# Ambulatory Care Practice Variation within a Medicaid Program

*Jonathan P. Weiner, Barbara H. Starfield, Neil R. Powe, Mary E. Stuart, and Donald M. Steinwachs*

**Study Questions.** What is the extent of variation in patterns of ambulatory care practice across one state's Medicaid program once case mix is controlled for? How much of this variation in resource consumption is explained by factors linked to the provider, patient, and geographic subarea?

**Data Sources/Study Setting.** Practices of all providers delivering care to persons who were continuously enrolled in the Maryland Medicaid program during FY 1988 were studied. A computerized summary of all services received during this year for 134,725 persons was developed using claims data. We also obtained data from the state's beneficiary and provider files and the American Medical Association's masterfile. Each patient was assigned to a "usual source of care" (primary provider) based on the actual patterns of service. The Ambulatory Care Group (ACG) measure was used to help control for case mix.

**Study Design.** This was a cross-sectional study based on the universe of continuously enrolled Medicaid enrollees in one state.

**Principal Findings.** After controlling for case mix, the variation in patient resource use by type of primary provider was 19 percent for ambulatory visits, 46 percent for ancillary testing, 61 percent for prescriptions, and 81 percent for hospitalizations. Across Maryland counties, comparing the low- to high-use jurisdiction, there was 41 percent variation in case mix–adjusted visit rates, 72 percent variation in pharmacy use, and 325 percent variation in hospital days. At the individual practice level, physician characteristics explain up to 17 percent of ambulatory resource use and geographic area explains only a few percent, while patient characteristics explain up to 60 percent of variation.

**Conclusions.** Since a large proportion of variation was explained by patient case mix, it is evident that risk adjustment is essential for these types of analyses. However, even after adjustment, resource use varies considerably across types of ambulatory care provider and region, with consequent implications for efficiency of health services delivery.

**Key Words.** Ambulatory care, physician profiling, small area variation, Medicaid, case mix

It is well known that the health care system is shifting away from the inpatient environment toward the ambulatory. Today, among working-age populations more resources are expended in ambulatory care settings than in hospitals, and for all patient groups total costs of ambulatory physician care are superseding the costs of inpatient physician care (Physician Payment Review Commission 1994; Welch, Miller, Welch, et al. 1993). Although the majority of U.S. health care resources are still expended on services delivered to patients in hospitals and other institutions, it has been estimated that over 70 percent of cost-related decisions take place in the ambulatory care setting (Eisenberg 1986; Starfield 1992). Thus, ambulatory-based providers leverage the health care dollar.

In the 1980s medical practice variation became a key focus of health services research. This area of inquiry, with few exceptions, has emphasized care provided in hospital and surgical settings (Wennberg and Gittelsohn 1972; McPherson 1982; Roos and Roos 1981; Gittelsohn and Powe 1995). National population-based variations research characterizing the use of ambulatory care provided by primary care physicians and others has been rare.

Historically, hospital and surgical practice variation research has faced a sequence of methodological challenges: the availability and reliability of data; constructing appropriate measures and indicators; and adjusting for differences in case mix and severity across providers (Paul-Shaheen, Clark, and Williams 1987). The technical hurdles faced by researchers focusing on ambulatory/primary variation research follow this paradigm and include:

- The relative incompleteness of computerized administrative data (e.g., insurance claims data) describing ambulatory care when compared to data related to inpatient or surgical care.

---

This research was supported in part by Grant #HS06170 from the U.S. Agency for Health Care Policy and Research. An earlier version of this article was presented at the 1993 Association for Health Services Research Annual Meeting in Washington, DC.

Address correspondence and requests for reprints to Jonathan P. Weiner, Dr.P.H., Professor, Johns Hopkins University, School of Public Health, Department of Health Policy and Management, 624 North Broadway–Room 605, Baltimore, MD 21205. Barbara H. Starfield, M.D., M.P.H., is Professor of Health Policy and Management at Johns Hopkins. Neil R. Powe, M.D., M.P.H., M.B.A., is Associate Professor of Internal Medicine and Health Policy and Management at Johns Hopkins. Mary E. Stuart, Sc.D., is Director, Policy and Statistics Administration, Maryland Department of Health and Mental Hygiene. Donald M. Steinwachs, Ph.D., is Chairman of the Department of Health Policy and Management at Johns Hopkins. This article, submitted to *Health Services Research* on October 3, 1994, was revised and accepted for publication on July 3, 1995.

- Difficulty in defining and measuring the episode of care, or clinical unit of analysis, for an ambulatory event, particularly in comparison to discrete surgical procedures or hospital admissions (Steinwachs 1995; Hartley et al. 1987).
- Difficulty in identifying a "primary" locus of responsibility for the patient's ambulatory services. (Most ambulatory care in the United States is still delivered in the fee-for-service environment where the patient has no formal gatekeeper.)
- More advanced case-mix and severity measurement tools for hospital care than for ambulatory care. Until recently, no ambulatory care case-mix classification systems were available for use either as stratifiers for selecting reasonably homogeneous ambulatory physician-patient interactions, or as global adjustors to account for the morbidity mix of a primary physician's panel of patients (Weiner et al. 1991; Iezzoni 1992; Kravitz et al. 1992).

