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ABSTRACT

Although competition among health plans has been encouraged as a means to control health care expenditures, some fee-for-service (FFS) insurers attribute part of their increased average expenditures to favorable selection of low users into newly offered health maintenance organization (HMO) plans. To test this hypothesis, the health care expenditure patterns of approximately 30,000 employees in a large, multi-site aerospace firm were examined. FFS system expenditure patterns for people who joined HMOs were compared with those of people who remained in the FFS system. Information on socioeconomic status, plan choice, employee dependents, and filed claims were reviewed. The unit of observation was a family year of claimed expenditures. Expenditure data for families that switched between FFS and HMO plans between 1978 and 1982 were classified into four groups: (1) one year preHMO; (2) other years preHMO; (3) one year postHMO; and (4) other years postHMO. For families remaining in FFS plans, all years of data were "stayer" years. Family year expenditures were compared across these five groups. The results revealed that families selecting HMOs had lower mean expenditures than did families who remained in the FFS system. Families who left HMOs had higher mean expenditures than did those who entered HMOs. Some, but not all, of these differences were explained by family characteristics. (NB)

Fee-for-Service Health Care Expenditures

Evidence of Selection Effects Among Subscribers Who Choose HMOs

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PREFACE

This report compares health care utilization patterns in the fee-for-service sector for families that elect health maintenance organization (HMO) options and those that do not. For some families, the comparison covers periods before they enter the HMO; for other families, it covers periods after they leave it. The work was prepared for the Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services. It was undertaken as part of the nonexperimental portion of the Rand Health Insurance Experiment, which was designed to investigate the effects of alternative health insurance plans on the utilization of health services and on health status.

A shorter version of this report appeared in *Medical Care*, Vol. 24, No. 1, in January 1986.

SUMMARY

The Reagan administration encourages competition among health plans as a mechanism to control health care expenditures. If enhanced competition fosters greater efficiency in the delivery of health services, cost containment can be achieved. As part of this cost containment effort, the federal government promotes the development of health maintenance organizations (HMOs). HMOs, typically, have lower hospitalization rates and better incentives for cost control. HMO critics argue that the lower observed use results because many people who prefer HMOs are less sickly and historically lower utilizers of health care services. Some fee-for-service (FFS) insurers attribute at least part of their increased average expenditures to favorable selection of low users into newly offered HMO plans.

To test this hypothesis we looked at the health care expenditure patterns of approximately 30,000 employees in a large, multi-site aerospace firm. We compared FFS system expenditure patterns for people who joined HMOs with those of the people who remained in the FFS system. The firm supplied socioeconomic and plan choice information on each employee from their payroll system. Information on employee dependents came from the insurance plan eligibility files. Filed claims, from the insurance plan's claims payment system, became the source of our expenditure data. These data spanned the years 1978 through 1982.

Because insurance plans typically set their rates by the geographic area served and the type of insurance coverage selected (employee only, employee and one dependent, employee and two or more dependents), our first analyses controlled only for these factors. Later analyses controlled for other observable characteristics such as the family composition (the age and sex of each family member), income, and ethnic background.

Our unit of observation was a family year of claimed expenditures. For families that switched between HMO and FFS plans between 1978 and 1982, we classified their expenditure data into four groups. When we observed expenditure data before the family entered the HMO, we

classified these years as "preHMO" years if the year immediately preceded entry into the HMO and as "other preHMO" years for earlier years. Expenditures for the first year following HMO disenrollment were labeled "postHMO" years; subsequent years are referred to as "other postHMO" years. For families remaining in the FFS system, all family years of data are referred to as "stayer" years. We compared family year expenditures across these five groups.

We used a variety of models and techniques to test our hypotheses, drawing on other research conducted as part of Rand's Health Insurance Experiment. We compare analysis of variance (ANOVA) and analysis of covariance (ANOCOVA) models with a two part expenditure model because each approach has limitations that are partly compensated for in the other model. The first part of the two part model measures the proportion of families with positive expenditures, and the second component is the natural logarithm of truncated family expenditures for families with positive expenditures. All of our expenditure variables are truncated at $5000, the top 3-1/2 percent of the distribution. To explore the effect of this truncation, we also model the likelihood that the family's filed claims will exceed this level. Our results were consistent across model specifications.

We found that families selecting HMOs had lower mean expenditures than families who remained in the FFS system. These expenditures were even lower in the year immediately preceding the switch in health plans, which suggests that families may withhold use in anticipation of changing plans. The families who leave the HMOs have higher mean expenditures than those who entered. Some, but not all, of these differences are explained by family characteristics.

ACKNOWLEDGMENTS

Many individuals were instrumental in helping us complete this work. The management consulting firm of Towers, Perrin, Forster, and Crosby (TPFC) provided some of the data and generously shared with us its understanding of the definitions and limitations of the data. At Rand, Daniel Relles provided guidance on the file-structuring tasks along with his STATLIB software, which made the process financially feasible. Sally Trude, our programmer, executed the file design. Willard Manning, M. Susan Marquis, Arleen Leibowitz, and Emmett Keeler commented on our preliminary drafts. Albert P. Williams and Joseph Newhouse established the project and the contacts with institutions and people that made this work possible.

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I. INTRODUCTION

The health maintenance organization (HMO) has been promoted as a more efficient method of rendering health services than the fee-for-service (FFS) system. Recent federal legislation encourages the development of HMOs and mandates the availability of a "dual choice" to employees of large companies. The federal government hopes to control rising health care costs with its strategy of encouraging competition among health plans. Theorists have pointed out, however, that competition among insurance plans may not achieve the desired ends if plans (such as HMOs) lower costs by attracting healthier clients instead of being more efficient. In this report, we study whether a dual choice environment fosters the segregation of high expenditure families into HMO or FFS plans.

Early research on prepaid group practices led to speculation that those who selected prepaid medical care might be sicker and thus have higher health care costs than those who chose FFS plans. However, the empirical evidence has not been clearcut, and it has become weakened as the HMO model has expanded to include various financial arrangements with physicians and institutional providers of care. Some FFS insurance plans that are in direct competition with HMOs for a particular group of subscribers have even suggested that part of their rising costs are due to the adverse selection of those with higher medical costs into the FFS plans. Part of the impetus for this study came from just such speculation by a large aerospace corporation that underwrites its own FFS insurance plan.

Luft (1981) reviewed the literature on selection between HMO and FFS plans. He identified three major determinants of selection: the premium differential, the types of options available, and the selecting family's degree of integration into their current medical system. Families with strong ties are unlikely to change their delivery system; older or more sickly families are more likely to have developed such ties. The introduction of a new HMO option may therefore result in short-run adverse selection into the FFS plan. As the HMO plans and

their clients age, more families will develop ties within the HMO, which may reduce or even reverse the selection effect.

We analyzed the health plan selection history of approximately 30,000 employees of a large aerospace corporation. Our data show that families selecting HMOs were younger and had less time on the job, consistent with a lower integration into the medical care system. Premiums were usually higher for the HMO. However, premium differentials, which never exceeded $130 per year, did not appear to be a major determinant of plan choice. Employees selecting coverage only for themselves had to pay the largest differential to select the HMO, and this group appears to have a higher rate of switching into the HMO than those selecting family coverage.

We also examined the total medical claims filed by the employees and their families while they were enrolled in the FFS plan. Services that are not covered in the FFS plan may not appear in the claims data, so we do not know the true health care costs in the FFS sector, only the costs of services for which claims were filed. Despite this limitation, the HMOs did indeed attract families with lower annual claimed expenditures, and these families' claimed expenses were lower still in the year immediately before they switched into the HMO. Lower costs among families switching into the HMOs are partly explained by their composition compared with that of the families who stayed in the FFS plan. However, the selection pattern persisted even after we adjusted for the size of the family, the age and sex of family members, and such other family characteristics as race and income. These HMO-bound families had the same fraction of their claims paid by the insurer as loyal FFS families, suggesting that both out-of-pocket expenditures and the cost to the insurer were lower for the HMO-bound families. Families switching out of HMOs had higher total annual claims during their first year back in the FFS sector than families about to switch into HMOs. However, recent HMO leavers did not always differ from families who had never left the FFS plan.

Section II describes our model of family health plan choice. A brief review of the relevant literature appears here. We then present the plans offered by the firm. The firm has two main locations, California and Arizona. Differences between the HMOs in the two areas

are discussed. We describe the data provided by the corporation and how it was merged. The sampling scheme used to obtain exploratory files and working analytic files is discussed. In Sec. V we describe our methods of analysis, including a definition of the groups to be analyzed and the dependent and independent variables used. The first set of analyses adjusts only for factors typically used by insurance companies and plans to set rates--that is, the geographic area they serve and the number of dependents covered in the family unit. Subsequent analyses adjust for actual family composition--that is, the age and sex of each family member and other socioeconomic characteristics such as income and race. In Sec. VI we present our results. Section VII contains our conclusions and a brief discussion of the results.

