NBER WORKING PAPER SERIES

MANAGED CARE AND PROVIDER VOLUME

Sarah Feldman
David Scharfstein

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 1998

This paper was prepared for the National Bureau of Economic Research conference on Not-for-Profit Hospitals, Nov. 21-22, 1997 in Palm Beach, Florida. The research was supported by a grant from the National Institutes of Aging. We are grateful for helpful input from conference participants and from Laurence Baker, Judy Chevalier, David Cutler, Martin Gaynor, Jennifer Haas, Nancy Rose, Julio Rotemberg, and Alan Weil. Aileen Chen provided exceptional research assistance.

Managed Care and Provider Volume
Sarah Feldman and David Scharfstein
NBER Working Paper No.
March 1998

ABSTRACT

There is considerable evidence that patients that are treated by high volume physicians and hospitals have better health outcomes than patients treated by low volume physicians and hospitals. Thus, as an indirect measure of quality differences between managed care and traditional fee-for-service insurance, we compare the average provider volume of cancer patients covered by these two types of plans. We find that managed care patients tend to be treated by lower volume providers and that the magnitude of the differences vary by the particular cancer and managed care plan.

Sarah Feldman
Brigham and Women's Hospital
and Harvard Medical School
75 Francis Street
Boston, MA 02115
sfeldman@bics.bwh.harvard.edu

David Scharfstein
E52-433
Sloan School of Management
Masschusetts Institute of Technology
50 Memorial Drive
Cambridge, MA 02142-1347
and NBER
dscharf@mit.edu

1. Introduction

Between 1980 and 1995, the number of individuals covered by managed care plans grew more than five-fold. With this increase, have come growing concerns about the quality of the care provided by managed care plans. There have been a number of responses to these concerns: the establishment of the National Committee on Quality Assurance (NCQA) to measure health care quality and provide accreditation of health plans; the attempt by some health care plans to create legally enforceable national standards for patient protection; and a presidential advisory committee on health care quality.

Despite the widespread interest in measuring health care quality, there is still limited understanding of the differences in the quality of managed care and more traditional fee-for-service (FFS) health plans. Indeed, in their survey of research on the topic, Miller and Luft (1997) concluded that it is difficult to draw definitive conclusions about the differences between the two types of coverage. Of the fifteen studies they reviewed, some found evidence that managed care plans offer higher quality care than FFS plans; others found just the opposite; and still others found little difference between the two types of health plans.

Research on quality takes two approaches. In one approach, researchers examine the *process* of health care, comparing the ways in which health care providers treat disease.[1] In the second approach, researchers compare patients' health *outcomes.*

For example, Sheldon Rechtin and co-authors (1990, 1991a,b), taking the process approach to study the medical management of colorectal cancer, diabetes, and congestive heart failure, found no meaningful differences in the way patients in managed care plans are treated

[1] The NCQA takes the process approach, collecting information, for example, on whether health plans screen for breast and cervical cancer, advise smokers to quit smoking, and prescribe appropriate medication for heart disease.

compared to patients in fee-for-service plans. In a more recent study, however, Rechtin et. al. (1997) found that stroke patients covered by managed care plans were less likely to be discharged to a rehabilitation center, suggesting that they received less comprehensive (and perhaps lower quality) therapy.

An example of the outcomes approach is Rechtin et. al. (1992) which found no differences in the health status of elderly patients under the two types of coverage. Similarly, Yelin et. al. (1996) found no outcome difference for patients suffering from rheumatoid arthritis. By contrast, Ware et. al. (1996) did find differences between managed care and FFS plans. They found that, over a four-year period, chronically ill non-elderly patients fared better in managed care plans, while chronically ill elderly and poor patients fared better in the FFS plans. Exactly why they observed different patterns depending on age and income remains an open question.

There are a number of studies that combine the process and outcomes approaches to measure quality. Young and Cohen (1991) found that managed care patients were less likely to receive coronary artery bypass graft and arteriography following AMI, but there were no statistically significant differences in post-AMI mortality. Similarly, Cutler, McClellan, and Newhouse (1997) found lower resource utilization in managed care plans, but no difference in AMI mortality rates. Carlisle et. al. (1992) took a similar approach although with a more in-depth analysis of the process of medical care for AMI patients. They found higher quality processes in managed care plans and lower AMI mortality rates.[2]

In this paper, we take a different approach. In particular, we compare the hospitals and

[2] One limitation of this study, however, is that it covers only three HMOs. The three are among the most successful HMOs in the United States, whereas the patients in the FFS plans were drawn from a broader sample reflecting hospitals and health care providers of average quality. It is an open question whether one would continue to see differences in performance if one compared the FFS patients to patients in a broader cross-section of HMOs.

physicians that treat managed care patients and FFS patients. The starting point for our analysis is the large literature establishing that patients have better clinical outcomes when they are treated by physicians and hospitals with more experience treating the disease. For example, it has been shown that the patients of surgeons and hospitals that perform a larger number of coronary artery bypass grafts (CABGs) are less likely to die during or shortly after the procedure. The relationship between physician and hospital volume and outcomes has also been established for a wide range of surgical procedures and some medical treatments of chronic illness including: orthopedic surgery, angioplasty, organ transplantation, colorectal and breast cancer surgery, hysterectomy, and AIDS.

The precise mechanism that links volume and outcome is unknown. It could be that experience makes physicians and hospitals better, i.e. there is some sort of learning-by-doing.[3] Or, it could be that higher volume hospitals and physicians attract more patients because they are correctly perceived by patients to be better. For our purposes, the exact cause of the relationship between volume and outcome is less important than the fact that such a relationship exists.

