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Adverse Selection Among Multiple Competing Health Maintenance Organizations

JAMES C. ROBINSON, PhD* AND LAURA B. GARDNER, MD, PhD†

This study examines risk selection among nine health plans competing for 16,182 employees of one large firm in 1989: one conventional fee-for-service plan, one group-model health maintenance organization (HMO), and seven network and independent practice model HMOs. We develop and compare measures of risk using weights based on HMO and fee-for-service expenditure data, respectively. We use a multiequation statistical model to develop two sets of utilization and expenditure weights for enrollees in each plan. One set of weights, based on discharge abstracts and outpatient records from the large group-model HMO, measures how much each of the nine groups of employees and dependents would have spent, had they been enrolled in a stringently managed plan with no consumer cost sharing. The other set of weights, based on fee-for-service claims data, measures how much each group would have spent, had it been enrolled in an unmanaged health plan with significant coinsurance and deductibles. Predicted annual expenditures per enrollee exhibit a 23% range from lowest (favorable selection) to highest (adverse selection) risk plans using the HMO weights and a 17% range using fee-for-service weights. The fee-for-service plan and group-model HMO with large enrollments have risk mixes near the center of the spectrum. Smaller HMOs exhibit the extreme forms of both favorable and adverse selection.

The statistical methods adopted in this study can be used to risk-adjust capitation payments to competing health plans. As mergers among HMOs and group purchasing arrangements among employers increase the average enrollment in each plan from each payor, however, risk differences among plans will be attenuated and the need to risk-adjust payments will be less severe. Key words: health insurance; adverse selection; managed competition; health maintenance organization. (Med Care 1995;33:1161-1175)

The managed competition approach to health care reform relies on price-conscious choice by consumers to spur cost-conscious performance by health plans. To the extent healthy and sick consumers systematically

select different plans, however, premiums will reflect epidemiologic risk as well as organizational efficiency. Numerous studies have compared risk differences between individual fee-for-service health insurance plans and prepaid health maintenance organizations (HMOs).¹⁻⁴ The emerging marketplace, however, features competition among multiple HMOs rather than competition between one fee-for-service plan and one HMO.

We analyze risk differences among nine competing health plans that contracted with

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a large private employer in 1989. Using demographic, personnel, outpatient utilization, and hospital discharge data from one large HMO, we estimate the annual expenditures each of the nine plans' enrollees would have incurred, had they been enrolled in that HMO. Most published studies use fee-for-service claims data as the basis for relative risk comparisons, despite the fact that consumer enrollment and policy interest are shifting toward HMOs. Risk weights based on HMO data will better predict patterns of utilization among competing HMOs than will weights based on fee-for-service claims. To compare our HMO-based results with fee-for-service-based studies, we use outpatient and inpatient claims from a fee-for-service plan to predict annual expenditures each plan's enrollees would have incurred had they been enrolled in the fee-for-service plan.

The two sets of risk weights, based on HMO and fee-for-service expenditure data respectively, are used to calculate two measures of risk selection for each of the nine health plans. We compare the relative risk among plans according to whether they have large or small enrollments from the firm under study and according to plan type: group HMO, independent practice or network HMO, and fee-for-service plan. We compare the HMO and fee-for-service weights for particular health plans and evaluate whether the different weights produce different rank orderings for adverse and favorable selection.

Methods

Statistical Model of Medical Expenditures

Differences in enrollee expenditures among health plans depend on differences in epidemiologic risk, differences in benefit packages (service coverage, cost sharing provisions), and differences in plan efficiency (administrative costs, style of utilization management). To ascertain the differ-

ences in risk, it is first necessary to account for the benefit and efficiency factors. Relative risk among health plans can be conceptualized as the differences in expenditures that would be observed among the various enrollee groups if all were covered by the same benefit package and subject to the same style of utilization management and other health plan features.

Most studies of adverse selection control for benefit package and plan efficiency by studying utilization differences between fee-for-service enrollees who remain in their plan and fee-for-service enrollees who switch to an HMO.²⁻⁴ That approach assumes that utilization patterns in the year prior to switching accurately measure utilization patterns in the years after switching, when enrollees of the fee-for-service plans have joined the HMO. Moreover, it assumes that the small number of new HMO members who switched from the fee-for-service plan are representative of the larger population of long-term HMO enrollees. The one published study of post-switch utilization raised questions concerning the validity of both these assumptions.⁵

The alternative approach to measuring risk selection uses data from one health plan to develop a set of weights for each enrollee characteristic, based on the statistical correlation between demographic characteristics and medical care expenditures. These weights are then assigned to the enrollees in the other health plan based on their demographic characteristics. This approach produces a measure of predicted expenditures for each enrollee, regardless of the health plan in which he or she actually is enrolled. Intuitively, it measures the medical care expenditures each individual would have incurred, had he or she been enrolled in the plan from which the expenditure data were obtained. Comparisons of predicted expenditures per enrollee across the two health plans identifies differences in propensity to incur costs, independent of benefit package and plan efficiency.

