Articles

HMO Penetration, Competition, and Risk-Adjusted Hospital Mortality

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Objective. HMOs have been shown to have an effect on the care provided directly to their enrollees. They may also influence the care provided to individuals in fee-for-service plans through a spill-over effect. The objective of this study was to investigate the associations among HMO market penetration, HMO and hospital competition, and the quality of care received by Medicare fee-for-service patients measured by risk-adjusted hospital mortality rates.

Data Sources. The 1990 data for 1,927 hospitals in 134 metropolitan statistical areas (with five or more hospitals) included Medicare fee-for-service risk-adjusted mortality rates from the Medicare Hospital Information Reports, hospital characteristics from the American Hospital Association annual survey, and HMO market penetration and competition calculated from InterStudy and Group Health Association of America data.

Study Design. Statistical regression techniques were used to identify the associations between HMO market penetration, competition, and risk-adjusted mortality, controlling for other hospital characteristics and region.

Principal Findings. Higher HMO market penetration and to a lesser degree increased HMO competition were associated with better mortality outcomes for fee-for-service Medicare enrollees. Competition between hospitals did not exhibit a significant association.

Conclusions. HMOs may have a spill-over effect on quality of care received by individuals enrolled in fee-for-service plans. These findings may be explained by a positive effect on local practice styles or a preferential selection by HMOs for areas with better hospital care.

Key Words. Competition, hospitals, managed care, quality of care, risk-adjusted mortality rates

Quality of care provided by HMOs is of major concern to the public and its representatives who are charged with formulating health care policy. Recently these concerns have translated into legislative initiatives at both the federal and state levels, often labeled "patients' bills of rights." These concerns focus on the quality of care HMOs provide to their enrollees. Left out of the

public debate to date is the potential effect that HMOs may have on the quality of care provided to non-HMO patients. The continuing increase in HMO enrollment, HMOs' dominance in many local health care markets, and HMOs' effect on health care expenditures through deceleration of historical increases in hospital and physician costs (Melnick, Zwanziger, and Bradley 1989; Melnick et al. 1992; Simon and Born 1996; Zwanziger and Melnick 1996, 1988), as well as premiums of non-HMO traditional insurance plans (Baker and Corts 1996), suggest the possibility for a quality spill-over effect, an HMO effect on the quality of care of non-HMO patients. HMOs may affect the care non-HMO patients receive through the following mechanisms.

HMOs often attempt to influence local practice patterns through financial and administrative programs. For example, during the 1980s most of the cost effect that HMOs achieved was the result of changes in practices related to hospital utilization: declines in both hospital admission rates and lengths of stays (Miller and Luft 1994). As practice styles change they are likely to apply to all patients, even if initially the changes emerge in response to HMO incentives. Tussing and Wojtowycz (1994) found that cesarean section rates in New York State declined among HMO enrollees and that a spill-over effect to the fee-for-service population occurred. Another example is care for patients with diabetes. The Health Plan Employer Data and Information Set (HEDIS) (Epstein 1995) HMO quality report card publishes rates of diabetic retinopathy screening, a component of the diabetes care guidelines (American Diabetes Association 1995). In response many HMOs implemented programs designed to increase knowledge of diabetes care guidelines among primary care physicians. As physicians become more knowledgeable they are likely to implement the guidelines for all of their patients, not only their HMO patients, as was found by Herbert, Maciejewski, and McBean (1999).

Limiting local health systems' resources is another way in which HMOs may affect the care of both HMO and non-HMO patients. HMOs have been successful in negotiating lower prices with providers, leading to lower rates

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of increase in costs (Simon and Born 1996; Zwanziger, Melnick, and Bamezai 1994). Furthermore, they limit the ability of providers to cost shift, a practice that historically allowed providers to mitigate the revenue effects of cost-containment efforts (Morrisey 1993). Such financial pressures limit the ability of providers to invest in improved technologies and other quality-enhancing strategies. For example, studies have found that increases in HMO market penetration are associated with a decrease in hospital beds (Chernew 1995) and availability and use of magnetic resonance imagery (MRI) (Hill and Wolfe 1997; Baker and Wheeler 1998). To the degree that such resources (e.g., the latest MRI machine) are shared by all patients, providers' inability to purchase them would have an effect on the care of all patients, not just those enrolled in HMOs.