II. A MODEL OF FAMILY HEALTH PLAN CHOICE

A major concern in the literature on family choice of health plan is whether there is "adverse selection." When families can choose between an HMO and a FFS plan, one type of plan may be consistently more attractive to sicker, higher utilizing families. If so, the "adversely selected" plan may have higher costs because of the greater health needs of its subscribers. Premium costs in this plan will tend to rise, making that type of plan even less attractive to healthier subscribers.

Luft (1981) reviewed the literature on selection between HMO and FFS plans and found that selection is based on risk and utilization. However, he also found that predicting the direction of the selection effect is difficult. He identified three major determinants of selection: premium differential, benefits available, and the family's degree of integration into their current system.

Manning et al. (1984) report on the purest test of selection effects in the literature. They show some differences in socio-demographic characteristics, initial health, and previous use of health services between families selecting the HMO and those experimentally assigned to plans; their findings suggest adverse selection into the HMO. Their study found significant cost savings when HMO members' utilization is contrasted to utilization in the fee-for-service system.

The hypothesis that families with strong ties to physicians are less likely to change delivery systems is supported by several studies: Gaus (1971); Roughman et al. (1975); Juba, Lave, and Shaddy (1980); and Tessler and Mechanic (1975). Scitovsky, McCall, and Benham (1978) found that those with longer tenure in a given plan are less likely to leave the plan. Mechanic, Weiss, and Cleary (1983) and Wersinger and Sorenson (1982) found that families leaving HMOs were less integrated into the HMO as evidenced by lower utilization in the year before leaving and lower likelihood of being able to identify one physician as the usual source of care.

The literature on selection between HMO and FFS health plans suggests that two sets of factors are important in influencing family health plan choice:

1. Economic factors, determining the family's financial vulnerability;
2. Social factors, determining the family's integration into an existing medical care delivery system.

Economic considerations are undoubtedly critical for many families. The expected costs of a plan are determined by the cost of the premium, the cost-sharing provisions of the policy, the set of medical services covered, and the family's expected health needs. Family size and the age, gender, and health status of each family member influence expected health needs. See Newhouse et al. (1982).

Usually the premium for an HMO plan is higher than the premium for a fee-for-service insurance plan. However, the HMO has less cost sharing and covers more services. Because copayments are minimal in an HMO, total expenditures do not vary much with utilization. In FFS plans, high utilizers may have substantially higher out-of-pocket costs than low utilizers. On financial grounds, then, families with higher expected expenditures might prefer the HMO, where their net out-of-pocket expenses ought to be lower. In families with few or no expected expenditures (young single adults, for example), the premium costs should represent most of their health expenditures, and they may tend to prefer the FFS plan with its lower premium.

A family's integration into an existing medical care delivery system is also an important determinant of their willingness to switch plans. Integration refers to the family's knowledge about how the delivery system works, where to get different kinds of care, and the personal relationships they develop with providers of care. The degree of integration usually grows through time. The integration factor increases loyalty to a family's current health plan. HMOs are fairly new in many communities, so the current health plan is, more often than not, a fee-for-service plan. A decision to change plans involves the

fixed (mostly nonmonetary) costs involved in integrating into the new system.

Based on the integration factor, low risk rather than high risk families may be expected to select HMO plans. Families with poor health and more past utilization will be more integrated into their existing system (usually the FFS system). Young families, families new to an area, and healthy families with little knowledge or experience with the local medical care delivery system may prefer HMOs with their easily identified point of entry into a fairly complete set of medical services.

The effect of the integration factor on health plan selection may be expected to change as HMO plans mature. Communities with established HMOs may have better information about the advantages and disadvantages of the plans. Further, as any particular plan ages, it develops a base of loyal, well-integrated subscribers.

We assume that a family selects the health plan with the combination of economic and social characteristics that maximizes its welfare. A family's plan preferences will depend on family characteristics and its utility function. Young people selecting a health plan for the first time, or those new to a community, may view the choices differently from those who are considering switching plans. In this study, we are interested in learning whether families selecting an HMO option after enrolling in a FFS plan tend to be high risk, high utilizing families or low risk, low utilizing families.

III. THE CORPORATION AND THE PLANS

The corporation providing the data for this study is a large, multi-site aerospace firm. The sites with the most employees are in California and Arizona, near large urban centers. At these two sites the employees are offered a choice between a fee-for-service health insurance plan underwritten by the corporation and HMO plans. Employees are free to select either plan when they are hired and are able to change plans once a year during an open enrollment period.

The fee-for-service plan includes a schedule of basic benefits and a major medical component. The basic benefit package requires 10 percent coinsurance for nonphysician hospital fees. Surgeons' fees, physicians' fees, laboratory, and radiology are covered according to a fee schedule in the basic benefits, with the major medical coverage applying to fees in excess of the schedule. The major medical has an annual deductible of $100 per person, with a maximum of two deductibles per family. The coinsurance rate on the major medical component is 20 percent on all services except mental health services. The coinsurance rate for mental health is 60 percent, with a maximum coverage of $1000 per year. Well care visits are not covered, nor are the first two illness-related outpatient visits.

Four HMO plans are currently offered, two in California and two in Arizona. The first California HMO was offered in 1977, and the second was added in 1980. Both Arizona plans, group model HMOs, were first offered mid-year 1979. The Arizona plans were established in 1973 and are the only two HMOs in that region. In 1981 the total membership in each was still below 70,000. By 1982, 16 percent of the company's Arizona employees were enrolled in one of the HMO options.

The California plans are somewhat larger. The plan first offered in 1977, a network model,[1] was established in 1973 and had a total enrollment of 110,000 in 1981. A majority of the California-based

[1]A network model HMO is defined in the Interstudy National HMO Census as an HMO that contracts with two or more group practices to provide health services.

employees of the company who enrolled in an HMO selected this plan. The other California plan, originally established in 1966, changed ownership in 1980. Its membership in 1981 was 140,000, but enrollment from the corporation under study was limited. California's well established HMOs (for example Kaiser) were not among the plans offered by the company. By 1982, 26 percent of the company's California employees had enrolled in HMOs.

Table 1 presents the premium differentials between the HMO and fee-for-service plans. In California, the surcharge for Plan A (with the largest corporate enrollment) has declined from just over $100 per year to about $50 year. (These figures are not adjusted for inflation.) The differential was consistently higher for those selecting "employee only"

Table 1

DIFFERENCE BETWEEN ANNUAL EMPLOYEE CONTRIBUTION TO HMO AND FFS PREMIUM

(Positive differences indicate that the HMO premium was higher)

Year	Dependents Covered	California		Arizona	
		HMO A	HMO B	HMO C	HMO D
1977	0	$128			
	1	119			
	2+	112			
1978	0	62			
	1	52			
	2+	45			
1979	0	63		$ 23	$ 42
	1	52		-49	- 9
	2+	45		-49	- 9
1980	0	48	50	91	93
	1	14	6	114	104
	2+	3	7	114	104
1981	0	61	55	104	46
	1	49	16	102	-47
	2+	15	17	102	-47

coverage than for those covering one or more dependents. In California, Plan B has essentially the same rate structure as Plan A.

The Arizona plans have had a more volatile premium history, ranging from $50 less to $100 more expensive than the FFS plan. Except in 1980, "employee only" coverage was more expensive than family coverage.

IV. THE DATA SET

The corporation agreed to provide data on all employees' health plan enrollment history from 1977 to 1982, as well as insurance claims filed by all those enrolled in the fee-for-service plan from 1978 to 1981. We were not able to obtain data on utilization for those enrolled in the HMOs.

DATA SOURCES

Our data come from two separate data processing systems within the corporation, the payroll system and the health plan claims payment system. The payroll data provided annual "snapshots" of all employees, including the health plan in which the employee was enrolled, the type of coverage (employee only, employee and one dependent, or employee and two or more dependents), the employee's hire date and birthdate, monthly wages, ethnic background, whether the employment was hourly or salaried, a job classification code, and an identifier to link into the health plan claims system.

The health claims payment system had two main components, eligibility files and claims transaction files. Separate eligibility files, one for employees and one for their dependents, were maintained. In addition, separate eligibility and claims files were maintained in California and Arizona. The employee and dependent eligibility files contained enrollment and termination dates, birthdate, sex, and an indication of whether other insurance was present.

The claims transaction data covered the period between 1978 and 1981. Because this system was designed for financial management, data on the dollar amount of claims filed and paid are reliable. Other data within the transaction files, such as the codes for types of service, are not always accurate, especially when another FFS plan was the primary insurer. General categories are sometimes substituted for details on the type of services. This occurs frequently for dependents with other insurance coverage. Consequently, inpatient services are not clearly differentiated from outpatient services. As a result we chose to concentrate on the total claims filed.

