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How does managed care do it?

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Integrating the health services and insurance industries, as health maintenance organizations (HMOs) do, could lower expenditure by reducing either the quantity of services or unit price or both. We compare the treatment of heart disease in HMOs and traditional insurance plans using two datasets from Massachusetts. The nature of these health problems should minimize selection. HMOs have 30% to 40% lower expenditures than traditional plans. Both actual treatments and health outcomes differ little; virtually all the difference in spending comes from lower unit prices. Managed care may yield substantial increases in measured productivity relative to traditional insurance.

1. Introduction

■ The structure of the $1 trillion U.S. 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 now 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. The resulting 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, the vast majority 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, even if this is only a change in rents, the movement of

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patients from unmanaged into managed insurance increases the productivity of the sector as measured by the official statistical agencies.[1] To the extent that managed care saves money by reducing the quantity or quality of health 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.[2]

In this article we consider how managed care affects the price and hence the productivity of medical care services. We focus on care for patients with heart disease—both acute care for patients with new heart attacks and long-term care for patients with new occurrences of less-severe forms of ischemic heart disease. We analyze heart disease in part because of its importance and cost but also because the severity of new cases is not likely to be known by an individual in advance of its occurrence. As a result, the distribution of disease severity is likely to be independent of plan choice, a point we return to below.

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 spending on services between persons with traditional indemnity insurance and persons with managed care insurance, and then to decompose this 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 spending 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 health plans because of adverse selection. Managed care plans generally enroll healthier people than traditional insurance plans (Cutler, 1994; Newhouse, 1996; Glied, 2000). As a result, differences in the treatment of the average patient in each plan will misstate the differences in services for a fixed patient across plans.

We address the selection problem principally by limiting the sample to patients with two types of newly diagnosed heart disease. Although 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—who is to know whether, if he or she suffers a heart attack, it will lead to major impairment or death? Once the attack occurs, patients are locked into their plan for the remainder of the enrollment period, so selection effects should be minimal.

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%. The services received are reasonably similar, however, and when we look at health outcomes, we are unable to find significant differences across plans.

[1] Because changes in productivity are a function of changes in spending divided by changes in a price index, any change in measured prices will change measured productivity. Price changes can, of course, stem from changes in rents; as a result, the measured productivity of an industry can change without a change in its physical productivity (defined as the physical quantity of output coming from a given physical quantity of input(s)). Implicitly this happens because the theory behind the official indices assumes perfectly competitive markets and that input prices measure opportunity costs.

[2] 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 nonquality components (Reinsdorf, 1993).

These results imply higher productivity for managed care insurance relative to traditional indemnity insurance.

We begin in Section 2 with a discussion of alternative types of insurance arrangements. Section 3 shows theoretically the productivity and price of alternative insurance systems. Section 4 describes the conditions we analyze, and Section 5 presents the data. Sections 6 and 7 present results on differences in care for patients with heart attack and patients with ischemic heart disease. Section 8 concludes.

2. Forms of health insurance

■ The dominant American 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, "Indemnity Insurance," shows the operation of this system.[3] To restrain utilization, traditional insurers usually imposed demand-side cost sharing for covered services. In general, however, insurers had little incentive to minimize the use of services because costs were passed on fully to employers. It is this system that we shall contrast with managed care.

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).[4] A description of this plan is in the last column of Table 1, Cost savings in HMOs generally come from supply-side restraints: inducing physicians to provide less care or to provide care in less-expensive settings. Physicians were encouraged to provide less care because they were on a salary and their utilization was monitored, with the implicit threat to release high-cost physicians. A typical finding in the older literature is that group and staff model HMOs saved about 10% of the cost of traditional indemnity insurance, mostly through fewer hospital admissions (e.g., Miller and Luft, 1997).

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. These plans typically limit spending using an even wider range of supply-side techniques. First, the plans set up networks of favored providers. Since patients usually stay within networks of physicians and hospitals, plans bargain hard for low rates to join the network. Second, capitated (per-patient) payments with risk sharing on small groups of physicians induce less utilization of services. Third, plans use command-and-control restrictions on utilization, such as prior approval requirements. Finally, many managed care plans require a primary care gatekeeper to approve access to more expensive specialty services.[5] The managed care plans in our sample use all four techniques to control utilization, though we have no direct measure of the degree to which each is used.

