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Are HMOs bad for health maintenance?†

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Summary

This study examines the impact of Health Maintenance Organization (HMO) coverage on the provision of preventive medicine. We investigate whether any association reflects selection effects on the part of patients and/or physicians or a causal impact of managed care itself. Causal effects may occur on the supply side or the demand side. Using a large national database of Medicare and non-Medicare patients, we investigate these issues for eight common preventive medical procedures. We find that preventive care is substantially higher with HMO coverage than with traditional fee-for-service reimbursement. Our findings also suggest that the impact of HMOs on preventive medicine is a causal one, and does not merely reflect selection effects. Both supply-side (e.g. provider) and demand-side (e.g. patient) factors appear to play a role in the higher incidence of preventive care among HMO enrollees. Patient demand effects are stronger for simple treatments such as physicals, while supply-side effects seem to dominate for relatively complex preventive care procedures such as mammograms. Copyright © 2005 John Wiley & Sons, Ltd.

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Introduction

Since the Health Maintenance Organization (HMO) Act of 1973, enrollment in managed care plans in the United States has risen dramatically. As of 2000, 165.4 million Americans were covered by managed care plans [1]. Much of this growth has occurred since the early 1980s [2]. Despite such popularity, managed care generally and Health Maintenance Organizations (HMOs) in particular are coming under increased scrutiny and criticism as policymakers and consumers perceive that these health care organizations may be compromising the quality of patient care. Leading observers have expressed serious reservations about HMOs. In commenting on the development of HMOs in the United States, Paul Ellwood, MD, one of the leading architects of the movement, states that:

> For those of us who devoted our lives to reshaping the health system – and where our motives were typical of many physicians, trying to make the health system better for patients – the thing has been a profound disappointment. [3]

Most evidence suggests that health care providers are less satisfied with managed care because it reduces their autonomy and interferes with other

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aspects of their practice behavior [4–7]. An exception to this trend is a study by Dixon *et al.* [8], who report that physicians perceive that the care they provided in Medicare HMOs was at least as good as in traditional Medicare plans. However, that study examined two non-profit, academically oriented HMOs, which may not be reflective of the typical experience of physicians with HMOs.

Evidence points to consumer disenchantment as well. While managed care patients tend to be more satisfied with their out-of-pocket payments and the ability to receive care at one location, they are less satisfied with the friendliness and thoroughness of their physicians, access to specialty care, and professional competence [9–12].

Do HMOs maintain health? The answer to this question has enormous policy implications, as it affects whether and how these organizations should be regulated, and how medical care delivery should be organized. In commenting on this issue, Uwe Reinhardt argues that:

> HMO is a misnomer... Most don't engage in health maintenance. The tenure of the enrollee isn't long enough to make those up-front investments worthwhile. What you have are these amorphous creatures that are basically organizations that regulate the doctor–patient relationship. HMOs are private-sector health care regulators. [3]

Yet, evidence on this important question is inconclusive. In part, this reflects the difficulty of measuring quality of care, a complex, multidimensional concept. A further complication is that managed care is itself heterogeneous. Robinson [12] has noted that a limitation of the literature on managed care is that 'very few studies compare performance in terms of different models of managed care (p. 5)'.

The present study focuses on a particular marker for quality – preventive care – and a particular kind of managed care entity – the HMO. This focus is warranted because preventive medicine is the cornerstone of good medical care and as such it has important effects on disease progression, morbidity, and mortality. Despite the importance of good preventive care, research suggests that such care has been underutilized in the United States [13]. In a report identifying key problems with quality of care in the United States, The President's Advisory Commission on Consumer Protection and Quality in the Health Care Sector [14] specifically cited problems with underutilization of preventive care, including flu shots, mammography and screenings for colorectal cancer. Moreover, HMOs have emerged as a major form of managed care delivery system in the United States. If HMOs create incentives that influence preventive care, the implications for preventive care delivery in the US are potentially quite large.

Previous research provides limited and inconclusive evidence on the impact of HMOs on preventive medicine. Results differ as to whether HMOs increase or decrease preventive care, and whether this relationship has evolved over time. Moreover, most of these studies examined time periods going back 20 years or more, when managed care was at an early stage in its development. Hence, they may not be reflective of contemporary behavior in managed care organizations.

It remains unclear as to whether any associations between HMO membership and preventive medicine reflect a causal impact of HMOs or selection effects. For example, do HMOs provide incentives to increase preventive care, either because patient out-of-pocket costs tend to be lower (a demand-side effect) or because HMOs create incentives for physicians to provide more preventive care, limiting down line costs (a supply-side effect)? Or is it that physicians and/or patients with preferences for preventive care tend to select to HMOs?

The present study seeks to bridge these gaps in the literature. In addition to single equation estimates, we provide instrumental variables (IV) estimates of the relationship between HMO membership and preventive care to isolate any causal effects of HMO membership on preventive care. If any association between HMO membership and preventive care reflects purely selection effects (e.g. unobserved differences in patient and/or physician preferences for preventive care), links between HMO membership and preventive care should vanish when IV estimation is employed, as this removes such endogeneity. But if a relationship between HMO membership and preventive care persists with IV estimation, this would point to a causal effect of HMOs on preventive care.

We specify and test our empirical models using a more up-to-date and comprehensive database than has been available in previous studies. In particular we employ a national database – the 1996 Medical Expenditure Panel Survey (MEPS) – to estimate the impact of HMOs on a broad range of

preventive care measures. We examine both Medicare and non-Medicare patients. We also contrast the impact of HMOs with other managed care arrangements. The results are striking. Other things being equal, the provision of preventive care is substantially higher with HMO coverage than with traditional fee-for-service reimbursement. This result holds across a broad range of procedures, and is apparent in both Medicare and non-Medicare populations. These findings are robust to alternative model specifications. These relationships persist in IV estimation, suggesting that the relationship between HMOs and preventive care is a causal one, rather than the artifact of selection effects. The estimated impacts of managed care on preventive medicine are considerably diminished once we adjust for patient out-of-pocket costs and the propensity to utilize physician care (e.g. demand-side effects). This, in turn, suggests that demand-side effects play an important role in the observed effects of managed care on the provision of preventive medicine.

We also find evidence of a higher provision of preventive medicine in non-HMO managed care relative to traditional plans, though this effect is weaker than is the case with respect to HMOs. The stronger effect in HMOs relative to other types of managed care is consistent with Robinson's [12] notion that accounting for heterogeneity in managed care plans is important in evaluating their effects.

The remainder of this paper is divided into four sections. The next section briefly reviews available evidence on the relationship between HMOs and quality of care. Data, variables, and estimation issues are discussed in the following section, and the results are presented in the penultimate section. The last section summarizes the results and discusses their policy implications.