This approach was developed by the authors in an earlier study using weights from a fee-for-service plan, which were then used to compare predicted expenditures per enrollee in the fee-for-service plan with predicted expenditures per enrollee in one HMO.⁶ Here we extend the approach by using HMO utilization and expenditure data as the primary source for weights and by comparing risk among multiple competing health plans rather than just between two.

We use a four-equation maximum likelihood model developed by the RAND Health Insurance Experiment.⁷ The demographic and personnel characteristics of enrollees in one HMO were used as covariates to generate four sets of parameter estimates determining the probability of any medical care utilization during the year, the probability of inpatient utilization, annual expenditures if outpatient but not inpatient care is used, and annual expenditures if inpatient care is used. The four-equation model is superior to a single equation approach given the underlying distribution of expenditures in the population; some individuals use no medical care during any given year, many use outpatient care only, and some use inpatient as well as outpatient care. Formally:

- (1) $\Pr [\text{EXP} > 0] = L(X A_1)$
- (2) $\Pr [\text{HOSPEXP} > 0 / \text{EXP} > 0] = L(X A_2)$
- (3) $\log [\text{EXP} / \text{EXP} > 0] = X B_1 + U_1$
- (4) $\log [\text{EXP} / \text{HOSPEXP} > 0] = X B_2 + U_2$

Here EXP indicates total annual expenditures and HOSPEXP indicates inpatient expenditures. Parameter vectors A_1 and A_2 in equations (1) and (2) are estimated using logit; parameter vectors B_1 and B_2 in equations (3) and (4) are estimated using ordinary least squares. The statistical properties of this model have been analyzed in detail by the RAND researchers.⁸

These parameter vectors were used to develop a measure of predicted expenditures indicating how much each employee (and his or her dependents) would have incurred if enrolled in the HMO. We use the sub-

scriber unit (employee plus any covered dependents) rather than the individual as the unit of observation because all members of a subscriber unit must make the same choice of health plan. Furthermore, data are not available on the demographic characteristics of dependents. Predicted values were calculated by multiplying the employee's values on the covariates (age and gender, marital status, number covered in subscriber unit, employment tenure, salary, geographic area) by the parameters. The predicted probability of employee i using any medical care services during the year is $L(X_i A_1)$, the predicted probability of using hospital care is $L(X_i A_2)$, predicted logarithmic expenditures if outpatient but not inpatient care is used is $(X_i B_1)$, and predicted logarithmic expenditures if inpatient and outpatient care are used is $(X_i B_2)$. The predicted logarithmic expenditures are reconverted into dollar units using the formula $[(\exp(X_i B) * Z)]$, where Z is Duan's nonparametric transformation.⁹ Predicted values are based on demographic and personnel variables that are available for enrollees in all nine health plans, not merely for enrollees in the HMO.

The four predicted values for each employee unit are combined into a single measure of predicted annual medical care expenditures using the formula:

- (5) Predicted expenditures $_i = P_i * [(1 - Q_i) * \exp(X_i B_1) * Z] + [Q_i * \exp(X_i B_2) * Z]$

Predicted expenditures for subscriber unit i are based on the probability that any care will be used [$P_i = L(X_i A_1)$] multiplied by a weighted average of expenditures if only outpatient services are used [$\exp(X_i B_1) * Z$] and expenditures if both inpatient and outpatient services are used [$\exp(X_i B_2) * Z$], with weights based on the probability of using [$Q_i = L(X_i A_2)$] or not using $(1 - Q_i)$ inpatient services. A second set of four regression equations is then estimated using inpatient and outpatient claims data from the fee-for-service plan. The parameter estimates are used to generate a second set of weights for

demographic and personnel characteristics and hence a new measure of predicted expenditures for all employees and dependents.

The parameter estimates and risk weights derived from them are subject to self-selection bias because employees choose their health plans rather than being assigned randomly. In general, we anticipate that employees will select the health plan whose benefit package and style of utilization management best corresponds to the employee's needs and preferences. For example, young workers anticipating need for maternity services are more likely to choose an HMO, which fully covers prenatal and well baby care, than are otherwise similar young workers not anticipating need for these forms of care. The HMO-based regression parameters in equations (1) to (4) and measure of predicted expenditures in equation (5) will reflect accurately the utilization of those young employees who choose the HMO but will overestimate the utilization of covered services for young employees who choose the fee-for-service plan. Conversely, fee-for-service-based weights will underestimate the utilization of covered services for young workers who choose the HMO despite accurately estimating the utilization of those who select the fee-for-service plan.

