Hospital Expenditures and Utilization: The Impact of HMOs

Gerard F. Anderson, PhD; Nannan Zhang, PhD; and Chantal Worzala, MPA

Abstract

Objective: **To determine whether hospital utilization and expenditures have declined more rapidly in metropolitan statistical areas (MSAs) with high health maintenance organization (HMO) penetration compared with MSAs with low HMO penetration.**

Study Design: **Levels and rates of change in hospital expenditures and hospital utilization in MSAs with varying levels of HMO penetration (1982 to 1996) were compared in a natural experiment.**

Methods: **MSAs were grouped into 4 categories based on HMO penetration rates in 1996. Levels and rates of change in hospital admission rates, hospital inpatient days, emergency room visits, total expenditures per capita, and expenditures per adjusted inpatient day from 1982 to 1996 were compared. A first-difference multivariate model was evaluated for 1993 to 1996.**

Results: **At the MSA level, the rates of change in hospital utilization and hospital expenditures varied only modestly with the level of HMO penetration. Changes in hospital admission rates did not vary systematically with HMO penetration rates except in the 1993 to 1996 period, when MSAs with the highest HMO penetration had the largest decline. Reductions in hospital days per capita and expenditures per day did not vary systematically by level of HMO penetration. Emergency room days declined most rapidly in the MSAs with the highest HMO penetration in the 1982 to 1993 period and were similar in the 1993 to 1996 period. Hospital expenditures per capita showed the greatest association with managed care penetration. They averaged 1.6% slower annual growth in MSAs with high versus low HMO penetration in the 1982 to 1996 period.**

Conclusion: **This national study using data from 1982 to 1996 suggests that the effects of HMO penetration on hospital expenditures and hospital utilization at the MSA level are small (generally less than 1% per year).**

(Am J Manag Care 1999;5:853-864)

For Editorial comment, please see page 939.

There is wide variation in the level of health maintenance organization (HMO) penetration among the metropolitan statistical areas (MSAs) in the United States. According to 1996 InterStudy data, the range of HMO penetration varies from a low of 0% in 34 MSAs to a high of 68% in Stockton-Lodi, California.[1] In some MSAs, most of the growth in HMO enrollment has occurred recently, whereas in other MSAs the penetration of HMOs began decades ago. This naturally occurring geographic variation in the penetration of HMOs offers an opportunity to explore the impact of HMOs on healthcare providers such as hospitals.

It is widely believed that HMOs are at least partially responsible for many of the recent changes in how medical care is delivered and the slowdown in the rate of increase in the level of healthcare spending.[2,3] This paper focuses on the potential impact of HMOs on hospital expenditures and hospital utiliza-

From the Johns Hopkins Center for Hospital Finance and Management, Baltimore, MD.

This work was done in collaboration with the Center for Studying Health System Change, which is funded by the Robert Wood Johnson Foundation and affiliated with Mathematica Policy Research. It was supported by a grant from the Robert Wood Johnson Foundation.

Address correspondence to: Gerard F. Anderson, PhD, Center for Hospital Finance and Management, Johns Hopkins University, 624 N. Broadway, Baltimore, MD 21205. E-mail: ganderso@jhsph.edu.

tion for several reasons. First, the largest percentage of the healthcare dollar (36%) is spent on hospitals.[2] Second, there was a 7.5% decline in hospital admissions and a 15.5% decline in inpatient days in the period from 1985 to 1995.[4] In addition, real growth in hospital expenditures has slowed in recent years.[2] Third, recent empirical studies[5-9] and the hospital management literature[10,11] suggest that the recent declines in utilization and the slowdown in hospital expenditures are partially due to changes in the healthcare financing and delivery system, particularly the growth of HMOs.

One notable exception to the literature linking managed care to decreased hospital expenditures is a study by McLaughlin,[12] who looked at the effect of prepaid group practices on hospital utilization and expenditures in 25 standard MSAs from 1972 to 1982. She found no effect of prepaid group practice on per capita hospital expenses, a negative effect on admission rates and average length of stay, and a positive effect on hospital expenditures per day and per admission. More recent studies have found an association between HMO penetration and hospital expenditures. These studies have examined the impact of either only one payer or a small sample of MSAs.[5-9,13]

In this paper we investigate whether HMOs are having an impact on aggregate hospital expenditures and utilization at the MSA level for all US MSAs. We believe this is a more policy-relevant test of the impact of HMOs on the hospital industry than analysis at the hospital level. We are not interested in whether there are spillover effects from managed care to fee-for-service or to other types of providers. The expectation, based on previous studies, is that there will be greater reductions in the utilization of hospital services and slower rates of growth in hospital spending in MSAs with greater levels of HMO penetration.