Previous work

Evidence on the relationship between managed care and quality of care is mixed. Reviews of the literature by Robinson and Steiner [11] and Miller and Luft [15, 16] find no conclusive evidence in one direction or the other. Many of these studies lumped HMOs and other forms of managed care together. Studies that focused specifically on the relationship between HMOs and quality of care find little difference in health outcomes. Several of these studies have examined cardiac outcomes. Using two data sets from Massachusetts, Cutler *et al.* [17] found very similar outcomes for heart disease patients in HMOs and traditional health insurance plans. Seddon *et al.* [18] found similar results for cardiac medication treatment and outcomes in HMOs and fee-for-service plans. Escarce *et al.* [19] found inconclusive evidence on HMOs and the quality of the hospital where patients receive coronary artery bypass graft surgery. In a study from Minnesota, Soumerai *et al.* [20] reported no differences in the timeliness and quality of care for HMO versus fee-for-service patients with acute myocardial infarction.

In a study comparing cancer outcomes, Merrill *et al.* [21] reported that patients treated for colorectal cancer in an HMO setting had lower overall mortality than patients treated in a fee-for-service setting. However, colorectal cancer-specific mortality did not differ significantly between the two groups. Despite noting substantial differences in treatment methods for prostate cancer, Potosky *et al.* [22] found similar 10-year survival outcomes among prostate cancer patients treated in HMO versus fee-for-service settings.

Studies of preventive care also yield conflicting evidence. In a literature review, Robinson and Steiner [11] found that managed care tended to increase such preventive measures as cancer screenings, well-child visits, and immunizations. Similarly, evidence from the RAND Health Insurance Experiment [23] found that subjects with HMO coverage used more preventive care than subjects in traditional plans. The RAND study results pertained to a single HMO – the Group Health Plan of Puget Sound (GHC). It is unclear how generalizable preventive care treatment among GHC enrollees is to other settings, because the GHC has a comprehensive educational program that emphasizes preventive care [24]. More recently, in a study of breast cancer detection, Lee-Feldstein *et al.* [25] reported that HMO enrollees were more likely to be diagnosed early.

In contrast, Kenkel [26] found that HMO members used less preventive care (as measured by breast examinations and PAP smears). Weinick and Beauregard [27] examined the relationship between HMO enrollment and blood pressure checks, breast examinations, PAP smears, and mammography in 1987 and 1992. For the earlier period, the researchers found that HMO enrollment was associated with significantly higher rates

of care in three of the four preventive treatments examined. Yet by 1992, no significant differences were observed for any of the treatments. As Robinson [12] notes, these results

> ... led the authors to conclude that managed care had lost its relative advantage in relation to preventive services as fee-for-service providers had responded to competition by offering more of these services themselves. (p. 3)

While this is a possible explanation for the observed pattern, it should be noted that Weinick and Beauregard employed different databases in 1987 and 1992. In the earlier year, they used the National Medical Expenditure Survey (NMES), while in 1992, data from the National Health Interview Survey (NHIS) were used. This difference is potentially significant because, as the authors note:

> Unlike the NMES data on HMO status, there was no followback to providers of insurance to verify HMO status. (pp. 185–186)

Furthermore, the 1987 and 1992 comparisons were simple bivariate comparisons, so that the observed associations between HMO enrollment and preventive care use may have been confounded by omitted variables bias. The authors also performed multivariate logistic regression analysis, but this was done for the 1987 sample only. They treated HMO enrollment as endogenous, using as instruments variables measuring whether each woman was a holder of the health insurance policy, census region, and the woman's attitude toward health insurance. It is unclear, both conceptually and empirically, how reliable these measures are as instruments (the empirical results from the HMO regressions are not provided in the paper). Moreover, in estimating the impact of HMO enrollment, they simply inserted the predicted propensity to be enrolled in an HMO into logistic regressions predicting preventive care use. A preferable approach would be to use the simultaneous equations framework for a linear probability model developed by Heckman and MaCurdy [28].

Data, variables, and estimation

In a recent review of the literature, Miller and Luft [16] report that most studies on preventive care point to greater use of preventive care in HMOs. The researchers note, however, that most of these studies considered cancer screening rather than broad-based comparisons of preventive medicine. In the empirical analysis to follow, we seek to gain insight into the effects of HMOs on a variety of preventive care treatments.

To examine the impact of HMO coverage on preventive medicine, we use data from the 1996 MEPS. This database, cosponsored by the Agency for Healthcare Research and Quality (AHRQ) and the National Center for Health Statistics (NCHS), provides nationally representative estimates of medical treatments and health care expenditures, health status, health insurance coverage, and sociodemographic and economic characteristics for the civilian, non-institutionalized population in the United States. The MEPS sample was chosen as a nationally representative subsample of the ongoing National Heath Interview Survey (NHIS) conducted by the NCHS, and may be linked to the NHIS database as well. The MEPS survey respondents were interviewed in person. The survey achieved a response rate of 77.7% [29]. The MEPS validates information on medical care utilization by contacting health care providers and pharmacies identified by survey respondents.

The MEPS has a complex survey design, involving sample stratification into primary sampling units, clustering, and oversampling of certain subgroups. As a result, we perform all statistical analyses using weights provided in MEPS to correct mean values, coefficient estimates, and standard errors to be reflective of national averages. Nonetheless, the results were quite similar to those reported in the text when these weights were not used.

Separate estimates are conducted for Medicare patients and non-Medicare patients. Because we wish to focus on the impact of different types of insurance, rather than on the presence or absence of any insurance, our non-Medicare sample consists of 4995 privately insured, employed subjects between 25 and 64 years of age. The Medicare sample includes 2071 subjects aged 65 and over who are covered by Medicare.

Preventive medicine measures

In the MEPS database, survey respondents were asked eight questions pertaining to whether

they had received specific types of preventive medicine. Using this information, we created the following variables indicating whether subjects had received blood pressure checks during the past year (GETBP), cholesterol screenings (GETCHOL), flu shots (GETFLU), and physical examinations (GETPHYS). For females, we also included variables indicating whether subjects had received a breast exam (GETBRST), a PAP smear (GETPAP), or mammography (GETMAM). For males, an indicator of a prostate examination was included (GETPROST).

The criterion of receiving care within the past year is the standard approach taken in previous studies to measure preventive medicine. For some of these procedures, such as blood pressure checkups, 'good' preventive medicine means receiving such care relatively frequently. For others, like cholesterol screening, there is more latitude. Using preventive medicine treatment guidelines provided by Beryl Companies/MED America for adult men and women [30] we constructed broader definitions of 'good' preventive medicine as well. Each of these measures equals one if the patient received treatment within the timeline set by these guidelines or sooner and zero otherwise. Thus, if a guideline recommended that patients receive a specific type of preventive care every 2 years, our alternative measure scored a patient as having received preventive medicine if they had received this treatment within the past year or two. This criterion provides less stringent measures of what constitutes good preventive care. If HMOs were to provide more preventive care as measured by the former set of variables but not the latter, this would suggest that such extra care is of minimal benefit, as it exceeds current guidelines. On the other hand, if subjects in HMOs receive more preventive medicine under this broader measure as well, this would indicate that they are receiving better preventive care. In most cases, more preventive care is better care. It is difficult to argue that receiving more frequent blood pressure checkups, cholesterol screenings, physical examinations, or breast examinations, for example, is on average bad. More controversial are mammography screenings, which expose the patient to small amounts of radiation per exam, and which have fairly high false-positive rates. We will also examine managed care effects using these broader definitions of 'good' preventive medicine.