Channeling beneficiaries to high-quality (or low-quality) providers may also affect all patients. HMOs often direct all of their patients to a subset of providers in their market area. The impetus for such selective contracting is the market power it offers HMOs in price negotiations. A potentially unintended result is that HMOs may be taxing the capacity of the providers they contract with, making them unavailable to other patients. If HMOs' contracting practices result in panels that include the best (or worst) providers in the area, the quality choices remaining to non-HMO patients are constrained (Mukamel, Mushlin, Weimer, et al. 2000). This phenomenon is likely to be observed mostly with respect to specialized physicians, such as cardiac surgeons, rather than with respect to hospitals, which typically operate at sufficiently low occupancies that HMOs are not likely to tax their capacities.

Finally, HMOs place burdens, both financial and administrative, on providers. Many of the methods used to control utilization and costs impinge on provider autonomy and increase their costs (e.g., preauthorization and utilization review, bonuses and penalties, and risk transfer through capitation) (Gold, Hurley, Lake, et al. 1995). As HMOs become dominant in local markets, providers may not be able to maintain the volume of business they desire while still avoiding HMO patients. Some may choose to leave such markets. It is possible that the higher-quality providers with the better reputations are more mobile and more likely to exit markets dominated by HMOs. Such selective exit would affect the care of both HMO and non-HMO patients.

Most studies to date focus on the quality of care that HMOs provide to their own enrollees (Ware, Brook, Rogers, et al. 1986; Chernew, Scanlon, and Hayward 1998; Miller and Luft 1994; Sullivan 1999). These studies offer mixed evidence, suggesting that the care HMO enrollees receive is of variable

quality when compared with fee-for-service patients. Little is known about the effect of HMOs on overall quality level in markets they dominate. A study by Shortell and Hughes (1988) found that increased HMO penetration measured at the state level is associated with poorer inpatient mortality outcomes for 16 conditions, suggesting a negative HMO effect on overall quality. The analyses presented here evaluate the quality spill-over effect that HMOs may have by investigating the association between HMO penetration and competition with outcomes for fee-for-service Medicare patients for a large national sample.

DATA AND METHODS

Evaluating Hospital Quality: Excess Mortality

Risk-adjusted mortality rates have in recent years been used to evaluate quality of care in hospitals (HCFA 1992; Pennsylvania Healthcare Cost Containment Council 1992; New York State Department of Health 1997). These measures allow an assessment of excess mortality after accounting for patient risk factors that hospitals cannot control. Although the use of risk-adjusted outcomes to identify outliers is controversial (Davis, Iezzoni, Phillips, et al. 1995; Iezzoni 1998; Spector and Mukamel 1998), these measures have been shown to capture systematic differences in quality across all hospitals. They were found to be correlated with other measures of quality such as explicit and implicit chart reviews (Keeler, Rubenstein, Kahn, et al. 1992) and results of peer review (Hartz, Gottlieb, and Kuhn 1993).

In this study we used the risk-adjusted mortality measures developed by the Health Care Financing Administration (HCFA 1992). These measures are based on individual patient-level hazard models, which predict mortality hazard conditional on individual risks. Individual risk factors include patient age; gender; specific diagnoses and comorbidities; admission source; emergency or elective admission; and patient risk group based on hospitalizations during the preceding six months. These hazard models are then used to predict for each patient the probability of death within 30 days of admission. The average probability for all patients treated at the hospital is the predicted mortality rate for the hospital, conditional on its patient mix and assuming average quality. The deviation between this predicted rate and the observed rate (i.e., excess mortality) is a measure of hospital quality. The HCFA measures have been validated through comparisons with errors in care found by peer-review processes (Hartz, Gottlieb, and Kuhn 1993) and risk-adjustment models based

on extensive physiologic and clinical data (Krakauer, Bailey, and Skellan 1992). The latter study found that the correlation of hospital ranking based on the HCFA data and the clinical data is .91 and that models relating hospital characteristics to these quality measures give similar results.

