 8) We hypothesized that high levels of local managed care activity will also affect the care of non-enrolled patients. To address this, we examined the effects of managed care on recommended treatments for elderly fee-for-service patients with acute myocardial infarction.

2. Data and Methods

2.1. Patients

We used data from the Cooperative Cardiovascular Project that is well described elsewhere.(9) The Cooperative Cardiovascular Project identified nearly all Medicare fee-for service beneficiaries with the principal-discharge ICD-9-CM diagnosis of 410.xx (acute myocardial infarction) excluding codes 410.x2 (subsequent care) for the period between February 1994 and July 1995. Research abstractors employed by independent contractors entered demographic, history, physical exam, hospital course, in-hospital and discharge treatment data into an electronic data base. Quality checks using random reabstractions were performed on the resulting data.(10) Patients with age less than 65 years and those not residing in one of 320 metropolitan statistical areas in the continental United States were excluded.

2.2. Treatment and Outcome Measures

We used guidelines from the American College of Cardiology and the American Heart Association (11) and expert opinion to identify treatments recommended for patients with acute myocardial infarction based on data available in 1994. We examine 8 different treatments here: aspirin during hospitalization, aspirin at discharge, β-blocker during hospitalization, β-blocker at discharge, reperfusion during the first 24 hours of hospitalization with thrombolysis of primary percutaneous transluminal angioplasty (PTCA), coronary angiography during hospitalization, angiotensin converting enzyme (ACE) inhibitor at discharge, and smoking cessation counseling at discharge. Not every patient is a good candidate for every treatment. From the overall sample, we identified patients who were good candidates for each treatment using the standard criteria listed in Table 1.

We also examined mortality rates. Mortality following admission was identified by linking patient records to the Health Insurance Skeletonized Eligibility Write-off (HISKEW) file. Some analyses incorporate measures of expected 30 day and 1 year mortality, which we computed using the same variables and methods used in a previously published model of mortality in Medicare patients with acute myocardial infarction from the CCP dataset.(13)

2.3. Managed Care Activity

In principle, many forms of managed care organizations could bring about changes in care patterns. Because we have data for health maintenance organizations (HMOs), we use HMO market share as the measure of managed care activity. We expect this to be a reasonable indication of the presence of organizations that make strong attempts to control utilization and influence provider behavior.

We used county-level estimates of the percentage of the population enrolled in HMOs that were developed for previous studies using data from the Group Health Association of America and Interstudy.(12) County level data for 1994 were combined to obtain HMO market share data for each of 320 metropolitan statistical areas (MSAs) within the United States. MSAs are a common definition of health care markets, and are frequently used in research on the effects of managed care. Managed care (HMO) market share was classified as low (<10%), medium (10-30%) or high (>30%). Breaking MSAs into three groups allows the relationship between treatment and managed care market share to be non-linear, and will limit the effects of any misestimation of managed care market share.

2.4. Statistical Analysis

For each treatment, we computed the fraction of good candidates that received the treatment for markets at each level of managed care market share (<10%, 10-30%, >30%). Differences between treatment rates in markets with the different managed care levels were compared using χ^2 tests. The relationship between managed care activity and use of recommended treatments for acute MI among good candidates was examined using logistic regression that modeled the use of each treatment (yes or no) as a function of managed care market share, area characteristics, U.S. census division, patient demographic (age group, gender and race) admission clinical variables, and characteristics of the hospital and physician caring for the patient. Certain characteristics of a metropolitan statistical area may make it more or less attractive for HMOs to offer services, while at the same time these characteristics may be associated with use of appropriate treatments. To control for potential confounding factors we included per capita income (coded as <$15,000, $15,000 to $19,999, $20,000 to $25,000 and >$25,000), population density (coded as <2,500, 2,500 to 4,999, 5,000-10,000 and >10,000 persons/square mile), and proportion with a college degree (coded as <15%, 15% to 19%, 20% to 25% and > 25%) for each metropolitan statistical area. We controlled for severity of illness using expected 30-day mortality from a previously published model that uses clinical data available at admission.(13) We controlled for admission to a teaching hospital by using data from the American Hospital Association in 1994. Hospitals with 20 or more full time residents were considered teaching hospitals. We control for hospital volume by including indicators for high volume hospitals, defined to be those with at least 50 admissions for acute myocardial infarction per year. We include an indicator for whether the patient was cared for by a cardiologist based using HCFAs UPIN file.