Explanatory variables

Health insurance measures. For both the Medicare and non-Medicare subjects, HMO coverage is measured as a binary variable (HMO) equal to one if the subject is insured by an HMO and 0 otherwise. The comparison group of interest is fee-for-service practice. Some non-Medicare subjects were covered by managed care organizations which were neither traditional HMOs, nor fee-for-service plans. Such plans include Preferred Provider Organizations (PPOs), wherein a network of providers are available to the patient, usually for a discount in fees and with some restrictions on utilization (e.g. prior authorization), and Point-of-Service (POS) plans, in which a primary care provider of the beneficiaries' choosing coordinates care within a provider network. We measure this group with a variable (MNCARE) equal to one if the subject is in a managed care organization that is not an HMO, and equal to 0 otherwise. In developing the MEPS database, the AHRQ devoted considerable effort in cognitive pretesting to ascertain respondents' ability to identify their health insurance plan type. Respondents were found to understand the acronym 'HMO' well, but had more difficulty distinguishing between PPOs, POS plans, and other managed care arrangements. Hence, on the actual MEPS survey, subjects were asked whether they were enrolled in and HMO or other non-HMO managed care plan (see [31] for further details). Because these managed care organizations share features of both HMOs and FFS plans, we expect that the impact of these plans on preventive care will fall in between the two extremes represented by HMOs and traditional fee-for-service plans.

Sociodemographic factors. Our empirical models also control for the effects of age, education, and race. Kenkel [26] has demonstrated the importance of age and education on preventive medicine, at least with respect to PAP smears and breast examinations. The impact of age involves a trade-off. On the one hand, older age raises the probability of discovering a problem, making preventive screening more beneficial. At the same time, advanced age lessens the potential benefits in terms of increased longevity in the event that screening helps to prevent a medical problem from occurring or worsening. We measure age using a series of binary variables. For the non-Medicare

cohort, these variables are AGE2534, AGE4554, and AGE5564. Subjects aged 35–44 serve as the reference group. For Medicare subjects, we use AGE75UP, with subjects aged 65–74 as the reference group. More education may increase the use of preventive care, possibly because better-educated individuals possess greater knowledge of the benefits associated with preventive care. This may provide only a partial explanation of the relationship between schooling and demand for preventive medicine, however. Kenkel [32] finds evidence that better health knowledge explains part of the relationship between schooling and healthy behaviors. At the same time, he notes that most of schooling's effects on healthy behaviors remain even after differences in health knowledge have been controlled for. Other explanations for a positive association between schooling and healthy behaviors include unobservable differences across individuals [33], and the hypothesis that schooling raises the marginal product of inputs used in the household production of health [34, 35].

Consistent with Kenkel's [26] findings, we hypothesize that preventive medicine will be greater among more educated subjects. The rationale is that these individuals have better information as to the benefits of preventive medicine and hence are more pro-active in obtaining such care. Education is measured as a series of binary variables: less than a high school education (NOHS), some college (SOMECOLL), college graduate (COLLGRAD), and graduate school (GRADSCHL). Subjects having a high school education constitute the reference cohort.

We also control for race. Race may relate to preventive medicine because disadvantaged minorities may have less information about the benefits of preventive care, or less generous health insurance plans and/or fewer financial resources generally. Race-specific differences in certain types of disease may also prompt differential use of preventive care. Variables measuring race include whether the subject is African-American (AFRICAM), Hispanic (HISPANIC), or other non-white (OTHRACE). Caucasians serve as the reference cohort.

Health status. Health status may also affect preventive care, to the extent that the provider and/or the patient recognize that the need for screening increases as the patient's health status declines. Health status is measured by subject's responses about their overall health status. Thus we include a series of binary variables indicating whether the subject's health status is excellent (HEALTHEXC), very good (HEALTHVG), fair (HEALTHFAIR), or poor (HEALTHPOOR). Subjects in good health are the reference group.

Estimation issues

HMOs may be associated with preventive care due to selection effects or a causal relationship. Our primary estimation objective is to determine whether HMOs exert a causal impact on preventive care. But in addition to this, any causal relationship may reflect supply-side as well as demand-side (patient) factors. On the supply side, HMOs may provide incentives to their networks of physicians to offer more preventive care to their HMO patients if this will reduce higher costs down the line. On the other hand, supply-side effects could cut in the opposite direction if patient turnover reduces the attractiveness of these future cost savings. In this regard, Goodman and Stano [36] have noted that high disenrollment rates cause HMOs to under appreciate the benefits of their treatment decisions, leading to an under provision of treatment relative to the socially optimal level. Demand-side factors would come in to play if HMO enrollees have differential access to care and/or out-of-pocket expenses. In estimating the effects of HMOs on preventive care, we will address a number of econometric concerns in an effort to identify casual linkages and to gain some insight into the importance of supply and demand factors in these linkages.

One econometric concern involves switching histories among different types of insurance; that is, the extent to which HMO subjects switched from FFS coverage and vice versa. For preventive medicine treatments that should be provided annually, such histories are less pertinent. But for preventive measures assessing whether the subject had received treatment over a period of years, such histories could matter. The effect of this switching should be to decrease the estimated impact of HMO care on preventive medicine, however. To illustrate, suppose our hypothesis that HMOs increase preventive medicine is true. Given the growth in managed care over time, it is reasonable to assume that some people currently covered by HMOs were covered by fee-for-service arrangements in the past. To the extent this is true, the estimated impact of HMO care on preventive

medicine will be dampened, because some influence of the lower preventive care under fee-for-service is averaged in with the HMO cohort. Some of the higher HMO preventive care will be averaged in with the FFS cohort as well, to the extent that some subjects with FFS insurance had HMO care in the past. This would also serve to dampen the estimated impact of HMO care on preventive medicine. Because the trend is toward increasing HMO care over time, however, we would expect this type of switching to be less common than the switch from FFS care to HMO care. Thus, to the extent that this type of intra-insurance switching occurs, our empirical estimates amount to conservative tests of the hypothesis that HMO care increases preventive medicine.

