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# Enrollee mix, treatment intensity, and cost in competing indemnity and HMO plans

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**Abstract**

Why do indemnity insurance plans cost substantially more per capita—77% more in our study—than HMOs? We answer this question using data from a large organization's insurance pool, covering 215,000 lives. We decompose cost differences for eight major medical conditions into four sources: demographics, incidence within demographic groups, treatment intensity, and prices per service. Greater incidence of disease in the indemnity plan (both from demographics themselves and within demographic groups) and higher prices each explain nearly 50% of the difference. Contrary to conventional wisdom, indemnity plans do not have greater treatment intensity.
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## 1. Introduction

Indemnity health insurance plans frequently cost far more than their managed care competitors. A generous indemnity insurance plan for an individual, for example, might cost more than US$ 3000 annually, while a plan offered by a tightly managed health maintenance organization (HMO) might cost only half as much.

Effective policy-making requires understanding the sources of such significant differences in cost. If managed care plans are substantially cheaper than indemnity plans yet achieve equivalent medical outcomes, policies should encourage more people to join those plans (for example, by converting insurance options into a fixed-dollar-contribution voucher system). By contrast, if managed care plans achieve their savings solely by selecting better risks, or by skimping on quality, such encouragement would not be warranted.

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This paper examines why managed care plans are less expensive than traditional indemnity plans. It focuses on medical care costs and treatments for the employees of state government in Massachusetts.[1] The Group Insurance Commission (GIC) of Massachusetts is responsible for providing insurance to these individuals and their families. It contracts with an indemnity plan, 10 HMOs, and a preferred provider organization (PPO). We group the HMOs together for this analysis and examine the cost difference between the indemnity plan and the HMOs as a whole.

The GIC is particularly valuable for study because of its large insurance pool—more than 215,000 covered lives under age 65 during the sample period—and the wide differences in spending across plans. In fiscal year 1998 (FY1998), for example, the individual premium for the indemnity policy was 77% greater than the individual premium for the most expensive HMO. Beyond its academic interest, this large premium differential concerns the GIC commissioners. They want to know why the plans charge such different amounts, even after the GIC pushes hard to negotiate fees down close to the plans' costs.[2] Do the plans have substantially different clienteles, do they provide different types of care, or are the plans' underlying costs for each service different?

We divide spending differences into three possible sources. The first source is differences in *enrollee mix* across plans. There are two types of differences in mix. HMOs may be cheaper because of *incidence mix* (the incidence of costly medical conditions is lower in those plans) or because of *within-condition mix* (HMO enrollees have less severe cases of disease than indemnity plan members).

Differences in both types of mix may result from adverse selection. Evidence on adverse selection is plentiful. (See Cutler and Zeckhauser, 2000, for a review.) Studies uniformly show that HMOs enroll younger, healthier members than indemnity insurance plans (e.g. Scitovsky et al., 1978; Jackson-Beeck and Kleinman, 1983; Ellis, 1989; Langwell and Hadley, 1989). Given a choice, healthier people are more likely to choose managed care plans than are less healthy people (Cutler and Zeckhauser, 1998). In addition, people who stay in the same plan over time may contribute significantly more to indemnity plan costs than to the HMOs' costs as they age (Altman et al., 1998).

The second potential source of cost differences is variation in *treatment intensity*. The indemnity plan may be more expensive because it provides more intensive procedures for patients with similar diagnoses, perhaps because its benefit structure is more generous. However, HMOs could actually be more intensive than indemnity plans for services such as preventive care, as a result of their effort to stave off high-cost medical events down the road.

The third potential source of cost differences is variation in *prices* paid for the same services. HMOs may simply pay less than the indemnity plan. Price differences might result from bargaining; HMOs enjoy bargaining leverage because they can direct large groups of patients to providers. If the group elasticity of demand is greater than the individual elasticity of demand, HMOs might use their greater demand elasticity to extract lower prices. Price differences could also stem from a more efficient production process, for instance in billing and administering purchases of medical services.

[1] A small number of employees of local authorities are also enrolled.

[2] Zeckhauser is a GIC commissioner.

Differentiating among enrollee mix, treatment intensity, and price effects requires detailed data on incidence, treatments received, and prices paid for a variety of medical conditions. There could also be interactive relationships among these variables. For example, prices paid by the two plans might be somewhat closer together for conditions where the indemnity plan has relatively higher incidence. This would produce a negative interaction term. In this analysis, we parcel out direct (non-interactive) effects.

The major empirical concern in parceling out these effects is selection into treatment. Imagine that rates of respiratory infection are common across plans, but that affected people in HMOs are less likely to see a doctor and only visit when they are very sick. Naïve analysis of medical care utilization would suggest that HMOs have healthier enrollees than indemnity plans (fewer treatments for respiratory infection) but treat them more aggressively (more intense treatment when they do visit a doctor). Neither of these inferences would be valid.

To control for differing selection into and out of treatment, we examine conditions where treatment of some form is extremely likely. We focus on eight common and easily identifiable medical conditions: heart attacks; births; cancers of the breast, colon, cervix, and prostate; and type I (juvenile-onset) and type II (adult-onset) diabetes.[3] Together, these eight conditions account for over 13% of total medical spending in the GIC's health plans.

Our results show that differences in costs between the indemnity plan and HMOs stem mostly from differences in incidence and price. Indeed, seven of our eight conditions have significantly higher incidence rates in the indemnity plan. For these conditions, differences in the incidence of disease account for about 47% of cost differences on average. An additional 45% of cost differences result from differences in the price of the same services. Incidence differences are largely within age and sex groups. Differences in the age and sex of those suffering the conditions accounts for no more than 4 or 5% of cost differences.

Our analysis is unique in being able to examine price, treatment and intensity differences. Miller and Luft (1994, 1997), for example, report that HMOs have both fewer hospitalizations and shorter hospital stays than indemnity plans, saving about 10% of costs.[4] But they do not have information on prices (given competitive conditions, data on prices are in general very difficult to obtain). Eichner et al. (1999), using a sample of plans compiled from several private employers, find that demographic mix and treatment costs are largely responsible for cost differences. But they are unable to separate cost differences into treatment intensity and price.[5] Cutler et al. (2000) show that price differences between managed care and indemnity insurance explain a large part of cost differences for patients with heart disease. Their sample is limited to two conditions, however, and does not consider differences in disease incidence. To our knowledge, a decomposition such as we perform has not yet been presented.

This paper is structured as follows. The second section describes the methods that we use to parcel out cost differences across plans. The third section outlines the data, and the fourth section presents the cost decomposition. The last section concludes.

[3] We omit lung cancer because it is most common among elderly insurees, who are not covered in this research, since they hold a combination of Medicare and private insurance.

[4] This is net of some increase in outpatient utilization.

[5] In part, this stems from the fact that Eichner, McClellan, and Wise look at annual spending rather than disease-specific spending. Examining price effects requires more detail.

## 2. Methodology

Individuals who are sick may have one of a variety of conditions, which we index by $j$. The set of conditions that people may contract is very large; in our empirical analysis, we address eight that are well defined and relatively common. Within each condition, we index treatments $t$ by $k$, where $k$ runs from 1 to $K_j$. We think of these treatments as treatment paths—major ways of approaching a given disease—rather than a completely specified set of procedures. For example, treatment paths for breast cancer are surgery, radioactive oncology/chemotherapy, or a combination of the two. This formulation serves both theoretical and practical purposes. Theoretically, treatment paths are the item about which patients care the most. Practically, many of the plans do not report use of more disaggregated services, since payment is often not made on that basis. We divide patients into demographic categories indicated $d_i$, where $i$ runs from 1 to $N$. Finally, plans are indexed by $P$, where $P = I$ for the indemnity plan and $P = H$ for the HMOs.