To test the hypothesis that HMOs have played a role in changing the output of the hospital sector, we compared expenditure and utilization patterns in MSAs with high HMO penetration with those in MSAs with low HMO penetration. HMO penetration is defined as the percentage of the population in an MSA that belongs to an HMO. Specifically, MSAs in the United States were divided into 4 groups based on their level of penetration (defined as the percentage of the population enrolled in HMOs). Although many types of managed care organizations are proliferating, because of data constraints we only present data on HMOs, including staff/group-model and IPA-model plans, but not preferred provider organizations (PPOs). We analyzed the impact of PPO activity using a different data set that includes PPOs. The source of the data is considered to be less reliable than the InterStudy data. The results using the PPO data were similar to those presented here. We elected not to include these results in this paper because the results were so similar.

We also ran multivariate analyses on data from 1993 through 1996—the period of greatest growth in managed care. The quality of the HMO data does not permit us to run multivariate statistics before 1993. Based on the availability of data on HMO penetration in 1993, first-difference multivariate analysis was performed on 188 of 296 MSAs. Unfortunately, the remaining MSAs did not have data on market penetration in 1993.

··· DATA ···

Hospital utilization and expenditure data were obtained from the American Hospital Association Annual Survey.[4] The most recent year of data available from the American Hospital Association is 1996. The demographic information was obtained from the 1998 Area Resource File.[14]

There are 328 MSAs in the United States, excluding Puerto Rico.[15] Data on HMO penetration as of July 1, 1996, were obtained from InterStudy. (InterStudy conducts a biannual census of HMOs, including information on the number of enrollees and the counties in which each HMO operates. It asks the HMOs to assign their enrollment to specific MSAs.) The level of HMO penetration was not available for 30 MSAs, which, according to InterStudy, may not be served by any HMOs (InterStudy, personal communication, November 11, 1997). These MSAs were not included in the study. They tended to be small (the average population was 169,182 in 1996), with per capita income and education levels below the average for all MSAs (data not shown). The remaining 298 MSAs were grouped by level of HMO penetration in 1996 and included in the analysis.

The MSAs were grouped based on the level of penetration in 1996. (They also were grouped based on the level of penetration in 1993; see "Sensitivity Analysis.") Any groupings based on level of penetration will be somewhat arbitrary. In selecting the cutoff values, an attempt was made to differentiate those MSAs where little HMO activity had taken place (less than 20%) from those with significant HMO activity (more than 40%). The 4 groups were as follows:

- group 1, less than 20%
- group 2, from 20% to less than 30%
- group 3, from 30% to less than 40%
- group 4, 40% or more

Group 1 contained 174 MSAs that had between 0 and 20% of their population in HMOs in 1996. Group 2 (20-30% penetration) had 54 MSAs; group 3 (30-40% penetration) had 31 MSAs, and group 4 (>40% penetration) had 39 MSAs. In 1995, group 1 included 1447 hospitals. Groups 2, 3, and 4 had 970, 728, and 703 hospitals, respectively.

HMO penetration has increased over time (Table 1). Data from 1982, 1990, 1993, and 1996 are presented. The year 1982 was chosen because it was the year before the introduction of the Medicare Prospective Payment System and before HMOs had penetrated most MSAs. The year 1990 was chosen because it was before the recent growth in HMOs in most MSAs. Some experts have identified the year 1993 as the beginning of the recent growth in HMOs in many MSAs.[3] The most recent year of data that was available from the American Hospital Association is 1996.

The 1982, 1990, and 1993 values in Table 1 used penetration levels measured where the HMO headquarters was located. InterStudy performed a special survey in 1993 that asked the HMOs to assign enrollees by county. Unfortunately, it contains only 202 MSAs.

Two patterns emerge from the data presented in Table 1. First, there is always a progression in penetration rates from group 1 to group 4. In 1982, for example, there were already different HMO penetration rates across the 4 groups, ranging from 0.5% in group 1 to 9.2% in group 4. The differences across groups are statistically significant in all 4 years ($P < .0001$). Second, within each group the HMO penetration rates increased over time, with significant increases occurring from 1993 to 1996 in all 4 groups.

Table 2 presents selected demographic characteristics for the groups over time. Overall, the MSAs included in the study contained 209 million people in 1996. Of those, 69 million (33%) lived in MSAs classified as group 1, and 56 million (27%), 43 million (21%), and 42 million (19%) lived in MSAs classified as groups 2, 3, and 4, respectively. In 1996, the average population size of the MSAs in group 1 was 398,400. In group 2 it was 1,046,700; in group 3, 1,387,900; and in group 4, 1,065,000. Very little difference was seen among the 4 groups in terms of the percentage of the population age 65 years or older. There were statistically significant differences in education levels and per capita incomes. The per capita income in group 1 was consistently lower, ranging from 6% to 10% below the average of the other 3 groups over the years. Group 1 also had lower levels of educational attainment. Although there appear to be some differences between group 1 and groups 2, 3, and 4, there also was wide variation within the groups on nearly all of the demographic variables. There are, for example, many small MSAs with high HMO penetration (data not shown).

