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## ABSTRACT

Integrating the health services and insurance industries (HMOs) could lower expenditure by reducing either the quantity of services or unit price. We compare the treatment of heart attacks and newly diagnosed chest pain in HMOs and traditional plans in two data sets. The nature of these health problems should minimize selection, and OLS and instrumental-variable estimates yield consistent results. HMOs have 30 to 40 percent lower expenditures than traditional indemnity plans. Actual treatments and health outcomes differ little; virtually all the difference in spending comes from lower unit prices. Managed care may yield substantial productivity improvements relative to traditional insurance.

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The structure of the $1 trillion American health care services industry is rapidly changing. Traditionally, the provision of medical services and the payment for those services were separate industries. Patients and providers decided on appropriate treatments, and insurers paid the bill. Increasingly, however, medical services and insurance are becoming integrated, and medical care is being "managed". Insurers commonly use financial incentives to physicians to limit utilization, restrict the services that they provide through command-and-control methods, and bargain with provider networks to obtain lower prices. Such managed-care insurance contracts have quickly become the norm among the privately insured population. Whereas only one-quarter of the privately insured population was in managed care in 1987, more than three-quarters are enrolled in managed care today (Gabel et al., 1989; Jensen et al., 1997).

The growth of managed care poses a great difficulty for price and productivity measurement in the medical sector. To the extent that managed care reduces the prices paid for equivalent services, the movement of patients from unmanaged into managed insurance increases the productivity of the sector. To the extent that managed care saves money by rationing care, however, it will either reduce or increase the effective price of medical care, depending on whether the care that is rationed was worth more or less to consumers than it cost to provide.[1]

In this paper we consider how managed care affects the price and productivity of medical care services. We use two data sources . One comes from a large firm offering both managed care policies and a traditional policy; the other from all hospitals in the state of Massachusetts. Conceptually, our strategy is to measure the difference in reimbursement between traditional

[1] The issue is similar to the productivity consequences of the movement of consumers away from traditional retail stores to wholesale providers. These stores charge less than traditional stores but also provide somewhat lower quality service. Determining the effective price of this switch requires decomposing the nominal price change into its quality and non-quality components (Reinsdorf, 1993).

indemnity insurance and managed care insurance and then divide this reimbursement difference into a pure price component and a quantity/quality component. By valuing the quantity and quality of medical care explicitly, we can adjust the average reimbursement difference to form a price index for managed care insurance.

The major empirical difficulty is determining the quality of medical care. Even under the best of circumstances, it is difficult to estimate the production function for medical care. But it is particularly hard to compare output measures across plans because of adverse selection. Managed care plans generally enroll healthier people than traditional insurance plans (Newhouse, 1996). As a result, comparisons of the average patient in each plan will misstate the differences for a fixed patient across plans. We address the selection problem in two ways. First, we limit the sample to patients with two newly diagnosed diseases. While patients certainly select across plans on the basis of expected *incidence* of disease, it is much less likely that plan decisions are made with knowledge of *severity* of disease should a given disease occur. Second, we use an instrumental-variables approach to adjust for selection across plans. Our instruments are the health of other members of a person's family, controlling for the person's own health. Selection on the basis of other family member's health should not influence disease treatment, once own health is controlled for (Eichner, 1996).

We focus on care for patients with heart disease – both acute care for patients with a heart attack, and chronic care for patients with new occurrences of chest pain. We analyze heart disease because of its importance and cost and because its severity is not likely to be known by an individual who has not recently been treated for it in advance of its occurrence.

We find that essentially all of the difference in reimbursement between traditional and managed care insurance in Massachusetts is a result of differences in the prices paid for

particular services, rather than differences in the quantity or quality of services received. In both acute and chronic treatments, the prices paid differ across plans by as much as 40 percent. The services received are reasonably similar, however, and when we look at health outcomes, we are unable to find significant differences across plans. These results imply higher productivity for managed care insurance relative to traditional indemnity insurance.

We begin in the first section with a discussion of alternative types of insurance arrangements. The second section shows theoretically the productivity and price of alternative insurance systems. The third section describes the conditions we analyze, and the fourth section presents the data. The fifth and sixth sections presents results on differences in care for patients with heart attack and patients with chest pain. The seventh section considers the health outcomes of treatment for these different conditions. The last section concludes.

## I. Forms of Health Insurance

The dominant medical care system of the past half century (the "traditional system") was characterized by a division of medical care into a medical services industry that provided care and a health insurance industry that financed it. The first column of Table 1 shows the operation of this system. Traditionally, medical providers, especially physicians, were independent actors. Patients could generally seek care from any licensed provider, and providers could perform any services or refer patients for any services they thought were medically necessary. Spurred by the tax exclusion for employer-provided health insurance, by the 1980s the typical insurance policy, at least among large employers, was quite generous, covering hospital services, physician services, drugs, supplies, and lab tests.

The patient's insurer reimbursed in full or in part for covered services. Of course, insurers could not agree to reimburse any price a supplier named.[2] Insurers therefore developed fee schedules or maximum fees that they would pay. These fee schedules were typically on a piece-work (fee-for-service) basis and were generally very disaggregated (e.g., urinalysis, operating room time, treatment of a simple fracture), although sometimes they were partially bundled (e.g., a fee for all obstetrical services connected with a normal delivery). Use of a fee schedule naturally required a contract with providers, but the fees specified in the contracts were usually high enough to elicit the participation of almost all providers in an area.[3]

To restrain demand insurers usually imposed cost-sharing for covered services. Policies often had a deductible, usually specified per person per year, with coinsurance above the deductible up to either an upper limit or a stop-loss amount.[4] Insurers had little incentive to minimize the use of services in other ways because they were generally not at risk for additional expenditures. For large and medium size employers (above 25 employees) insurance was often experience rated – the rate charged this year was a function of last year's experience.[5] Often, the company made this official by self-insuring – bearing all of the risk themselves and hiring an insurance company only to administer the claims payment. To the extent that demand was

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[2] Although coinsurance would in principle restrain prices, the provider could forgive the coinsurance and accept the insurance as payment in full, thereby negating the coinsurance (in general providers, not insurers, collected any cost sharing).

[3] For example, hospitals and physicians dominated the boards of Blue Cross and Blue Shield and thus set their fees, until this was deemed a violation of the antitrust laws.

[4] For unionized workers in certain industries such as automobile and steel, there usually was (and still is) no such cost sharing.

[5] If insurers quoted too low a premium and sustained losses that they tried to recoup next year, the employer might seek another insurance company, but often in practice did not.

limited, it was generally because of the patient cost sharing; we term this a demand-side spending restraint.

Along with the traditional system, a model of complete integration of medical care provision and insurance has also existed for the past half century – the group and staff model Health Maintenance Organization [HMO].[6] A description of this plan is in the last column of Table 1.

Group and staff model HMOs, of which the best known was the Kaiser system on the west coast, agreed to provide all necessary services in return for a fixed annual premium. In the HMO, all medical services were supplied by a medical group that exclusively served HMO patients; physicians were often salaried, with some modest bonus payments if utilization was low relative to a target.[7] Patients received no reimbursement for using physicians outside the HMO, and cost sharing by the patient was typically modest (e.g., $5 per visit). But patients did not have complete choice of providers, even inside the HMO. Typically, patients had to see a primary care "gatekeeper" for referral to a specialist.

The source of cost savings in HMOs is not reduced demand from high cost sharing for non-network providers; this effect is minimal. Rather, cost savings come from supply-side restraints: inducing network physicians to provide less care or to provide care in less expensive

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[6] The distinction between a group and staff model HMO refers to whether the physicians are employed by a medical group that contracts exclusively with the HMO, or whether the HMO employs the physicians directly. This distinction is largely irrelevant for the underlying economics.

[7] The incentives implied by the bonus for the individual physician were very weak, because the bonus was calculated on the basis of costs incurred by a large number of physicians. Typically the bonus was only a few percent of an annual salary.

settings. A typical finding in the older literature is that group and staff model HMOs saved about 10 percent of the cost of traditional indemnity insurance, generally through fewer hospital admissions (e.g., Miller and Luft, 1994).

The last two decades – and particularly the last half decade — have seen the development of plans in between the traditional insurance model and the group/staff model HMO, as exemplified in Table 1. In the 1970s, Independent Practice Associations [IPAs] and network HMOs developed; these plans typically included many physicians in office-based practice who treated IPA and HMO patients in part of their practice. Like traditional HMOs, IPAs agreed to provide necessary services in return for a fixed capitation rate; to ensure that they broke even, IPAs often shifted some risk to physicians, for example by *ex post* adjusting their fees downward if the aggregate utilization of services was high. Moreover, IPAs contracted only with certain physicians and hospitals, thereby obtaining more favorable rates.

