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HMO Market Penetration and Hospital Cost Inflation in California

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Objective. —Health maintenance organizations (HMOs) have stimulated price competition in California hospital markets since 1983, when the state legislature eliminated barriers to selective contracting by conventional health insurance plans. This study measures the impact of HMO-induced price competition on the rate of inflation in average cost per admission for 298 private, non-HMO hospitals between 1982 and 1988.

Data. —HMO market penetration was calculated using discharge abstract data on insurance coverage, ZIP code of residence, and hospital of choice for 3.35 million patients in 1983 and 3.41 million patients in 1988. Data on hospital characteristics were obtained from the American Hospital Association and other sources.

Results. —HMO coverage grew from an average of 8.3% of all admissions in local hospital markets in 1983 to 17.0% of all admissions in 1988. The average rate of growth in costs per admission between 1982 and 1988 was 9.4% lower in markets with relatively high HMO penetration compared with markets with relatively low HMO penetration (95% confidence interval, 5.2 to 13.8). Cost savings for these 298 hospitals are estimated at $1.04 billion for 1988.

Conclusion. —Price competition between HMOs and conventional health insurers can significantly reduce hospital cost inflation if legislative barriers to selective contracting are removed. The impact of competition in California was modest, however, when evaluated in terms of the 74.5% average rate of California hospital cost inflation during these years.

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MARKET-oriented proposals to reform the health care system rely heavily on health maintenance organizations

(HMOs) to stimulate cost consciousness among hospitals and other health care providers.[1,2] Hospitals and physicians

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treating significant numbers of HMO members should face direct pressures to control diagnostic and therapeutic procedures and length of stay. More important, in principle, is the indirect effect of HMOs on hospital behavior that results from price competition in health insurance markets. Conventional health insurance plans should control hospital costs to hold down their premiums and successfully compete with HMOs for enrollees.

This conceptual framework predicts that health care markets with high levels of HMO penetration should exhibit lower costs than markets with low HMO penetration. Empirical studies have repeatedly failed to support this hypothesis, however, reporting no consistent association between HMO enrollment and either average hospital costs per admission or average health care costs per capita.[3-9] This lack of association suggests that legal and institutional limits on the ability of hospitals to compete for patients on the basis of price have motivated them to focus on nonprice, quality-oriented strategies.[10-12] Nonprice competition has produced a pattern in which hospital costs per admission are significantly higher in competitive than in concentrated hospital markets.[13] Without the ability to contract selectively with hospitals on the basis of price, conventional insurers have no means to convince those institutions to desist from cost-increasing forms of quality competition.[14] Increased HMO market penetration could stimulate, rather than dampen, nonprice competition among hospitals for the remaining non-HMO patients.

This article uses data from 1982 to 1988 on 298 private hospitals in California to examine the influence of HMO market penetration on hospital cost inflation. Since 1983, when fee-for-service (FFS) health insurance plans were permitted to contract selectively with health care providers,[15] California hospital markets have become increasingly price-competitive.[16,17] This study documents the rapid growth in HMO market penetration and the effect of the 1983 deregulation of FFS plans on hospital responses to HMO plans. It then estimates the HMO-induced reductions in 1988 hospital costs, compared with what they would have been in the absence of the 1983 legislative reforms and

the growth in HMO market penetration between 1983 and 1988.

DATA AND METHODS
Data on HMO Market Penetration

Information on insurance coverage for hospitalized patients in California was obtained from the computerized discharge abstract files maintained by the Office of Statewide Health Planning and Development, which include payer source (Medicare, Medicaid, HMO, other private insurance, no form of health insurance). The discharge abstracts also identify the hospital where the patient was treated and the ZIP code area in which the patient resides. There was a total of 3.35 million patient records in 1983 and 3.41 million in 1988.

