Understanding Biased Selection in Medicare HMOs

Michelle M. Mello, Sally C. Stearns, Edward C. Norton, and Thomas C. Ricketts III

Objective. To investigate the extent of favorable health maintenance organization (HMO) selection for a longitudinal cohort of Medicare beneficiaries, examine whether the extent of favorable selection varies with the degree of Medicare HMO market penetration in a county, and explain conflicting findings in the literature on favorable HMO selection.

Data Sources. A panel of 1992–1996 data from the Medicare Current Beneficiary Survey (MCBS), supplemented with linked data from the Area Resource File and Medicare administrative datasets.

Study Design. Using random effects probit estimation, we model a beneficiary's HMO enrollment status as a function of self-reported health status and Medicare HMO market penetration.

Data Extraction Methods. The MCBS data for beneficiaries residing in states served by Medicare HMOs in 1992–1996 were linked by county to the supplementary datasets.

Principal Findings. We find that favorable selection persists in the cohort over time on some, but not all, measures. We find no substantial association between favorable HMO selection and HMO market penetration. We find that conflicting findings in the literature on favorable HMO selection may be explained by several methodological choices, including the choice of health status measure and the structure of the sample.

Conclusions. Our results support further risk adjustment of the adjusted average per capita cost (AAPCC) payment formula.

Key Words. Managed care, health maintenance organizations, Medicare, selection bias, market penetration

The Medicare risk program (now Medicare+Choice) is a managed care initiative in which qualified health maintenance organizations (HMOs) assume responsibility for providing comprehensive health services to Medicare beneficiaries in exchange for a monthly capitated payment. Attempts to evaluate the effectiveness of the program in reducing Medicare costs have been complicated by biased selection in Medicare HMO enrollment. Beneficiaries can choose whether or not to enroll in a Medicare HMO, and those who choose to join an HMO may differ systematically from those who remain in fee-for-service (FFS) with respect to their health status. If so, then observed differences in the number of hospital days, physician visits, or other utilization in HMOs and FFS plans may be due not to efficiencies in care but to baseline differences in the insured groups. If Medicare HMOs attract a disproportionate share of relatively healthy Medicare beneficiaries within the payment "cells" defined by the risk adjustment variables in the payment formula, then *favorable HMO selection* has occurred.

Most, but not all, studies of Medicare HMOs have found evidence of favorable HMO selection. However, drawing firm conclusions about the magnitude of the selection effect and trends over time is difficult because studies have employed considerably different measures and methods. In this article, we attempt to sort through the literature on favorable HMO selection and explain how particular methodological choices may lead to results that are noncomparable or even conflicting. In addition, we present a new analysis of favorable HMO selection and its relationship to HMO market penetration using 1992–1996 data from the Medicare Current Beneficiary Survey.

Understanding Favorable HMO Selection

An Overview of Medicare Managed Care

The Medicare risk program was implemented in 1985 under the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA) after two demonstration projects. Membership in Medicare HMOs is open to all Medicare beneficiaries except those with preexisting end-stage renal disease and those receiving hospice care. Most participating HMOs must accept any beneficiary who applies, and are not permitted to disenroll members involuntarily. Health plans also must adhere to certain marketing rules, including prohibitions on discriminatory marketing.

After a slow start, interest in the risk program picked up markedly. The number of risk contractors grew from 87 in 1985 to a high of 346 in 1998. It

---

This work was funded by a Dissertation Grant from the Health Care Financing Administration, grant no. 30-P-90887/4-01. The findings and opinions reported here are those of the authors and do not represent the views of any other individuals or organizations.

Address correspondence to Michelle M. Mello, J.D., Ph.D., Assistant Professor of Health Policy and Law, Department of Health Policy and Management, Harvard School of Public Health, 677 Huntington Ave., Boston, MA 02115. Sally C. Stearns, Ph.D., and Edward C. Norton, Ph.D., are Associate Professors in the Department of Health Policy and Administration, University of North Carolina at Chapel Hill. Thomas C. Ricketts III, Ph.D., is Professor in the Department of Health Policy and Administration, and Deputy Director of the Cecil G. Sheps Center for Health Services Research, Chapel Hill, North Carolina.

declined to 262 in 2000 due to decisions by a number of plans to discontinue participation in the program (Health Care Financing Administration 1999). As of 2000, 69 percent of Medicare beneficiaries lived in areas served by a Medicare+Choice HMO (Medicare Payment Advisory Commission 2001).

Medicare HMO market penetration (the percentage of Medicare beneficiaries enrolled in an HMO) rose from 3.5 percent in 1985 to 16 percent in 1999 (Health Care Financing Administration 1996, 2000a). During our study period, enrollment increased from 5 percent in 1993 to 10 percent in 1996 (Lamphere et al. 1997). Medicare HMO penetration varies significantly from state to state.

The method of reimbursing participating HMOs was significantly reformed as part of the Balanced Budget Act of 1997 (BBA). Prior to 1997, the adjusted average per capita cost (AAPCC) formula paid HMOs 95 percent of the estimated cost of FFS care for a Medicare beneficiary residing in the same county, adjusted for certain risk factors. At that time, the AAPCC formula included risk adjustments for the beneficiary's age, gender, Medicare status (aged/disabled), institutional status, working-aged status, and Medicaid eligibility.

Under the BBA 1997, the risk program became known as Medicare+Choice and was expanded to include a broader range of managed care entities. A new individual-level risk adjuster called the Principal In-Patient Diagnostic Cost Group (PIP-DCG) was added to the payment formula to adjust for the higher predicted costs of caring for beneficiaries with one of several diagnoses associated with heavy inpatient services utilization. More significantly, BBA introduced a new payment structure as a means of reducing disparities in capitation rates among counties. Today, the county reimbursement rate is the maximum of: (1) a "floor" rate; (2) a minimum update (2 percent, with a one-time increase to 3 percent for 2001) applied to the previous year's rate; or (3) a blended rate combining a national rate and the local rate. The local rate is the 1997 payment rate trended forward by a national update factor. Blended rates are being phased in from 1998 (10 percent national and 90 percent local blend) to 2003 (50–50 blend) (Medicare Payment Advisory Commission 2001).

The BBA reforms mean that HMOs are no longer uniformly paid 95 percent of the estimated FFS cost. Rather, the reimbursement ratio varies from county to county. Although BBA was intended to lower payments to HMOs relative to FFS spending, it is estimated that average payments in 2001 for beneficiaries enrolled in Medicare+Choice plans were actually about 98 percent of spending for those in the FFS sector (without risk adjustment)

(Medicare Payment Advisory Commission 2001). Average payments in "floor" counties were estimated to be considerably higher (119 percent of FFS costs in 2000) (Medicare Payment Advisory Commission 2001). The presence of favorable HMO selection would boost this ratio of Medicare+Choice to FFS payments even further.

Does Favorable HMO Selection Persist?

Studies of Medicare HMOs during the demonstrations and the early years of the risk program consistently found evidence of strong favorable HMO selection (Table 1). Studies of the demonstration HMOs found that HMO joiners had significantly lower pre-enrollment health care utilization, lower postenrollment mortality rates, and better self-reported health status and functional status than FFS stayers (Brown 1987, 1988a; Eggers 1980; Eggers and Prihoda 1982; General Accounting Office 1986; Kasper et al. 1988; Langwell and Hadley 1989, 1990; Riley, Rabey, and Kasper 1989). These studies also identified evidence of favorable HMO selection in demonstration HMOs on sociodemographic characteristics that are predictive of health services utilization, such as income and marital status (Langwell and Hadley 1989; Retchin et al. 1992).

