Profiling Resource Use by Primary-Care Practices: Managed Medicare Implications

Stephen T. Parente, Ph.D., Jonathan P. Weiner, Dr.P.H., Deborah W. Garnick, Sc.D., Jinnet Fowles, Ph.D., Ann G. Lawthers, Sc.D., and R. Heather Palmer, M.D.

Variations in elderly Medicare beneficiaries' health service use are examined using a 100-percent sample of fee-for-service (FFS) claims data from Alabama, Iowa, and Maryland. Provider specialty, group practice type, practice size, and location are found to be significant factors affecting hospital and ambulatory care utilization and cost, after controlling for patient and regional characteristics. These results provide insights into utilization and cost expectations from different types of primary-care gatekeepers as the Medicare managed care market develops.

INTRODUCTION

In the near future, the proportion of Medicare beneficiaries enrolled in managed care plans is likely to grow from the 10 percent enrolled in 1995 (Health Care Financing Administration, 1996) to at least 50 percent or more. Private health plans will need to be developed and expanded to accommodate the continuing growth in this market. Designing a managed care plan is a complex task, particularly if it is to serve the elderly (Blankenau, 1993; Kissick, 1993). Government decisionmakers, private insurers, and providers all need information to plan and evaluate changes to Medicare. What data can they use to examine changes in health care use under a reorganized delivery system? What information will health plans need to identify cost-effective practices, control inappropriate service use, and encourage preventive services? Can evidence gleaned from the current huge FFS program be valuable to the designers of the new managed Medicare? The evidence we provide in this article helps meet these needs.

This analysis demonstrates the feasibility of developing a comprehensive profile of Medicare patient care use and cost for office-based primary-care practices. Using claims data from three States, we generate practice profiles of the utilization and costs of beneficiaries who receive the majority of their primary-care from a single provider, in essence a "voluntary" (i.e., non-mandatory) gatekeeper. Although the practices we profile are not formal managed care gatekeepers, we assume that they behave as the patient's agent and medical care manager. We recognize that some beneficiaries may not choose to regularly consult a primary-care physician, but our previous research has shown that even under FFS, most Medicare beneficiaries do rely on a single primary-care physician for the majority of their ambulatory care (Garnick et al., 1994; Weiner et al., 1995; Parente et al., 1995).

This work was completed as part of as part of the Health Care Financing Administration (HCFA) project to Develop and Evaluate Methods to Promote Ambulatory Care Quality (DEMPAQ) under subcontract to the Delmarva Foundation for Medical Care, PRO Contract Modification Number 500-89-0624. Stephen T. Parente is with the Project HOPE Center for Health Affairs and the Department of Health Policy and Management, Johns Hopkins University; Jonathan P. Weiner is with the Department of Health Policy and Management, Johns Hopkins University; Deborah W. Garnick is with the Institute for Health Policy, Heller Graduate School, Brandeis University; Jinnet Fowles is with the Park Nicollet Medical Foundation; and Ann G. Lawthers and R. Heather Palmer are with the Center for Quality of Care Research and Education, Harvard School of Public Health. The opinions expressed in this article are those of the authors and do not necessarily reflect the views of the Project HOPE Center for Health Affairs, The Johns Hopkins University, Brandeis University, the Park Nicollet Medical Foundation, Harvard School of Public Health, the Delmarva Foundation for Medical Care, or HCFA.

Examining patient care managed by primary-care physicians is not a new area of research. Many studies have demonstrated variation in health service use and expenditures. Wennberg and Gittlesohn's (1973) pioneering research in population-based variations in health service delivery has been followed by subsequent investigations focusing on hospital services (Chassin et al., 1986; Gittlesohn and Powe, 1995), ambulatory services (Kelman and Thomas, 1988; Stuart and Steinwachs, 1993; Weiner et al., 1996), physician services (Stano and Folland, 1988; Hartley et al., 1987; Greenfield et al., 1992; Welch, Miller, and Welch, 1994), specialty differences (Kravitz et al., 1992), quality of care (Weiner et al., 1995), primary-care providers (Greenwald et al., 1984), and office-based practices (Cherkin et al., 1987).

The provider profile is a practical analytic tool produced, in large part, by advances in health services research. These profiles provide managed care plans with information to improve the efficiency and quality of the care that is delivered (Physician Payment Review Commission, 1992; Lasker, Shapiro, and Tucker, 1992; Garnick et al., 1994). Creating practice profiles from existing public use data sources can provide valuable strategic information to health plans and policymakers as the Medicare managed care market develops.

This study builds upon previous variations research. Specifically, we identify the practice characteristics of office-based primary-care physicians and group practices that are most likely to be associated with significant differences in Medicare beneficiaries' health service use and cost. This type of office-based analysis has yet to be attempted on Medicare's new National Claims History file (NCHF) data base. Although other studies have taken a similar approach by analyzing claims data, this is the first study to examine cross-State variation in office-based practices using a 100-percent sample of a patient population during an entire year of service. Moreover, this is one of the first studies to demonstrate the potential of using Medicare claims data to comprehensively profile the inpatient and ambulatory service use and expenditures of beneficiaries from the perspective of their usual primary-care source.

STUDY HYPOTHESES

Four study hypotheses were developed to guide our empirical analysis. These hypotheses are offered to narrow the scope of our analysis to issues that are likely to be relevant for an evolving Medicare managed care market.

Hypothesis One: Primary-care specialty differences exist. This hypothesis is based on the assumption that different primary physician specialties have distinct preferences in their medical management of a patient's case. Evidence of specialty differences in resource use will be valuable knowledge to managed care plans as they begin to extend (or start) the development of their provider panels for their Medicare products.

Hypothesis Two: Different types of group practices will have different patterns of resource use. Further, multispecialty group practices may achieve sufficient economies of scale to be less costly than other group practices or solo practitioners. Managed care plans seeking to develop and maintain efficient provider panels will want to know if group practices can manage a Medicare patient's resource use more efficiently than solo practitioners.

Hypothesis Three: Physicians practicing in rural regions will have lower costs than their colleagues in metropolitan communities. Primary-care physicians in rural communities may have limited opportunities to refer their patients to the same range of providers and services available in nonrural areas. As a result, metropolitan practices are likely to be associated with higher levels of utilization and expenditures, because demand has a greater likelihood of being satisfied if the supply of providers is less limited. Managed care plans entering the Medicare market will need to know the extent of use and cost differences between rural and urban markets, particularly if utilization in rural areas may be below an acceptable standard of care for adequate access to health care providers.

Hypothesis Four: Patient case-mix factors will have significant effects on the need for resources. The range of clinical conditions is assumed to be far more diverse in the population over 65 years of age than the under-65 population, simply because multiple morbidities are more common among the aged. Managed care plans have a large interest in finding a suitable actuarial adjustment mechanism to control for case mix. The results used to test this hypothesis are likely to be useful for plans setting provider payment rates and defining quality-improvement strategies.

We test these study hypotheses explicitly using the results of our multivariate statistical analysis.