Separate models were estimated for each of the eight recommended treatments. Logistic regressions naturally produce odds rations, but because odds ratios are easily misinterpreted as relative risks we converted the coefficients obtained from the logistic regression models to relative risks with 95% confidence intervals for comparisons between high and medium managed care areas with low managed care areas.(14) We repeated the analyses after adjusting for the likelihood of being in an area with high managed care market share using the propensity score method.(15)

We investigated the relationship between HMO market share and mortality using a series of logistic models. We first estimated a model that included only the managed care variables. We then estimated models that added controls for severity of illness (expected 30 day mortality), hospital characteristics, physician specialty, and area characteristics (population density, percent college educated, per capita income and region of the United States). Finally, we wished to investigate the effects of controlling for two treatments where high HMO market share areas have higher rates of use, so we added variables indicating the use of aspirin and β–blockers.

3. Results

3.1. Patient characteristics

The baseline data set used in this study contained information on 161,962 fee-for-service elderly (age 65 years or older) Medicare patients with documented myocardial infarction. After excluding patients that resided in rural areas, 112,900 patients remained and were used to determine appropriate treatment and mortality. Patients residing in areas with high managed care activity (>30% market share) were older and less likely to be in Killip class 1 on admission than patients residing in low managed care (<10% market share) areas (Table 2). Patients residing in high and medium managed

care areas were more likely to be admitted to a teaching hospital than were patients residing in low managed care areas. Areas with high and medium rates of managed care had higher per-capita incomes, were more densely populated, and had a higher proportion college educated residents compared with low managed care areas. Over half of the patients from the Pacific, New England, and Mountain regions resided in high managed care areas compared to less than 5% for the four central census regions.

3.2. Treatment Differences

In unadjusted comparisons among patients who were good candidates for each treatment we found that patients in high-managed care areas were more likely to be appropriately treated with β-blockers during hospitalization than patients in low managed care areas (Table 3). Patients in high market share areas were also more likely to receive β-blockers at discharge and for smoking cessation counseling. In contrast, good candidates for coronary angiography or reperfusion were less likely to undergo these procedures if they resided in high managed care areas.

We then used a multivariate model that controlled for patient characteristics and demographic and other characteristics of each metropolitan area. Some of these were associated with different rates of appropriate treatment. For example, appropriate β-blocker use at discharge was greater in areas with high per capita income areas (52% for incomes >$25,000 per year vs. 31% for incomes ≥ $15,000 per year, $p<0.001$), high population density (50% for >10,000 persons/square mile vs. 45% for ≤2,500 persons/ square mile, $p<0.001$) a high proportion of college educated residents (49% if >25% were college educated vs. 44% if ≤ 15% were college educated, $p<0.001$), and geographic area (59% for residents of New England vs. 46% for residents from elsewhere in the United States).

Patients were more likely to receive β-blockers at discharge if they were admitted to a teaching (53% vs 44%) or high volume hospital (48% vs 40%), or were cared for by a cardiologist (51% vs 43%, all $p<0.001$).

After adjusting for area-related characteristics, U.S. census division, age, gender, race, hospital characteristics, physician specialty, and 30-day predicted mortality, some of the differences in use for good treatment candidates persisted between high and low managed care areas (Figure 1). Compared with patients residing in areas with low managed care activity, patients residing in high managed care areas were more likely to receive β-blockers (16% greater use, 95% CI 7% to 24%) and aspirin (4% greater use, 95% CI 1% to 6%) during hospitalization. These relative uses correspond to a number needed to treat of 33 for aspirin and 13 for β-blockers, indicating that there was one additional patient treated with aspirin for every 33 good aspirin candidates in high compared to low managed care areas, and one more per 13 good β-blocker candidates. The difference in treatment between high and low managed care areas persisted at discharge for β-blockers (18%, 95% CI 6% to 29%) and aspirin (5% greater for high managed care areas, 95% CI 2% to 7%). These patterns are consistent with better treatment in higher managed care areas.