The goal of this article is to describe and contrast the degree to which ambulatory (and overall) health care utilization and resources vary by source of primary/ambulatory care, geographic area, and patient characteristics within a large population enrolled in a state's Medicaid program. Specifically, we assess variations in practice across broad provider categories, individual office-based practices, and county jurisdictions.

Addressing this objective, we developed and applied innovations in ambulatory health services research methods to surmount the technical challenges just described. These included the construction of person-oriented ambulatory utilization histories from insurance claims, the assignment of a usual-source provider from claims, and the incorporation of an ambulatory case-mix adjuster.

## METHODS

### STUDY POPULATION

The study population consists of 134,725 persons under the age of 65 continuously enrolled in the State of Maryland's Medicaid program for the 12-month period July 1, 1987 through June 30, 1988, and making at least one ambulatory visit to a Maryland office-based physician or clinic participating in the program. (Approximately 5 percent of all continuous enrollees used no services and another 10 percent used services but had no documented face-to-face ambulatory physician or clinic contact. These persons were excluded

from the study cohort.) Persons enrolled in one of the three main Medicaid eligibility categories–Aid to Families with Dependent Children (AFDC), Supplemental Security Income (SSI), and General Public Assistance (GPA) were included in this study. The AFDC group ($n = 107,715$) is made up primarily of mothers and children, whereas persons in the other two categories ($n = 27,010$ combined) are primarily individuals with disabilities or medical conditions that prevent their gainful employment.

We excluded other population subgroups: persons enrolled in capitated HMOs (approximately 18,000) for whom no claims data are available; those groups who resided in a nursing home for any part of the year; and persons whose annual resource use was in the top 1 percent of the distribution for total costs (approximately the third standard deviation). The latter were excluded because other variations studies have indicated that it is not possible to predict the utilization of persons who are outliers.

During the study period, the Medicaid recipients received care on a fee-for-service (FFS) basis with no mandated gatekeeper. In order to assess patterns of practice by provider, as well as the impact of the patient's primary provider on his or her care, we assigned each patient to a "usual source of care" (USC), defined as the physician or provider organization (e.g., a hospital outpatient department [OPD] or community health center [CHC]) that delivered over 50 percent of the face-to-face ambulatory visits during the year. Approximately 31 percent of all continuously enrolled ambulatory users did not have more than half of their services delivered by a single USC provider during the period. These persons were considered to have "no regular source of care." For other analyses, all 134,725 study members were included. The "majority source" method and its limitations are described in a previous article (Stuart et al. 1990).

Because our study focused mainly on practice variation at the provider level, only the patients of in-state providers "actively" involved in the Medicaid program were included in the sample. Being "active" was defined as being the USC for at least ten continuously enrolled Medicaid patients meeting our selection criteria. Therefore, the patients included in the study relied on providers who treated at least nine other Medicaid patients on a regular basis. For comparison purposes, the entire group of patients with no regular source of care was also included.

The 92,620 patients who were assignable to a usual source of care were served by approximately 915 unique provider organizations, of which 828 were office-based physician practices. In this article, provider-related analyses include only those patients who were assigned to a USC. For other analyses, all 134,725 study members were included.

The characteristics of the 134,725 study members were as follows: 49 percent were younger than age 17; 11 percent were above age 45; 64 percent were women; 66 percent were nonwhite; 53 percent were residents of Baltimore City; 29 percent resided in suburban counties; and 18 percent lived in nonmetropolitan counties.

## DATA SOURCES

The main source of data for this study was the claims processing files of the State of Maryland's Medical Assistance (Medicaid) program, that is, the Medicaid Management Information System, or MMIS. From the program's raw claims transactions files, we developed a summary of all claims submitted for services provided to the members of the study population. These services included those provided by physicians and other independent practitioners, hospitals and other institutions, independent laboratories and imaging centers, and pharmacies. All therapeutic and preventive medical care services are covered in full by the program with no deductible or co-pay (except for a 50 cent co-pay for pharmacy services during the period).

The many millions of claims transactions representing the services provided to the study group were summarized into a single computerized case history per patient. This record documented all services billed to Medicaid for each member of the study population over the year period. To describe the demographic characteristics of the beneficiaries, we obtained the computerized beneficiary files obtained from the Medicaid Program. Office-based physicians' characteristics (e.g., specialty and place of training) were abstracted from the American Medical Association's (AMA) physician masterfile directory and Medicaid's provider files. Information on each Maryland county was obtained from state health planning documents and the federal Area Resource File (ARF).

### CASE-MIX METHODOLOGY

To assess the degree to which variation could be explained by factors other than patient morbidity, we applied the Ambulatory Care Group (ACG) system (Weiner et al. 1991; Starfield et al. 1991).

The system categorizes each patient into one of 51 mutually exclusive case-mix categories based on age and gender and the ICD-9-CM codes the patients have been assigned by all ambulatory providers seen during a year's period of time. The building blocks of the ACG system are 34 morbidity clusters known as "ambulatory diagnostic groups" or ADGs. Validation studies

have indicated that this system explains up to 50 percent of the variance in ambulatory care resource use; this exceeds the explanatory power of age and gender alone by a factor of about ten.

We used the ACG measure, along with Medicaid eligibility status (i.e., AFDC versus SSI/GPA) as case-mix cells for calculating expected rates via indirect adjustment. For multivariate analyses, we used the non-mutually exclusive ADGs (entered as dummy variables) as our measures of morbidity.