Heckman¹⁰ has analyzed this self-selection problem as a form of specification bias and proposed a solution based on extending the set of covariates used in the regression equation. A first-stage regression is used to derive the predicted probability for each individual of selecting one option over the other. A nonlinear function of each observation's predicted probability (the inverse Mills ratio) is then inserted in the second stage regression as a covariate. Ideally, the analyst would possess variables that strongly influence initial choice of health plan but do not influence utilization for enrollees after they

have chosen their plans, and hence that would be included in the first-stage regression but excluded from the second-stage regression. If such a class of variables is not available, the Heckman correction reduces to a change in the functional form of the equation of interest (here, the expenditure equation). Interpretation of the coefficient on the inverse Mills ratio as an indicator of self-selection rather than merely as a second order term in the uncorrected equation presumes a priori knowledge of the true functional form. Moreover, the Heckman correction has been shown to produce unstable parameter estimates if the true functional form of the prediction equation is not known and is misspecified.¹¹

No data were available in this study that could plausibly influence choice of health plan but not utilization subsequent to plan choice. An extension of the Heckman approach from the conventional context of dichotomous choice for the first stage (ie, whether to participate in the labor force) and single least squares regression for the second stage (ie, log wages for those participating in the labor force) to this context of polychotomous choice in the first stage (choice among nine health plans) and nonlinear equation system for the second stage (four equation censored lognormal maximum likelihood model) was unattractive.

Our approach relies on comparison of the HMO-based weights and the fee-for-service-based weights to evaluate whether the self-selection problem seriously undermines the validity of the risk-adjustment methodology. A full evaluation of this issue would require data from contexts where individuals are assigned to health plans rather than being permitted to choose for themselves. Comparison of the relative risks and rank orders of risk among nine health plans using the HMO and fee-for-service weights will provide preliminary evidence on whether the differences are significant.

Enrollment, Demographic, Personnel, and Utilization Data

Health plan enrollment, demographic, and personnel data were obtained from the Bank of America for 16,182 employees in Northern California in 1989. Analysis was limited to full-time employees aged younger than 65 years who were employed the entire year and who were enrolled in any of the nine principal health plans used by the Bank. These included a self-insured fee-for-service plan administered by Blue Shield of California, a large group model HMO (Kaiser Permanente of Northern California), and seven independent practice and network HMOs (Lifeguard; QualMed; Health Plan of America, Childrens Hospital Plan; Foundation; HealthNet; TakeCare).

The data files included number of covered individuals in the subscriber unit (one, two, three or more), age, gender, marital status, monthly salary, employment tenure, and zip code of residence. These data elements were recoded as dichotomous variables: eight age and gender categories, three marital status categories (single, female married, male married), three subscriber unit categories (one, two, three or more covered members), four employment tenure categories (less than or equal to 3 years, 3 to 6 years, 6 to 13 years, more than 13 years), three monthly salary categories ($\leq \$1500$, $\$1500$ to $\$2100$, $> \$2100$), and five geographic area categories.

Health care utilization and expenditure data were obtained from the two plans with the largest Bank enrollment: Kaiser Permanente and Blue Shield. In each case these data are aggregated to the level of the subscriber unit: expenditures incurred by covered dependents are thus ascribed to the employee. Health plan data were linked to the Bank's personnel data using employee identifiers. Utilization data were not available for Bank enrollees in the other seven health plans. Demographic and personnel data were available for these employees, however.

Kaiser provided annual expenditures for each Bank employee and dependents based on inpatient discharge abstracts, outpatient utilization records, and internal cost weights (Kaiser physicians and hospitals are compensated on a capitation basis and do not file fee-for-service claims to the Kaiser HMO). Inpatient expenditures per employee and dependents are calculated based on the hospital discharge abstract (diagnosis-related group [DRG], disease stage [I through IV], and length of stay). Weights for each element were calculated by Kaiser based on charge data by DRG, disease stage, and length of stay from non-Kaiser hospitals in California, using the comprehensive patient discharge data system from the California Office of Statewide Health Planning and Development. Outpatient expenditures per subscriber unit were calculated based on annual number of visits by major department, with cost weights for each departmental visit based on allocation of direct and overhead expenditures. Expenditures for each subscriber were truncated at \$50,000 and converted to logarithmic units.

Comprehensive medical care claims data for 1989 were obtained from Blue Shield of California and linked to the personnel files for fee-for-service plan enrollees. Claims incurred in 1988 but filed in 1989 were excluded; claims incurred in 1989 but filed in 1990 were included. Expenditures were measured in terms of the allowed charge on each claim, summed for each subscriber unit over the entire year. Billed charges that exceeded the Blue Shield allowed charge per procedure or not covered by the benefit package were excluded. Annual expenditures per subscriber unit were truncated at \$50,000 and converted into logarithmic units. Four variables (any utilization, any inpatient utilization, expenditures if no hospital care was used, expenditures if hospital care was used) were calculated. The entire allowed charge was used without regard to its distribution among the employee

(through deductible and coinsurance provisions), Blue Shield, or other insurers (through coordination of benefits provisions).