DATA

We used claims data from HCFA's NCHF for services provided from July 1, 1990, to June 30, 1991, for 100 percent of the Medicare beneficiaries 65 years of age or over residing in Alabama, Iowa, and Maryland. The NCHF provides encounter data describing the patterns of care for the States' beneficiaries, regardless of whether a patient traveled out of State (e.g., to spend the winter in Florida). These three States were chosen because they were the focus of the HCFA DEMPAQ initiative. The DEMPAQ project examined the methods and costs of using claims and charts data to examine ambulatory care quality (Lawthers et al., 1993). The medical provider organizations in these three States offered to play an active role in the evaluation of the DEMPAQ project's data sources and results. As a result, the methods used to identify primary-care sources as well as our resource use measures were validated for usefulness and accuracy by the medical societies of the three States profiled (Delmarva Foundation for Medical Care, Inc., 1993).

The three States profiled represent significantly different regions of the country. Although these States are not truly representative of all regions in the continental United States (e.g., the Southwest or the Pacific Northwest), they are representative of regions with greater proportions of Medicare beneficiaries (Health Care Financing Administration, 1995).

Several beneficiary groups were excluded from the study population to eliminate possible confounding factors affecting our results. All beneficiaries participating in Medicare health maintenance organizations (HMOs) were removed from the study population because we could not measure their health service use or costs. This decision is estimated to have excluded 1.2 percent of the beneficiaries in Maryland, 3.0 percent of beneficiaries in Iowa, and 0.85 percent of beneficiaries in Alabama (Health Care Financing Administration, 1992). We also removed any beneficiary who spent more than 3 consecutive months in a nursing home or other institutional setting. These institutionalized beneficiaries were identified using the place-of-service indicators found in the claims. The remaining beneficiaries in the study population were 65 years of age or over, continually enrolled in FFS Medicare, and not institutionalized.

By removing the institutionalized population, we excluded a large segment of the beneficiaries who were dually eligible for

Medicare and Medicaid benefits. Many of the institutionalized patients were being treated in long-term-care settings paid for by Medicaid. During the development of our analytic files, we decided not to identify the non-institutionalized dually eligible beneficiary population because of a data limitation in our original beneficiary data base that prevented accurate identification of the dually eligible population. This decision was also influenced by the DEMPAQ goal of evaluating ambulatory care use and quality given the patient's health status and the provider's practice characteristics. If we found practices with a larger share of dually eligible beneficiaries that were more likely to have higher patient costs, it is unclear how peer review organizations would act on these findings.

We constructed a series of analytic files from claims data in three steps: (1) define a primary-care practice as the unit of observation; (2) specify practice covariates for multivariate analysis; and (3) develop resource-use measures.

Define the Unit of Observation

The primary-care practice is the unit of observation in this study. These practices are defined by applying the primary-care source (PCS) algorithm we developed as part of the DEMPAQ project (Delmarva Foundation for Medical Care, Inc., 1993; Lawthers et al., 1993). The PCS algorithm is an application of the usual-source-of-care concept (Kasper, 1987; Kelman and Thomas, 1988; Franks, Nutting, and Clancy, 1993), where each beneficiary was assigned to the primary-care physician who provided more care than any other primary-care physician.

Using only claims for face-to-face services, the primary-care physician associated with the majority of services to a single patient was designated as that patient's PCS. A face-to-face medical encounter is defined as an office-based medical procedure for which the physician must physically interact with the patient. This type of encounter would include physician office visits, minor surgical procedures, and diagnostic procedures. Pathology and radiology services performed by another provider who has no contact with the patient are excluded using the face-to-face encounter criteria.

In the case of a tie between two primary-care physicians, total charges were used to assign the PCS. In situations in which a group practice was listed as the provider of service instead of a physician, we designated the group as the patient's PCS, if the group practice had a majority of primary-care physician affiliates. The composition of the group practice was assessed in a separate analysis by matching the claims files with provider files supplied by Medicare carriers.

Only PCSs seeing at least 25 Medicare patients and providing at least 2 medical visits during each quarter of the study period were retained in the study population. This decision was motivated by discussions with clinicians about the appropriate minimum size of a provider's practice in order to have sufficient continuous experience with elderly patients. Approximately 30 percent of the initial population PCS of 4,266 practices (across the three States) were discarded using the minimum-practice-size criteria.

The PCS algorithm was developed with the assumption that Medicare beneficiaries seek primary-care physicians as if the beneficiaries had participated in a managed care plan with a voluntary gatekeeper system. To validate this assumption, we conducted a series of sensitivity analyses to test what proportion of Medicare beneficiaries received a majority of their outpatient services from a primary-care physician. Of the 389,765 beneficiaries in Maryland, 68 percent were assigned to a PCS who provided approximately 87.6 percent of their primary-care vis-

Table 1

Percent of Study Patients with Selected Characteristics, by State: 1990-91

Characteristic	Alabama	Iowa	Maryland
PCS Specialty		Percent	
General or Family Practice, Solo	32.9	30.2	19.6
General or Family Practice, Group	6.9	16.2	4.1
General Practice or Internal Medicine, Solo	20.3	11.7	43.1
Internal Medicine, Group	12.5	8.6	13.5
Multispecialty Group	6.2	9.8	4.4
Primary-Care Group	21.2	23.5	15.3
PCS Region			
Metropolitan	61.3	35.3	88.2
Non-Metropolitan	38.7	64.7	11.8
PCS Practice Size			
Above 70th Percentile	69.5	74.6	47.5
Between 30th and 70th Percentiles	25.4	21.0	40.4
Below 30th Percentile	5.1	4.4	12.2
Patient Age			
65-74 Years	56.7	52.4	59.3
75-84 Years	34.9	36.2	33.1
85 Years or Over	8.4	11.5	7.7
Patient Gender			
Male	35.9	37.8	36.8
Female	64.1	62.2	63.2
Number of Medical Comorbidities[1]			
0-1	9.5	9.9	14.5
2-3	29.1	28.6	35.8
4-5	27.8	27.1	26.7
6-9	27.8	28.1	20.2
10 or More	5.7	6.3	2.9
Number	244,479	244,666	239,036

[1]Based on the Ambulatory Diagnostic Group clusters of the Johns Hopkins Ambulatory Care Group case-mix system (Weiner et al., 1991).

NOTE: PCS is primary-care source.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the National Claims History file, July 1, 1990-June 30, 1991; data analysis by Parente, S.T., Weiner, J.P., Granick, D.W., et al., 1996.

its. We found slightly higher assignment rates associated with beneficiaries in Iowa (73 percent) and Alabama (72 percent). The one-third of beneficiaries who could not be assigned a PCS had considerably less contact with the health system (e.g., one or two non-primary-care visits in a year). Consequently, we believe the PCS algorithm is a good approximation of a gatekeeper model for the beneficiaries who make extensive use of health services provided by Medicare.

Develop Profiling Variables

Table 1 describes the study population after each beneficiary included in the study population was assigned a PCS. The table presents the proportion and size of each State's population and its practice and case-mix characteristics. A description of these variables follows.