More recent studies of the Medicare risk program have produced similar findings, though not as uniformly. Hill and Brown (1990) and Call and colleagues (1999) found that persons who joined Medicare HMOs in 1987 and 1994, respectively, had significantly higher pre-enrollment utilization than those who remained in FFS. Riley, Lubitz, and Rabey (1991) and Maciejewski and colleagues (2001) found that Medicare HMO enrollees in the late 1980s and early 1990s had significantly lower mortality rates than nonenrollees. Others have determined that HMO members in this period had significantly better self-perceived health and fewer functional impairments than nonenrollees (Lichtenstein et al. 1991; Hill and Brown 1992; Riley et al. 1996). In contrast, Price Waterhouse (1996) found no differences in predicted costs between HMO enrollees and nonenrollees using 1992 Medicare Current Beneficiary Survey (MCBS) data. Dowd and colleagues (1994) also found that differences between enrollees and nonenrollees in the prevalence of various health conditions were not large, though there were some differences on sociodemographic characteristics.

Policy Significance of Favorable HMO Selection

There are two reasons to be concerned about possible favorable HMO selection in Medicare. First, if HMO enrollees differed from nonenrollees on

Table 1: Studies of Favorable HMO Selection in Medicare

Study	*Data Years*	*Health Status Measures*	*Cross-sectional Analysis?*	*Immediate Postenrollment Period Only?*	*Data Pooled Across Plans?*	*HMO Enrollees Healthier?*
Demonstration HMOs						
Eggers 1980	1974–1976	Pre-enrollment utilization	Yes	Yes	No (1 plan)	Yes
Eggers and Prihoda 1982	1976–1979	Pre-enrollment utilization	Yes	Yes	No	Yes
Hornbrook, Bennett, and Greenlick 1992	1980–1982	Pre-enrollment utilization	No	Yes	No (1 plan)	Yes
Garfinkel et al. 1986	1980–1982	Self-reported health status:	Yes	Done both ways	No	
		Self-perceived health				No
		Functional limitations				No
		Health conditions				Yes, at 1 of 3 plans
Kasper et al. 1988	1979–1982	Pre-enrollment utilization	Both cross-sectional and panel	Yes	No	Yes
		Self-reported health status				Yes, at 1 of 2 plans
		Self-perceived health				
		Functional limitations				
Mathematica/MCV Evaluation	1980–1985	Pre-enrollment utilization	Yes	Yes	Done both ways	Yes, in 14 of 17 plans
(Brown 1987, 1988;		Self-reported health status	Yes	No	Yes	Yes
Brown and Langwell 1988;		Self-perceived health IADLs				Yes
Langwell and Hadley 1989;		Bed days				Yes
Rossiter et al. 1989)		Health conditions				Yes
		Sociodemographics:	Yes	No	Yes	
		Marital Status				Yes
		Income				No
		Education				No
		Race				No

Table 1: Continued

Study	*Data Years*	*Health Status Measures*	*Cross-sectional Analysis?*	*Immediate Postenrollment Period Only?*	*Data Pooled Across Plans?*	*HMO Enrollees Healthier?*
Mathematica/MCV Evaluation *(cont)*		Postenrollment mortality	Yes	No	Done both ways	Yes, in 12 of 17 plans
GAO 1986	1984	Postenrollment mortality	Yes	No	Done both ways	Yes
Riley, Rabey, and Kasper 1989	1980–1986	Postenrollment mortality	No	No	No	Yes
TEFRA HMOs						
Hill and Brown 1990	1986–1987	Pre-enrollment utilization	Yes	Yes	Yes	Yes
Riley, Lubitz, and Rabey 1991	1987	Postenrollment mortality	Yes	No	Yes	Yes
Lichtenstein et al. 1991	1988	Self-reported health status: Functional status	Yes	Yes	No	Yes, in 19 of 23 plans
Dowd et al. 1994	1988	Sociodemographics:	Yes	No	Yes	
		Income				Yes
		Marital status				Yes
		Self-reported health status: Health conditions				No
Dowd et al. 1996	1988	Self-reported health status: Health conditions	Yes	No	Yes	Yes

Hill and Brown 1992	1990	Self-reported health status:	Yes	No	Yes	
		Self-perceived health				Yes
		Health conditions				Yes
		Bed days				Yes
Price Waterhouse 1996	1992	Predicted costs	Yes	No	Yes	No
Riley et al. 1996	1994	Self-reported health status:	Yes	No	Yes	
		Self-perceived health				Yes
		ADLs/IADLs				Yes
		Health conditions				No
		Predicted costs				Yes
Call et al. 1999	1993–1994	Pre-enrollment utilization	Yes	Yes	Yes	Yes
Maciejewski et al. 2001	1993–1994	Postenrollment mortality	Yes	No	Yes	Yes
Present study	1993–1996	Self-reported health status:	No	No	Yes	
		Self-perceived health				Yes
		ADLs/IADLs				No
		Health conditions				Yes, for 3 conditions
		Social limitations				No

characteristics that are (1) predictive of lower utilization and (2) omitted from the payment formula, then the payment formula would overpay Medicare risk contractors. For the pre-1997 period, favorable HMO selection would mean that HMO enrollees would have incurred FFS costs lower than the average FFS reimbursement, so the AAPCC would thus overcompensate HMOs, saving Medicare less than the intended 5 percent and perhaps even costing it money (Riley, Lubitz, and Rabey 1991). Estimates of the extent of historical overpayment have ranged from 5.7 percent to 50 to 74 percent (Brown et al. 1993; Langwell and Hadley 1989). For the post-BBA period, the impact of favorable HMO selection will vary according to the payment structure in a particular county, but as a general matter, favorable HMO selection will continue to result in overpayment of HMOs (Medicare Payment Advisory Commission 2001).

A second issue is that favorable HMO selection makes it difficult to determine whether HMOs are able to reduce Medicare beneficiaries' utilization of inpatient care and other health services. Controlled trials in which Medicare beneficiaries are randomized to an HMO or an FFS plan are a practical impossibility, so studies of utilization in Medicare HMOs have been entirely nonexperimental and the results may be subject to bias due to selection effects.

The RAND Health Insurance Experiment, a randomized trial, showed that HMOs significantly reduce inpatient care utilization for the working-aged population (Manning et al. 1984). However, these findings may not extrapolate to the Medicare population because the elderly have much higher average health care costs and are more likely to die in a given year, to have a high-cost illness, and to be functionally impaired (Gruenberg, Tompkins, and Porell 1989). Furthermore, HMO cost-containment mechanisms such as substitution of ambulatory for inpatient care may not be as easy to accomplish for elderly patients (Bates and Connors 1987; Siu, Brook, and Rubenstein 1986).

Several estimates of the effect of HMOs on Medicare beneficiaries' health services utilization have used simultaneous equation methods to control for selection bias (Hornbrook, Bennett, and Greenlick 1992; Dowd et al. 1996; Mello, Stearns, and Norton 2002). Yet the different modeling approaches are subject to certain criticisms based on the complex methods and problems of identification. If favorable HMO selection has dissipated over time, then more straightforward single-equation models of utilization can be used.

Does Favorable HMO Selection Diminish as HMO Market Share Increases?

Favorable HMO selection may be more pronounced in areas of low HMO market penetration than in higher-penetration areas for several reasons (Call et al. 1999). First, beneficiaries with existing physician ties are less likely to have to sever them to join an HMO in high-penetration markets because rates of physician contracting with HMOs are higher in high-penetration areas (Table 2). Because chronically ill individuals are especially likely to have strong physician ties, this effect reduces the disincentives for Medicare beneficiaries in poor health to join an HMO.