Application of Statistical Model

The predictive accuracy of the model was measured through a comparison of predicted with actual expenditures for Kaiser enrollees. The full sample of 7415 Kaiser enrollees was sorted into two random subsamples. Parameters were estimated on one subsample and then applied to the other subsample to generate predicted expenditures per enrollee unit. These predicted expenditures were summed over the subsample and compared with the actual expenditures for that subsample. The mean predicted expenditures and the mean actual expenditures differed by only 1.07%.

Predicted expenditures per employee and dependents were aggregated for each of the nine health plans. The mean predicted expenditure measures the risk of the enrolled population in each plan, interpreted in terms of how much the enrollees in that plan would have spent, had they been enrolled in Kaiser. We calculate the mean predicted expenditure for each of the nine health plans, the 95% confidence interval for the means, the mean and 95% confidence interval for all nine health plans combined, and the ratio of mean expenditures for each health plan to mean expenditures for all health plans combined.

A second set of analyses was conducted for Bank employees in each of the nine health plans using fee-for-service claims data from Blue Shield in a manner analogous to that used with the Kaiser data. This generated a second set of predicted expenditures for each Bank employee and dependents, a second set of mean predicted expenditures and confidence intervals per health plan, and a second set of expenditure ratios between each health plan and all health plans combined.

Results

Determinants of Health Maintenance Organization Utilization and Expenditure

Table 1 presents parameter estimates for the four equation model estimated using personnel and expenditure data for Kaiser enrollees. Of the 7,415 enrollees, 6,625 (89%) used some services during 1989. Of those using any services, 653 (9.8%) used inpatient as well as outpatient services. The mean annual expenditure for persons using only outpatient services was \$1,129. For users of inpatient services, expenditures averaged \$10,720.

The parameters on the covariates differ substantially across the four equations, indicating the importance of using a multiequation approach. Compared with young men (the reference category), probability of outpatient and inpatient use does not increase significantly with age among men (within this employed population), but annual expenditures rises steeply and significantly with age among those with inpatient use. Gender differences are important and vary across the four measures of utilization and expenditure. Compared with young men, young women workers have significantly higher probability of using any services, somewhat higher probability of being admitted to a hospital, and significantly higher outpatient expenditures. Expenditures for young women admitted to a hospital are lower than those of young men admitted to a hospital. Probability of any use exhibits a U-shaped relation with age for women, with the highest use among the youngest and oldest groups. The probability of hospital admission declines after age 35. Outpatient expenditures increase gradually with age among women, as do expenditures among women who use the hospital. These parameters illustrate the importance of maternity care, a relatively frequent but relatively low-cost inpatient service, for young women compared with young men and older women.

TABLE 1. Determinants of Utilization and Expenditures Among HMO Enrollees

	Probability of Outpatient Use	Probability of Hospital Use	Log Outpatient Expenditures	Log Total Expenditures
Male 36–45 years	-0.199 (0.145)	-0.080 (0.191)	0.181 (0.050)	0.127 (0.112)
Male 46–55 years	-0.160 (0.224)	-0.141 (0.250)	0.060 (0.066)	0.236 (0.148)
Male 56–65 years	0.149 (0.384)	0.028 (0.342)	0.148 (0.101)	0.521 (0.202)
Female 18–35 years	0.820 (0.115)	0.309 (0.202)	0.287 (0.044)	-0.235 (0.130)
Female 36–45 years	0.622 (0.145)	-0.120 (0.221)	0.321 (0.049)	-0.091 (0.136)
Female 46–55 years	0.692 (0.178)	0.004 (0.243)	0.317 (0.057)	0.091 (0.152)
Female 56–65 years	0.989 (0.255)	-0.056 (0.323)	0.440 (0.077)	0.365 (0.199)
1 dependent	1.229 (0.126)	0.534 (0.131)	0.488 (0.035)	-0.018 (0.076)
2 or more dependents	2.445 (0.171)	0.521 (0.134)	0.998 (0.036)	0.107 (0.076)
Male married	0.500 (0.163)	0.571 (0.215)	0.181 (0.051)	-0.235 (0.129)
Female married	-0.110 (0.123)	0.610 (0.125)	-0.011 (0.034)	0.016 (0.072)
Tenure 3–6 years	0.142 (0.118)	0.058 (0.149)	0.119 (0.040)	-0.090 (0.089)
Tenure 6–13 years	0.183 (0.113)	0.152 (0.134)	0.083 (0.037)	-0.072 (0.079)
Tenure 14+ years	0.108 (0.138)	-0.130 (0.156)	0.004 (0.042)	-0.162 (0.093)
Salary: medium	0.267 (0.107)	0.044 (0.109)	-0.076 (0.032)	0.078 (0.064)
Salary: high	0.294 (0.103)	-0.197 (0.117)	-0.022 (0.032)	0.103 (0.070)
Region: San Francisco	-0.388 (0.125)	-0.078 (0.119)	0.007 (0.034)	0.075 (0.070)
Region: Oakland	-0.311 (0.125)	-0.046 (0.113)	0.099 (0.034)	0.020 (0.066)
Region: San Jose	-0.210 (0.178)	-0.058 (0.168)	-0.010 (0.048)	-0.010 (0.099)
Region: Fresno	-0.259 (0.285)	-0.161 (0.255)	0.070 (0.074)	-0.300 (0.151)
Intercept	0.896 (0.152)	-2.969 (0.221)	5.750 (0.053)	9.107 (0.137)
Adjusted R^2	—	—	0.21	0.05
-2 log L	4317	4111	—	—
N	7415	6625	5972	653

HMO, health maintenance organization.