We define our statistical terms as follows: $q_j^P$ is the incidence of condition $j$ among people in plan $P$, $d_{ij}^P$ is the fraction of the people in plan $P$ who suffer condition $j$ and are also in demographic group $i$: $\sum_{i=1}^{N} d_{ij}^P = 1$; $t_{ijk}^P$ is the fraction of the people in plan $P$ who suffer condition $j$ and are in demographic group $i$ who also receive treatment $k$: $\sum_{k=1}^{K} t_{ijk}^P = 1$; and $r_{ijk}^P$ is the average costs for the people in plan $P$ who suffer condition $j$, are in demographic group $i$, and receive treatment $k$.

Average per capita costs in plan $P$ stemming from condition $j$ are therefore given by

$$x_j^P = q_j^P \sum_{i=1}^{N} \left( d_{ij}^P \sum_{k=1}^{K} t_{ijk}^P r_{ijk}^P \right). \tag{1}$$

The difference in per capita average costs across plans for treatment of a given condition $j$, $\Delta x_j^{I-H}$, can be decomposed into incidence, within-condition mix, treatment, and price effects. Taking the indemnity plan as the base, this difference is approximately:[6]

$$\begin{aligned}\Delta x_j^{I-H} \cong & \left\{ (q_j^I - q_j^H) \sum_{i=1}^{N} \left[ d_{ij}^I \left( \sum_{k=1}^{K} t_{ijk}^I r_{ijk}^I \right) \right] \right\} \\ & + q_j^I \left\{ \sum_{i=1}^{N} \left[ (d_{ij}^I - d_{ij}^H) \left( \sum_{k=1}^{K} t_{ijk}^I r_{ijk}^I \right) \right] + \sum_{i=1}^{N} \left[ d_{ij}^I \left( \sum_{k=1}^{K} (t_{ijk}^I - t_{ijk}^H) r_{ijk}^I \right) \right] \right. \\ & \left. + \sum_{i=1}^{N} \left[ d_{ij}^I \left( \sum_{k=1}^{K} t_{ijk}^I (r_{ijk}^I - r_{ijk}^H) \right) \right] \right\}. \end{aligned} \tag{2}$$

The first term:

$$(q_j^I - q_j^H) \sum_{i=1}^{N} \left[ d_{ij}^I \left( \sum_{k=1}^{K} t_{ijk}^I r_{ijk}^I \right) \right],$$

[6] Our results are similar if we take the HMOs as the base.

represents the per capita cost difference resulting from differences in the incidence of condition $j$ between plans. The top term in the second set of brackets:

$$q_j^I \sum_{i=1}^{N} \left[ (d_{ij}^I - d_{ij}^H) \left( \sum_{k=1}^{K} t_{ijk}^I r_{ijk}^I \right) \right],$$

is the cost difference from differences in the demographic mix of sufferers of the condition; the middle term:

$$q_j^I \sum_{i=1}^{N} \left[ d_{ij}^I \left( \sum_{k=1}^{K} (t_{ijk}^I - t_{ijk}^H) r_{ijk}^I \right) \right],$$

is the cost difference from treatments conditional on demographics; and the bottom term:

$$q_j^I \sum_{i=1}^{N} \left[ d_{ij}^I \left( \sum_{k=1}^{K} t_{ijk}^I (r_{ijk}^I - r_{ijk}^H) \right) \right],$$

is the difference from prices conditional on demographics and treatments. Eq. (2) is only approximate as it omits the second-, third-, and fourth-order covariance terms. The Methodology Appendix[7] supplies a hypothetical, easy-to-follow example of our calculations.

## 3. Data

Our data are from the Group Insurance Commission (GIC) of Massachusetts, the organization that insures state employees. In FY1995, there were 215,287 enrollees in the under-65 portion of the GIC's pool. These enrollees enrolled in three plan types: 67,789 in an indemnity plan, 122,421 in 10 HMOs, and 25,077 in a PPO.[8] The PPO was new in FY1994, and is relatively small. We therefore omitted it from this analysis (see Altman et al., 1998 for further discussion).

The indemnity plan offers the most generous coverage and carries the highest premium. Cost sharing in the indemnity plan is fairly small (it varies over time, but the plan was always relatively generous). There are no restrictions on use of services, with the exception of a mental health carve out. We do not analyze mental health as one of our conditions. The HMOs mostly follow the independent practice association or network model, with one staff-model plan. Although the HMOs differ, cost sharing is generally US$ 5–10 for an outpatient visit. The networks of the plans are generally very wide; Massachusetts is characterized by HMOs with substantially overlapping networks of providers.

On net, we expect some selection in this group, but less than in many other circumstances. The wide networks and loose restrictions of the HMOs are one reason. The generous payment from the GIC is another. The employer, i.e. the state, covers 85% of the cost differential

[7] All appendices are available on Cutler's website, which is located at http://post.economics.harvard.edu/faculty/dcutler/dcutler.html.

[8] We include part-year enrollees in our data. The share of part-year enrollees is very similar across plans, and it increases the sample size.

Table 1
GIC plan premiums, enrollment, and benefit costs for fiscal year 1995

| Plan group | Premium (US$) | Enrollment | Benefit cost (US$) |
|---|---|---|---|
| Indemnity | 2670 | 67,789 | 2638 |
| PPO | 1631 | 25,077 | 1340 |
| HMOs | 1686 | 122,421 | 1226 |

*Note*: Enrollment and benefit costs include only individuals under age 65. Premiums and benefit costs represent means over entire plan groups.

between plans. This significantly reduces the incentive for the insured to choose an HMO over the more expensive indemnity plan. Cutler and Zeckhauser (1998) discuss selection in the GIC in some detail.

Table 1 shows average costs in the indemnity plan and the HMOs for fiscal year 1995. The HMOs' premiums are approximately 35% lower than the indemnity plan's.

Our data, compiled and maintained for the GIC by the MEDSTAT Group, describe plan enrollees' detailed use of inpatient and outpatient hospital services as well as their claims for prescription drugs. For each medical visit, a record gives the primary and secondary diagnoses, the principal procedure administered, and the relevant payment information. This enables us to construct detailed histories of each enrollee's use of a variety of health care resources. Eligibility information is available for essentially all the patients.[9]

Reimbursement information for treatments rendered is based on actual payments rather than "list prices". Our methods cannot account for the effects of any differences in reporting practices between the HMOs and the indemnity plan. For example, bulk purchases of medical treatment from providers by HMOs could lead to peculiar disaggregations of payments at the patient level. However, we have no reason to suspect any systematic biases.[10]

We focus on eight conditions where treatment of some form is necessary or highly likely in order to minimize selection into treatment. For both research and policy purposes, these conditions have the advantage of being very expensive. In total, they account for 15% of the indemnity plan's costs and 11% of the HMOs' costs. The conditions are listed in Table 2 along with their respective treatment options and the universes of patients within which we study them. The universes are chosen to exclude demographic groups where incidence is extremely low or zero.