Data

The study included 1,927 hospitals in 134 metropolitan statistical areas (MSAs) with five or more acute-care hospitals in 1990.[1] For each MSA we obtained data on all nonfederal, acute-care, short-term hospitals in operation during 1990.

Observed and risk-adjusted expected mortality rates (30 days post-admission) for all hospitals for 1990 were obtained from the Medicare Hospital Information Reports (HCFA 1992). Rates were obtained for death from all causes and from six specific causes: acute myocardial infarction, congestive heart failure, pneumonia, stroke, cardiac artery bypass graft procedures, and hip-replacement surgery. Following Hartz, Krakauer, Kuhn, et al. (1989) we also included in the analyses the percentage of Medicaid patients, days in the intensive care unit (ICU) as percentage of total inpatient days, and emergency room (ER) visits as percentage of total inpatient days as additional risk adjusters.

Information about ownership and teaching status, expenditures and utilization, bed size, and availability of technologically sophisticated services were obtained from the annual survey of the American Hospital Association (AHA). Following Hartz, Krakauer, Kuhn, et al. (1989), technological sophistication was measured as the number of the following five services available at the hospital: cardiac catheterization laboratory, extracorporeal lithotripter, MRI, open-heart surgery, and organ transplantation. To capture differences in resource intensity across hospitals, the analyses included wage-adjusted expenditures per adjusted admission using the AHA survey data and the Medicare local hospital wage index.

HMO penetration rates and competition measures for each MSA in 1988 and 1990 were calculated from the HMO census compiled by InterStudy and county enrollment reported in the Group Health Association of America (GHAA) HMO directory. Competition was measured by the Herfindahl-Hirschman index (HHI), defined as the sum of squared market shares. The HHI ranges between 0 and 1, with lower values corresponding to more competitive markets. The HMO HHI was calculated based on county-level enrollment data that were aggregated to the corresponding MSA level, thus assuming that HMOs compete throughout the whole metropolitan area.

Because hospitals tend to have more localized markets, the hospital HHI was based on each hospital's Medicare referral patterns by zip code areas as described in Zwanziger and Melnick (1988). Measures of hospital competition were calculated from 1990 Medicare discharge data.

The analyses also included the census region of each MSA. HMO market penetration has a distinct geographic pattern, with higher HMO penetration in the Pacific and New England regions. Controlling for the region would therefore prevent attribution of regional variations in hospital mortality statistics to HMO market penetration.

Analyses

We estimated regression models in which the observed 30-day postadmission mortality rate for each hospital was the dependent variable. The risk-adjusted predicted rate as well as other hospital and market characteristics were the independent variables.

The regression models included MSA random effects, allowing for correlation among observations of hospitals that are located in the same MSA.[2] To account for differences in sample sizes across hospitals and the resulting differences in the accuracy of the risk-adjusted mortality rates, each observation was weighted by the inverse of the standard error of its expected mortality rate.

To test the hypothesis that HMOs influence quality primarily through their effect on hospital expenditures, the model was first estimated without expenditures variables and then reestimated with the expenditures variables. In the first model the HMO coefficients would capture the total HMO effect, both the direct effect HMOs may have on quality and their effect through expenditures. The second model would separate these effects, and the HMO coefficient will capture only the direct association between HMOs and quality.

To test the robustness of the results to differences in practice styles and variations in admission patterns across regions, the analyses were repeated for six cause-specific mortality rates: acute myocardial infarction, congestive heart failure, pneumonia, stroke, cardiac artery bypass graft procedures, and hip-replacement surgery. These represent conditions of different degrees of variations in practice styles (Wennberg, Bubolz, Fisher, et al. 1996).