Compared with Bank employees with no covered dependents, the reference category, those with one and those with two or more dependents are significantly more likely to use any services and to use hospital services. The association is much stronger for outpatient than for inpatient utilization, consistent with the fact that most dependents are children who use many outpatient services but are rarely in need of hospitalization. Employees with two or more dependents are not more likely to use hospital services at least once during the year than are those with only one dependent. Even after adjusting for type of coverage, marital status exerts a significant impact on utilization and expenditures. Subscriber units with married men are much more likely to use some services and to use hospital services than are single employees, controlling for number of dependents covered. Among those with some hospital use, however, married men have lower annual expenditures than do singles. This again illustrates the importance of maternity utilization, here being incurred by dependents rather than by Bank employees directly. Compared with single employees, married women are no more likely to use outpatient services but

are more likely to use inpatient services. The marital status variables are also picking up the effect of number of dependents among employees with more than two covered dependents.

After adjusting for age, employment tenure is not consistently associated with utilization and expenditures. Compared with the reference category of workers with less than three years tenure, outpatient expenditures are higher for those with intermediate years of tenure but not for the longest employed. Compared with the reference category of the lowest paid employees, probability of using any services is higher among middle and high income employees, while the probability of using hospital services is not.

Adverse Selection Among Health Plans: Health Maintenance Organization Weights

Table 2 presents enrollment size, mean predicted expenditures, the 95% confidence interval for the mean, and the ratio of plan mean to global mean for each of the nine health plans, using predicted expenditures derived from the parameters in Table 1. Average risk (mean predicted expenditures) ranges from a low of \$1,693 in Health Net to

TABLE 2. Enrollment, Predicted Expenditures per Enrollee, and Relative Risk for Nine Health Plans (HMO Risk Weights)

Health Plan	Enrollment From Firm in Plan	Predicted Expenditures per Enrollee (\$)	95% Confidence Interval	Ratio to Total	Risk Rank
Blue Shield	5,019	1,886	(1,862, 1,910)	1.00	4
Kaiser	7,415	1,873	(1,852, 1,894)	0.99	5
Foundation	428	2,085	(2,008, 2,162)	1.11	1
Take Care	624	1,845	(1,777, 1,913)	0.98	7
Childrens	1,060	1,775	(1,719, 1,831)	0.94	8
HP America	352	1,871	(1,784, 1,958)	0.99	6
QualMed	739	2,024	(1,959, 2,089)	1.07	3
Health Net	112	1,693	(1,540, 1,846)	0.90	9
Lifeguard	433	2,071	(1,988, 2,154)	1.10	2
All plans	16,182	1,886	(1,872, 1,900)	1.00	—

HMO, health maintenance organization.

a high of \$2,085 in Foundation, a difference of 23% between lowest and highest. Kaiser Permanente and Blue Shield, with the largest enrollee populations, had mean predicted expenditures similar to the average across all plans. Five independent practice associations and network health plans have risk differences significantly different from the average across all plans: Foundation, Childrens Hospital Plan, QualMed, Health Net, and Lifeguard. No consistent correlation is observed between type of health plan and risk mix. Both the highest and lowest cost populations are found in independent practice and network HMOs; the group model HMO and the fee-for-service plan are near the center of the distribution. The one salient factor is enrollment size. Generally, plans with larger enrollments have predicted expenditures closer to the global mean, suggesting the influence of risk averaging in large groups.

Determinants of Fee-for-Service Utilization and Expenditure

Table 3 presents parameters from the four equation model estimated using the fee-for-service claims data from Blue Shield of California, comparable with the Kaiser-based parameters in Table 1. The dependent variables differ significantly across the two health plans, consistent with the general literature on cost differences between traditional fee-for-service and group model HMOs. Compared with Kaiser enrollees, fee-for-service enrollees are less likely to use any services (83% compared with 89%) due to cost sharing provisions, but more likely to use hospital services (12.3% compared with 8.8%). Among those using outpatient services only, mean expenditures are \$1,554. Among those using inpatient services as well, mean annual expenditures are \$15,118. Generally, therefore, the distribution of expenditures is broader in the fee-for-service plan than in the HMO: more persons with zero expenditures, more

with very high expenditures, and correspondingly fewer with intermediate expenditures. The mean expenditure for fee-for-service enrollees is substantially higher than the mean expenditure for HMO enrollees, illustrating the substantial reductions in medical expenditures achieved by this prepaid group practice relative to the unmanaged indemnity plan.