### MEASURES OF RESOURCE USE

Eight measures of annual per patient resource use served as the study's dependent measures:

1. Ambulatory visits. Face-to-face ambulatory contacts with a physician or other independent provider in any setting
2. Ancillary charges. All paid charges for services provided in the ambulatory care setting, except physician fees for face-to-face visits or procedures
3. Ambulatory charges. Charges associated with ambulatory visits, procedures, and ancillary services
4. Filled prescriptions. Number of prescriptions billed (and reimbursed) by a pharmacy
5. Pharmacy charges. Paid charges for all prescriptions
6. Hospital admission. Number of admissions to acute care general hospitals
7. Hospital days. Number of days (per year per person) in acute care general hospitals
8. Total charges. Sum of all charges paid by the Medicaid administration to all providers of service.

## RESULTS

### DESCRIPTIVE STATISTICS

#### *Variation by Type of Provider*

Table 1 presents five measures of resource use across the three main types of USC providers[1] based on claims data pooled at the *provider level.* The first set of columns for each provider presents the unadjusted raw mean across provider type. These numbers represent the mean of means, that is, the average per

Table 1: Actual and Case Mix–Adjusted Variation in Resource Use by Type of Ambulatory Provider

| | *Provider Type* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Office-Based Physician* | | *Hospital Outpatient Department* | | *Community Health Center* | | *Variation across Provider Type* | |
| *Number Providers* | *499* | | *63* | | *17* | | | |
| *Number Patients* | *43,119* | | *35,493* | | *4,758* | | | |
| *Resource Measure* | *Actual* | *O/E** | *Actual* | *O/E* | *Actual* | *O/E* | *Actual* | *O/E* |
| Visits | 8.91 | 1.06 | 6.71 | .91 | 5.99 | .89 | 1.49 | 1.19 |
| Ancillary charges ($) | 191 | .81 | 258 | 1.18 | 172 | .85 | 1.50 | 1.46 |
| Filled prescriptions | 11.62 | 1.14 | 5.61 | .71 | 7.16 | .91 | 2.07 | 1.61 |
| Hospital days | .64 | .75 | 1.07 | 1.36 | .51 | .86 | 2.10 | 1.81 |
| Total charges ($) | 1011 | .83 | 1220 | 1.12 | 791 | .83 | 1.54 | 1.35 |

Note: Continuously enrolled Medicaid recipients, making at least one ambulatory visit to a usual source of care provider with at least 25 patients, were included in analysis. The results are based on patient data pooled at the provider level.

*Observed/Expected: Observed is equal to the unadjusted average across the provider's patient cohort. The expected is based on the Ambulatory Care Group system/eligibility category mix of each provider's cohort, where the expected rate for each cell is the statewide average for that cell.

patient resource use across each provider's patient cohort, averaged across each provider in the category.

The second set of columns on Table 1 presents observed to expected (O/E) ratios to better adjust for potential differences in case mix across type of provider. To determine this ratio, "expected" rates were calculated for the patient panels of each practice using the indirect adjustment technique. The standardization cells consisted of the 51 ACG categories across each of the two Medicaid eligibility classes. A mean O/E below 1.00 (where the observed is less than the expected) suggests that the providers' patients are receiving fewer services than similar patients in the same ACG/eligibility category cells. An O/E ratio greater than 1.00 suggests that they are receiving services at a higher than average rate. In the case of ambulatory visits within the office MD provider class, the ratio of 1.06 suggests that when taking provider case mix into consideration, visit rates are higher (by 6 percent) than would be expected based on case mix alone.

The last two columns of Table 1 summarize the (high-divided-by-low) variation across provider type, first for the unadjusted (actual) figures and then

for the case mix–adjusted (actual) figures, and then for the case mix–adjusted (O/E) figures.

For example, ambulatory visits vary by 19 percent between the highest (office MDs) and lowest (CHCs) class of providers. This compares to an unadjusted variation of 49 percent across provider type.

Table 1 shows that case mix–adjusted variation for the ambulatory care resource measures is lower than for the inpatient resource measures. Of note is that the OPD providers' patients are receiving fewer ambulatory visits and prescriptions and more inpatient services than expected, whereas the private MD patients receive slightly more ambulatory visits and prescriptions, but less hospital care than expected. Health center patients use fewer than expected resources in all categories.

*Variation by Geographic Area*

Table 2 presents a summary of the raw and case mix–adjusted variation in resource use across the 24 Maryland counties. The data indicate considerable variation across the jurisdictions: for all measures except hospital days, case-mix adjustment decreases the variation.

To explore potential explanations for this cross-county variation, several multivariate analyses were performed at the patient level for ambulatory visits as the dependent measure. Holding constant patient case mix (age, gender, eligibility category, and ADGs) and usual source of care, the effects of the following independent variables were assessed: (1) urban, suburban,

Table 2: Variation of Actual and Observed/Expected Resource Use across Maryland Counties ($n = 134, 725$)

| *Resource Measure* | *Patient-Level Mean* | *Actual High/Low County** | *O/E: High/Low County†* |
|---|---|---|---|
| Visits | 7.47 | 1.68 | 1.41 |
| Lab/x-ray charges ($) | 225 | 2.32 | 1.63 |
| Filled prescriptions | 8.70 | 1.86 | 1.72 |
| Hospital days | .77 | 2.06 | 3.25 |
| Total charges ($) | 1095 | 1.41 | 1.25 |

*High-to-low ratios (extremal quotients) are based on patients pooled by the county of their residence. Twenty-four jurisdictions were included in this analysis.