3. Price and productivity differences across insurance plans

■ The question for our research is how to measure the effects of managed care on the price and productivity of insurance. To provide a framework for our empirical work,

[3] More details on indemnity insurance, as well as the other plans shown in Table 1, are given in Cutler, McClellan, and Newhouse (1998).

[4] 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 (group model), or whether the HMO employs the physicians directly (staff model). This distinction is largely irrelevant to the underlying economics.

[5] This last control could be viewed as a special case of command-and-control restrictions.

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)

we consider a representative consumer before he knows which diseases he will contract.[6] The individual's utility function is given by[7]

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

The first term is health ($H(d, m_d)$), which depends on the person's disease (d) and the vector of medical services the person receives when sick (m_d). Disease d occurs with probability π_d.[8] The second term is nonmedical consumption,[9] defined as income (Y) less out-of-pocket payments for medical care ($p \cdot m_d$) and the insurance premium (I).

Suppose we compare two insurance plans, a base indemnity plan (denoted 0) and an alternate managed care 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 the two plans:

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

C can be interpreted as the quality-adjusted price of the managed care plan in comparison to the indemnity plan (Fisher and Shell, 1972). If consumers are willing to pay to have the managed care plan relative to the indemnity plan, then the quality-adjusted price of managed care is below that of indemnity insurance. The real output of managed care, in turn, is the nominal cost difference divided by the quality-adjusted price.

Using infinitesimal price changes for convenience and approximating C using a Taylor series expansion of (2) yields

[6] Cutler et al. (1998) develop this model for the case of time-series changes in the receipt of medical care.

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

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

[9] We assume that medical services provide no direct utility to the patient; they affect welfare only through their effect on health. For most medical services this is a reasonable approximation.

$$C \cong \sum_d \pi_d \cdot \left[\frac{U_H H_m}{U_x} \cdot \frac{dm_d}{dIns} - \frac{d(p^* \cdot m_d)}{dIns} + R \cdot \frac{d(p \cdot m_d)^2}{dIns^2} \right], \tag{3}$$

where x is nonmedical consumption, p^* is the full price of medical care, R is the coefficient of relative risk aversion ($U_{xx}/2U_x$), and we have converted the two discrete plans in (2) to a continuous measure of insurance *Ins*.

Equation (3) is the fundamental comparison of insurance plans. Moving from traditional to managed care insurance involves three effects. The first term is the value of the difference in health resulting from differences in medical treatments; the term ($U_H H_m/U_x$) is the marginal rate of substitution between health and nonmedical consumption. Public discussion often assumes 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) and in treatment complications. 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 for reasons of data availability, but that should not be a serious limitation in this context.[10] The change in "effective price" from managed care is thus the cost savings in managed care less the dollar value of any reduced health from less intensive use of medical services.

A critical question in evaluating (3) is what to assume about how the quantity of medical services is determined. In most markets we assume that people buy a good only 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.

For a variety of reasons, however, we are reluctant to invoke this assumption for health insurance. Since employers often choose insurance and not individuals, the assumption is tantamount to assuming complete passthrough 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 have perfect knowledge about which plan is best under various uncertain health states. Additionally, adverse selection across plans means that plan premiums generally do not reflect just efficiency differences (Cutler and Reber, 1998; Cutler and Zeckhauser, 1998). Finally, there is often no ready way for an insured consumer to reveal his willingness to pay at the time services are rendered, because the price paid the provider is set in a transaction between the insurer and provider. As a result, there is no assurance that any rationing of services will occur among those with the lowest valuation of the service.[11]

[10] We lack information on out-of-pocket payments, but the risk they impose is typically small in any event (Newhouse and Insurance Experiment Group, 1993). To the extent that the effect is important, out-of-pocket payments tend to be much smaller in managed-care plans, so that our estimates of the productivity gains from managed care are understated. We ignore other interaction terms, as they are likely to be small.

[11] In a world of full information the consumer would know how he would be treated in each state of the world and would choose an insurance plan accordingly. In practice, insurance contracts are incomplete, and consumers have great difficulty learning how they would be treated when ill. Moreover, the treatment that would have been rendered today for a given disease may change in the future as technology changes. Our reluctance to invoke the assumption of full information is consistent with the political demand for patient protection legislation.

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. Finally, this strategy permits direct estimation of the health effect, so no assumption about the optimality of choosing managed care for patients in managed care plans is required.