IPAs also developed methods of utilization review, essentially command-and-control methods for reducing utilization. Non-emergency hospital admissions might require prior authorization by the IPA, and nurses or other case managers might be stationed in hospitals to determine if a patient could be discharged sooner (if so, the IPA might refuse to pay for additional days, generating substantial pressure on the physician to discharge the patient).

In the 1980s hybrid plans began to appear that gave the consumer incentives to use network providers, but unlike the traditional HMO, offered some reimbursement for consumers who used non-network services. The first such plans to appear were Preferred Provider Organizations [PPOs]. These plans usually built from an underlying indemnity insurance plan. PPOs sought a discount from physicians and hospitals in fees (generally about 20 percent); in exchange, the patient would face little or no payment at the time of use when using those

physicians or hospitals. If patients used non-network providers, they were reimbursed according to an underlying indemnity plan. In practice the reduced cost sharing led most patients to use the preferred providers, so PPOs laid a basis for price competition among physicians and hospitals. But the initial experience with this model was not particularly favorable; the reduced cost sharing increased use of care, largely wiping out the savings from the discount (Zwanziger and Auerbach, 1991). As a result, PPOs began to employ some utilization review methods for controlling the quantity of services, though the usual PPO did not rely on these methods as much as IPA or network HMOs.

Later both group/staff and IPA HMOs began to introduce so-called point-of-service [POS] options. An enrollee in this option could receive some reimbursement for going outside the HMO, although usually the price was non-trivial; a common provision was that the consumer would pay the first $500 for any use outside the network and 20 percent of the next $2,500 of use. This type of option has been growing rapidly, since many people like the option of using out-of-network services.

Perhaps the most important development, however, has been in new methods of reducing utilization. IPAs and Network HMOs frequently pay groups of physicians and sometimes individual physicians on a capitated basis – providers receive a fixed payment per member per month and in exchange bear much or all of the cost of services used. Generally, the financial incentives are placed on primary care physicians.[8] Financial incentives have to some degree

[8] Physicians may be at risk for just their own services or for most or all services used by patients, including hospitalization, services of other physicians, and even services outside of the network. Tiered arrangements have developed in some areas, with large groups of physicians (as large as 1,000 or more) accepting all or most of the risk from an insurance plan and then contracting with smaller groups of physicians for the delivery of care. In this case the large group of physicians rather than the plan may also perform any command-and-control regulation

replaced command-and-control regulation of utilization, although command-and-control regulations are still used (particularly when the financial incentives are weak).

Managed care today typically limits spending in four ways. First, since patients tend to stay within networks, plans often bargain hard for low rates from providers. With a large number of patients in the plan, the group elasticity of demand is quite high; thus, prices paid by tightly managed networks can be much lower than prices paid by more open-ended plans. Second, capitated payments with risk sharing on the physician could induce less utilization of services than did the old fee-for-service payment system or even the salaried system of the first HMOs. Coupled with this are command-and-control restrictions on utilization, such as prior approval requirements. Finally, many managed care plans place emphasis on the primary care gatekeeper as the contact point in accessing medical services, thus limiting access to more expensive specialty services. This last control could be viewed as a special case of command-and-control restrictions.

## II. Prices and Productivity Across Insurance Plans

The question for our research is how to measure the effective price and productivity differences between managed care and traditional insurance. To demonstrate the issues involved, we consider a model with a representative consumer, taken to be an individual before he knows which diseases he will contract.[9] Individual welfare is a function of health *(H)* and

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of services.

[9] Cutler, McClellan, Newhouse, and Remler (1996) develop this model for the case of time-series changes in the receipt of medical care.

consumption of goods and services *(x)*. Health depends on the possible diseases the person has *(d)*,[10] and the medical care the patient receives when sick (the vector $m_d$). Disease $d$ occurs with probability $\pi_d$.

We assume the price the patient pays out-of-pocket for medical care is the vector $p$. $p$ may differ across plans and within plans, depending on whether the service is received inside or outside of the network. In addition to $p$, people also pay an insurance premium of $I$. Consumption is income less spending on medical care,[11] or $(Y - p \cdot m_d - I)$ for a consumer with disease $d$. Expected utility is therefore:

$$(1) \quad E[U] = \sum_d \pi_d \cdot U(H(d, m_d),\ Y - p \cdot m_d - I).$$

The first term in the utility function is health; the second term is consumption of non-health goods. We have assumed that medical care services provide no direct utility to the patient; they affect welfare only through their effect on health. For most medical services this is likely to be a reasonable approximation.

Suppose we compare two insurance plans, a base plan (denoted 0) and an alternate plan (denoted 1). We define a measure of compensation, $C$, as the amount of money the consumer would be willing to pay (or would have to be compensated) to be indifferent between plan 1 and plan 0:

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[10] One "disease" consists of being healthy.

[11] This is implicitly a one-period model, although one could easily expand it to multiple periods.

$$(2) \quad \sum_d \pi_d \cdot U(H(d, m_d^1),\ Y - p^1 \cdot m_d^1 - I^1 - C) \quad = \quad \sum_d \pi_d \cdot U(H(d, m_d^0),\ Y - p^0 \cdot m_d^0 - I^0)$$

The change in the cost-of-living associated with moving from plan 0 to plan 1 is proportional to $C$. If consumers are willing to pay to have plan 1 relative to plan 0 at prices $p^1$ and $p^0$, then the quality-adjusted price of plan 1 is lower than the quality-adjusted price of plan 0. The opposite is true if $C$ is negative. Indeed, Fisher and Shell (1972) show that the true change in the cost of living from changing insurance plans is $COL_{0,1} = 1 - C / Y$.[12]

Similarly, C is directly related to productivity measurement as well. A quality-adjusted price can be defined as the compensating change in $p^1$ that would leave C equal to zero with equality in equation (2) holding. A quality-adjusted price deflator is necessary for defining productivity change.

We can approximate $C$ using a Taylor series expansion of equation (2). This yields:

$$(3) \quad U_x C \cong \sum_d \pi_d \cdot [\, U_H H_m \frac{d\, m_d}{dIns} - U_x \frac{d(I + p \cdot m_d)}{dIns} + \frac{U_{xx}}{2} \frac{d(p \cdot m_d)^2}{dIns^2} \,]$$

where $x$ is income net of spending on medical care, $U_x$ is the marginal utility of income, and we have converted the two discrete plans in equation (2) to a continuous measure of insurance, Ins.

Finally, note that in a competitive insurance market the insurance premium is the total cost of services received less the out-of-pocket payment from the patient.[13] Denoting $p^*$ as the contracted price for the services in the policy, the insurance premium is $I = \Sigma_d \pi_d \cdot (p^* - p) \cdot m_d$. Substituting this into equation (2) and dividing by the marginal utility of income yields:

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[12] The equation is more standard when written in terms of expenditure functions. If we consider just a price change, the change in the cost-of-living is defined as $COL_{0,1} = e(p^1,U) / e(p^0,U)$. This can be rewritten as $COL_{0,1} = 1 - (e(p^0,U) - e(p^1,U)) / e(p^0,U) = 1 - C/Y$.

[13] We assume that there are no other payments — for example, from the insurance policy

$$(4) \quad C \cong \sum_d \pi_d \cdot \left[ \frac{U_H H_m}{U_x} \cdot \frac{d\, m_d}{dIns} - \frac{d(p^* \cdot m_d)}{dIns} + R \cdot \frac{d(p \cdot m_d)^2}{dIns^2} \right]$$

where $R$ is the coefficient of relative risk aversion, $U_{xx} / 2U_x$.

Equation (4) shows how to compare insurance plans. Moving from traditional to managed care insurance involves three effects. The first term is the difference in health resulting from differences in medical treatments. We typically think this will be negative – that is, health will be lower under managed care – but it could be positive because of better management of the overall care process or reduction in iatrogenic (medically caused) events (Weiler et al., 1993). The second term is the cost savings in managed care – from lower prices and reduced utilization of services. The third term is the financial risk from different out-of-pocket payments. The direction of this third effect depends on the services covered, the cost sharing provisions of each plan, and the reimbursement for out-of-network service use.

We limit our analysis to the first two terms.[14] We define the "effective price" of managed care as the cost savings in managed care less the dollar value of any reduced health from less intensive use of medical services. Corresponding to this price change is a productivity change; if managed care lowers the price of medical care, it also raises its productivity.