†Expected rates for each county are determined on the basis of Ambulatory Care Group system and eligibility category standardization.

or rural nature of county; (2) physician supply (active MD/DOs per 1,000 population); and (3) hospital supply (beds per 1,000). These regressions indicated that

- Visit rates were highest in the suburban counties (i.e., the metropolitan counties other than Baltimore City), next highest in the rural counties, and lowest in the central city of Baltimore.
- Counties with a greater supply of physicians did have a somewhat higher visit rate. For example, in a county of 50,000, two additional physicians were associated with 0.2 more visits per year per patient.
- The greater the availability of hospital resources, the *lower* the visit rate. This could be explained by a substitution effect.

*Variation across Individual Primary Care Practices*

Table 3 describes variation across the individual practices of private physicians in the three primary care specialties.

For five different utilization variables, this table presents five descriptive measures to help characterize the extent of variation across the patient panels of 310 practices with at least 25 continuously enrolled USC patients. These measures are presented on an unadjusted basis, as well as a case mix–adjusted (O/E) basis. Specifically, Table 3 presents the mean resource use across patient panels, the coefficient of variation of this measure across the practices, the lowest and highest rate of average resource use across the cohort of providers, and the "extremal quotient," as calculated by dividing the "high" provider's patient panel mean, by the "low" provider's mean (Diehr et al. 1990).

For example, Table 3 indicates that the mean unadjusted visit rate of patients cared for by internists is 39 percent higher than for family practitioners (12.45 versus 8.98), and that the overall charges are 48 percent higher ($1,550 versus $1,047), but that the O/E ratios are only slightly higher for internists; this suggests that much of the difference is due to patient case mix. Not surprisingly, pediatricians as a group have patients who receive less in resources per patient, but their O/E ratios are comparable to those of the other two specialties.

Note that both the raw and the observed-to-expected resource use varies considerably across the "high" and "low" individual practices within each specialty group. As in the previous tables, when resource use is case mix–adjusted, the variation across practices–as measured by the extremal quotient –is lower when the unadjusted measure is compared.

Table 3: Variation in Patient Resource Use by Physician Specialty: Unadjusted and Adjusted Results for Office-Based Practices

| *Office MD Specialty* (n *of provider)* (n *of patients)* | *Measure* | *Type of Service* | | | | |
|---|---|---|---|---|---|---|
| | | *Ambulatory Visits* | *Ancillary Charges ($)* | *Filled Prescriptions* | *Hospital Days* | *Total Charges ($)* |
| *Family/General Practice* | *Unadjusted* | | | | | |
| (127) | Mean | 8.98 | 193 | 14.08 | .62 | 1047 |
| (10,000) | (CV)* | (40.61) | (49.93) | (45.39) | (72.21) | (44.73) |
| | Low† | 3.74 | 50 | 4.29 | .00 | 256 |
| | High‡ | 21.96 | 552 | 34.26 | 2.28 | 2550 |
| | EQ§ | 5.87 | 11.04 | 7.99 | 228.00 | 9.96 |
| | *Observed/ Expected*¶ | | | | | |
| | Mean | 1.01 | .70 | 1.20 | .63 | .76 |
| | (CV) | (32.07) | (31.56) | (25.70) | (67.68) | (26.34) |
| | Low | .48 | .25 | .62 | .00 | .34 |
| | High | 2.40 | 1.43 | 2.37 | 2.08 | 1.47 |
| | EQ | 5.00 | 5.72 | 3.82 | 208.00 | 4.32 |
| *General Internal Medicine* | *Unadjusted* | | | | | |
| (54) | Mean | 12.45 | 251 | 21.21 | 1.00 | 1550 |
| (4,072) | (CV) | (80.73) | (44.01) | (43.28) | (80.13) | (51.32) |
| | Low | 4.24 | 70 | 5.82 | .04 | 433 |
| | High | 74.46 | 624 | 42.81 | 3.18 | 3727 |
| | EQ | 17.56 | 8.91 | 7.36 | 79.50 | 8.61 |
| | *Observed/ Expected* | | | | | |
| | Mean | 1.05 | .72 | 1.28 | .66 | .81 |
| | (CV) | (51.57) | (31.34) | (22.84) | (60.22) | (29.21) |
| | Low | .45 | .32 | .70 | .07 | .42 |
| | High | 4.05 | 1.32 | 1.89 | 1.58 | 1.34 |
| | EQ | 9.00 | 4.13 | 2.70 | 22.57 | 3.19 |
| *Pediatrics* | *Unadjusted* | | | | | |
| (129) | Mean | 6.40 | 128 | 5.85 | .31 | 565 |
| (12,831) | (CV) | (38.29) | (63.83) | (44.09) | (111.20) | (69.92) |
| | Low | 3.05 | 33 | 1.97 | .00 | 189 |
| | High | 20.74 | 757 | 14.67 | 2.30 | 3442 |
| | EQ | 6.80 | 22.94 | 7.45 | 230.00 | 18.21 |
| | *Observed/ Expected* | | | | | |
| | Mean | 1.04 | .86 | 1.06 | .76 | .84 |
| | (CV) | (24.48) | (39.44) | (30.33) | (89.19) | (28.28) |
| | Low | .26 | .28 | .43 | .00 | .39 |
| | High | 2.31 | 2.04 | 1.96 | 3.90 | 1.67 |
| | EQ | 8.88 | 7.29 | 4.56 | 390.00 | 4.28 |

*Continued*

Table 3: Continued

Note: Continuously enrolled Medicaid patients (both AFDC and SSI/GPA), were served by office-based primary care MDs with at least 25 Medicaid patients in FY 1988 were included in analysis. All rates represent annual per person resource use. Results are based on patient data *pooled* at the physician practice level.