Thus, our empirical goal is simply to examine whether patients in managed care plans tend to be treated by higher or lower volume physicians and hospitals. We analyze this question using data on all hospital discharges in Massachusetts in 1995. These data identify the physicians and hospitals providing the care, as well as the patient's insurance plan (e.g., Harvard Community Health Plan, HMO Blue, Blue Cross/Blue Shield. Medicare etc.) The dataset also provides fairly detailed clinical information --- patient diagnoses and procedures performed --- as well as some demographic information on the patients.

[3] Laffel et. al. (1992) suggests that learning by doing is part of the explanation. They examined the performance of physicians and hospitals as they became more experienced performing heart transplantation

We examine the relationship between managed care and volume for surgeries related to three types of cancer: breast cancer, colorectal cancer, and gynecologic cancer. We chose these particular diseases because they are almost always treated surgically, and thus there is unlikely to be major differences in the way managed care and FFS plans treat their patients. We find that, on average, and after controlling for demographic differences, patients with breast cancer who are covered by managed care plans are operated on by physicians who performed 22% fewer procedures than the physicians of FFS patients. Managed care patients with gynecologic cancers are operated on by physicians who perform 25% fewer surgeries. There is no appreciable difference between managed care and FFS plans in the volume of the physicians operating on patients with colorectal cancer.

These averages mask considerable heterogeneity across plans. Some managed care plans, use considerably lower volume physicians than the average. For example, one of the plans used physicians performing 43% fewer breast surgeries and 68% fewer hysterectomies. By contrast, patients in another plan were treated by physicians who were slightly less experienced than the physicians of FFS patients, and the difference was statistically insignificant.

We also find that managed care patients tend to be treated at hospitals that perform fewer procedures. For example, in the case of breast cancer surgery, patients in five of the six largest plans are treated at significantly lower volume hospitals --- hospitals with volume 35% below the average of FFS patients' hospitals. One finds similar results for colorectal cancer surgery, and statistically insignificant differences for gynecologic cancer surgery. However, one of the managed care plans sends patients to hospitals with 23% - 41% higher volume than the hospitals of FFS patients (depending on the procedure).

If one accepts the view that volume and quality are related, then these results indicate that,

in many cases, managed care plans offer lower quality care than FFS plans. The results also indicate that not all managed care plans are alike --- not surprisingly, some are better than others. Moreover, even the same managed care plans can offer different quality care for different diseases.

In the next section of the paper, we discuss the data used in this study and describe our empirical approach. Section 3 presents the basic empirical results. We discuss the implications of the results and suggest future research opportunities in Section 4.

2. Data and Empirical Approach

We use the 1995 *Hospital Case Mix and Charge Data* compiled by the Division of Health Care Finance and Policy of the Massachusetts Office of Health and Human Services. Like most states, Massachusetts requires hospitals to report detailed clinical and financial information on all hospital stays. However, Massachusetts is one of the few states that includes (encrypted) physician identifiers in the dataset and identifies the health care plan by name and type.[4] We use 1995 data because it is the first full year with physician identifiers, and the 1996 data were not available when we began this study.

While, in principle, one could analyze all hospital admissions, we chose not to do so. The reason is that hospital admissions and surgeries may differ in the extent to which they are discretionary. For example, prostate cancer can be treated with surgery or by outpatient radiation therapy. Because we did not want our analysis to be confounded by the possibility that managed care plans and fee-for-service plans differ in the extent to which they treat patients on an inpatient

[4] Other states may indicate the type of health care coverage, but not the actual name of the health plan.

or outpatient basis, we chose to focus on diagnoses and treatments where there is little discretion as to whether to perform inpatient surgery. While there are possibly many such diagnoses and treatments, we focus on the following three:

1. *Breast Cancer* treated with *mastectomy or lumpectomy*.[5]

2. *Gynecologic Cancer* (ovarian, uterine, cervical) treated with *hysterectomy* (total abdominal or radical).[6]

3. *Colorectal Cancer* treated with *resection* of colon or rectum.[7]

For each of these procedures there is evidence that the patients of high volume providers have better outcomes. As a measure of experience with one of the procedures, for each physician we calculate the total number of such procedures the physician performed during the year. This number includes procedures that were performed for diagnoses other than cancer, e.g. hysterectomy for non-malignant uterine fibroids.[8] Of course, this measure --- which we refer to as *physician volume* --- is only an imperfect proxy for the physician's experience with the procedure, and an even more imperfect proxy for the physician's skill with the procedure. Unfortunately, we were unable to get further information on physicians such as years of practice, board certification, and sub-specialty training. The analogous measure of a hospital's experience with one of the procedures is the total number of the procedures performed at the hospital for the relevant

[5] Breast cancer is defined here as ICD9 hospital codes 1740-1749 inclusive. The surgical procedures are ICD9 hospital codes 8521-8523, 8541, 8543.

[6] Gynecologic cancer is defined here as ICD9 hospital codes 179, 1800-1839 inclusive; total abdominal hysterectomy is ICD9 code 6840 and radical abdominal hysterectomy is ICD9 code 6860.

[7] Colorectal cancer is defined here as ICD9 hospital diagnoses codes 1530-1541 inclusive; the procedures are ICD9 hospital procedure codes 4573-4576 inclusive and 4863.

[8] An alternative measure of physician experience with the procedure could include only the procedures performed to treat the cancer diagnoses. Although we do not report the results, the basic conclusions are unaffected by this alternative definition of physician experience.

diagnoses, which we refer to as *hospital volume*.