Age and gender exert different effects on utilization and expenditure in the fee-for-service plan compared with the Kaiser HMO. Women are significantly more likely to use outpatient services than are men, with the differential much larger than for Kaiser, illustrating the disproportionate influence of cost sharing on male compared with female utilization. However, among those actually using outpatient services, expenditures are not consistently higher among young female (35 or younger) than among young male Blue Shield enrollees. Among those using hospital services, expenditures for young women are lower than expenditures for young men. The age-related gradient of outpatient utilization and expenditures is steeper among women in the fee-for-service plan than in the HMO.

Fee-for-service plan enrollees with covered dependents use significantly more outpatient and inpatient services than those without dependents, but the association is weaker than in the case of Kaiser. Married men are significantly more likely to use outpatient services than are single workers, with the association being slightly stronger than for Kaiser enrollees. Only a modest and statistically insignificant association is observed between marital status for men and inpatient utilization in the fee-for-service plan, however, in contrast with the strong association for Kaiser. In other research, we have documented the tendency for married workers to switch to an HMO when anticipating inpatient maternity services, because of the lower cost sharing and more extensive coverage for well-baby care in the HMO.⁵

TABLE 3. Determinants of Utilization and Expenditures Among Free-for-Service Plan Enrollees

	Probability of Outpatient Use	Probability of Hospital Use	Log Outpatient Expenditures	Log Total Expenditures
Male 36–45 years	0.359 (0.160)	-0.331 (0.216)	0.296 (0.102)	0.312 (0.181)
Male 46–55 years	0.296 (0.193)	-0.094 (0.230)	0.395 (0.114)	0.548 (0.189)
Male 56–65 years	0.367 (0.273)	0.294 (0.283)	0.601 (0.154)	0.813 (0.228)
Female 18–35 years	1.271 (0.160)	0.033 (0.247)	0.070 (0.109)	-0.498 (0.226)
Female 36–45 years	1.295 (0.163)	-0.389 (0.253)	0.326 (0.109)	-0.535 (0.227)
Female 46–55 years	1.115 (0.174)	-0.116 (0.260)	0.379 (0.115)	-0.520 (0.238)
Female 56–65 years	1.494 (0.205)	-0.034 (0.283)	0.636 (0.129)	-0.229 (0.250)
1 dependent	0.943 (0.141)	0.408 (0.150)	0.456 (0.073)	-0.029 (0.124)
2 or more dependents	1.188 (0.117)	0.383 (0.130)	0.554 (0.061)	-0.075 (0.108)
Male married	0.774 (0.158)	0.349 (0.220)	0.106 (0.096)	-0.415 (0.187)
Female married	0.044 (0.119)	0.438 (0.143)	0.096 (0.065)	0.322 (0.118)
Tenure 3–6 years	0.540 (0.156)	0.052 (0.187)	0.183 (0.089)	0.158 (0.158)
Tenure 6–13 years	0.443 (0.134)	0.041 (0.168)	0.122 (0.080)	0.038 (0.141)
Tenure 14+ years	0.112 (0.138)	-0.150 (0.173)	0.038 (0.081)	0.199 (0.146)
Salary: medium	-0.197 (0.121)	-0.262 (0.141)	-0.202 (0.071)	-0.061 (0.116)
Salary: high	0.336 (0.112)	-0.360 (0.125)	0.069 (0.063)	-0.161 (0.102)
Region: San Francisco	0.068 (0.148)	0.091 (0.163)	0.104 (0.079)	0.133 (0.136)
Region: Oakland	0.077 (0.154)	0.138 (0.167)	0.104 (0.081)	0.198 (0.139)
Region: San Jose	-0.155 (0.170)	0.107 (0.185)	-0.046 (0.092)	0.140 (0.156)
Region: Fresno	0.036 (0.198)	0.048 (0.202)	-0.160 (0.101)	-0.100 (0.169)
Region: North	0.247 (0.218)	-0.326 (0.224)	-0.322 (0.104)	0.011 (0.194)
Intercept	-0.423 (0.213)	-1.930 (0.299)	5.771 (0.139)	9.290 (0.257)
Adjusted R^2	—	—	0.07	0.06
-2 log L	4095	3419	—	—
N	5019	4182	3563	619

Adverse Selection Among Health Plans: Fee-for-Service Weights

Table 4 presents enrollment and mean predicted expenditures for each of the nine health plans based on fee-for-service parameters from Table 3. Average expenditures per enrollee range from a low of \$2,695 in Health Net to a high of \$3,144 in Lifeguard. While the average expenditure for all nine plans is much higher using the fee-for-service weights compared to the HMO weights (\$2,900 compared with \$1,886), the spread in risk among the nine plans is narrower using the fee-for-service weights (17% compared with 23%).