Second, consumers in high-penetration markets are more likely than consumers in low-penetration markets to be familiar with the concept

Table 2: Medicare Managed Care Penetration and Physician Participation

Census Region	*Medicare Managed Care Penetration*[1]	*Physicians with Medicare Managed Care Contracts*[2]	*Mean Practice Revenue from Medicare Managed Care per Physician*[2]
New England	18.1%	69.3%	10.9%
Massachusetts	23.1	68.7	9.0
Other	14.3	69.7	12.3
Middle Atlantic	19.7	69.6	12.8
New Jersey	15.1	67.0	11.6
New York	17.7	63.5	12.7
Pennsylvania	24.8	82.5	13.7
East North Central	9.0	59.2	8.9
Illinois	10.5	50.2	6.9
Michigan	4.0	63.1	10.3
Ohio	15.8	72.0	11.0
Other	4.4	53.8	8.1
West North Central	9.4	53.9	6.8
South Atlantic	13.8	57.4	10.7
Florida	27.3	68.9	16.7
Other	5.6	51.9	7.8
East South Central	4.2	57.0	9.6
West South Central	12.9	54.5	9.7
Texas	14.7	50.8	8.8
Other	10.3	60.9	11.3
Mountain	26.5	67.3	9.8
Pacific	37.5	67.4	11.5
California	40.1	64.8	11.3
Other	30.2	74.0	12.2

[1]1998 data (Health Care Financing Administration 2000b).

[2]1999 data (American Medical Association 2001).

of managed care through marketing. Therefore, Medicare beneficiaries in high-penetration markets are more likely to know that they have the option to join an HMO. Persons in high-penetration markets are also more likely to have a choice among several HMOs, including open-panel HMOs that allow members to retain established relationships with physicians. This may make chronically ill beneficiaries more disposed to join an HMO.

Third, favorable HMO selection may also have diminished over time in markets in which Medicare HMOs have been operating for a long time. The enrollee population of HMOs in these markets will have aged considerably since their time of enrollment, causing any initial favorable HMO selection in enrollment to dissipate over time (unless there is selective disenrollment or replenished favorable enrollment). Also, more Medicare HMOs have begun to offer prescription drug coverage, making HMOs more attractive to chronically ill persons.

Finally, HMOs in high- rather than low-penetration markets may be more likely to enroll Medicare beneficiaries whose health is relatively poor. Even if they first attract relatively healthier beneficiaries, HMOs must eventually recruit higher-risk individuals in order to increase their market share. This effect may be relatively mild at all but the highest levels of penetration, however, since Medicare expenditures are heavily concentrated on the sickest decile of the Medicare population. Feldman and Dowd (1982) showed that it may be profit-maximizing for HMOs to stop short of 100 percent market penetration. Furthermore, the measured selection differential could first increase with increased penetration because the people remaining in FFS will be increasingly sicker on average.

The relationship between favorable HMO selection and market penetration has been the subject of limited empirical study. Call and colleagues (1999) found that favorable HMO selection existed at low market penetration, but declined significantly as both HMO market share and the change in HMO market share increased from 1993 to 1994. The authors estimated that the degree of favorable HMO selection decreased by about 46 percent with an increase from 0 to 50 percent market penetration, but that selection still persisted in attenuated form at the highest level of market penetration observed (52 percent). A second analysis of these data by the same investigators did not find a relationship between favorable HMO selection and penetration using postenrollment mortality as the indicator of selection (Maciejewski et al. 2001).

UNDERSTANDING STUDY FINDINGS ON FAVORABLE HMO SELECTION

While most studies have concluded that favorable HMO selection persists in Medicare, study findings regarding the exact nature and magnitude of the selection bias have varied in part due to the sensitivity of results to several key choices in the design of studies.

Choice of Health Status Measure

The strength of favorable HMO selection depends on the choice of selectivity indicators. Studies of favorable HMO selection have employed four measures of differences in the underlying health status of the HMO and FFS populations: health services utilization immediately prior to HMO enrollment, postenrollment mortality, sociodemographic variables thought to be associated with health services use, and various self-reported health status measures.

Each measure has shortcomings. Studies using self-reported health status as an indicator of selection bias are limited by the measurement error inherent in most self-reporting instruments. However, many aspects of health status are objectively measurable, and perceived health status may be just as important in explaining propensity to consume health care services as a person's true health status. A second potential problem with self-reported health status is the possibility that general health status in a geographic area might be correlated with HMO market penetration. A third, and potentially more serious, issue is whether health status self-reports are sufficiently predictive of which beneficiaries will have high health expenditures. The policy problem of favorable HMO selection pertains to the relative propensity of HMO enrollees to utilize health services. Beneficiaries' utilization forms a highly skewed distribution. But self-reported health status measures, which often are not highly skewed, may not identify high-users with a high degree of sensitivity. Consequently, the use of such measures may lead to false-negative findings concerning favorable HMO selection.

In contrast, pre-enrollment utilization (controlling for the AAPCC) offers a measure of favorable selection that is calibrated to the local market area, accounting for correlations between market characteristics and health care utilization. Yet differences in pre-enrollment utilization as the measure of biased selection are also problematic because much of individuals' health services use is due to acute, transitory health events. This transitory part of health care expenditures leads to two problems. First, the point of using pre-enrollment utilization (measured by either expenditures or services used) is to control for the permanent component of health—meaning, the component that is exogenous to the health plan and relates to chronic disease or disability. The fact that utilization varies widely from year to year because of the transitory component means that prior use may not be sufficiently predictive of future use (Welch 1985a). Second, if people make enrollment decisions based in part on the transitory portion of health expenditures, especially if they consider only one year's prior utilization, then there may be a problem of regression to the mean, in which people with artificially low expenditures will enroll in HMOs in the next period. This point is explored in greater depth shortly. An additional problem with using pre-enrollment utilization is that such analyses necessarily exclude people who die.

The other two indicators, mortality and sociodemographic characteristics, also have limitations. Differences in postenrollment mortality rates may be due to differences in the quality of care in HMO and FFS settings rather than differences in the baseline health of their enrollees. In addition, mortality rates may be unstable over time. Riley, Rabey, and Kasper (1989), for example, found a rapid convergence in mortality rates between HMO enrollees and nonenrollees over a two-year period. This finding suggests that mortality may be a good measure of health status (or the HMO's effect on health status), but only for a relatively short period of time. Studies comparing HMO enrollees and nonenrollees on sociodemographic characteristics suffer from the problem that many of the characteristics are not consistently found to be predictive of utilization. In order to constitute selection bias, the characteristic in question must predict HMO membership *and* utilization *and* be omitted from the AAPCC formula.

A comparison of the results of existing studies suggests that the choice of measure may explain some of the differences in findings (Table 1). All of the studies examining pre-enrollment utilization or postenrollment mortality found evidence of favorable HMO selection. In contrast, some studies comparing HMO enrollees and nonenrollees on sociodemographic characteristics or self-reported health status did not find favorable HMO selection on some measures (income, education, race, gender, self-reported functional status, and self-reported major health conditions).

Reporting of Results

The extent of favorable HMO selection found in different studies may be influenced by the way in which the effects are reported. In some studies, although the regression coefficients are statistically significant, the magnitude of the effect is small. For example, Call and colleagues (1999) found that the average health expenditures of HMO enrollees in the year prior to enrollment were significantly lower than those of persons who remained in FFS ($p<0.001$). However, a $1,000 increase in pre-enrollment expenditures only decreased the odds of joining an HMO by 2 percent.

Similarly, the framing of predicted probabilities in terms of absolute versus relative change is important. The magnitude of a relative change is a function of the baseline probability: the lower the baseline, the greater the relative change represented by a given percentage point change. For example, Call and colleagues (1999) found that the decrease in the probability of joining an HMO in 1994 associated with a $1,000 increase in 1993 health expenditures was only 0.5 percentage points, but because the baseline probability of joining was only 3 percent, the relative change was more than 16 percent. In comparing results across studies, it is important to ascertain whether the effects are reported in the same terms.