PCS Practice Type

Using provider files provided by each State's Medicare carrier, we identify primary-care physicians (e.g., general practice, family practice, internal medicine), using the provider's unique physician identifier, a group practice indicator, a provider tax identification code, and the Medicare carrier's provider identification. Although we recognize that general and family practice (GFP) physicians have different medical management styles (Cherkin et al., 1987; Linn et al., 1984), we chose to combine these two specialties because of weak representation of general practitioners in the sample. As a result, there are only two specialty categories: internal medicine and GFP. The 12 physicians specializing in osteopathic medicine are included in the sample as internists. Specialist usual sources of care (e.g., cardiologists) were not included as primary-care sources even though they may be a better agent for patients with chronic illnesses. This decision was guided by our intent to examine the impact of primary-care specialties that commonly take the role of gatekeeper in a managed care plan. A sensitivity test showed that including specialists as usual care sources increased the proportion of "assigned" beneficiaries by slightly less than 5 percent.

We use the provider files to define six practice types:

- GFP, solo.
- GFP, group.
- Internal medicine, solo.
- Internal medicine, group.
- All primary-care specialties group.[1]
- Majority primary-care specialties group.[2]

PCS Practice Size

We identify the Medicare beneficiary practice size of the PCS population by defining the 30th and 70th percentiles as thresholds for defining small and large practices, respectively. For the multivariate analysis, we develop practice-size regressors that are relative to whether the PCS was a solo practitioner or group practice because group practices are generally larger. Otherwise, large-practice effects would tend to be correlated with group-practice effects. As a result, the 30th percentile for group practices is 155 patients, and the 70th percentile is 458 patients. Similarly, the 30th percentile for solo practices is 96 patients, and the 70th percentile is 224 patients. These thresholds apply to the entire study population and are not State-specific.

PCS Practice Location

A practice is identified as either metropolitan or rural. This distinction is based on the ZIP Code of the practices listed in the provider files. ZIP Codes are mapped into metropolitan statistical areas (MSAs); if the practice ZIP Code is within an MSA, then practice location is defined as metropolitan.

PCS Patient Age and Gender

Using beneficiary eligibility information, we extract patient age and gender information to develop patient-level categorical variables. In Table 1, patient age is delineated into three categories: 65-74 years, 75-84 years, and 85 years or over. For the regression analysis, patient age was represented as the mean patient age of a PCS's practice. Patient gender is represented by three categories to which the practice can be assigned; the provider's female case mix may be either below the 30th percentile, above the 70th percentile, or between these two thresholds. This approach was used because of a small variance in distribution of the share of female patients. Using percent-female share of the practice as a regressor produced erroneous results in several different specifications of the empirical model. This approach was chosen to meet the goal of accounting for the impact of gender, while taking into account the distribution of the data.

[1]All primary-care specialties group is defined as a group practice consisting only of physicians we identify as primary-care, including GFP, internal medicine, and osteopathic medicine.

[2]Majority primary-care specialties group is defined as multispecialty group practices in which at least 50 percent of the physicians in the group have a specialty of primary care, as defined in the study.

PCS Patient Illness Burden

We describe the PCS practice's illness burden by aggregating patient information to the provider level and by counting the number of unique morbidity categories. Morbidity categories are identified using Ambulatory Diagnosis Group (ADG) designations of the Johns Hopkins Ambulatory Care Groups (ACGs) algorithm. The ADGs are designed to explicitly measure the extent of a patient's comorbid state or illness burden (Weiner et al., 1991). In our multivariate analysis, patient illness burden is represented by the mean number of comorbid states (defined as the number of ADGs) of a PCS's patient population.[3] Ideally, we would use ADG-specific dummy variables to represent the patient's illness burden. However, because the unit of analysis is the PCS, the use of categorical variables was not an option. One can also interpret the mean number of patient comorbid states in a PCS's practice as an index of that practice's illness burden.

There are several differences in provider characteristics among the States, most notably between Maryland and the other two States, Iowa and Alabama. Maryland has a greater proportion of internists (56.5 percent) than Iowa (20.2 percent) or Alabama (32.8 percent). Conversely, Iowa and Alabama have a larger share of general practice and group practice PCSs. Nearly 90 percent of Maryland beneficiaries receive their care from PCSs located in metropolitan regions. In contrast, only 35 percent of Iowa beneficiaries receive their care from metropolitan PCSs. With respect to practice size, Maryland has the largest practices, and Iowa has the smallest. Given the high population density of Maryland in comparison to Iowa and Alabama, these findings are to be expected.

Among the patient case-mix characteristics, there are few noticeable differences across all three States. The only major difference is that Maryland practices appear to have fewer patients with high numbers of comorbidities than Iowa and Alabama. Two explanations are possible: Maryland's elderly population is healthier, or Maryland providers code diagnoses differently than the other two States' providers. The relatively younger population in Maryland clearly supports the first explanation. The second explanation may also be valid because Maryland hospitals' Medicare claims are paid through an all-payer system, while the other States' hospitals are paid using the diagnosis-related group (DRG) payment system. However, hospitals are required to provide identical diagnosis-code detail for DRG groupings to determine case-mix differences among the hospitals. As a result, it is uncertain whether Maryland hospitals have the same "upcoding" incentive to maximize DRG payment as Iowa and Alabama hospitals. Furthermore, there should be few State-specific differences in diagnosis codes reported on Part B claims for ambulatory services.

Develop Resource-Use Measures

Table 2 provides the means and variances of the ambulatory and inpatient dependent variables used in our analysis. State-specific and total practice estimates are presented. The unit of analysis for these measures is the practice of the PCS. Across the three States, 2,973 practices have been linked to 728,181 unique beneficiaries resulting in an overall beneficiary-to-practice ratio of nearly 245

[3]Our final empirical model was developed after several different specifications were tested to account for patient illness burden, including the use of ACGs. ACGs are developed from ADGs and include patient gender and age attributes as well as characteristics that describe the patient's condition as acute or chronic. When the ACG system was used, the ACGs with the largest impact were those associated with ADGs. To estimate the independent effects of age and gender, we chose to use a combination of ADGs, age, and gender attributes to characterize the case mix of a practice.

patients per practice. Of the three States, Maryland has the largest PCS population (1,300 practices), followed by Alabama (865) and Iowa (808). Using the beneficiary sample size information from Table 1, the beneficiary-to-PCS ratio is highest in Iowa (302.8) and lowest in Maryland (183.87), with Alabama's ratio falling between the two States (282.6).

Three different measures of hospital utilization were developed:

- Admissions per patient provides an indication of each practice's use of inpatient services.
- Average length of stay (ALOS) measures to what extent practices discharge patients earlier or later than others.
- Average inpatient visits per admission by any provider serves as a gauge for how much a patient is monitored once the patient is admitted to an inpatient facility.

Four measures of ambulatory care utilization were developed:

- Total visits reflects the total number of clinical consultations the patient received.
- Non-PCS visits is the number of visits provided by any specialists or primary-care physicians other than the PCS. This measure gives an estimate of the number of referrals to other providers that would occur if the PCS were a true gatekeeper. The difference between these two measures is the average number of visits a PCS practice provides to assigned patients. Maryland physicians have the highest referral rate, with an average of 3.35 non-PCS visits per patient. However, Maryland also has the highest total visit rate, demonstrating that the additional referrals in this State are complements to visits provided by PCSs rather than substitutes.
- Laboratory and imaging service utilization measures are based on service counts of a specific range of Medicare procedure codes—the HCFA Common Procedure Coding System.