Table 1. HMO Penetration Levels*

	Percent Penetration						
Year	All MSAs	Group 1	Group 2	Group 3	Group 4	F Statistic	*P* Value
1982†	2.8	0.5	2.1	8.4	9.2	9.74	0.0001
1990†	9.4	3.7	10.5	20.6	24.7	24.95	0.0001
1993†	11.0	4.0	14.7	21.7	29.0	28.44	0.0001
1996‡	19.6	8.8	24.2	35.1	49.1	655.0	0.0001

MSA = metropolitan statistical area.
*Differences in the weighted means across the 4 groups are presented, with the weight being the population size of the MSA. The statistical significance of differences across the 4 groups was measured by using the generalized linear models (GLM) procedure for testing analysis of variance (ANOVA) with unbalanced data (ie, with an unequal number of data points in each group). ANOVA tests the hypothesis that the means are equal across the groups, using the F distribution. Nonparametric tests also were performed and the results were very similar. The GLM results are presented in the text.
†Data are from reference 14.
‡Data are from InterStudy as of July 1, 1996.[1]

··· RESULTS ···

Utilization

Table 3 presents data on hospital utilization rates, including admissions, inpatient days, and emergency room visits. In all 4 years there was a statistically significant, consistent pattern in the admission rates. Rates were highest in group 1, followed by groups 2, 3, and then 4. Group 4 had the lowest rate of hospital admissions in 1982: 4.3% below the average of all MSAs. In 1996, the admission rate in group 4 was still the lowest of the 4 groups: 9% below the overall average. The data presented here contradict a widely held assumption that HMOs targeted MSAs with high admission rates. In 1982 and in 1996, the MSAs with the lowest levels of HMO penetration had the highest average admission rates.

An alternative way to examine the data in Table 3 is to calculate rates of change in admission rates during certain time intervals. The number of hospital admissions per 1000 persons in all 298 MSAs declined from 164 in 1982 to 129 in 1996, a total decrease of 23% or 1.7% per year. The annual decline in admission rates between 1982 and 1996 in groups 1, 2, 3, and 4 was 1.8%, 1.5%, 1.5%, and 2.1%, respectively. Further analysis shows that most of the reduction in admission rates in all 4 groups occurred between 1982 and 1990. Between 1993 and 1996, a period of rapid growth in HMO penetration, the annual rate of decline in admission rates was 0.5%, 0.5%, 0.8%, and 1.7% in groups 1, 2, 3, and 4, respectively.

In all 4 years the ranking for the rate of inpatient days per 1000 persons was the same (Table 3). Group 2 had the most

Table 2. Demographic Characteristics*

Year	All MSAs	Group 1	Group 2	Group 3	Group 4	F Statistic	*P* Value
Average population size (in thousands)							
1982	604.6	340.4	920.0	1183.0	887.8	11.40	0.0001
1990	661.1	368.6	986.7	1314.0	997.4	12.15	0.0001
1993	686.1	384.9	1019.9	1356.9	1035.7	12.22	0.0001
1996	706.0	398.4	1046.7	1387.9	1065.0	12.26	0.0001
Percentage of population age 65 or older							
1980	12.0	11.8	12.0	11.6	12.9	2.02	0.11
1990	12.0	12.3	11.9	11.5	12.2	0.98	0.40
1993	12.2	12.5	12.0	11.8	12.3	0.76	0.51
1996	12.3	12.6	12.1	12.0	12.4	0.61	0.61
Percentage of high school graduates among adults age 25 and over†							
1980	68.8	66.0	68.5	69.8	72.8	17.04	0.0001
1990	77.0	75.4	77.1	76.9	79.5	8.40	0.0001
Per capita income (current dollars)							
1982	11,777	11,032	12,151	12,074	12,203	8.73	0.0001
1990	19,825	18,024	21,019	20,276	20,699	13.00	0.0001
1993	22,056	20,284	23,577	22,315	22,674	11.46	0.0001
1995‡	24,681	22,829	26,336	24,740	25,479	9.88	0.0001

MSA = metropolitan statistical area.
*Demographic and income information and historical data on the levels of managed care penetration into the MSAs were obtained from the 1997 update of the Area Resource File.[14]
The assumption was made that the level of in-and-out migration of hospitalized patients into the MSAs was minimal. For a small number of MSAs, this assumption may not be valid.
†Data are available for census years only.
‡Data for 1996 are not available.

inpatient days, followed by groups 1, 3, and 4. Although in 1982 there were no statistically significant differences between the groups in the number of inpatient days per 1000 persons, by 1990 a statistically significant difference was observed and continued in subsequent years. MSAs with high numbers of inpatient days per 1000 persons in 1982 did not appear to attract HMOs looking to reduce hospital utilization through effective management.

Hospital inpatient days per 1000 persons declined 43% (3.9% per year) in the period from 1982 to 1996 in all MSAs. Again, the rates of decline per year were relatively similar across the 4 groups, although they were slightly higher in the groups with higher HMO penetration: 3.7% in group 1, 3.7% in group 2, 3.9% in group 3, and 4.5% in group 4. Unlike admissions, the rate of decline in hospital inpatient days was fastest between 1993 and 1996. Between 1993 and 1996, the decline in number of inpatient days per 1000 persons per year averaged 5.5% overall: 5.3% in group 1, 5.6% in group 2, 4.9% in group 3, and 6.4% in group 4.