Our focus is on the relationship between the patient's health plan and the experience of the physicians treating the patient. There are several different categories of health plans recorded in the *Case Mix* data. Two are *Medicaid* and *Free Care* (a state-run program for the otherwise uninsured), which we exclude from the analysis because the indigent populations they serve are likely to be quite different from the population with private insurance and Medicare. There are four managed-care plan categories: health maintenance organizations (HMOs), preferred provider organizations (PPOs), commercial managed care, and Medicare managed care. Because the differences among HMOs, PPOs, and commercial managed care are unclear --- at least in the way it is coded in the data --- we make no distinction among these types of plans.

In 1995, the managed care plans in Massachusetts with the largest number of hospital admissions were:

(1) *HMO Blue* (a managed care plan offered by Blue Cross/Blue Shield) with 35,949 admissions;

(2) *Harvard Community Health Plan* (HCHP) with 30,621 admissions;

(3) *Tufts Associated Health Plan* with 24,584 admissions;

(4) *Pilgrim Health Care* (since merged with HCHP) with 20,379 admissions;

(5) *Fallon* with 11,488 admissions;

(6) *Bay State Health Care* (another Blue Cross/Blue Shield managed care plan) with 9997 admissions.

In our analysis, we will break out the results for these large managed care plans, and group all other managed care plans together. Because of the preliminary nature of our results, we will not identify these plans by name when we present the specific results.

There are also a number of different types of fee-for-service plans. The largest is *Medicare* with 287,285 hospital admissions, and the largest private plan is *Blue Cross/Blue Shield Indemnity* with 40,269 admissions. There are also 31 commercial plans identified by name, the largest of which is *John Hancock Life Insurance*, with 4211 hospital admissions. In our analysis we separate out the results for Medicare fee-for-service, and we group BC/BS together with all commercial FFS plans.

In addition to the type of health insurance, there are other factors that can have an effect on physician and hospital choice. In particular, proximity to high volume hospitals should increase the likelihood that patients are treated by high volume providers. As a measure of proximity we use the shortest distance from the zip code of the patient's residence to the ten highest volume hospitals for the procedure.[9] Income may also have an effect on provider choice since higher income patients are likely to be more educated health care consumers. Although we do not have patient income data, we do have information on median income in the patient's zip code of residence. Age and race may also affect provider choice.

In the patient-level regression analysis for each procedure, we examine whether managed care patients are treated by higher or lower volume providers than are FFS patients, controlling for patient demographic characteristics. Thus, the regressions take the following form:

$$\textit{Provider Volume}_i = a_0 + S_j\, a_j\, \textit{InsurancePlan}_{ij} + b_1\, \ln(\textit{Age}_i) + b_2\, \ln(\textit{Income}_i) + S_k\, b_{3k}\, \textit{Race Dummies}_i + b_4\, \ln(\textit{Distance}_i) + e_i,$$

[9] One could also calculate distance to high volume physicians, but it is highly correlated with distance to high volume hospitals.

where *Provider Volume* refers to the number of procedures performed by the provider (hospital or physician) during the year and *i* indexes patients.

Before presenting the results of the regression analysis, it is worth reviewing the characteristics of the sample. Table 1 provides summary statistics for each of the three cancer surgeries. The mean physician volumes for breast cancer surgery, colorectal cancer surgery, and gynecologic cancer surgery are 15.6, 18.4, and 21.0, respectively. There is substantial heterogeneity in the physician volumes for each of these procedures. For example, the standard deviation of physician volume for breast cancer surgery is 14.5, almost as large as the mean. The physician in the lowest 25th percentile performs 6 surgeries, while the physician in the 75th percentile performs 20.

These numbers count physicians each time they perform surgery, thus oversampling the high volume physicians and understating the number of low volume physicians. For example, of the 400 physicians performing at least one breast cancer surgery in the sample, 25% performed 3 or fewer, 75% performed 9 or fewer, and only 7.5% (30 physicians) performed 20 or more. For gynecologic cancer, the median physician performed only one hysterectomy, and there were only 14 out of 313 (4.5%) who performed 20 or more. For colon cancer, 451 physicians performed at least one surgery for the disease, the median performed 9 surgeries, and 58 (12.91%) performed 20 or more surgeries.

Table 1 shows that mean hospital volume is 91.9 for breast cancer surgery, 119.2 for colon cancer surgery, and 65.1 for gynecologic cancer surgery. Here too the variation across providers is very large. Of the 76 hospitals performing at least one surgery for breast cancer, 25% performed fewer than 15, 75% performed fewer than 52, and there were only 6 that performed more than 100 surgeries during the year. The volume numbers are even lower for gynecologic

cancer: of the 66 hospitals operating on women with gynecologic cancer, 25% performed fewer than 4 such procedures, 75% performed fewer than 17, 7 performed more than 60 procedures, and only 3 performed more than 100. In the case of colorectal cancer, the hospital volume numbers are considerable higher. Of the 73 hospitals, 25% performed fewer than 29, 50% performed fewer than 65, and 75% performed fewer than 100. There are 19 hospitals that perform 100 or more surgeries for colon cancer.

In addition to summary statistics on some of the demographic variables, Table 1 provides information on patients' insurance. Given that cancer tends to be concentrated among the elderly, it is not surprising that most of the patients (51% to 78% depending on the cancer) have Medicare insurance. However, only a small fraction of these Medicare patients (3% to 4%) are covered by managed care. The non-Medicare patients are covered by private managed care plans or fee-for-service plans. Depending on the procedure, between 60% and 65% of these privately insured patients are covered by managed care plans.