For acute myocardial infarction (AMI, or heart attack in common parlance), we follow Cutler et al. (1998a,b, 2000) and group patients into four major treatment categories. Coronary artery bypass graft surgery (CABG) is the most radical procedure; the patient's artery is cut and augmented with an unblocked section of artery from elsewhere in the body, usually a leg. Percutaneous transluminal coronary angioplasty (PTCA) inflates a balloon inside the patient's artery in an attempt to clear blockages; for less serious cases, it is an alternative to CABG, less invasive and sometimes cheaper.[11] Some patients receive cardiac

[9] Same-sex twins present a problem, as they have almost always have the same date of birth, sex, and relationship to the principal enrollee. Our methods may collapse some same-sex twins into one enrollee. Tabulations using eligibility files indicate that very few such cases exist in the data.

[10] We are grateful to Don Westwater of the GIC for discussing this issue with us.

[11] We find only a handful of cases where a PTCA, presumably unsuccessful, is followed by a CABG; these cases are categorized as CABG patients.

Table 2
Summary of medical conditions examined

| Condition | Demographic universe | Major treatments | Claim identification |
|---|---|---|---|
| Acute myocardial infarction (AMI) | Men and women, 30–64 | Cardiac catheterization, alone or accompanied by either percutaneous transluminal coronary angioplasty (PTCA) or coronary artery bypass graft (CABG); patients could receive none of the above | All claims within 90 days of diagnosis of an AMI |
| Live birth | Eligible mothers, 15–44 | Normal delivery or cesarean-section | Births identified as new enrollees with birth date within fiscal year; eligible mothers are female heads-of-household or spouses ages 15–44; all claims from 9 months before the birth through 7 days after the birth |
| Cancers | | | |
| Breast | Women, 30–64 | Surgery and/or radioactive oncology and chemotherapy, or none of the above | All claims within 6 months of first cancer diagnosis for patients with at least two diagnoses for the same type of cancer |
| Colon | Men and women, 30–64 | | |
| Cervix | Women, 30–64 | | |
| Prostate | Men, 30–64 | | |
| Diabetes (juvenile and adult-onset) | Men and women, 0–64 | – | All claims over two fiscal years for individuals with at least two diabetes-related diagnoses |

*Note*: Diagnoses are identified using codes from the *International Classification of Diseases, 9th Edition, Clinical Modification* (ICD9-CM). Procedures are identified using codes from the *Physician's Current Procedural Terminology* and the ICD9-CM.

catheterization, a diagnostic procedure in which a dye is circulated through the patients' arteries to determine the location and magnitude of blockages, but there is no further invasive procedure. Finally, some patients are treated without any of the intensive procedures (designated the "null" treatment path). To gauge the statistical significance of our results, we group the PTCA and CABG paths together as "intense" treatments, which are contrasted with the "null" and catheterization paths.

For births, we distinguish between normal and caesarian-section deliveries (the latter being intense). We consider only pregnancies that result in live births, as these are the simplest to identify in the GIC eligibility files. Twins are treated as one birth event. We consider cancers affecting four different parts of the body: the breast, cervix, colon and prostate. For the cancers, the three different treatment paths are surgery, radiation oncology/chemotherapy (RO/C), and a combination of the first two treatments. A rough ranking

of the paths' intensity would position RO/C alone as the least intense, then surgery, then a combination of the two as the most intense. The vast majority of cancer sufferers in either plan undergo surgery, and thus follow either the first or the third treatment path. We consider either path involving surgery to be a intense treatment. We also track inpatient and outpatient visits involving diagnostic radiology and patient management.[12]

The last column of Table 2 describes our conventions for identifying condition-related claims. The issue of identifying conditions is complicated, and there is a potential for "ascertainment bias"—the method of determining people with each condition could lead to differing severity of illness and thus differences in treatment and incidence. For the reasons specified, however, we suspect this issue is small.

We follow AMI patients for 90 days starting from the first admission for a heart attack. A 90-day window is common in the literature (Cutler et al., 1998a,b, 2000) and encompasses virtually all of the intensive care provided to heart attack patients. For births, we include 9 months of spending prior to the birth, and spending for mother and child for 7 days after the birth. The 9-month criterion includes all costs, including fertility costs, if they occurred during that window. Costs incurred earlier will not be included.

Limiting the cutoff to 7 days after birth ignores potential complications after that period resulting from poor prenatal care (e.g. care for infants with respiratory-distress syndrome), but it avoids picking up conditions that occur for reasons other than the birth. To test the sensitivity of this assumption, we formed an alternate estimate of costs including all spending through 180 days after birth. The Results Appendix presents the results of that specification. They are very similar to those using the 7-day definition.

We identify cancer patients as those whose records contain a diagnosis of one of four major cancers matched with either surgery or radioactive oncology and/or chemotherapy (RO/C) treatment. We do not include a null path for cancer treatment, since records may contain cancer diagnoses for procedures designed only to detect (and not to treat) cancers. For example, mammograms performed to detect breast cancer are usually accompanied by a breast cancer diagnosis though the results of the tests could be negative. Past studies have shown that claims data are good for assessing intensive treatment of cancer, but not cases treated without such an intervention (Warren et al., 1999; Cooper et al., 2000; Freeman et al., 2000). Staging information on claims data are also poor (Cooper et al., 1999).

Cancers elicit a mix of acute and chronic care. They may result in a high initial expenditure followed by ongoing monitoring costs, with considerable extra costs should there be a recurrence. We sum cancer patients' expenditures for 6 months after the initial diagnosis of a tumor.[13] Initial treatment for cancer (the acute phase) is generally defined as care within about 5 months of diagnosis and ranges of 6–9 months are common in the literature (Warren et al., 2002).

To analyze diabetes, a chronic condition, we use a longer time horizon. We code individuals as diabetic if they have two or more diabetes-related diagnoses over the

[12] Patient management includes office visits, inpatient observation, emergency room visits not resulting in procedures, counseling, etc. Note also that the surgery path corresponds to *any* cancer-related surgery during the 6-month episode (to allow for metastasization, the spread of cancer through the body).

[13] Since we do not have access to insurees' medical histories before FY1994, an "initial" diagnosis of cancer could be part of an ongoing treatment process.

Table 3
Demographic distributions of GIC enrollees by insurance plan group, FY1995

| Age group | Indemnity plan[a] | | HMOs[b] | |
|---|---|---|---|---|
| | Males | Females | Males | Females |
| 0–19 | 9.00 | 8.65 | 12.68 | 16.28 |
| 20–34 | 6.26 | 7.15 | 9.76 | 12.03 |
| 35–49 | 12.51 | 16.13 | 14.59 | 16.43 |
| 50–64 | 15.47 | 19.80 | 6.77 | 7.28 |
| All ages | 45.78 | 54.22 | 47.99 | 52.01 |

*Note*: Each entry is the share of that plan's enrollees in that age and sex group.
[a] Enrollees (males and females): 67,789.
[b] Enrollees (males and females): 122,421.

entire time period. The two-diagnosis requirement is designed to rule out mistaken codes, and to eliminate patients where diabetes is suspected but not confirmed. The two-diagnosis rule has been suggested by other researchers (Maskarinec, 1997; Hux et al., 2002) as balancing sensitivity, specificity, and positive predictive value. We examined the importance of this assumption by looking at the distribution of the number of diabetes codes that people have in each plan. The Results Appendix shows that this criterion is a reasonable one. We distinguish between type I and II diabetes using the specific ICD-9 code. Once we have identified a diabetic, we collect all his or her medical costs for the entire 2-year period of our sample.[14] A multitude of symptoms, side effects, costs and complications can accompany diabetes, so we do not focus on any specific treatments or associated diseases.