In 1982, there were no statistically significant differences in utilization rates for emergency room services across the 4 groups. Utilization increased in groups 1 and 2 between 1982 and 1996 and declined in groups 3 and 4. In 1982 utilization rates were essentially the same. By 1996, however, the rate in group 1 was 22.9% above the rate in group 4. Overall, the number of emergency room visits per 1000 persons increased 3.5% from 1982 to 1996. The increase occurred between 1982 and 1993. Between 1993 and 1996, the rate of emergency room utilization declined in all 4 groups, and the rate of decline was generally similar across all 4 groups.

Expenditures

Table 4 shows that there were statistically significant differences in hospital expenditures per capita across the 4 groups in all 4 years. These differences were for 2 indicators: total expenditures per capita and expenditures per adjusted inpatient day.

Hospital expenditures per capita increased from $567 in 1982 to $1330 in 1996: a 135% increase in nominal value. This translates to a 6.3% average annual increase in hospital expenditures per capita between 1982 and 1996. The average annual increase in groups 1, 2, 3, and 4 was 7.0%, 7.3%, 6.5%,

Table 3. Utilization Rates per 1000 Persons in MSA

Year	All MSAs	Group 1	Group 2	Group 3	Group 4	F Statistic	*P* Value
Hospital admission rates							
1982	164	178	167	160	157	3.38	0.0188
1990	135	144	139	134	128	2.95	0.033
1993	132	140	137	132	123	4.44	0.0046
1996	129	138	135	129	117	6.47	0.0003
Hospital inpatient days							
1982	1641	1636	1810	1614	1589	1.67	0.1747
1990	1216	1248	1352	1167	1141	3.10	0.0272
1993	1116	1142	1262	1080	1021	3.90	0.009
1996	942	971	1062	929	836	4.71	0.003
Emergency room visits							
1982	339	342	353	348	334	0.19	0.9045
1990	346	377	353	333	331	5.97	0.0006
1993	362	404	376	341	332	10.12	0.0001
1996	351	392	367	328	319	11.33	0.0001

MSA = metropolitan statistical area.

and 5.7%, respectively. Between 1993 and 1996, the annual rate of increase in hospital spending overall was 1.8%. The increases for groups 1, 2, 3, and 4 were 2.4%, 2.1%, 1.5%, and 0.6%, respectively.

Expenditures per adjusted inpatient day reflect both inpatient and outpatient expenditures and utilization, thereby capturing changes in the use of inpatient versus outpatient services. Expenditures per adjusted inpatient day increased 240% from 1982 to 1996 (9.1% per year). The respective annualized increases in expenditures per day in groups 1, 2, 3, and 4 were 9.5%, 9.2%, 8.7%, and 8.9%.

··· SENSITIVITY ANALYSIS ···

One possible criticism of this methodology is that the MSA groupings are based on 1996 penetration rates. To determine whether the results were sensitive to when the groupings of MSAs were done, we grouped the MSAs using 1993 penetration data. Before 1993, Interstudy assigned the entire HMO population to the MSA where the HMO was headquartered, rather than assigning HMO membership to MSAs based on where the person lived. For a few MSAs such as Oakland, California (headquarters of Kaiser Permanente of Northern California), this could introduce bias into the results. In 1993, Interstudy began asking the HMOs to assign their enrollment by county.

In 1993, 202 MSAs had HMO penetration values assigned based on where the person lived. The remaining 126 MSAs could not be grouped because no data on HMO penetration levels were available. Most of the missing MSAs were in group 1. When we used the 1993 groupings instead of the 1996 groupings, the empirical results were similar (data not presented).

To determine whether the results were sensitive to the particular classification system chosen, 3 alternative grouping algorithms were developed. The first used cluster analysis to group the MSAs into 4 categories.* The second used linear discriminant analysis to classify the MSAs.† The third used a combination of penetration and concentration to group the MSAs. (A number of researchers have suggested that concentration levels are an important factor to consider in grouping MSAs in addition to penetration rates, especially at high levels of managed care penetration.) Our fourth classification used only penetration to classify MSAs at low levels (≤30%). At higher penetration rates (>30%), MSAs were further classified by their level of market concentration, as measured by the absolute number of HMOs.

The precise grouping algorithms are available from the authors. The empirical results (data not presented) suggest that generally the results do not depend on the grouping algorithm. Although the absolute numbers change, essentially the same conclusions can be drawn with all 4 grouping methods.

There were, however, some differences that should be noted. Group 4 did not always have the lowest rate of hospital admissions. In discriminant analysis, group 4 was 2% above the average in 1982 and below average in subsequent years. In the classification created by combining penetration and concentration measures, the admission rate in group 4 (high penetration and greater concentration) was consistently above average in each time period. A similar set of results was obtained for inpatient days. No pattern for emergency room visits was shown by the cluster analysis grouping. Discriminant analysis showed that group 2 had lower hospital expenditures per capita than the other groups. Finally, the method combining penetration and concentration did not show that expenditures per day were higher in group 4 compared with group 1. In summary, however, there was agreement in at least 2 out of 3 grouping methods with the results presented here. For most of the results, there was agreement in the ranking among all 4 grouping methods.