Of greater concern is the possibility that some individuals lacked any health insurance in the past. For preventive medicine outcomes that measure whether the subject has received care within the past year, health insurance histories are not critical, because that would affect treatment patterns only in the more distant past. However, for broader measures of preventive medicine, which consider whether subjects have received preventive care over a period of several years, health insurance histories assume greater significance. If, for example, health insurance histories differed systematically between HMO versus non-HMO cohorts, measured differences between preventive care for these cohorts may reflect, at least in part, such differences in these histories.

Available evidence suggests that this effect is small, however. Thus, Sloan and Conover [37] report that fewer than 2% of subjects having private group health insurance in 1994 lacked insurance in 1992. Swartz and McBride [38] report that, when they do occur, uninsured spells tend to be quite brief among subjects in the labor force.

Instrumental variables estimation. Finally, HMO enrollees and/or their providers may simply have different preferences for preventive care that leads them to select into HMOs. Because this potentially important source of endogeneity is unobservable, we employ instrumental variables estimation, following a technique developed by Heckman and MaCurdy [28]. This method essentially applies two-stage least squares estimation to a linear probability model, with health insurance status treated as endogenous. In this setup, the health insurance equations must be checked for heteroskedasticity. An examination of residuals from the insurance equations revealed little evidence of heteroskedasticity in the present case, however. A drawback to the linear probability model is that predicted values may not lie within the unit interval. As Heckman and MaCurdy [28] note, however, this is more a problem in forecasting rather than when – as in the present case – one is trying to estimate structural relationships:

> For empirical studies focusing on hypothesis testing and exploration of structural relationships among discrete endogenous variables, such problems are of less concern. For empirical studies that seek to develop forecast equations, these problems are a source of great concern. (p. 36)

As a growing body of literature attests [39–41], estimation with weak instruments can lead to quite serious bias and errors in inference. Fortunately, we are able to obtain good instruments in this study. Although the MEPS data base includes little information on geographic location of respondents because of confidentiality considerations, it does include a variable identifying observations that came from the same geographic sampling area. There are approximately 200 such areas in the MEPs database. Using this variable, we constructed aggregate HMO and managed care penetration measures for each of these geographic areas (I thank Randall Olsen for suggesting this approach). Each individual's own response was excluded from these calculations. That is, for individual i in sampling area j, HMO penetration would be measured as the proportion of all subjects other than i in sampling area j that had HMO coverage. Results when HMO penetration was calculated without these exclusions were quite similar to those reported in the text, however. Bound *et al.* [40] note that the partial F-test is an important indicator of the usefulness of an instrument or set of instruments. The partial F-statistics on each managed care penetration variable was quite high for all models in which HMO insurance and other managed care insurance were treated as endogenous, suggesting that this approach provides reasonable instruments.

A similar procedure was used to construct Medicare HMO penetration. We also use the number of workers at the individual's place of employment as an instrument to predict HMO enrollment and managed care penetration. Large employers may be more likely to have a number of managed care options available to their workers,

increasing the likelihood of enrollment in these types of plans. But there is little reason to believe that employer size directly affects the provision of preventive medicine (I thank an anonymous reviewer for suggesting employer size as an instrument). In the empirical results below, we contrast single equation (logistic regression) results with IV estimation results. If any observed relationship between managed care and preventive medicine persists in IV estimation, this would suggest a causal effect of managed care, rather than simply patient or provider selection factors. However, the IV estimates do not delineate whether any causal effect reflects supply-side (e.g. physician) or demand-side (e.g. patient) factors. To gain some insight into the importance of these effects, we perform IV estimation with and without adjusting for patient demand. The unadjusted results will reflect both supply and demand factors that may determine the impact of managed care on preventive medicine. Any effects that persist once patient demand has been controlled for would presumably reflect supply-side factors. Patient demand is captured using two variables: whether the patient visited his or her physician during the study period (HADMDVIS) and the patient's share of out-of-pocket costs for medical treatment (SHRSLFEXP). The variable SHRSLFEXP is observed only for those patients who visited their physicians. For the minority of patients without physician visits, this variable is set to 0. Thus, SHRSLFEXP measures the impact of higher cost share, conditional on a visit, not the (unconditional) coinsurance rate, which is not observable in this database.

Results

Descriptive evidence

Table 1 provides the names, descriptions, and mean values for variables used in this study. As the table indicates, preventive care is commonly provided to each of the Medicare and non-Medicare populations we consider. For the non-Medicare cohort, fully 50% of subjects are enrolled in an HMO. This figure is considerably smaller (16%) in the Medicare cohort. In each cohort, most subjects rate their health as excellent or very good.

How does preventive care vary by insurance type? In terms of simple stratified comparisons, there is generally a higher incidence of preventive care use among HMO enrollees. Among non-Medicare subjects, HMO enrollees have significantly higher rates for blood pressure checkups, cholesterol checkups, physicals, breast examinations, and PAP smears. They also have higher rates of mammography and prostate examinations, though not significantly so in bivariate analysis. A similar pattern emerges for other managed care enrollees, though statistically significant differences are achieved in only two instances (blood pressure and cholesterol checkups), the likely result of the smaller sample of other managed care participants than HMO members. Medicare subjects reveal a similar pattern. In five of eight cases, preventive care is significantly higher in the HMO cohort, with no significant differences in the remaining three cases. In the interest of brevity, the full set of these results are not reported here, but are available from the author on request.

Based on this descriptive evidence, it appears that there are important differences in the frequency of preventive medicine between managed care plans including HMOs, and traditional fee-for-service insurance. Whether this pattern persists in multivariate analysis is an empirical issue, to which we now turn.

Multivariate results

Logistic regression results for the basic model predicting preventive medicine are provided in Table 2 for non-Medicare members and in Table 3 for Medicare members.

Non-Medicare subjects. Turning first to the results in Table 2, a clear and consistent pattern emerges. In particular, the propensity to receive preventive care is significantly higher for HMO members than for members of traditional health insurance plans. In fact, in seven of the eight types of preventive care examined, HMO members are significantly more likely to receive care. The lone exception is flu shots, where there is no significant difference.