The Newcomer Effect

Findings concerning favorable HMO selection also appear to be influenced by the choice to study HMO enrollees in the years immediately preceding and following their enrollment, as opposed to studying a cross-section of HMO enrollees that includes persons who have been members for a number of years. Several previous studies have focused exclusively on newcomers to Medicare HMOs (Call et al. 1999; Eggers 1980; Eggers and Prihoda 1982; Hornbrook, Bennett, and Greenlick 1992; Kasper et al. 1988; Brown 1988a; Hill and Brown 1990), either modeling the probability of joining an HMO as a function of health expenditures in the year prior to enrollment or comparing enrollees' expenditures in the first year postenrollment to expenditures by persons in the FFS sector. In contrast, our analysis and others (Dowd et al. 1994, 1996; Riley et al. 1996; Hill and Brown 1992; Price Waterhouse 1996) sample a group of Medicare beneficiaries enrolled and not enrolled in an HMO at a given point in time, regardless of their date of enrollment.

A person's health care utilization in the year prior to and following enrollment in an HMO may not be representative of their underlying health status. One reason may be regression to the mean, discussed above. Another is that beneficiaries who anticipate enrolling in an HMO may delay seeking care in the final year prior to enrollment because they anticipate receiving more comprehensive coverage from the HMO. If they do, their pre-enrollment FFS expenditures will be artificially low and their immediate postenrollment HMO expenditures will be artificially high. Because of this phenomenon, confining a study sample to new HMO newcomers and comparing pre-enrollment utilization or predicted costs may produce an overestimate of the extent of favorable HMO selection. Models of postenrollment mortality may also be affected, because newcomers to HMOs have been shown to have lower mortality rates than persons who have been enrolled longer (Riley, Lubitz, and Rabey 1991). The studies that have not found evidence of favorable HMO selection on some or all measures examined a sample of both new and existing enrollees (Table 1). All of the studies that have focused on newcomers only have found strong evidence of favorable selection.

The Panel Effect

A related issue is bias from the use of a single year of data, as opposed to a multiyear panel, to study selection dynamics. While the newcomer effect concerns the specific phenomenon of atypical health services utilization by a given individual in the years prior to and following his enrollment in an HMO, the panel effect concerns the broader phenomenon of changes in a person's health status and health care utilization over time.

A broader question is whether individuals tend to regress to the mean over time in their health services use. If consistently low users of health services join Medicare HMOs in disproportionate numbers and remain consistently low users thereafter, then the HMOs will be overcompensated for many years. If, however, initially low users use more services over time, then incorrect capitation payments are only a temporary problem. Regression to the mean may occur for Medicare HMO enrollees because the sickest FFS individuals are more likely to die quickly and because the entire Medicare population ages over time; people who were low users at HMO enrollment cannot remain so forever (Welch 1985a).

Unfortunately, it is difficult to draw a firm conclusion about regression to the mean because there are excellent studies showing that regression to the mean occurs (Welch 1985b; Congressional Budget Office 1982; Newhouse et al. 1981), and excellent studies showing that there are consistently high and low users of medical care (Anderson and Knickman 1984; McCall and Wai 1983). Beebe (1988) has reconciled these findings in part by suggesting that when beneficiaries are grouped on prior use, they will regress to the mean, but when they are grouped on the basis of demographic characteristics, utilization levels will be quite consistent over time. This is because the demographic groupings are more likely to cluster people with chronic conditions together, while stratification on prior use tends to capture differences in utilization due to acute, transitory health events.

Beebe's finding highlights an important point: the extent of regression to the mean depends on how the groups are defined. The mean expenditure for groups formed on the basis of high expenditures alone can be expected to regress to the population mean. However, the mean expenditure for groups formed on the basis of membership in FFS Medicare in year t–1 (where t is the year in which a decision is made to join or not join an HMO) will only regress to the mean for that group, which may be higher than the overall average.

The use of panel data is desirable in order to account for the possibility of regression to the mean as well as to avoid bias due to the unrepresentativeness of a particular year's utilization. Estimating the magnitude of the difference in findings regarding favorable HMO selection arising from the use of cross-sectional versus panel data cannot be readily done by reference to the literature, because few studies have used a panel approach. Nearly all of the studies that used cross-sectional data found evidence of favorable HMO selection (Table 1).

The Disenrollment Effect

The treatment of HMO disenrollees also affects the estimates of the strength of favorable HMO selection. The total bias present in HMO enrollment is a function of three components: who enrolls, who disenrolls, and how enrollees change while enrolled (Welch 1985a). The first and second components are forms of selection bias, while the third component is a source of bias but not a selection effect. However, changes in enrollees' health status during their enrollment will ultimately result in measured differences in health status between HMO enrollees and nonenrollees that will lead to inaccurate payment if not adjusted for in the payment formula.

Although one early study examined disenrollment patterns (Brown 1988b), most studies have examined only the first component, selectivity in enrollment. Our analysis also focuses on this component, but our use of a panel of four years of data also provides some information about the third component. Several recent studies have focused on the disenrollment component. These studies consistently found that disenrollment patterns exacerbate the total amount of favorable HMO selection (Riley, Ingber, and Tudor 1997). The HMO disenrollees appear to be disproportionately sicker than those who remain in HMOs and those who remain in FFS, whether the measure used is postdisenrollment utilization (Morgan et al. 1997), preenrollment utilization (Call et al. 1999; Cox and Hogan 1997; Maciejewski, Dowd, and O'Connor 2002), or postdisenrollment mortality (Cox and Hogan 1997; Maciejewski et al. 2001). Thus, disenrollment augments the average health of the remaining HMO members and decreases the average health of FFS beneficiaries.

Because this favorable HMO retention effect is so pronounced, studies (including our own) that confine the analysis to selective HMO enrollment tell only part of the story. We do not examine disenrollment patterns because there were very few disenrollees in the Medicare Current Beneficiary Survey (MCBS) dataset. The proportion of HMO enrollees who disenroll is greater, but still not large, in the broader Medicare+Choice population. A recent analysis of the 124 counties with one thousand or more Medicare+Choice enrollees found that 16 percent of those who belonged to an HMO in 1994 chose to disenroll over a three-year period (Maciejewski, Dowd, and O'Connor 2002).

The Pooling Effect

Some early studies of demonstration HMOs conducted plan-specific analyses of a small number of HMOs and found significant variation across plans in the degree of favorable HMO selection (Table 1). In contrast, all but one study conducted in the post-TEFRA era used datasets pooling individuals from a large number of different HMOs and did not attempt to model differences in selectivity among plans. The one post-TEFRA study that involved plan-level analyses did find differences across plans: 9 of 23 HMOs experienced favorable HMO selection, while 14 experienced neutral selection (Lichtenstein et al. 1991). Pooling data over all plans might have averaged out these effects.

Conducting multiple plan-specific analyses reduces the ability to detect favorable HMO selection due to the smaller sample size and the need to make Bonferroni corrections to the significance levels. Additionally, policymakers assessing the savings to the Medicare budget associated with capitation are most interested in the aggregate degree of favorable HMO selection rather than plan-specific statistics. On the other hand, plan-level analyses of favorable HMO selection can help determine whether certain plan characteristics are associated with favorable, neutral, or unfavorable selection. Such information may facilitate development and targeting of mechanisms for protecting risk contractors who experience unfavorable HMO selection, such as reinsurance, and may be helpful in encouraging contractors to continue to offer a Medicare+Choice product line.

An Analysis of Favorable HMO Selection in the 1993–1996 Period

We investigated the extent of favorable HMO selection in Medicare HMOs in the early 1990s, and the relationship between favorable HMO selection and market penetration, using data from the MCBS. To place our analysis within the context of the methodological choices discussed above, we would note the following design features at the outset: the measure of health status used is self-reports of general health and functional status and particular chronic conditions; results are reported in both absolute and relative terms; the analysis avoids the newcomer effect by using a sample that contains both new HMO joiners and those have been enrolled in an HMO for many years; the analysis investigates the panel effect using a panel of four years of data; the analysis does not examine the disenrollment effect; and the analysis pools data across plans.