## 4. Results

In this section, we decompose differences in costs across plans into mix effects, treatment effects, and price effects.

### *4.1. Mix effects*

Mix effects are divided into two types, *incidence* and *within-condition mix*.

#### *4.1.1. Incidence*

Table 3 presents data on the demographic characteristics of enrollees in the different plans. The table shows the share of each plan's total enrollment in different age and sex groups. The indemnity plan has much older members. One-third of indemnity plan enrollees under age 65 are above age 50, compared with fewer than 15% of HMO enrollees. Children account for nearly twice as large a share of enrollees in the HMOs as in the indemnity plan. The mix of men and women is roughly similar across plans.

These age differences translate into substantially different incidence rates, particularly for AMI and cancer. Columns 2–4 of Table 4 show unadjusted incidence rates for the

[14] This implicitly assumes that the diabetes was contracted before our sample period begins.

Table 4
Summary of incidence rates of major conditions by plan, FY1994–1995

| Condition | Overall incidence | | | Incidence adjusted for demographics | | |
|---|---|---|---|---|---|---|
| | Indemnity | HMOs | Ratio | Indemnity | HMOs | Ratio |
| Acute myocardial infarction | 0.67 | 0.30 | 2.23* | 0.54 | 0.40 | 1.35* |
| Live birth | 6.09 | 5.05 | 1.21* | 6.80 | 4.82 | 1.41* |
| Breast cancer | 1.33 | 0.59 | 2.25* | 1.12 | 0.72 | 1.56* |
| Cervical cancer | 0.13 | 0.13 | 0.93 | 0.14 | 0.13 | 1.08 |
| Colon cancer | 0.21 | 0.08 | 2.62* | 0.16 | 0.10 | 1.60* |
| Prostate cancer | 0.75 | 0.26 | 2.88* | 0.52 | 0.38 | 1.37* |
| Type I diabetes | 1.39 | 0.55 | 2.53* | 1.18 | 0.65 | 1.82* |
| Type II diabetes | 2.33 | 1.07 | 2.18* | 1.76 | 1.36 | 1.29* |

*Note*: The universes of enrollees for each condition are described in Table 2.

* Denotes that the ratio of the indemnity plan rate to HMOs' rate is significantly different from one at the 5% level.

different conditions. For every condition except cervical cancer, incidence rates are statistically significantly higher in the indemnity plan than in the HMOs. The ratio of incidence rates in the indemnity plan compared to the HMOs is generally two or three to one.

Differences in incidence rates may result from demographic differences across plans as well as differences within demographic groups—healthy 50-year-old may be more likely to enroll in an HMO than sick 50-year-old, for example. Columns 5–7 of Table 4 examine this by adjusting incidence rates for differences in demographics across plans (5-year age and sex groups). The demographic adjustments matter, but even within demographic groups, mix differences are important. The intra-group incidence rate for all of the conditions except cervical cancer is about 50% higher in the indemnity plan than in the HMOs.

The differences in incidence rates between the plans result in large gaps in per capita costs. Columns 2 and 3 of Table 5 report per capita costs in the indemnity and HMO plans from all conditions and from specific conditions within different universes of patients in the indemnity plan and HMOs. Column 4 shows what per capita costs would have been for specific conditions in the indemnity plan if the incidence rates had been the same as in the HMOs. The last column shows what percentage of the difference in per capita plan costs for *all* conditions is accounted for by the incidence rate for the *single* condition in question. For example, the AMI row shows that of the US$ 143 difference in average costs on AMI care, US$ 110 of that (US$ 200–90) results from a higher incidence rate within the indemnity plan. This is 3.1% of the total difference in costs for men and women aged 30–64 (US$ 6449–2861). Incidence rates for each of these conditions *individually* are responsible for roughly 3% of the difference in *total* per capita plan costs.

We show the importance of mix effects for spending on these conditions in Table 6. Column 2 of the table shows the difference in per capita costs for each of the eight conditions we analyze, and an average across the eight.[15] The average difference is US$ 107. Column 3 reports the difference resulting from the higher incidence of conditions in the indemnity

[15] Here, "per capita" covers the groups of enrollees we follow to track the incidence of the eight conditions as listed in Table 2 (e.g. men aged 30–64 for prostate cancer). The overall average is unweighted. Since the demographic groups for the different conditions overlap, it is difficult to determine an appropriate weighting scheme.

Table 5
Comparisons of condition-specific costs and total costs from all diseases with the effect of incidence rates, FY1994–1995

| Costs per capita, sum of FY1994 and FY1995, by universe of enrollees and condition(s) | Indemnity plan | HMOs | Indemnity plan with HMO incidence rates | Percent of difference in total costs from incidence |
|---|---|---|---|---|
| Men and women aged 0–64 | | | | |
| Total costs (US$) | 5232 | 2277 | – | – |
| Costs from type I diabetes (US$) | 158 | 105 | 62 | 3.2 |
| Costs from type II diabetes (US$) | 167 | 97 | 77 | 3.0 |
| Men and women aged 30–64 | | | | |
| Total costs (US$) | 6449 | 2861 | – | – |
| Costs from AMI (US$) | 200 | 57 | 90 | 3.1 |
| Costs from colon cancer (US$) | 65 | 9 | 24 | 1.1 |
| Men aged 30–64 | | | | |
| Total costs (US$) | 6011 | 2451 | – | – |
| Costs from prostate cancer (US$) | 128 | 28 | 44 | 2.4 |
| Women aged 30–64 | | | | |
| Total costs (US$) | 6793 | 3223 | – | – |
| Costs from breast cancer (US$) | 342 | 69 | 151 | 5.3 |
| Costs from cervical cancer (US$) | 20 | 11 | 22 | −0.1 |
| Eligible mothers aged 15–44 | | | | |
| Total costs (US$) | 6007 | 2956 | – | – |
| Costs from live births (US$) | 582 | 430 | 482 | 3.3 |

*Note*: Total costs are sums of FY1994 and FY1995 per capita costs within the noted universes of patients. The last column shows what percentage of total costs (for all conditions) is accounted for by incidence rates of the condition in question. It is computed as column 4 divided by the overall difference in total costs for people of the indicated demographic group. These figures are not adjusted for specific demographic characteristics.

Table 6
Summary of decompositions of cost differences between plans among sufferers, FY1994–1995

| Condition | Difference in per capita plan costs (US$), indemnity—HMO* | Mix effect | | Percent of difference from treatment intensity | Percent of difference from price or unobserved selection |
|---|---|---|---|---|---|
| | | Percent of difference from incidence mix | Percent of difference from within-condition mix | | |
| Average | 107 | 46.8 | 4.2 | 5.1 | 45.1 |
| Acute myocardial infection | 143 | 57.6 | 4.5 | 0.9 | 37.0 |
| Live birth | 152 | 51.4 | 0.4 | 11.3 | 36.9 |
| Breast cancer | 273 | 51.9 | −6.7 | 1.2 | 53.6 |
| Cervical cancer | 9 | −10.6 | 24.4 | 14.4 | 71.8 |
| Colon cancer | 56 | 46.1 | −5.0 | 5.3 | 53.6 |
| Prostate cancer | 100 | 58.2 | 6.3 | −2.5 | 38.0 |
| Type I diabetes | 53 | 64.3 | 4.1 | – | 31.5 |
| Type II diabetes | 70 | 55.8 | 5.6 | – | 38.6 |

*Note*: The percentages in the last four columns refer only to relative importances of the first-order effects from the decompositions. Appendix Table I lists the actual first-order effects.