3. Empirical Results

A. Physician Volume

For each of the three surgeries, Table 2 lists the mean physician volumes for: (1) all private fee-for-service plans; (2) the six largest private (non-Medicare, non-Medicaid) managed care plans; (3) all other private managed care plans grouped together; (4) standard Medicare fee-for-service; and (5) Medicare managed care plans grouped together.

In all three cases, the mean physician volume of private FFS patients exceeds that of private managed care patients. We discuss the results for each of the three surgeries in turn.

Breast Cancer Surgery. The mean physician volume for private FFS plans is 20.8,

compared to 6.4 for private managed care patients, i.e. FFS is 27% higher than managed care. For all of the large managed care plans except Plan A, the differential is statistically significant. In the case of Plan B and Plan F, the difference in physician volume is very large; physicians that treat private FFS patients perform 60% more surgeries than the physicians treating Plan B and Plan F patients (i.e. 20.5 vs. 13.0 for Plans B and F).

Physicians treating patients covered by Medicare --- both FFS and managed care --- perform fewer surgeries than the physicians treating private FFS patients. The differences are large: the physician volume of private FFS patients is 49% higher than the physician volume of Medicare FFS patients (14.0) and 40% higher than the physician volume of Medicare managed care patients (14.9).

Table 3 indicates the predicted physician volumes for the various health care plans using the regression model described in Section 2 above. The predicted values are based on the means of the demographic variables --- age, income, distance to large hospitals, and race. The table indicates that there continue to be statistically significant differences in physician volumes between private managed care and FFS plans and that the magnitude of the differences is not changed much. The difference between Medicare and private FFS is reduced and is no longer statistically significant.

Colorectal Cancer Surgery. The mean volume of physicians treating private FFS patients with colorectal cancer is 18.0 as compared to 17.3 for private managed care patients. The overall difference is not statistically significant and only one of the seven private managed care plans, Plan A, exhibits a statistically significant difference in physician volume as compared to FFS plans. The regression analysis which controls for demographic variables, does not change this conclusion. The mean physician volume of Medicare FFS patients is slightly higher (but

insignificantly so) than FFS patients, while the mean physician volume of Medicare managed care patients is significantly higher than that of private FFS patients. In Table 3, once demographic controls are included, the difference between Medicare FFS and private FFS becomes statistically significant and the difference between Medicare managed care and private FFS remains statistically significant.

Gynecologic Cancer Surgery. The average number of procedures performed by physicians treating private FFS patients for gynecologic cancer is 23.9 as compared to 18.3 for physicians treating patients in private managed care plans. Physicians used by patients in four of the six largest managed care plans have statistically significant lower volume than physicians used by FFS patients. The magnitude of the differences are very large. In the case of Plan F, the average physician volume is only 62% lower than the average volume of private FFS plans (9.2 vs. 23.9). Physician volume in Medicare managed care plans (8.4 surgeries per year) is also significantly lower than physician volume in private FFS plans and Medicare FFS plans (22.0 surgeries per year). The differences continue to hold once demographic controls are included, as Table 3 shows.

B. Hospital Volume

Tables 4 and 5 indicate that managed care and FFS patients are treated at hospitals with significant differences in the number of procedures they perform. Table 4 gives the raw means for the various plans, while Table 5 adjusts the means for demographic factors.

Breast Cancer Surgery. The average private FFS patient is treated at a hospital that performs 120.9 surgeries per year, while the average managed care patient is treated at a hospital that performs 99.8 surgeries per year. However, patients in one of the managed care plans, Plan

A, are treated by hospitals with significantly higher volume than the patients covered by private FFS plans --- 171.1 for Plan A vs. 120.9 for the private FFS plans. As will be discussed shortly, this differential for Plan A is true of the other procedures as well. Interestingly though, while Plan A patients are treated at higher volume hospitals than private FFS patients, Table 2 indicates that they are not treated by higher volume physicians. In fact, patients covered by Plan A are treated by relatively low volume physicians at high volume hospitals.

The patients covered by the other managed care plans are treated at significantly lower volume hospitals --- from 23% lower in the case of Plan C to as much as 56% lower in the case of Plan F. On average, patients in Plans B-F are treated at hospitals with volumes of 79.2, 34% below the average for FFS patients.

Finally, patients covered by both types of Medicare plans --- FFS and managed care --- are treated at lower volume hospitals.

Table 5 presents the means once they are adjusted for demographic differences and there is no appreciable difference in the results. Plan A patients are treated at higher volume hospitals than FFS patients, and patients in PlansB-F ate treated at hospitals with 35% lower volume.

Colon Cancer Surgery. The same pattern exists for colon cancer surgery, although the magnitude of the differences are somewhat smaller. On average, patients in private FFS plans are treated at hospitals with a volume of 134.7 colorectal surgeries, while it is 121.2 for private managed care plans. Here too, Plan A patients are treated at higher volume hospitals than FFS patients. As Table 2 shows, they are treated by low volume physicians at these high volume hospitals. Patients in all other managed care plans are treated at lower volume hospitals than patients in private FFS plans. On average, they are treated at hospitals with a volume of 110.2 as compared to 134.7 for FFS patients, an 18% differential.

The same pattern of results carry over to Table 5 where demographic controls are included. Plan A patients are treated at higher volume hospitals and patients in Plans B-F are treated at hospitals that perform an average of 22% fewer surgeries than the hospitals of FFS patients.

Gynecologic Cancer Surgery. The difference between private FFS and private managed care plans are somewhat less pronounced for gynecologic cancer surgery. The overall mean for private FFS patients is 67.1, while it is 63.4 for private managed care patients. Plan A patients are treated at relatively high volume hospitals, those with an average volume of 90.8. Patients in the other plans are treated at hospitals with lower volume, but the only plan where the difference is statistically significant is Plan B with an average volume of 33.0 as compared to 67.1 for private FFS patients. Inclusion of demographic controls does not alter this basic conclusion.