MERGING AND CLEANING THE FILES[1]

The first step was to exclude from the payroll file retirees and employees residing in parts of the country where HMOs were not offered. The annual open enrollment period was in January, so we chose the calendar year as the time unit. Our payroll snapshots corresponded to year-end 1977, year-end 1978, March 1980, March 1981, and March 1982. Employees hired after the snapshot date did not have records for their hire year. We therefore had to reconstruct annual files and enrollment histories, based on the next year's data with deflated wage variables and reconstructed health plan enrollment histories. Duplicate records appeared when employees transferred, and these were eliminated.

The augmented annual payroll files were merged with the employee and dependent eligibility files to define the set of households to be included each year in a master eligibility file. Dependents were given family level data from the employee's payroll record for that year. If no payroll record was present from the augmented payroll file (as would be the case for retirees), the eligibility record, employee or dependent, was eliminated.

The health insurance claims were aggregated into annual expenditures for each individual and appended to the master eligibility file. This individual level file was then processed over all family members to construct family level variables, such as family size and total family expenditures.

Data on health plan enrollment and the type of insurance coverage (employee only, employee and one dependent, employee and two or more dependents) from the payroll file did not always agree with data from the health plan eligibility files. Some differences arose because the payroll data referenced particular points in time whereas the eligibility files reflected births, deaths, and other changes throughout the year. Inevitably, there were differences due to the different data entry points. Disagreements on the type of coverage were resolved with data from the claims system eligibility files, because these reflected

[1]We are indebted to Dan Relles, whose software enabled us to manage these very large datasets, and to Sally Trude, whose programming skills accomplished the tasks.

what transpired throughout the year. When the two systems disagreed about the health plan (HMO or FFS) in which the family was enrolled, those families were excluded.

Finally, when employees reenrolled in the fee-for-service plan, either because they were laid off and rehired or after an interim enrollment in an HMO, only eligibility data on the most recent FFS enrollment was kept. In the case of a family who left the FFS plan to join an HMO and subsequently rejoined the FFS plan, we could only analyze their post-HMO experience in the FFS sector.

SAMPLING

After we eliminated families who had selected only HMOs or who did not reside in California or Arizona, the final merged files contained about 60,000 family years of observation on about 30,000 families who had at least one year of expenditure data in the fee-for-service sector between 1978 and 1981. In addition, we knew the plan choice for such families for the years 1977 through 1982. The first step in creating the analysis file was to separate those families who had ever selected an HMO from those families who selected only the fee-for-service sector. Figure 1 gives an overview of the sampling process. About 10 percent of the families were identified as "switchers," with a total of 5203 family years of data on "switcher" families while they were in the FFS system. The five subgroups of switchers are defined in the Methods section.

To avoid overfitting the data, we randomly divided the "stayer" file into an exploratory and a confirmatory file. This sampling was done at the family level. Because these two stayer files still contained over 30,000 family years of observations, we created a working exploratory file containing a 20 percent random sample of all family years in the larger exploratory file. The working exploratory file was used in developing the age, sex and family composition adjustment factor described in Sec. V. The final analyses were carried out on one of two confirmatory files:

1. A "small" confirmatory file consisting of a 100 percent sample of switching families and a 10 percent sample of stayer families, and

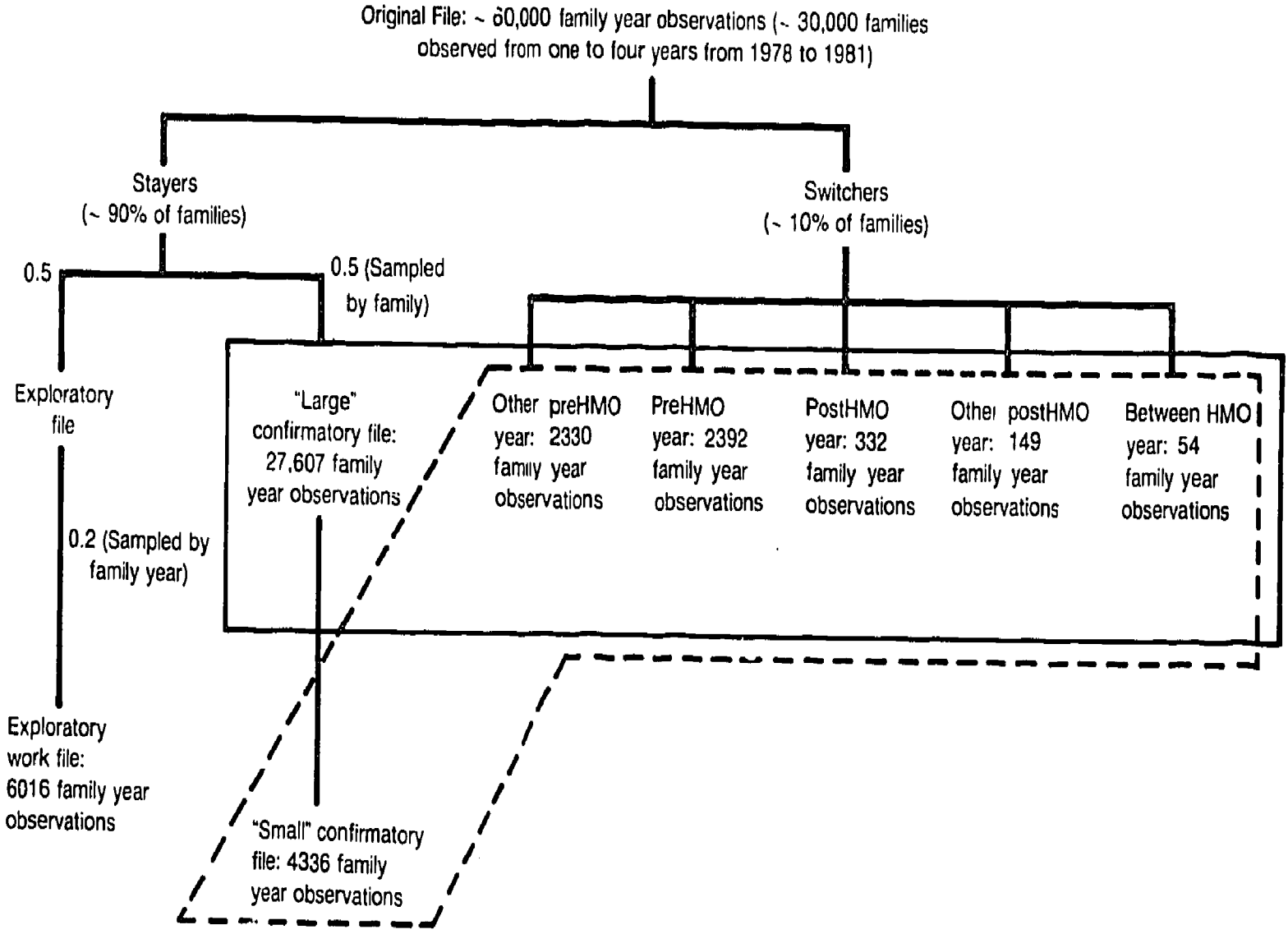

Fig. 1 -- Sampling process

2. A "large" confirmatory file consisting of a 100 percent sample of switching families and a 50 percent sample of stayer families.

V. METHODS

DEFINITION OF DEPENDENT VARIABLES

The dependent variables in this study all relate to annual family level health care expenditures and are based on filed claims. To adjust for inflation in the health care sector during the period 1978 to 1982, we converted all expenditures to a 1978 dollar equivalent by using a deflation factor based on the regional health services Consumer Price Index. Expenditures over $5000 (the upper 3.5 percent of our distribution) were truncated to $5000 to reduce the sensitivity of our means and variances to rare "big spenders."

As a preliminary step, we looked at the distributions of several variables. We obtained detailed runs on expenditure and utilization variables on our exploratory file (which consisted only of "stayers") and served as the basis of our decisions about the truncation of variables. This file was also used to assess the effectiveness of our deflation factors in controlling for inflation and helped us identify problems in some of the variables.

For each family year observed, we analyzed annual truncated family expenditures, proportion of families with positive expenditures, the log of positive truncated family expenditures, and the proportion of families with expenditures over $5000. Annual truncated family expenditures consisted of the sum of the deflated annual expenditures for each individual member of the family. Any family expenditures over $5000 were truncated to $5000.

Although this variable is simple to understand, the distribution of the variable complicates our analyses. In particular, 25 to 30 percent of our families had zero claimed expenditures in any given year, leading to a bimodal distribution. We attempted to create better behaved variables by looking at a "two-part" model of expenditures, which consists of two variables: a marker indicating whether a family had positive expenditures, and the logarithm of annual truncated family expenditures calculated only for families with positive expenditures in a given year (Duan et al., 1982). In addition, we did some preliminary

analyses on the proportion of families with annual expenditures over $5000.