*Coefficient of variation.

†Low provider.

‡High provider.

§Extremal Quotient = high ÷ low provider (where the low provider has .00 use rate, .01 used to calculate EQ).

¶Observed/Expected. Observed is equal to the raw unadjusted average across the provider's patient panel. Expected rates for each provider are calculated based on ACG and eligibility characteristics of the provider's patient panel. The statewide averages for each ACG/eligibility class cell are used. The expected rates that are incorporated into the O/E ratios are based on the entire study populations, not just on those patients served by private physicians.

## MULTIVARIATE MODELS

### *Factors Contributing to Variation in Resource Use*

Multivariable models were constructed with both the patient and provider as the unit of analysis.

Table 4 presents the adjusted $R$-squares from 12 patient-level linear regression analyses, where two alternative dependent measures of resource use (ambulatory visits and ambulatory charges) were each regressed on six sets of independent variables.

The first two models summarized on Table 4 indicate that the usual source type (which in this case also includes "no USC") and provider county explain very little variation in resource use. On the other hand, the results for model "three" indicate that the patient characteristics–age, gender, eligibility category, and case mix–explain a very substantial proportion of variation. The results of the subsequent models (four through six), indicate that when county and/or type of USC are added to patient characteristics, they do not appreciably improve the explanatory power of the model.

The regressions were repeated to examine the effects of physician characteristics. Table 5 presents results that are analogous to Table 4, except that the unit of analysis is the solo office–based physician. We included only solo, office–based physicians in this analysis because it was not possible to determine accurately the personal characteristics of physicians billing as part of an institution or private group practice. To accomplish this analysis, a

Table 4: Alternative Models Explaining Ambulatory Resource Use Across Patients Served by All Provider Types

| *Independent Variables in Model* | *Adjusted $R^2$ for Each Dependent Variable* | |
|---|---|---|
| | *Ambulatory Visits* | *Ambulatory Charges* |
| 1. Usual source of care (USC) | .002 | .013 |
| 2. County of residence | .003 | .002 |
| 3. Patient characteristics (age, gender, race, eligibility category, ADGs*) | .239 | .359 |
| 4. Patient characteristics and county | .242 | .361 |
| 5. Patient characteristics and usual source of care | .239 | .368 |
| 6. Patient characteristics, usual source of care, and county | .242 | .370 |

Note: Models are based on standard linear regression models at enrollee level; 134,725 Maryland Medicaid recipients continuously enrolled in FY 1988 were included in the model.

*Ambulatory Diagnosis Groups are morbidity clusters that are the building blocks of the ACG case-mix system. For this analysis, 34 dummy variables were included in the model as indicators of whether the patient had one or more diagnoses that fell into each cluster.

special analytical file was created where the claims histories of the 33,474 Medicaid recipients served by private solo physicians were pooled across the physician practices. There were 647 USC physicians included in this analysis. Each of these physicians was the USC for at least ten continuously enrolled Medicaid patients; the average caseload was 52 patients.

Table 5 indicates that provider and geographic factors explain much less cross-practice variation than patient panel characteristics do (model 3). When the physician and/or county factors are added to the patient model, the *R*-squares improve, although not appreciably.

Some of the salient findings from the detailed regression analyses[2] summarized on Tables 4 and 5 are these: (1) even after morbidity (as measured by physician-assigned diagnoses) is held constant, SSI/GPA patients are more costly than AFDC patients; (2) once other factors are controlled, the patient's race has a negligible effect on resource variation (plus or minus 1 percent); (3) the effects of several ADG diagnostic clusters–such as likely to recur-progressive, psychosocial major, malignancy, and pregnancy–appear important (see Stuart and Steinwachs [1993] for more detailed discussion on case mix and the Medicaid population); and (4) all else equal, patients whose USC is a foreign medical graduate use less in resources overall (13 percent less).

Table 5: Alternative Models Explaining Ambulatory Resource Use Pooled at the Provider Level for Private Solo Physicians Only

| *Independent Variables in Model* | *Adjusted* $R^2$ *for Each Dependent Variable* | |
|---|---|---|
| | *Ambulatory Visits* | *Ambulatory Charges* |
| 1. Physician characteristics (specialty, certification, FMG* status) | .133 | .171 |
| 2. County of physician's main practice site | .005 | .007 |
| 3. Characteristics of physician's patients (age, gender, race eligibility category, ADGs†) | .492 | .591 |
| 4. Patient and physician characteristics | .498 | .597 |
| 5. Patient, physician characteristics, and county | .516 | .609 |

Note: All results based on standard linear regression of variables pooled at the solo *physician* level (n = 647).

These results, based on all services received by 33,474 Medicaid beneficiaries continuously enrolled during FY 1988 and assigned a solo office-based physician as usual source of care. The patients of the 647 solo physicians serving at least 10 Medicaid patients are included in this analysis.