The total number of hospital admissions and the number of hospital admissions covered by HMOs in 1983 and 1988 were calculated for each ZIP code area. The ratio of HMO-covered admissions to total admissions measured the extent of penetration by HMOs into each ZIP code area. Each hospital's market area was defined as the aggregation of all ZIP code areas from which it drew patients. The level of HMO penetration into each hospital's market was calculated as the average of the HMO penetration levels for each ZIP code area in the hospital's market area, weighted by the fraction of the hospital's patients who resided in each ZIP code area.

This measure of HMO market penetration embodies the perspective of the hospital, since it is based on the fraction of hospital patients who are covered by HMOs rather than the fraction of the privately insured population that is enrolled in HMOs. Given that HMO patients tend to exhibit lower hospital admission rates than non-HMO patients,[18] this measure of HMO market share will be lower than measures based on health plan enrollment data. From the perspective of the hospital, however, it is HMO share in the hospital market (admissions) rather than HMO share in the insurance market that is the matter of primary concern.

A complementary measure of the extent of HMO coverage of the patients in each hospital was also developed for 1983 and 1988. The number of each hospital's patients covered by HMOs, non-HMO private insurance, Medicare, Medicaid, and no form of insurance was calculated and divided by the total number of discharges from the hospital. In calculating the degree of HMO penetration into each hospital's market, data were used on all admissions to all short-term general hospitals in California, regardless of the hospital to which they were admitted. In calculating the frac-

tion of each hospital's patients who were covered by HMOs, however, the calculations were limited to data from private hospitals that were not owned by the Kaiser-Permanente HMO. Kaiser hospitals were excluded from the subsequent statistical analyses, since this study was meant to focus on the effects on hospital performance caused by market competition from HMOs, rather than caused by HMO ownership. Public hospitals were also excluded, since they usually do not compete in significant ways for privately insured patients in California.

Data on Hospital Characteristics

Data on annual hospital expenditures for 1982 and 1988 were obtained from the Annual Survey of Hospitals, conducted by the American Hospital Association. The American Hospital Association survey provided additional information on number of staffed beds, annual number of inpatient surgical procedures, annual number of outpatient surgical procedures, annual number of inpatient admissions, annual number of outpatient visits, average annual salary for nonphysician employees, and the percentage of annual inpatient days consisting of each of six broad categories of care (general medical and surgical, pediatrics, obstetrics, intensive care, other acute, subacute). The 1982 American Hospital Association data were chosen as representing California hospital and market conditions in the year immediately preceding the legislative reforms of 1983. Complete discharge abstract data from the Office of Statewide Health Planning and Development are available only beginning in 1983, however. It was thus assumed that 1983 HMO shares in hospital markets and hospital patient populations accurately indicated shares in 1982.

The number of neighboring hospitals within a 24-km radius of each hospital included in the study was also measured. The 24-km radius was chosen under the assumption that this was the maximum distance a community-based physician would travel regularly between hospitals to conduct rounds. Although deregulation and HMO growth have stimulated price competition for patients among hospitals in California, most hospitals have traditionally used nonprice strategies to attract physician staff affiliations as an indirect means for attracting patient admissions. The method for calculating distances between hospitals has been described elsewhere.[13,17]

Physician, population, and economic data were obtained for each county in California from the 1982 and 1988 De-

partment of Health and Human Services Area Resource Files, using information from the American Medical Association's masterfile of physicians, the Census of Population, and the Census Bureau's Current Population Survey. Three measures were developed from these data, including practicing physicians per 1000 county residents, population density (1000 residents per square mile), and median family income.

Statistical Analysis

A "varying parameter" statistical method was employed and has been described in detail elsewhere.[19] It permits the user to test the hypothesis that hospital cost inflation was influenced both by the change between 1983 and 1988 in the level of HMO market penetration and by a change between 1983 and 1988 in the response by hospitals to any given level of HMO market penetration. Both the level of HMO penetration and the coefficient on that variable change over time. This contrasts with the conventional "fixed parameter" method, which permits changes in the level of the independent variables to influence the rate of change in the dependent variable but assumes that the coefficients on the independent variables remain constant. The varying parameter method is well designed to test the hypothesis that deregulation of health insurance markets in California changed the way in which hospitals and FFS health plans responded to HMOs.