In this report, we chose to emphasize the family year level (rather than the individual year level) analysis for two reasons. First, the family year is the unit of enrollment in a health plan. Second, by aggregating to the family year level we can ignore intrafamily correlations. At the same time, we are aware that individual characteristics, such as age and sex, are important determinants of health expenditures. We therefore developed an adjustment factor that attempted to incorporate the effects of individual level characteristics at the family level.

DEFINITION OF GROUPS

Our goal is to compare patterns of health care expenditures for families who were enrolled only in the FFS plan with expenditure patterns for families who switched between the FFS and HMO plans. Annual expenditures were the basis for our analyses. For families who were always enrolled in the FFS plan, we make no distinctions between years. We define a stayer as any employee who worked for the study company for one or more years between 1978 and 1981 and always enrolled in the FFS plan. A stayer year is any year such an employee spent in the FFS plan between 1978 and 1981.

Families who switched between the HMO and FFS systems exhibited many different patterns of switching. We developed a way of categorizing their years in the fee-for-service sector into one of five groups. These groups are:

1. PreHMO year--the year in the FFS sector immediately preceding a change into an HMO,
2. PostHMO year--the year in the FFS sector immediately following one or more years in an HMO,
3. Other preHMO year--a year in the FFS sector preceding a change into an HMO by two or more years,
4. Other postHMO year--a year in the FFS sector following enrollment in an HMO by two or more years, and

5. Between HMO year--a year between two periods of HMO enrollment. There were too few years in the "between HMO" category to analyze this group.

For example, suppose a family had the following enrollment history:

1977--FFS
1978--FFS
1979--HMO
1980--FFS
1981--FFS
1982--FFS

Then, 1977 would be an "other preHMO year," 1978 would be a "preHMO year," 1980 would be a "postHMO year," and 1981 and 1982 would both be "other postHMO years."

The rationale behind creating the "other preHMO" and "other postHMO" categories was to allow us to determine the persistence of observed expenditures just before or after enrollment in an HMO.

In creating the groups to be analyzed we excluded families where the employee was over 65. We also excluded individuals who were over 65 in analyzing family expenditure patterns. When an employee was terminated and then rehired or when an employee rejoined the FFS plan after an interlude in the HMO, data on family members' eligibility in the earlier period was written over. For this reason, we excluded rehires from the study; and in the case of families who switched out of and then back into the FFS plan we are able to analyze only the postHMO and other postHMO years.

DESCRIPTIONS OF THE GROUPS

Here we describe the composition of our switcher and stayer groups by age, sex, race, and other characteristics. The data reported here are the results of analyzing our "full" confirmatory file. Table 2 indicates the number of family years of observation in the various groups. The preHMO and other preHMO groups are on the order of ten times larger than the postHMO and other postHMO groups.

Table 2

SAMPLE SIZE, FAMILY YEARS

Area	Other PreHMO Year	PreHMO Year	"Large" Confirm File Stayer Year	"Small" Confirm File Stayer Year	PostHMO Year	Other PostHMO Year
California						
Employee only	548	601	4725	760	58	19
Employee and one dependent	299	288	4176	659	45	16
Employee and two or more dependents	687	607	5933	922	77	41
Total	1534	1496	14834	2341	180	76
Arizona						
Employee only	150	189	2489	393	27	16
Employee and one dependent	161	159	3278	513	35	18
Employee and two or more dependents	475	543	7006	1040	89	38
Total	786	891	12773	1946	151	72
Combined						
Employee only	698	790	7214	1153	85	35
Employee and one dependent	460	447	7454	1172	80	34
Employee and two or more dependents	1162	1150	12939	1962	166	79
Total	2320	2387	27607	4287	331	148

Detailed tables showing the distribution of employees by gender, the mean age of the employee, the mean monthly salary, the distribution by race, and the mean job tenure are contained in the appendix. These tables indicate that employees who elect to stay in the FFS sector do differ from those who elect to switch into or out of an HMO. Those who join the HMO are younger, with lower salaries and less time on the job. Those who cover only one dependent are underrepresented in the HMO groups. However, families do not seem to differ in the number of their family members covered.

Other insurance is less likely to be present in preHMO and other preHMO years. Given the problem we have in accurately identifying hospitalizations in families with other insurance, we would expect to understate the hospital utilization of stayers and postHMO years relative to preHMO years. We see the opposite effect, with lower probability of hospitalization, in the preHMO years. However, these are raw probabilities, and the younger ages of the preHMO group may explain the observed differences.

The crude birth rate per 1000 employees is much higher in groups who switched plans. Here again, the age differences may account for the higher birth rates among the preHMO and postHMO groups.

DEVELOPMENT OF FAMILY COMPOSITION FACTOR

To understand whether differences in expenditures were explained by differences in family characteristics, it was necessary for us to adjust for age, sex, and family composition. This adjustment factor was developed on the exploratory stayer file. Using truncated, deflated individual expenditures, we first scaled up the expenditures to "equivalent annual expenditures" for anyone with less than a full year's eligibility. Newborns were not scaled up, because we assumed that the majority of expenditures in the first year of life were associated with birth. We then developed the set of age-sex factors shown in Table 3. These factors represent the ratio of annual truncated deflated expenditures for a person in a given age-sex category relative to the overall mean. The age-sex factors for each individual member of a family were aggregated. At the same time, adjustments were made for any family members with less than 12 months enrollment. Once again newborns were not scaled.

Each family year in the confirmatory file was assigned a family composition factor value, from the exploratory file based on the age and sex of each family member and on the number of months of enrollment that year for each member. Table 4 shows the mean value of this variable for each of our groups. Although family size did not vary across our groups, the average family adjustment factor is lower for families who switch plans, especially in the "employee plus one dependent" and the

Table 3

RELATIVE TOTAL TRUNCATED EXPENDITURES[a]
BY AGE FOR FEMALES AND MALES

Age (Years)	Female	Male
Newborn	1.41	1.49
0-2	.69	.61
3-5	.27	.43
6-10	.38	.40
11-15	.44	.60
16-20	.63	.50
21-25	1.12	.45
26-30	1.51	.73
31-35	1.38	.68
36-40	1.57	.87
41-45	1.55	.96
46-50	1.59	1.14
51-55	1.97	1.26
56-60	2.18	1.86
61-65	2.30	2.52

[a]The ratio of annual truncated deflated expenditures relative to the overall means.

"employee plus two or more dependents" coverage categories, primarily because of the younger age of these families.

RESEARCH QUESTIONS

We have adopted a hierarchical set of research questions, which we then apply to our three primary variables: total family expenditures, the probability of positive expenditures, and the log of truncated positive expenditures. First we ask whether the five groups we have identified differ in their expenditures. We then attempt to explain these differences using a set of family level variables. In particular, the questions we ask are:

Table 4

FAMILY FACTOR MEANS AND STANDARD ERRORS

Area	Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
California						
Employee only	.82 (.022)	.82 (.020)	.98 (.009)	.96 (.063)	1.22 (.120)	.95 (.008)
Employee and one dependent	1.92 (.059)	1.96 (0.58)	2.69 (.019)	2.25 (.139)	2.12 (.250)	2.60 (.018)
Employee and two or more dependents	3.19 (.041)	3.18 (.045)	3.46 (.015)	2.96 (.120)	2.98 (.176)	3.40 (.013)
Arizona						
Employee only	.63 (.038)	.68 (.032)	.89 (.012)	.82 (.088)	.91 (.120)	.86 (.011)
Employee and one dependent	2.03 (.099)	1.90 (.086)	2.67 (.022)	2.02 (.129)	2.32 (.172)	2.60 (.021)
Employee and two or more dependents	3.07 (.057)	3.01 (.054)	3.35 (.014)	2.82 (.112)	3.51 (.159)	3.30 (.013)

1. Do expenditures differ by group, controlling for site and type of dependent coverage?
2. If there are differences, are these explained by age, sex, family composition, race, income, or the presence of other health insurance?

ESTIMATION METHODS AND CORRECTIONS FOR INTERTEMPORAL CORRELATION

Ordinary least squares estimation is used for all the specifications. Haggstrom et al. (1982) provides justification for this use when our dependent variable is binary. Because the probability of exceeding $5000 is very small, we confirmed our original results using logistic regression.

We use both an analysis of covariance (ANOCOVA) model and a two part model because each approach has limitations that are, at least partly, compensated for in the other model. Consistent results from both models strengthen our confidence in the findings. ANOCOVA limitations, primarily sensitivity to extreme values, are discussed in Duan et al. (1982). Their split sample analysis showed that it was a fair model on mean forecast bias grounds, but it was consistently worse than the two and four part models they tested on mean squared forecast error grounds. The use of truncated expenditures in our models reduces this problem.