C. Effect of Demographic Variables

Panels A and B of Table 6 provide information on the effect of demographic variables on the choice of physician and hospital. The effects are estimated from the regression analysis described in Section 2 and are evaluated at the means of all the other variables in the regression.

The tables indicate that higher income patients --- or more precisely, patients living in higher income zip codes --- are more prone to go to higher volume physicians (Panel A) and higher volume hospitals (Panel B). For all the procedures, the effect of income on volume is highly statistically significant. In the case of breast cancer surgery, patients with income one standard deviation above the mean are treated by physicians with 22% higher volume than the physicians of patients with income one standard deviation below the mean (16.9 procedures vs. 13.8). The higher income breast cancer patients are treated at hospitals with 28% higher volume

than the hospitals that treat lower income patients (103.3 vs. 80.5).

The effect of income on physician and hospital volume are somewhat smaller for colorectal cancer surgery; higher income patients are treated by physicians that perform 11% more surgeries and than the physicians of lower income patients (17.9 vs. 16.1) and at hospitals that perform 17% more surgeries (128.4 vs. 110.0).[10] Finally, the effect of income on physician volume is quite large in the case of gynecological cancer surgery, with higher income patients being treated by physicians that perform 47% more surgeries than the physicians of lower income patients (25.0 vs. 17.0). The effect of income on hospital volume for this procedure is smaller; higher income patients are treated at hospitals with only 11% higher volume than the hospitals of lower income patients (69.5 vs. 60.7).

These results are consistent with the findings of McClellan and Skinner (1997) that higher income Medicare patients use more Medicare services, mostly physician and outpatient services. This suggests that higher income patients are more aggressive in seeking high quality health care. Thus, it is not surprising that they tend to seek care from higher volume physicians and hospitals.

Age also has an effect on provider choice; older patients tend to be treated by lower volume physicians and hospitals. For example, the average 84 year old with breast cancer (one standard deviation above the mean) is treated by physicians who performed 12.9 breast cancer surgeries during the year, while the average 61 year old with breast cancer (one standard deviation below the mean) was treated by a physician who performed 17.8 (38% more) breast cancer surgeries. The average 84 year old is treated at hospitals that perform 81.3 breast cancer surgeries, while the average 61 year old is treated at hospitals that perform 102.5 surgeries.

[10] One could also calculate distance to high volume physicians, but it is highly correlated with distance to high volume hospitals.

There are similar effects of age for the other procedures, though the magnitudes of the effects are smaller. It is not completely clear how to interpret the results on age. One possible interpretation is that it is more difficult for elderly patients to find high volume physicians or travel to high volume hospitals.

Table 6 presents inconclusive evidence on the effects of race on provider choice. White patients tend to be treated by higher volume physicians than African-American patients for colorectal cancer, but the opposite is true for gynecologic cancer, and there is no significant difference for breast cancer. African-American women are treated for breast cancer at significantly higher volume hospitals than white women, but there are no significant effects of race for colorectal cancer and gynecologic cancer.

Finally, Table 6 presents evidence that proximity to high volume hospitals increases the likelihood that patients will be treated at higher volume hospitals. The effect is relatively small for breast cancer and gynecologic cancer and larger for colorectal cancer. Hospital proximity has no effect on physician choice for breast cancer and gynecologic cancer, but does have an effect for colorectal cancer.

4. Discussion and Conclusion

The results of this paper indicate that patients covered by managed care plans tend to be treated by lower volume physicians and at lower volume hospitals than patients covered by FFS plans. Although this is the overall pattern, there is quite a bit of variation across health plans. The patients in one plan (Plan B) were treated by physicians who performed many fewer surgeries than physicians treating FFS patients, while there was little difference in physician volume for another plan (Plan C). One of the health plans (Plan A) treated their patients at considerably higher volume hospitals than FFS patients, but Plan B patients were treated at hospitals with

considerably lower volume. If volume is a valid indicator of quality, it suggests that there is substantial variation in health-care quality across managed care plans.

Our results, at first glance, seem difficult to reconcile with the literature on managed care quality, which find little systematic differences in the health outcomes of managed care and FFS patients. If our results are valid --- i.e., there are quality differences between the two types of coverage as a result of provider-volume differences --- why don't we see these differences in the health outcomes of managed care and FFS patients? There are two possible answers. One is that the literature investigating quality differentials tends to focus on outcomes of chronic diseases that are generally managed through medical, rather than surgical, intervention. The quality of medical intervention may be harder to measure than the quality of the kinds of surgical interventions we are studying. The second answer may be that existing studies compare quality of FFS plans and the *average* managed care plan. As our study indicates, however, looking at averages may mask considerable heterogeneity across plans. Some managed care plans may be better than FFS plans, other may be worse. Ultimately, to reconcile our results with the literature it would be useful to more directly measure the health outcomes of patients in our sample.

One question that we have not addressed is exactly why it is that managed care patients tend to be treated by low volume providers. One possibility is that managed care plans limit patients to using relatively low volume providers. They might not be referred to specialists for their procedures, or their access to high-volume specialists may be restricted. In addition, managed care health plans may not send their patients to high-volume tertiary care, teaching hospitals because they only have contracts with low-volume community hospitals. This interpretation is plausible because lower cost community hospitals and low-volume surgeons are likely to offer their services at more attractive rates to managed-care health plans. To determine

whether this is indeed the explanation one could collect information on the hospitals and providers with whom the managed care plans have contracts.