* "Per capita" refers only to the universe of enrollees in which the condition is examined; see Table 2 for details. Costs are totals for FY1994 and FY1995.

plan, holding the demographic distribution of the people having the condition the same in both plans. The incidence mix explains about 45% of the difference in average costs.[16]

*4.1.2. Within-condition mix*

The importance of within-condition demographic differences for the costs of those conditions is shown in the column 4 of Table 6. To calculate this share, we hold the overall incidence of the condition, the shares of patients following different treatment paths, and the average costs of each treatment path constant in both plans, but allow the demographic mix of sufferers within each condition to vary. Averaged across the eight conditions, demographic differences in the within-condition mix of sufferers explains only about 4% of overall cost differences.

### *4.2. Treatment-intensity effects*

To see how treatment differences affect cost across plans, we compare the share of each plan's patients receiving more intensive (or costly) treatments for the same diagnoses. Tables 7–10 report the plans' demographically-adjusted likelihoods of receiving the various treatment paths for each medical condition. In each case, we compare the chances of following different treatment paths in the two plans, but always employ the demographics of the indemnity plan as the base. For a condition $j$ and a treatment path $k$, the difference is given as

$$\text{treatment-intensity effect} = \sum_{i=1}^{N} d_{ij}^{I} t_{ijk}^{I} - \sum_{i=1}^{N} d_{ij}^{I} t_{ijk}^{H}.$$

Similarly, the standardized difference between payments is given by

$$\text{payment effect} = \sum_{i=1}^{N} d_{ijk}^{I} r_{ijk}^{I} - \sum_{i=1}^{N} d_{ijk}^{I} r_{ijk}^{H}.$$

To determine whether differences between treatment intensities and payments in the two plans are statistically significant, we use a bootstrap technique. We concentrate on differences in the chances of receiving a resource-intense procedure.

Our bootstrap methodology is as follows: For each age group and sex combination covered for a specific condition, we produce a simulated sample. The sample replicates the age and sex distribution among sufferers from the specified condition in the indemnity plan. Each member of the simulated sample is assigned either an intense or less intense treatment path using the observed probabilities for the corresponding age group and sex combination in the indemnity plan. We then compute the overall chance of the intense treatment path in the simulated indemnity plan. We generate 20,000 such simulated samples and compare 10,000 pairs to see whether the differences in frequencies of intense treatments are as large

[16] Incidence mix explains 58% of cost differences for AMI. Among 30–64-year-old, members of the indemnity plan are one-third more likely to suffer AMI than members of HMOs. Though sufferers in the indemnity plan are older, their payments are higher for every age group between 30 and 64 years. Sufferers in the HMOs receive more of some intense treatments, reducing the contribution of treatment intensity to the overall cost differences.

Table 7
Frequency of treatments and payments for acute myocardial infarction (AMI) by plan, FY1994–1995

| | Plan | |
|---|---|---|
| | Indemnity | HMOs |
| 2-Year incidence of AMI (%) | 0.54 | 0.40* |
| Average cost per episode (US$) | 29,488 | 19,821* |
| Share by treatment path (%) | | |
| Null | 51.9 | 53.0 |
| Catheterization | 22.3 | 13.5 |
| PTCA | 13.0 | 19.3 |
| CABG | 12.7 | 14.2 |
| Intense paths (PTCA + CABG) | 25.7 | 33.5* |
| Payments, AMI episodes (US$) | | |
| By path | | |
| Null | 17,473 | 10,573 |
| Catheterization | 24,907 | 21,939 |
| PTCA | 37,330 | 21,302 |
| CABG | 64,109 | 51,885 |
| Intense paths (PTCA + CABG) | 50,569 | 33,562* |

*Note*: All figures in rows 2 and 3 are demographically adjusted for the age and sex composition of the total insurance pool using ordinary least squares regression. Statistical significance for figures in rows 4–13 is computed with a bootstrap method, using the indemnity plan as a base. This analysis includes only individuals between the ages of 30 and 64. Payments refer to all services and prescription drugs within 90 days from the date of diagnosis of the AMI. CABG is coronary artery bypass graft surgery. PTCA is percutaneous transluminal coronary angioplasty. Catheterization refers to instances in which the patient underwent a cardiac catheterization but not CABG or PTCA. The null path indicates none of the three major surgical treatments were undertaken. Nine cases in which patients underwent both PTCA and CABG were classified as CABG.

* Denotes that means are significantly different at the 5% level.

Table 8
Frequency of treatments and payments for live births by plan, FY1994–1995

| | Plan | |
|---|---|---|
| | Indemnity | HMOs |
| Incidence of live birth (%) | 6.80 | 4.82* |
| Average cost per birth (US$) | 9,624 | 8,446 |
| Cesarean-section share (intense path) (%) | 25.5 | 19.6* |
| Payments, pregnancy episodes | | |
| With cesarean (US$) | 14,964 | 10,103* |
| No cesarean (US$) | 7,728 | 7,707 |

*Note*: All figures in rows 2 and 3 are demographically adjusted for the age and sex composition of the total insurance pool using ordinary least squares regression. Statistical significance for figures in rows 4–6 is computed with a bootstrap method, using the indemnity plan as a base. This analysis includes only women between the ages of 15 and 44 classified as heads-of-household or heads' spouses. Payments refer to all services and prescription drugs from 9 months before a normal birth through 7 days after the birth. All pregnancies resulting in births between 1 April 1994 and 31 June 1995 are included.

* Denotes that means are significantly different at the 5% level.

Table 9
Frequency of treatments and payments for four cancers by plan (indemnity and HMOs), FY1994–1995

| | Breast cancer | | Cervix cancer | | Colon cancer | | Prostate cancer | |
|---|---|---|---|---|---|---|---|---|
| | Indemnity | HMOs | Indemnity | HMOs | Indemnity | HMOs | Indemnity | HMOs |
| Incidence (%) | 1.12 | 0.72* | 0.14 | 0.13 | 0.16 | 0.10* | 0.52 | 0.38* |
| Average cost per episode (US$) | 26,562 | 10,935* | 13,925 | 7,308* | 33,510 | 8,816* | 17,504 | 11,023* |
| Share with treatment | | | | | | | | |
| Patient management | 99.2 | 97.0* | 98.9 | 90.3# | 96.4 | 79.9* | 98.5 | 95.8 |
| Diagnostic radiology | 95.1 | 92.7 | 64.4 | 64.7 | 84.2 | 70.0* | 82.1 | 74.8 |
| Share by treatment path (%) | | | | | | | | |
| RO/C | 3.8 | 3.3 | 0.0 | 1.0 | 4.8 | 0.4 | 7.9 | 6.7 |
| Surgery | 65.0 | 65.4 | 94.3 | 93.3 | 76.7 | 60.8 | 82.9 | 79.6 |
| Surgery-RO/C | 31.2 | 31.3 | 5.7 | 5.7 | 18.4 | 36.9 | 9.1 | 13.7 |
| Intense (surgery) paths | 96.2 | 96.7 | 100 | 99.0 | 95.1 | 97.7 | 92.0 | 93.3 |
| Payments by episode (US$) | | | | | | | | |
| By path | | | | | | | | |
| RO/C | 18,315 | 8,866 | –+ | –+ | 19,832 | –+ | 11,824 | 17,815 |
| Surgery | 19,476 | 5,830 | 14,784 | 7,150 | 24,436 | 6,214 | 15,498 | 8,404 |
| Surgery-RO/C | 40,701 | 20,714 | 11,191 | 12,590 | 49,334 | 22,414 | 39,095 | 14,286 |
| Intense (surgery) paths | 26,353 | 11,159* | 14,579 | 7,464* | 29,265 | 12,332* | 17,842 | 9,266* |