*Foreign medical graduate.

†Ambulatory Diagnostic Groups.

# DISCUSSION

## SUMMARY

Although many studies have documented variation of hospital and surgical services, and a few have identified variation in physician charges across national and local subregions (Mitchell 1992; Stano and Folland 1988), no other study, to our knowledge, has looked at cross-practice and cross-area variation in visit rates, ambulatory laboratory and radiologic procedures, and prescription drug usage within a large population in a single state. Further, few prior studies have applied a population-oriented measure of case mix to control for patient-linked differences in the use of ambulatory physician services or overall services as provided by primary providers. This study, which applies a validated method of case-mix adjustment, shows that adjusted rates of variation (e.g., across provider type or specialty) are lower than the raw rates by a factor of more than two. That is, for all measures of resource use, case mix contributes heavily to observed variation.

However, even after accounting for differences in the case mix of patient panels, variation in resource use across various units of aggregation is significant. Across counties, there appears to be variation in visit rates of about 40 percent. For ancillary ambulatory services and ambulatory prescriptions, the geographic rate difference is even higher. All of these rates are much lower than the cross-county variability in hospital admissions and stays, which vary more than threefold.

Even though rates vary by county, at the individual patient level the overall effect of geographic area relative to other factors is not great, accounting for less than 1 percent of overall variation in resource use.

Past research has identified differences in care received by patients when their primary providers are based in different types of settings. With the exception of earlier research using Maryland Medicaid data limited to an urban AFDC population (Stuart et al. 1990; Stuart and Steinwachs 1993), and an episode-based project using Medicaid data from Michigan (McDevitt and Dutton 1989), these other studies have derived their findings from patient surveys (Kelman and Thomas 1988; Kasper 1987). Our study expands on this previous work.

The results of our study indicate that within one state there is very significant variation across major types of primary providers (hospital OPD, private physician, and community health center). After case-mix control, it appears that source of care alone is associated with ambulatory visit rate variation of about 20 percent, ancillary testing and prescription variation in the 50–60 percent range, and variation in admission rates of about 80 percent.

Multivariate analyses confirm these results, indicating that, all else constant, patients with the OPD as a usual source of care use $228 more ambulatory services per year than those using a private MD, and $375 more overall.

The results of our study indicate that after case mix is controlled for, the difference is significant in all measures of resource use across specialty of the office physician. Family/general practitioners use somewhat less in resources than general internists (by 7 percent), and the standardized overall resource use of pediatricians is also slightly higher than FPs (by 10 percent).

At the provider level, the physician characteristics alone explained a significant proportion of resource use (up to 17 percent for ambulatory charges). However, the small incremental difference between the $R$-squared of the model that includes patient factors only and that of a patient-physician combined model, suggests that most of the "physician effect" is associated with patient characteristics that are intercorrelated with specialty type.

Case-mix characteristics (which also include the eligibility class of the patient) are by far the most important of the series of independent variables associated with variation in resource use. For example, at the patient level patient characteristics explain up to 36 percent of variation, as compared to less than 1 percent for type or location of provider. This high level of explanatory power also holds at the level of individual office practice, where case mix explains 95 percent of all explainable variation.

## LIMITATIONS

Some potential limitations deserve comment. First, our cohort represents Medicaid enrollees making at least one ambulatory visit and residing in a single middle-sized state. Although all hospital OPDs and CHCs in Maryland actively participate in the Medicaid program and are thus incorporated into the analysis, only 828 office physician practices (out of a total of approximately 2,000) are included in the sample. This sample may or may not be fully representative of the universe of providers in Maryland.

Second, we used a series of selection criteria to constitute the patient population for our analysis. Most importantly from the perspective of assessing biases, the study population included only persons continuously eligible for Medicaid for an entire year period. A large percentage (over 40 percent) of the Medicaid population in Maryland (and elsewhere) are not enrolled for such an extended period. Thus, patterns of care documented among our study population may differ from that of the entire universe of Medicaid enrollees.

Third, although the ACGs, which embody a considerable amount of clinical information, appear to serve as an effective case-mix adjustment methodology for assessing resource use for variation, other potential factors still could influence the resource requirements of a provider's patient panel. Most notably, within a single ACG or ADG category, there are likely to be differing levels of disease severity and different patient propensities toward seeking care. Although there is no evidence that these other unmeasured factors co-vary with any of the independent variables reported in this study, this possibility exists.

Fourth, this study used physicians' self-designated label, as reported to the AMA, to categorize them into an office-based specialty. This might lead to some misclassification when compared to a specialty designation based on board certification or eligibility. Although this label is the measurement approach used by most studies, we assessed the potential impact of certification, in additional multivariate analyses (not reported). Although the beta coefficient suggested that the certification variable was associated with a

modest increase in resource use above and beyond the "specialty" effect, the results were not statistically significant.

Fifth, given the fact that claims data are the main source of information for this study, errors–particularly of an unsystematic nature–could be a threat to internal validity. For better assessment of errors intrinsic to the Maryland Medical Assistance claims data systems, we performed a series of "validation" analyses where claims data derived from a sample of 2,408 of our study group members were compared to their medical charts, as obtained from 138 providers (Steinwachs et al. 1995). The results suggest that for the visit variable, the accuracy levels are surprisingly high. Overall, about 90 percent of all claims visits were found in the chart exactly as submitted. Moreover, the overall yearly match rate was within 3 percent (and in favor of the Medicaid administration).