An alternative interpretation of the findings is that managed care plans do not restrict patient choice, but rather that individuals who enroll in managed care plans are less aggressive health care consumers. In this interpretation, even if they had enrolled in a FFS plan, they would choose to be treated by low volume providers because they care less about the quality of their care. This leaves open the question of why managed care plans don't direct these patients to high volume providers who offer higher quality care. We suspect the answer again is that high volume providers are more expensive.

This discussion raises the related question of why some managed care plans use high volume providers and others do not. Ultimately, the negotiated prices between health care providers and insurers will depend on provider costs and the bargaining power of the two parties. It is likely that size gives providers and insurers bargaining power. Thus, one would expect the patients of larger insurance plans --- those with more bargaining power vis a vis the hospitals --- to be treated by higher volume providers that the patients of smaller insurance plans. This implcation is easy to analyze with our data. In addition, one could examine whether mergers between health plans --- such as that between Harvard Community Health Plan and Pilgrim --- affected the volume of the providers treating patients in these plans.

Another way to address this question is to analyze data from other states where managed care penetration levels differ. For example, in southern states where there is relatively little managed care penetration, high volume physicians and hospitals are in better positions to turn away low-priced managed care contracts. As a result, one might expect to see bigger differences in the volume of physicians and hospitals treating managed care and fee-for-service patients in

these states. By contrast, in California, the state with the largest managed care penetration, there may be little difference between managed care and fee-for-service plans, because all hospitals and physicians are reliant on managed care business. With a long enough time series one could also examine how changes over time in managed care penetration affect the allocation of patients across low volume and high volume providers.

Finally, in order to draw more general conclusions about provider volume differences between managed care and FFS, one would have to analyze more procedures. Our preliminary analysis of other procedures --- including those that are more elective in nature --- indicates that the sort of effects we have identified are prevalent, at least in Massachusetts in 1995.

Table 1
Sample Summary Statistics

The table below records means of some of the variables in the dataset broken out by breast cancer surgery, colorectal cancer surgery, and gynecological cancer surgery. (See footnotes 5-7 for more precise definitions of the diseases and surgeries.) The number in brackets is the median of the variable, and the number in parentheses is the standard deviation. Physician volume is the number of procedures performed by the physicians including those that were not performed for a cancer diagnosis. The sample includes only those patients covered by private insurance and Medicare, thus eliminating patients covered by Medicaid, Free Care, other government programs, and patients paying themselves.

Variable	Breast Cancer Surgery	Colorectal Cancer Surgery	Gynecologic Cancer Surgery
Physician Volume	15.6 [11] (14.5)	18.4 [17] (11.4)	21.0 [5] (24.9)
Hospital Volume	91.7 [67] (81.3)	120.4 [102] (79.1)	65.1 [65] (56.7)
Age	63.3 [66] (14.6)	72.5 73 (10.8)	62.6 [65] (13.6)
Income (1990)	18178.9 [16741] (6138.8)	17758.2 [16683] (5797.4)	17726.7 [16409] (5499.2)
Distance (in miles) to High-Volume Hospital	22.0 [11.3] (88.5)	11.7 [9.9] (11.8)	19.3 [11.9] (43.2)
% White	92.8	93.9	93.1
% Private Fee-for-Service	16.2	9.0	19.2
% Private Managed Care	30.4	13.2	29.7
% Medicare Fee-for-Service	52.2	75.3	48.9
% Medicare Managed Care	1.2	2.5	2.2
Number of Observations	2042	2220	902

Table 2
Mean Physician Volume for Various Health Care Plans

The table below records the mean physician volumes broken out by breast cancer surgery, colorectal cancer surgery, and gynecological cancer surgery and type of health plan (See footnotes 5-7 for more precise definitions of the diseases and surgeries.) The number in parentheses is the p-value of the difference with the private fee-for-service health plans, calculated using White's (1980) robust standard errors. Physician volume is the number of procedures performed by the physicians including those that were not performed for a cancer diagnosis. The sample includes only those patients covered by private insurance and Medicare, thus eliminating patients covered by Medicaid, Free Care, other government programs, and patients paying themselves.

Type of Health Insurance Plan	Breast Cancer Surgery	Colorectal Cancer Surgery	Gynecologic Cancer Surgery
Private Fee-for-Service	20.8	18.0	23.9
Private Managed Care	16.4	17.3	18.3
Plan A	18.6 (0.217)	13.2 (0.008)	24.4 (0.891)
Plan B	13.0 (<0.001)	17.2 (0.562)	13.0 (0.004)
Plan C	16.9 (0.027)	18.6 (0.733)	18.3 (0.237)
Plan D	16.2 (0.003)	18.3 (0.887)	13.6 (0.002)
Plan E	16.1 (0.071)	18.1 (0.991)	13.7 (0.017)
Plan F	13.0 (<0.001)	22.2 (0.114)	9.2 (<0.001)
Other	16.2 (0.002)	17.3 (0.611)	23.7 (0.496)
Medicare			
Fee-for-service	14.0 (<0.001)	18.6 (0.486)	22.0 (0.406)
Managed care	14.9 (0.007)	23.1 (0.004)	8.4 (<0.001)
Number of Observations	2148	2353	947

Table 3
Mean Demographically- Adjusted Physician Volume for Various Health Care Plans

The table below records the predicted physician volumes broken out by breast cancer surgery, colorectal cancer surgery, and gynecological cancer surgery and type of health plan. (See footnotes 5-7 for more precise definitions of the diseases and surgeries.) The number in parentheses is the p-value of the difference with the private fee-for-service health plans, calculated using White's (1980) robust standard errors. Physician volume is the number of procedures performed by the physicians including those that were not performed for a cancer diagnosis. The sample includes only those patients covered by private insurance and Medicare, thus eliminating patients covered by Medicaid, Free Care, other government programs, and patients paying themselves. The demographic adjustments include: race, log of age, log of median income in the patient's zip code, and the log distance to the closest of the 10 highest volume hospitals performing the procedure. The predicted physician volumes are derived from the regression model described in the text evaluated at the means of the demographic controls.