Estimates of the costs used to treat a PCS's patients, defined as resource units (RUs) were generated to account for regional differences in labor and capital

Table 2

Means and Standard Deviations of State-Specific Health Care Use Measures, by State

Measure	Alabama Mean	Alabama Standard Deviation	Iowa Mean	Iowa Standard Deviation	Maryland Mean	Maryland Standard Deviation
Number of PCS Practices	865	—	808	—	1,300	—
Hospital Services						
Admissions per Primary Patient	0.45	0.24	0.37	0.22	0.41	0.25
Average Length of Stay	10.46	4.82	8.45	4.11	11.46	6.73
Number of Inpatient Visits	4.57	3.19	3.12	2.37	3.96	3.39
Ambulatory Services per Patient						
Total Number of Visits	7.04	1.70	6.59	1.79	7.52	1.93
Non-PCS Visits	2.75	1.08	2.56	1.04	3.35	1.17
Number of Laboratory Tests	11.13	6.40	9.57	5.95	8.43	5.77
Number of Imaging Services	3.02	1.21	2.90	1.37	2.74	1.20
Resource Units						
Total Resource Use	$4,489	2,204	$3,248	1,716	$5,308	2,851
Ambulatory Resource Use	$1,292	689	$1,180	741	$1,828	1,021
Part A Inpatient Resource Use	$2,865	1,588	$1,852	1,065	$2,983	1,858
Part B Inpatient Resource Use	$159	89	$124	67	$300	186

NOTE: PCS is primary-care source.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the National Claims History file, July 1, 1990-June 30, 1991; data analysis by Parente, S.T., Weiner, J.P., Garnick, D.W., et al., 1996.

input prices. The RUs acted as measures of resource use and were derived from two sources: the financial data from the claims records and the resource-based relative value scale (RBRVS) system developed by HCFA for Medicare Part B payment (*Federal Register*, 1991). Although we chose to use the RBRVS system to provide an approximation of the true cost to provide a service, application of the system did not include the use of the geographic practice cost indices.

Our initial RU calculations did not appear to reflect actual State-specific per capita Medicare program expenditures. As a result, we calibrated each States' PCS's practice RU calculations to each State's relative actual program expenditures by patient. Our rationale for adjusting the RUs was to control for known State-specific differences in per capita expenditures. Although we believe that our RU values are fair expenditure estimates reflecting the relative costs of different medical services for this type of research application, interpretation of the State-specific dummy variables as indications of each State's relative efficiency may be inappropriate. Further, we strongly caution against using the RUs for actuarial or accounting purposes.

Descriptions of four RU variables follow. All of the following variables described are practice-specific per patient averages.

Ambulatory Resource Use

Ambulatory services are defined as any Part B procedure that was provided outside of an inpatient setting. To create this measure, the RBRVS weights were multiplied by a conversion factor of $32 at the procedure level. In procedure-specific cases where there was no RBRVS weight, we constructed an estimated payment for the procedure by taking an average of all allowed charges associated with that procedure.

Part A Inpatient Resource Use

DRGs were used as inpatient procedure codes to develop common admission-specific payment levels across all PCS practices. For each DRG, a mean allowed charge was calculated based on claims data. This DRG-specific estimate of expenditures was aggregated to both the patient and physician levels to create a PCS-specific value of Part A inpatient resource use.

Part B Inpatient Resource Use

For each hospitalized patient, we summarized the Part B services provided during the patient's hospital stay. To create this variable, Part B services that were provided during a hospital admission were summarized at the procedure-code level for each patient and multiplied by the resource use associated with the procedure, using the RBRVS or the average allowed charge. Part A inpatient claims were used to identify the time interval (the dates of service between the admission and discharge) of admission, so that Part B claims provided to the patient during the same interval could be summarized.

Total Resource Use

Total resource use reflects a sum of all Part A and Part B expenditures summarized by PCS-specific per patient averages. In effect, the Part A and Part B resource use components already described could be summed together to calculate this measure. As shown in Table 5, the means of all of the ambulatory RUs, Part A inpatient RUs, and Part B inpatient RUs do not sum to the total RUs. This is because of a missing component associated with a subset of services provided in a hospital setting as a Part B benefit.

METHODS

We use ordinary least-squares regression methods to model the extent to which PCS practice characteristics and patients' case mix affect the use of inpatient and ambulatory resources. The unit of observation used for the regression was the primary-care source. All of the variables presented in Table 2 were employed as dependent variables in a series of regressions. A common set of independent variables reflecting the PCS practice characteristics is regressed upon these dependent variables. All of the gatekeeper practice characteristics including specialty, practice type, practice size, and practice location are represented as categorical dummy variables.

Several different specifications of the model were developed. To correct for the skewed distribution of charge data, a log transformation of the dependent variables was used. However, because the dependent variables were already practice-level means, the tightening of the distribution from using the log transformation did not provide much of an improvement in either the significance of the parameter estimates or the fit of the model. Consequently, the regressions providing the final results of the analysis use untransformed dependent variables to facilitate the interpretation of the parameter estimates.

RESULTS

The results of regressing PCS practice characteristics on a set of inpatient utilization measures (Table 3), outpatient utilization measures (Table 4), and resource-use measures (Table 5) are presented. Table 5 presents the impact of these variables on resource use in terms of dollar units. All dependent (outcome) variables are PCS-specific per patient averages. For example, the dependent variables for ambulatory services include total visits per patient, non-PCS visits per patient, and so on. In each table, the same set of regressors is used to compare how different practice characteristics affect ambulatory as well as inpatient service use. A summary of the empirical findings that support or refute the study hypotheses follows.

Primary-care specialty differences exist. After accounting for case mix, internists provide more resource-intensive care than other physicians. Internists generally appear to admit their patients to hospitals more often than GFP physicians and are associated with higher per patient utilization of all ambulatory services. In particular, internal medicine PCSs are associated with a larger number of visits to all providers (0.5 visits more for solo internists, 0.8 more for group practice internists) than GFP physicians. As for expenditures, internists manage their patients with more resources than do GFP physicians. Compared with the solo family practice reference category, solo internists and group internists manage their patients with a greater total per capita cost of $1,347 and $2,157, respectively, even after taking case mix into account. This is an interesting finding because GFP groups, compared with GFP solo practices, have no such significant difference in utilization or resource use.

Different types of group practices have different patterns of resource use. Beneficiaries treated by multispecialty groups have lengths of stay of about 1 day longer than solo family practices. Internal medicine group practices provide a greater number of ambulatory services than any other PCS practice type. Multispecialty group practices are associated with the highest inpatient (both Part A and Part B) per capita expenditures. However, internal medicine group practices are associated with the most expensive patients with per patient expenditures $2,157 higher than a solo family practice.