A full assessment of the accuracy of the diagnostic information found in the claims systems was beyond the scope of our chart validation. However, we performed a more limited analysis to gauge potential biases inherent in our ICD-based ACG case-mix system. This assessment determined that for several common conditions, the claims-based diagnoses had a specificity of greater than .90. This means that among the sampled charts, when the claims were used to designate the patient as having a condition, the chart verified this over 90 percent of the time. The sensitivity of the claims designation was lower–in the .70 to .80 range. This suggests that when a person is assigned an ACG on the basis of the claims diagnosis, it is quite probably an accurate determination, but a significant (though not large) proportion of conditions may not be captured by the claims. This suggests that to a degree, the claims-derived case-mix measure may underestimate the true morbidity burden of the population.

## IMPLICATIONS

The methods we developed and applied can be used not only by academic researchers, but also by analysts involved in the ongoing management of health benefits programs. Specifically, this study supports the premise that claims data can be effectively used to provide meaningful profiles of the patterns of care delivered by primary providers. It also shows that the ICD-9-CM codes found in a typical claims data system can be used to derive a practical case-mix measure applicable to ambulatory care.

Our finding that patient-related characteristics overshadow provider-linked factors makes it abundantly clear that variation analysis or physician practice profiling should always incorporate some type of case-mix methodology. Otherwise, true variation in clinical patterns of practice will be clouded

by differences in the morbidity mix of patient panels. To the extent that payment is linked to these practice patterns–for instance, in managed care plans that share risk with physicians–this concern should be underscored even further.

The practice patterns of primary providers appear to vary significantly by setting, geographic area, individual practice, and physician specialty. These differences have considerable implications for understanding and controlling costs of care. A series of estimates illustrate the potential financial consequences of variation among our selected group of Medicaid enrollees.

The case mix–adjusted utilization for patients using outpatient departments as their usual source of care is roughly $460 per person higher than patients using private MDs (in 1993 terms). If this increased cost is extrapolated across all OPD users within the entire study population, this conservatively amounts to a difference of about $17 million per annum. The overall potential cost impact to the state is even higher, given that the study group represents less than half of all Medicaid enrollees. If Medicaid program managers were able to direct all OPD patients to private physician offices for their regular care, there might be considerable cost savings.

If the case mix–adjusted, per patient resource use within the several counties that constituted the top quartile, could be decreased to average, the cost savings would amount to approximately $240 per county resident. This translates to an estimated total annual savings of more than $10 million for the study population alone. Any managers attempting to decrease utilization within a Medicaid program based on geographic norms should, of course, take into consideration reasonable standards of access. It is possible that the use rates among counties in the bottom end of the distribution is too low; it would not be desirable to decrease utilization in counties with appropriate access levels to some lower common denominator.

If the resource use among patients served by office MDs in the top quartile of practices decreased to the case mix–adjusted average for all practices, it can be estimated that over $5 million in savings would result for the study group alone.

These estimates are based on the assumption that some providers are delivering more services than are clinically indicated. This supposition is largely confirmed by the quality and outcomes component of this study, which showed no consistently significant quality difference between providers at the low end of the resource use distribution and those at the high end (Starfield, Powe, Weiner, et al. 1994; Powe, Weiner, Starfield, et al. 1994).

In addition to administrators and policymakers concerned with resource management, this study has implications for those interested in physician

education and workforce planning. Differences in practice patterns across physician specialties bring into question the appropriate role of the various specialists in serving as the primary gatekeeper for patients.

Our population-oriented analysis supports the findings of previous visit-oriented studies (Greenfield et al. 1992; Cherkin, Rosenblatt, Hart, et al. 1987; Greenwald, Peterson, Garrison, et al. 1984) that family practitioners are efficient providers relative to general internists and pediatricians.

The current trajectory of the U.S. health care system is increasing the importance of ambulatory care. Now more than ever, integrated delivery networks that emphasize noninstitutional care are becoming the norm. We believe that the practices of these provider networks–whether publicly or privately sponsored–will need to be assessed along the lines described in this study in order to assure that society's resources are expended efficiently and equitably.

## NOTES

1. Given the practice-specific focus of this analysis, smaller office-MD practices with fewer than 25 assigned USC patients were excluded.
2. Detailed results of regressions are available from the authors upon request.

## ACKNOWLEDGMENTS

The collaboration of the State of Maryland Department of Health and Mental Hygiene, Medical Assistance Administration, is gratefully acknowledged. Other members of the research team over the course of the project included Andrew Baker, Tom Richards, Andrea Gerstenberger, Sc.D., Sarah Scholle, Dr.P.H., Michael Fox, Sc.D., Cheryl Kaplowitz, Sc.D., Jennifer Harlow, Jane Foreman, Deborah Jay, and Ann Kerns. Beverly Siegel assisted in the preparation of this manuscript.

## REFERENCES

Cherkin, D. C., R. A. Rosenblatt, L. G. Hart, R. Schneeweiss, and J. LoGerfo. 1987. "The Use of Medical Resources by Residency-Trained Family Physicians and General Internists: Is There a Difference?" *Medical Care* 25 (6): 455–69.