Better-educated subjects are more likely to receive prevented care, a result consistent with findings reported by Kenkel [26]. Subjects in worse health are more likely to receive preventive care as well, probably because they are perceived to be at

Table 1. Variable names, descriptions, and means

Variable	Description	Non-Medicare ($n = 4995$)	Medicare ($n = 2071$)
GETBP	Binary variable (BV) = 1 if received blood pressure check during previous year else = 0	0.80	0.92
GETCHOL	BV = 1 if received cholesterol check during past year else = 0	0.46	0.75
GETPHYS	BV = 1 if received physical exam during past year else = 0	0.46	0.68
GETFLU	BV = 1 if received flu shot during past year else = 0	0.21	0.68
GETBRST[a]	BV = 1 if received breast exam during past year else = 0	0.70	0.58
GETPAP[a]	BV = 1 if received PAP smear during past year else = 0	0.67	0.39
GETMAM[a]	BV = 1 if received mammogram during past year else = 0	0.52	0.47
GETPROST[a]	BV = 1 if received prostate exam during past year else = 0	0.29	0.69
HMO	BV = 1 if insured by a HMO else = 0	0.50	0.16
MNCARE	BV = 1 if insured by managed care organization other than an HMO else = 0	0.08	–
FEMALE	BV = 1 if subject is female else = 0	0.50	0.58
AGE2534	BV = 1 if subject age is 25–34 else = 0	0.30	–
AGE4554	BV = 1 if subject age is 45–54 else = 0	0.26	–
AGE5564	BV = 1 if subject age is 55–64 else = 0	0.10	–
AGE75UP[b]	BV = 1 if subject is 75 or older else = 0	–	0.41
NOHS	BV = 1 is subject has less than a high school education else = 0	0.03	0.20
SOMEHS	BV = 1 is subject has attended high school else = 0	0.06	0.19
SOMECOLL	BV = 1 if subject has attended college else = 0	0.24	0.14
COLLGRAD	BV = 1 is subject has a college education else = 0	0.21	0.08
GRADSCHL[c]	BV = 1 if subject has more than a college education else = 0	0.12	0.06
HLTHEXC	BV = 1 if subject is in excellent health else = 0	0.36	0.20
HLTHVG	BV = 1 if subject is in very good health else = 0	0.36	0.27
HLTHFAIR	BV = 1 if subject is in fair health else = 0	0.05	0.18
HLTHPOOR[d]	BV = 1 if subject is in poor health else = 0	0.01	0.07
HISPANIC	BV = 1 if subject is Hispanic else = 0	0.06	0.05
AFRICAM	BV = 1 if subject is African-American else = 0	0.10	0.08
OTHRACE[e]	BV = 1 if subject is other non-white else = 0	0.04	0.02
EMPSIZE	Number of employees at subject's place of work	173.99	–
HADMDVIS	BV = 1 if subject had visit with office based physician else = 0	0.71	0.88
SHRSLFEXP	Share of expenses for office visits with physician paid for out of pocket	0.22	0.16

[a] Sample sizes for these variables are smaller, as they are gender-specific.
[b] Age 35–44 is the reference age group for the non-Medicare population; age 65–74 is the reference age group for the Medicare population.
[c] High school education is the reference education group.
[d] Good health is the reference health group.
[e] Caucasian is the reference race group.

Table 2. Determinants of preventive medicine: basic model results for non-Medicare subjects (logistic regression analysis; *t*-statistics in parentheses)

	Dependent Variable							
	GETBP ($n=4995$)	GETCHOL ($n=4995$)	GETPHYS ($n=4995$)	GETFLU ($n=4995$)	GETBRST ($n=2494$)	GETPAP ($n=2494$)	GETMAM ($n=1433$)	GETPROST ($n=2353$)
Intercept	0.61 (4.42)***	−0.57 (5.38)***	−0.73 (7.51)***	−1.68 (14.25)***	0.15 (1.00)	−0.02 (0.11)	−0.71 (4.10)***	−1.44 (8.86)***
Explanatory variable								
HMO	0.40 (4.40)***	0.26 (3.96)***	0.26 (3.53)***	0.10 (1.23)	0.33 (3.69)***	0.40 (4.35)***	0.28 (2.22)**	0.29 (2.39)**
MNCARE	0.19 (1.25)	0.37 (3.10)***	0.19 (1.57)	−0.06 (0.40)	0.40 (1.93)*	0.40 (2.01)**	0.41 (2.01)**	0.29 (1.67)*
FEMALE	0.86 (10.75)***	0.21 (3.06)***	0.38 (5.94)***	0.31 (4.12)***	–	–	–	–
AGE2534	−0.05 (0.60)	−0.38 (4.37)***	−0.08 (1.00)	−0.37 (3.58)***	0.17 (1.34)	0.25 (1.95)*	–	−0.61 (3.79)***
AGE4554	0.52 (4.64)***	0.61 (6.94)***	0.39 (4.34)***	0.53 (5.44)***	0.32 (2.63)***	0.11 (0.95)	0.78 (5.45)***	1.04 (7.86)***
AGE5564	0.84 (5.39)***	1.07 (9.17)***	0.63 (5.91)***	1.03 (7.61)***	0.38 (2.29)**	−0.07 (0.41)	0.97 (5.23)***	1.65 (9.98)***
NOHS	−0.27 (1.21)	−0.37 (1.94)*	−0.39 (1.96)**	0.26 (1.04)	−0.26 (0.83)	0.003 (0.01)	0.23 (0.59)	−0.68 (1.85)*
SOMEHS	0.02 (0.13)	−0.17 (1.03)	0.05 (0.31)	−0.33 (1.94)*	−0.68 (3.54)***	−0.25 (1.34)	−0.47 (1.82)*	−0.001 (0.004)
SOMECOLL	0.32 (3.14)***	0.16 (1.79)*	0.19 (2.25)**	0.40 (3.88)***	0.28 (2.38)**	0.27 (2.46)**	0.14 (0.97)	0.17 (1.17)
COLLGRAD	0.37 (3.46)***	0.20 (2.23)**	0.13 (1.42)	0.44 (4.02)***	0.41 (2.76)***	0.34 (2.43)**	0.06 (0.35)	0.15 (1.03)
GRADSCHL	0.68 (5.02)***	0.39 (3.84)***	0.32 (3.07)***	0.50 (3.52)***	0.86 (4.79)***	0.79 (4.64)***	0.40 (1.99)**	0.11 (0.61)
HISPANIC	−0.22 (1.62)	0.12 (1.10)	0.34 (2.89)***	−0.37 (2.46)**	0.07 (0.42)	0.04 (0.23)	−0.33 (1.62)	−0.15 (0.77)
AFRICAM	−0.07 (0.48)	0.39 (3.07)***	0.51 (3.98)***	−0.59 (3.87)***	0.13 (0.76)	0.07 (0.42)	−0.14 (0.71)	0.24 (1.30)
OTHRACE	−0.68 (2.82)***	0.02 (0.10)	−0.18 (0.90)	0.05 (0.21)	−0.05 (0.21)	0.15 (0.49)	−0.16 (0.46)	−0.51 (1.45)
HLTHEXC	−0.36 (3.49)***	−0.42 (4.70)***	−0.22 (2.57)**	−0.42 (3.54)***	0.20 (1.48)	0.29 (2.29)**	0.02 (0.12)	−0.21 (1.40)
HLTHVG	−0.10 (0.83)	−0.12 (1.33)	−0.08 (0.89)	−0.22 (2.14)**	0.11 (0.87)	0.25 (2.10)**	0.08 (0.51)	−0.08 (0.56)
HLTHFAIR	0.75 (3.27)***	0.41 (2.53)**	0.38 (2.52)**	0.50 (3.01)***	−0.16 (0.68)	−0.07 (0.32)	0.17 (0.63)	0.44 (1.68)*
HLTHPOOR	1.34 (2.11)**	0.48 (1.42)	0.92 (2.77)***	0.75 (2.26)**	1.20 (1.82)*	1.13 (1.92)*	1.00 (1.47)	−0.07 (0.18)

***Statistically significant at the 1% level.
**Statistically significant at the 5% level.
*Statistically significant at the 10% level.