Model

We modeled a Medicare beneficiary's choice to participate in a Medicare HMO in year t as a function of market penetration variables M, the individual's health status H, the interaction of M and H, sociodemographic characteristics S, and available HMO options O:

$$P_{it} = \beta_0 + \beta_1 M_{it} + \beta_2 H_{i(t-1)} + \beta_3 (M_{it} \times H_{i(t-1)}) + \beta_4 S_{it} + \beta_5 O_{it} + (u_i + e_{it})$$

where P is health plan choice (1 = continuously enrolled in Medicare HMO throughout the year), β is a vector of parameters to be estimated, i is the index for individuals, u_i is the individual-level error term, and e_{it} is the random error.

We estimated the model using random effects probit estimation to control for unobserved individual-level heterogeneity. Statistically significant coefficients on the health status variables would suggest that biased selection into Medicare HMOs is occurring. Statistically significant coefficients on interactions of HMO market penetration with the health status variables would suggest that managed care penetration affects the extent to which selection bias occurs in a county.

Data

The model was run on linked 1992–1996 data from the MCBS, the Bureau of Health Professions Area Resource File, and the Health Care Financing Administration's Medicare Market Penetration File and Prepaid Health Plans Monthly Report File. Using a three-stage cluster sampling scheme, the MCBS surveys a representative sample of Medicare beneficiaries through interviews conducted three times per year. Interview data are supplemented with Medicare claims data and selected administrative data.

The model was run on a panel of 38,185 observations (21,965 persons) that were present in the MCBS sample for at least one year during the 1993–1996 period, including persons newly eligible to Medicare and persons who died. The MCBS data from 1992 were used to obtain lagged values of the health status variables. Excluded from the analysis were individuals residing in counties not served by a Medicare HMO, persons younger than age 65, residents of Puerto Rico, and persons with end-stage renal disease (who are not permitted to join Medicare HMOs). Persons who switched between an HMO and an FFS plan during a given year ($n = 972$ observations) were excluded for the year of their switching only. Because the MCBS does not calculate three-year backward longitudinal sampling weights for persons newly eligible to Medicare and persons who died, our analysis was unweighted.

Variables in the model are described in Table 3. All health status variables were lagged by one year to account for possible endogeneity between health status and health plan choice. Although lagging the health status measures may reduce the extent of endogeneity, it may be that the measures still are endogenous with respect to health plan choice for nonswitchers. It was not possible to test for endogeneity or to identify a better alternative to the lagged measures. Preliminary analyses led to decisions to include three chronic condition indicators (arthritis, cancer, and stroke), the number of up to 14 other disease conditions present, and interactions of the arthritis, other disease count, and general health and functional status variables with market penetration. Robust Huber-White standard errors were calculated for all models to correct for heteroscedasticity.

Approximately 5 percent of individuals in the 1993 sample were enrolled in a Medicare risk HMO for the entire year, while 95 percent were in FFS settings for the entire year (Table 4). Twenty-two percent of the 1996 sample were HMO enrollees, and the overall average over the 1993–1996 period was 12 percent. The average county market share of Medicare HMOs in our sample, expressed as the average over counties, was 3 percent in 1993

Table 3: Variable Definitions

Market characteristics:	
Market penetration	HMO market share in the county in year t
IPA plan available	At least one IPA-model plan serving the county in year t
AAPCC rate	AAPCC rate in year t (deviation from the mean)
Census region	Eight dummy variables for census region
Rural/urban continuum code	Six dummy variables for rural/urban continuum code
Health and functional status:†	
Excellent health	Excellent or very good self-perceived health status in year $t-1$
Poor health	Poor self-perceived health status in year $t-1$
ADLs	Activities of Daily Living (of 6) performed in year $t-1$
IADLs	Instrumental Activities of Daily Living (of 6) performed in year $t-1$
Social limitations	Limitations on social life due to health problems in year $t-1$
History of arthritis	Past or present diagnosis of arthritis reported in year $t-1$
History of cancer	Past or present diagnosis of cancer reported in year $t-1$
History of stroke	Past or present diagnosis of stroke reported in year $t-1$
Number of other conditions	Number of other health conditions in year $t-1$ of 14: atherosclerosis, Alzheimer's Disease, high blood pressure, myocardial infarction, coronary heart disease, other heart problem, skin cancer, diabetes, rheumatoid arthritis, Parkinson's Disease, osteoporosis, broken hip, emphysema, and partial paralysis
Demographics:	
Ages 75 to 84	Age 75 to 84 in year t
Ages 85+	Age 85 or above in year t
Male	Male
Medicaid recipient	Medicaid recipient in year t
Nursing home resident	Nursing home resident in year t
Less than high school education	Less than high school education
Some college	Some college or college graduate
Medigap policy	Medigap policy in year $t-1$
Black	African American race

Table 3: (Continued)

Other nonwhite race	Nonwhite race other than African American
Married	Married in year t
Has a usual source of care	Had a usual source of health care in year t
Income < $10,000	Income less than $10,000 in year t
Income $30,001–$50,000	Income between $30,001 and $50,000 in year t
Income > $50,000	Income greater than $50,000 in year t
Other control variables:	
Missing income data	Missing income data for year t
Missing education data	Missing education data for year t
Missing Medigap data	Missing Medigap policy data for year $t-1$
Year	Three dummy variables representing year of data (year t)
Interaction terms:	
Market penetration × Excellent health	
Market penetration × Poor health	
Market penetration × ADLs	
Market penetration × IADLs	
Market penetration × Social limitations	
Market penetration × History of arthritis	
Market penetration × Number of other conditions	

[†]Because the MCBS asks whether respondents have "ever had" various chronic conditions, the chronic conditions variables exhibit little intraperson variation over time. The general health and functional status indicators capture both transitory and permanent aspects of health status, though the amount of intraperson variation is still modest.

Table 4: Sample Descriptive Statistics (N = 38,185 observations, 21,965 persons)
Statistics Listed Are: 1993 Average/1996 Average/Average over All Observations

HMO Member	Yes:	5% / 22% / 12%	**Health Status:**		
			Self-perceived:	Excellent/ very good:	42% / 44% / 42%
Sociodemographics:				Good/fair:	50% / 49% / 50%
Age	65–74:	40% / 43% / 40%		Poor:	8% / 7% / 8%
	75–84:	40% / 40% / 40%			
	85+:	20% / 17% / 20%	ADLs:	Mean:	4.89 / 5.09 / 4.95 (s.d. 1.81 / 1.65 / 1.77)
Sex:	Male:	39% / 41% / 40%	IADLs:	Mean:	4.57 / 4.85 / 4.66 (s.d. 2.03 / 1.85 / 1.98)
Race:	White:	88% / 88% / 88%	Health limits social life:	Yes:	38% / 32% / 36%
	Black:	9% / 9% / 9%	Number of health conditions (of 17):	Mean:	2.98 / 2.82 / 3.00 (s.d. 2.06 / 2.00 / 2.07)
	Other:	3% / 3% / 3%			
Nursing home:	Yes:	10% / 7% / 9%	Arthritis:	Yes:	57% / 54% / 57%
Education:	<High school:	27% / 23% / 25%	Cancer:	Yes	20% / 18% / 20%
	High school:	45% / 46% / 46%	Stroke:	Yes:	13% / 13% / 14%
	Some college	25% / 28% / 26%	Other conditions (of 14):	Mean:	2.16 / 2.02 / 2/16 (s.d. 1.75 / 1.68 / 1.75)
			Market Characteristics:		
	Missing:	3% / 3% / 3%	IPA model HMO in county:	Yes:	91% / 98% / 95%

Table 4: (Continued)