In our two part model, the logarithm of truncated family expenditures for families with positive expenditures is retransformed using the log normal approximation:

$$\overline{Y} = e^{(\mu+\sigma^2/2)}$$

We did not test other retransformations, but found that expected expenditures for each of our groups obtained using this retransformation for the two part model were very similar to those obtained from the untransformed ANOCOVA model.

We developed the two part model because results in Duan et al. (1982) suggested that for predicting individual expenditures, the two part and four part models outperformed the ANOCOVA model. (Inadequacies in our data precluded the development of a four part model). Although this model worked well for individual level expenditures, it does not necessarily follow that it is appropriate to aggregate across family members and then transform family expenditures by taking logarithms. If a family of size one has expenditures that are truly log normal, expenditures summed over larger numbers of family members will not be log normal, because the log normal distribution does not convolute. In theory, this aggregation leads to heteroscedasticity with respect to family size. We looked at residual plots on the family factor variable and did not detect the predicted heteroscedastic pattern. The consistency of results between the two part models and the ANOCOVA model also suggest that this is not problematic in our data. Adding family

size to the specifications discussed in the results section did not add to the explanatory power of the specification. Family size also did not perform as well when substituted for family factor variable.

Because we developed the family factor variable on stayers, we looked for, but did not detect, significant interaction effects between the family factor and the group classifications variable that distinguishes types of switchers from stayers.

Other analyses were carried out using indicator variables for the years 1978-1981. After deflating expenditures, we observed no secular effects.

We have not addressed the problem of intertemporal correlations among our family year observations. In the preHMO and postHMO groups we have no problem, because very few families appear more than once in either of these groups. However, the stayer group and the other preHMO and other postHMO groups do involve repeated observations on the same families. Our probable underestimation of the standard errors in these latter three groups will affect the ANOVA and ANOCOVA (analysis of variance and analysis of covariance) models. We provide a bound on the error in the t-statistics for some of these models; the method is discussed below.

As part of their work on Rand's Health Insurance Experiment, Will Manning and Carl Morris developed bounds on the bias of the residual variance and on the standard error of ordinary least squares (OLS) coefficients when clustered sampling occurs as frequently happens in analysis of cross-section time series data. We use these results to correct for intertemporal correlation. Duan (1983) extended these bounds for probit equations. The true covariance matrix is assumed to be block diagonal because of the constant correlation among observations of one family across years.

Manning and Morris show that the ratio ϕ of the true variance of the coefficient estimator to its OLS value when the independent variables are centered at their means is approximately

$$\frac{\text{var}(\beta_r)}{\text{var}_{OLS}(\beta_r)} = \phi = 1 - \rho + \frac{\rho \Sigma m_j^2}{n}$$

where ρ is the correlation across years and m_j is the number of family

years of data for family j. For time invariant variables, the t-statistics should be deflated approximately $1 - \phi^{-1/2}$. For variables that are random across years, t values need not be deflated. We apply this deflation as a conservative estimate of the inflation in the t-statistics of our contrasts.

VI. RESULTS

This section reports the results of two sets of analyses using ANOVA and ANOCOVA models on four dependent variables: truncated family expenditures, probability of positive expenditures, the log of truncated family expenditures for those families with positive expenditures, and the probability of family expenditures exceeding $5000. In all these analyses, expenditures are deflated to 1978 constant dollars and are based on the total claims filed with the FFS insurer. Table 5 summarizes the dependent and independent variables used in the analyses reported here.

Our primary independent variable, Group, is based on the categorization of family years into the five groups described earlier:

- Other preHMO years
- PreHMO years
- Stayer years
- PostHMO years
- Other postHMO years.

In our first set of analyses we compare expenditures across groups, controlling for coverage and site. In the second set of analyses we introduce variables related to family characteristics: income, race, whether other health insurance is present, and the family factor adjustment variable. In these analyses we examine eight contrasts: four comparing stayer years with each of the other groups, one comparing preHMO with other preHMO, one comparing postHMO with other postHMO, one comparing preHMO with postHMO and one comparing all preHMO years with all postHMO years.

Table 6 summarizes the ANOVA and ANOCOVA results. Only the significant variables and interactions were retained in the models.

Table 5

SUMMARY OF VARIABLES

Dependent Variables	
Truncated family expenditures	Total claims filed by the family in a year, deflated to 1978 constant dollars and truncated at $5000
Proportion with positive expenditures	Binary variable is zero for families with no expenditures in a given year, one otherwise
Log (Truncated family expenditures)	The natural logarithm of truncated family expenditures, defined only for families with positive expenditures
Proportion with expenditures over $5000	Binary variable is zero for families with expenditures under $5000 and one otherwise
Independent Variables	
Group	Categorical variable with five levels: (1) Other preHMO year, (2) PreHMO year, (3) Stayer year, (4) PostHMO year, (5) Other postHMO year
Site	Employee's work site: either California or Arizona
Coverage	Employee's health insurance coverage category: employee only; employee plus one dependent; employee plus two or more dependents
Family factor	Composite variable reflecting the expected family health expenditures based on the age and sex of family members and number of months of eligibility
Log (family factor)	Natural logarithm of family factor
Income	Monthly salary of employee, deflated to 1978 dollars
Log (income)	Natural logarithm of income
Race	Categorized as Black, Hispanic, and other
Presence of other insurance	Binary variable is one when one or more family members have other health insurance coverage, zero otherwise

Table 6

SUMMARY OF ANOCOVA MODELS AND RESULTS

Dependent Variable	Independent Variables	R^2
Truncated family expenditures	Group Coverage Family factor Log (income) Presence of other insurance GroupxSite interaction	.094
Proportion with positive expenditures	Group Site Coverage Log (family factor) Log (income) Race Presence of other insurance Log (family factor)xSite interaction	.193
Log (truncated family expenditures)	Group Log (family factor) Log (income) Presence of other insurance Group Site interaction Log (family factor)xSite interaction	.088

SET I COMPARISONS

Table 7 compares the mean annual expenditures for preHMO, postHMO, and stayer years. Mean family expenditures in years before they enter an HMO are significantly lower compared with expenditures of those who never leave the fee-for-service sector and compared with expenditures of those who just left HMOs. This difference is observed in both Arizona and California and is due to lower mean expenditure levels among those who have nonzero expenditures.

In modeling truncated family expenditures and the log of positive expenditures we found that the preHMO, postHMO, and stayer groups behaved differently in California and Arizona (Tables 8 and 9). In

Table 7

SET [illegible]ION OF MEAN TRUNCATED FAMILY EXPENDITURES
CONTROLLING FOR SITE AND COVERAGE

(In 1978 constant dollars)

	Truncated Family Expenditures		Probability of Positive Expenditures		Log (Truncated Family Expenditures) for Those with Positive Expenditures		Retransformed Mean in Dollars(c)
	Mean	Standard Error(a)	Mean	Standard Error(a)	Mean	Standard Error(a)	
Other preHMO years	88	(32)	.70	(.010)	5.92	(.042)	998
PreHMO years	00	(30)	.70	(.010)	5.78	(.040)	868
Stayers	18	(21)	.71	(.007)	6.13	(.028)	1231
PostHMO years	89	(70)	.74	(.023)	6.15	(.089)	1256
Other postHMO years	97	(104)	.73	(.034)	5.99	(.132)	1070

Contrasts	Difference	t-value(b)	Standard Error(a)	Difference	t-value(b)	Standard Error(a)	Difference	t-value(b)	Standard Error(a)
PreHMO vs stayers	-218	-6.03	(36)	-.01	-0.78	(.012)	-.35	-7.49	(.046)
PostHMO vs stayers	71	0.98	(73)	.03	1.05	(.024)	+.03	0.29	(.092)
Other preHMO vs stayers	-130	-3.48	(37)	-.02	-1.43	(.012)	-.21	-4.36	(.048)
Other postHMO vs stayers	-21	-0.20	(106)	.01	0.43	(.035)	-.13	-0.98	(.134)
PostHMO vs preHMO	289	3.82	(76)	.03	1.38	(.025)	.37	3.90	(.096)
PostHMO vs other postHMO	92	0.74	(125)	.01	0.25	(.041)	.16	1.00	(.158)
PreHMO vs other preHMO	-88	-2.04	(43)	.01	0.58	(0.14)	.14	-2.54	(.055)
All post vs all pre	199	3.01	(66)	.03	1.52	(.022)	.23	2.69	(.084)

(a) Standard errors are uncorrected for intratemporal correlation.

(b) Joint confidence levels for all 8 contrasts can be estimated using the Bonferroni Method. A 70 percent confidence level for all eight statements require that significant t-values are those greater than 2.11. At 80 percent confidence levels, the significant t-value increases to 2.26. At 95 percent this value becomes 2.87.

(c) Retransformed using log-normal approximation: $\bar{Y} = e^{(\mu+\sigma^2/2)}$.