The critical question in evaluating equation (4) is what to assume about how medical services are determined. In most markets we assume that people only buy a good if it is worth it to them to do so. Thus, knowing that people have chosen managed care over traditional insurance is a sign that people see themselves as better off in managed care insurance.

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of a spouse — that are relevant.

For a variety of reasons, however, we are reluctant to depend on this assumption for health insurance. Since employers often choose insurance and not individuals, the assumption is tantamount to assuming complete pass through from employees to employers; this is unlikely. In addition, information problems and the complexity of medical care services mean that even employees with a choice of policies may not know which plan is best. Finally, adverse selection across plans means that plan premiums generally do not reflect just efficiency differences (Cutler and Reber, 1998).

We thus follow an alternate path: we evaluate the prices paid and treatments received for the same set of diseases in different insurance policies. By looking at detailed treatments across plans, we can measure accurately quantity and price differences. In addition, focusing on particular newly diagnosed diseases should minimize selection problems. As noted above, it seems much more likely that selection is based on the expected *incidence* of disease than on its expected *severity*. Thus, if we focus on treatment for a disease once it has occurred (i.e., condition on the presence of the disease), we should minimize differences in spending across plans due to selection. Finally, this strategy has the advantage that it requires no assumption about the optimality of choosing managed care for patients in managed care plans.

We focus our analysis on patients with heart disease. Heart disease is natural to study for several reasons. First, it is a common condition; about one-sixth of the U.S. population over age 45 suffers from heart disease, and there are about 700,000 heart attacks annually. Second, because the severity of heart disease is difficult to predict, forecasts of severity of disease are unlikely to affect one's choice of plan. Third, heart disease, and particularly heart attacks, is

[14] We lack information on out-of-pocket payments, but the risk they impose is typically small in any event (Newhouse and the Insurance Experiment Group, 1993, chapter 4).

generally treated, so issues of selection into treatment are less important. Finally, there are a number of expensive treatment options for heart disease and thus the potential for substantial financial savings from managed care. Before discussing our data and empirical results, we present more detail on the conditions and treatments for heart disease.

## III. The Treatment of Heart Disease

We analyze two forms of heart disease: less severe forms of ischemic heart disease (IHD) – that is, disease caused by blockages in the blood vessels supplying the heart – and heart attacks. Figure 1 illustrates a typical treatment path for a patient with ischemic heart disease.

The most typical symptom of IHD is chest pain, possibly associated with other symptoms like shortness of breath, especially with exercise that challenges the heart. A difficult diagnostic problem for physicians is distinguishing between chest pain that is the result of IHD, and thus may require substantial medical interventions, and chest pain that is the result of less worrisome causes such as digestive or musculoskeletal problems.

Some, but not all, cases of IHD will result in a hospitalization. Patients with known IHD or possible IHD tend to be hospitalized if their symptoms are "unstable," that is, progressive, occurring at rest, or leading to significant functional impairments. Such hospitalizations often occur to "rule out" a new heart attack, and to modify the patient's ongoing treatment under careful monitoring conditions. IHD patients may also be hospitalized for performance of some intensive procedures that we discuss below.[15]

[15] Catheterization and angioplasty are often performed on an outpatient basis for relatively uncomplicated cases of IHD.

Because there are no bright lines between mild and more severe IHD symptoms, and because the benefits of many IHD treatments are uncertain for many patients, considerable variation exists in the use of hospital-based treatments for IHD. Indeed, variation also exists in the frequency and intensity of outpatient treatment for these conditions, such as the frequency of visits to a physician and the performance of outpatient diagnostic tests such as exercise tolerance tests (treadmill tests or stress tests) and echocardiograms to determine whether the symptoms reflect serious IHD. We analyze the use of these tests below.

In some cases, ischemic heart disease will lead to an acute health event, of which one of the most common (and most serious) is a heart attack. Heart attacks are often fatal and, if not fatal, often result in permanent damage to the heart, causing symptoms of congestive heart failure. Because of these potentially serious health consequences, a heart attack generally leads to an inpatient hospital admission.

Some of the major intensive procedures that are used in the treatment of heart attacks are outlined in Figure 2. One key decision in heart attack treatment is whether to perform *cardiac catheterization*, an intensive procedure that involves threading a catheter into the blood vessels supplying the heart and injecting a radiopaque dye that can be visualized on x-ray images of the procedure. Depending on the results of the catheterization, the patient may subsequently receive one of two procedures to help restore blood flow to the heart. *Bypass surgery* is a major, open-heart surgical procedure that restores blood flow via grafts of arteries or veins around areas of blockage in the blood vessels supplying the heart. *Angioplasty* is a percutaneous procedure developed more recently than bypass. It is performed through a catheter like cardiac catheterization, and seeks to restore blood flow by inflating a balloon in the area of blockage.

In addition to these invasive procedures, many other treatments may be used in the care

of heart attack patients, including acute treatments like clot-busting drugs and careful monitoring for irregular rhythms in specialized coronary care units, and chronic treatments like counseling to encourage changes in risky lifestyles and drug therapies such as cholesterol-lowering medications and aspirin. These latter therapies are often prescribed for patients with less severe ischemic heart disease as well.

We direct particular attention to the use of invasive procedures in our analysis, since these major procedures are generally coded reliably by all health plans. In addition, these procedures are costly and may have major consequences for many other treatment decisions. Finally, previous studies have shown that use of these procedures varies widely across providers, geographic areas, and probably health plans (McClellan, 1995), suggesting that their use may provide a sensitive indicator of how managed-care plans may influence use of medical technologies.

In analyzing both of these conditions, we pay particular attention to the time over which we observe the case. Patient with a heart attack or with ischemic heart disease may see physicians or be in and out of hospitals for a several week period, receiving various diagnostic tests and therapeutic procedures. It is more natural to treat this care as one continuous episode rather than a series of separate episodes of care. To do this, we take all claims within 90 days of the beginning of the care episode and group them together into a "heart attack episode" or an "ischemic heart disease episode". The 90 day window is long enough to capture essentially all of the acute services provided for the initial heart attack without including care related to a recurrent attack (McClellan, McNeil, and Newhouse, 1994). Throughout the rest of the paper, when we refer to episodes of care, we include all services received in the 90 day window. In all of our samples, we omit people with a heart attack or ischemic heart disease that begins within

90 days of the end of our data.

## IV. Data

We use two sources of data in our empirical work. The first is the complete claims records of a large firm in the Massachusetts area for the 30 months from July 1993 through December 1995 (the "firm data"). The firm has about 250,000 covered lives, although some of these (about 45,000) are retirees who are insured by Medicare. Since reimbursement for these individuals is primarily through Medicare and the firm provides only supplemental insurance coverage beyond Medicare,[16] the claims data for Medicare-eligible individuals are not always reported. We thus use data for the non-retiree population only.

The firm data cover both inpatient and outpatient care (including prescription drugs). The data are generally believed to be reliable, since the firm uses them to monitor the premiums that insurers charge.[17] Not all HMOs have prices for all services. For example, some HMOs run their own clinics, and patients come to those clinics for outpatient care. A record is kept for the visit, but there is no specific payment attached to the record because the staff are paid on salary. In such situations we impute payments, using payments other HMOs make for purchased services. The Appendix describes the imputation procedure in more detail.

The firm offers three types of insurance policies: a generous indemnity policy with

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[16] That is, coverage for services Medicare does not reimburse (such as prescription drugs) or for the costsharing required under Medicare.

[17] To examine the completeness of the data, we simulated premiums using plan payments and compared them to actual premiums. The data generally match well. The load implied in the HMOs is about 30 percent. There is essentially no load in the indemnity policy. This matches well anecdotal information about the profitability of the different plans.

relatively few cost containment measures; a Blue Cross/Blue Shield PPO; and a number of HMOs. In most of our analysis, we group the HMOs together. The first column of Table 2 shows the number of enrollees in each plan. There are about 70,000 to 100,000 people in the indemnity and HMO policies, and about one-quarter that number in the PPO.

The premiums for the policies are dramatically different. As the second column shows, the premium for the PPO is only 85 percent of the premium for the indemnity policy, and the premium for the average HMO is only 70 percent of the premium for the indemnity policy. Indeed, for a family the indemnity policy costs over $2,000 more per year than the HMOs. This large difference in premiums naturally raises the issue of price and quality differences.[18]

The national annual incidence of heart attacks is about 0.14 percent in the non-elderly population (Graves 1994). As the fourth column of Table 2 shows, our sample has roughly the same incidence (recall that our sample is a 2½ year period): 554 heart attacks in the indemnity insurance policy (0.8 percent), 55 heart attacks in the PPO (0.2 percent), and 299 heart attacks in the HMOs (0.3 percent). The higher incidence rate of heart attacks in the indemnity policy is consistent with adverse selection in the plan (e.g., on average an older population). Since there are so few heart attacks in the PPO, most of our analysis compares treatment in the HMOs relative to the indemnity insurance policy. These are the most generous and least generous policies, so this comparison is a natural one.