We found no significant differences in the use of reperfusion, angiography, smoking cessation counseling at discharge, or ACE inhibitor use at discharge. Nonetheless, some of the trends we observed in the data suggest continued attention. In particular, we observed almost statistically significant lower use of angiography among good candidates (recurrent ischemia or shock) in high managed care areas (-7%, 95% CI 1% to –14%). This lower use is equivalent to one less angiogram performed for every 31 patients that were good candidates for angiography. Among all patients, high managed care areas used significantly less angiography (-6%, 95% CI –2% to –10%). Results for

reperfusion also suggest less use in high managed care areas, while the results for smoking cessation counseling suggest improved care with increases in HMO market share.

If HMO market share is correlated with other area characteristics, our results could be biased. One method of adjusting for confounding in the estimates of the effect of HMOs is the use of propensity scoring. For each patient, we computed the propensity for residing in a high managed care area, and then included this propensity score in the model as a way of adjusting for potential confounding. Similar results were observed. After adjustment for propensity to reside in a high managed care area, the greater relative use of treatments persisted for high managed care compared to low managed care areas for β-blockers during hospitalization (16%, 95% CI: 8% to 23%), β-blockers at discharge (17%, 95% CI: 7% to 26%), and aspirin during hospitalization (2%, CI: 0% to 4%). Differences in coronary angiography use for patients with recurrent angina or shock were slightly larger with the propensity score adjustment (9% lower use in high relative to low managed care areas; 95% CI 2% to 15%).

3.3. Mortality Differences

Mortality at 30 days among all patients in the sample was 18.6%. Unadjusted 30-day mortality was slightly lower for patients residing in high (18.0%) and medium (18.5%) managed care areas compared to patients in low-managed care areas (19.6%, $p<0.0001$). Mean expected 30-day mortality using clinical data at admission (13), however, was higher for patients from high (19.3 ± 17.5%) than for medium (18.9 ± 17.7%) or low (18.3 ± 18.0%) managed care areas ($p<0.0001$).

Figure 2 plots results from a series of models of mortality rates. The first two points are the relative risk for high and medium market share areas from a model that uses only HMO market share controls. Here, patients in high HMO market share areas have relative risk of mortality about 8 points lower than those in the lowest market share areas. Relative survival differences increase after

adjustment for clinical characteristics at admission and persist after controlling for hospital characteristics and physician specialty. But, when region of the U.S. and area characteristics (population density, % with college education, per capita income) are included, the differences in mortality between high and low market share areas are not longer evident (relative risk 1.02, 95% CI 0.95 to 1.10).

4. Discussion

This analysis of elderly Medicare beneficiaries with fee-for-service insurance found differences in the treatment of acute myocardial infarction according to the level of managed care market share. Fee-for-service patients residing in areas with high managed care market share were more likely to be appropriately treated with aspirin and β-blockers, consistent with better care. On the other hand, these patients were (almost significantly) less likely to receive appropriate coronary angiography than were patients residing in areas with low managed care market share. We found no strong differences in the use of reperfusion at 24 hours, smoking cessation counseling at discharge, and ACE inhibitor use at discharge.

The differences in aspirin, β-blockers, and angiography among fee-for-service patients suggest that the presence of managed care can have widespread effects on area treatment patterns and the quality of care, sufficient to influence care for patients not enrolled in managed care plans. These results are consistent with other studies that suggest that managed care can have broad effects on care delivery. High levels of managed care have been associated with lower health care expenditures for fee-for-service patients. In a recent study of fee-for-service Medicare patients, for example, an increase in the managed care market share of 10% to 20% was associated with a 2% decrease in Part A fee-for-service expenditures and a 1.5% decrease in Part B fee-for-service expenditures.(2) But, these studies

have not been clear about the ability of managed care to influence treatment patterns specifically, or about the quality implications of any managed-care induced changes in treatments.

