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Use of ambulatory care services in three provider plans: interactions between patient characteristics and plans

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Use of Ambulatory Care Services in Three Provider Plans: Interactions between Patient Characteristics and Plans

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Abstract: A previous study of low-income enrollees in a closed-panel health maintenance organization (HMO) and a Blue Cross/Blue Shield (BC/BS) plan showed that the effect on the use of health services of the age, sex, health status, previous health care use, race, and family size of the enrollees was different in the two plans. We have replicated this study using the same two provider plans but studying a different group of white collar, middle class enrollees. A third plan, an experimental independent practice association (IPA), was also available for analysis. Utilization was defined as use (yes/no) and the quantity of use for those who used services (in standardized dollars). Significant interactions were detected between plan and all of the independent variables but race. The use of services in the HMO was least affected by enrollees' characteristics (age, sex, race, health status, prior use, family size) and use was most sensitive to patient characteristics in BC. In some respects, the IPA was more like the HMO and in other respects more like the BC/BS plan. (Am J Public Health 1984; 74:47-51.)

Introduction

Many studies have found patient characteristics to be correlated with the use of health services. However, we are aware of only one study of whether the effects of these correlates on ambulatory use is the same in different provider plans. That study compared a closed-panel health maintenance organization (HMO) to a comprehensive Blue Cross/Blue Shield (BC/BS) plan. The age, sex, health status, previous cost of services, and family size of enrollees had less effect on the number of visits in the HMO than in the BC/BS plan. However, the effect of race was stronger in the HMO.

Since these findings might have been unique to the time period or to the low income of the enrollees studied, we have replicated this analysis using new ambulatory care data on largely middle class, white collar enrollees in the two original plans and a third plan, an independent practice association (IPA).

Methods

The data are taken from the State Employees Insurance Board Utilization Study (SEIBUS). Comprehensive inpatient and outpatient health care benefits were offered to Washington State employees through an employer-sponsored health insurance program in which the State paid all the premiums. The study population consisted of all state employees living in King County (Washington), which is the Seattle metropolitan area. The employees could select from among three alternative health insurance plans.

The first plan was Blue Cross (BC), a comprehensive insurance plan with inpatient and outpatient coverage, similar to a comprehensive BC/BS plan. There was a $50 per individual and $150 per family annual deductible, and 10 per cent coinsurance, up to a maximum of $1,950 per family. Blue Cross paid physicians on a fee-for-service basis, and enrollees could select from nearly any community provider of care.

Group Health Cooperative of Puget Sound (GHC), a consumer-owned prepaid closed-panel health maintenance organization with no deductible and no copayment provisions except on drugs, maternity, and mental health services, was the second plan offered. Enrollees were required to use GHC facilities and GHC's salaried physicians.

The third plan was United Healthcare (UHC), a prepaid independent practice association based on primary care networks. Enrollees selected a primary care physician from among those who had contracts with United Healthcare, which included most of the primary care physicians in the area. The primary care physician was responsible for coordinating all care for his or her panel of patients, and had to approve referrals to specialists and for hospital admissions and emergency room visits. There were no deductibles and there were copayments only for drugs, routine physical examinations, maternity, and mental health services. The primary care physician shared the financial risks to a limited extent if the expenditures for an enrollee exceeded the premium pool. UHC was thus similar to GHC in its first-line use of primary care physicians, but similar to BC in its use of community physicians and fee-for-service payment. In 1982, subsequent to the completion of data collection for this study, United Healthcare, which was owned by Safeco Insurance Company, went out of business.

The study group consisted of a random sample of state employees and their families. Use and other health care measures were studied for 18 months starting July 1, 1978. The study sample totaled 3,392 subscribers and dependents and excluded interview nonrespondents (5 per cent) and individuals who did not maintain continuous enrollment for the six months prior to and the 18 months during the study (6 per cent). Eighty-two per cent (2,774) of these enrollees used some outpatient services in this time period.

There were three primary sources of data: interviews, medical records, and claim files. At the beginning of the study period each enrollee was interviewed in person. The data collected included health status, attitudes toward health care, and background sociodemographic information. The response rate for the household interview survey was 95 per cent. Information on in-plan use and charges was abstracted from medical records at Group Health Cooperative and from claims records at Blue Cross and United Healthcare.

Since GHC does not charge for services, "standardized costs" of health services for each person were calculated, as documented elsewhere. In brief, the median Blue Cross...
charge for each procedure performed was attached to that procedure, and these were summed for each person to provide "Blue Cross standardized costs." These standardized costs were used for each plan to provide comparable measures of the volume of services performed, independent of the pricing structure of each plan. This means, for instance, that any cost savings achieved at GHC through the use of less expensive personnel are not reflected in these standardized costs. The "standardized costs" are not necessarily estimates of the actual costs of care in any of the plans.