These models were used to calculate the mortality rate for the average hospital by setting all of the variables to their average value in the sample. We then changed one variable at a time and recalculated the risk-adjusted mortality rate to obtain the effect of each variable. For example, to determine the effect of teaching status, all variables were set to the average and the

teaching variable was set once to 0 (no teaching) and once to 1 (teaching). The difference in the mortality rate calculated for these two cases is the marginal effect of teaching status, holding all other hospital and market characteristics constant.

RESULTS

Table 1 provides descriptive statistics on the hospital and market characteristics included in the study. The average observed mortality rate was 9.19 deaths per 100 Medicare discharges, compared to the predicted risk-adjusted rate of 9.17.

Of the 1,927 hospitals included in the analyses, the majority (67.8 percent) were private nonprofit, with public and for-profit hospitals accounting for 14.2 percent and 18.0 percent, respectively. Both hospital bed size and number of high-technology services were highly variable, with coefficients of variation of 77 percent and 119 percent, respectively. Wage-adjusted expenditures, on the other hand, exhibited less variation, with a coefficient of variation of 37 percent.

HMO penetration ranged from a low of 0.2 percent to a high of 50 percent, with an average of 18.4 percent. Competition also varied substantially across market areas for both hospitals and HMOs. The HHI ranged between 0.07 and 0.80 for hospitals and between 0.09 and 1.00 for HMOs. Average HMO penetration was highest in the Pacific region, at 31 percent, followed by New England, with 25 percent. The areas with the lowest penetration were the three southern regions. No clear geographic pattern in degree of competition was found between hospitals or HMOs.

Table 2 reports results based on the estimated models. It shows the mortality rate for the average hospital and the mortality rate for hospitals with specific characteristics, as well as the significance level (p-value) for each characteristic, as calculated from the estimated regression models. To place the size of the association of each variable in perspective, the last column in Table 2 shows the difference in the mortality rate due to the variable as percentage of the standard deviation of excess mortality. For example, for-profit hospitals have an average mortality rate of 9.05 compared to an average of 9.24 for private nonprofit hospitals. The difference of 0.19 between the two groups is 11.5 percent of the standard deviation of excess mortality of 1.66, measured across individual hospitals.

Table 2 reports results for two models, one that excludes expenditure variables and one that includes them. The results were similar for all variables

Table 1: Characteristics of the Study Sample

	Mean	*Standard Deviation*
Hospital Characteristics (N = 1,927)		
Observed mortality rate	9.19	2.23
Predicted mortality rate	9.17	1.53
Ownership (%)		
Public	14.2	
For profit	18.0	
Private nonprofit	67.8	
Council of Teaching Hospitals membership (%)	12.6	
Osteopathic hospital (%)	3.7	
High technology index (range 0–5)	1.27	1.51
Hospital size (No. of beds)	257	199
Wage-adjusted expenditures per adjusted admission ($)	4,866	1,819
Severity of Illness		
% Medicaid days	12.8	11.8
% ICU days	6.4	4.6
Ratio of ER visits to total inpatient days	.52	.38
Market Characteristics		
Hospital competition HHI (range 0–1)	.28	.12
% of population in hospital zip code with college degrees	14.1	7.8
HMO penetration rate (% of MSA population enrolled)	18.4	10.9
Change in HMO penetration between 1988 and 1990 (%)	.1	4.1
HMO competition HHI (range 0–1)	.29	.17
Regional Distribution (%)		
New England: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut	4.0	
Mid-Atlantic: New York, New Jersey, Pennsylvania	17.7	
South Atlantic: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida	16.6	
East North Central: Ohio, Indiana, Illinois, Michigan, Wisconsin	16.7	
East South Central: Kentucky, Tennessee, Alabama, Mississippi	6.0	
West North Central: Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas	6.0	
West South Central: Arkansas, Louisiana, Oklahoma, Texas	11.1	
Mountain: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada	3.5	
Pacific: Washington, Oregon, California, Alaska, Hawaii	18.4	

in terms of the direction, magnitude, and significance of the association with mortality. The only exception was teaching status, for which the direction of the association changed but was not significant in either model. We therefore discuss the results of the full model only.