Multiple factors in addition to HMO penetration can influence hospital expenditures and utilization. For

*Cluster analysis is a technique used to find "natural" groupings within a data set that are defined by similarities within the values of the parameters, rather than by a priori criteria. This procedure uses unweighted, average distances to sort data into clusters. The clustering process is agglomerative; each observation begins in a cluster by itself, and clusters that are close together are merged to form a new cluster. Thus, the observations are grouped according to their relative distance from each other using all the variables included in the analysis.

†Discriminant analysis is used to classify observations into 2 or more known groups on the basis of 1 or more quantitative variables. In the case of linear discriminant analysis, a parametric method based on generalized squared distance is used to generate a discriminant function that is then applied to the observations. Linear discriminant analysis requires that a classification variable be known a priori. We used the rankings of MSAs according to managed care market maturity developed by the University HealthSystems Consortium (UHC, Chicago, IL) for this purpose because they represent the most intensive attempt to classify markets to date. A subset of the data containing those MSAs that had been classified by UHC was used to develop the discriminant function. That function was then used to evaluate and classify all of the MSAs, including those used to derive the discriminant function.

this reason, we conducted multivariate analyses. Unfortunately, data on penetration of HMOs is available only for 1993 and 1996 and only for a reduced set of MSAs (Table 5). A first-difference-equation model was used to control for any difference across markets. This allows the change in hospital capacity to be a function of initial market characteristics as well as a function of the changes that occurred over the period. According to previous models,[8,12,13] utilization and expenditures are a function of the following variables: HMO penetration rates, HMO penetration rates squared, number of HMOs, percentage of the population age 65 years or older, population density, number of teaching hospitals, Medicare hospital wage index, per capita income, number of physicians per 1000 persons, and unemployment rate. The model was run using the 1993 values and the rate of change for 1993 to 1996 (Table 6). The change in HMO penetration had no statistically significant effect on the change in hospital admissions, emergency room visits, expenditures per capita, and expenditures per adjusted inpatient day. The HMO penetration had a statistically significant impact only on inpatient days. Few of the other independent variables showed a statis-

Table 4. Hospital Expenditures

Year	Overall	Group 1	Group 2	Group 3	Group 4	F Statistic	*P* Value
Total expenditures per capita (current dollars)							
1982	567	512	615	621	590	5.61	0.001
1990	999	958	1094	1031	992	3.00	0.0308
1993	1262	1234	1397	1289	1215	3.85	0.01
1996	1330	1325	1487	1346	1238	5.23	0.0016
Expenditures per adjusted inpatient day (current dollars)*							
1982	307	280	302	340	327	9.30	0.0001
1990	670	626	670	718	700	6.06	0.0005
1993	875	831	870	932	904	4.11	0.007
1996	1043	994	1042	1094	1084	3.65	0.013

* Adjusted inpatient day reflects "the number of days of inpatient care, plus an estimate of the volume of outpatient services, expressed in units equivalent to an inpatient day in terms of level of effort."[4(pxvi)]

Table 5. Rates of Change in Hospital Utilization and Expenditures With 1993 Groupings

Year Range	Percent Change				
	Overall MSAs	Group 1	Group 2	Group 3	Group 4
Hospital admission rates					
1993-1996	-3.0	-6.3	-4.9	1.6	-2.4
Hospital inpatient days					
1993-1996	-15.7	-26.3	-10.3	-6.9	-12.7
Emergency room visits					
1993-1996	-4.1	-7.6	-1.3	-8.4	1.2
Total expenditures per capita (current dollars)					
1993-1996	4.7	-6.6	13.0	11.5	5.5
Expenditures per adjusted inpatient day (current dollars)					
1993-1996	18.4	18.1	20.0	19.8	13.7

Table 6. Estimates of First Difference With Change as Dependent Variable (1993-1996)*