Two dependent variables are used in this analysis: use, a binary variable indicating use of any outpatient services in 18 months (yes/no), measured for all enrollees; and cost, the standardized cost of outpatient services only for those enrollees who had some use. The standardized cost was divided by 1.5 to give an annual cost. Since the distribution of cost is skewed to the right we assumed a log-normal distribution and analyzed the logarithm of cost, transforming estimates back to their original units for presentation.

The independent variables used in the analysis, shown in Table 1, include plan, age, sex, health status (an index composed of perceived health status, number of chronic conditions, and number of disability days developed elsewhere), the standardized cost of health services in the preceding six months, race, and family size.

Regression equations were developed to predict use and cost from the independent variables. Logistic regression and discriminant analysis were used to predict use, which is a binary variable. We analyzed the logarithm of cost, using ordinary least squares, for users only. The equations in logarithms were then transformed back into their original units for ease of interpretation. [The note at the bottom of Table 3 gives more information about these transformations.]

The regression analyses were designed to test for the effect of some independent variables while holding others constant. Since this was a fairly complex procedure, the detailed methods are described in the results section. The general strategy was to control first for age, sex, and plan, next for health, and finally for each of previous use, race, and family size. We thus tested hypotheses about health controlling for age, sex, and plan; and hypotheses about previous use, race, and family size controlling for age, sex, plan, and health status. At each step, tests were made to determine whether the effect of these variables differed with plan.

Results

Table 1 shows the distribution of enrollees for each independent variable. The three plans did not differ significantly with respect to sex or health, but there were significant differences for all of the other variables. GHC enrollees were the youngest, BC had the most previous cost, and GHC had more Blacks and larger families. UHC fell between the other two plans on all measures, and was similar to BC except for previous cost, where UHC was more like GHC. When race is analyzed, we study only Blacks and Whites, eliminating the enrollees of "other" race, to make these results comparable to previous work.21

Table 2 shows that the proportion of enrollees with use of services was lowest in BC; however, the standardized cost of the services per user and per enrollee was lowest in GHC. UHC had a high percentage using as well as a high cost per user.

When the three plans were combined, based on bivariate testing, female sex, worse health, more previous cost, White race, and smaller family size were significantly associated with more use, but age did not have a significant effect. All of the independent variables were significantly related to cost (for users only) with older, female, sicker, previous users, Whites, and those in families with 2, 3, or 4 members having higher cost.

Age and Sex

A multiple regression analysis was performed to test for the relationship of the independent variables to use while controlling for other variables and to test for interactions between the independent variables and plan. Age and sex were analyzed first, and other variables were examined only after controlling for age and sex. We modeled both use and cost as functions of age, age², sex, age × sex, and age² × sex. Sex was a dummy variable. This parameterization allows separate quadratic equations to be estimated for males and females. The resulting regressions were highly significant (p < .001). We then added two dummy variables to represent the three plans: BC and GHC. These made a significant improvement in both the use and cost equations; in particular, BC was significantly different from both GHC and UHC in both equations, but UHC and GHC were not significantly different from each other.

To test for interactions between plan and age and sex, we created ten interaction variables: BC × age, BC × sex, . . . , GHC × age² × sex. These variables were all added to the equation. With these variables in the equation, it is possible for six separate quadratic equations to be estimated.
one for each sex by plan grouping. The addition of these 10 variables made a significant improvement (p < .001) to the cost equation. In the use equation the ten variables did not make a significant improvement (p < .25). However, if not all 10 interaction variables were needed, this would decrease the significance of the overall test. In fact, one of the 10 interaction variables had a significant F-to-enter, and four had a significant F-to-remove once entered, suggesting strongly that some interaction is present. In particular, the coefficient of age x sex in BC was significantly different from the coefficients in the other two plans.

Thus, there are significant interactions between plan, age, and sex for both use and cost. To make this more interpretable, we calculated the six quadratic equations for use and for cost. These equations are shown in Table 3. The equations were transformed, as explained in the footnote, and plotted in Figures 1 and 2. Figure 1 shows the logistic estimate of the percent of enrollees with use in 18 months, by age, sex, and plan. The interactions between age and sex are clear, since the shapes of the curves for males and females are quite different. Similarly, the curves are quite different among the plans, demonstrating the plan interactions. Age and sex had relatively little effect on use in UHC and GHC.

In Figure 2, interaction between age, sex, and plan with respect to annualized cost (for users only) is again evident. Age and sex have less effect for GHC enrollees, and more for BC and UHC. Thus, with respect to cost, UHC is more like BC, while UHC is more like GHC with respect to use.