Table 2: Hospital Risk-Adjusted Mortality Rates by Hospital and Market Characteristics

	Model Excluding Expenditure Variables		*Model Including Expenditure Variables*		*Difference as % of Variation in Mortality Not Explained by HCFA Risk Adjustment (Based on Model Including Expenditures)*
	*Mortality**	p-*Value*	*Mortality**	p-*Value*	
Average hospital	9.26		9.23		
Region					
New England	8.65	.000	8.60	.000	62.1
Mid-Atlantic	8.74	.000	8.71	.000	55.4
South Atlantic	9.20	.005	9.19	.000	26.5
East North Central	9.15	.001	9.10	.000	31.9
East South Central	9.07	.002	9.06	.000	34.3
West North Central	9.31	.064	9.28	.001	21.0
West South Central	9.78	.478	9.77	.268	8.4
Mountain	9.79	.525	9.70	.658	4.2
Pacific	9.66	†	9.63	†	†
Hospital Characteristics					
Ownership					
Public	9.39	.274	9.40	.119	9.6
For profit	9.05	.010	9.05	.031	11.5
Private nonprofit	9.28	†	9.24	†	†
Membership in Council of Teaching Hospitals					
Yes	9.18	.289	9.26	.635	2.4
No	9.27		9.22		
Osteopathic hospital					
Yes	9.31	.752	9.28	.764	3.0
No	9.25		9.23	†	
High technology index					
Top quartile (2)	9.19	.000	9.19	.014	
Bottom quartile (0)	9.36		9.31		7.2
Hospital bed size					
Top quartile (341)	9.23	.054	9.20	.059	
Bottom quartile (111)	9.30		9.27		4.2
Expenditures per inpatient adjusted day (wage adjusted)					
10th percentile			9.15	.099	12.7
25th percentile			9.21	.096	9.0
50th percentile			9.36	†	†
75th percentile			9.11	.000	15.1
90th percentile			8.84	.000	31.3
% of residents with college education					
Top quartile (18.9)	9.19	.000	9.16	.000	9.0
Bottom Quartile (8.27)	9.34		9.31		

continued

Table 2: Continued

	Model Excluding Expenditure Variables		*Model Including Expenditure Variables*		*Difference as % of Variation in Mortality Not Explained by HCFA Risk Adjustment (Based on Model Including Expenditures)*
	*Mortality**	p-*Value*	*Mortality**	p-*Value*	
Severity of Illness					
% Medicaid					7.2
Top quartile (15.8)	9.29	.000	9.26	.000	
Bottom quartile (4.8)	9.17		9.14		
% ICU days					
Top quartile (8.9)	9.27	.505	9.25	.261	2.4
Bottom quartile (3.7)	9.25		9.21		
Ratio of ER visits to inpatient days					
Top quartile (.66)	9.33	.000	9.30	.000	12.1
Bottom quartile (.29)	9.13		9.10		
Market Characteristics					
Hospital competition (HHI)					
Top Quartile (.19)	9.28	.399	9.26	.168	3.6
Bottom Quartile (.35)	9.24		9.20		
HMO penetration (%)					
Top quartile (24.5)	9.19	.025	9.16	.020	9.0
Bottom quartile (10.6)	9.34		9.31		
Change in HMO penetration 1988–90 (%)					
Top quartile (3.7)	9.29	.227	9.26	.232	2.4
Bottom quartile (.04)	9.25		9.22		
HMO competition (HHI)					
Top quartile (.19)	9.22	.058	9.19	.084	3.6
Bottom quartile (.34)	9.28		9.25		

*Mortality rate based on the estimated multivariate model, with all variables set to sample average.

†Reference category.