Income:	< \$10,000:	35% / 25% / 31%	Percent penetration:[†]	Mean:	4.99 / 13.80 / 9.00 (s.d. 9.55 / 14.74 / 12.80)
	\$10,000–\$30,000:	49% / 49% / 50%			
	\$30,001–\$50,000:	11% / 13% / 12%	**Control variables:**		
	> \$50,000:	5% / 5% / 5%	AAPCC rate:[‡]	Mean:	− 45.59 / 48.18 / 3.41 (s.d. 82.32 / 104.87 / 101.68)
	Missing:	0% / 6% / 2%			
Medigap:	Yes:	67% / 63% / 65%	Year of observation:	1993:	N = 7,810 (21%)
	No:	31% / 37% / 34%		1994:	N = 8,528 (22%)
	Missing:	2% / 0% / 1%		1995:	N = 8,474 (22%)
Medicaid:	Yes:	13% / 11% / 13%		1996:	N = 13,373 (35%)
Usual source of care:	Yes:	87% / 88% / 88%			

[†]The relatively high HMO membership and mean penetration in 1996 reflects the MCBS's 1996 oversample of HMO enrollees
[‡]Deviation from the mean

and nearly 8 percent in 1996. Expressed as the average over individuals, the mean market penetration in the sample was approximately 5 percent in 1993 and nearly 14 percent in 1996. Because the MCBS oversampled HMO enrollees in 1996, these sample statistics are not generalizable to the broader population of Medicare enrollees.

RESULTS

The regression results suggest that there was some favorable HMO selection in the Medicare program during 1993–1996 (Table 5). Three of the nine health status indicators were statistically significant. The coefficient for excellent self-reported health is positive and statistically significant near the 1 percent level ($p = 0.012$). The cancer and stroke variables are negative and significant at the 1 and 5 percent levels, respectively. All of the health status variable main effect coefficients are signed in a direction consistent with favorable selection.

The coefficients on the market penetration interaction terms in the regression indicate whether or not the degree of favorable HMO selection in the Medicare program varies with the degree of HMO market penetration in a county. Of the seven interaction terms, only the positive coefficient for penetration $\times$ arthritis is statistically significant ($p = 0.029$), suggesting that favorable selection on arthritis is less pronounced in high- rather than low-penetration counties. Thus, we did not find appreciable evidence that market penetration alters the favorable HMO selection dynamic, at least on a county level, for most of the characteristics considered. To explore the possibility that modeling market penetration as a continuous variable may have obscured effects that are only visible above or below a certain penetration threshold, we dropped out individuals residing in counties with medium market penetration (10–29 percent) and reran the model on the remaining observations including a dummy variable for residence in a high-penetration county. The results were robust to this change.

The total effect of changes in health status on the probability of HMO membership, which must consider both main and interaction coefficients, can be illustrated by comparing the mean predicted probabilities of HMO membership at different values of the entire set of health variables (Table 6). The mean predicted probability of HMO membership under the actual data was 12.12 percent. When the health status data for all observations are recoded to take on an "excellent health" profile, the mean probability rises slightly, to 13.87 percent. The mean predicted probability falls to 12.24

Table 5: Regression Results
Probit Estimation: Probability of HMO Membership

	N = 38,185 χ^2_{53} = 6097.67 (p = 0.0000)	
	Coeffecient	*Robust S.E.*
Constant	– 1.34**	(0.201)
Market penetration:		
Percent penetration	3.47**	(0.51)
Penetration × Excellent health[L]	– 0.19	(0.17)
Penetration × Poor health[L]	0.0052	(0.37)
Penetration × ADLs[L]	0.12	(0.088)
Penetration × IADLs[L]	– 0.0054	(0.087)
Penetration × Social limitations[L]	– 0.019	(0.19)
Penetration × History of arthritis[L]	0.38*	(0.17)
Penetration × Number of other conditions[L]	– 0.103	(0.056)
IPA plan available	0.22	(0.15)
Health and functional status:		
Excellent health[L]	0.099*	(0.040)
Poor health[L]	– 0.085	(0.089)
ADLs[L]	0.0033	(0.0201)
IADLs[L]	0.0109	(0.020)
Social limitations[L]	– 0.051	(0.046)
History of arthritis[L]	– 0.014	(0.0401)
History of cancer[L]	– 0.11**	(0.037)
History of stroke[L]	– 0.12*	(0.049)
Number of other conditions[L]	– 0.014	(0.014)
Demographics:[†]		
AAPCC adjusters:		
Ages 75 to 84	– 0.094**	(0.030)
Age 85+	– 0.17**	(0.044)
Male	0.017	(0.030)
Medicaid recipient	– 1.21**	(0.068)
Nursing home resident	– 0.24**	(0.092)
Other:		
Less than high school education	– 0.16**	(0.038)
Some college	– 0.12**	(0.034)
Medigap policy[L]	– 1.39**	(0.033)
Black	– 0.00079	(0.0507)
Other nonwhite race	– 0.036	(0.086)
Married	0.0808**	(0.0307)
Has a usual source of care	0.50**	(0.058)
Income < \$10,000	– 0.0012	(0.035)
Income \$30,001–\$50,000	– 0.13**	(0.0403)
Income > \$50,000	– 0.29**	(0.065)
County variables:[†]		
AAPCC rate (deviation from mean)	0.00097**	(0.00022)

*$p \leq 0.05$, ** $p \leq 0.01$; [L]Lagged by one year; [†]Included in model but not reported in table: census region, rural/urban residence code, year, and missing data indicators for income, education, and Medigap.

Table 6: Mean Predicted Probability of HMO Membership

Under actual data	12.12%
All observations coded to "excellent health" profile[1]	13.87%
All observations coded to "fair health" profile[2]	12.24%
All observations coded to "poor health" profile[3]	7.40%

[1]Excellent health = yes, Poor health = no, ADLs performed = 6, IADLs performed = 6, Social limitations = no, Arthritis = no, Cancer = no, Stroke = no, Number of other conditions = 0.

[2]Excellent health = no, Poor health = no, ADLs performed = 4, IADLs performed = 4, Social limitations = no, Arthritis = yes, Cancer = no, Stroke = no, , Number of other conditions = 2.

[3]Excellent health = no, Poor health = yes, ADLs performed = 1, IADLs performed = 1, Social limitation = yes, Arthritis = yes, Cancer = yes, Stroke = yes, Number of other conditions = 3

percent when all observations are given a "fair health" profile, and to 7.40 percent when all are coded to "poor health." Thus, on average, having excellent health increases the probability of HMO membership by 1.63 percentage points (13.32 percent) compared to being in fair health. Excellent health increases the probability by 6.47 percentage points (87.43 percent), on average, compared to poor health. While the absolute change in the average predicted probability of joining an HMO was small, the relative change (percentage difference) in the probability for poor versus excellent health was large.

COMMENT

In summary, our analysis found that Medicare HMO enrollees are not markedly healthier than nonenrollees on most measures, but that the healthiest beneficiaries—those who perceive their health to be excellent—are significantly more likely than others to be HMO members. People with a history of cancer or stroke were found to be less likely to be enrolled. We found no evidence of continued favorable HMO selection on functional status measures tested in earlier studies (Brown 1988a; Hill and Brown 1992; Lichtenstein et al. 1991; Retchin et al. 1992; Riley et al. 1996). We also did not find evidence of an association between the degree of favorable HMO selection and the extent of HMO market penetration in a county except for arthritis, which is a chronic condition with a high frequency (57 percent of the sample).

Our findings regarding favorable HMO selection generally support the current direction of risk adjustment efforts. The current risk adjustment strategy of the Centers for Medicare and Medicaid Services (CMS, formerly the Health Care Financing Administration) centers on major diagnoses, and our analysis found evidence that HMO enrollees and nonenrollees did differ systematically with respect to the presence of certain diagnoses. Currently, the PIP-DCG risk adjuster only takes into account a limited number of serious diagnoses associated with high inpatient utilization. Our finding that HMO enrollees are significantly more likely to suffer from arthritis than nonenrollees in high penetration areas supports CMS's planned expansion of the adjuster to include diagnoses associated with high consumption of outpatient services and may support adjustment for diagnoses associated with high consumption of prescription drugs (such as arthritis).