For our sample of patients with chest pain, we make a distinction between new cases and

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[18] One might wonder how the indemnity policy manages to survive with such a high premium. The answer is that the firm pays much more of the premium for the indemnity policy than for the HMOs. The cost to employees of the indemnity policy is only $500 more per year than the cost for the average HMO. In the absence of this subsidy, it is likely that the indemnity policy would lose market share in an adverse selection spiral (Cutler and Zeckhauser, 1998).

care for patients receiving ongoing treatment. Treatment for ongoing patients will more likely reflect selection across plans; we thus sample only new cases of chest pain. In particular, we include in our sample patients who saw a physician on an outpatient basis for acute myocardial infarction, ischemic heart disease, or congestive heart failure, and who had not seen a physician (inpatient or outpatient) for one of these conditions in the previous year.[19] Generally, a patient with chronic heart disease will see a physician for management of that disease at least once a year, so this restriction is reasonable. As Table 2 shows, there are about twice as many patients with chest pain as with heart attacks. The incidence of chest pain is also greater in the indemnity policy than in the HMOs.

Our second source of data is the complete set of inpatient claims for people admitted to hospitals in Massachusetts in fiscal years 1994 and 1995 (the "state data"). Beginning with calendar year 1994, hospitals provided Social Security Numbers for the patients they admitted, so that admissions can be linked (even across hospitals) to form an episode of care. As the last column of Table 1 shows, there are 1,929 heart attack patients who have Blue Cross/Blue Shield or commercial (indemnity) insurance, 891 patients who have non-HMO managed care policies (generally PPOs), and 1,423 patients who have HMO insurance. There are also a number of Medicare patients, Medicaid patients, and patients with other forms of insurance; our primary focus, however, is on the under-65 privately insured population.[20]

The state data have more heart attack patients than the firm data, so they are better for

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[19] We require patients to have been enrolled for the first 12 months to be eligible for the sample.

[20] Other insurance includes, for example, Workers Compensation. We group Medicare and Medicaid managed care patients in with the other members of these programs.

analyzing the relation between insurance and inpatient care received. The state data have two limitations, however. First, there are no outpatient records, so that we have only a partial record of services used. Second, there are no reimbursement data. Hospitals report their charges (list prices) for treatment, but not the payment they received. For analysis of reimbursement information (transaction prices), we must of necessity use the firm data.

It is important to note that most of the HMOs in our study contract with local providers (particularly hospitals) rather than employing their own providers. Thus, patients with heart disease or heart attacks in the managed care plans will generally receive care from the same providers as patients in traditional insurance. That does not mean that the care is the same in the different policies, but it does limit the potential variation in care relative to situations where the HMOs are providing medical care outside of the system of traditional insurance (as sometimes occurs with group/staff model HMOs). In addition, treatment of a heart attack, and to a lesser extent heart disease, is a medical necessity. Thus, the treatment margin itself is relatively unresponsive to insurance. For these two reasons, we suspect that the differences we find in the quantity of medical care provided in different plans are smaller than what one would find over the entire range of diseases (see also Frank et al. 1997).

## V. Care for Heart Attack Patients

In this section we examine differences in the treatment of heart attack patients across insurance plans. The upper panel of Table 3 shows summary statistics on reimbursement for heart attacks. Because we have reimbursement information only for the firm data, the Table shows results for just that sample. The first column shows average reimbursement for all

patients. Heart attacks are expensive; average reimbursement in the indemnity policy is $38,502. Reimbursement is much lower in the other plans. Average reimbursement in the PPO is only 69 percent as high as in the indemnity policy ($26,483), and reimbursement in the HMO is only 61 percent as high ($23,632). The reimbursement differentials match the differences in plan premiums.

We want to divide the reimbursement differences into differences in prices paid and differences in the quantity of care received. The most important question is: what is the good we should be pricing? There are literally thousands of individual services that a heart attack patient can receive – specific tests, units of blood, operating room time, etc. Disaggregating to the individual service level does not seem the most appropriate way to proceed, however. It seems more natural to think of the good as "bypass surgery and its related services" or "angioplasty and its related services," since this is the type of good which individuals or physicians acting as their agents decide to purchase.

The next four columns of Table 3 show reimbursement and the share of patients by broad treatment regimen.[21] Reimbursement differences within treatment regimens mirror the overall reimbursement differences. In each case, reimbursement in the HMOs is only 50 to 60 percent as high as reimbursement in the indemnity policy. In contrast, the share of patients receiving different treatment regimens is roughly the same in the different plans. In the firm data, managed care patients are slightly *more* likely to receive intensive surgical procedures than are patients in the indemnity policy; in the state data, managed care patients are slightly less likely to receive intensive surgical procedures than are patients in indemnity insurance. The final column

[21] We do not show statistics for the PPO because the number of heart attack patients is so small.

of Table 3 shows that, adjusted for differences in the share of patients receiving different treatments (using population weights), reimbursement in the HMOs is still only 55 percent of reimbursement in the indemnity policy.

Thus, essentially all of the cost differences across plans result from differences in reimbursement conditional on a treatment rather than a different type of care provided. We formalize this finding in Table 4. As the first row of Table 4 shows, the average heart attack patient in an HMO spends $14,869 less than the average heart attack patient in the indemnity policy. Payment conditional on treatment regimen accounts for over 100 percent of the difference in costs. Differences in the quantity of services received actually decrease the payment difference between the plans. [22]

One concern about these results is that they may be driven by a small number of patients with high spending. If high-cost patients are disproportionately concentrated in the indemnity policy, they could affect average reimbursement a great deal. To examine this question, the last panel of Table 3 shows the ratio of HMO to indemnity insurance reimbursement at different points in the distribution of each plan: the 10$^{th}$ percentile[23], the median, and the 90$^{th}$ percentile. Reimbursement in the HMOs is lower throughout the distribution of patients, and by roughly the same amount as the mean differences. The results are thus not driven by a few outliers.

So far, our results have not been adjusted for patient characteristics. Demographic factors such as age and sex and community factors such as median income have repeatedly been shown to be important in explaining variations in medical treatments (Weissman and Epstein,

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[22] Frank, McGuire, and Newhouse (1995) note a similar finding about mental health care.

[23] This statistic, for example, is the 10$^{th}$ percentile of HMO reimbursement divided by the 10$^{th}$ percentile of indemnity reimbursement.

1994), and we want to control for these factors.

To do this we estimate regression models for treatments and reimbursement. We include as control variables five-year age dummy variables and a dummy variable for men. In addition, we include dummy variables for region in the state,[24] and the logarithm of median household income in the person's zip code, taken from the 1990 Census. We also include dummy variables for the six month period in which the person suffered the heart attack. Finally, to control for the severity of illness, we include a dummy variable for whether the person was admitted to the hospital prior to the heart attack (but during our sample period). There are a number of additional medical controls we would like to include — such as the detailed physiology of the heart attack — but this information is not included in our data.[25]

Table 5 presents our regression results. The first two columns report ordinary least squares estimates of the probability that a patient receives cardiac catheterization or coronary revascularization.[26] Men are more likely to receive intensive treatment than are women, a finding consistent with other data (McClellan, McNeil, and Newhouse, 1994). Income is not related to treatment intensity, but people from MSAs are more likely to receive these procedures than are people outside of MSAs (not reported).

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[24] In the firm data we divide people into those living in the Boston MSA, those living in another MSA, and those living outside of an MSA. In the state data we include dummy variables for each of the metropolitan areas in the state and a dummy variable for people living outside of an MSA.

[25] We do know about comorbid conditions, but we suspect these are not reliably coded. For example, if the patient dies during the hospital stay, comorbid conditions may not be noted on the admission record.

[26] We use ordinary least squares estimates to be compatible with our later instrumental variables estimates. Logit models of treatment regimens yield very similar qualitative results.