The dependent variable in the cost inflation analysis was the change in the logarithm of hospital costs per admission between 1982 and 1988. The difference in the logarithm of costs is approximately equal to the percentage rate of change in costs. Exact point estimates in percentage terms were derived using the standard transformation for semilogarithmic functions.[20]

The HMO market and hospital share variables were entered into the regression equation in two forms. The change between 1983 and 1988 in the fraction of the market covered by HMOs and the change between 1983 and 1988 in the fraction of the hospital's patients covered by HMOs, Medicare, and Medicaid and uninsured (with non-HMO privately insured patients serving as the comparison category) were included to measure the effect of changing levels of HMO penetration on changes in hospital costs. The 1983 levels of the HMO market penetration variable and the four hospital payer mix variables (with the 1983 fraction covered by non-HMO private insurance again serving as comparison category) were included to mea-

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sure the effect on costs caused by changes in hospital responses to the level (rather than change) of HMO penetration. In the varying parameter cost method, the coefficients on changes in the independent variables measure the level of behavioral response. Coefficients on the levels of the independent variables, on the other hand, measure the changes in behavioral response.[19]

The other variables in the statistical analysis were measured in terms of their changes between 1982 and 1988, to the exclusion of their 1982 levels, since there was no reason to assume that the coefficients on these variables were changing over time. The variables measuring staffed beds, inpatient surgery, outpatient surgery, and outpatient visits were divided by annual admissions to control for scale effects, since the dependent variable was measured in terms of costs per admission. The rationale for this approach has been presented elsewhere.[21]

The statistical analysis also controlled for the effects of regression to the mean over time in hospital costs per admission. Hospitals with particularly low costs in any one year often exhibit higher than average rates of cost growth in subsequent years, as the special circumstances responsible for the initially low costs disappear and the individual hospital's performance reverts to that of its peer group. If HMOs selectively contract with low-cost hospitals that subsequently exhibit regression to the mean in costs, the cost-decreasing effect of the HMOs will be understated by the statistical analysis. The importance of regression-to-the-mean effects in hospital cost dynamics has been demonstrated elsewhere.[19]

The analysis then tested the hypothesis that HMO effects were greater on hospitals facing large numbers of neighboring hospitals than on hospitals with fewer neighboring institutions. The full sample of 298 hospitals was divided into two evenly sized groups according to whether the number of neighboring hospitals faced by each particular institution was below or above the median for all hospitals. The cost inflation analysis for the period from 1982 to 1988 was then conducted for each group separately.

The effect of HMOs on average costs for each of the 298 private non-Kaiser hospitals was calculated as the sum of two components. The first component was the change between 1983 and 1988 in HMO market penetration for the hospital, multiplied by the coefficient on the 1983 HMO market penetration variable in the regression analysis. The second was the 1983 level of HMO market pene-

tration for the hospital, multiplied by the coefficient on the 1983 to 1988 HMO penetration change variable in the regression analysis. These two components were summed for each individual hospital and then converted from logarithmic to dollar units using Duan's nonparametric method.[22] The total effect for all 298 hospitals was the sum of the effects for each individual hospital.

RESULTS
Growth in HMO Market Penetration

The first and second rows of Table 1 present the 1983 and 1988 percentages of patients enrolled in HMOs in the markets faced by the 298 hospitals, while the third and fourth rows present the percentage of the patients admitted to those 298 hospitals who were HMO enrollees. Both sets of figures show strong HMO growth. While HMOs covered an average of 8.3% of patients in the markets facing private non-Kaiser hospitals in 1983, they covered 17.0% in 1988. The changes are proportionately more striking for the percentage of patients admitted to these hospitals. While an average of only 2.0% of patients admitted in 1983 were HMO enrollees, 10.7% were HMO enrollees in 1988. This represents a growth in numerical terms from 49 920 patients in 1983 to 257 747 patients in 1988. The difference between the two sets of HMO figures in Table 1 is due to the large numbers of patients admitted to Kaiser-Permanente hospitals, who are included in the market share figures in the first two rows but excluded from the hospital share figures in the third and fourth rows.