Health, Previous Cost, Race, and Family Size

Additional regression equations were developed separately for each plan, to avoid the use of the plan interaction variables. Health status was added to the regression model which already included the age and sex variables. The coefficients of previous cost, race, and family size were each estimated with the age and sex variables and health status already forced into the equation. The regression coefficients are shown in Table 4, with the significance of each coefficient in each plan. In addition, the coefficients were tested for differences among the plans, and the significant results are noted in the Table.

For use, the least squares regression coefficient can be thought of as the increase in the percentage with services due to a change in the variable of interest; for instance, a shift of health status of 5 units increased the BC per cent with use by 4.52 percentage points, and the GHC per cent with use by 1.74 percentage points.

For cost, the regression coefficient is essentially uninterpretable since the logarithm of cost was analyzed. The exponential of the coefficient is shown in Table 4. This estimates the multiplicative factor by which a person’s cost would increase if his/her health status increased by 5 units; the factor is 1.25 for BC and 1.17 for GHC, for example.

Health status is a significant correlate of use in all three plans, but has the most impact in BC and least in GHC, a significant difference. For example, an increase of 5 units of “health” resulted in about 4.5 percentage points increase of users in BC but only 1.7 percentage points in GHC. For users, health status is highly related to cost in all three plans, but the effect is significantly stronger in BC and UHC. For instance, an increase of 5 “health” units increased cost by about 25 percentage points in BC and UHC, but by only 17 percentage points in GHC.

Previous cost is a significant predictor of use in all plans, but has a significantly higher effect in BC. For example, an increase of $100 in previous cost is associated with increased use of 6 percentage points in BC but only about 2 percentage points in GHC and UHC. For users, cost is significantly related to previous cost, and the relationship is not significantly different across the plans.

Race (Black versus White) is significantly correlated with use in all three plans. It is associated with 10 percentage points less use for Blacks in UHC, 14 in GHC, and 20 in BC. The race effect is not significantly different across the three plans. The effect of race on cost (for users only) is statistically significant only in GHC and UHC, although blacks had lower cost in all three plans: 93 per cent as much

TABLE 3—Equations and Coefficients*‡

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Plan</th>
<th>Sex</th>
<th>Const</th>
<th>Age</th>
<th>Age Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
<td>BC M</td>
<td>1.943</td>
<td>-0.097</td>
<td>.01</td>
<td></td>
</tr>
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<td></td>
<td>GH M</td>
<td>2.396</td>
<td>-0.051</td>
<td>.001</td>
<td></td>
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<tr>
<td></td>
<td>UH M</td>
<td>1.845</td>
<td>-0.025</td>
<td>.009</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BC F</td>
<td>0.519</td>
<td>0.010</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GH F</td>
<td>2.313</td>
<td>0.008</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UH F</td>
<td>2.750</td>
<td>0.009</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Log cost</td>
<td>BC M</td>
<td>4.18</td>
<td>0.0317</td>
<td>-0.0021</td>
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</tr>
<tr>
<td></td>
<td>GH M</td>
<td>4.26</td>
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<td>0.0013</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UH M</td>
<td>4.29</td>
<td>-0.0273</td>
<td>-0.0019</td>
<td></td>
</tr>
</tbody>
</table>

*Logistic regression was used for analyzing use. If G is the value of the equation for a certain age, sex, and plan, the probability of use is exp([G]/1 + exp([G]).
‡ If G is the value of the equation for a certain age, sex, and plan, then exp(m + s^2/2) is an estimate of the mean cost for that age, sex, and plan, where m is the mean of log cost and s^2 is the variance of log cost multiplied by (1-s^2).

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in BC, 81% per cent as much in GHC, and 78% per cent as much in UHC. Although the estimated effect of race is much smaller in BC, the coefficients across the three plans are not significantly different, apparently because of the high variability of cost in the BC group.

Family size is significantly related to use only in UHC, but the three plans do not differ significantly. For cost there is a significant effect in BC but not in GHC or UHC, and the slope is significantly different for BC and GHC. In BC, an enrollee in a family with an additional member had only 93% per cent as much cost. There is essentially no effect of family size on cost in GHC or UHC.

Thus, all of the variables studied interact with plan: age, sex, health, and previous costs have significantly different relationships with use across the three plans, and age, sex, health and family size have significantly different relationships with cost across the three plans. There is a suggestive but non-significant interaction between race and plan.

Discussion

We separated the analysis of ambulatory services into two parts. The first dealt with use, the probability of making any use of the system. It seems reasonable (although perhaps over-simplified) to consider that this variable is more related to patient choice than to a system effect. Health status, prior use, race, age, and sex were all significantly related to this propensity to seek care. And, all of these independent variables but race had significantly different effects in the three plans, with the least effect in GHC and the most in BC. This suggests that patients sought care from GHC and UHC with less regard to their need for care. One possibility is that these two plans emphasized (and were more likely to pay for) preventive care, or that enrollees who selected these plans desired preventive care. Alternatively, since enrollment in GHC and UHC required the selection of a usual source of care, a frequent correlate of use, the observed differences may actually be a system effect; i.e., BC enrollees may have had less use because some of them had no usual source of care, possibly because they were in better health. However, the most likely reason for lower use is the $50 deductible in BC which may have deterred use. The similarity of UHC to GHC supports all of these hypotheses.