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 annually about 700,000 heart attacks (the most severe manifestation of heart disease). Second, because the severity of heart disease is difficult to predict, forecasts of the severity of a first attack, a principal determinant of treatment, are unlikely to affect one's choice of insurance plan. Third, heart disease, and particularly a heart attack, generally receives some treatment, 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 some relevant background on heart disease and its treatment.

4. 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 IHD. 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 result in substantial medical intervention, 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.[12]

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 geographic variation exists in the use of hospital-based treatments for IHD. Variation also exists in the 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.

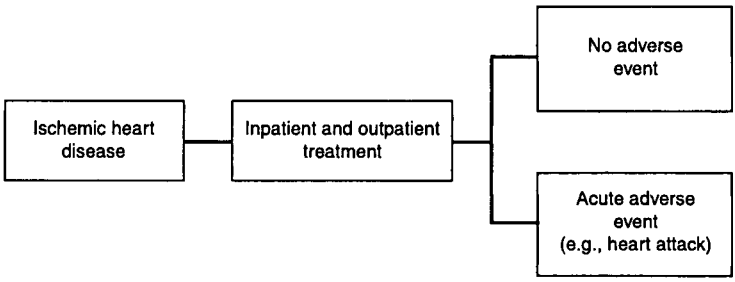
In some cases, ischemic heart disease will lead to an acute health event, of which the most serious is a heart attack, or acute myocardial infarction (AMI).[13] Heart attacks are often fatal and, if not fatal, often result in permanent damage to the heart, causing

[12] Many intensive procedures, including catheterization and angioplasty, are often performed on an outpatient basis for uncomplicated cases of IHD.

[13] Throughout the text, we refer to patients with the less severe form of ischemic heart disease as IHD patients, and patients with the more severe acute form as heart attack or AMI patients.

FIGURE 1

TREATMENT OF ISCHEMIC HEART DISEASE



symptoms of congestive heart failure. Because of these potentially serious health consequences, a heart attack generally leads to an inpatient hospital admission unless it causes sudden death.

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 to determine the extent of blockage. 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 less invasive 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.

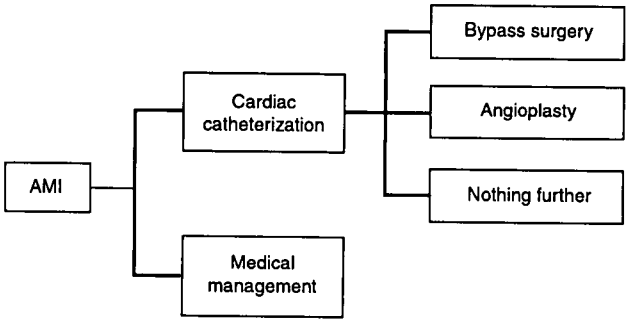
In addition to these invasive procedures, many other treatments may be used in the care of heart attack patients, including acute treatments like clot-busting drugs and careful monitoring for irregular rhythms in specialized coronary care units, and chronic treatments like counseling to encourage changes in risky lifestyles and drug therapies such as cholesterol-lowering medications and aspirin. These latter therapies are often prescribed for patients with less severe IHD as well, and the invasive procedures may also be used.

We focus on the use of invasive procedures in our analysis, since these major procedures are generally reported reliably by all types of health plans. In addition, these procedures are costly and have major implications for many other treatment decisions. Finally, previous studies have shown that use of these procedures varies widely across providers, geographic areas, and health plans, as well as over time (Gatsonis et al., 1995; McClellan and Noguchi, 1998), suggesting that their use may provide a sensitive indicator of how managed care plans may influence medical treatment.

In analyzing both of these conditions, we pay particular attention to the time over which we observe the case. A 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 natural to treat this care as one continuous episode. 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 the acute services provided for the initial heart attack without including care related to a recurrent attack (McClellan, McNeil, and Newhouse, 1994). Throughout

FIGURE 2

TREATMENT OF PATIENTS WITH A HEART ATTACK



the rest of the article, when we refer to episodes of care, we include all services received in the 90-day window. In all our samples, we omit people with a heart attack or ischemic heart disease that begins within 90 days of the end of our data.