California, the mean truncated family expenditures are $120 to $60 lower in preHMO and other preHMO years than in stayer years. In Arizona, preHMO and other preHMO years have mean expenditures $310 to $200 lower than in stayer years. This difference is attributable to differences in the level of expenditures for those who have expenditures, rather than to differences in the probability of having positive expenditures.

The other major site difference occurs in postHMO years. In both California and Arizona, the mean expenditure in other postHMO years is virtually identical to the mean in stayer years. In California, the postHMO year expenditures are significantly higher than either preHMO or stayer year expenditures. In Arizona, the postHMO year expenditures are midway between the preHMO year and stayer year expenditures.

Two warnings apply in interpreting our results. First, the standard errors are not corrected for intertemporal correlation, which means we have underestimated the standard errors. For Set II results, however, we provide a bound on the error in the t-statistics to allow for the correction for intertemporal correlation among observations. Second, in making multiple comparisons using the same data, one should use joint confidence intervals. Using the Bonferroni Method for multiple comparisons, a 70 percent confidence level requires t-values greater than 2.11; an 80 percent confidence level requires t-values greater than 2.26; and a 95 percent confidence level requires t-values of 2.87 or more (Neter and Wasserman, 1974). Most of the differences just discussed involve t-values in excess of 3, so our results are not likely to be dramatically affected by further refinements. In the presence of correlation, the Bonferroni Method is conservative; that is, it overcorrects.

SET II COMPARISONS

In Table 10 we compare the mean expenditure levels in our groups, controlling for family characteristics as well as for site and coverage. Controlling for family characteristics has the effect of raising the mean expenditures in preHMO years and postHMO years relative to stayer years. Although expenditures in preHMO years are still significantly smaller than in stayer years, the unexplained differences are $130

Table 8

SET IA COMPARISON OF MEAN TRUNCATED FAMILY EXPENDITURES
CONTROLLING FOR COVERAGE IN CALIFORNIA

(In 1978 constant dollars)

	Truncated Family Expenditures		Log (Truncated Family Expenditures) for Those with Positive Expenditures		
	Mean	Standard Error(b)	Mean	Standard Error(b)	Retransformed Mean in Dollars(d)
Other preHMO years	697	(36)	5.86	(.049)	940
PreHMO years	633	(36)	5.94	(.049)	1018
Stayers	756	(27)	6.11	(.037)	1207
PostHMO years	1098	(94)	6.43	(.120)	1662
Other postHMO years	747	(145)	5.96	(.191)	1039

Contrasts	Difference	t-value(c)	Standard Error(b)	Difference	t-value(c)	Standard Error(b)
PreHMO vs stayers	-123	-2.74	(45)	-.25	-4.08	(.060)
PostHMO vs stayers	342	3.49	(97)	.32	2.54	(.125)
Other preHMO vs stayers	-59	-1.31	(45)	-.17	-2.78	(.060)
Other postHMO vs stayers	-9	-0.06	(147)	-.15	-0.75	(.195
PostHMO vs preHMO	465	4.63	(101)	.57	4.37	(.129)
PostHMO vs other postHMO	351	2.03	(173)	.46	2.06	(.226)
PreHMO vs other preHMO	-64	-1.27	(50)	-.08	-1.16	(.068)
All post vs all pre	258	2.87	(90)	.29	2.49	(.118)

(a) There were no site differences in the probability of positive expenditure.
(b) Standard errors are uncorrected for intratemporal correlation.
(c) Joint confidence levels for all eight contrasts can be estimated using the Bonferroni Method.
A 70 percent confidence level for all eight statements requires that significant t values are those greater than 2.11.
At 80 percent confidence levels, the significant t-value increases to 2.26. At 95 percent this value becomes 2.87.

(d) Retransformed using log-normal approximation: $\bar{Y} = e^{(\mu+\sigma^2/2)}$.

Table 9

SET IB COMPARISON OF MEAN TRUNCATED FAMILY EXPENDITURES
CONTROLLING FOR COVERAGE IN ARIZONA
(In 1978 constant dollars)

	Truncated Family Expenditures		Log (Truncated Family Expenditures) for Those with Positive Expenditures		
	Mean	Standard Error(b)	Mean	Standard Error(b)	Retransformed Mean in Dollars(d)
HMO years	679	(52)	5.90	(.065)	978
ars	567	(48)	5.70	(.061)	801
	880	(31)	6.15	(.039)	1256
ears	680	(103)	5.88	(.130)	959
tHMO years	847	(149)	6.03	(.182)	1114

	Difference	t-value(c)	Standard Error(b)	Difference	t-value(c)	Standard Error(b)
	-313	-5.54	(57)	-.45	-6.39	(.070)
s	-200	-1.87	(107)	-.27	-1.98	(.135)
change vs	-201	-3.38	(60)	-.25	-3.38	(.074)
tHMO vs	-33	-0.22	(152)	-.12	-0.64	(.185)
s	113	1.00	(113)	.18	1.29	(.142)
s other	-167	-0.92	(181)	-.15	-0.62	(.222)
other	-112	-1.60	(70)	-.20	-2.31	(.087)
vs all pre	140	1.45	(97)	.16	1.32	(.120)

ere were no site differences in the probability of positive expenditures.
andard errors are uncorrected for intratemporal correlation.
int confidence levels for all eight contrasts can be estimated using the Bonferroni Method. A 70 percent confidence
all eight statements requires that significant t-values are those greater than 2.11. At 80 percent confidence levels,
ficant t-value increases to 2.26. At 95 percent this value becomes 2.87.

transformed using log-normal approximation: $\overline{Y} = e^{(\mu+\sigma^2/2)}$.

rather than $200. The lower mean expenditures are explained solely by lower levels of expenditures among those with expenditures, as the probability of expenditure is identical in the preHMO and stayer years.

We found that in the total expenditure equation, race was not significant, but it was a factor in the probability of having positive expenditures. Black families were significantly less likely to have positive expenditures. When other insurance is present, mean total truncated family expenditures were 44 percent higher. Families with other insurance were both more likely to have positive expenditures and had higher levels of expenditures when they were positive.

As before, there are site differences (Tables 11 and 12). Again, the differences between preHMO and stayer years are roughly twice as large in Arizona as in California. Controlling for family characteristics has a more profound effect on comparisons involving postHMO years. In California, the postHMO year is over $400 higher than either the preHMO or stayer year expenditure level. This is attributable both to a higher probability of expenditure and to higher expenditure levels once expenditures occur.

In Arizona, controlling for family characteristics raises the postHMO year expenditure sufficiently to remove any previously observed differences between postHMO and stayer years. The postHMO year means are somewhat higher than the preHMO means, but not significantly so.

The intertemporal correlation, ρ,[1] for the total truncated family expenditures was estimated to be 0.23, whereas it was 0.27 for the log of positive expenditures equation. In both equations, the Manning-Morris bound indicates that the t-statistics should be deflated an additional 19 percent.

The use of total expenditures as the dependent variable raises the question of whether out-of-pocket expenditures might actually have been higher in the groups with lower mean total expenditures. Under many FFS insurance plans with firm deductibles, one would at least expect the percent of paid claims to be lower in groups with lower mean

[1]We are indebted to Dan Relles of The Rand Corporation and his computationally efficient software in the STATLIB package, which enabled us to perform these calculations.

Table 10

SET II COMPARISON OF MEAN TRUNCATED FAMILY EXPENDITURES CONTROLLING FOR COVERAGE, SITE, AND FAMILY CHARACTERISTICS

(In 1978 constant dollars)

	Truncated Family Expenditures		Probability of Positive Expenditures		Log (Truncated Family Expenditures) for Those with Positive Expenditures		
	Mean	Standard Error(a)	Mean	Standard Error(d)	Mean	Standard Error(a)	Retransformed Mean in Dollars(b)
Other preHMO years	849	(29)	.68	(.010)	6.13	(.038)	1201
PreHMO years	795	(28)	.70	(.010)	6.04	(.037)	1098
Stayers(e)	926	(10)	.70	(.005)	6.24	(.010)	1341
PostHMO years	1142	(69)	.76	(.023)	6.45	(.087)	1655
Other postHMO years	986	(102)	.73	(.035)	6.20	(.130)	1209

Contrasts	Difference	t-value(c)	Standard Error(a)	Difference	t-value(c)	Standard Error(a)	Difference	t-value(c)	Standard Error(a)
PreHMO vs stayer	-131	-4.75	(28)	-.00	-0.13	(.009)	-.21	5.59	(.037)
PostHMO vs stayers	215	3.12	(69)	.06	2.73	(.023)	.21	2.38	(.087)
Other preHMO vs stayers	-77	-2.71	(29)	-.02	-2.08	(.009)	-.11	-2.91	(.038)
Other postHMO vs stayers	59	0.58	(102)	.03	0.78	(.034)	-.04	-0.34	(.130)
PostHMO vs preHMO	347	4.71	(74)	.06	2.62	(.025)	.42	4.44	(.094)
PostHMO vs other postHMO	156	1.27	(123)	.04	0.88	(.041)	.25	1.62	(.156)
PreHMO vs other preHMO	-54	-1.42	(38)	.02	1.47	(.012)	-.10	-1.89	(.051)
All post vs all pre	242	3.75	(64)	.06	2.56	(.021)	.24	2.95	(.082)

(a) Standard errors are uncorrected for intertemporal correlation. Upper bound on error correction indicates that t-statistics should be deflated by at most 19 percent.