The insurance variables are similar to the means in Table 3. Controlling for demographics, HMO patients are about 8 percent *more* likely to receive revascularization procedures than are patients in indemnity insurance. To examine the robustness of the results on treatment differences, the last two columns of the Table report similar estimates using the state data. In this sample HMO patients are slightly *less* likely to receive cardiac catheterization (by 3. percent) and there is no measurable effect on the probability of receiving coronary revascularization. We also detect no effect on use of being enrolled in a non-HMO managed care plan. That the HMO effect is positive in one data set and negative in the other, and that there is no measurable effect of non-HMO managed care enrollment suggests to us that treatment differences across plans – if there are any – are small.

The third column of the Table shows the effect of insurance on reimbursement conditional on the treatment regimen. In contrast to the results for treatment differences, we find large effects of insurance on reimbursement within a given treatment regimen. The coefficient on the HMO dummy variable implies that HMOs pay 44 percent less (1-exp(-.578)) than indemnity insurance.

Although we believe that selection concerns are small in assessing care conditional on having a heart attack, we test for selection effects using an alternative estimation approach. In the firm data, we know about the medical care utilization of members of the family other than the individual with a heart attack. We thus instrument for the plan in which the individual is enrolled, using the utilization information from other family members. If people with less healthy relatives are more likely to enroll in the indemnity policy, these variables will predict indemnity policy enrollment, but be uncorrelated with the severity of the heart attack and other

clinical determinants of treatment.[27] Instruments of this form were pioneered by Eichner (1996).

Empirically, we instrument for enrollment in the HMO with a dummy variable for whether the person has a family or individual policy, and a dummy variable for whether another member of the family was hospitalized during our sample.[28] Our first stage equation is:[29]

$$(6)\quad HMO\ Enrollment = -\underset{(.050)}{.110}\ Other\ Hospitalization + \underset{(.039)}{.101}\ Have\ Family;$$

($N$=853; $R^2$=.065). The instrument works well: people with a family are more likely to be enrolled in an HMO; conditional on having a family, if someone else in the family was hospitalized, the person is less likely to be in an HMO.

Table 6 shows instrumental variables estimates of treatment and reimbursement differences across plans. The treatment differences do not suggest that selection is a particular concern. The IV estimates in both cases indicate that HMO patients are *more* likely to receive intensive surgical procedures than are patients enrolled in the indemnity policy. The point estimates are implausibly large, but the standard errors are sufficiently large that even these estimates are not statistically significant. The equation for reimbursement conditional on treatment again implies a large negative effect of HMOs on reimbursement, but the standard error is extremely large. Although more precise instrumental variables estimates would be

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[27] It is possible that one's health may be correlated with the health of relatives, but this seems unlikely for heart disease. Moreover, we still control for own health by controlling for whether the individual with heart disease was previously admitted to a hospital.

[28] We examined a variety of other instruments, including measures of outpatient use of other family members, but found that these measures were unrelated to plan enrollment.

[29] The other variables in our second stage equation are included in the regression but are not reported.

desirable, in all cases the instrumental variables results suggest the same conclusions as the ordinary least squares estimates. We are unable to find significant reductions in treatment intensity in managed care, but the data suggest much lower prices. We thus interpret these results as consistent with the results from our least squares equations.

*Are Reimbursement Differences Just Unmeasured Quantity Differences?*

Differences in reimbursement for a given treatment regimen may result from true differences in reimbursement per service, or from differences in the provision of services within a treatment regimen. For example, if length of stay in the hospital is lower in HMOs than it is in indemnity insurance — as most studies find — we would expect reimbursement within each treatment regimen to be lower in HMOs even if the price paid per day in the hospital were the same.

To address this issue, we would need to decompose reimbursement in each treatment regimen into detailed units of services and payments per service. This is difficult, in large part because the method of payment differs across plans and our data are structured around payment methods. For example, in some of the HMOs hospital payments are on a *per diem* basis (one price per day in the hospital regardless of the services received) while in others they are on a *DRG* basis (a fixed price per treatment regimen). In both of these circumstances, we know the number of days of hospital care but little else about the particular visits, lab tests, and other services provided. Some plans bundle all the ancillary services into the room rate (an "all-inclusive" per diem) while others do not, so that we are unable to examine ancillary service in all plans.

Table 7 summarizes our reliable information on differences in inpatient and outpatient care across plans. The first column shows average length of stay during the hospital admission, adjusted (using population weights) for differences in the share of patients in each treatment regimen. Length of stay is 13.2 days in the indemnity policy and 10.0 days the HMOs. The middle row shows the coefficient of the logarithm of length of stay, using the same model as in Table 5. The implied difference between the two plans is 16 percent, and is significantly different from zero.

Total inpatient reimbursement, however, differs by much more than the difference in length of stay. As the second column shows, inpatient reimbursement is nearly 50 percent lower in the HMOs than in the indemnity policy, in both the raw and regression values. Thus, if all services varied as much across plans as did length of hospital stay, these differences could explain only a third of the difference in reimbursement for each treatment regimen.Because reducing length of stay has been a widely-targeted goal for managed care utilization review, it seems unlikely that declines in other aspects of treatment intensity will be this large.

We can address this question further using the state data. The state requires hospitals to report charges (list prices) in each of several revenue centers, for example laboratory or X-ray. Since hospitals have list prices for all services (some payers pay list prices or a discount off list prices), total charges can be measured even if reimbursement information is not available. We use average charges as a measure of the resources involved in treating patients. That is, we use average charges as a quantity index for each plan, with individual service charges as price weights.

Table 8 shows differences in inpatient charges by plan. As before, the first rows are standardized for differences in treatment regimens across plans using population weights, and the

next two rows present regression-adjusted differences with the other variables included. Because hospitals may have different average discounts (average differences between list and transactions prices), we include hospital fixed effects in our regressions. Our managed care effects are therefore within-hospital differences in charges, controlling for the treatment regimen of the patient. Managed care patients are in the hospital for fewer days than non-managed care patients, particularly on routine care (non-intensive) wards. And total routine care charges are lower for HMO patients. But the difference is only 5 percent , far below the total reimbursement difference in Table 7. Consistent with our earlier speculation, ancillary care charges – the bulk of AMI charges – differ even less across plans than do routine care charges.

The overall differences in total inpatient care charges, less than 1 percent, are nowhere near as large as the difference in reimbursement conditional on treatment regimens (about 50 percent). This evidence, along with the dominant share of inpatient care in the costs of heart attack cases (see Table 7), suggest that most of the differences in reimbursement within treatment regimens represents true differences in the prices paid for similar types of care, rather than differences in the specifics of the treatments received.

*Outcome Differences Across Plans*

That inputs do not differ significantly across plans does not necessarily mean that there are no outcome differences. For example, managed care insurers might contract with lower quality physicians than traditional indemnity insurers, or physicians may exert less effort for lower-priced services, so that even if the services received appear to be the same, patient outcomes may differ.

To examine differences in health outcomes across plans, we use two measures of adverse outcomes: whether the patient died in the hospital during the 90-day heart attack episode; and

whether the patient was subsequently readmitted to the hospital with complications from the heart attack between the 90-day treatment window and 1 year from the heart attack. The data are from the state sample, because the number of heart attacks is greater there. We use in-hospital death only because that is what is recorded on state data; information on non-hospital death is not recorded. Most heart attack deaths occur in the hospital, however, so this is not a major concern. We choose the readmission period from 90 days after the heart attack through the end of the first year to exclude treatments related to the initial heart attack. We include in our sample only those people who did not die in a hospital in the first 90 days after the heart attack and those who we can observe for a full year after a heart attack.

The first two columns of Table 9 show information on these adverse outcomes. The first three rows show average rates of adverse outcomes across plans. As in the earlier tables, the top rows give the mean effects while the next rows present regression-adjusted estimates of the effects of managed care. HMO patients are *less* likely to die in the hospital than are patients in indemnity insurance; this may in part reflect their shorter hospital stays. HMO patients are somewhat more likely to be readmitted with a complication after the acute treatment episode. As the regression coefficients show, only the first of these effects is statistically significant. We have examined these results using the firm data as well. Although the samples are smaller, and thus the standard errors larger, the point estimates, including the instrumental variables estimates, do not suggest that managed care patients fare worse than patients in indemnity insurance. We thus find no evidence that health outcomes are worse for patients in managed care insurance.

## VI. Care for Patients with Ischemic Heart Disease

We now turn to treatment differences for patients with less severe chest pain. Because chest pain is less life-threatening than a heart attack, there might be greater differences in treatment patterns across plans for these patients than for the heart attack patients.