5. 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 the retirees is primarily through Medicare and the firm provides only supplemental insurance coverage beyond Medicare,[14] the claims data for Medicare-eligible individuals are not always reported. We thus restrict our analysis to the non-Medicare population. 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.[15] 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 of the visit, but there is no specific payment attached to the record because the staff is salaried. 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 traditional indemnity policy with 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 65,000 and 118,000 people in the indemnity and HMO policies respectively, and about 24,000 in the PPO.

The premiums for the policies are dramatically different. As the second column shows, the premium for the PPO is only 85% of the premium for the indemnity policy, and the premium for the average HMO is only 70% of the premium for the indemnity

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

[15] 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%. There is essentially no load in the indemnity policy. This matches well with anecdotal information about the profitability of the different plans.

TABLE 2 Summary Statistics

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

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

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

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

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

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.[16]

The national annual incidence of heart attacks is about .14% in the nonelderly 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 (.8%), 55 heart attacks in the PPO (.2%), and 299 heart attacks in the HMOs (.3%). 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). Because there are so few enrollees and 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 the comparison is a natural one.

For our sample of patients with IHD, we make a distinction between new cases and care for patients receiving ongoing treatment. Treatment for ongoing patients will more likely reflect selection across plans; we thus sample only new cases of IHD. In particular, we include in our sample patients who saw a physician on an outpatient basis for acute myocardial infarction (heart attack), ischemic heart disease, or congestive heart failure (which in the vast majority of cases is caused by and occurs with ischemic heart disease), and who had not seen a physician (inpatient or outpatient) for one of these conditions in the previous year.[17] 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

[16] 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 Reber, 1998).

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

IHD as with heart attacks. The incidence of new cases of IHD 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 2 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 focus, however, is on the under-65 privately insured population.[18]

The state data have more heart attack patients than the firm data, so they are better for analyzing the relation between insurance and inpatient treatment. 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 actually received. Because few payers pay charges, 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 employ 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).[19]

6. 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, we report 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% as high as in the indemnity policy, and reimbursement in the HMO is only 61% as high. The reimbursement differentials match the differences in plan premiums.

We want to decompose the reimbursement differences into differences in prices paid and differences in the quantity of care received. A critical question is: At what level of aggregation should quantities be measured? 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. Rather, it is more natural to think of the good as "bypass surgery and its related services" or "angioplasty and its related

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

[19] The situation we study is the typical one; group/staff model HMOs account for only a small fraction of private insurance contracts, and they have been growing much less rapidly than other forms of managed care.

TABLE 3 Heart Attack (AMI) Reimbursement and Treatment by Plan

Plan	Average Reimbursement (Unadjusted)	Treatment Regimen				Average Reimbursement (Adjusted)
		Medical Management	Cardiac Catheterization	Bypass Surgery	Angioplasty	
Average Reimbursement						
Indemnity	$38,502	$26,601	$38,448	$97,347	$41,597	$39,410
BC/BS PPO	26,483 [69%]	—	—	—	—	—
HMO	23,632 [61%]	16,318 [61%]	17,604 [46%]	55,826 [57%]	24,181 [58%]	22,836 [58%]
Treatment Shares—Firm Data						
Indemnity	—	63%	9%	12%	16%	—
HMO	—	55	12	14	19	—
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%	56%	48%	44%	46%	—
50th percentile	57	56	58	59	51	—
90th percentile	67	60	55	65	74	—

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

services," since this is the principal decision that individuals or physicians acting as their agents are making.

The next four columns of Table 3 show reimbursement and the share of patients by broad treatment regimen.[20] Reimbursement differences within treatment regimens mirror the overall reimbursement differences. In each case, reimbursement in the HMOs is only 50% to 60% 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, shown in the next rows of the table, managed care patients are slightly less likely to receive intensive surgical procedures than are patients in indemnity insurance. The final column 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 58% of reimbursement in the indemnity policy.

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

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

in the indemnity policy, they could affect average reimbursement a great deal. To examine this question, the last rows of Table 3 show the ratio of HMO to indemnity insurance reimbursement at different points in the distribution of each plan: the 10th percentile,[21] the median, and the 90th 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.