Variable	Hospital Admissions	Inpatient Days	Emergency Room Visits	Expenditures per Capita Adjusted	Expenditures per Inpatient Day
Change HMO share	-0.0598 (-0.437)	-1.6322 (-0.769)	1.2966 (1.322)	-2.4686 (-1.394)	0.1306 (0.096)
HMO share	0.2436 (1.023)	0.3506 (0.095)	-0.9403 (-0.551)	5.1846 (1.597)	-2.1927 (-0.925)
Change, HMO share squared	-0.0006 (-0.149)	0.0087 (0.129)	-0.0263 (-0.842)	0.0218 (0.366)	-0.0032 (-0.075)
HMO penetration squared	-0.0050 (-1.052)	-0.0114 (-0.154)	0.0257 (0.752)	-0.0918 (-1.413)	0.0358 (0.757)
Change in Number of HMOs	-0.2513 (-0.644)	-1.5334 (-0.253)	3.8661 (1.382)	-0.5574 (-0.105)	0.1737 (0.045)
Number of HMOs	-0.3371 (-0.787)	1.4359 (0.216)	3.2197 (1.0490)	-9.6269 (-1.649)	-9.6626 (-2.267)†
Change in the population age 65 or older	-1.4730 (-0.433)	4.7329 (0.102)	-15.747 (-0.646)	20.3111 (0.438)	53.6860 (1.587)
Population age 65 or older	0.2539 (0.735)	-5.8615 (-1.092)	-4.1404 (-1.672)	3.5186 (0.747)	4.8548 (1.457)
Change, no medical school	-0.0054 (-0.009)	-0.8578 (-0.092)	-1.1620 (-0.269)	-1.6391 (-0.199)	-6.4512 (-1.074)
No medical school	0.206 (0.568)	-1.3047 (-0.232)	1.3612 (0.522)	5.5403 (1.118)	5.3365 (1.475)
Change, wage index	-8.558 (-0.403)	2.575 (0.008)	-25.570 (-0.168)	61.411 (0.212)	536.30† (2.540)
Wage index	4.0970 (0.321)	257.128 (1.300)	-1.7738 (-0.019)	10.408 (0.060)	143.44 (1.130)
Change, per capita income	0.0004 (0.233)	-0.0118 (-0.439)	0.0068 (0.547)	-0.0248 (-1.050)	-0.0141 (-0.818)
Per capita income	-0.0008 (-1.592)	-0.0144 (-1.801)	0.0014 (0.371)	-0.0079 (-1.119)	0.0062 (1.207)
Change, population density	-4.3923 (-0.330)	36.9520 (0.179)	-116.783 (-1.222)	-120.056 (-0.661)	300.88† (1.269)
Population density	0.0379 (0.117)	-2.2916 (-0.455)	1.9431 (0.835)	4.2156 (0.953)	-2.7736 (-0.859)
Change, no physician	14.838 (1.799)	-72.784 (-0.569)	33.114 (0.560)	112.4923 (1.102)	27.774 (0.338)
No physician	0.0109 (0.014)	-9.824 (-0.805)	-27.882† (-4.931)	22.9002† (2.130)	-7.8195 (-0.996)
Change, unemployment	-1.4768 (-1.332)	-23.8322 (-1.389)	-4.0972 (-0.515)	-20.7244 (-1.371)	6.3101 (0.572)
Unemployment	0.5436 (0.984)	-0.9919 (-0.116)	-5.5611 (-1.404)	-3.8821 (-0.515)	-4.0171 (-0.730)
Change, population	0.0242 (0.802)	0.2084 (0.445)	-0.0819 (-0.378)	0.8425 (0.205)	-0.4694 (-1.561)
Population	0.0006 (-0.280)	0.0082 (0.235)	-0.0145 (-0.887)	-0.0287 (-0.925)	-0.4694 (-0.074)
Constant	-2.174 (-0.185)	-2.427 (-0.013)	65.711 (0.781)	196.077 (1.225)	-90.01 (-0.770)
R^2	0.11	0.12	0.20	0.19	0.14

*T statistics are in parentheses.
†Value is significant at the 5% level.

tically significant association with changes in hospital capacity.

Analysis with a 2-stage least-squares model also was performed to estimate the effect of HMO penetration on hospital utilization and expenditure.[9,16,17] The instrumental variable is unemployment rate. The change in HMO penetration had no statistically significant effect on the change in hospital admissions, emergency room visits, expenditures per capita, and expenditures per adjusted inpatient day. The HMO penetration had a statistically significant impact only on the number of inpatient days per capita. Few of the other independent variables showed a statistically significant association with changes in hospital utilization and expenditures.

Because the results differed from those of previous studies, we wondered whether differences in the sample could explain the differences in results. We analyzed two subsets of MSAs discussed in Gaskin and Hadley[5] and Robinson.[6] The results are summarized in Tables 7 and 8. Table 7 shows there are significant differences in the allocation of MSAs across the 4 groups in both the Gaskin and Hadley and the Robinson data. Table 8 presents the total expenditures per capita, which show much greater differences among the 4 groups. The expenditure patterns show a much stronger relationship between managed care and hospital expenditures in both of these samples. Perhaps the smaller samples in the other studies could partially explain the differences in empirical results.

···DISCUSSION ···

In contrast to most recent studies, which have found that HMO penetration has a significant impact on hospital expenditures and hospital utilization, the data presented here suggest that, at the MSA level, the rates of change in hospital utilization and hospital expenditures vary only modestly with the level of HMO penetration. Changes in hospital admission rates did not vary systematically with HMO penetration rates except in the 1993 to 1996 period, when the decline was slightly more rapid in group 4. Most of the growth in HMOs has occurred in MSAs that had low admission and utilization rates in 1982. This is contrary to a widely held belief that HMOs targeted areas with high utilization rates.