The second analysis, dealing with cost for users, may be thought of as a system effect, since physicians have a large effect on the quantity and type of services provided to an individual patient. All of the variables studied were significantly related overall to the quantity or standardized cost of services received. However, two of the variables (in addition to age and sex) had significantly different effects among the plans: sicker enrollees received relatively less care at GHC than in the other two plans, and family size had an effect only in BC. There was also some evidence of a smaller race effect in BC.

If we think of cost as the response of the system to the user, UHC and BC are alike in responding more to patient characteristics than GHC. This could be because the two plans included essentially the same physicians, who treated patients in the same way (with respect to their health characteristics) regardless of their insurance plan. System response to age, health, and family size was less at GHC, where patients tended (on average) to receive a more uniform volume of services.

The effect of family size in BC is not well understood.
TABLE 4—Regression Coefficients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BC</td>
</tr>
<tr>
<td>% with usea</td>
<td>4.52***</td>
</tr>
<tr>
<td>Health (5 units)f</td>
<td>6.33***</td>
</tr>
<tr>
<td>Previous Cost ($100)t-d</td>
<td>-19.50**</td>
</tr>
<tr>
<td>Race (Black)</td>
<td>-74</td>
</tr>
<tr>
<td>Family Size</td>
<td>1.25***</td>
</tr>
<tr>
<td>cost for usersp</td>
<td>1.14***</td>
</tr>
<tr>
<td>Health (5 units)f</td>
<td>93</td>
</tr>
<tr>
<td>Previous Cost ($100)</td>
<td>.93***</td>
</tr>
</tbody>
</table>

Text for relationship of variable to use measure:
* p < .05 (two-tailed test)
** p < .01
*** p < .001

a) Coefficient is change in percentage points with use.
b) Coefficient is factor by which to multiply cost.
c) BC coefficient significantly different from GHC (p < .05) (one-tailed).
d) BC coefficient significantly different from UHC (p < .05).
e) GHC coefficient significantly different from UHC (p < .10).

Based on this and other unreported analyses, we do not believe that it is due to the different ages of people in families of different sizes. It is difficult to believe that it is a system effect, unless family size is a surrogate for another variable which can be recognized by the system.

The effect of patient characteristics in BC and GHC was also studied in the Seattle Prepaid Health Care Project, which compared GHC to a Blue Cross/Blue Shield plan similar to BC here, except that there was no deductible. Use was defined as the number of outpatient visits. In that study, it was also found that use of services in GHC was less sensitive to patient characteristics, providing a fairly uniform number of visits to all enrollees, while in the BC/BS plan the young healthy enrollees had very little or no use and those with greater health needs had a good deal of use. There was a significantly larger race effect in GHC than in the BC/BS plan, which was evident in the current data but was not statistically significantly here. We cannot determine from this study whether this represents a system effect or differential self-selection into plans. It does seem less likely now that the previous findings were due to the low income of the enrollees, since the present study included generally middle class enrollees.

These results may change the way in which we think about "adverse selection" in various health plans. In this study, the HMO had a younger group of enrollees, or favorable selection; however, as age was not found to be a strong correlate of use in GHC, this apparent advantage may not have been real. Contrariwise, BC had the worst selection on age and age was a strong factor in BC, suggesting that adverse selection is a serious problem for BC/BS types of plans. It would also be a problem for an IPA like United Healthcare, which did not experience adverse selection with respect to use, but did with respect to cost.

We have shown the per cent with use and the standardized cost per user in Figures 1 and 2. The product of these numbers (multiplied by 1.5 to give 18 months) is the standardized cost per enrollee, which is also of interest.

These findings appear to be consistent over time and over economic class of enrollees, but should be extended with care to other settings. They may be specific to the Seattle area, and to the age groups studied. In addition, these results might change somewhat if we had included inpatient standardized costs and out-of-pocket costs. Because both of these costs are highly variable, their inclusion would probably have lowered the statistical significance. From a health care delivery perspective, it seemed important to separate the various components of health care and to look first at how the type of plan modifies the effect of patient characteristics on ambulatory use. This paper considers in-plan ambulatory use because we believed it would be most sensitive to patient characteristics. Finally, we analyzed individuals from families, suggesting that an adjustment for intraclass correlation might attenuate the significance of the findings somewhat. Additional research on these topics would be welcome.

REFERENCES


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