A different concern is that medical care is effectively a local public good and therefore providers ignore insurance status (or treat at a modal insurance level) in their choice of treatment. This hypothesis has been decisively rejected in a prior study of Massachusetts cardiac patients, exactly the population we are studying. Controlling for a series of demographic, clinical, and hospital factors, privately insured patients received 80% more catheterizations, 40% more bypass grafts, and 28% more angioplasties than uninsured patients (Wenneker, Weissman, and Epstein, 1990). The disparities were as large or larger comparing privately insured patients and Medicaid patients.

Table 3 does not control for differing patient characteristics across plans. 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, 1994), and we want to control for these factors. To adjust for these factors, we estimate regression models for treatments provided and reimbursement conditional on treatment. 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,[22] 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. 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). In the state data, we include dummy variables for the hospital where the patient was first admitted with the heart attack, since past research shows that hospital of admission has an important effect on subsequent treatments (McClellan, McNeil, and Newhouse, 1994).[23] In the firm data, many hospitals have only a few admissions, so we maximize our sample size by leaving out hospital fixed effects. The results are qualitatively very similar with and without hospital controls. 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.[24]

Table 4 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.[25] Men are more likely to receive intensive treatment than

[21] This statistic, for example, is the 10th percentile of HMO reimbursement divided by the 10th percentile of indemnity reimbursement.

[22] 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.

[23] Since the selection of hospitals an insurance company contracts with is a matter of choice, it is not obvious that hospital fixed effects should be included in the equations. In practice, our results are very similar with and without hospital fixed effects.

[24] 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. We have estimated models with a number of additional control variables for diagnoses before the heart attack, including diabetes, other cardiovascular conditions, respiratory conditions, and kidney problems. Adding these variables had very little effect on our results.

[25] We use ordinary least-squares estimates to be compatible with our instrumental-variables estimates. Logit models of treatment regimens yield very similar qualitative results. Revascularization refers to bypass surgery or angioplasty.

TABLE 4 Ordinary Least-Squares Estimates of the Effect of Insurance on Treatments and Reimbursement for Heart Attacks (AMIs)

	Firm Data			State Data	
	Treatment Regimen		Reimbursement Treatment	Treatment Regimen	
Variable	Cardiac Catheterization	Coronary Revascularization	ln(Reimbursement)	Cardiac Catheterization	Coronary Revascularization
Insurance					
HMO	.040	.020	−.554**	−.023	−.013
	(.036)	(.034)	(.060)	(.016)	(.016)
Non-HMO managed care	—	—	—	.026	.011
				(.018)	(.019)
Demographics					
Male	.125**	.145**	.016	.037**	.050**
	(.036)	(.034)	(.060)	(.016)	(.016)
White	—	—	—	−.074**	−.046*
				(.024)	(.025)
Ln(median income)	−.087	−.033	.171*	.046	.026
	(.062)	(.058)	(.103)	(.029)	(.030)
Previous admission	−.061	−.053	.118*	−.026	−.031
	(.038)	(.036)	(.064)	(.020)	(.021)
Treatment Dummies	—	—	Yes	—	—
Summary Statistics					
N	853	853	853	4,243	4,243
σ^2_ϵ	.231	.202	.636	.240	.180

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. Hospital fixed effects are included in the last two columns. Standard errors are in parentheses.
* (**) Statistically significant at the 10% (5%) level.

are women, a finding consistent with other data (McClellan, McNeil, and Newhouse, 1994). Zip-code 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 shown).

The insurance variables yield results that are similar to the unadjusted means in Table 3. Controlling for demographics, HMO patients are about 2% *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 and coronary revascularization (by 1 to 2%), but these effects are not statistically significant. 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 dataset and negative in the other, and that there is no significant effect

of non-HMO managed care enrollment, suggests to us that treatment differences across plans—if there are any—are small.

To examine whether our results might be due to selection, we also estimated models using instrumental variables. Following Eichner (1996), we used two instruments: whether the person had a family or individual policy, and whether another member of the family was hospitalized during our period of observation. Although both instruments worked well in the first stage (predicting HMO enrollment), the standard errors in the second stage were large. Thus, although we could not reject the difference between the IV estimates and the OLS estimates, we could also have failed to detect a rather substantial difference. Details are available in our working paper (Cutler, McClellan, and Newhouse, 1998).

The third column of the table shows the effect of insurance on reimbursement conditional on the treatment regimen. We estimate such models by including dummy variables for each of the treatment regimens in the regression.[26] 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 43% less ($1 - \exp(-.554)$) than indemnity insurance.