(b) Retransformed using log-normal approximation: $\bar{Y} = e^{(\mu+\sigma^2/2)}$.

(c) Joint confidence levels for all eight contrasts can be estimated using the Bonferroni Method. A 70 percent confidence level for all eight statements requires that significant t-values are those greater than 2.11. At 80 percent confidence levels, the significant t-value increases to 2.26. At 95 percent this value becomes 2.87.

(d) Standard errors are uncorrected for intertemporal correlation.

Table 11

SET IIA COMPARISON OF MEAN TRUNCATED EXPENDITURES CONTROLLING FOR COVERAGE AND FAMILY CHARACTERISTICS IN CALIFORNIA

(In 1978 constant dollars)

	Truncated Family Expenditures		Log (Truncated Family Expenditures) for Those with Positive Expenditures		
	Mean	Standard Error(b)	Mean	Standard Error(b)	Transformed Mean in Dollars(c)
10 years	866	(33)	6.18	(.046)	1263
rs	833	(34)	6.12	(.046)	1190
	912	(12)	6.25	(.015)	1355
rs	1330	(93)	6.67	(.119)	2062
MO years	966	(143)	6.16	(.189)	1238

	Difference	t-value(e)	Standard Error(b)	Difference	t-value(e)	Standard Error(b)
	-78	-2.30	(34)	-.13	-2.71	(.047)
	418	4.47	(93)	.42	3.55	(.119)
10 rs	-46	-1.36	(34)	-.07	-1.54	(.047)
MO rs	55	0.38	(143)	-.09	-0.45	(.189)
	496	5.05	(93)	.55	4.35	(.127)
tHMO	363	2.13	(171)	.51	2.28	(.223)
HMO all pre	-33	-0.72	(45)	-.06	-0.87	(.064)
	298	3.38	(88)	.27	2.33	(.116)

e were no site differences in probability of positive expenditures.
dard errors are uncorrected for intratemporal correlation.

ransformed using log-normal approximation: $\overline{Y} = e^{(\mu+\sigma^2/2)}$.

er sample of stayers.

t confidence levels for all eight contrasts can be estimated using the Bonferroni Method. A 70 percent confidence level ht statements requires that significant t values are those greater than 2.11. At 80 percent confidence levels, the t-value increases to 2.26. At 95 percent this value becomes 2.87.

Table 12

SET IIB COMPARISON OF MEAN TRUNCATED EXPENDITURES CONTROLLING FOR COVERAGE AND FAMILY CHARACTERISTICS IN ARIZONA

(In 1978 constant dollars)

	Truncated Family Expenditures		Log (Truncated Family Expenditures) for Those with Positive Expenditures		
	Mean	Standard Error(b)	Mean	Standard Error(b)	Transformed Mean in Dollars(c)
eHMO years	833	(45)	6.09	(.059)	1154
ears	757	(43)	5.95	(.056)	1004
d)	941	(13)	6.24	(.016)	1341
years	954	(101)	6.23	(.127)	1328
stHMO years	1005	(146)	6.23	(.178)	1328
s	Difference	t-value(e) Standard Error(b)	Difference	t-value(e)	Standard Error(b)
s	-184	-4.25 (43)	-.29	-5.04	(.057)
vs s	13	0.13 (	-.01	-0.05	(.128)
eHMO yers	-109	-2.37	-.15	-2.50	(.060)
stHMO yers	64	0.44 (146)	.00	-0.02	(.178)
vs	197	1.80 (109)	.28	2.03	(.139)
vs postHMO	-51	-0.29 (178)	.00	-0.01	(.218)
s preHMO	-75	-1.24 (61)	-.14	-1.72	(.080)
vs all pre	185	1.97 (94)	.21	1.84	(.116)

here were no site differences in the probability of positive expenditures.
tandard errors are uncorrected for intratemporal correlation.

etransformed using log-normal approximation: $\overline{Y} = e^{(\mu+\sigma^2/2)}$.

arger sample of stayers.

oint confidence levels for all eight contrasts can be estimated using the Bonferroni Method. A 70 percent confidence r all eight statements requires that significant t-values are those greater than 2.11. At 80 percent confidence the significant t-value increases to 2.26. At 95 percent this value becomes 2.87.

expenditures. Table 13 reports the percent of filed claims paid by the insurer in our preHMO, stayer, and postHMO groups. There is not much difference in the percent of claims paid despite significantly lower mean expenditures in the preHMO years. This suggests that not only total claims filed, but also costs to the insurer and out-of-pocket costs to the insured, are higher in the stayer years than in the preHMO years.

BIG SPENDERS

We began our analysis with a truncated expenditure variable so that comparisons among means would not be unduly influenced by differences in the tails of the highly skewed expenditure distribution. It is nonetheless very important to understand whether there are any differences in the tail among our groups. Rand's Health Insurance Experiment results show that 1 percent of the population account for over 25 percent of the expenditures. See Newhouse et al. (1982). We looked at the probability of expenditures exceeding $5000 and perform a one way analysis of variance on our group variable. We found that preHMO years had significantly lower probabilities of exceeding $5000 than stayer years. Adding family factor to the specification explains some of the difference between the preHMO years and stayers. However,

Table 13

PERCENT OF FILED EXPENDITURES PAID BY INSURER

Area	Dependents Covered	PreHMO Year	Stayer Year	PostHMO Year
California	0	82	82	84
	1	78	74	77
	2+	78	77	75
Arizona	0	84	78	86
	1	76	72	77
	2+	75	75	69

significant unexplained differences remain between the preHMO and stayer years. No site differences could be detected, and the type of insurance coverage was not significant when family factor is used. These results are shown in Table 14. Raw means on total expenditures for these groups are presented in col. (3). Because the group sizes are so small (all five groups together are less than 350), further modeling was not performed on the "big spenders."

OTHER RESULTS

Other analyses were carried out using number of family members covered and indicator variables for the years 1978 through 1981. After deflating expenditures, we found no secular effects. Number of family members did not perform as well as the family factor variable. Runs using only site, coverage, family factor, and indicated interaction terms gave results very similar to the Set II comparisons reported above.

Table 14

COMPARISON OF PROBABILITY FAMILY EXPENDITURES EXCEED $5000
(In 1978 constant dollars)

	By Group		By Group Controlling for FAMFAC		Mean Expenditures for Those Families Exceeding $5000	
	Mean	Standard Error(a)	Mean(b)	Standard Error(a)	Mean	Standard Error(a)
Other preHMO years	.039	(.005)	.035	(.004)	9959	(803)
PreHMO years	.028	(.004)	.027	(.004)	8882	(773)
Stayers	.047	(.003)	.041	(.003)	9896	(422)
PostHMO years	.045	(.011)	.047	(.010)	7775	(938)
Other postHMO years	.047	(.016)	.045	(.015)	14108	(5427)

Contrasts	Difference	t-value(c)	Standard Error(a)	Difference	t-value(c)	Standard Error(a)
PreHMO vs stayer	-.019	-3.51	(.005)	-.014	-2.90	(.005)
PostHMO vs stayers	-.002	-0.19	(.011)	.006	0.60	(.011)
Other preHMO vs stayers	-.009	-1.57	(.006)	-.006	-1.29	(.005)
Other PostHMO vs stayers	-.000	-0.01	(.017)	.004	0.25	(.016)
PostHMO vs preHMO	.017	1.45	(.012)	.020	1.85	(.011)
PostHMO vs other postHMO	-.002	-0.10	(.020)	.002	0.13	(.018)
PreHMO vs other preHMO	-.010	-1.64	(.006)	-.008	-1.42	(.005)
All post vs all pre	.013	1.25	(.010)	.015	1.58	(.010)

(a) Standard errors are uncorrected for intratemporal correlation.
(b) We repeated this analysis using a logistic regression model and obtained essentially the same results. All proportions were somewhat lower than those obtained using OLS. Proportions in the PreHMO years were again significantly lower than those in the stayer years, .022 rather than .034.
(c) Joint confidence levels for all eight contrasts can be estimated using the Bonferroni Method. A 70 percent confidence level for all eight statements requires that significant t-values are those greater than 2.11. At 80 percent confidence levels, the significant t-value increases to 2.26. At 95 percent this value becomes 2.87.