Regional Mortality Patterns

Table 2 identifies a clear geographic pattern to hospital mortality, a pattern that exists even when controlling for important hospital and market characteristics including HMO penetration and competition. Risk-adjusted mortality rates were the lowest in the eastern parts of the country. They were higher in the central United States and higher still in the west. The differences in risk-adjusted mortality rates were substantial and exhibited the largest effect compared with any other variable.

Associations Between Risk-Adjusted Mortality and Hospital Characteristics

Of the hospital characteristics included in the model, several were significantly associated with risk-adjusted mortality at the 5 percent significance level. Risk-adjusted mortality rates were lower in for-profit hospitals compared to private nonprofit hospitals. The difference in rates was 11.5 percent of the standard deviation in excess mortality rates. Hospitals with two technologically advanced services (top quartile) had a lower rate compared with hospitals that had no such services. Expenditure levels above the 75th percentile were also associated with better outcomes, with the largest effect observed for hospitals with expenditures at or above the 90th percentile.

A higher percentage of college graduates in the hospital's zip code area was significantly associated with better outcomes. Percentage of Medicaid patients and ER visits as percentage of inpatient days was associated with increased mortality rates. These variables may partially or wholly reflect severity not captured by the HCFA risk adjustment or characteristics of demand faced by each hospital.

Associations Among Excess Mortality, Hospital and HMO Competition, and Managed Care Penetration

Only HMO penetration was significantly associated with mortality rates at the 5 percent level (p-value of .02). The association was negative, indicating that areas with higher HMO penetration had lower risk-adjusted mortality rates. Areas at the top quartile for HMO penetration (penetration of 25 percent or more) had a mortality rate of 9.16 compared with areas at the lowest quartile (penetration of 11 percent or less), which had a mortality rate 9.31. This difference is 9 percent of the standard deviation in excess mortality. The association between HMO competition and mortality was only marginally significant, with p-values of .06 in the model excluding expenditures and .08 in the model including expenditures. In both cases the difference in mortality between the top and bottom quartiles was 3.6 percent of the standard deviation of excess mortality. Neither the change in HMO penetration between 1988 and 1990 nor competition between hospitals was significantly associated with mortality ($p = .23$ and .17, respectively).

The association between HMO penetration and mortality changed very little and insignificantly, as did all other HMO variables, when expenditures were excluded from the model. This suggests that the relationship between HMOs and hospital quality is through mechanisms other than the effect of

HMOs on hospital costs. These results were robust to alternative specification of the model. Qualitatively similar results were obtained in models in which the dependent variable was one of the six cause-specific mortality rates, when Medicare discharge rates were added as independent variables, and when other variables that could be construed to reflect HMO practice styles—the technology index, percentage ICU days, and percentage ER visits—were excluded from the model.

DISCUSSION

Health care markets are becoming increasingly dominated by managed care and price competition, a trend that began in California in 1983 and continued in all areas of the country. The question addressed in this study is whether increased HMO penetration is associated with quality of hospital care received by fee-for-service Medicare patients as measured by their risk-adjusted mortality rates. The findings we present should be considered from two perspectives: their statistical significance and their policy significance.

The analyses identify a statistically significant and positive association between HMO penetration and quality (i.e., negative association with mortality) and only a marginally significant relationship with regard to HMO competition. The magnitude of the association, however, is relatively small, particularly when considered vis-à-vis the regional variation in mortality. The difference in risk-adjusted mortality rates between areas at the top and the bottom quartiles in terms of HMO penetration was only 9 percent of the standard deviation of excess deaths, whereas differences across regions amounted to between 20 percent and 60 percent of the standard deviation. Furthermore, the regional variation in risk-adjusted mortality seems to persist over time, even during a period of substantial change in the health care system. A study by Manheim et al. (1992) of 1987 data shows regional effects similar to those we find for 1990. The effect of HMO penetration—and for that matter of other factors, such as ownership, technological sophistication, and teaching status, influencing hospital behavior—seem to be important only at the margin. Therefore, future research aimed at understanding the causes of these regional variations may provide important insights into factors influencing mortality outcomes and the policies that might be effective in improving them.