Reductions in hospital days per capita and increases in hospital expenditures did not vary systematically by level of HMO penetration. Emergency room days declined most rapidly in groups 3 and 4 in the 1982 to 1993 period and were similar in the 1993 to 1996 period. Hospital expenditures per capita showed the greatest association with managed care penetration. They increased somewhat more slowly in areas with greater HMO penetration. Over the period from 1982 to 1996, expenditures per capita increased at an average annual rate of 7.0% in group 1, 6.5% in group 2, 5.7% in group 3, and 5.4% in group 4. The difference between group 1 and group 4 was 1.6% per year.

The article by McLaughlin, which presented similar results based on data for 25 standard MSAs from 1972 to 1982, generated a methodological debate concerning her ability to control for simultaneity, selection bias, and model bias specification.[12] Although we agree with the concern, we do not see empirical evidence that HMO penetration is endogenous. In 1982, group 4 (the group with the highest HMO penetration at the time) had low utilization rates. HMO penetration continued to increase in these areas in spite of low (not high) utilization. This would suggest that selection and simultaneity bias is not an issue. Zellner and Wolfe[18] criticized McLaughlin for not considering nonlinearities that may occur between prepaid group practices and hospital expenditures per capita as well as the interaction between prepaid group practices and other independent variables. This is a valid argument if one is attempting to measure the spillover impact. However, in this analysis we are trying to examine the total effect and not the spillover effect. In the multivariate analysis, we considered many of the independent variables that have been proposed in other models and found that most of them are statistically insignificant.

Table 7. Comparison of MSA Groupings

Group	This Paper (298 MSAs)	Robinson[6] (22 MSAs)	Gaskin and Hadley[5] (84 MSAs)
1	174	5	21
2	54	5	28
3	31	9	17
4	39	3	18

MSA = metropolitan statistical area.

This study differs from earlier studies that have examined the impact of HMOs on hospital expenditure and utilization in a number of ways. First, this analysis included 298 MSAs, whereas other studies have examined only the largest MSAs or only MSAs in California. When we analyzed only their samples of MSAs, we found results similar to those in their studies. The results presented here may be more generalizable, given that they include all US MSAs.

Many recent studies have used the hospital and not the market as the unit of analysis. Thus, they examined the effect of a market-level variable, penetration, on an individual hospital, whereas this study examined the effect of penetration on hospital utilization and expenditures at the market level. This could partially explain the difference in results. Second, other studies used cost-function approaches, which include many independent variables in the analysis (eg, admissions, length of stay, number of beds per adjusted admission, wage rates). Including these variables in the equation assumes that there is no independent effect of HMO penetration on these variables. However, it is precisely through some of these variables, such as admissions and length of stay, that managed care organizations influence expenditures and utilization. By looking at overall changes in variables, we measured the total effect, rather than the partial effect, of higher levels of penetration. Finally, it is noteworthy that in this analysis, the level of HMO enrollment in itself was not a significant predictor of expenditures, whereas the change in the percentage of enrollment was.

Table 8. Expenditures per Capita in MSA Groupings

Year	Group 1	Group 2	Group 3	Group 4
Total expenditures per capita (current dollars, California)*				
1982	369	364	642	562
1990	711	575	934	865
1993	870	817	1134	1030
1996	932	850	1158	1024
1993-1996 (%)	7.1	3.9	2.1	-0.58
1990-1996 (%)	31.08	47.8	23.98	18.38
1982-1996 (%)	152	133	80.3	82
Total expenditures per capita (current dollars)†				
1982	525	625	634	599
1990	941	1121	1036	995
1993	1190	1428	1296	1221
1996	1238	1517	1334	1238
1993-1996 (%)	4.0	6.2	2.9	1.4
1990-1996 (%)	31.5	35.3	28.7	24.4
1982-1996 (%)	135.8	142.7	110.4	106.6

MSA = metropolitan statistical area.
*Data are from Robinson.[6]
†Data are from Gaskin and Hadley.[5]

Our focus is on a simple question: over the long run, are HMOs having any impact on total hospital expenditures in an MSA? Individual insurers are interested in spillover effects; however, with most people now insured by managed care organizations, this is a less important issue. Our results suggested that HMOs had both a direct and indirect effect on hospital utilization and expenditures. The direct effect was seen in markets with high HMO penetration. The indirect effect came from the anticipation of HMOs entering the market. Surveys of individual MSAs conducted at the Center for Studying Health System Change[19] suggest that hospital managers in MSAs with low HMO penetration anticipate that changes will occur even before the market forces them to change.

The results presented here should be evaluated with caution. First, they are based on bivariate analysis and partially verified by multivariate analysis. We are testing the hypothesis that managed care will have a large impact on hospital expenditures and utiliza-

tion at the local level. In Table 2, we show 4 factors that could influence hospital expenditures and utilization: total population, education levels, percentage of the population age 65 years or older, and per capita income. These changed at similar rates during this time period in all 4 groups. However, the average population size of the MSAs in group 1 was consistently smaller, the residents of group 1 were less educated, and the per capita income in group 1 was consistently lower. The age distribution of the population did not vary across the groups.