*Note*: All figures in rows 2–5 are demographically adjusted for the age and sex composition of the total insurance pool using ordinary least squares regression. Statistical significance for figures in rows 6–13 is computed with a bootstrap method, using the indemnity plan as a base. This analysis includes only individuals between the ages of 30 and 64—women only for breast and cervical cancer, men only for prostate cancer, and both men and women for colon cancer. Payments include all services and prescription drugs within 6 months from the first date of a service with a relevant cancer diagnosis and a surgery, radioactive oncology, or chemotherapy treatment. RO/C is radioactive oncology or chemotherapy. The treatment paths are mutually exclusive.

# Denotes that means are significantly different at the 10% level.

+ Denotes that there are insufficient observations to report this figure.

* Denotes that means are significantly different at the 5% level.

Table 10
Alternate comparisons of treatment intensity and costs for six conditions

| Condition | Ratio of indemnity plan intensity to HMO intensity using indemnity plan costs as weights | Ratio of indemnity plan intensity to HMO intensity using HMO costs as weights | Ratio of indemnity plan costs to HMO costs using treatment frequencies from entire pool |
|---|---|---|---|
| Acute myocardial infarction | 0.96 | 1.00 | 1.52* |
| Live birth | 1.05 | 1.03 | 1.23 |
| Cancer | | | |
| Breast | 0.98 | 0.96 | 2.44* |
| Cervix | 1.01[a] | 1.01 | 1.85* |
| Colon | 0.89 | 0.65# | 4.55* |
| Prostate | 0.96 | 0.95 | 1.56* |

*Note*: The method for computing the indices is described in Section 4. The index numbers for cancers of the cervix and colon should be viewed as approximate, since the underlying figures were computed from too few observations to test confidence of differences across plans.

[a] Denotes that this figure is approximate because no patients in the indemnity plan followed the RO/C path. Costs for RO/C were approximated by multiplying the average costs for surgery by the ratio in the HMOs of RO/C costs to surgery costs.

# Denotes that ratio is significantly different from 1 at the 10% level.

* Denotes that ratio is significantly different from 1 at the 5% level.

as the observed differences in the indemnity and HMO plans. If the differences are smaller in 95% of cases, we consider the observed indemnity-HMO difference to be different from zero with 95% confidence.

For payments, we again produce simulated samples with the same numbers of members as in the indemnity plan. Each member is given a payment amount drawn, with replacement, from the payments of the actual indemnity patients in the corresponding age group and sex combination. We compute overall payments, weighted by demographics, for the simulated plans. Then, as before, we compare 10,000 pairs of samples to see whether the observed indemnity-HMO difference exceeds the simulated differences in payments.

#### *4.2.1. AMI*

Table 7 summarizes differences between plans in the incidence, treatment, and cost of AMI, with all figures standardized to a common age and sex distribution.[17] The second row of the table shows that indemnity sufferers cost approximately 50% more to treat than HMO sufferers. This is true despite the fact that HMO patients are just about as likely to undergo CABGs as indemnity patients (13 or 14% in each plan), but substantially more likely to receive PTCAs (19% compared to 13%). HMO patients are significantly more likely to receive an intense treatment. That HMO patients disproportionately receive more intense treatments is contrary both to conventional wisdom and to the treatment-intensity hypothesis.

[17] The standardization is based on 5-year age and sex groups. Since the groups are so small, the possibility of confounding from incomplete adjustment is minimal.

The fact that treatment intensity is greater in the HMOs suggests that this factor does not contribute to higher costs for the indemnity plan. Column 5 of Table 6 confirms that this is the case; treatment effects explain only 1% of differences in AMI costs.[18]

One potential explanation for greater treatment intensity in HMO heart attack cases is that they are more severe than those in the indemnity plan. This seems unlikely, however; approximately the same percentages of patients follow the null (or non-surgical) path in the two insurance plans. A second potential explanation is that HMO patients get treated in more intensive hospitals, perhaps because they are more likely to live in urban areas or because the HMOs direct their patients to particularly high-tech institutions (for discussion in other settings, see Feldman and Scharfstein, 1998; Chernew et al., 1998; Escarce et al., 1997). To test this, we estimated treatment-intensity models controlling for the MSA of the patient (or alternatively the zip code) and the hospital of admission.[19] The results, shown in Results Appendix Tables D–H, are very similar to those reported here. Neither patient location nor admitting hospital explains the greater treatment intensity in the HMOs. The hypothesis most consistent with the evidence is that HMOs simply provide greater treatment intensity for AMI.

#### *4.2.2. Live birth*

Table 8 examines live births. Women in the indemnity plan are significantly more likely to receive a cesarean-section than their counterparts in HMOs, even controlling for differences in age. The cesarean-section rate is almost one-third higher in the indemnity plan than in the HMOs. This higher cesarean-section rate contributes to higher indemnity plan costs. Differences in caesarian rates explain one-ninth of cost differences between plans (Table 6). This evidence favors the treatment-intensity hypothesis. Live birth is the only condition we study where indemnity patients clearly receive more intense treatment than HMO patients. Whether this results from plan actions or differential selection on the part of high-risk women is unclear.[20]

#### *4.2.3. Cancer*

Table 9 shows details on the treatment of cancer in the two plans. There are no significant differences in intense treatment paths—those involving surgery—between indemnity and HMO patients. In each case, a preponderance of people receive surgery alone, with the next largest share receiving surgery combined with radioactive oncology or chemotherapy. HMO patients suffering from colon cancer are somewhat more likely to receive the most intense

[18] It may seem puzzling that Table 7 shows more intense treatment of AMI in the HMOs, while the fraction of the difference in AMI costs due to treatments in Table 6 is positive. In Table 7, we report average treatment rates across all demographics in the two plans; the weights are the numbers of people in each demographic. In Table 6, we vary treatment differences within every demographic and then compute the difference between costs in the indemnity plan and costs in a simulated plan: the indemnity plan with treatments as in the HMOs. In the latter case, however, prices and incidence rates, as well as demographic shares conditional on incidence, are employed as weights for the treatment differences. If a large treatment difference occurs in a demographic where average prices are particularly high in the indemnity plan, that difference receives extra weight. Given that their weights differ, the results in Tables 6 and 7 can be expected to differ as well.

[19] To control for MSA and hospital we use least squares regression, calculating the usual standard errors, rather than a bootstrap method.