Table 3
Multivariate Analysis of Hospital Service Use

Independent Variables	Admissions per Patient	Average Length of Stay	Inpatient Visits per Admitted Patient
		Dependent Variables	
		Average of All Patients for Each Practice	
Intercept	***-2.02	***-21.31	***-29.47
PCS Specialty[1]			
Internal Medicine, Solo	***0.13	0.29	***1.29
General or Family Practice, Group	0.02	-0.23	0.26
Internal Medicine, Group	***0.18	0.70	***2.32
Multispecialty Group	***0.20	**0.97	***2.18
Primary-Care Group	**0.06	0.52	*0.44
Metropolitan Region[2]	0.02	***2.03	***1.02
PCS Practice Size[3]			
Above 70th Percentile	***-0.04	-0.14	***-0.45
Below 30th Percentile	***0.06	*0.57	***0.78
PCS Practice Mean Age	***0.03	***0.39	***0.39
PCS Female Caseload[3]			
Above 70th Percentile	***-0.04	**0.71	***-0.41
Below 30th Percentile	***0.07	0.27	***0.68
PCS Practice Mean Number of Comorbidities per Patient	0.01	-0.15	***0.33
State of Practice[4]			
Alabama	***0.11	***1.82	***1.67
Maryland	*0.03	***2.15	***0.61
Adjusted R^2	0.19	0.08	0.19
Mean	0.41	10.35	3.91

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

[1] Reference group is general or family practice, solo.
[2] Reference group is rural.
[3] Reference group is 30th to 70th percentile.
[4] Reference group is Iowa.

NOTE: PCS is primary-care source. N=2,972.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the National Claims History file, July 1, 1990-June 30, 1991; data analysis by Parente, S.T., Weiner, J.P., Garnick, D.W., et al., 1996.

Physicians practicing in rural regions have lower costs than their colleagues in metropolitan communities. Compared with rural practices, metropolitan practices are more costly ($259 per patient) and are associated with more hospital days (2.0 on average). Patients associated with a metropolitan practice are more likely to receive referral visits as well as laboratory services than beneficiaries seen by a rural PCS. This finding may be explained by the greater supply of specialty care providers in metropolitan areas.

Related to the third hypothesis (see the section on "Study Hypotheses") is the finding of significant differences in health service use by State. Maryland patients receive 1.5 more visits per capita than those in Iowa. Alabama's hospital service use stands out as well. On average, Alabama's PCSs are associated with an increased admission rate (0.1). Also, Alabama practices complete 1.52 more lab tests that Iowa practices.

Patient case-mix factors have significant effects on the need for resources.

Table 4
Multivariate Analysis of Ambulatory Service Use

Independent Variables	Total Visits	Visits to Other Providers	Laboratory Services	Imaging Services
	Dependent Variables			
	Average of All Patients for Each Practice			
Intercept	***9.55	**2.79	-0.77	*2.79
PCS Specialty[1]				
Internal Medicine, Solo	***0.54	***0.57	***2.03	***0.57
General or Family Practice, Group	**-0.31	-0.04	-0.05	0.67
Internal Medicine, Group	***0.70	***0.89	***3.77	***1.02
Multispecialty Group	0.04	***0.74	***1.41	***0.78
Primary-Care Group	*0.30	*0.19	0.58	0.16
Metropolitan Region[2]	**-0.17	***0.23	**0.57	-0.04
PCS Practice Size[3]				
Above 70th Percentile	***-0.26	***-0.24	***-0.97	***-0.19
Below 30th Percentile	***0.26	***0.42	*0.45	0.09
PCS Practice Mean Age	***-0.13	***-0.05	-0.12	*-0.03
PCS Female Caseload[3]				
Above 70th Percentile	0.08	0.01	0.28	0.03
Below 30th Percentile	-0.06	***0.19	-0.12	**0.13
PCS Practice Mean Number of Comorbidities per Patient	***1.33	***0.52	***3.58	***0.44
State of Practice[4]				
Alabama	***0.42	**0.14	***1.52	*0.12
Maryland	***1.47	***0.72	0.02	-0.10
Adjusted R^2	0.42	0.40	0.33	0.18
Mean	7.13	2.96	9.52	2.87

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

[1] Reference group is general or family practice, solo.
[2] Reference group is rural.
[3] Reference group is 30th to 70th percentile.
[4] Reference group is Iowa.

NOTE: PCS is primary-care source. N=2,972.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the National Claims History file, July 1, 1990-June 30, 1991; data analysis by Parente, S.T., Weiner, J.P., Garnick, D.W., et al., 1996.

Consistently throughout Tables 3-5, patient factors are associated with statistically significant coefficients. This result confirms the fourth hypothesis. The older the gatekeeper's case mix, the greater the total resource use. Increasing the mean age of a PCS's practice by 1 year leads to $150 increase in Part A RUs. Thus, a PCS with patients who are, on average, 5 years older than the mean would be treating patients with Part A payments averaging $750 more.

The gender case mix of a PCS's practice appears to be an important determinant of service use and expenditure. For example, if a physician has a practice with the percent of share of female beneficiaries below the 30th percentile, then the provider is associated with a marked increase in admissions per primary patients (0.07). Conversely, if the provider has a greater share of female patients, the average admission per patient is significantly less. Also, a decrease in the proportion of female patients leads to 0.68 more inpatient visits. With regard to resource use, providers with high concentrations of

Table 5
Multivariate Analysis of Hospital and Ambulatory Resource Use

Independent Variables	Total Resource Use	Ambulatory Resource Use	Part A Inpatient Resource Use	Part B Inpatient Services
	Dependent Variables			
	Average of All Patients for Each Practice			
Intercept	***-9,554.1	*2,049.1	***-10,202.0	***-463.2
PCS Specialty[1]				
Internal Medicine, Solo	***1,346.8	***413.9	***831.6	***62.3
General or Family Practice, Group	155.6	2.8	135.6	11.5
Internal Medicine, Group	***2,156.8	***803.4	***1,201.9	***92.6
Multispecialty Group	***2,079.8	***500.4	***1,398.5	***106.3
Primary-Care Group	*356.4	49.3	*278.7	14.2
Metropolitan Region[2]	**259.1	-5.7	***220.7	***30.6
PCS Practice Size[3]				
Above 70th Percentile	***-376.1	***-123.1	***-222.3	**-14.5
Below 30th Percentile	***608.9	***154.0	***404.0	***33.9
PCS Practice Mean Age	***138.9	**-28.9	***149.7	***6.0
PCS Female Caseload[3]				
Above 70th Percentile	***-354.0	*-81.3	***-251.5	**-17.9
Below 30th Percentile	***773.2	***142.4	***572.2	***40.9
PCS Practice Mean Number of Comorbidities per Patient	***274.6	***209.9	31.5	***15.3
State of Practice[4]				
Alabama	***1,378.4	*103.6	***1,145.2	***38.7
Maryland	***1,826.7	***599.4	***957.3	***158.4
Adjusted R^2	0.28	0.25	0.25	0.36
Mean	4,510.0	1,495.9	2,641.1	211.0

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

1 Reference group is general or family practice, solo.
2 Reference group is rural.
3 Reference group is 30th to 70th percentile.
4 Reference group is Iowa.

NOTE: PCS is primary-care source. N=2,972.