A second possible reason for caution is the grouping methodology. The methodology presented here is based on only 1 dimension: HMO penetration. Although it is possible that different results could be obtained from alternative grouping algorithms, we used different combinations of HMO penetration rate, number of HMOs, and a market index that equals 1 minus the sum of squared market shares. We also tried different methodologies such as cluster analysis and linear discriminate analysis. We combined penetration and concentration measures in the same analysis. All of these methodologies produced similar results.

A third reason for caution is that the HMO penetration occurred at different rates in different MSAs. The MSAs were grouped based on HMO penetration rates in June 1996. Although it is certainly possible that because managed care diffuses at different rates that could confound the analysis, the overall results presented in Table 1 suggest that the average MSA in group 4 began with a higher level of HMO penetration in 1982 and had higher rates of penetration in each subsequent year. On the other hand, MSAs classified into group 1 had consistently lower levels of HMO penetration in all 4 years. A cumulative effect of high HMO penetration rates was hypothesized based on the literature.[5-10] When we grouped a subset of the MSAs using 1993 instead of 1996 data and examined the rates of change between 1993 and 1996, the results were generally similar.

···CONCLUSION ···

A recent literature review by Miller and Luft concluded that "market-level studies showed that higher HMO market penetration reduced hospital resource use in the market as a whole."[3] National studies first using data from 1972 to 1982[12] and now repeated using data from 1982 to 1996 suggest HMO penetration has only a small effect (generally less than 1% per year) on hospital expenditure and utilization at the market level.

One hypothesis that cannot be tested with this data is that managed care is having a national effect on hospitals. In other words, hospitals in all geographic areas are responding simultaneously to the incentives created by managed care. Perhaps hospital managers in all MSAs are reading the same journals and magazines, attending the same conferences, and making the same preparations. In this case, the managed care plans may be having an overall impact on the hospital sector, but it is not based on what is happening in the local market. If this is the case, then the anticipation of managed care is having more of an impact on hospital managers than its actual arrival in the local area. Based on the available data, we cannot accept or reject this hypothesis.

A policy implication of these results is that studies that have based national or local projections of utilization and expenditures on the most advanced managed care markets should reevaluate the assumption that all MSAs will emulate the expenditure and utilization patterns of these MSAs. The data presented here suggests that long-established differences across MSAs will persist.

··· REFERENCES ···

1. InterStudy Publications. *The InterStudy Competitive Edge 7.1, Part III: Regional Market Analysis.* Minneapolis, MN: InterStudy; 1997.
2. Levit KR, Lazenby HC, Braden BR, and the National Health Accounts Team. National health spending trends. *Health Aff* 1997;16(5):35-51.
3. Miller RH, Luft HS. Does managed care lead to better or worse quality of care? *Health Aff* 1997;16(5):7-25.
4. American Hospital Association. *1996/97 Hospital Statistics.* Chicago, IL: AHA; 1996.
5. Gaskin DJ, Hadley J. The impact of HMO penetration on the rate of hospital cost inflation, 1985-1993. *Inquiry* 1997;34:205-216.
6. Robinson JC. Decline in hospital utilization and cost inflation under managed care in California. *JAMA* 1996;276:1060-1064.
7. Robinson JC. HMO market penetration and hospital cost inflation in California. *JAMA* 1991;266:2719-2723.
8. Chernew M. The impact of non-IPA HMOs on the number of hospitals and hospital capacity. *Inquiry* 1995;32:143-154.
9. Baker LC. The effect of HMOs on fee-for-service health care expenditures: Evidence from Medicare. *J Health Econ* 1997;16:453-481.
10. Dunn D. Health care 1999: A national bellwether. *J Health Care Finance* 1996;22(3):23-27.
11. Ginzberg E. Hospitals: From center to periphery. *Inquiry* 1995;32:11-13.

12. McLaughlin CG. The effect of HMOs on overall hospital expenses: Is anything left after correcting for simultaneity and selectivity? *Health Serv Res* 1988;23(3):421-441.
13. Hill SC, Wolfe BL. Testing the HMO competitive strategy: An analysis of its impact on medical care resources. *J Health Econ* 1997;16:261-286.
14. *The Bureau of Health Professions.* [book on CD-ROM]. Fairfax, VA: Quality Resources, Inc.; 1998.
15. Metropolitan areas [US Census Bureau Web site]. Available at: http//www.census.gove/population/www/estimates/metrodef.html. Accessed May 9, 1998.
16. Simon CJ, Dranove D, White MD. The effect of managed care on the incomes of primary care and specialty physicians. *Health Serv Res* 1998;33(3):549-569.
17. Dranove D, Simon CJ, White WD. Determinants of managed care penetration. *J Health Econ* 1998;17:729-745.
18. Zellner B, Wolfe B. HMO growth and hospital expenses: A correction. *Health Serv Res* 1988;23(3):409-413.
19. Kohn LT, Kemper P, Baxter RJ, et al, eds. *Health System Change in Twelve Communities.* Washington, DC: Center for Studying Health System Change; 1997.