In contrast to the figures presented in Table 2 using the HMO weights, the fee-for-service plan has predicted expenditures above the global average in Table 4 using fee-for-service weights. This illustrates the influence of benefit design, cost sharing, and utilization review on relative risk for different types of subscriber units and of the tendency for different types of subscriber units to select the health plan that provides the most congenial environment for the type of medical care services they seek. For example, young families incur relatively low costs (compared with older single men) in a conventional fee-for-service plan with heavy cost sharing restrictions on outpatient utilization

and with exclusion of well-baby care from the benefit package but with few controls on inpatient utilization for chronic diseases common among older men. In contrast, an HMO such as Kaiser has little cost sharing, generous coverage of preventive and well baby visits, but stringent management of inpatient utilization for nonmaternity causes.

Health Maintenance Organization and Fee-for-Service-Based Measures of Risk Selection

Table 5 presents descriptive statistics on the distribution of predicted expenditures for the entire workforce (N = 16,182) using the HMO-based and fee-for-service-based risk weights, respectively. As reported in Tables 2 and 4, the means from the two distributions are quite different, with predicted expenditures per enrollee using the fee-for-service weights being 54% greater than predicted expenditures using the HMO weights. Of equal interest, however, is the spread of predicted risk using the two measures. The range and standard deviations of risk using the fee-for-service weights are 2.7 and 1.5 times the range and standard deviation using the HMO weights. While the maximum predicted expenditures is 8.5

TABLE 4. Enrollment, Predicted Expenditures per Enrollee, and Relative Risk for Nine Health Plans (Fee-for-Service Risk Weights)

Health Plan	Enrollment From Firm in Plan	Predicted Expenditures per Enrollee (\$)	95% Confidence Interval	Ratio to Total	Risk Rank
Blue Shield	5,019	2,988	(2,950, 3,026)	1.03	3
Kaiser	7,415	2,850	(2,820, 2,880)	0.98	6
Foundation	428	2,877	(2,771, 2,983)	0.99	5
Take Care	624	2,931	(2,828, 3,034)	1.01	4
Childrens	1,060	2,721	(2,651, 2,791)	0.94	7
HP America	352	2,698	(2,573, 2,823)	0.93	8
QualMed	739	3,028	(2,944, 3,112)	1.04	2
Health Net	112	2,695	(2,480, 2,910)	0.93	9
Lifeguard	433	3,144	(3,020, 3,268)	1.08	1
All plans	16,182	2,900	(2,880, 2,920)	1.00	—

TABLE 5. The Distribution of Predicted Expenditures per Year Using HMO-Based and FFS-Based Weights

	HMO Weights	FFS Weights	FFS/HMO Ratio
Mean	1,886	2,900	1.54
Standard deviation	894	1,318	1.47
Coefficient of variation	0.47	0.45	0.96
Minimum	523	639	1.22
Maximum	4,462	11,311	2.53
Range	3,939	10,672	2.71
Maximum/minimum	8.53	17.7	2.08

HMO, health maintenance organization; FFS, fee-for-service.

times the minimum using the HMO weights, the maximum is 17.7 times the minimum using the fee-for-service weights. The two distributions yield similar coefficients of variation, however, because the fee-for-service weights produce a larger mean, as well as a larger standard deviation than the HMO weights.

The differences between the HMO and fee-for-service weights in risk spread is consistent with the financial incentives in each plan. The HMO has no deductible and only very small copayments, which encourages use of ambulatory services and reduces the number of enrollees with zero expenditures, but stringent management of inpatient utilization, which reduces expenditures for the sickest enrollees. The fee-for-service plan has significant deductible and copayment provisions, which inhibit utilization of ambulatory services and produce large number of enrollees with zero reported expenditures, but no management of inpatient utilization, which permits high expenditures for the sickest enrollees. However, the narrow spread of predicted expenditures observed using the HMO weights is also caused partly by the manner in which the HMO expenditure data were calculated. The Kaiser HMO does not generate claims data for inpatient expenses but, rather, imputes expenditures based on the DRG, stage of disease, and length of stay for each patient. This implies that particularly high and low values within

each individual DRG/stage/length of stay cell are replaced by the average values for all patients within that cell. This narrows the variance across patients. However, the variance in expenditures relative to average expenditures (coefficient of variation) is the same for the HMO and fee-for-service weights, as noted above. The important issue for present purposes is not whether one set of weights better reflects true costs than the other but, rather, whether the two sets of weights produce substantially different measures of risk selection among competing health plans.