[20] It is also controversial whether this is beneficial for patients on net.

treatment, but the share of cost differences resulting from differences in treatment intensity is small. As Table 6 shows, differences in treatment intensity account for no more than a few percent of differences in per capita costs (except in the case of cervical cancer, where the cost difference itself is extremely small). These results again contradict the treatment-intensity hypothesis.

We also examined the likelihoods of several more minor treatments for cancer. In general, indemnity patients appear more likely to have physician visits for patient management; in addition, colon cancer patients are more likely to undergo diagnostic radiology in the indemnity plan. However, the vast majority of patients in both plans receive these treatments. Because of the potentially informal nature of patient management, which could be as simple as a conversation with a primary care physician, reporting on this 'treatment' may be inconsistent across the two plans. On the other hand, these results could indicate a higher quality of 'customer care' in the indemnity plan, which may explain the anecdotally popular belief that indemnity plans provide better care than do HMOs.

#### *4.2.4. Diabetes*

Since diabetes treatment consists of many procedures stretched over time rather than a few highly expensive ones, we do not track the incidence of specific procedures across plans. As a result, we cannot present any results relating to treatment intensity for diabetes.

#### *4.2.5. Summary*

To summarize the treatment differences, we form a weighted average of treatment shares in the different plans, where the weights are the reimbursement of the different treatment options. For example, a comparison of treatments for condition $j$ in the HMOs and indemnity plan, using the indemnity plan's reimbursements as weights, takes the following form:

$$\text{summary of treatment differences} = \frac{\sum_{k=1}^{K_j} \overline{t_{jk}^{H}}\,\overline{r_{jk}^{I}}}{\sum_{k=1}^{K_j} \overline{t_{jk}^{I}}\,\overline{r_{jk}^{I}}},$$

where an upper bar signifies an average of treatment rates or costs for sufferers of condition $j$ in the specified plan. Table 10 shows the results.[21] Column 2 uses indemnity plan reimbursements as the weights; column 3 uses HMO reimbursements. Whichever plan is used as the norm, the results are similar. Most of the values are less than 1, implying that the indemnity plan is less intense than the HMOs, although the results are generally not statistically significantly different from 1. The only statistically significant value (at the 10% level) is for colon cancer standardized to HMO costs, where the HMOs actually deliver more intense treatment.

A summary of treatment effects is shown in Table 6. Driven largely by our finding of significantly more cesarean-sections as a fraction of births in the indemnity plan (and cervical cancers, where the overall difference in treatment costs between plans is very small), we estimate that treatment differences explain 5% of per case cost differences. Treatment intensity explains a modest share of the cost differences we observe between plans.

[21] Confidence intervals for the ratios are calculated using a bootstrap method. We randomly assign patients to the indemnity plan or HMOs, then create a distribution of simulated treatment ratios with which to measure the likelihood that the actual ratios differ from 1.

### 4.3. Price effects

The ideal data to measure price effects would include unit prices paid by each insurer for each type of care. Such data are not available, however. Indeed, they are not even available conceptually, since the basis of payment differs across plans (e.g. DRG versus per-diem payments for hospitalizations). Instead, we measure prices differences as differences in reimbursement dollars per sufferer that persist after controlling for demographics and treatments.

There are three potential problems with this assumption. First, we cannot disentangle true price differences from the effects of within-demographic-group selection. For example, if indemnity patients with one of these conditions are more severely ill than HMO patients with the same condition, they may use more services and thus cost more, even at equal prices.[22] This situation introduces a bias toward overstating the importance of price differences if indemnity patients are more severely ill. However, the modest differences in treatment intensity suggest that this is not a significant factor.

Second, any changes in services provided other than the major treatment paths we have identified will be included as price changes. For example, if HMO patients receive fewer tests than do indemnity plan patients, this will be incorrectly classified as a price change rather than a treatment change. In the case of heart attacks, Cutler et al. (2000) showed that such service differences were not a major part of cross-plan differences. We do not have sufficiently detailed data to test this with our current sample, but we suspect it is not important.

Third, we do not adjust for quality-of-care differences across plans. A true price index would take this into account (Cutler et al., 1998a,b). One measure of quality is the hospital that a patient is sent to. We have attempted to control for this by including hospital dummy variables where feasible (for AMI and births). The Results Appendix shows that the price differences are not reduced by these controls. Thus, this part of quality variation is unlikely to be important.

There could be within-hospital differences in quality as well. Surgeon expertise and case volume have been shown to be related to outcomes for both cardiovascular surgery (Tu et al., 2001) and cancer (Hodgson et al., 2001), for example. It is possible that the doctors treating indemnity patients are better than those treating HMO patients. We have no way to know this. Given our findings on treatment intensity and hospital dummy variables, however, we suspect this issue is not significant.

#### 4.3.1. AMI

Indemnity patients suffering from heart attacks incurred significantly more reimbursements than HMO patients, both as a whole and along intense treatment paths. As Table 7 shows, reimbursement per patient in the indemnity plan averages US$ 29,488, compared to US$ 19,821 for HMO patients. For intense treatments, the difference is wider and still significant: US$ 50,569 versus US$ 33,562. These differences are meaningful; 37% of the differences in costs across plans for AMI are accounted for by differences in prices (Table 6). This evidence strongly favors the price hypothesis.

[22] Since we only have records of principal diagnoses, it is difficult to detect the relative severity of each condition across patients.

#### 4.3.2. Live birth

Average reimbursement for the 9 months preceding and week following a birth do not differ significantly between the indemnity plan and the HMOs (Table 8). However, there is a large and statistically significant difference in reimbursement between plans for births involving a cesarean-section—a live birth in the indemnity plan generates an average of US$ 14,964 in payments per episode, versus only US$ 10,103 in the HMOs. Since this difference emerges between groups receiving the same distribution of treatments, it supports the price hypothesis. Again, close to 40% of total cost difference between the indemnity plan and HMOs is accounted for by differing prices.

#### 4.3.3. Cancer

Average payments generated by cancer patients in the indemnity plan are significantly higher than in the HMOs for all four cancers, both overall and along intense treatment paths (Table 9). For example, breast cancer patients in the indemnity plan average US$ 26,562 in payments over each 6-month episode, while sufferers in the HMOs average only US$ 10,935. Payment differences are statistically significant for intense treatments of all cancers. As Table 6 demonstrates, price differences account for approximately half of the cost differences across plans for cancers, strongly supporting the price hypothesis.

#### 4.3.4. Diabetes

Total payments generated by both types of diabetics in the indemnity plan statistically significantly exceed those of their HMO-based counterparts (Table 11). Over 2 years, type I diabetics in the indemnity plan required US$ 11,023 in reimbursement while those in the HMOs required only US$ 7748. For type II diabetics, this disparity is US$ 6898 versus US$ 4479. As Table 6 shows, price differences account for about one-third of total costs differences in treating diabetics.

Table 11
Incidence and payments for diabetics by plan, FY1994–1995

| | Plan | |
|---|---|---|
| | Indemnity | HMOs |
| Incidence (%) | | |
| Type I | 1.16* | 0.66* |
| Type II | 1.71 | 1.36* |
| Payments (US$) | | |
| Type I | 11,023 | 7,748* |
| Type II | 6,898 | 4,479* |

*Note*: All figures are demographically adjusted for the age and sex composition of the total insurance pool using ordinary least squares regression. This analysis includes individuals between the ages of 0 and 64 years. Payments include all services and prescription drugs within the two fiscal years of data. Patients were identified as diabetics if they had two services with diabetes-related diagnoses within the 2-year period. Type I diabetes is juvenile, insulin-dependent diabetes; type II is adult-onset, non-insulin-dependent diabetes.