VII. DISCUSSION AND CONCLUSIONS

Purely financial arguments suggest that HMOs, with their higher premiums and more comprehensive benefits, should attract families with larger health expenditures. Our results suggest that other factors, such as the degree of integration into an existing medical care network, may work in the opposite direction from the financial incentives. In particular, older, sicker people with well-established ties in the fee-for-service system may be reluctant to elect a newly offered HMO plan. Similarly, when the premium differentials are modest (as they are in the instance under study), young, healthy families looking for access into a coordinated health care system may opt for an HMO.

In both California and Arizona, we observed lower mean expenditures among families who entered HMOs. Some, but not all, of this observed difference is explained by family characteristics. We also see evidence in both sites that in the year immediately preceding entry into the HMO, expenditures drop even lower. This suggests that families who have decided to switch systems begin to withhold utilization until entering their new, preferred system. In California, the high expenditures in the first postHMO year fall somewhat in subsequent postHMO years, which may be evidence of the same type of "storing" behavior.

In both California and Arizona, we see a consistent pattern: Families with expenditures at the low end of the distribution enter the HMOs. The families who leave the HMOs have higher mean expenditures than those who entered. In Arizona, the differences between preHMO and stayer year expenditures are twice those observed in California. The Arizona preHMO families have such depressed expenditures that although the postHMO means are higher than the preHMO year expenditures, they do not exceed the expenditures of those who never try the HMO.

Because well care and the first two illness visits are not covered in this fee-for-service plan, undetected differences are possible in ambulatory utilization between the families in our sample that select HMOs and those remaining in the fee-for-service plan. Certainly other studies have found higher ambulatory use patterns among HMO enrollees

faced with positive premium differential. We cannot resolve this issue but note that we obtained no differences between the groups in the likelihood of having positive expenditures; differences appear in the level o expenditures, given they are positive.

Our findings are consistent with those for the Medicare population in Eggers (1980) and Eggers and Prihoda (1982), which also compare prior claims. Manning et al. (1984), however, found evidence of adverse selection into the HMO in their randomized controlled trial. We have no premium information from their study and the HMO had a long history in the region.

It is difficult to explain the more extreme selection in Arizona. In Arizona the preHMO groups are even younger, with less time on the job than their counterparts in California. Perhaps in California, where HMOs are a more established, better known alternative to fee-for-service medical care, a broader cross-section of people are willing to enroll. The contrast between network and group model plans could account for this difference. The local medical care markets may also have affected the selection differences. In Arizona, inflation in the medical care market was exceptionally high during this period.

In the future, we hope to look more closely at the characteristics that predict who selects the HMO, both as an initial choice on first being hired and subsequently during open enrollment periods. Such analyses may give us more insight into the differences in behavior we observe in our Arizona and California populations.

Despite the site differences, one finding is consistent: Those families who will switch into HMOs have lower total expenditures than those who will remain in the FFS insurance plan. The possibility of adverse selection into FFS plans has no bearing on the relative efficiency of FFS and HMO plans. HMO plans may be more efficient regardless of whether they experience favorable or adverse selection. However, these results do suggest the need to further study the effects of newly introduced HMO plans on costs for competing fee-for-service insurers. Our results also support the suggestion in the literature that subscriber choices are influenced by social variables as well as the direct costs associated with health insurance plans.

Appendix

DETAILED SAMPLE CHARACTERISTICS

Table A.1

PERCENT FEMALE EMPLOYEES

Area	Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
California	19.7	21.4	19.0	31.1	30.3	19.5
Arizona	11.1	10.8	[illegible]	13.8	12.3	12.9

Table A.2

EMPLOYEE AGE MEANS AND STANDARD ERRORS

Area	Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
California						
Employee only	33 (.48)	33 (.44)	36 (.12)	33 (1.48)	37 (2.77)	35 (0.16)
Employee and one dependent	38 (.67)	37 (.70)	46 (.20)	39 (1.98)	34 (3.38)	45 (0.19)
Employee and two or more dependents	38 (.34)	38 (.38)	42 (.12)	37 (1.13)	39 (1.67)	42 (0.11)
Arizona						
Employee only	28 (.78)	30 (.68)	34 (.24)	34 (1.99)	34 (2.90)	34 (0.22)
Employee and one dependent	38 (1.11)	37 (1.05)	46 (.23)	38 (1.83)	40 (2.39)	45 (0.22)
Employee and two or more dependents	37 (.42)	36 (.37)	41 (.11)	37 (.90)	38 (1.35)	40 (0.10)

Table A.3

MONTHLY SALARY MEANS AND STANDARD ERRORS

(In 1978 dollars)

Area	Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
California						
Employee only	1008	1019	1142	1135	1193	1117
	(13)	(15)	(6)	(56)	(98)	(5)
Employee and one dependent	1222	1208	1578	1218	1035	1528
	(27)	(29)	(13)	(56)	(70)	(11)
Employee and two or more dependents	1330	1387	1722	1474	1391	1653
	(19)	(22)	(7)	(82)	(88)	(11)
Arizona						
Employee only	1031	1118	1202	1315	1352	1189
	(29)	(25)	(9)	(84)	(87)	(8)
Employee and one dependent	1265	1304	1541	1478	1720	1518
	(32)	(38)	(11)	(71)	(98)	(10)
Employee and two or more dependents	1295	1354	1630	1521	1591	1590
	(18)	(21)	(8)	(67)	(72)	(7)

Table A.4

ETHNIC DISTRIBUTION

(Percent)

Area	Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
California						
Black	16	15	13	9	14	13
Hispanic	26	25	19	21	16	21
Asian	7	7	8	10	9	8
Other	51	53	60	60	61	58
California Total	100	100	100	100	100	100
Arizona						
Black	6	4	3	3	1	3
Hispanic	15	12	9	9	8	10
Asian	1	1	1	6	7	1
Other	77	82	86	82	83	86
Arizona Total	99[a]	99[a]	99[a]	100	100	100

[a]Totals do not add to 100 percent due to rounding.

Table A.5

JOB TENURE IN YEARS, MEANS AND STANDARD ERRORS

Area	Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
California						
Employee only	3.8 (.23)	3.6 (.19)	6.1 (.11)	4.2 (.55)	5.1 (.93)	5.6 (.09)
Employee and one dependent	6.8 (.45)	6.6 (.45)	12.6 (.17)	7.4 (1.24)	5.7 (1.47)	11.8 (.15)
Employee and two or more dependents	7.1 (.24)	7.3 (.26)	10.8 (.11)	6.7 (.79)	5.9 (.97)	10.0 (.10)
Arizona						
Employee only	2.8 (.37)	3.0 (.27)	5.8 (.13)	4.1 (.74)	6.2 (1.39)	5.4 (.12)
Employee and one dependent	7.1 (.60)	6.5 (.61)	13.2 (.18)	6.6 (1.08)	9.1 (1.84)	12.6 (.17)
Employee and two or more dependents	5.9 (.24)	5.6 (.24)	10.2 (.10)	1 (.67)	8.7 (1.08)	9.6 (.09)

Table A.6

PERCENT OF EMPLOYEES IN EACH INSURANCE COVERAGE CATEGORY

Area	Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
California						
Employee only	35.7	40.2	31.9	32.2	25.0	32.8
Employee and one dependent	19.5	19.3	28.2	25.0	21.1	26.6
Employee and two or more dependents	44.8	40.6	40.0	42.8	53.9	40.5
California Total[a]	100	100.1	100.1	100.0	100.0	99.9
Arizona						
Employee only	19.1	21.1	19.5	17.9	22.2	19.6
Employee and one dependent	20.5	17.8	25.7	23.2	25.0	24.9
Employee and two or more dependents	60.4	60.9	54.9	58.9	52.8	55.6
Arizona Total[a]	100.0	99.9	100.1	100.0	100.0	100.0

[a]Total may not add due to rounding.

Table A.7

NUMBER OF COVERED FAMILY MEMBERS FOR EMPLOYEES COVERING TWO OR MORE DEPENDENTS, MEANS AND STANDARD ERRORS

Area	Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
California	4.05 (0.04)	4.03 (0.04)	4.02 (0.01)	3.96 (0.14)	3.69 (0.15)	4.02 (0.01)
Arizona	4.23 (0.06)	4.22 (0.06)	4.19 (0.01)	4.00 (0.09)	4.18 (0.14)	4.17 (0.01)

Table A.8

PERCENT WITH OTHER INSURANCE

Area	Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
California	12.4	7.8	16.6	12.8	17.1	15.5
Arizona	13.8	8.4	18.0	17.8	21.9	17.2

Table A.9

PROBABILITY OF ONE OR MORE HOSPITALIZATIONS

Area	Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
California	.140	.126	.143	.217	.171	.142
Arizona	.179	.156	.195	.204	.164	.192

Table A.10

BIRTHS PER 1000 EMPLOYEES ENROLLED

Other PreHMO Year	PreHMO Year	Stayer Year	PostHMO Year	Other PostHMO Year	All Years
51.1	50.6	27.2	57.2	47.0	30.9

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