Table 3. Determinants of preventive medicine: basic model results for Medicare subjects (logistic regression analysis; *t*-statistics in parentheses)

	Dependent Variable							
	GETBP ($n=2071$)	GETCHOL ($n=2071$)	GETPHYS ($n=2071$)	GETFLU ($n=2071$)	GETBRST ($n=1198$)	GETPAP ($n=1198$)	GETMAM ($n=1215$)	GETPROST ($n=816$)
Intercept	2.61 (9.09)***	1.21 (7.66)***	1.04 (7.14)***	0.90 (5.21)***	0.76 (4.46)***	−0.15 (0.96)	−0.20 (1.15)	1.15 (5.01)***
Explanatory variable								
HMO	0.39 (1.24)	0.49 (2.67)***	0.58 (3.37)***	0.06 (0.37)	0.66 (3.29)***	0.42 (2.34)**	0.54 (2.59)***	0.002 (0.01)
FEMALE	0.20 (1.04)	0.08 (0.87)	−0.13 (1.44)	−0.05 (0.49)	–	–	–	–
AGE75UP	0.06 (0.33)	−0.18 (1.51)	−0.24 (2.30)**	0.13 (1.05)	−0.65 (5.21)***	−0.61 (4.30)***	−0.77 (5.65)***	−0.15 (0.89)
NOHS	−0.19 (0.80)	−0.49 (3.26)***	−0.31 (1.95)*	−0.42 (2.43)**	−0.35 (1.86)*	−0.39 (1.89)*	−0.39 (1.91)*	−0.67 (2.75)***
SOMEHS	−0.05 (0.19)	−0.24 (1.40)	−0.15 (0.94)	−0.30 (1.84)*	−0.46 (2.50)**	−0.31 (1.62)	−0.32 (1.76)*	−0.08 (0.28)
SOMECOLL	0.30 (1.05)	0.06 (0.30)	0.14 (0.83)	0.27 (1.33)	0.16 (0.86)	0.10 (0.51)	0.08 (0.40)	0.38 (1.24)
COLLGRAD	0.19 (0.62)	0.29 (1.10)	0.32 (1.47)	0.61 (2.68)***	0.84 (2.62)***	0.34 (1.13)	0.93 (3.02)***	−0.08 (0.27)
GRADSCHL	0.44 (0.82)	0.53 (1.70)*	0.34 (1.38)	0.27 (0.99)	0.44 (1.05)	0.46 (1.42)	0.18 (0.48)	0.62 (1.50)
HISPANIC	−0.23 (0.62)	0.13 (0.54)	−0.03 (0.16)	−0.15 (0.77)	−0.25 (1.09)	0.53 (2.21)**	−0.004 (0.02)	−0.25 (0.79)
AFRICAM	−0.57 (2.18)**	0.32 (1.43)	0.41 (1.88)*	−0.74 (3.27)***	−0.05 (0.18)	0.28 (1.04)	0.05 (0.18)	0.09 (0.32)
OTHRACE	−0.14 (0.26)	0.36 (0.87)	0.07 (0.20)	−0.53 (1.14)	−0.54 (1.05)	0.21 (0.40)	−0.15 (0.30)	−2.37 (3.68)***
HLTHEXC	−1.10 (3.82)***	−0.38 (2.08)**	−0.52 (3.01)***	−0.36 (2.08)**	−0.49 (2.69)***	−0.14 (0.76)	−0.22 (1.21)	−0.40 (1.47)
HLTHVG	−0.54 (1.88)*	−0.25 (1.60)	−0.27 (1.77)*	−0.06 (0.43)	−0.18 (1.01)	−0.02 (0.09)	0.16 (1.05)	−0.05 (0.18)
HLTHFAIR	0.54 (1.50)	0.28 (1.55)	0.07 (0.36)	0.14 (0.79)	0.06 (0.30)	−0.17 (0.85)	0.14 (0.73)	−0.26 (1.02)
HLTHPOOR	0.11 (0.30)	0.48 (1.42)	−0.04 (0.17)	0.15 (0.66)	0.22 (0.65)	−0.19 (0.55)	−0.54 (1.37)	−0.26 (0.72)

***Statistically significant at the 1% level.
**Statistically significant at the 5% level.
*Statistically significant at the 10% level.

higher risk for medical complications. Evidence suggests that HMO members tend to be younger and healthier [2, 42–45], perhaps because sicker individuals are discouraged from joining HMOs, or because such individuals tend to avoid HMOs. Our multivariate models control for global measures of health status. Moreover, if HMO members are somewhat healthier, and these differences in health status have not been fully controlled for, our models will likely understate the impact of HMOs on preventive medicine. The reason is that – as clearly shown by our estimates – healthier subjects are less likely to receive preventive care, regardless of their insurance type.

Older subjects and females are more likely to receive preventive care. As noted earlier, the relationship between age and preventive care is unclear *a priori*. On the one hand, older persons are at greater risk of illness, increasing the returns to directing preventive care at them. On the other hand, the shorter life expectancy of older individuals limits the benefits of preventive care. Among the non-Medicare cohort, the former effect clearly dominates. Likewise, there is no *a priori* reason why preventive care should be higher among females. This pattern may reflect gender-specific differences in preferences for such care. Cholesterol checkups are significantly higher among African-Americans, which is consistent with the higher known incidence of hypercholestemia among African-Americans. African-Americans are also more likely to receive physical examinations. This result may in part reflect a greater tendency to screen this cohort for hypercholestemia. That is, physical examinations may be scheduled in order to obtain information on cholesterol counts and other cardiovascular risk factors in this cohort.

Medicare subjects. The results for Medicare patients (see Table 3) are quite consistent with those reported for the non-Medicare cohort. We again find a strong, positive, and consistent relationship between HMO membership and the likelihood of receiving preventive care. HMO enrollees are significantly more likely to receive cholesterol checks, physicals, breast examinations, PAP smears, and mammograms.

Alternative models. As a check on the robustness of these findings, we estimated several alternative models. These models included broader measures of preventive medicine as described earlier and, for the non-Medicare cohort, included additional factors such as job tenure and type of employment. Subjects who have enjoyed longer job tenure have not incurred unemployment spells in the recent past, and are less likely to have incurred spells of being uninsured as well. For the Medicare cohort, we also reestimated the models including only those Medicare subjects aged 70 and above.