SOURCE: Health Care Financing Administration, Bureau of Data Management and Strategy: Data from the National Claims History file, July 1, 1990-June 30, 1991; data analysis by Parente, S.T., Weiner, J.P., Garnick, D.W., et al., 1996.

female patients have less total resource use ($354 less per patient) than practices with a high concentration of male patients ($773 more per patient). One explanation for this finding is that women who live longer than men require less medical care in the aggregate from Medicare providers. Also, women who live longer may be receiving their care in part through the Medicaid program as nursing home patients.

There are several common findings across all ambulatory measures. The patient-condition coefficients indicate that patients who are sicker generally require a significant amount of ambulatory service use. In contrast to most other coefficients, the PCS practice mean-number-of-comorbidities variable clearly has the largest and most significant positive effect on ambulatory case use. For example, if a PCS's average number of comorbidities is one greater than the mean, then patients assigned to that PCS are likely to receive 1.33 more visits, on average. The case-mix coefficients associated with medical conditions are, in most cases, larger than the gender-effect coefficients, although they are not as precise.

As expected, a practice with sicker patients will be more expensive than a practice profile with healthier patients. The findings on practices with older patients make intuitive sense; an older cohort of patients will consume more financial resources than a younger group of patients. In addition, we find the precision and magnitude of the case-mix covariates of sufficient size to assume that we can make general inferences about the efficiencies of different types of practices.

DISCUSSION

Our study offers four interesting results. First, we find evidence to support our assumption that PCS practices are "voluntary gatekeepers," even though at the time of this study, these practices have no such formal relationship with beneficiaries. Given that PCS practices provide almost 90 percent of all primary-care visits to this particular cohort, it is clear that they are de facto already serving a critical role in the care of these patients. On average, nearly 60 percent of all office-based visits (both primary-care and specialty visits) are provided by PCS practices. This constitutes a significant amount of PCS practice contact. Although patient contact may not always translate into patient care coordination, PCS practices with this degree of contact are far more likely to affect treatment than most other provider types, including specialists, emergency departments, and hospitals. We also found the medical provider organizations participating in the DEMPAQ project to support our assumption that PCS practices are acting as gatekeepers. Feedback from a sample of physicians across the three States participating in the DEMPAQ project indicated that providers generally agreed with our definition of PCS. Few of these physicians disputed our assertion that they acted as gatekeepers when they were each given their own practice profiles (Delmarva Foundation for Medical Care, Inc., 1993).

As our second result, we find significant variation in use and cost among different PCS practice types. Internal medicine and group practices are consistently associated with higher per patient resource use. Several explanations are possible. Internists and groups either manage their patients less efficiently than family practitioners, or sicker patients self-select themselves to providers who are likely to provide more intensive services (e.g., more admissions). Some general practitioners do not have hospital privileges. As a result, a portion of the large hospital resource use and total resource differences associated with the solo GFP PCS category may be explained by general practitioners' reduced capacity to admit a patient. A patient needing emergency care is unlikely to be affected by this situation. However, patients with less serious conditions may be less likely to be admitted if they are associated with a GFP PCS.

Third, we find that smaller practices are associated with higher rates of service use and cost. Patients managed by large practices (above the 70th percentile) are associated with less utilization of hospital services. For ambulatory care use, every large-practice coefficient is negative and significant at the $p < 0.001$ level. Small practices are associated with higher ambulatory service utilization. Large practices, with $376 less per patient expenditures than average-size practices, are clearly associated with less resource use than small practices, with a per patient increased expenditure of $609.

This result suggests that patients managed by smaller practices require more intensive treatments. Because smaller practices are associated with greater per capita inpatient visits, it is possible that the treatments are more complex and expensive and, as a consequence, require greater supervision. However, a sensitivity analysis of the relationship between practice case mix and resource use by different practice size provided little evidence that smaller practices were seeing sicker patients. Another explanation may be that small practices are associated with a more costly use of medical care resources. Unfortunately, our data cannot provide any insights into why smaller practices are more resource-intensive than larger ones. Further study of the relationship between practice size and resource use may yield a better explanation for this result.

Fourth, we find patient case-mix characteristics are an important component of profiling Medicare primary-care practices. This finding may not be as interesting as those previously mentioned because previous practice-variation studies have consistently found case mix to be an important determinant of treatment use and cost. However, it is intriguing to see how case mix affects utilization and for what services it does not. For example, laboratory use is not associated with the age or gender composition of a PCS's practice. Also, gender appears to have less effect on ambulatory visits than hospital services. These findings suggest that patient gender may play less of a role in the use of more discretionary and diagnostic procedures (e.g., X-rays) than major therapeutic treatments (e.g., angioplasty) that are likely to require hospitalization.

The interpretation of the significance of patient age is the most intuitive; as people age, their health service use and cost increase. The impact of gender is not as easy to explain. Clearly, males are receiving more medical care than women. This finding was found previously by Ayanian and Epstein (1991) and with respect to procedures provided to treat coronary heart disease. Similar findings have been documented for other procedures including dialysis (Kjellstrand, 1988) and upper gastrointestinal endoscopy (Brook et al., 1990). One possible explanation for this finding relates to the fact that women live longer, on average, and consequently have a greater likelihood of spending the last years of their lives as institutionalized patients. However, because we have excluded institutionalized Medicare patients from our study, this explanation seems less plausible. Another explanation may be that men delay going to a physician's office until they have a significant medical problem, which is costlier than women being seen for a combination of less expensive preventive services and substantial procedures. If true, male health service users would appear to be costlier to treat, on average, than female patients.

Further research in this area would be valuable, given the future demographic picture of an older population. If men are significantly more expensive to care for than women, is it because of patient behavior, provider preferences, or physiological determinants? Given that the relative proportion of elderly males in the population will increase significantly for several decades as the baby-boom population ages, knowledge of the gender differences in elderly aggregate health resource use will be important public policy information to project future Medicare outlays.

Limitations

We address five potential limitations of this study. First, Medicare claims data are an excellent and inexpensive source of information with great breadth, but claims data may not provide enough detail about the patient's true clinical state (Weiner et al., 1995). This limitation may not be as critical for this analysis because the claims system was designed to record service transactions and payments. Although we adjusted for case mix in our empirical model using an advanced methodology, we may not have been able to fully account for differences across providers' case mixes. However, many of the case-mix coefficients were significant, and the change in these variables with respect to the dependent variables generally made intuitive sense. We do not suggest that our method of accounting for case-mix differences captures all cross-practice morbidity differences, but it is suitable when comparing different specialties and group practice types.

The second limitation of the study is our adjustment method for accounting for State-specific differences in resource use. By weighting State-specific measures of resource use, we have controlled for the true impact each State may have on Medicare per capita expenditures. At best, we have captured some of the true resource-use differences by State. At worst, our estimates of each State's impact are not accurate, though we have controlled for the States' effect on the other covariates in our analysis. As a result, interpretations of each State's impact on expenditures should be made with caution. It is important to note that this limitation only affects our estimates of resource use presented in Table 5. The interpretation of each State's impact on hospital and ambulatory service use (as presented in Tables 3 and 4) is not affected.