Our estimates of price differences will be overstated if the provision of services within treatment regimens differs. 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 in HMOs to be lower than reimbursement in the FFS plan, even conditional on the treatment regime.

Addressing this issue completely would require a complete decomposition of treatment regimens into 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, some of the HMOs pay hospitals on a per diem basis (one price per day in the hospital regardless of the services received) and some pay on a *DRG* basis (a fixed price per treatment regimen). In both of these circumstances, we know the number of days of hospital care and major procedures performed but little else about the particulars of treatment.

Table 5 summarizes the information we have 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 almost a third longer in the indemnity policy. The next row shows the coefficient of the logarithm of length of stay from regressions similar to those in Table 4. The implied difference between the two plans is 15% 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% lower in the HMOs than in the indemnity policy, even without control variables. Thus, if all services (real quantities) 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 differences in other aspects of treatment intensity will be as 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. Because hospitals have list prices for all services (some payers

[26] Consistent with Table 3, we do not find large differences in reimbursement effects across treatment regimens.

TABLE 5 Components of Care Received by Heart Attack (AMI) Patients, Firm Data

Plan	Inpatient Care		Outpatient Care	
	Average Length of Stay	Total Reimbursement	Total Reimbursement	Prescription Drugs
Indemnity	13.0	$35,395	$3,797	$219
HMO	10.4	19,530	3,119	188
Regressive Coefficient				
HMO/indemnity	−.154**	−.617**	−.346**	.201*
	(.067)	(.064)	(.087)	(.119)
N	853	853	839	543
σ^2_ϵ	.805	.735	1.32	1.39

Note: Spending is within 90 days of the initial heart attack admission. Regression estimates are from models similar to those for reimbursement in Table 4. Standard errors are in parentheses.
* (**) Statistically significant at the 10% (5%) level.

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. In essence, average charges is a quantity index for each plan, with individual service charges as price weights.

Table 6 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

TABLE 6 Components of Care Received by Heart Attack (AMI) Patients, State Data

Plan	Average Length of Stay		Inpatient Care Charges			
	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	.030	.037	.002	.018	.027	.024
	(.029)	(.030)	(.022)	(.027)	(.029)	(.023)
HMO/indemnity	−.052**	−.022	−.006	−.047**	−.007	−.002
	(.026)	(.026)	(.019)	(.024)	(.025)	(.024)
N	3,870	3,767	4,243	3,871	3,761	4,243
σ^2_ϵ	.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 4 including hospital fixed effects. Standard errors are in parentheses.
* (**) Statistically significant at the 10% (5%) level.

variables included.[27] Managed care patients are in the hospital for fewer days than non-managed-care patients, particularly on routine care (nonintensive) wards. And total routine care charges, which reflect length of stay outside intensive or coronary care units (the latter are special charges), are lower for HMO patients. But the difference is only 5%, far below the total reimbursement difference in Table 5. 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%, are nowhere near as large as the difference in reimbursement conditional on treatment regimens (about 50%). This evidence, along with the dominant share of inpatient care in the costs of heart attack cases (see Table 5), suggests 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 across plans. For example, managed care insurers might contract with lower-quality physicians than traditional indemnity insurers (Feldman and Scharfstein, 2000). Alternately, 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. Or the allocation of services to different kinds of patients may differ.

To examine differences in health outcomes across plans, we use two measures of adverse outcomes: whether the patient died, and whether the patient was subsequently readmitted to the hospital with complications from the heart attack. Data on mortality come from a match of the hospital records with Social Security death records; ours is one of the few studies using nonelderly data that has complete information on mortality. We measure death during the 90-day heart attack episode, and then between 90 days and 1 year after the heart attack episode. Readmission is similarly measured from the end of the 90-day treatment window to 1 year from the heart attack. The data are from the state sample, because the number of heart attacks is greater there.[28]

The first two columns of Table 7 show information on these adverse outcomes. HMO patients are somewhat *less* likely to die than are patients in indemnity insurance but are somewhat more likely to be readmitted with a complication after the acute treatment episode. Only the first of these effects is statistically significant, however. We thus find no evidence that health outcomes are worse for patients in managed care insurance. This accords with other findings in the literature (Carlisle et al., 1992).