There are several mechanisms by which managed care activity could influence the care of patients with fee-for-service insurance. First, managed care could alter the availability of services such as coronary angiography laboratories. If an increase in managed care activity reduced the number of available laboratories, the overall use of angiography could decline regardless of the patient's insurance status. Past studies have demonstrated that increases in HMO market share are associated with reductions in the availability of costly medical services (3, 4, 16) and changes in the number and type of practicing physicians.(17)

Managed care may also influence the care of fee-for-service patients by influencing physician practice patterns. Many physicians treat both managed care and fee-for-service patients. In a survey from 1996, managed care enrollees comprised 25% (median) of active patients treated by U.S. physicians that had at least 1 managed care contract.(18) Physicians may find it difficult or undesirable to vary their treatment patterns for different patients. As managed care grows and exerts more and more influence over physician practices, even fee-for-service patients may be treated differently. Physicians who have only fee-for-service patients may be indirectly influenced by managed care activity if they adopt the practice patterns of other local physicians.(6)

Managed care organizations have incentives to improve guideline compliance among physicians and hospital personnel. One popular measure of the quality of managed care organizations is the Health Plan Employer Data and Information Set (HEDIS) developed by the National Committee for Quality Assurance.(19, 20) The measures from HEDIS are used to aid employers in choosing health plans for their employees. One of the new HEDIS measures (instituted after the data for our study was collected) is the fraction of patients discharged on a β-blocker following acute myocardial infarction. In

a recent survey of managed care physician groups, 85% had instituted methods to improve guideline compliance.(21)

Our findings of managed care effects on treatment of fee-for-service patients are consistent with past retrospective studies that directly compared patients in HMOs with those in fee-for-service for the treatment of acute coronary syndromes. In an analysis of Medicare beneficiaries with acute myocardial infarction from Minnesota, patients with managed care insurance received more appropriate aspirin therapy (88% vs. 83% p=0.03) than those with fee-for-service insurance.(7) In a review by the RAND Corporation, Medicare patients with acute myocardial infarction in three HMOs were compared to a fee-for-service sample using process of care measures developed by an expert panel.(8) There was greater compliance with process of care measures of the provider's clinical assessment and treatment for the HMO patients. However, fee-for-service patients received more appropriate procedures and diagnostic tests. Similar findings were noted in a report of patients from the Global Unstable Angina Registry and Treatment Evaluation (GUARANTEE) study.(22) Patients in HMO's were 10% more likely to be discharged on aspirin, and 14% more likely to be discharged on β-blockers (relative risk 1.14), while fee-for-service patients were more likely to receive angiography.

A previous report of patients with acute coronary syndromes did not find a difference in survival between Medicare patients with fee-for-service and those with managed care insurance. (22) Our study, perhaps because of its large size, found a small difference in mortality favoring areas with high managed care market share when no adjustments were made for clinical, hospital or area characteristics. Because patients from high managed care areas were more ill on admission than patients from low managed care areas adjustment for clinical variables increased the survival difference between high and low managed care areas. Patients in high managed care areas were more likely to be admitted to a teaching hospital, which have been shown to have better outcomes for patients in general, (23,24)

and acute MI in particular, (25) when compared with non-teaching hospitals. Both admission to a high volume hospital (26) and management by a cardiologist (27) have been associated with better survival following acute myocardial infarction in studies using the same datasets as in our analysis. However, adjustment for hospital characteristics and specialty of treating physician did not alter the relationship between high managed care areas and survival. Past studies have documented regional differences in mortality for acute myocardial infarction. (28) Our study also found that community characteristics consistent with high socioeconomic status (e.g. per capita income) were associated with both more managed care penetration and improved survival. After controlling for these area characteristics and the region of the U.S., the differences in survival between high and low managed care areas were no longer apparent.