* Denotes that means are significantly different at the 5% level.

#### 4.3.5. Summary

To estimate the overall contribution of price differentials to cost differences across plans, the last column of Table 10 shows the ratio of reimbursement in the indemnity plan to reimbursement in the HMOs for each condition, adjusting for differing treatment shares in the two types of plans. The ratios are usually substantially above 1, ranging from 23 to 355% higher in the indemnity plan compared to the HMOs. The spending ratios' differences from 1 are statistically significant for five of the six conditions.

The magnitude of the difference is highlighted in the first row of Table 6. For the eight conditions for which decompositions are available, we estimate that price differences account for 45% of differences in plan costs.

We have not explained these differences in prices. As noted above, the differences are not attributable to different hospitals of admission (for births and heart attacks). It is likely that price discounts received by HMOs reflect greater bargaining power on their part. But we have no direct evidence of this.

### 4.4. Covariance terms

In our decomposition of cost differences, we did not discuss covariance terms. These terms represent the shares of cost differences arising from interactions between incidence, within-condition mix, treatment, and price effects. Appendix Table I summarizes the higher-order terms from our decomposition of cost differences for AMI. For that condition, most effects are small;[23] the same is true for most other conditions as well. We do not attach any special interpretation to these results, which are presented only for completeness.

## 5. Conclusions and implications

We analyzed three sources of significant cost difference between the indemnity plan and the HMOs in the GIC pool: mix (either from demographic differences among sufferers or different incidence rates within demographic groups), treatment intensity, and prices for treatments. Table 6 summarizes our results. Incidence rates are important. Indeed, for six of the eight conditions we study, the incidence was twice as high in the indemnity plan as in the HMOs. Across the conditions, 47% of differences in plan costs are attributable to differences in the likelihoods that patients in the two types of plans suffer from these conditions. On average, approximately 3% of the difference between plans in total costs for *all* conditions results from differing incidence rates. Conditional on having a condition, mix effects are much less important.

[23] The most significant interaction is between incidence and price. It suggests that the groups where incidence is higher in the HMOs are those for whom more expensive treatments are more common in the indemnity plan (and vice versa). For example, incidence rates of acute myocardial infarction are much more similar across age groups in the HMOs than in the indemnity plan, but younger patients are much more likely to receive the most expensive procedures (bypass surgeries) in the indemnity plan than in the HMOs. Simulating costs in the indemnity plan using HMO incidence rates and prices therefore gives more weight to the most expensive treatments, increasing the cost difference.

Price differences are the other major component, explaining 45% of cost differences in total. This provides strong evidence that price differentials are a key source of cost differences, although our results must be qualified by our inability to separate pure price effects from the effects of unobserved, within-age-and-sex-cohort selection. Finally, treatment-intensity differences explain only a small part of cost differences. The indemnity plan offers more intense treatment only for live births. The HMOs, in contrast, offer more intensive treatment for AMI and possibly for colon cancer.

The source of the price differences is not entirely clear. We test and reject the hypothesis that HMO patients are admitted to less expensive, and perhaps lower quality, hospitals. It is likely that the lower prices are a result of greater bargaining leverage that HMOs have in comparison to indemnity plans.

How is it possible that HMOs have essentially the same treatment intensity, given that HMOs provide incentives to curb expenditure? It seems extremely unlikely that HMO patients generally have more severe cases, since both the unadjusted and age- and sex-adjusted incidences of these diseases are greater in the indemnity plan. Moreover, an alleged advantage of HMOs is that they are more vigorous in screening for diseases, which would suggest that if anything they detect less advanced cases that are presumably cheaper to treat.

We propose three possible explanations for study: (1) HMOs' genuine concern about their patients and their individual management of cases offset any adverse effects of cost-saving considerations; (2) HMOs, which tend to compete vigorously with one another, have a deep concern for their reputations, which can spread easily within the workplace. Thus, HMOs do not cut back on treatments for fear of losing valuable customers; (3) preventive care—a supposed specialty of HMOs—works, but tilts towards eliminating the more mild cases of a disease. If so, treatment intensity for the remaining cases would be greater than in the indemnity plan and it would offset the incentives to provide less care.[24]

Whatever the explanation for the surprisingly small contribution of treatment intensity to cost differences, our overall results are good news for policy-makers who want to save money through managed care. It costs substantially less, without reducing the use of expensive treatments. Our results should be complemented with studies of a broad range of medical conditions and other settings. But assuming no unpleasant surprises, we have the positive finding that cost savings by HMOs are not achieved through curtailing essential medical treatments.[25]

Treatment intensity, as measured by the cost of the treatments provided, is but one factor that helps to determine medical outcomes. Physician skill levels or patient compliance rates could differ between the two types of plans. Outcome differences between plans should also be examined. Past evidence, however, does not suggest clear conclusions about outcome differences between patients in HMOs and patients in indemnity plans (Miller and Luft, 1997). This result has been found particularly for heart attack care (Cutler et al., 2000) and colorectal cancer (Hodgson et al., 2001), two of our eight conditions.

[24] Of course, the reverse effect could be true as well—preventive care could lower the severity of events when they occur.

[25] In addition, out-of-pocket expenses are lower for high-cost patients in the HMOs; it certainly appears that HMO patients get more bang—or at least more treatment—for their medical care buck.

If treatments are no different on average between the two types of plans, why are older and sicker individuals more likely to stay in the indemnity plan? Our strong suspicion is that, not unlike many health policy analysts and economists, the employees enrolled in the GIC's health plans simply have the wrong view about treatment intensity, believing that the indemnity plan offers more intense treatments. It may also be the case, though, that unmeasured aspects of the treatment environment favor the indemnity plan. For example, customer satisfaction and relationships with providers may receive greater emphasis in the indemnity plan. A strong relationship with caregivers could be as important an input for patient satisfaction and selection as the treatment itself. Alternatively, factors such as unlimited choice of physicians and the absence of "gatekeeper" primary care providers may explain why high-risk patients prefer the indemnity plan.

Responding to the sense that the indemnity plan was overpaying for the same services, the GIC has taken action to cut the prices of that plan. In 1998, the GIC implemented rates in the indemnity plan closer to those paid by HMOs and Medicare. The GIC estimated FY1999 savings of 11% in the indemnity plan from this move, with additional savings to come in future years.[26] The cost savings created by the new payment system suggest either that our price hypothesis is correct, or that treatment intensity is falling in the indemnity plan. We prefer the former explanation, since it is unlikely that treatments would become less intense in the indemnity plan than in the HMOs when all plans effectively face the HMOs' payment rates.

Understanding the source of cost differentials between HMO and indemnity plans should help employers decide whether and how to implement risk-adjustment in their efforts to efficiently subsidize employee health plans. Efficiency requires that prices to consumers reflect "true" differences in plans' costs. Our results from Massachusetts show that mix effects—which do not reflect true differences in costs—account for half of the excess cost of the indemnity plan. However, price effects, which are a true difference, account for most of the rest.

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