The CMS is also investigating an alternative risk adjuster based on survey reports of general health status and functional status (Health Care Financing Administration 1999). Our analysis found evidence of favorable HMO selection on self-reported general health status, but not functional status. This casts some doubt about whether a functional-status-based adjuster would be worthwhile, particularly in light of the high cost of collecting of survey data on beneficiaries' functional status and the susceptibility of such data to measurement error (Health Care Financing Administration 1999).

Comparing our results to those of previous studies is difficult in light of the previously identified methodological differences. The choice of health status measure is clearly very important to the results obtained in studies of favorable HMO selection. In this regard, the limitations of our use of self-reported health status measures should be emphasized. As discussed earlier, our findings may reflect a lack of skewness in the self-reported health status measures that limited detection of selection effects. These findings therefore should not be interpreted as conclusive evidence that favorable HMO selection has waned over time.

Other design choices likely influenced our results. We were unable to test the magnitude of the newcomer effect for our data because the number of persons switching from FFS to HMO in the MCBS sample is very small. To investigate whether the panel design of our analysis was responsible for the lack of significance of the functional status measures, on which prior studies have consistently found a selection effect, we reran our model on four cross-sectional subsets of our data using simple probit estimation. The three health status indicators that were significant in the panel estimation were almost uniformly not significant in the cross-sectional estimations for 1993, 1994, and 1995 (results available upon request). The difference in significance levels may be attributable to differences in sample composition across the years, regression to the mean, or simply the smaller sample sizes of the cross-sectional estimations. Thus, while the panel data estimation clearly made a difference in our results, it did not explain the lack of significance of functional status in our analysis. It should be noted that there was relatively little within-person variation in health status or HMO enrollment status across the four years of data in this sample, which may have limited our ability to observe panel effects.

Our lack of significant findings concerning market penetration contrasts with the findings of Call and colleagues (1999) using data from the same period, possibly due to methodological differences. Call and colleagues looked at new HMO enrollees, while our HMO sample included both new and existing enrollees. Their analysis was cross-sectional, while ours was run on a panel of data. Their sample size was much larger than ours. Furthermore, Call used pre-enrollment expenditures, which have more variation than the self-reported health status measures used in our analysis. While we did not have sufficient pre-enrollment utilization data to rerun our model using these data as the selection indicator, the results of a second analysis by Call and colleagues of the same sample using a different health status measure, postenrollment mortality (Maciejewski et al. 2001), indicate that choice of health status measure matters, as the relationship between market penetration and favorable HMO selection was not significant (except for a subsample of HMO disenrollees).

We explored several other possible explanations for the difference between our findings and Call's. Our model included a greater number of interaction terms; however, our results were robust to changes in the number of interaction terms included in the model. Our model also included a larger number of control variables, but we found that when we dropped these additional variables from the model, only one of the penetration interactions (penetration $\times$ IADLs) became statistically significant. Finally, because Call's sample was restricted to counties with at least one thousand Medicare HMO enrollees, the mean market penetration in that sample (21 percent) was higher than in ours (9 percent). However, when we dropped individuals in counties with less than 5 percent penetration, raising the mean penetration to 20.48 percent, the interaction terms still did not attain statistical significance. We conclude that the strongest explanatory factors in comparing our results to Call's are the newcomer effect, the panel effect, and the choice of health status measure.

A limitation of our analysis relates to the use of sampling weights. Our model ideally would have incorporated sampling weights to account for the MCBS's complex survey design. However, the MCBS provides longitudinal weights only for continuously enrolled individuals. We performed a sensitivity analysis on a panel of 7,432 persons continuously enrolled in the 1993–1996 period incorporating longitudinal sampling weights and obtained results that were broadly consistent, with any differences possibly attributable to the disparities in sample coverage and size.

CONCLUSION

In this review, we demonstrate the complexities and contingencies involved in modeling selection dynamics in Medicare HMOs. Reconciling divergent study findings requires an understanding of the way in which key methodological choices may impact the results obtained. We explain that choice of health status measure, method of reporting results, decisions about sample composition (studying newcomers, disenrollees, and multiple years of data), and the decision whether or not to pool data across plans may all be influential. In particular, we suggest that the conflicting findings regarding the relationship between favorable HMO selection and market penetration may be a function of the choice of health status measure and the newcomer effect.

Future researchers should consider these methodological issues very carefully. We believe that the optimal study design would involve a panel data estimation on a large multiyear dataset that includes sufficient numbers of HMO newcomers, disenrollees, and stayers to conduct separate analyses for each of these groups. The range of health status measures would include pre-enrollment utilization (measured by number of hospital days, physician visits, and use of other services rather than costs), mortality, major diagnoses, and survey report data on self-perceived health and functionality. Ideally, plan-specific analyses would be tried, though this approach might require a multistage cluster-sampling design using HMOs as one cluster level (with FFS beneficiaries drawn from the same county). In selecting from among possible alternatives, the tradeoffs and implications of particular choices merit reflection and acknowledgment.

ACKNOWLEDGMENTS

The authors thank Steven A. Garfinkel, Ph.D., and Susan I. DesHarnais, Ph.D., for their contributions to the planning of this study. The support of the Cecil G. Sheps Center for Health Services Research, the programming assistance of Ann Howard, and helpful comments on the draft manuscript from Harold Luft, Stephen Shortell, and two anonymous reviewers are also gratefully acknowledged.

REFERENCES

American Medical Association. 2001. *Physician Socioeconomic Statistics 2000–2002 Edition*, edited by J. D. Wassenaar and S. L. Thran. Chicago: American Medical Association.

Anderson, G., and J. R. Knickman. 1984. "Patterns of Expenditures among High Utilizers of Medical Care Services: The Experience of Medicare Beneficiaries from 1974 to 1977." *Medical Care* 22 (2): 143–9.

Bates, E. W., and K. A. Connors. 1987. "Assessing Process of Care under Capitated and Fee-for-Service Medicare." *Health Care Financing Review* (annual supplement): 57–68.

Beebe, J. C. 1988. "Medicare Reimbursement and Regression to the Mean." *Health Care Financing Review* 9 (3): 9–22.

Brown, R. 1987. *Biased Selection in the Medicare Competition Demonstrations, Report Prepared for the Health Care Financing Administration.* Princeton, NJ: Mathematica Policy Research.

———. 1988a. *Biased Selection in the Medicare Competition Demonstrations.* Princeton, NJ: Mathematica Policy Research.

———. 1988b. *Biased Selection in Medicare HMOs.* Paper presented at the Fifth Annual Meeting of the Association for Health Services Research, San Francisco, CA, July 26–28.

Brown, R. S., D. G. Clement, J. W. Hill, S. M. Retchin, and J. W. Bergeron. 1993. "Do Health Maintenance Organizations Work for Medicare?" *Health Care Financing Review* 15 (1): 7–23.

Brown, R. S., and K. Langwell. 1988. "Enrollment Patterns in Medicare HMOs: Implications for Access to Care." *Advances in Health Economics and Health Services Research* 9: 69–96.

Call, K. T., B. Dowd, R. Feldman, and M. Maciejewski. 1999. "Selection Experiences in Medicare HMOs: Pre-Enrollment Expenditures." *Health Care Financing Review* 20 (4): 197–209.

Congressional Budget Office. 1982. *Catastrophic Medical Expenses: Patterns in the Non-Elderly, Non-Poor Population.* Washington, DC: Congressional Budget Office.

Cox, D. F., and C. Hogan. 1997. "Biased Selection and Medicare HMOs: Analysis of the 1989–1994 Experience." *Medical Care Research and Review* 54 (3): 259–74.