Table 10 shows reimbursement in the 90 days after the person first saw the doctor for the treatment of chest pain. Recall that our sample is people who were not treated for any condition associated with heart disease in the prior year; thus, this treatment is essentially for the first incidence of the disease. Once again, there is a substantial difference in reimbursement across plans. Relative to the indemnity policy, reimbursement in the PPO is 30 percent less in the three month period after the initial visit (4845/6891), and reimbursement in the HMOs is about 40 percent less. As the next row shows, the difference between reimbursement in the HMO and the indemnity policy is statistically significant.

The other columns show more details on reimbursement across plans. Reimbursement is greater in the indemnity policy than the HMO for both inpatient and outpatient care, and for inpatient services particular to cardiovascular disease. Decomposing these reimbursement differences into differences in prices and quantities of services is more difficult in this case than in the heart attack example, because there are no well-defined, reliably-observed treatment regimens for these patients. We make two attempts to decompose the expenditure differences into intensity and price differences, however. First, we look at rates of hospitalization in the initial treatment phase for heart disease. The Table shows the share of patients hospitalized in the first week after the initial visit for chest pain, as well as in the period between one week and three months. Some treatments (for example, admissions to rule out heart attacks or to perform

bypass surgery) are likely to occur in a hospital, so that hospitalization may indicate more intensive diagnostic and therapeutic interventions. As the Table shows, controlling for demographic characteristics, HMO patients are hospitalized more frequently for these services than are patients with indemnity insurance.

Our second test of treatment differences between HMOs and indemnity insurance is the use of a number of common tests for measuring the degree of heart disease: cardiac procedures such as echocardiograms, cardiac stress tests, and electrocardiograms; lab tests such as drug tests or panels and chemical tests; and radiological tests such as chest x-rays and chest imaging procedures. We focus on these procedures because it is easier to identify them reliably than other types of treatments.

The last columns of Table 10 show reimbursement for these procedures during the 90 days after the first physician visit. In the first of these columns, we show average reimbursement by plan; the second column shows average reimbursement assuming that the prices paid for each procedure were the same as in the indemnity plan. Comparing the columns shows that although average reimbursement differs markedly across plans, a quantity index of services (the Common Prices column) is about the same. Thus, essentially all of the spending difference stems from differing prices paid for particular services across plans, rather than varying quantities of services.

We formalize this finding in the second column of Table 4. Using the set of select outpatient procedures, we decompose reimbursement differences between the indemnity plan and the HMOs into differences in the quantity of services received and differences in the price paid for each service. Average reimbursement in the HMOs is $371 below average reimbursement in the indemnity policy. Differences in the price of services can explain virtually

all of this difference (96 percent). As in the case of AMI, the finding of similar treatments in the indemnity plan and the HMOs does not imply that outcomes are the same in the two sets of plans. To examine outcome differences directly, we formed an indicator of adverse outcomes for ischemic heart disease. We define an adverse outcome as being admitted to the hospital with a severe form of heart disease.[30] We compare admission rates for patients in different insurance plans between 90 days after the first treatment for ischemic heart disease and one year after their first treatment for ischemic heart disease. Thus, we do not count hospital admissions associated with the initial treatment episode for ischemic heart disease to be an adverse outcome.

The last column of Table 9 shows differences in adverse long-term outcomes across plans. Managed care patients are somewhat more likely to be hospitalized with cardiovascular complications than are patients in the indemnity plan; the effect is about 2 percentage points and is statistically significant at the 10 percent level. The larger point estimate for the non-HMO managed care patients, coupled with the lack of observed treatment differences across plans, however, suggests some caution in concluding there are important outcome differences across plans.

Indeed, to a great extent our analysis of patients with less severe ischemic heart disease mirrors our analysis of patients with a heart attack. There are substantial cost savings in managed care plans compared to indemnity plans, but essentially all of these savings are from differences in prices paid for a common set of procedures, rather than differences in the medical services provided. There is weak evidence that managed care patients with ischemic heart disease have modest adverse effects, but this effect is not particularly large. ).

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[30] We define a severe form of disease as acute myocardial infarction, ischemic heart disease, or congestive heart failure.

## VII. Conclusions

Managed care has come to dominate the health system for the privately insured. Traditional indemnity insurance is in rapid decline, and most observers believe the decline will continue. Perhaps because of the newness of managed care – and the continued evolution of its techniques – there have been relatively few studies of its implications for the well-being of the insured (see Miller and Luft, 1997, for a recent review).

In this paper we have examined how managed care affects treatments and the cost of illness. By focusing on the management of heart disease, and particularly heart attacks, we avoid many of the selection problems that would otherwise complicate answering this question. We find that essentially all of the differences in reimbursement across plans result from differences in the prices paid for particular services, not from the quantity of services received. HMOs reimburse only a little over half what indemnity insurance pays for the same procedure. But the rates of procedure use and adverse outcomes across plans are relatively similar.

If one is not a medical provider, these findings are good news. They suggest medical care costs can be substantially reduced with little or no effect on the quality of care – equivalently, that managed care is more productive than traditional insurance at providing medical services.[31]

A key question is whether our results generalize to the medical system as a whole. Some caution about the generality of these results is warranted. Most importantly, heart disease, and particularly heart attacks, is a life-threatening event that demands immediate action; it is more

plausible that providers' practices might not differ according to the patient's insurance status. Indeed, analyses of less acute conditions, such as treatment of outpatient episodes of depression, suggest larger differences in actual practices between managed and unmanaged insurance (Frank et al., 1997). Second, it is widely believed that cardiac procedures contain rents; i.e., that the cardiology and cardiac surgery divisions of hospitals have been "profit centers." Our results are consistent with this view. To the degree that rents were disproportionately present for these services, reimbursement is not likely to fall as much in other treatments, , at least with minimal outcome effects. Moreover, and perhaps most importantly, our data have only one indemnity policy and represent one state (Massachusetts) where managed care plans have traditionally been known for providing high quality care, and where managed-care plans have become prevalent relatively recently. It would be useful to replicate these results for other plans in other parts of the country.

Finally, whether these price reductions are a one-time or a lasting phenomenon is an important question. The popular press tends to portray the problem of medical costs as one of an excessive level of spending, and it is certainly true that the United States spends substantially more on medical care than any other country, both absolutely and as a share of GDP. A less remarked upon issue, however, is the real rate of increase in per capita medical costs, which has been about five percent per person per year for the past half century, well above the growth rate of the economy (Newhouse 1992). Whether managed care can or will alter the steady-state growth rate in costs remains to be determined.

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[31] This ignores any potential long-run changes in the number or quality of medical care

personnel resulting from these price reductions.

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## Data Appendix

This appendix describes the data that we use in our analysis.

*State Data*

The state data are for all admissions to Massachusetts hospitals in fiscal years 1994 and 1995. There are about 800,000 admissions to Massachusetts hospitals each year. We divide the insurance categories into six groups: Medicare, Medicaid, Indemnity Insurance (including Blue Cross/Blue Shield and other indemnity policies), HMOs, non-HMO managed care (Blue Cross/Blue Shield managed care, commercial managed care, PPOs, and other managed care), and other (self-pay, workman's compensation, free-care and other government insurance). Each observation contains a unique patient identifier, allowing us to track patients across hospitals and time. The patient identifier begins with calendar year 1994.

Each observation in the data set contains the date of admission and discharge, sex, age, race, zip code, the length of stay in the hospital, the diagnosis for which the patient was admitted, the procedures performed on the patient, where the patient was discharged (if the patient survived), and the charges for the admission. Charges are services priced at list prices; they do not correspond to actual revenues received. We match the zip code of residence to Census data on median income in 1989. We define region variables for each MSA in the state; the matching of zip codes to MSAs is based on information from the Census Bureau.

Over the two year period, 14 hospitals (out of approximately 100) did not pass the data checks imposed by the state. Generally, this was because the hospital did not accurately record Social Security numbers and so matching of patients could not occur. The data from these hospitals were not used. These hospitals account for only about 5 percent of the admissions in the state, however.

*Firm Data*

The firm data begin in fiscal year 1994 (July 1993) and end midway through fiscal year 1995 (December 1995). The insurance providers here are divided into three categories: Indemnity Insurance (there is one indemnity policy), a Blue Cross/Blue Shield PPO, and a number of HMOs.

The firm data are composed of an eligibility file, an inpatient file (two files: one with detailed services and one summarizing the stay), an outpatient file, and a pharmaceutical file. The firm data contain reimbursement information for each patient. We use as reimbursement the entire amount for the services, whether by the insurer, the patient (in the form of cost sharing), or an alternate insurer (for example, the insurer of the employee's spouse).