While small compared to the regional effect, when compared with hospital and other market characteristics included in the analyses, HMO

penetration exhibited one of the largest associations with outcomes, suggesting that HMOs have a positive effect on the quality of care in areas in which they have substantial presence. This finding should, however, be interpreted with caution, recognizing the limitations of this study. Because of its cross-sectional design, this study cannot rule out other potential explanations for the observed associations. It is possible that the observed association is spurious, reflecting a separate association between HMO penetration, hospital quality, and a third unobserved variable. For example, prior studies suggest selective entry by HMOs into higher-cost markets (Dranove, Simon, and White 1998). This preference by HMOs probably reflects expectations of an increased potential for cost savings in markets with higher expenditures. Such markets may, however, also be characterized by better outcomes. We found that hospitals with higher expenditures have lower risk-adjusted mortality rates. If similar associations exist at the market level, they may explain the association we found between HMO penetration and better outcomes.

Another possible explanation is that high-expenditure areas are also high-admission-rate areas. Areas with higher admission rates are likely to have more discretionary admissions, which are likely to be of lower severity and have a lower probability of mortality. If the risk adjustment is not sufficient to capture the effect of discretionary admissions on predicted mortality rates, the models we estimated may show a spurious and negative correlation between HMO penetration and excess mortality. To test this hypothesis we also estimated models that included the Medicare discharge rate in the MSA as an additional independent variable. The results remained unchanged and the Medicare discharge rate was not statistically significant, suggesting that this hypothesis does not explain the observed negative association between HMO penetration, HMO competition, and excess mortality.

HMOs' selective contracting practices may also lead to the results we observed if HMOs channel their own enrollees to the lower-quality hospitals, forcing a switch of fee-for-service patients to the better hospitals. This explanation, however, seems unlikely because most hospitals have significant excess capacity that would allow a shift of HMO patients without requiring a complementary shift in fee-for-service patients. Furthermore, the evidence in the literature to date does not suggest that HMOs systematically channel their enrollees to low-quality hospitals (Mukamel, Mushlin, Weimer, et al. 2000; Chernew, Scanlon, and Hayward 1998; Escarce, Shea, and Chen 1997; Escarce, Van Horn, Pauly, et al. 1999). On the other hand, HMOs may have a positive effect on the quality of care offered in their markets through changes in local practice styles and selective contracting. Further study is required to

understand the causal linkages between HMO penetration and non-HMO outcomes of care.

Two limitations of the study should be noted: its limitation to HMOs and its limitation to risk-adjusted mortality as a measure of quality. Because this study included information only about HMOs, which account for only 41 percent of managed care enrollment, its results may not be generalizable to all managed care. Preferred provider organizations (PPOs) and point-of-service (POS) plans are different types of managed care organizations having different arrangements with physicians and hospitals, leading to different incentives and different behavior, and they ultimately may have a different effect on quality. This study did not investigate the effect of PPOs or POS plans on quality and therefore offers only a partial picture of the relationship between managed care and quality.

Relying on risk-adjusted mortality rates to measure quality also limits the generalizability of the findings. Although mortality is a very important outcome, other outcomes such as morbidity and quality of life are also important. Furthermore, mortality may not be a very sensitive measure and may not capture more subtle differences in quality.

This study suggests that increased HMO penetration is associated with better mortality outcomes for non-HMO patients. Further research is required to provide insights into the nature of these associations, to evaluate the relationships between other types of managed care organizations and quality, and to assess the stability and generalizability of the relationship between managed care penetration and health care outcomes identified here.

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NOTES

1. Of the 2,093 hospitals in the initial sample, 166, or 8 percent, were excluded because of incomplete HMO or mortality data. These hospitals tended to be smaller than average and for profit, had lower than average expenditures, and were located primarily in the south west central part of the country.
2. Cook's D statistic was used to test for outliers. No outliers were found.

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