The percentage of discharges covered by private non-HMO insurance fell from an average of 43.7% in 1983 to 34.4% in 1988, representing a decline from

952 473 to 683 244 patients. Uninsured discharges grew from an average of 5.7% of discharges in 1983 to 7.5% in 1988, representing a change from 114 642 to 137 715 patients. The percentage of discharges covered by Medicare fell slightly, from an average of 34.1% to 32.6%, representing a decline from 678 295 to 592 047 patients. The relative importance of Medicaid grew from an average of 13.2% of discharges in 1983 to 14.9% of discharges in 1988, representing a growth from 258 191 to 280 772 patients. The total annual number of discharges from these 298 hospitals declined from 2 053 522 in 1983 to 1 951 525 in 1988.

HMO Effects on Hospital Cost Inflation

Costs per admission increased by an average of 74.5% over the period from 1982 to 1988 for the 298 hospitals analyzed in this study, from an average of $3653 to an average of $6386. The SD of the growth rate in average cost per admission was 34.5%, indicating substantial variability among hospitals in inflation rates. Table 2 presents regression coefficients and SEs from the statistical analysis of the determinants of this variation.

Hospitals operating in markets with high HMO penetration experienced rates of growth in costs per admission significantly less rapid than hospitals in markets with low HMO penetration, controlling for other relevant factors. A 10–percentage-point difference in 1983 HMO market penetration produced a 9.4% difference in the rate of cost inflation through 1988 ($P<.0001$). This figure is derived by multiplying 0.10 by 0.8986, the coefficient on the 1983 HMO market variable in Table 2, to obtain the

Table 1.—Health Maintenance Organization (HMO) Shares in California Hospitals and Hospital Markets (N = 298) (Percentages)

	Mean	Median	Minimum	Maximum	SD
HMO Shares in Market Discharges					
1983	8.3	9.0	0.1	27.0	5.5
1988	17.0	18.9	0.3	34.1	7.8
Shares in Hospital Discharges					
HMO 1983	2.0	0.2	0.0	32.4	4.7
1988	10.7	7.0	0.0	96.1	12.2
Private (non-HMO) 1983	43.7	43.2	5.8	86.7	12.0
1988	34.4	32.9	2.5	93.0	13.5
Medicare 1983	34.1	33.6	0.1	74.7	12.0
1988	32.6	30.9	0.0	67.0	13.0
Medicaid 1983	13.2	10.6	0.0	55.3	10.8
1988	14.9	12.3	0.0	67.9	13.0
Uninsured 1983	5.7	4.7	0.0	24.5	4.0
1988	7.5	6.3	0.0	33.3	5.1

effect in logarithmic terms. The exact percentage effect is derived from this approximate percentage effect by exponentiating and then subtracting 1.[20] The 95% confidence interval in percentage terms is 5.2 to 13.8.

No effect is observed for differences across hospitals in the fraction of their own patients who are enrolled in HMOs. This suggests that the influence of HMOs on non-HMO hospitals primarily operated indirectly, via the HMOs' influence on the cost-consciousness of FFS health plans. The lack of size and significance for the HMO patient share variables suggests that hospitals treated their HMO patients similarly to their non-HMO privately insured patients (the comparison category). This lack of association between the HMO hospital share measures and hospital costs remained even when the HMO market share measures were excluded from the statistical analyses. The strong observed association between HMO market share and hospital costs was also insensitive to whether the measure of HMO hospital share was included or excluded from the statistical analyses.