These individuals have presumably been Medicare beneficiaries for at least 5 years, so that their preventive care history during the previous 5 years reflects care under the Medicare system. These results, omitted here in the interest of brevity, were quite consistent with the findings reported in the text, and are available from the author on request.

IV estimation results. Table 4 presents the IV estimation results for both the non-Medicare and Medicare cohorts. For each group, we report IV estimations with and without adjusting for demand-side effects, as discussed above. Also included for the sake of comparison are the marginal effects of HMOs on preventive care from the logistic regressions, computed using the estimated coefficients from the logistic regressions and the preventive medicine outcome probabilities. The instruments employed to predict HMO and other managed care enrollment performed quite well. In every case, the geographic measures of HMO and other managed care penetration were directly and significantly associated with individual HMO and other managed care enrollment at the 1% level. For non-Medicare subjects, employer size was also a highly significant predictor of HMO enrollment.

Turning first to the non-Medicare cohort, the unadjusted IV estimates consistently reveal a positive and significant effect of HMO membership on preventive care. The estimated impact of other managed care is generally positive, though not significantly so with the exception of cholesterol checks. These findings suggest that HMO enrollment has a causal effect on preventive care, and does not merely reflect selection factors. The demand-adjusted results also reveal a positive effect of preventive medicine, though the relationship is weaker.

It is interesting to contrast the demand-adjusted and unadjusted HMO effects on specific types of preventive care. For more complex types of preventive care, such as mammography, the adjusted and unadjusted results are quite close. This suggests that supply-side (e.g. physician)

Table 4. Determinants of preventive medicine: IV results compared to logistic regression results (marginal effects reported)[a]

	Dependent Variable							
	GETBP	GETCHOL	GETPHYS	GETFLU	GETBRST	GETPAP	GETMAM	GETPROST
Non-Medicare patients								
Logistic regression results								
HMO	0.06***	0.07***	0.07***	0.02	0.07***	0.09***	0.07**	0.06**
MNCARE	0.03	0.09***	0.05	−0.01	0.08*	0.09**	0.10**	0.06*
IV Estimation without demand side effects								
HMO	0.11***	0.12***	0.09**	0.002	0.16***	0.13**	0.21***	0.19***
MNCARE	0.10	0.48***	0.20	−0.15	0.26	0.32	0.31	0.14
IV Estimation adjusted for demand side effects								
HMO	0.05	0.06	0.004	−0.03	0.10*	0.08	0.17**	0.12*
MNCARE	0.002	0.40***	0.10	−0.18	0.26	0.32	0.33	0.04
Medicare patients								
Logistic regression results								
HMO	0.03*	0.09***	0.13***	0.01	0.16***	0.10**	0.14***	0.0004
IV Estimation without demand side effects								
HMO	0.03	0.17**	0.12	0.08	0.07	−0.06	0.25**	−0.04
IV Estimation adjusted for demand side effects								
HMO	0.01	0.14*	0.09	0.04	0.03	−0.10	0.22**	−0.07

[a] Because the linear probability model does not produce odds ratios, we report the estimated coefficients from the linear probability model, which correspond to marginal probability effects here. In Table 4, the exact marginal effects are also reported for the HMO and MNCARE variables from the logistic regressions, to facilitate comparisons.
***Statistically significant at the 1% level.
**Statistically significant at the 5% level.
*Statistically significant at the 10% level.

factors may be more important for these types of preventive care. But for simpler types of preventive care, such as physicals, demand-side factors appear to be much more important. It may be that HMO patients are more likely to request simple preventive measures such as physicals, while providers initiate more complex preventive treatments in these settings.

The IV estimation results for Medicare patients are usually positive, but achieve statistical significance only in the cases of mammography and cholesterol checks. In these two cases, the demand-adjusted and unadjusted results are similar, suggesting that supply-side factors play a role in these types of preventive care. Selection factors into HMOs may be more important in the Medicare cohort, where only 16% of subjects choose HMOs, than in the non-Medicare group, where roughly 50% are HMO members. This could account for the greater discrepancy in terms of statistical significance between the IV and logistic regression results for the Medicare cohort.

Conclusion

This study presents empirical evidence on the impact of HMO membership on preventive care. We sought to delineate whether any relationships between managed care and preventive medicine have a causal link or reflect selection factors. The model is tested empirically using a national database that includes eight common types of preventive care. The results reveal that preventive care is strongly and significantly more prevalent among HMO members than among members of traditional health insurance plans. These results persist under IV estimation, suggesting that HMOs have a causal impact on preventive care, and that this association is not merely the artifact of selection factors. The results further suggest that both supply-side (e.g. physician) and demand-side (e.g. patient) factors matter. Patient demand factors appear to be more important for relatively simple preventive procedures such as physicals, while supply-side effects may be important for more complex procedures like mammograms. As

our database lacks physician-specific measures of incentives to provide care, however, these results should be viewed with caution. Future research should further delineate the importance of supply- and demand-side factors in accounting for the higher incidence of preventive care among HMO enrollees.

HMOs and health maintenance

Quality of health care is an issue of increasing concern and debate among the medical community, policymakers, and the general public. The relationships between alternative forms of financing care and quality lie at the heart of this debate. Because good preventive care can help reduce or avoid serious health problems in the future, it is an important component of quality assurance. The present study provides evidence that, at least in terms of preventive medicine, quality of care is quite good for HMO members.

Of course, these results may not be generalizable to other types of care. Indeed, based on available evidence to date, it remains unclear whether HMOs lead to better or worse acute care or mortality care outcomes. What is clear, however, is the considerable dissatisfaction and frustration among both providers and consumers as to how care is delivered in the managed care setting. Providers do not like restrictions imposed on their clinical discretion. Patients want providers who are readily available and responsive to their needs.

In light of these concerns, managed care reform has assumed major political significance. Legislation is being introduced to provide managed care patients with protection against inadequate treatment by managed care organizations. The passage of the Norwood-Dingell Bill on 7 October 1999, also known as the Patients' Bill of Rights Act, guaranteed patients greater access to specialist care, provided for an appeals process when health plans deny care, and held HMOs accountable for decisions that harm patients. Companion bills have been introduced amending various aspects of the Bill of Rights, and a number of states are pursuing such legislation as well. More objective evidence on the performance of HMOs, and the role of economic incentives within these organizations, will be required if such legislative efforts are to succeed.