This study has several important limitations. Because the detailed clinical data used for this study were from a single time period (1994-1995) we are unable to prove that a change in the level of managed care market share changes the care of fee-for-service patients. Such a study would require several observations over time that are of similar detail to the measures in the Cooperative Cardiovascular Project. Because the metropolitan statistical areas are not randomized to different levels of managed care activity it is possible that certain unmeasured area-related variables have confounded the results.

In summary, our study found that Medicare beneficiaries with fee-for-service insurance and who resided in areas with high managed care activity were more likely to receive appropriate aspirin and β-blockers, and less likely to receive appropriate coronary angiography following admission for myocardial infarction than were patients residing in areas with low managed care activity. These results suggest that effects of managed care are not limited to patients enrolled in managed care plans.

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Table 1: Definitions of Good Candidates for Selected Acute MI Treatments

Aspirin during hospitalization
All acute MI patients without an allergy to aspirin, history of bleeding, evidence of bleeding on admission or during hospitalization, history of internal bleeding, coagulopathy (history of bleeding disorder), platelet count < 100 x 109/L, warfarin on admission, chronic liver disease, peptic ulcer disease, hemotacrit <30% or hemoglobin <100 g/L, highest creatinine > 265 µmol/L (3mg/dl), or terminal illness.

b **-Blocker during hospitalization**
All acute MI patients without systolic blood pressure < 100mmHg at admission, shock, conduction disorder including second, or third-degree heart block, bifasicular or trifasicular block, wheezing during hospitalization, bradycardia <50 beats per minute on admission, any left ventricular ejection fraction <50%, pulmonary edema or CHF unless ejection fraction > 50%, history of chronic obstructive pulmonary disease, dementia, antidepressant on admission, insulin on admission, or terminal illness.

Reperfusion with thrombolytic therapy or primary PTCA
Patients with acute MI and ST elevation without a time from chest pain to admission > 6 hours, history of bleeding, active internal bleeding, coagulopathy, history of stroke, trauma in the last 4 weeks, surgery or biopsy in the last 8 weeks, cardiac arrest, warfarin on admission, refusal of thrombolysis, systolic blood pressure >180mmHg or diastolic blood pressure >110mmHg, age greater than 80 years, peptic ulcer disease, chronic liver disease, or terminal illness.

Angiography during admission
All patients with acute MI and recurrent chest pain more than 48 hours after admission, or shock, but without a highest creatinine of > 176 µmol/L (2mg/dl), or terminal illness.

Aspirin prescribed at discharge
All acute MI patients discharged alive without allergy to aspirin, history of bleeding, evidence of bleeding on admission or during hospitalization, history of internal bleeding, coagulopathy (history of bleeding disorder), platelet count < 100 x 109/L, warfarin at discharge, chronic liver disease, peptic ulcer disease, hemotacrit <30% or hemoglobin <100 g/L, highest creatinine > 265 µmol/L (3mg/dl), or terminal illness.

ß-Blocker prescribed at discharge
All acute MI patients discharged alive without systolic blood pressure < 100mmHg at discharge, shock, conduction disorder including second, or third-degree heart block, bifasicular or trifasicular block, wheezing during hospitalization, bradycardia <50 beats per minute on discharge, any left ventricular ejection fraction <50%, pulmonary edema or CHF unless ejection fraction > 50%, history of chronic obstructive pulmonary disease, dementia, antidepressant at discharge, insulin on admission, or terminal illness.

Table 1, continued

ACE inhibitor prescribed at discharge
All patients with acute MI and left ventricular ejection fraction < 40% discharged alive without allergy or intolerance to ACE inhibitor, systolic blood pressure at discharge < 100 mmHg, aortic stenosis, highest creatinine > 176 µmol/L (2mg/dl), or terminal illness.

Smoking cessation counseling at discharge
All patients with acute MI discharged alive that were current smokers at the time of discharge.

Table 2. Patient and Regional Characteristics and Managed Care Market Share.