Dowd, B., R. Feldman, I. Moscovice, C. Wisner, P. Bland, and M. Finch. 1996. "An Analysis of Selectivity Bias in the Medicare AAPCC." *Health Care Financing Review* 17 (3): 35–57.

Dowd, B., I. Moscovice, R. Feldman, M. Finch, C. Wisner, and S. Hillson. 1994. "Health Plan Choice in the Twin Cities Medicare Market." *Medical Care* 32 (10): 1019–39.

Eggers, P. 1980. "Risk Differential between Medicare Beneficiaries Enrolled and Not Enrolled in an HMO." *Health Care Financing Review* 2 (2): 91–9.

Eggers, P. W., and R. Prihoda. 1982. "Pre-Enrollment Reimbursement Patterns of Medicare Beneficiaries Enrolled in 'At-Risk' HMOs." *Health Care Financing Review* 4 (4): 55–72.

Feldman, R., and B. Dowd. 1982. "Simulation of a Health Insurance Market with Adverse Selection." *Operations Research* 30 (6): 1027–42.

Garfinkel, S. A., W. E. Schlenger, K. R. McLeroy, F. A. Bryan Jr., B. J. York, G. H. Dunteman, and A. S. Friedlob. 1986. "Choice of Payment Plan in the Medicare Capitation Demonstration." *Medical Care* 24 (7): 628–40.

General Accounting Office. 1986. *Medicare: Issues Raised by Florida Health Maintenance Organizations: Report to Congress.* Publication no. GAO/HRD-86-97. Washington, DC: Government Printing Office.

Gruenberg, L., C. Tompkins, and F. Porell. 1989. "The Health Status and Utilization Patterns of the Elderly: Implications for Setting Medicare Payments to HMOs." *Advances in Health Economics and Health Services Research* 10: 41–73.

Health Care Financing Administration. 1996. "1996 Statistical Supplement." *Health Care Financing Review.*

———. 1998. *1998 Data Compendium.* Baltimore, MD: Health Care Financing Administration.

———. 1999. *Report to Congress: Proposed Method of Incorporating Health Status Risk Adjusters into Medicare+ Choice Payments.* Baltimore, MD: Health Care Financing Administration.

———. 2000a. "Protecting Managed Care Beneficiaries after Medicare+Choice Organizations Withdraw." *HCFA Fact Sheet.* Available at http://www.hcfa.gov/facts/fs000606.htm (June).

———. 2000b. "Medicare and Medicaid Statistical Supplement." *Health Care Financing Review* (supplement): 266–8.

Hill, J. W., and R. S. Brown. 1990. *Biased Selection in the TEFRA HMO/CMP Program.* Princeton, NJ: Mathematical Policy Research.

———. 1992. *Health Status, Financial Barriers, and the Decision to Enroll in Medicare Risk Plans.* Princeton, NJ: Mathematica Policy Research.

Hornbrook, M. C., M. D. Bennett, and M. R. Greenlick. 1989. "Adjusting the AAPCC for Selectivity and Selection Bias under Medicare Risk Contracts." *Advances in Health Economics and Health Services Research* 10: 111–49.

Kasper, J. D., G. F. Riley, J. S. McCombs, and M. A. Stevenson. 1988. "Beneficiary Selection, Use, and Charges in Two Medicare Capitation Demonstrations." *Health Care Financing Review* 10 (1): 37–49.

Lamphere, J. A., P. Neuman, K. Langwell, and D. Sherman. 1997. "The Surge in Medicare Managed Care: An Update." *Health Affairs* 16 (3): 127–33.

Langwell, K. M., and J. P. Hadley. 1989. "Evaluation of the Medicare Competition Demonstrations." *Health Care Financing Review* 11 (2): 65–79.

———. 1990. "Insights from the Medicare HMO Demonstrations." *Health Affairs* 9 (1): 74–84.

Lichtenstein, R., J. W. Thomas, J. Adams-Watson, J. Lepkowski, and B. Simone. 1991. "Selection Bias in TEFRA At-Risk HMOs." *Medical Care* 29 (4): 318–31.

Maciejewski, M. L., B. Dowd, K. T. Call, and R. Feldman. 2001. "Comparing Mortality and Time until Death for Medicare HMO and FFS Beneficiaries." *Health Services Research* 25 (6): 1245–65.

Maciejewski, M. L., B. Dowd, and H. O'Connor. 2002. "Pre-HMO Spending and Disenrollment from Medicare HMOs." Manuscript.

Manning, W. G., A. Leibowitz, G. A. Goldberg, W. H. Rogers, and J. P. Newhouse. "A Controlled Trial of the Effect of a Prepaid Group Practice on Use of Services." *New England Journal of Medicine* 310 (23): 1505–10.

McCall, N., and H. S. Wai. 1983. "An Analysis of the Use of Medicare Services by the Continuously Enrolled Aged." *Medical Care* 21 (6): 567–85.

Mello, M. M., S. C. Stearns, and E. C. Norton. 2002. "Do Medicare HMOs Still Reduce Health Services Use after Controlling for Selection Bias?" *Health Economics* 11 (4): 323–40.

Medicare Payment Advisory Commission. 2001. *Report to the Congress: Medicare Payment Policy.* Washington, DC: Medicare Payment Advisory Commission.

Morgan, R. O., B. A. Virnig, C. A. DeVito, and N. A. Persily. 1997. "The Medicare-HMO Revolving Door—The Healthy Go in and the Sick Go out." *New England Journal of Medicine* 337 (3): 169–75.

Newhouse, J. P., W. G. Manning, C. N. Morris, L. L. Orr, N. Duan, E. B. Keeler, A. Leibowitz, K. H. Marquis, M. S. Marquis, C. E. Phelps, and R. H. Brook. 1981. "Some Interim Results from a Controlled Trial of Cost Sharing in Health Insurance." *New England Journal of Medicine* 305 (25): 1501–7.

Price Waterhouse. 1996. *Is There Biased Selection in Medicare HMOs?* Washington, DC: Price Waterhouse.

Retchin, S. M., D. G. Clement, L. F. Rossiter, B. Brown, R. Brown, and L. Nelson. 1992. "How the Elderly Fare in HMOs: Outcomes from the Medicare Competition Demonstrations." *Health Services Research* 27 (5): 651–9.

Riley, G. F., M. J. Ingber, and C. G. Tudor. 1997. "Disenrollment of Medicare Beneficiaries from HMOs." *Health Affairs* 16 (5): 117–24.

Riley, G., J. Lubitz, and E. Rabey. 1991. "Enrollee Health Status under Medicare Risk Contracts: An Analysis of Mortality Rates." *Health Services Research* 26 (2): 137–63.

Riley, G., E. Rabey, and J. Kasper. 1989. "Biased Selection and Regression Toward the Mean in Three Medicare HMO Demonstrations: A Survival Analysis of Enrollees and Disenrollees." *Medical Care* 27 (4): 337–47.

Riley, G., C. Tudor, Y. P. Chiang, and M. Ingber. 1996. "Health Status of Medicare Enrollees in HMOs and Fee-for-Service in 1994." *Health Care Financing Review* 17 (4): 65–76.

Rossiter, L. F., K. M. Langwell, R. Brown, K. W. Adamache, and L. Nelson. 1989. "Medicare's Expanded Choices Program: Issues and Evidence from the HMO Experience." *Advances in Health Economics and Health Services Research* 10: 3–40.

Siu, A. L., R. H. Brook, and L. Z. Rubenstein. 1986. "Medicare Capitation and Quality of Care for the Frail Elderly." *Health Care Financing Review* (annual supplement): 57–63.

Welch, W. P. 1985a. "Medicare Capitation Payments to HMOs in Light of Regression toward the Mean in Health Care Costs." *Advances in Health Economics and Health Services Research* 6: 75–96.

———. 1985b. "Regression Toward the Mean in Medical Care Costs: Implications for Biased Selection in Health Maintenance Organizations." *Medical Care* 23: 1234–41.