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References

1. Managed Care National Statistics (website: www.mcareo1.com/factshts/factnati.htm).
2. Glied S. Managed care. In *Handbook of Health Economics*, vol. 1A, Newhouse J, Cuyler A (eds). North-Holland: Amsterdam, 2000; 707–753.
3. Mitka M. A quarter century of health maintenance. *J Am Med Assoc* 1998; **280**(24): 2059–2060.
4. Grumbach K, Osmand D, Vranizan K *et al*. Primary care physicians' experience of financial incentives in managed-care systems. *N Engl J Med* 1998; **339**(21): 1516–1521.
5. Burdi M, Baker L. Physicians' perceptions of autonomy and satisfaction in California. *Health Affairs* 1999; **18**(4): 134–145.
6. Warren M, Weitz R, Kulis S. The impact of managed care on physicians. *Health Care Manage Rev* 1999; **24**(2): 44–56.
7. Linzer M, Konrad T, Douglas J *et al*. Managed care, time pressure, and physician job satisfaction: results from the physician worklife study. *J Gen Intern Med* 2000; **15**(7): 441–450.
8. Dixon M, Kirschner P, Edelberg H *et al*. Physician perceptions of HMO care for older persons. *J Am Geriatr Soc* 2000; **48**(6): 607–612.
9. Lake T. Do HMOs make a difference? Consumer assessments of health care. *Inquiry* 1999; **36**(4): 411–418.
10. Tudor C, Riley G, Ingber M. Medicare beneficiaries' perceptions of care: a comparison of managed care enrollees to fee-for-service beneficiaries using data from the Medicare Current Beneficiary Survey (abstract). *Assoc Health Serv Res* 1997; **14**: 240 (Abstract Book).
11. Robinson R, Steiner A. *Managed Health Care*. Open University Press: Buckingham, 1998.
12. Robinson R. Managed care in the United States: a dilemma for evidence-based policy? *Health Econ* 2000; **9**: 1–7.
13. Schauffler H, Rodriguez T. Managed care for preventive services: a review of policy options. *Med Care Rev* 1993; **50**(2): 153–198.
14. President's Advisory Commission on Consumer Protection and Quality in the Health Care Industry. *The State of Health Care Quality: How Good is*

Care? Agency for Healthcare Research and Quality: Rockville, MD, 1998.
15. Miller R, Luft H. Does managed care lead to better or worse quality of care? *Health Affairs* 1997; **16**: 7–25.
16. Miller R, Luft H. HMO performance plan update: an analysis of the literature 1997–2001. *Health Affairs* 2002; **21**(4): 63–86.
17. Cutler D, McClellan M, Newhouse J. How does managed care do it? *RAND J Econ* 2000; **31**(3): 526–548.
18. Seddon M, Ayanian J, Landrum M *et al*. Use of cardiac medications and functional outcomes after myocardial infarction: a comparison of ambulatory care for Medicare beneficiaries in fee-for-service and managed care (abstract). *Assoc Health Serv Res* 1999; **16**: 103 (Abstract Book).
19. Escarce J, Van Horn R, Pauly M *et al*. Health maintenance organizations and hospital quality for coronary artery bypass graft surgery. *Med Care Res Rev* 1999; **56**(3): 340–362.
20. Soumerai S, McLaughlin T, Gurwitz J *et al*. Timeliness and quality of care for elderly patients with acute myocardial infarction under health maintenance organization vs. fee-for-service insurance. *Arc Intern Med* 1999; **159**(17): 2013–2020.
21. Merrill R, Brown M, Potosky A *et al*. Survival and treatment for colorectal cancer Medicare patients in two group/staff health maintenance organizations and the fee-for-service setting. *Med Care Res Rev* 1999; **56**(2): 177–196.
22. Potosky A, Merrill R, Riley G *et al*. Prostate cancer treatment and ten-year survival among group/staff HMO and fee-for-service Medicare patients. *Health Serv Res* 1999; **34**(2): 525–546.
23. Manning W, Liebowitz A, Goldberg G *et al*. A controlled trial of the effect of a prepaid group practice on use of services. *N Engl J Med* 1984; **310**: 1505–1510.
24. Bates I, Winder A. *Introduction to Health Education*. Mayfield: Palo Alto, CA, 1984.
25. Lee-Feldstein A, Feldstein P, Buchmueller T. Determination of breast cancer detection and treatment outcomes in an ethnically diverse population (abstract). *Assoc Health Serv Res* 1998; **15**: 37 (Abstract Book).
26. Kenkel D. The demand for preventive medical care. *Appl Econ* 1994; **26**: 313–325.
27. Weinick R, Beauregard K. Women's use of preventive screening services: a comparison of HMO versus fee-for-service enrollees. *Med Care Res Rev* 1998; **54**: 176–199.
28. Heckman J, MaCurdy T. A simultaneous equations linear probability model. *Can J Econ* 1985; **18**: 28–37.
29. Cohen J, Monheit A, Beauregard K *et al*. The Medical Expenditure Panel Survey: a national health information resource. *Inquiry* 1996; **33**: 373–389.
30. Preventive Medicine guidelines. See: www.beryl.net/htl/Common/21001.htm
31. Banthin J, Taylor A. HMO enrollment in the United States: evidence based on household reports, 1996. *MEPS Research Findings No. 15*, *AHRQ Pub. No. 01-0014*, Agency for Healthcare Research and Quality: Rockville, MD, 2001.
32. Kenkel D. Health behavior, health knowledge, and schooling. *J Polit Econ* 1991; **99**(2): 287–305.
33. Fuchs V. Time preference and health: an exploratory study. In *Economics Aspects of Health,* Fuchs V (ed.). University of Chicago Press (for NBER): Chicago, 1982.
34. Grossman M. On the concept of health capital and the demand for health. *J Polit Econ* 1972; **80**: 223–255.
35. Michael R. Education in nonmarket production. *J Polit Econ* 1973; **81**(2): 306–327.
36. Goodman A, Stano M. HMOs and health externalities: a local public good perspective. *Public Finance Rev* 2000; **28**(3): 247–269.
37. Sloan F, Conover C. Life transitions and health insurance coverage of the near elderly. *Med Care* 1998; **36**(2): 110–125.
38. Swartz K, McBride T. Spells without health insurance: distributions of durations and their link to point-in-time estimates of the uninsured. *Inquiry* 1990; **27**(3): 281–288.
39. Nelson C, Startz R. The distribution of the instrumental variables estimator and its *t*-ratio when the instrument is a poor one. *J Business* 1990; **63**(Part 2): S125–S140.
40. Bound J, Jaeger D, Baker R. Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak. *J Am Stat Assoc* 1995; **90**(430): 443–450.
41. Staiger D, Stock J. Instrumental variables estimation with weak instruments. *Econometrica* 1997; **65**(3): 557–586.
42. Scitovsky A, McCall N, Benham L. Factors affecting the choice between two prepaid plans. *Med Care* 1978; **16**(8): 660–675.
43. Jackson-Beeck M, Kleinman J. Evidence for self-selection among health maintenance organization enrollees. *J Am Med Assoc* 1983; **250**(20): 2826–2829.
44. Ellis R. Employee choice of health insurance. *Rev Econ Stat* 1989; **71**(2): 215–223.
45. Langwell K, Hadley J. Evaluation of the Medicare competition demonstrations. *Health Care Finan Rev* 1989; **11**(2): 65–80.