Type of Health Insurance Plan	Breast Cancer Surgery	Colorectal Cancer Surgery	Gynecologic Cancer Surgery
Private Fee-for-Service	17.9	16.4	21.7
Private Managed Care	14.0	15.7	16.2
Plan A	15.8 (0.229)	11.4 (0.007)	19.9 (0.605)
Plan B	10.2 (<0.001)	15.7 (0.634)	8.0 (<0.001)
Plan C	14.8 (0.087)	17.1 (0.351)	19.3 (0.615)
Plan D	14.1 (0.016)	17.0 (0.283)	15.1 (0.055)
Plan E	14.1 (0.187)	16.5 (0.981)	11.0 (0.005)
Plan F	10.9 (<0.001)	19.7 (0.210)	10.3 (<0.001)
Other	14.2 (0.010)	15.8 (0.413)	21.2 (0.860)
Medicare			
Fee-for-service	15.8 (0.094)	19.0 (0.016)	24.0 (0.396)
Managed care	16.8 (0.634)	21.7 (0.009)	9.8 (0.001)
Number of Observations	2042	2220	902

Table 4
Mean Hospital Volume for Various Health Care Plans

The table below records the mean hospital volumes broken out by breast cancer surgery, colorectal cancer surgery, and gynecological cancer surgery. (See footnotes 5-7 for more precise definitions of the diseases and surgeries.) The number in parentheses is the p-value of the difference with the private fee-for-service health plans, calculated using White's (1980) robust standard errors. Physician volume is the number of procedures performed by the physicians including those that were not performed for a cancer diagnosis. The sample includes only those patients covered by private insurance and Medicare, thus eliminating patients covered by Medicaid, Free Care, other government programs, and patients paying themselves.

Type of Health Insurance Plan	Breast Cancer Surgery	Colorectal Cancer Surgery	Gynecologic Cancer Surgery
Private Fee-for-Service	120.9	134.7	67.1
Private Managed Care	99.8	121.2	63.4
Plan A	171.1 (<0.001)	168.4 (0.002)	99.9 (<0.001)
Plan B	63.7 (<0.001)	98.4 (<0.001)	33.0 (<0.001)
Plan C	89.0 (<0.001)	121.2 (0.208)	54.3 (0.288)
Plan D	81 (<0.001)	116.9 (0.035)	56.3 (0.207)
Plan E	80.8 (0.001)	104.9 (0.018)	70.3 (0.021)
Plan F	53.9 (<0.001)	102.1 (0.016)	54.7 (0.083)
Other	83.0 (<0.001)	117.5 (0.057)	62.7 (0.496)
Medicare			
Fee-for-service	80.9 (<0.001)	119.2 (0.015)	65.6 (0.761)
Managed care	73.9 (<0.001)	156.7 (0.007)	63.2 (0.696)
Number of Observations	2148	2353	947

Table 5
Mean Demographically-Adjusted Hospital Volume for Various Health Care Plans

The table below records the predicted hospital volumes broken out by breast cancer surgery, colorectal cancer surgery, and gynecological cancer surgery and type of health plan. (See footnotes 5-7 for more precise definitions of the diseases and surgeries.) The number in parentheses is the p-value of the difference with the private fee-for-service health plans, calculated using White's (1980) robust standard errors. Physician volume is the number of procedures performed by the physicians including those that were not performed for a cancer diagnosis. The sample includes only those patients covered by private insurance and Medicare, thus eliminating patients covered by Medicaid, Free Care, other government programs, and patients paying themselves. The demographic adjustments include: race, log of age, log of median income in the patient's zip code, and the log distance to the closest of the 10 highest volume hospitals performing the procedure. The predicted hospital volumes are derived from the regression model described in the text evaluated at the means of the demographic controls.

Type of Health Insurance Plan	Breast Cancer Surgery	Colorectal Cancer Surgery	Gynecologic Cancer Surgery
Private Fee-for-Service	106.5	120.4	63.5
Private Managed Care	87.1	107.1	58.3
Plan A	149.9 (<0.001)	148.1 (0.011)	90.8 (0.003)
Plan B	46.2 (<0.001)	86.0 (<0.001)	23.8 (<0.001)
Plan C	75.1 (0.001)	99.5 (0.064)	55.8 (0.533)
Plan D	74.9 (<0.001)	106.0 (0.088)	52.3 (0.231)
Plan E	66.9 (0.002)	92.6 (0.044)	56.4 (0.618)
Plan F	46.2 (<0.001)	96.2 (<0.041)	54.3 (0.454)
Other	74.2 (<0.001)	103.7 (0.053)	58.8 (0.538)
Medicare			
Fee-for-service	89.9 (0.013)	121.4 (0.873)	69.6 (0.324)
Managed care	85.7 (0.130)	159.7 (<0.001)	70.1 (0.625)
Number of Observations	2042	2220	902

Table 6:
Panel A
Effects of Demographic Variables on Physician Volume

The table below records the predicted physician volumes broken out by breast cancer surgery, colorectal cancer surgery, and gynecological cancer surgery for different values of the demographic control variables. (See footnotes 5-7 for more precise definitions of the diseases and surgeries.) The number in parentheses is the p-value of the coefficient of the demographic control in the regression analysis described in the text. Physician volume is the number of procedures performed by the physicians including those that were not performed for a cancer diagnosis. The sample includes only those patients covered by private insurance and Medicare, thus eliminating patients covered by Medicaid, Free Care, other government program, and patients paying themselves. The demographic controls are race, log of age, log of median income in the patient's zip code, and the log distance to the closest of the 10 highest volume hospitals performing the procedure.