The mix of patients by insurance coverage exerted a significant influence on rates of hospital cost inflation, as evidenced in the following rows of Table 2. Hospitals with high fractions of their patients covered by Medicare or Medicaid or uninsured had significantly lower rates of cost inflation than hospitals with proportionately more privately insured patients (the comparison category). The Medicare effect is consistent with earlier analyses reporting cost-reducing effects of the shift from retrospective to prospective payment of hospitals under the diagnosis related groups system.[23] The Medicaid effect is smaller than that reported earlier using data through 1986; that study was limited to geographical areas where the California Medicaid selective contracting program was in place.[19] The effect for uninsured patients suggests that hospitals were not able to completely shift to insured patients the cost of treating uninsured patients and were forced to reduce (the rate of growth in) expenditures.

The impact of HMOs was apparently greater on hospitals in areas with many neighboring institutions within 24 km than those in areas with fewer neighbors. The coefficient on 1983 HMO market penetration for hospitals with 24 (the sample median) or more neighbors was −1.4446, implying a 15.5% lower rate of inflation for hospitals facing high HMO market penetration compared with hospitals facing lower HMO market penetration. For hospitals with few-

Table 2.—Regression Results for Determinants of the Rate of Hospital Cost Inflation, 1982 through 1988 (N = 298)*

	Coefficient	SE
HMO market penetration		
1983 level	−0.8986	0.2003†
1983-1988 change	0.1830	0.2562
HMO patient share		
1983 level	0.0512	0.2087
1983-1988 change	−0.1017	0.1082
Medicare patient share		
1983 level	−0.2896	0.1039†
1983-1988 change	0.0443	0.1422
Medicaid patient share		
1983 level	−0.1785	0.1030‡
1983-1988 change	−0.0357	0.1312
Uninsured patient share		
1983 level	−1.0515	0.2912†
1983-1988 change	−0.1534	0.2345
Control variable for regression-to-the-mean effects	−0.6192	0.0488†
Change in logarithm of average salary	0.3682	0.0374†
Change in logarithm of staffed beds	0.5047	0.0299†
Change in logarithm of inpatient surgeries	0.0262	0.0174
Change in logarithm of outpatient surgeries	0.0110	0.0094
Change in logarithm of outpatient visits	0.0508	0.0119†
Change in % of annual inpatient days accounted for by		
Adult medical/surgical	0.0008	0.0007
Pediatrics	0.0065	0.0043
Obstetrics	−0.0001	0.0030
Intensive care	0.0059	0.0013†
Other acute	−0.0004	0.0012
Change in logarithm of median family income	0.0856	0.1462
Change in population density, 1000s	−0.0003	0.0054
Change in physicians per 1000 capita	−0.9812	0.9226
Intercept	0.5504	0.0950†

*HMO indicates health maintenance organization. Adjusted $R^2 = 0.72$.
†$P < .01$.
‡$P < .10$.

Table 3.—Estimated Savings due to Health Maintenance Organization Market Penetration

	Mean	Median	Minimum	Maximum	Sum
Savings per admission, $	483	462	−121	2711	...
Total savings, $1000	3475	1848	−1420	32 211	1 035 500
% Saved	6.66	7.11	−2.65	21.42	...

er than 24 neighboring institutions, the coefficient on 1983 HMO market penetration was −0.4129, implying a 4.2% lower rate of inflation attributable to HMOs. The median number of neighboring hospitals is high, reflecting the urbanized nature of the California population. Restriction of the analysis to the 106 hospitals with fewer than 10 neighbors produced an estimated HMO effect of 5.4%, quite similar to the effect produced for all hospitals with fewer than 24 neighbors.

These various subsample effects should be compared with the 9.4% effect estimated using the full sample of 298 hospitals. The large SEs on the subsample coefficients mean that they cannot be distinguished with statistical significance from the 9.4% figure and, more generally, that they should be treated with caution. The estimate of the overall

impact of HMOs on hospital cost inflation in California, to be discussed below, is therefore based on the coefficients derived from the full sample and presented in Table 2.