We define our demographic variables similar to the state data, with two exceptions. First, the firm data does not contain information on race. Second, the MSA groupings are somewhat different in these data. Because of the concentration of employees in the firm data, we form dummy variables for residents of Boston, residents of other MSAs, and non-MSA residents. Residence is noted in the firm data only for inpatient services. Since the majority of patients with new incidences of chest pain have only outpatient claims, we do not create region dummy variables for this sample.

Not all HMOs have prices for all outpatient services. HMOs sometimes pay on a fee-for-service basis, depending on the service provided and the nature of the provider. Services are frequently bundled into a common payment, however. In such cases, HMOs sometimes provide "fee-for-service equivalents" - fee-for-service amounts that approximate the reimbursement for the service. In other cases, however, there is no fee-for-service equivalent that is available. As Table Al shows, 11 percent of outpatient claims for the heart attack sample are without fee-for-service payments or their equivalents, as are 5 percent of outpatient claims for the chest pain sample.

We impute reimbursement information when no direct information is available. Our imputations are based on average reimbursement by other HMOs in that year for the specific service that we are missing. For example, if reimbursement for a visit to a cardiologist in a particular HMO is not known, we form average fee-for-service reimbursement or its equivalent in other HMOs and impute this for the missing observation. As Table Al shows, imputations account for 9 percent of the outpatient dollars for the heart attack sample and 4 percent of the outpatient dollars for the chest pain sample.

Table Al: Imputation of Reimbursement for Patients in HMOs, Firm Data

| | Outpatient Claims | | Pharmaceutical Claims | |
|---|---|---|---|---|
| Claim Type | Heart Attacks | Chest Pain | Heart Attacks | Chest Pain |
| Fee-for-Service | 9% [5%] | 11% [9%] | | |
| Capitation, with FFS equivalent | 79% [85%] | 85% [87%] | | |
| Capitation, without FFS equivalent | 11% [9%] | 5% [4%] | 11% [11%] | 5% [5%] |

Note: The first number in each cell is the share of claims in that column. The second number is the share of dollars in that column.

In virtually all cases we have reliable information on inpatient payments; missing data account for only about one-half of one percent of the inpatient claims. In such cases

we use the same imputation procedure as above, using the detailed treatments provided in the hospital.

We also have to impute missing pharmaceutical reimbursements. As Table Al shows, 5 to 10 percent of pharmaceutical claims in the HMOs do not contain reimbursement information (this would generally be true when the HMO runs its own pharmacy which supplies pharmaceuticals to its members). Imputing pharmaceutical payments is more difficult because we do not know the specific drug prescribed nor the size of the prescription. We thus use a less precise procedure. We first find the average reimbursement per prescription by HMOs for the specific sample we are analyzing (for example, a prescription in the first 90 days after a heart attack or in the first 90 days after visiting a physician for chest pain). We assume that prescriptions where we do not have exact reimbursement information have the same average as these samples.

**Figure 1: Treatment of Ischemic Heart Disease**

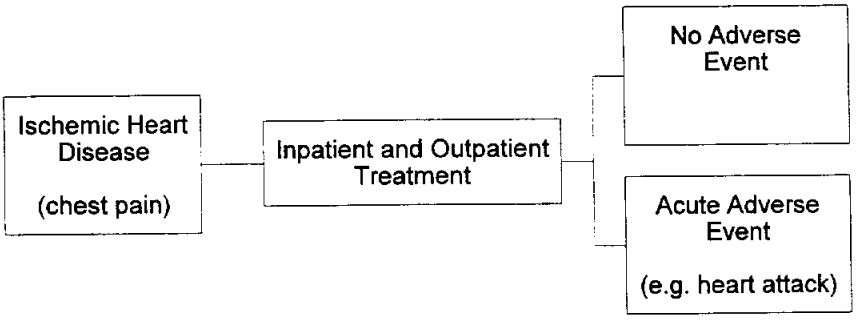


**Figure 2: Treatment of Patients with a Heart Attack**

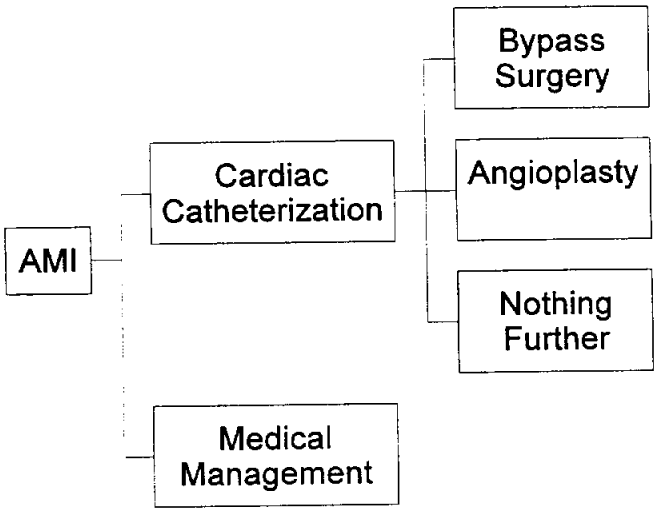

Table 1: Characteristics of Insurance Policies

| Dimension | Indemnity Insurance | Managed Care | | |
|---|---|---|---|---|
| | | PPO | IPA/Network HMO | Group/Staff HMO |
| Qualified Providers | Almost all | Almost all (Network) | Network | Network |
| Choice of Providers | Patient | Patient | Gatekeeper (in network) | Gatekeeper (in network) |
| Payment of Providers | Fee-for-service | Discounted FFS | Capitation | Salary |
| Cost Sharing | Moderate | Low in network; High out of network | Low in network; High out of network | Low in network; High/all out of network |
| Role of insurer | Pay bills | Pay bills; Form network | Pay bills; Form network; Monitor utilization | Provide care |
| Limits on utilization | Demand-side | Supply-side (price) | Supply-side (price, quantity) | Supply-side (price, quantity) |

Table 2: Summary Statistics

| | Firm Data | | | | State Data |
|---|---|---|---|---|---|
| | | | Number of Patients with | | |
| Plan | Total Enrollees | Family Premium | AMI | IHD | Number of AMIs |
| Indemnity[#] | 65,869 | $7,494 | 554 | 1,103 | 1,929 |
| BC/BS PPO[##] | 24,026 | 6,346 | 55 | 186 | 891 |
| HMOs | 117,652 | 5,164 | 299 | 782 | 1,423 |
| Medicare[###] | 45,737 | --- | --- | --- | 11,251 |
| Medicaid[###] | --- | --- | --- | --- | 402 |
| Other | --- | --- | --- | --- | 639 |
| PPO/Indemnity | --- | 85% | --- | --- | --- |
| HMO/Indemnity | --- | 69 | --- | --- | --- |

Note: AMI is acute myocardial infarction (heart attack). IHD is ischemic heart disease (less severe chest pain).

[#] Blue Cross/Blue Shield and other indemnity insurance in the state data.

[##] All non-HMO managed care in the state data.

[###] HMO enrollees in public programs are included in these lines in the state data.

Table 3: Heart Attack Reimbursement and Treatment by Plan

| Plan | Average Reimbursement (unadjusted) | Treatment Regimen: Medical Management | Cardiac Catheterization | Bypass Surgery | Angioplasty | Average Reimbursement (adjusted) |
|---|---|---|---|---|---|---|
| *Average Reimbursement* | | | | | | |
| Indemnity | $38,502 | $24,721 | $47,105 | $106,303 | $44,542 | $40,329 |
| BC/BS PPO | 26,483 [69%] | --- | --- | --- | --- | --- |
| HMO | 23,632 [61%] | 14,475 [59%] | 24,447 [52%] | 55,826 [53%] | 24,098 [54%] | 22,048 [55%] |
| *Treatment Shares - Firm Data* | | | | | | |
| Indemnity | --- | 57% | 23% | 7% | 13% | --- |
| HMO | --- | 53 | 16 | 14 | 17 | --- |
| *Treatment Shares - State Data* | | | | | | |
| BC/BS and Indemnity | --- | 41% | 19% | 14% | 26% | --- |
| Non-HMO Managed Care | --- | 35 | 21 | 16 | 27 | --- |
| HMO | --- | 44 | 17 | 14 | 25 | --- |
| *Percentiles of HMO/Indemnity* | | | | | | |
| 10th Percentile | 59% | 59% | 53% | 42% | 45% | --- |
| 50th Percentile | 57 | 58 | 47 | 55 | 50 | --- |
| 90th Percentile | 67 | 63 | 59 | 65 | 63 | --- |

Note: Reimbursement is within 90 days of the initial heart attack.