Diehr, P., K. Cain, F. Connel, and E. Volinn. 1990. "What Is Too Much Variation? The Null Hypothesis in Small-Area Analysis." *Health Services Research* 24 (6): 741–72.

Eisenberg, J. 1986. *Doctors' Decisions and the Cost of Medical Care.* Ann Arbor, MI: Health Administration Press.

Gittelsohn, A., and N. Powe. 1995. "Small Area Variations in Health Care Delivery in Maryland." *Health Services Research* 30 (2): 295–318.

Greenfield, S., E. C. Nelson, M. Zubkoff, W. Manning, W. Rogers, R. L. Kravitz, A. Keller, A. R. Tarlov, and J. E. Ware, Jr. 1992. "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): 1624–30.

Greenwald, H. P., M. C. Peterson, L. P. Garrison, L. G. Hart, I. S. Moscovice, T. L. Hall, and E. B. Perrin. 1984. "Interspecialty Variation in Office-Based Care." *Medical Care* 22 (1): 14–29.

Hartley, C. M., J. P. Charlton, C. M. Harris, and B. Jarman. 1987. "Patterns of Physicians' Use of Medical Resources in an Ambulatory Setting." *American Journal of Public Health* 77 (5): 565–67.

Iezzoni, L. 1992. "Risk Adjustment for Medical Outcome Studies." In *Medical Effectiveness Research Data Methods,* edited by M. L. Grady. Department of Health and Human Services Publication No. (AHCPR)92–0056. Rockville, MD: Agency for Health Care Policy and Research.

Kasper, J. D. 1987. "The Importance of Type and Usual Source of Care for Children's Physician Access and Expenditures." *Medical Care* 25 (5): 386–98.

Kelman, H. R., and C. Thomas. 1988. "Hospital and Ambulatory Service Use by Urban Elderly under Different Health Care Delivery Systems." *Medical Care* 26 (8): 739–49.

Kravitz, R. L., S. Greenfield, W. Rogers, W. G. Manning, M. Zubkoff, E. C. Nelson, A. R. Tarlov, and J. E. Ware, Jr. 1992. "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 (23): 1617–23.

McDevitt, R. D., and B. Dutton. 1989. "Expenditures for Ambulatory Episodes of Care: The Michigan Medicaid Experience." *Health Care Financing Review* 11 (2): 43–55.

McPherson, K., J. E. Wennberg, O. B. Hovind, and P. Clifford. 1982. "Small-Area Variation in the Use of Common Surgical Procedures." *The New England Journal of Medicine* 307 (21): 1310–14.

Mitchell, J. B. 1992. "Area Variation in Medicare Physician Spending." *Health Affairs* 11 (1): 224–34.

Paul-Shaheen, P., J. Clark, and D. Williams. 1987. "Small Area Analysis: A Review and Analysis of the North American Literature." *Journal of Health Politics, Policy and Law* 12 (4): 741–809.

Physician Payment Review Commission. 1994. *1994 Report to Congress.* Washington, DC: Physician Payment Review Commission.

Powe, N., J. Weiner, B. Starfield, M. Stuart, A. Baker, and D. Steinwachs. 1994. "Assessment of System-wide Performance in the Medicaid Program: Development and Application of a Claims Data–Based Approach for Evaluation of the Care of Patients with Chronic Illness" (submitted for publication).

Roos, N. P., and L. L. Roos. 1981. "High and Low Surgical Rates: Risk Factors for Area Residents." *American Journal of Public Health* 71 (6): 591–600.

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

Starfield, B. 1992. *Primary Care: Concept, Evaluation and Policy.* New York and Oxford: Oxford University Press.

Starfield, B., N. Powe, J. Weiner, M. Stuart, D. Steinwachs, S. Scholle, and A. Gerstenberger. 1994. "Costs vs. Quality in Different Types of Primary Care Settings." *Journal of the American Medical Association* 272 (24): 1903–8.

Starfield, B., J. Weiner, L. Mumford, and D. Steinwachs. 1991. "Ambulatory Care Groups: A Categorization of Diagnoses for Research and Management." *Health Services Research* 26 (1): 53–74 .

Steinwachs, D., M. Stuart, S. Scholle, B. Starfield, M. Fox, and J. Weiner. 1995. "Validating Claims Data with Medical Records among a Medicaid Population" (submitted for publication).

Stuart, M., and D. Steinwachs. 1993. "Patient Mix Differences among Ambulatory Providers and Their Effects on Utilization and Payments for Maryland Medicaid Users." *Medical Care* 31 (12): 1119–37.

Stuart, M., D. Steinwachs, J. Harlow, and M. Fox. 1990. "Ambulatory Practice Variation in Maryland: Implications for Medicaid Cost Management." *Health Care Financing Review* (Supplement): 57–67.

Weiner, J., B. Starfield, D. Steinwachs, and L. Mumford. 1991. "Development and Application of a Population Oriented Measure of Ambulatory Care Case-Mix." *Medical Care* 29 (5): 452–72.

Welch, W. P., N. Miller, H. G. Welch, E. Fisher, and J. Wennberg. 1993. "Geographic Variation in Expenditures for Physician Services in the United States." *The New England Journal of Medicine* 328 (9): 621–27.

Wennberg, J., and A. Gittelsohn. 1973. "Small Area Variations in Health Care Delivery." *Scientific American* 182 (117): 1102–8.