Figure 1 plots the relative risks for enrollees in each of the nine health plans using the HMO and fee-for-service weights, respectively. These relative risks are calculated by dividing the mean predicted risk for each health plan by the mean predicted risk for all health plans combined. Health plans with risk indices > 1 suffer from adverse selection, while plans with risk indices < 1 benefit from favorable selection. The plans cluster along the 45° line, indicating that the HMO-based and fee-for-service-based measures of risk selection produce qualitatively similar relative risk indices. Four plans lie in the lower left quadrant of the Figure, indicating that they enjoy favorable selection using both the HMO and fee-for-service weights, while three plans lie in the upper right quadrant, indicating that they suffer from adverse selection using both sets of

FIG. 1. Relative risk among competing health plans using health maintenance organization and fee-for-service expenditure weights.

weights. One plan suffers from adverse selection using the fee-for-service weights while benefitting from favorable selection using the HMO weights, but the differences are only slight. One plan, however, which lies in the upper left quadrant, suffers from 10% above-average predicted expenditures (adverse selection) using the HMO weights while enjoying (very slight) favorable selection using the fee-for-service weights. The two aberrant health plans both have relatively small enrollment from the Bank. Thus, despite various differences between the HMO and fee-for-service expenditure data, the final measures of risk selection among competing health plans are similar for the two types of risk weights.

Discussion

Health plan premiums reflect the generosity of the benefit package, the efficiency of the delivery system, and the epidemiologic mix of the enrollees. For price competition to stimulate efficiency among health plans, the effects of benefit coverage and epidemiologic risk on price must be distinguished from that of plan efficiency. Advocates of a managed competition approach to health care reform often propose to mandate a standard benefit package (except for

allowing differences in copayments) to forestall competition based on dropping socially appropriate services and/or using benefit coverage to encourage enrollment of healthy consumers and discourage enrollment by the chronically ill.^{12,13} They propose to socialize the epidemiologic risk among health plans by mandating that public and private sponsors pay higher premium contributions to plans with more risky enrollees. The residual differences among plans in premiums are to be borne by the consumers themselves, preferably with after-tax dollars, as an incentive to choose more efficient plans and thereby stimulate efficiency among plans.

Serious methodological problems confront attempts to measure and compensate adverse selection among health plans. Better methods are under development, using additional predictor variables (eg, self-reported health status, prior use of nondiscretionary medical care) and flexible payment approaches (eg, blends of capitation and fee-for-service). Valid and reliable risk assessment and risk adjustment tools are essential to forestall health plan competition for healthy patients and discrimination against the chronically ill, unwarranted profits for plans benefitting from favorable selection and unwarranted losses for plans

suffering from adverse selection, and the economic demise of health plans treating those patients most in need of care.

This study highlights the fact that medical care utilization is not based solely on epidemiological factors but depends on organizational and economic factors in particular health plans. Any set of predicted expenditures, which forms the basis of risk adjustment models, depends on the source of the underlying utilization and expenditure data. As documented in this study, risk weights developed using HMO data vary somewhat from those using fee-for-service plan data. As Figure 1 shows, the HMO-based and fee-for-service-based measures are not dramatically different, but neither are they identical. In part, the observed variation is caused by differences in benefit packages, which would be attenuated if a standard package were mandated. However, some variation would remain because of differences among plans in utilization management practices.

It is important to highlight the limitations inherent in the HMO and fee-for-service risk weights presented here. The weights are based on the medical care utilization and expenditure patterns of individuals who were permitted to choose among multiple competing plans. They were not assigned randomly. It is to be expected that consumers select the health plan whose out-of-pocket cost, benefit package, network coverage, and style of utilization management best fit their budgets, needs, and preferences. The HMO risk weights provide unbiased estimates of the medical expenditures for those individuals who choose the HMO, but possibly biased estimates for those who choose the fee-for-service plan. Conversely, the fee-for-service risk weights provide unbiased estimates for fee-for-service enrollees but possibly biased estimates for HMO enrollees. There is no simple econometric solution to this data problem. In practice, however, the extent of the bias appears small. The HMO and fee-for-serv-

ice weights produce similar risk rankings for the nine health plan populations studied here. Further research is desirable. Nevertheless, it is encouraging that this study, the first to calculate risk selection using comparable HMO and fee-for-service weights, found no major differences in the final risk measures.

A major substantive finding of this study contradicts the common presumption that fee-for-service plans invariably attract the highest risk mix of enrollees and that HMOs invariably attract the lowest risk enrollee mix. Using both the HMO and the fee-for-service weights, the fee-for-service plan had a risk mix near the center of the overall distribution, as did the group model HMO. The IPA and network model HMOs exhibited both very high-risk and very low-risk mixes. One key determinant appears to be enrollment size, reflecting the law of large numbers: plans with many enrollees tend to have a representative mix of high and low risk patients. Smaller plans are more susceptible to unrepresentative enrollments.

The long-term solution to risk selection in a competitive health care system has three elements. First, standardization of the benefit package will reduce the incentives for risk selection and facilitate measurement of residual risk differences through comparisons of predicted expenditures among plans. Second, a consolidation of both purchasers (through purchasing cooperatives) and health plans (through the integration of physicians, hospitals, and HMOs) at the regional level will lead to larger and more similar enrollee populations from each sponsor in each health plan, further reducing variation among health plans in epidemiologic risk. Third, risk assessment and adjustment methods will be used to compensate health plans for residual differences in risk and, in particular, to remove the financial penalty currently suffered by plans that enroll patients with high cost conditions.

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