Table 4: Accounting for the Differences in Costs for Heart Disease Patients

| Factor | Acute Myocardial Infarction | Ischemic Heart Disease |
|---|---|---|
| Indemnity – HMO | $14,869 | $371 |
| *Difference Attributable To:* | | |
| Prices | $17,412 [117%] | $358 [96%] |
| Quantities | -4,860 [-34%] | 22 [6%] |
| Covariance | 2,317 [16%] | -9 [-2%] |

Note: Estimates are based on Tables 3 and 10.

Table 5: Ordinary Least Squares Estimates of the Effect of Insurance on Treatments and Reimbursement for Heart Attacks

| | Firm Data | | | State Data | |
|---|---|---|---|---|---|
| | Treatment Regimen | | Reimbursement \| Treatment | Treatment Regimen | |
| Variable | Cardiac Catheterization | Coronary Revascularization | ln(Reimbursement) | Cardiac Catheterization | Coronary Revascularization |
| *Insurance* | | | | | |
| HMO | .002 | .075** | -.578** | -.034** | -.025 |
| | (.037) | (.032) | (.060) | (.017) | (.017) |
| Non-HMO Managed Care | --- | --- | --- | .018 | -.008 |
| | | | | (.019) | (.020) |
| *Demographics* | | | | | |
| Male | .101** | .098** | .057 | .039** | .053** |
| | (.037) | (.031) | (.060) | (.017) | (.017) |
| White | --- | --- | --- | -.132** | -.104** |
| | | | | (.025) | (.025) |
| Ln(Median Income) | -.078 | -.039 | .184* | .034 | .037 |
| | (.063) | (.054) | (.103) | (.028) | (.029) |
| Previous Admission | -.031 | -.040 | .102* | .003 | .000 |
| | (.039) | (.034) | (.064) | (.021) | (.022) |
| *Summary Statistics* | | | | | |
| N | 853 | 853 | 853 | 4,243 | 4,243 |
| $\sigma^2_\epsilon$ | .243 | .178 | .635 | .217 | .226 |

Note: Care is all services provided within 90 days of the initial heart attack admission. All regressions include 5 year age dummy variables and region dummy variables. Standard errors are in parentheses.

*(**) Statistically significant at the 10% (5%) level.

Table 6: Instrumental Variables Estimates of the Effect of Insurance on Treatments and Reimbursement for Heart Attacks

| | Firm Data | | |
|---|---|---|---|
| | Treatment Regimen | | Reimbursement \| Treatment |
| Variable | Cardiac Catheterization | Coronary Revascularization | ln(Reimbursement) |
| *Insurance* | | | |
| HMO | .639 | .434 | -.834 |
| | (.420) | (.331) | (.584) |
| Non-HMO Managed Care | --- | --- | --- |
| *Demographics* | | | |
| Male | .097** | .096** | .056 |
| | (.043) | (.034) | (.061) |
| White | --- | --- | --- |
| ln(Median Income) | -.064 | -.031 | .181* |
| | (.074) | (.059) | (.104) |
| Previous Admission | .035 | -.003 | .076 |
| | (.063) | (.050) | (.088) |
| *Summary Statistics* | | | |
| N | 853 | 853 | 853 |
| $\sigma^2_\epsilon$ | .330 | .205 | .649 |

Note: Sample is people in indemnity policy or an HMO. All regressions include 5 year age dummy variables and region dummy variables. Standard errors are in parentheses.
*(**) Statistically significant at the 10% (5%) level.

Table 7: Components of Care Received by Heart Attack Patients, Firm Data

| | Inpatient Care | | Outpatient Care | |
|---|---|---|---|---|
| Plan | Average Length of Stay | Total Reimbursement | Total Reimbursement | Prescription Drugs |
| Indemnity | 13.2 | $36,327 | $3,785 | $216 |
| HMO | 10.0 | 18,732 | 3,128 | 186 |
| *Regression Coefficient* | | | | |
| HMO/Indemnity | -.176** | -.643** | -.352** | .227* |
| | (.067) | (.064) | (.088) | (.121) |
| N | 853 | 853 | 839 | 543 |
| $\sigma^2_\epsilon$ | .789 | .727 | 1.331 | 1.387 |

Note: Spending is within 90 days of the initial heart attack admission. Regression estimates are from models similar to those for reimbursement in Table 5. Standard errors are in parentheses.
*(**) Statistically significant at the 10% (5%) level.

Table 8: Components of Care Received by Heart Attack Patients, State Data

| | Average Length of Stay | | Inpatient Care Charges | | | |
|---|---|---|---|---|---|---|
| Plan | Routine | Special | Total | Routine | Special | Ancillary |
| Indemnity | 6.2 | 4.0 | $27,149 | $3,693 | $4,616 | $18,839 |
| Non-HMO Managed Care | 6.0 | 3.8 | 27,581 | 3,715 | 4,705 | 19,160 |
| HMO | 5.8 | 3.9 | 26,747 | 3,475 | 4,597 | 18,674 |
| *Regression Coefficients* | | | | | | |
| Non-HMO MC/Indemnity | -.004 | .025 | .023 | .017 | .027 | .024 |
| | (.027) | (.029) | (.022) | (.027) | (.029) | (.023) |
| HMO/Indemnity | -.044* | -.015 | -.006 | -.048** | -.007 | -.001 |
| | (.024) | (.025) | (.019) | (.024) | (.025) | (.023) |
| N | 3,871 | 3,767 | 4,243 | 3,871 | 3,767 | 4,243 |
| $\sigma^2_\epsilon$ | .399 | .441 | .261 | .390 | .419 | .306 |

Note: Charges are inpatient charges incurred within 90 days of the initial heart attack admission. Numbers in the last two rows are regression coefficients adjusted from models similar to those in Table 5. Standard errors are in parentheses.

*(**) Statistically significant at the 10% (5%) level.

Table 9: Insurance and Adverse Health Outcomes

| Plan | Heart Attack: In-Hospital Death, 90 Days | Heart Attack: Readmission with Complications, 90-365 Days | Ischemic Heart Disease: Hospitalized With Severe Heart Disease, 90-365 Days |
|---|---|---|---|
| Indemnity | 6.4% | 22.4% | 2.9% |
| Non-HMO Managed Care | 4.0 | 24.1 | 5.1 |
| HMO | 5.4 | 23.8 | 4.5 |
| *Regression Coefficients* | | | |
| Non-HMO MC / Indemnity | -.019** | .032 | .029 |
| | (.010) | (.030) | (.023) |
| HMO / Indemnity: | -.014* | .018 | .021* |
| | (.008) | (.027) | (.013) |
| N | 4,243 | 1,376 | 1,040 |
| $\sigma^2_\epsilon$ | .051 | .176 | .035 |

Note: Complications from a heart attack are admission to a hospital with a new heart attack, ischemic heart disease, or congestive heart failure.

Table 10: Reimbursement and Treatment for Patients with Ischemic Heart Disease

| | Reimbursement | | | | Treatments | | | |
|---|---|---|---|---|---|---|---|---|
| | | Inpatient Services | | | Hospitalized In@ | | Select Treatments | |
| Insurance | All Services | All | Cardiovascular | Outpatient Services | 7 Days | 7 - 90 Days | Own Prices | Common Prices |
| Indemnity | $6,891 | $3,617 | $1,076 | $3,273 | 3.5% | 2.9% | $915 | $863 |
| BC/BS PPO | 4,845 | 2,898 | 1,249 | 1,947 | 3.8 | 5.4 | 493 | 811 |
| HMO | 4,039 | 1,957 | 579 | 2,078 | 4.1 | 4.4 | 490 | 833 |
| *Regression Coefficient* | | | | | | | | |
| HMO/Indemnity | -.471** | -.671** | -.848** | -.466** | .006 | .019* | -.598** | -.070 |
| | (.074) | (.132) | (.213) | (.062) | (.009) | (.009) | (.070) | (.064) |
| N | 1,868 | 280 | 79 | 1,868 | 1,869 | 1,869 | 1,707 | 1,712 |
| $\sigma^2_\epsilon$ | 2.319 | 1.085 | .665 | 1.628 | .036 | .034 | 1.874 | 1.593 |

Note: Reimbursement is for services received within 90 days of the initial visit for chest pain. Select treatments include cardiac procedures (echocardiogram, cardiac stress test, electrocardiogram), lab tests (drug tests/panels, chemical tests, blood/coagulation tests), and radiological tests (chest x-ray, chest imaging procedure).

*(**) Statistically significant at the 10% (5%) level.

@ Regression coefficient is from a linear probability model.