The third limitation is that our practice-size estimate is based only on Medicare patients and not the true practice size including non-Medicare patients. We make the assumption that practices with a large Medicare patient volume are likely to have large numbers of patients in general. However, we do not know with certainty that this is the case. We include only practices with 25 patients or more in an attempt to profile only practices with significant experience treating elderly patients. Our findings do not reflect the experience of all providers, including those with small Medicare practices. Although the practice styles of providers with fewer than 25 patients could be quite different from those analyzed, they account for a small fraction of the patient care profiled.

The fourth limitation is that some of the specialty-specific differences may be attributable to internists with specialty or subspecialty training. To minimize the possibility that our classification of specialty was erroneous, we chose to identify internists based on the carriers' provider files rather than the self-reported specialty codes reported in the claims. We tested the accuracy of the specialty information by matching a sample of physicians' provider file specialty designations with those reported in American Medical Association (1993) Masterfile and found few differences. We also included a variable in earlier regression analyses indicating whether the PCS was a dual-specialist and found the resulting variable to be insignificant. As a result, we do not believe the aggregate measures of resource use in our empirical analysis should be significantly affected by variation in internist training. However, in the case of less aggregate measures such as imaging and laboratory services, the greater utilization associated with internists we observe may in part be the result of more specialized training.

Our fifth limitation is that we did not profile the resource use of beneficiaries who were not assigned a PCS. If these beneficiaries participated in a managed care plan, they would be assigned a gatekeeper. As a result, our resource-use results should not be used to develop a capitation payment for an HMO, such as HCFA's average adjusted per capita cost. Including patients who were not assigned a PCS may either increase or decrease our reported per capita resource use, depending on the health-service patterns of this population.

Beneficiaries not assigned a PCS may use fewer services than those assigned a PCS. If so, this cohort constitutes a very attractive population for a prospective managed care plan to identify. Of the three States, Maryland was the most costly on a per capita basis. At the same time, Maryland was also the State with the smallest proportion of beneficiaries assigned a PCS. If the non-assigned health service users in Maryland were included, the per capita Maryland resource measures would be smaller, if the unassigned PCS population had low health care costs. However, patients not assigned a PCS may also be high-service users because they are treated mostly by specialists or in acute care settings and have little or no exposure to a primary-care practice. For example, a patient with a serious cardiac condition may develop a long-standing relationship with a cardiologist who acts as the patient's primary contact to obtain treatment directly or referrals for treatment.

IMPLICATIONS

Our results provide three health-policy implications. First, our results suggest that an FFS gatekeeper program may be a viable transition and possibly alternate approach to enrolling the majority of elderly Medicare beneficiaries into managed care. Birmbaum et al. (1991) developed estimates of modest savings (3.8 percent) under a hypothetical "Medicare insured group" in which Medicare patients were managed by primary-care physicians. In addition, Miller and Luft's (1994) finding that staff-model HMOs may, in the long run, achieve only the same degree of savings as less structured managed care programs, such as an FFS gatekeeping or case-manager model, may provide a win for policymakers who want to contain Medicare outlays but are reluctant to mandate the use of HMOs as Federal policy. Because our results indicate that a significant majority of the elderly already have a "voluntary gatekeeper," encouraging the growth of FFS gatekeeper models may be the path of least political resistance to enrolling the majority of Medicare beneficiaries in cost-effective managed care health plans.

Second, it is technically possible to construct office-based practice profiles for FFS Medicare beneficiaries. This development demonstrates the substantial improvements made by HCFA to their inventory of claims data. Health plans seeking to enter the Medicare managed care market can utilize our methods to profile their panel of practices serving Medicare contracts to monitor utilization and cost differences. Profiling primary-care practices acting as gatekeepers will provide vital information for managed care organizations (MCOs) entering the Medicare market, particularly those with the intent to partially rely on some FFS transactions for enrollees to opt out of an existing network of providers.

Many MCOs already complete such analyses to keep their private sector lines of business healthy. Our methods of accounting for patient characteristics permit a straightforward interpretation of the impact of case-mix categories that can be easily used by health plans to negotiate discounts and promote provider efficiency. This approach can easily be extended to profile patient use of additional benefits, such as pharmacy and eyeglass benefits, by adding transaction data for these services to the analysis.

Third, this analysis clearly demonstrates the benefits of using a national claims data base to monitor the association between provider and patient characteristics and health service use and cost. Without legislation requiring Medicare HMOs to provide transaction-level claims data or some equivalent (e.g., episode-of-care data) to HCFA, comprehensive practice profiles of this nature will not be possible. However, many of the staff- and group-model HMOs that have enrolled Medicare beneficiaries would face significant costs providing this data to HCFA if they were mandated to do so because these organizations do not use claims to pay their providers. A proposal by Welch and Welch (1995) would have HCFA offer to pay a portion of the costs of HMOs to provide claims data. The authors' rationale is that the opportunity cost of losing access to FFS Medicare data to track changes in health service use, quality, and outcomes is significant enough to justify HCFA paying for the data.

Several initiatives to collect Medicare encounter data from HMOs have been discussed at HCFA, but none has been put into actual operation. An important consideration in the cost of obtaining HMO claims data is the types of MCOs associated with current and future growth in the Medicare managed care market. Preferred provider organizations (PPOs) and point-of-service (POS) plans largely use claims transactions. These organizations offer greater freedom in provider choice and may be more appealing to senior citizens than staff- or group-model HMOs. For PPOs and POS plans, a mandate or financial incentive to provide claims data to HCFA would be less of a hardship than it would be for other HMOs because these insurers already use claims data. Capitated staff- or group-model HMOs without claims data would need to complete a significant conversion process to meet a mandatory claims-data requirement. Unless adequate provisions are made to secure claims data or their equivalent from participating Medicare MCOs, a substantial loss of information on changes to the health care system will result.

In summary, we demonstrate the feasibility of creating practice profiles of office-based providers serving FFS Medicare beneficiaries. Our methods illustrate the power of using FFS claims to examine systematic differences in health service use and cost. By profiling all implicit gatekeepers for several hundred thousand Medicare beneficiaries residing in three States, we found significant differences in health service resource use by specialty, practice size, and group practice configuration. Our results suggest that family practitioners use fewer resources than internists and multispecialty group practices and that larger practices appear to be less costly than smaller practices, after controlling for practice case mix and metropolitan location.

ACKNOWLEDGMENTS

This work represents one of the products of DEMPAQ. The DEMPAQ research team includes the authors of this article, as well as Jean Edwards and Duc Nguyen, Ph.D., of the Delmarva Foundation for Medical Care in Easton, Maryland. The authors especially thank Paul Elstein, Ph.D., and Peggy Bowen for their facilitation of essential technical and logistical support from HCFA. Special thanks to Nancy McCall, Ph.D., for her advice and consultations. Tom Richards and Paul Chandler of The Johns Hopkins University Health Services Research and Development Center provided excellent programming and systems support.

REFERENCES

American Medical Association: *Socioeconomic Characteristics of Medical Practice.* Chicago. 1993.