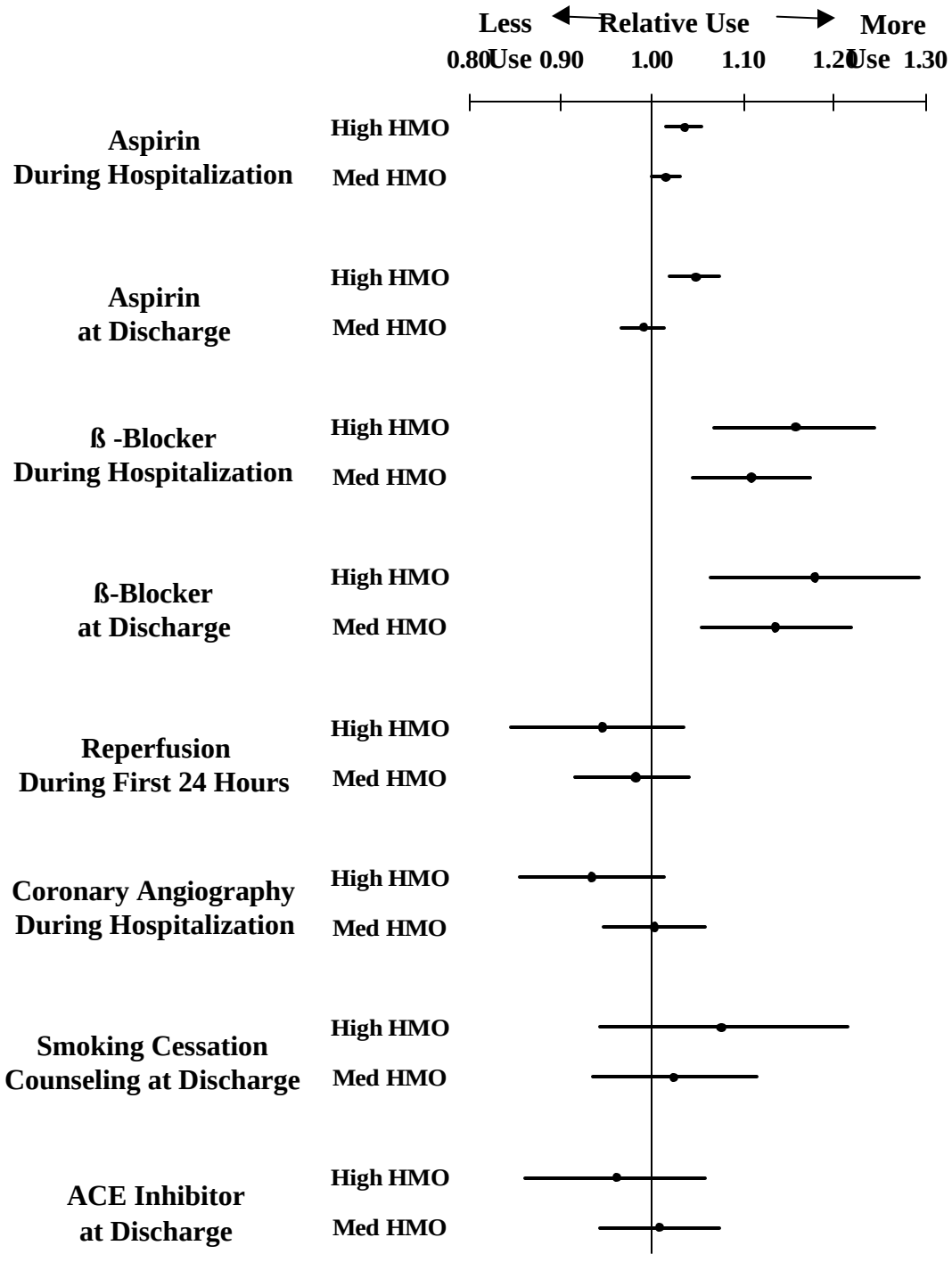
	Managed Care Market Share			
Characteristic	**<10% (N=16,951)**	**10%-30% (N=72,074)**	**>30% (N=23,875)**	**P value**
Demographic				
Age (years)	75.9 ± 7.3	76.4 ± 7.4	76.7 ± 7.4	<0.001
Male (%)	51.1	50.7	51.2	0.20
White race (%)	88.6	89.5	87.2	<0.001
Prior CHF (%)	20.8	21.8	22.4	0.03
Diabetes mellitus (%)	30.6	31.0	29.6	<0.001
Hypertension (%)	62.2	62.8	61.3	<0.001
Prior MI (%)	28.6	28.9	29.0	0.8
Prior angioplasty (%)	7.1	6.6	6.8	0.05
Prior bypass surgery (%)	12.3	12.3	12.7	0.11
Heart rate > 100 beats per minute (%)	24.6	25.1	24.1	0.01
Anterior infarction (%)	42.9	42.2	41.5	<0.001
Killip class (%)				<0.001
1	65.1	62.8	63.1	
2	9.4	9.1	8.8	
3	24.3	27.0	26.9	
4	1.1	1.2	1.2	
Admission to teaching hosp. (%)	16	29	21	<0.001
Admission to high volume hosp	76	80	76	<0.001
Treated by cardiologist	37	35	37	<0.001
Area Per-capita income ($)	18,100 ± 2,600	21,500 ± 3,500	22,500 ± 3,500	<0.001
Area Population with college education (%)	18.0 ± 4.6	21.1 ± 4.7	25.1 ± 6.1	<0.001
Area Population density (persons per square mile)	2,490 ± 1,600	12,100 ± 19,900	11,780 ± 7,900	<0.001