As a lower bound on the confidence interval in our findings, we note that the savings from managed care are on the order of $12,000 to $14,000 per heart attack (Table 3, column 1). Suppose on average each life were valued at $2,000,000. To offset a cost savings of $12,000 to $14,000 and considering only mortality, managed care would have to have a mortality rate that was .6 to .7 percentage points higher than in the indemnity plan (100 × 12,000/2,000,000). Based on the 95% confidence intervals shown in the first column of Table 7, we can rule out an effect this large.

[27] Because we are including hospital fixed effects, mean differences in cost-to-charge ratios across hospitals are controlled for.

[28] We have estimated similar models using the firm data. The samples are smaller and thus the standard errors are larger. But the qualitative results are very similar.

TABLE 7 Insurance and Adverse Health Outcomes

Plan	Heart Attack (AMI) State Data			Ischemic Heart Disease (IHD) Firm Data
	Death in 90 Days	Death in 90–365 Days	Readmission with Complications, 90–365 Days	Hospitalized with Severe Heart Disease, 90–365 Days
Indemnity	7.8%	3.4%	22.6%	2.9%
Non-HMO managed care	4.9	1.6	24.5	5.1
HMO	6.0	1.2	23.9	4.5
Regression Coefficients				
Non-HMO MC/indemnity	−.020*	−.011	.028	.029
	(.010)	(.009)	(.032)	(.023)
HMO/indemnity	−.019**	−.020**	.013	.021*
	(.009)	(.008)	(.028)	(.013)
N	4,241	2,119	1,357	1,040
σ^2_ϵ	.059	.022	.174	.035

Note: Complications from a heart attack are admission to a hospital with a new heart attack, ischemic heart disease, or congestive heart failure. Hospital fixed effects are included in the first three columns.

7. Care for patients with ischemic heart disease

■ We now turn to treatment differences for IHD patients, who generally have less severe heart disease. Because IHD 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 8 shows reimbursement in the 90 days after the person first saw the doctor for the treatment of IHD. 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% less in the three-month period after the initial visit, and reimbursement in the HMOs is about 40% less. As the next row shows, the difference between reimbursement in the HMO and the indemnity policy is statistically significant using a regression akin to that of Table 4 using firm data.

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 particularly for inpatient services for 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 treatment regimens that are both commonly used and reliably measured 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. Some treatments (for example, admissions to rule out heart attacks or to perform bypass surgery) are likely to occur in a hospital,

TABLE 8 Reimbursement and Treatment for Patients with Ischemic Heart Disease (IHD)

	Reimbursement				Treatments			
		Inpatient Services			Hospitalized In[a]		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 [70%]	2,898	1,249	1,947	3.8	5.4	493	811
HMO	4,039 [59%]	1,957	579	2,078	4.1	4.4	490	833
Regression Coefficient								
HMO/ indemnity	−.471** (.074)	−.671** (.132)	−.848** (.213)	−.466** (.062)	.006 (.009)	.019* (.009)	−.598** (.070)	−.070 (.064)
N	1,868	280	79	1,868	1,869	1,869	1,707	1,712
σ^2_ϵ	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.

[a] Regression coefficient is from a linear probability model.

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 than are patients with indemnity insurance.

Second, we look at the use of a number of common tests for measuring the degree of heart disease that can be identified in the claims data: 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. The penultimate column of Table 8 shows average reimbursement for these services by plan; the last column shows average reimbursement assuming that the prices paid for all procedures were equal to their average price in the indemnity plan.[29] This column is thus a quantity index for services used. Comparing the columns shows that average reimbursement differs markedly across plans (by 45%), and that essentially all of this difference is because the prices of services vary. At the same prices, spending in the two plans is nearly identical (within 7%).

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 estimate models for whether the person was admitted to the hospital with a severe form of heart disease between the end of the 90-day treatment window and one year after the initial treatment for ischemic heart disease.[30] Hospitalization in this time period is likely to reflect a lack of adequate control of symptoms on an outpatient basis.

[29] The average is used for all patients receiving these services, so that mean spending in the indemnity plan is slightly different than with the exact payments.

[30] We define a severe form of disease as acute myocardial infarction, ischemic heart disease, or congestive heart failure. Beginning after the 90-day treatment window excludes hospital admissions associated with the initial treatment episode.

The last column of Table 7 shows differences in hospitalization rates across plans. Managed care patients are somewhat more likely to be hospitalized than are patients in the indemnity plan; the effect is about two percentage points and is statistically significant at the 10% 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 that there are important outcome differences across plans.