Costs per admission in 1988 were $483 lower than they would have been absent the changes in health insurance markets, as indicated in Table 3. This is equivalent to mean savings of $3.5 million per hospital per year and total 1988 savings for all 298 hospitals of $1.04 billion. The effects varied considerably across individual institutions, however, with seven hospitals experiencing savings greater than 15% and 20 hospitals experiencing small cost increases. Hospitals with estimated savings greater than 15% were in markets with high levels of 1983 HMO market penetration (>18%). Hospitals with cost increases were in markets with low 1983 HMO

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penetration (<3%). Three fourths of the hospitals are estimated to have had HMO-induced cost savings between 1.0% and 12.0%.

COMMENT

Given the theoretical presumption that HMOs reduce hospital cost inflation, the lack of empirical association between HMO market penetration and hospital costs is one of the most contentious findings in contemporary health economics. This article argues that the data used in previous studies have not been well suited for testing the hypothesis at issue. The published studies have typically used data from states and time periods in which non-HMO health plans faced legal and institutional barriers to competing with HMOs on the basis of price. Fee-for-service plans in these environments apparently responded to HMO market penetration through nonprice rather than price strategies, competing for consumer loyalty based on real or perceived differences in quality while raising costs. Only when FFS plans are legislatively permitted to follow HMOs in contracting with hospitals on the basis of price can HMO market penetration be expected to reduce hospital cost inflation.

This article reports results from a study of 298 private hospitals in California that are not owned by HMOs but face both a growing presence of HMOs in their local markets and a legal environment that permits selective contracting by FFS health plans. These data support the hypothesis that HMOs can exert indirect effects on hospital behavior by stimulating more price-competitive behavior on the part of other health insurance plans. Based on these calculations, hospital costs in 1988 were $1.04 billion lower than they would have been had HMO market penetration remained at 1983 levels and had the medical care environment remained unchanged.

The HMO-induced cost savings must be put into proper quantitative perspective. The 9.4% lower rate of inflation in markets with high HMO penetration compared with markets with low HMO penetration is modest when compared with the 74.5% overall rate of growth in average cost per admission during this 6-year period. After a sharp but brief slowdown in 1984, hospital costs in California resumed a high rate of growth. The causes of this continued inflation are not clear, but they possibly reflect an exhaustion of the savings to be obtained from reductions in average length of patient stay. The underlying dynamic of health care cost inflation, the development of new technologies and procedures, has apparently not been significantly altered.[24]

It is also possible, however, that the findings reported herein understate the full magnitude of the cost-controlling effects of HMOs: HMOs have lower rates of hospital admission per enrollee[18,25] and, at least in one prominent example, lower rates of unnecessary admissions.[26] High HMO market penetration may induce FFS plans to develop more effective hospital utilization review programs with an eye to reducing admissions. If this is the case, one would expect that hospitals in markets with high HMO penetration would experience increased average severity of illness for FFS plan enrollees, as the less severely ill are shifted to outpatient settings. This would, in turn, result in higher rates of inflation in costs per admission. This case-mix effect would work in the direction opposite the HMOs' effects on resource intensity and length of stay. The findings reported herein of lower inflation rates in markets with high HMO penetration would therefore understate the effect of HMOs on resource use and length of stay.

The HMOs have pioneered a style of medical practice that uses less intensive hospital care per enrollee than conventional insurance plans. As reported herein, market pressures in a deregulated legal environment can spread this more conservative hospital utilization pattern to FFS plans. The major test for market-oriented health care reform proposals in the coming years is whether HMOs will be able to develop, and market competition will be able to diffuse, a socially acceptable method for evaluating and controlling new clinical technologies. Absent these innovations, the HMO-related effects reported herein will prove transitory. This will generate increased political support for cost-control strategies that eschew market incentives in favor of governmental regulation.[27,28]

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