Demographic Variable	Breast Cancer Surgery	Colorectal Cancer Surgery	Gynecologic Cancer Surgery
Income			
1 st. dev. below mean	13.8	16.1	17.0
1 st. dev. above mean	16.9	17.9	25.0
	(<0.001)	(<0.001)	(<0.001)
Age			
1 st. dev. below mean	17.8	17.9	22.3
1 st. dev. above mean	12.9	16.1	19.6
	(<0.001)	(0.005)	(0.0189)
Race			
African-American	14.2	14.8	30.1
White	15.5	18.3	19.2
	(0.557)	(0.007)	(0.049)
Dist. to. High. Vol. Hosp.			
1 st. dev. below mean	15.4	18.2	19.8
1 st. dev. Above mean	15.3	15.8	22.2
	(0.824)	(0.001)	(0.265)
Number of Observations	2042	2220	902

Table 6:
Panel B
Effect of Demographic Variables on Hospital Volume

The table below records the predicted hospital volumes broken out by breast cancer surgery, colorectal cancer surgery, and gynecological cancer surgery for different values of the demographic control variables. (See footnotes 5-7 for more precise definitions of the diseases and surgeries.) The number in parentheses is the p-value of the coefficient of the demographic control in the regression analysis described in the text. Physician volume is the number of procedures performed by the physicians including those that were not performed for a cancer diagnosis. The sample includes only those patients covered by private insurance and Medicare, thus eliminating patients covered by Medicaid, Free Care, other government program, and patients paying themselves. The demographic controls are race, log of age, log of median income in the patient's zip code, and the log distance to the closest of the 10 highest volume hospitals performing the procedure.

Demographic Variable	Breast Cancer Surgery	Colorectal Cancer Surgery	Gynecologic Cancer Surgery
Income			
1 st. dev. below mean	80.5	110.0	60.7
1 st dev. above mean	103.3	128.4	69.5
	(<0.001)	(<0.001)	(0.024)
Age			
1 st. dev. below mean	102.5	127.4	70.4
1 st. dev. above mean	81.3	111.0	59.8
	(<0.001)	(<0.001)	(0.050)
Race			
African-American	148.6	131.9	73.6
White	88.3	129.2	65.6
	(0.002)	(0.795)	(0.573)
Dist. to. High Vol. Hosp.			
1 st. dev. below mean	98.0	137.3	68.6
1 st. dev. above mean	85.8	101.1	61.6
	(<0.001)	(<0.001)	(0.086)
Number of Observations	2042	2220	902

References

Carlisle, D. et. al. (1992), "HMO vs Fee-for-Service Care of Older Patients with Acute Myocardial Infarction," *American Journal of Public Health*, pp. 1626-1630.

Cutler, D., M. McClellan, and J. Newhouse (1997), "Prices and Production in Managed Care Insurance," Harvard University, working paper.

Feldman, S., B. Harlow, and D. Scharfstein (1997), "The Relationship between Surgical Volume and Complications, Length of Stay, and Inpatient Charges for Patients Undergoing Abdominal Hysterectomy," unpublished paper.

Hannan, E. et. al. (1997), "Coronary Angioplasty Volume-Outcome Relationships for Hospitals and Cardiologists," *Journal of the American Medical Association*, March 19, pp. 892-898.

Laffel, G., A. Barnett, S. Finkelstein, and M. Kaye, "The Relation between Experience and Outcome in Heart Transplantation," *New England Journal of Medicine*, Oct. 22, pp. 1220-1225.

Luft, H. et. al. (1990). *Hospital Volume, Physician Volume, and Patient Outcomes: Assessing the Evidence,* Ann Arbor, MI: Health Administration Press Perspectives.

McClellan, M. and J. Skinner (1997), "The Incidence of Medicare," National Bureau of Economic Research, working paper no. 6013.

Miller, R. and H. Luft (1997), "Managed Care Performance: Is Quality of Care Better or Worse?" *Health Affairs*, September/October, pp. 7-25.

Rechtin, S. and B. Brown (1990), "Management of Colorectal Cancer in Medicare Health Maintenance Organizations," *Journal of General Internal Medicine*, March/April, pp. 110-114.

Rechtin, S. and B. Brown (1991a), "Elderly Patients with Congestive Heart Failure Under Prepaid Care," *The American Journal of Medicine*, February, pp. 236-242.

Rechtin, S. and J. Preston (1991b), "The Effects of Cost Containment on the Care of Elderly Diabetics," *Archives of Internal Medicine*, November, pp. 2244-2248.

Rechtin, S. et. al. (1992), "How the Elderly Fare in HMOs: Outcomes from the Medicare Competition Demonstrations," *Health Services Research*, December, pp. 652-658.

White, H. (1980), "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," Econometrica, pp. 817-30.

Yelin, E., L. Criswell and P. Feigenbaum (1996), "Health Care Utilization and Outcomes Among Persons with Rheumatoid Arthtritis in Fee-for-Service and Prepaid Group Practices," *Journal of the American Medical Association*, October 2, pp. 1048-1053.

Young, G. and B. Cohen (1991), “Inequities in Hospital Care, the Massachusetts Experience,” *Inquiry*, Fall, pp. 255-262.