Thus, 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. Of course, for patients with IHD our direct measures of outcomes are very partial; nonetheless, given the modest quantity differences that we did observe, it seems unlikely to us that there are clinically important outcome effects for IHD patients that we have missed.

8. 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) and Glied (2000) for reviews).

In this article 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 otherwise complicate answering this question. Table 9 summarizes our findings.[31] For both sets of patients, 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; in other words, the differences in spending are in the p and not the q vector. Price differences account for 96% of the cost difference for IHD patients and 112% of the difference for AMI patients. Differences in the quantity of services received actually decrease the payment difference for AMI patients, and slightly increase the difference for IHD patients.[32] In short, 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 the measured productivity of managed care exceeds that of traditional insurance at providing medical services.[33]

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

[31] The analysis for IHD uses the select treatments. Since the controls we employ in our regression analysis do not substantially change our conclusions, Table 9 is based on the uncorrected data in Tables 3 and 8.

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

[33] This ignores any potential long-run changes in the number or quality of medical care personnel resulting from these price reductions.

TABLE 9 Accounting for the Differences in Costs for Heart Disease Patients

Factor	Acute Myocardial Infarction (AMI)	Ischemic Heart Disease (IHD)
Indemnity—HMO	$14,870	$371
Difference Attributable to		
Prices	$16,596 [112%]	$358 [96%]
Quantities	−2,309 [−16%]	22 [6%]
Covariance	583 [4%]	−9 [−2%]

Note: Estimates are based on Tables 3 and 8.

disease, and particularly a heart attack, is a life-threatening event that demands immediate action; providers' practices might not differ as much according to the patient's insurance status as for other diseases. Indeed, analyses of less-acute conditions, such as treatment of outpatient episodes of depression, suggest larger differences in treatments between managed and unmanaged insurance, though not necessarily differences that are unfavorable to managed care (Frank, Berndt, and Busch, 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 or, if it does, may have more consequences for outcomes. Moreover, and perhaps most important, 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. It would be useful to replicate these results for other plans in other parts of the country.

Nonetheless, our results may have more generality than at first appears. Medical care spending in the mid-1990s was well below its historical trend. For the five years from 1993 to 1997, medical care spending grew perhaps 2 to 2.5 percentage points less than its fifty-year trend, a decrease unique in the post–World War II period. Although most observers have attributed this fall to the spread of managed care, evidence has been lacking. Our results, however, support this inference. The nonelderly account for about two-thirds of health care spending. (Managed care is much less prevalent among the elderly.) About half of the nonelderly population shifted into managed care, including PPOs as well as HMOs. A fall of 40% in prices paid for those who switch plans would suggest about a 10 to 15 percentage point fall in overall spending (40% × 33%). In fact, the spending growth reduction of 2 to 2.5 percentage points per year for five years is roughly that magnitude. Our results suggest that this change was mostly attributable to a fall in prices. The results further suggest that the GDP deflator may have been overstated by about a quarter to a third of a point for those five years (2 to 2.5 percentage points per year × 13% of GDP).

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. An issue less remarked upon, however, is the real rate of increase in per-capita medical costs, which has been about 5% per person per year for the past half-century, well above the growth rate of the economy (Newhouse, 1992). Large

productivity effects from price reductions are unlikely to be achievable on an ongoing basis, and indeed recent evidence suggests some resurgence in medical care cost increases, consistent with this view. Thus, whether managed care can or will alter the steady-state growth rate in costs remains to be determined.

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, worker'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 dataset 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% 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 do 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 IHD 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 A1 shows, 11% of outpatient claims for the heart attack sample are without fee-for-service payments or their equivalents, as are 5% of outpatient claims for the IHD 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 A1 shows, imputations account for 9% of the outpatient dollars for the heart attack sample and 4% of the outpatient dollars for the IHD sample.

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 A1 shows, 5 to 10% 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

TABLE A1 Imputation of Reimbursement for Patients in HMOs, Firm Data

	Outpatient Claims		Pharmaceutical Claims	
Claim Type	Heart Attacks	IHD	Heart Attacks	IHD
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 group is the share of claims in that column. The second number is the share of dollars in that column.

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 IHD). We assume that prescriptions for which we do not have exact reimbursement information have the same average as these samples.

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