Ayanian, J.Z., and Epstein, A.M.: Differences in the Use of Procedures Between Women and Men Hospitalized for Cornonary Heart Disease. *New England Journal of Medicine* 325(4):221-225, 1991.

Birmbaum, H., Holland, S.K., Lenhart, G., et al.: Savings Estimates for a Medicare Insured Group. *Health Care Financing Review* 12(4):39-48, 1991.

Blankenau, R.: Medicare Meets Reform. Integrating Medicare Poses a Puzzle for Reformers. *Hospitals* 67(8):42-44, 1993.

Brook, R.H., Park, R.E., Chassin, M.R., et al.: Predicting the Appropriate Use of Carotid Endarterectomy, Upper Gastrointestinal Endoscopy, and Coronary Angioplasty. *New England Journal of Medicine* 323(17):1173-1177, 1990.

Chassin, M.R., Brook, R., Park, R., et al.: Variation in the Use of Medical and Surgical Services by the Medicare Population. *New England Journal of Medicine* 314(5):285-290, 1986.

Cherkin, D.C., Rosenblatt, R.A., Hart, L.G., et al.: The Use of Medical Resources by Residency-Trained Family Physicians and General Internists: Is There a Difference? *Medical Care* 25(6):455-469, 1987.

Delmarva Foundation for Medical Care, Inc.: *Developing and Evaluating Performance Measures for Ambulatory Care Quality (DEMPAQ)*. Final Report to the Health Care Financing Administration. Easton, MD. November 15, 1993.

Federal Register. Medicare Program: Fee Schedule for Physicians' Services. Vol. 56, No. 108:25863-25965. Office of the Federal Register, National Archives and Records Administration. Washington. U.S. Government Printing Office, June 5, 1991.

Franks, P., Nutting, P.A., and Clancy, C.M.: Health Care Reform, Primary Care, and the Need for Research. *Journal of the American Medical Association* 270(12):1449-1453, 1993.

Garnick, D.W., Fowles, J., Lawthers, A.G., et al.: Focus on Quality: Profiling Physician's Practice Patterns. *Journal of Ambulatory Care Management* 17(3):44-55, 1994.

Gittelsohn, A., and Powe, N.: Small Area Variations in Health Care Delivery in Maryland. *Health Service Research* 30(2):295-317, June 1995.

Greenfield, S., Nelson, E.C., Zubkoff, M., et al.: Variations in Resource Utilization Among Medical Specialties and Systems of Care. Results from the Medical Outcomes Study. *Journal of the American Medical Association* 267(12):1624-1630, 1992.

Greenwald, H.P., Peterson, M.C., Garrison, L.P., et al.: Interspecialty Variation in Office-Based Care. *Medical Care* 22(1):14-29, 1984.

Hartley, C.R., Charlton, J.R., Harris, C.M., and Jarman, B.: Patterns of Physician's Use of Medical Resources in Ambulatory Setting. *American Journal of Public Health* 77(5):565-567, 1987.

Health Care Financing Administration: Medicare and Medicaid Statistical Supplement. *Health Care Financing Review*. 1992 Annual Supplement. P. 20. February 1992.

Health Care Financing Administration. *Health Care Financing Review 1994 Medicare and Medicaid Statistical Supplement*. P. 166. February 1995.

Health Care Financing Administration. Medicare Managed Care Montly Contract Report. Office of Managed Care. Baltimore, MD. March 1996.

Kasper, J.D.: The Importance of Type and Usual Source of Care for Children's Physician Access and Expenditures. *Medical Care* 25(5):386-398, 1987.

Kelman, H.R., and Thomas, C.: Hospital and Ambulatory Service Use by the Urban Elderly Under Different Health Care Delivery Systems. *Medical Care* 26(8):739-747, 1988.

Kissick, W.L.: What Lessons Should We Take from Medicare? *Medical Economics* 70(12):60-62, 1993.

Kjellstrand, C.M.: Age, Sex, and Race Inequality in Renal Transplantation. *Archives of Internal Medicine* 148(6):1305-1309, 1988.

Kravitz, R.L., Greenfield, S., Roger, W., et al.: Differences in the Mix of Patients Among Medical Specialties and Systems of Care. Results From the Medical Outcomes Study. *Journal of the American Medical Association* 267(12):1617-1623, 1992.

Lasker, R.D., Shapiro, D.L., and Tucker, A.M.: Realizing the Potential of Practice Pattern Profiling. *Inquiry* 29(3):287-297, 1992.

Lawthers, A.G., Palmer, R.H., Edwards, J.E., et al.: Developing and Evaluating Performance Measures for Ambulatory Care Quality: A Preliminary Report of the DEMPAQ Project. *Joint Commission Journal of Quality Improvement* 19(12):552-565, 1993.

Linn, L.S., Yager, J., Leake B., et al.: Differences in the Numbers and Costs of Tests Ordered by Internists, Family Physicians, and Psychiatrists. *Inquiry* 21(3):266-275, 1984.

Miller, R.H., and Luft, H.S.: Managed Care Plan Performance Since 1980. A Literature Analysis. *Journal of the American Medical Association* 271(19):1512-1519, 1994.

Parente, S.T., Weiner, J.P., Garnick, D., et al.: Developing a Quality Improvement Database Using Health Insurance Data: A Guided Tour With Application to Medicare's National Claims History File. *American Journal of Medical Quality* 10(4):162-176, Winter 1995.

Physician Payment Review Commission: *Conference on Profiling*. Washington, DC. 1992.

Stano, M., and Folland, S.: Variations in the Use of Physician Services by Medicare Beneficiaries. *Health Care Financing Review* 9(3):51-58, 1988.

Stuart, M., and Steinwachs, D.: Patient Mix Differences Among Ambulatory Providers and Their Effects on Utilization and Payments for Maryland Medicaid Users. *Medical Care* 31(12):1119-1137, 1993.

Weiner, J.P., Starfield, B., Steinwachs, D., and Mumford, L.: Development and Application of a Population Oriented Measure of Ambulatory Case-mix. *Medical Care* 29(5):452-472, 1991.

Weiner, J.P., Parente, S.T., Garnick, D.W., et al.: Variation in Office-Based Quality: A Claims-Based Profile of Care Provided to Medicare Patients With Diabetes. *Journal of the American Medical Association* 273(19):1534-1537, 1995.

Weiner, J.P., Starfield, B., Powe, N., et al.: Ambulatory Care Practice Variations Within a Medicaid Population. *Health Services Research* 30(6):751-770, 1996.

Welch, H.G., Miller, M.E., and Welch, W.P.: Physician Profiling: An Analysis of Inpatient Practice Patterns in Florida and Oregon. *New England Journal of Medicine* 330(9):607-612, 1994.

Welch, W.P., and Welch, H.G.: Fee-for-Data: A Strategy to Open the HMO Black Box. *Health Affairs* 14(4):104-116, Winter 1995.

Wennberg, J., and Gittlesohn, A.: Small Area Variations in Health Care Delivery. *Science* 182(117):1102-1108, 1973.

Reprint Requests: Stephen T. Parente, Ph.D., Senior Research Director, The Project HOPE Center for Health Affairs, 7500 Old Georgetown Road, Suite 600, Bethesda, MD 20814.