Table 3. Use of Treatments for Different Levels of Managed Care Market Share.

Treatment	Number of Good Candidates	Overall Use (%)	Managed Care Market Share % Use (total N) <10%	10%-30%	>30%
During Hospitalization					
Aspirin	44,268	84.4	84.1 (6,376)	84.3 (27,902)	85.0 (9,990)
β-Blocker*	15,809	56.4	50.3 (2,161)	56.4 (9,777)	59.8 (3,871)
Thrombolytic therapy or primary angioplasty within 24 hours of admission*	5,309	70.8	72.9 (922)	71.1 (3,281)	66.6 (1,106)
Coronary angiography*	27,442	44.7	50.3 (4,742)	45.4 (17,639)	36.9 (5,061)
Treatment at Discharge					
Aspirin	32,587	76.5	78.4 (4,604)	75.6 (20,576)	78.0 (7,407)
β-Blocker*	14,131	48.3	42.3 (1,896)	48.2 (8,742)	51.5 (3,493)
ACE inhibitor	9,210	60.6	58.3 (1,327)	61.0 (6,098)	60.7 (1,785)
Smoking cessation counseling	10,627	39.4	38.6 (1,893)	38.3 (6,728)	43.7 (2,006)

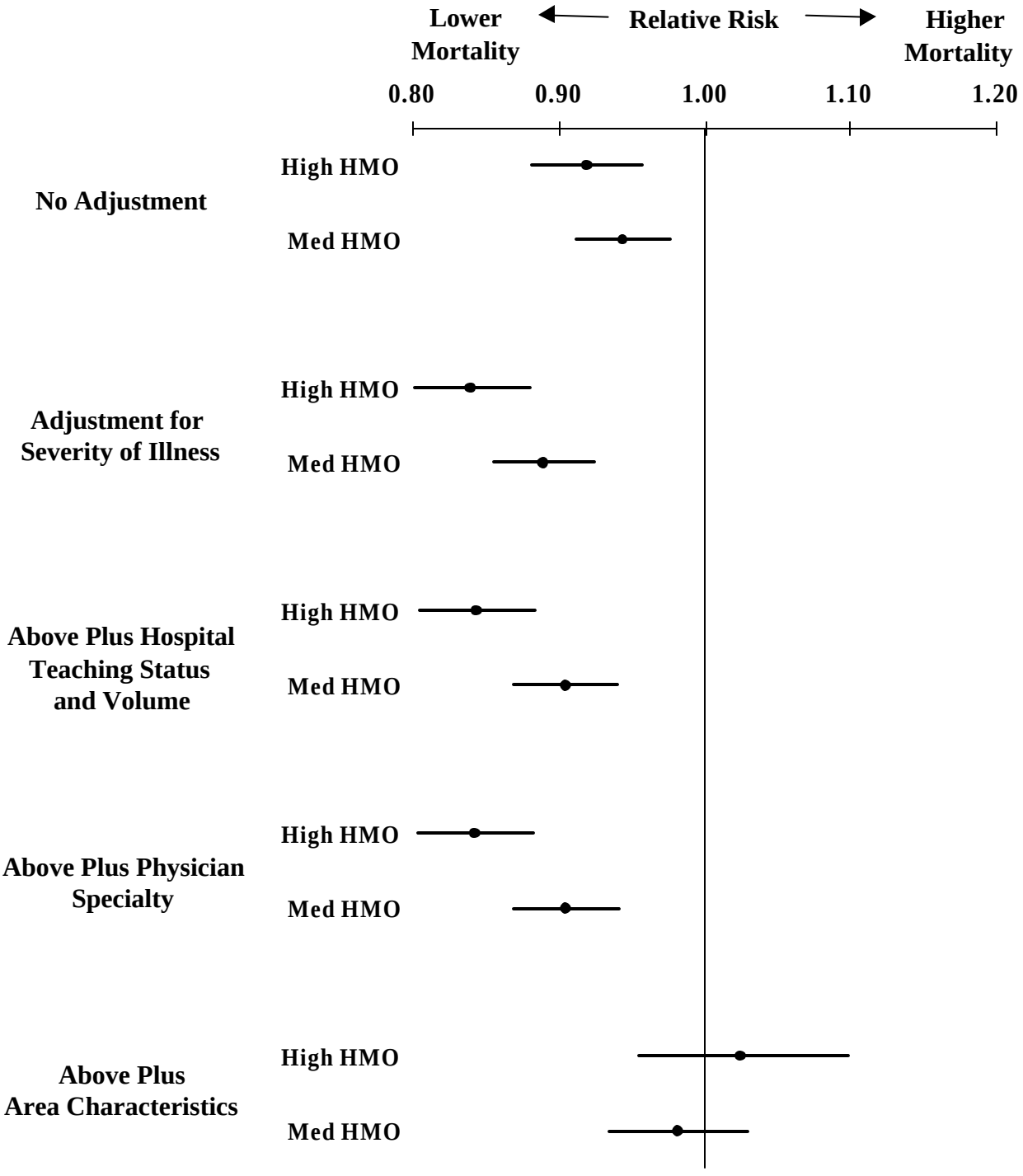
* P = 0.001 for differences across groups and for differences between high and low market share area

Figure 1: Area Managed Care Activity and Use of Appropriate Treatments for Elderly AMI Patients



The adjusted relative risks and 95% confidence intervals for the use of recommended treatments in good candidates are displayed for high and medium managed care (HMO) market share areas relative to low managed care market share areas. Values greater than 1.0 indicate greater use of therapies. The relative risks have been adjusted for age, gender, race, per-capita income, population density, mean education level, hospital characteristics, physician specialty, census region of the United States, and severity of illness. (13)

Figure 2: Area Managed Care Activity and Relative Risk of 30 Day Mortality



The relative risks and 95% confidence intervals for death at 30 days are shown for patients from high and medium managed care (HMO) market share areas compared to low managed care areas. Values greater than 1.0 indicate higher mortality. The unadjusted risk of death is lowest in high managed care areas. After adjustment for severity of illness (13) the differences increase and persist after including hospital and physician characteristics. When area characteristics are included (region, population density, % with college education, per capita income) the differences are no longer apparent. The c statistics (measures of area under the receiver operating curve) for the five models are 0.51 (no adjustment), 0.76 (+severity of illness), 0.76 (+ hospital characteristics), 0.76 (+physician characteristics), and 0.77 (+ area characteristics).